

Determination of Loan Repayment Potentials of Group Borrowers in Oyo State of Nigeria: A Discriminant Analysis Approach.

O. A. ORAFIDIYA and A. OSUNTOGUN

*Dept. of Agric. Economics
Obafemi Awolowo University
Ile-Ife.*

Introduction:

The history of institutional credit administration in many parts of Nigeria has not been impressive when evaluated on the basis of their repayment performance. In the past, many credit agencies were scrapped for gross inefficiency while others were heavily subsidised in order to keep them alive. These actions became necessary because of high default rates among borrowers.

It is now generally accepted that agricultural development effort which aims at improving the productivity of resources employed by farmers is not misdirected, since that sector employed the largest body of producers and contains most of the underemployed labour resources that can be mobilised. Early studies by Ugoh (1973), Osuntogun (1973) established that agriculture in less developed countries is characterised by use of more traditional methods of cultivation, unwillingness to adopt innovative ideas partly caused by a lesser access to financing and partly by farmers' aversion to undertake risky ventures. The major role of credit in peasant farming is the opening of greater opportunities for acquisition of much needed inputs. It is mainly in this way, that credit can effectively function to overcome agricultural stagnation in developing countries of the world (Osuntogun, 1983).

Thus lending agencies in developing countries are faced with the nagging problem of ensuring credit effectiveness in a sociological set up where government properties and financial assistance are erroneously considered as "booties" (Osuntogun, 1973). Added to this clug, are the inherent retrogressive government bureaucracy in processing and disbursing agricultural loans to applicants, lack of organised marketing arrangements for agricultural commodities produced with borrowed funds and the traditional land tenure system which together constitute formidable economic impediments to successful loan administration.

In spite of these odds, governments must ensure a continuous flow of fund into agriculture if they really aim at self sufficiency in essential agricultural needs. To achieve this objective in the face of declining national earning capacity- requires minimisation of losses emanating from loan defaults, maintenance of high repayment rate among existing beneficiaries, and, prompt and accurate detection of potential bad debtors prior to the time loans are erroneously given to them.

This study was designed to investigate the socioeconomic characteristics of group farmers who are beneficiaries of the Oyo State Investment and Credit Corporation (OYSICC) group loan scheme. The characteristics identified in the course of this study will be used to categorise borrowers into two distinct groups – the good and the bad credit customers.

Previous Studies

Group lending involves administration of credit among groups whose individuals differ in characters and reactions. The bulk of research studies on group credit appear to originate from the Asian continent; although, of recent, greater attention is being focussed on group financing in Nigeria. Wong (1979) observed that a faster developmental objective will be achieved in developing countries if group credit can be used for introducing institutional innovations to the rural sectors. Creation of rural employment which helps to halt rural-urban migration of youths and its associated effect of increasing productivity of resource inputs are unique advantages of innovations in a traditional agrarian set up.

The roles of credit in group farming were aptly documented by MacAndrews (1979). The success of the three land schemes studied by the author in Malaysia was attributed to the pattern of institutional financing in that country. Of particular significance in the schemes, is the granting of one hundred Malaysian dollars monthly allowance to participants in lieu of produce sale. This practice is similar to the consumption loan granted to Ivorian farmers whose BNDA project (1973) was assessed as a great success with an impressive repayment rate of 98 per cent for a five year average.

In Nigeria, it had been established through independent studies of Ugoh (1979), Osuntogun (1973), Ijose and Abaelu (1973) that group borrowers perform better than individuals in repayment of institutional loans. While Ugoh worked on Fund for Agricultural and Industrial Development (FAID) Scheme in the Eastern Nigeria, Osuntogun, Ijose and Abaelu separately worked on Western Nigeria Agricultural Credit Corporation (WNACC) loan scheme. The authors attributed poor loan repayment among individuals to over-centralisation of approving authority aggravated by obnoxious civil service red-tapism. The system was ob-

served to hinder prompt processing of applications and supply of essential inputs that were to come in kind. This finding was in agreement with that of Bahadur and Veeraswamy (1977) on SFDA credit scheme in Tamil Nadu. In addition to the foregoing, Khan (1971) in his study on Commilla cooperation model in Bangladesh, concluded that extent of indebtedness, inadequate supervision from credit officers, improper utilization of loans were sufficient characteristics capable of causing repayment default among Commilla groups.

By far, the most relevant literature to the present study is the work of Matienzo (1978) on repayment of group loan in the Province of Camarines Sur, Philippines. Using discriminant analysis, he classified, examined and tested two groups of loan beneficiaries in terms of their socio-economic characteristics. He was able to conclude that the two groups identified by him, viz; defaulters and non-defaulters were different on incomes, total cash expenses, size of irrigated holdings but not different on education, average age and living expenditure items. The discriminant function developed by Matienzo was able to make up to 74 per cent correct classification when subjected to validation tests.

This study will similarly identify socio-economic characteristics that will enable us to classify potential loan beneficiaries into two distinct groups of good or bad customers prior to loan disbursement. The result of classification efficiency obtained after testing will be compared with existing ones in order to assess the applicability of discriminant function analysis to the Nigerian situation.

Basic Concepts in Discriminant Analysis

Suppose we have a number of individuals that could belong to one of two groups in respect of which certain measurements have been taken. It may be difficult to distinguish the group to which an individual belongs. It, therefore, becomes desirable to find a linear compound of the available measurements which will yield the smallest possible frequency of misclassification when used as an instrument of discrimination. Such a linear compound is called a Discriminant Function of the measurements.

Now suppose there are two groups of borrowers; one with good accounts (G) and the other with bad accounts (B). If these two groups are measured on two distinct characteristics namely, X_1 and X_2 representing, for example, area of land cultivated and income respectively, a discriminant function can be developed such that the two variable profile of the borrowers can be transformed into a single discriminant score, Z . The discriminant function for the i th individual can be expressed as:

$$Z = \lambda_1 x_{1i} + \lambda_2 x_{2i} + \dots + \lambda_j x_{ji} \dots (1)$$

Where:

- Z = Total discriminant score for the groups,
- X_i^j = is the observation on i th variable
- λ_j = is the weight assigned to j th variable as a measure of its contribution to the Z – score.
($j = 1, 2$).

First, estimates of λ_1 and λ_2 are required such that the average value of Z for each group of customers will be maximum normalised distance away from the average Z for the other. For a two variable situation hypothesised above, equation 1 can be expressed as:

$$\lambda_1 \sigma_{11}^2 + \lambda_2 \sigma_{12}^2 = M_{11} - M_{12} \quad (2)$$

$$\lambda_1 \sigma_{21}^2 + \lambda_2 \sigma_{22}^2 = M_{21} - M_{22} \quad (3)$$

or in matrix form as:

$$\begin{bmatrix} \sigma_{11}^2 & \sigma_{12}^2 \\ \sigma_{21}^2 & \sigma_{22}^2 \end{bmatrix} \begin{bmatrix} \lambda_1 \\ \lambda_2 \end{bmatrix} = \begin{bmatrix} M_{11} - M_{12} \\ M_{21} - M_{22} \end{bmatrix} \quad (4)$$

where:

$$\sigma_{11}^2 = \sigma_{11G}^2 + \sigma_{11/B}^2 \quad (5)$$

$$\sigma_{12}^2 = \sigma_{12G}^2 + \sigma_{12B}^2 \quad (6)$$

$$\sigma_{22}^2 = \sigma_{22G}^2 + \sigma_{22B}^2 \quad (7)$$

The variance of each group can be estimated from:

$$\sigma_{11G}^2 = \frac{n_G}{\sum} (X_{1G} - \bar{x}_{1G})^2 / n_G \quad (8)$$

$$\sigma_{12G}^2 = \frac{n_G}{\sum} (X_{1G} - \bar{x}_{1G})(X_{2G} - \bar{x}_{2G}) / n_G \quad (8a)$$

$$\sigma_{22G}^2 = \frac{n_G}{\sum} (X_{2G} - \bar{x}_{2G})^2 / n_G \quad (10)$$

and for the debtors, we have

$$\sigma_{11B}^2 = \frac{n_B}{\sum} (X_{1B} - \bar{x}_{1B})^2 / n_B \quad (11)$$

$$\sigma_{12B}^2 = \frac{n_B}{\Sigma} (X_{1B} - \bar{X}_{1B})(X_{2B} - \bar{X}_{2B}) / n_B \text{ ----- (12)}$$

$$\sigma_{22B}^2 = \frac{n_B}{\Sigma} (X_{1B} - \bar{X}_{1B})^2 / n_B$$

while the values of the difference in means can be estimated from

$$M_{11} - M_{12} = \bar{X}_{1G} - \bar{X}_{1B} \text{ ----- (13)}$$

$$M_{21} - M_{22} = \bar{X}_{2G} - \bar{X}_{2B} \text{ ----- (14)}$$

Once values are obtained for all the σ_i^2 and M_i in equations (2) and (3) above, it is possible to solve for the two coefficients λ_1 and λ_2 using a simple algebraic method. Subsequently, Z scores for good Z_G and for bad Z_B can be estimated from

$$Z_G = \lambda_1 X_{1G} + \lambda_2 X_{2G} \text{ ----- (15)}$$

$$Z_B = \lambda_1 X_{1B} + \lambda_2 X_{2B} \text{ ----- (16)}$$

Cut-off Point

The exact value of the limit of each group for purpose of classification depends on how much premium is put on the relative cost of misclassification to the investigator. More frequently, the cut-off point is usually taken as the mid-point of Z_G and $Z_B = \frac{1}{2}(Z_G + Z_B)$ because discriminant function analysis itself assumes equal cost of misclassification Green and Tull (1975), Bauer and Jordan (1971), Peters and Summers (1968).

Methodology

This study covers 22 out of 24 local government areas of Oyo State. The remaining two local government areas are municipalities in which the target groups for this study (i.e. group farms) do not exist. All the four agricultural zones of the state were represented. One hundred and fifty nine villages were chosen for data collection. The distribution of these villages reflects the concentration of the target group in the main activity areas. Only maize production groups served as respondents and constitute the target groups for the study. In fact, 89% of group farmers who took loans from OYSICC loan scheme were maize farmers.

Two hundred and nineteen respondents were randomly selected from six hundred and seventy-four foodcrop groups that benefitted from food-

crop loan in 1983. A pretested structured questionnaire was used for data collection. Only two hundred groups co-operated with the enumerators. Out of this number, data provided in ten questionnaires were discarded for gross inconsistencies or incompleteness so that cross-sectional data for 190 groups were used for analysis.

Other sources of information for this study are the records of the groups most of which are kept at the headquarter office of the credit agency and their zonal offices. A number of groups whose records were not directly available gave approximate information on their performance.

Results and Discussion:

The management of Oyo State Investment and Credit Corporation (OYSICC) loan scheme shows clear preference for customers with proven ability to repay previous loans. Even where new applicants were to be considered for loans in any year, choice was made from the long list of customers whose approved applications had been pending before the Board. This bias therefore restricts potential beneficiaries to old customers whose repayment records are readily available for consideration.

Under the present constraint of financial inadequacy to maintain existing level of credit activities, the current loan restrictions may be justifiable. However, when agency's finances improve and credit expansion becomes necessary, then new applicants will necessarily be given equal consideration as old customers. It is therefore desirable to develop a discriminant function capable of identifying defaulters, with high degree of accuracy. This is the main objective of this study. Three years of groups' records were used to develop the function.

The estimated function for new applicants is stated in equation 17 below:

$$\begin{aligned}
 Z &= 0.00044385X_3 + 0.0024754X_4 + 0.0007069X_5 \\
 &= + 0.0015657X_7 + 0.00566864X_8 \dots\dots\dots(17)
 \end{aligned}$$

Where:

- Z = Total discriminant score
- X₃ = Liquidity of groups made up of members shares, subscriptions and savings (₦)
- X₄ = Area cultivated by groups (Ha)
- X₅ = Income of groups (₦)
- X₇ = Adoption of modern technology (fertilizer use kg/Ha.)
- X₈ = Proportion of group land utilised for maize (%).

The estimated centroid for good customers was found to be 0.0902 while that of bad customers was found to be 0.0608. This means that the

higher the composite score for any new observation in respect of an applicant, the higher the probability that the applicant will be classified as a good customer and vice-versa.

Following Pandey and Muralidharan (1971) relative contribution of variables to the total Z – score was estimated and expressed in percentage form. The result is presented in Table 1.

Table 1: PERCENT CONTRIBUTION OF INDIVIDUAL VARIABLES TO THE TOTAL Z–SCORE

Variables	Coefficients	Mean Difference	Product	Percent contribution
X ₃ = Liquidity of groups (₹)	0.0004	56.5	0.0226	3.84
X ₄ = Area cultivated by groups (HA.)	0.0025	14.8	0.037	6.26
X ₅ = Income of groups (₹)	0.0007	470	0.329	55.85
X ₇ = Adoption of Technology (Fert. use kg/ha.)	0.0016	27.7	0.0443	7.52
X ₈ = Proportion of group land utilised (%) for maize	0.0057	27.4	0.1562	26.51

Source: Field Survey Data, 1983

It will be noted from Table 1 that all the variables made positive contribution to the Z–score and that group income and proportion of group land cultivated account for more than 80% of the total Z value of Z–score for the function. This observation contrasts well with an earlier result obtained for old customers in which these two variables showed significant contributions after the leader variable (percentage loan repaid) in that function.

The direction of relationship observed in the estimated function is as postulated. Positive signs obtained for all the variables suggest that an applicant's chance of belonging to the group of good customers improves as his income increases. Similarly, a group's repayment potential will also improve when area of land cultivated, its liquidity and adoption of mo-

Table 2: GROUP MEANS AND MEAN DIFFERENCES FOR DISCRIMINATING VARIABLES

Vara Variables	Good Customers	Bad Customers	Difference
X ₃ = Liquidity of groups (₹)	137.4	80.9	56.5
X ₄ = Area cultivated by groups (Ha.)	35.6	20.8	14.8
X ₅ = Income of groups (₹)	1127	1257	470
X ₇ = Adoption of Technology (Fert. use kg/ha.)	99.2	71.5	27.7
X ₈ = Proportion of group land utilised (%)	83.7	56.3	27.4

Source: Field Survey Data, 1983

Table 3: ANALYSIS OF VARIANCE FOR DISCRIMINANT FUNCTION

Sources of variations	Sums of squares	Degrees of freedom	Mean square	F - Ratio
Discriminant	0.0116783	5	0.00233	
Residual Error	0.0564236	184	0.000613	3.81
Total	0.0681019	189		

Source: Calculation from data, 1983.

dern technology also increase.

The group means and differences in means between the good and bad customers are set out in Table 2. The estimated function was subjected to statistical test of significance. The result of the test is presented in Table 3.

The calculated F-ratio at 5% level of significance was found to be 3.81. The table value at the same level is 2.41.

Since $F_c = 3.81 > F_t (5.184) = 2.41$ then, the hypothesis that all the discriminant co-efficients were equal to zero is rejected. This means, that the estimated function can be used to discriminate between good and bad customers as initially defined.

Classification Performance of Discriminant Function

In order to know how well the function developed in the course of this study will perform in classifying potential applicants, it was subjected to validation tests using a fresh sample of 54 observations. Since the usefulness of a discriminant function lies in its power to classify correctly, then the higher this rate is, the better is the predictive power of the function.

The result obtained using the fresh sample of observations is given in Table 4. The result in Table 4 deserves some comments especially the proportion of bad customers erroneously classified as good customers. This group forms 22 percent of the 27 known bad customers subjected to test. This kind of error constitutes the greatest risk in agricultural credit adminis-

Table 4: CLASSIFICATION PERFORMANCE OF ESTIMATED DISCRIMINANT FUNCTION

Actual group membership	Classification Effort		Total
	Good	Bad	
Good	15 (56%)	12 (44%)	27
Bad	6 (22%)	21 (78%)	27
Both	21	33	54
Proportion correctly classified into good customers	————		56%
Proportion correctly classified into bad customers	————		78%
Proportion of Good customers classified as bad	————		44%
Proportion of Bad customers classified as good	————		22%
Overall correctly classified	————		67%

Source: Calculations from data, 1983

tration. Whereas the 44% misclassification of good customers for bad ones will mainly affect interest earnings foregone, the 22% bad customers may default in the payment of accruable interest as well as the principal loan. The totality of both may be high enough to reduce amount of loan available for subsequent operations. Because of the dual nature of losses to credit agencies, misclassification errors may lead eventually to loan shrinkage, ineffectiveness and liquidation.

Abstract

This study attempts to apply discriminant function analysis technique to an institutional credit agency (OYSICC) in Oyo State of Nigeria. The result shows that in giving loan to group farmers, the credit agency should focus attention on two major characteristics namely, gross annual income of such groups and the proportion of their land under cultivation. These two characteristics are together responsible for over 82 per cent of the predictive power of the function developed in the study. The chances of belonging to one group (good) or the other (bad) will increase when these characteristics also increase in magnitude.

The classification performance of the function is not sufficiently high to alleviate the fear associated with misclassification errors. However, the overall classification performance of 67 per cent is tolerable when compared with 75 per cent obtained by Bauer and Jordan (1971) and 74 per cent recorded by Matiezo (1978). The result will no doubt be improved by searching for more discriminating characteristics.

References

- Bahadur, Tej, and Veeraswamy, S., 'Impact of SFDA Credit to Small Farmers: A Study in South Arcot', *Behaviour Sciences and Community Development*, 1977.
- Bauer, L.L. and Jordan, J.P., 'A Statistical Technique for Classifying Loan Applications'. *A Bulletin No. 476 of the University of Tennessee*, 1971.
- B.N.D.A. Report, 'The Small Agriculture Credit in Ivory Coast', *A.I.D. Spring Review of Small Farmer Credit in Africa*, Vol. VI, Feb. 1973.
- Donald, C., *Credit for Small Farmers in Developing Countries*, Westview Press, Colorado, 1976.
- Green, P. L., and Tull, D.S. *Research for Marketing Decisions*, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1975.
- Ijose, A. and Abaelu, J. N. 'Institutional Credit for Small Holder Farmers: A Case Study of the WNACC', in *Small Farmer Credit in Africa* AID Spring, Vol. VI. 1973.
- Khan, A. A. 'Rural Credit Programme of Agricultural Cooperatives Federation', *Academy for Rural Development*, Comilla, Bangladesh.
- MacAndrews, Colin, 'The FELDA Land Schemes in Malaysia' in *Group Farming in Asia*, Ed. by John Wong, Singapore University Press, 1979.

- Matiezo, R. M., 'Repayment and Group Lending in the Province of Camarines Sur, Philippines', *Ph.D. Thesis, Ohio State University*, 1978.
- Osuntogun, A., Agricultural Credit Strategies for Nigerian Farmers: A Case Study of the Western Nigeria Agricultural Credit Corporation in *Small Farmer Credit in Africa*, A.I.D. Spring Review, Vol. VI, 1973.
- Osuntogun, A. Commercial Banks and the Financing of the Nigerian Agricultural Sector: An Analytical Overview in *Rural Banking in Nigeria*, Edited by Osuntogun and Adewumi, Longman Inc. 1983.
- Peters, W. S. and Summers, G. W., *Statistical Analysis for Business Decisions*, Englewood Cliffs.
- Ugoh, S., Small Holder Agricultural Credit in Eastern Nigeria: An Analysis of the FAID in *Small Farmer Credit in Africa*, A.I.D. Spring Review Vol. VI, 1973.
- Wong, John, Preliminary Comments on Experience and Potentials of Group Farming in *Group Farming in Asia*, Ed. John Wong, Singapore University Press, PTE, 1979.