such measures will in cases have to be accompanied by drastic changes in farm organization with reductions in the presence of farmers, particularly in intensive farming ventures (Lawers, 1992, 1994). Other measures proposed included changes in drainage water management to reduce or control pollution of rivers through reduced or blocked watercourses. Special attention was given to changes in irrigation water management to reduce water pollution. These measures would encourage farmers to reduce pollution, since it has been demonstrated that many farmers have a tradition of subdividing their water, rather than cost-recovery mechanisms. Neither will such proposals lead to solutions for non-irrigation pollution. They cannot be expected to improve efficiency either.

Application of the "polluter pays" principle will eventually, in the absence of insurance, lead to costly litigation and often to consequent default through insolvency. This increases the attraction of insurance of the third-party type.

6. Conclusion

It appears that compulsory insurance offers the potential for more efficient pollution reduction than many other instruments. The relative benefits of different instruments ought to be established by research. One study in South Africa (Aïhoon, 1994) quantified the relevant aspects of river basin salinization control (for the Olifants in Eastern Transvaal), and found pollution insurance in this case to be very feasible. One should, however, be cautious about expectations at this stage. More research is urgently needed.

Note:
1. Based on an MSc (Agric)-thesis by J. Kojo Aïhoon at the University of Pretoria.

References


1. Introduction

Formal credit for small-scale farmers in South Africa has been provided as an element of the Farmer Support Programme (FSP) begun by the Development Bank of Southern Africa in 1987 (Coetzer et al, 1993). The Agricultural Bank of Transkei was formed in 1990 to take over the agricultural loan functions of the loans division of the Transkei Agricultural Corporation which implemented the FSP in Transkei. Non-performing loans had been a major problem for the Transkei Agricultural Corporation, with estimated default rates of 40% and above in the 1980's. Specialised rural lending institutions elsewhere in Africa, the Middle East and Latin America also had high default rates over this period with some 30% to 95% of portfolios in arrears (Bradnerman & Glassch, cited by Aguiar-Alfred and Cuenca, 1991). The Agricultural Bank of Transkei aimed to offer short-term and long-term credit and enforce loan repayment based on banking principles.

In a credit relationship, the lender (the principal) is considered to contract with the borrower (the agent) to productively utilize and repay (with interest) the lender's funds currently and in the future. Research on the factors associated with successful small-scale farm loans or loan defaulters has been conducted, such as the Agricultural Bank of Transkei with information to (1) better screen loan applicants and (2) manage the agricultural risk (avoid adverse selection problems) and (2) reduce agency costs associated with credit control, monitoring and supervision. This research may also assist the present Commission of Inquiry into the Provision of Rural Financial Services (1995) to make recommendations for policy, legislative and institutional measures to improve financial services for rural households, farmers and other small-scale investors into the Provision of Rural Financial Services, 1995).

Many credit scoring models for agriculture have been developed in the United States of America (USA) and Canada to predict the worthiness of commercial farm loans. These studies were motivated primarily by a large number of farm failures and loan defaults among borrowers in the USA and Canada during the 1980's (see Turvey, 1990 and citations therein). The literature on small-scale farm financial markets has recently attempted to measure the magnitude and identify determinants of the loan repayment problems faced by specialised rural lending institutions (see Adams et al, for a review of studies). However, applications of credit scoring models to identify factors associated with small-scale farm loan success or default are limited.

Lyme and Otmann used discriminant analysis to distinguish between low risk applicants from those more likely to default on seasonal loans made by KwaZulu Finance Corporation (KFC) in 1991. The level of off-farm income (ability to service debt) and renting of farm land from other households (commitment to farming) significantly differentiated between loan defaulters and non-defaulters (Lyme & Otmann, 1993) studied the repayment capacity of borrowers in co-operative societies in Harare, India. Non-defaulters had higher levels of off-farm income, higher total farm assets, more diverse land-use, higher off-farm returns of agricultural activities, more diversified credit sources, and higher total credit overs. Defaulters used a larger proportion of their total earnings for consumption purposes, thereby leaving less for investments in production processes and reducing repayment capacity. Higher total cash returns and larger repayment capacity were associated with lower default rates. Lyme and Otmann's finding that low risk loan applicants have more off-farm income which increases ability to service debt. Older applicants (longer customer relationship) with larger asset bases (more collateral) were less likely to have repayment problems. Land tenure status did not significantly affect repayment performance. However, de Vries et al (1993) applied multinomial logit analysis to identify loan

DISCRIMINANT ANALYSIS OF SEASONAL AGRICULTURAL LOAN REPAYMENT BY SMALL-SCALE FARMERS IN TRANSKEI

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A linear discriminant model is used to identify loan and borrower characteristics associated with successful and default seasonal agricultural loans at the Agricultural Bank of Transkei in 1991. Results indicate that small-scale farmers with a proven credit history, higher repayment ability and collateral, and relatively more off-farm income were likely to be default risky.
success or default amongst small-scale farm clients of the Agricultural Bank of Transkei. Results will be compared with those of the Lyne and Ottmann study of KFC clients, and could help financing institutions and policymakers to formulate prudent policies to fund seasonal credit needs of small-scale and emergent commercial farmers.

2. Data source and research method

Data on seasonal input loan applications by 38 representative borrowers who received credit for the 1990/91 agricultural season from the Agricultural Bank of Transkei were obtained from application forms and loan records. The 38 borrowers were selected from the R293 to R19394, with an average loan size of R3450. Loans repaid (not repaid) by the end of March 1992 were classified as successful (in default). Thirteen of the 38 loans were successful and 25 were in default. Factors with loan default or success were estimated by linear discriminant analysis (LDA).

The objective of LDA is to find a linear function

\[ D = \sum_{j=1}^{n} b_j X_j \]

which distinguishes between the two loan groups (success and default) using discriminating variables which measure characteristics on which the groups are expected to differ. This is by analysis of variance that maximizes between-group variance, while minimizing the within-group variance. The standardized discriminant function coefficients are particularly important for policy analysis, since each shows the relative contribution of its associated variable (Xj) to the linear function. Discriminant scores D, estimated for each applicant are compared to the mean score for each variable. The linear function is

\[ D = 0.491\text{AL} + 0.601\text{PRVLN} + 0.3170 \]

2.1 Loan characteristics

APPRDT : The loan approval date is a key determinant of good potential yields and hence repayment ability. The optimum planting time for maize in Transkei is November. Loans approved before the end of September are expected to be successful, compared with late loan applicants who may miss the optimum planting date.

PRVLN : Borrowers who previously had loans from the Agricultural Bank of Transkei have sufficient knowledge of the Bank's lending policy and know the costs of late repayment. Bank policy is expected to have reliable information on its clients' past loan performances, and borrowers with a good credit history are not financed. Bank policy is not to lend to individuals with unpaid loans, hence previous successful loan recipients (PRVLN) are expected to be more likely to repay their loans in time.

The ten variables given in table I were chosen a priori as loan and borrower characteristics which may distinguish between successful and default loans.

<table>
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<tr>
<th>Loan characteristics</th>
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<td>( \text{AL} )</td>
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<td>( \text{DISTPROX} )</td>
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2.2 Borrower personal, resource and financial characteristics

AGE : If the borrower's age is a good proxy for the experience of the borrower, older borrowers are expected to have a better loan repayment performance, ceteris paribus.

GENDER : Past agricultural studies in Africa and Asia indicate that women are more credit-worthy (ILO, World Bank), as they are most involved with farm work in the household and more informed about repayment dates. Loans to women could be more likely to be successful than those made to male farmers.

FTFT : Off-farm income is a source of liquidity, implying that part-time farmers may have lower default risk. Skilled borrowers can easily arrange to repay Agricultural Bank of Transkei loans by having stop or deficit orders on their accounts. Farmers with off-farm incomes may thus be more likely to repay their loans in time, ceteris paribus.

AGRTRN : A borrower with training in agriculture and other related disciplines is more likely to successfully repay loans, as he/she is better equipped to achieve higher production levels. The \( D \) estimated for successful loans were univariate normally distributed, while those for default loans were positively skewed.

3. Results

Discriminant analysis, with prior probabilities of group membership equal to group size, was performed by direct and step-wise procedures, imposing the condition that only variables with coefficients statistically significant at the 0.15 level or below enter the estimated model. The stepwise variables were not highly correlated and hence no problems associated with multicollinearity are expected. Wilk's lambda (the ratio of within-group sums of squares to the total sum of squares) was monitored, to show the proportion of the total variance in the discriminant scores not explained by differences among groups. Some of Wilk's lambda values identify significant differences between groups and little variability within groups, implying effective classification ability. The estimated LDA was

\[ D = 0.350\text{AL} + 0.573\text{PRVLN} + 0.5670 \]
success or default amongst small-scale farm clients of the Agricultural Bank of Transkei in 1991. Results will be compared with those of the Lyne and Ortmann study of KFC clients, and could help financing institutions and policymakers to formulate better policies to fund seasonal credit needs of small-scale and emergent commercial farmers.

2. Data source and research method

Data on seasonal input loan applications by 38 representative borrowers who received credit for the 1990/91 agricultural season from the Agricultural Bank of Transkei were obtained from application forms and bank records. Applicant loan applications ranged from R293 to R19944, with an average loan size of R3450. Loan repay (not repaid) by the end of March 1992 were classified as successful (in default). Thirteen of the 38 loans were successful and 25 were in default. Factors with loan default or success were estimated by linear discriminant analysis (LDA).

The objective of LDA is to find a linear function

\[
D = \sum_{j=1}^{p} B_j X_j
\]

which distinguishes between the two loan groups (success and default) using discriminating variables which measure characteristics on which the groups are expected to differ. This is by analysis of variance that maximizes the between-group variance, while minimizing the within-group variance. The standardized within-group variables are important for policy analysis, since each shows the relative contribution of its associated variable \(X_j\) to the linear function. Discriminant scores \(D\), estimated for each applicant are compared to the mean score for each group with the score most similar to his own. Success in discrimination between the two loan groups is assessed by observing the proportion of correct loan classifications and the Wilk's lambda statistic (Klecka, 1975).

The major problem with LDA is the assumption that independent variables in the two groups come from populations with a normal distribution. If the independent variables are not from normal populations, or the variance-covariance matrices are not equal, then the estimators are not consistent (Turvey, 1990). The LDA is, however, robust to departures from the normality assumptions (Lachenbruch, 1975-40-50). In addition, a weaker sufficient conditions to justify the LDA is that the \(D\) be univariate normal (Truett et al, 1967). The ten variables given in table I were chosen as discriminant variables which may distinguish between successful and default loans.

2.1 Loan characteristics

A PROD: The loan approval date is a key determinant of good potential yields and hence repayment ability. The optimum planting time for maize in Transkei is November. Loans approved before the end of September are expected to be successful, compared with late loan applicants who may miss the optimum planting date.

PRVNL: Borrowers who previously had loans from the Agricultural Bank of Transkei have sufficient knowledge of the Bank's lending policy and know the costs of late repayments, and are expected to have reliable information on its clients' past loan repayment performances. Farmers with late repayment dates are expected to have a better loan repayment performance, ceteris paribus.

AGE: Age in years.

GENDER: A dummy variable equal to 1 for male borrower and 0 for female borrower.

FITT: Farmer status. A dummy variable equal to 1 for a part time farmer and 0 for a full time farm.

AORTEN (Xo): Agricultural training of the borrower. A dummy variable equal to 1 for a trained farmer and 0 otherwise.

FMSIZE (Xo): Farm size in hectares.

AREA (Xo): Agro-ecological classification. A dummy variable equal to 1 for high potential area and 0 for low potential area.

ATL (Xo): Assets to liability ratio.

DISTPROX (Xo): Distance from the borrowers residence (farm) to the nearest Agricultural Bank of Transkei branch in kilometers.

2.2 Borrower personal, resource and financial characteristics

AGE: If the borrower's age is a good proxy for the expected success of the borrower, older borrowers are expected to have a better loan repayment performance, ceteris paribus.

GENDER: Past agricultural studies in Africa and Asia indicate that women are more credit-worthy (ILO, World Bank), as they are most involved with farm work in the household. Therefore, they are more informed about the repayment dates. Loans to women could be more likely to be successful than those made to male farmers.

FITT: Off-farm income is a source of liquidity, implying that part-time farmers may have lower default risk. Salaried borrowers can easily arrange to repay their Agricultural Bank of Transkei loans by having stop or debit orders on their accounts. Farmers with off-farm incomes may thus be more likely to repay their loans in time, ceteris paribus.

AGTRN: A borrower with training in agriculture and related disciplines is more likely to successfully repay loans, as he/she is better equipped to achieve higher this ratio, the more favourable the solvency position and the more collateral borrowers have to pledge against loans.

ATL: The assets to liability ratio is measure of solvency, showing the extent to which business assets asset businesses can meet all liabilities in the event of bankruptcy. The higher this ratio, the more favorable the solvency position and the more collateral borrowers have to pledge against loans.

DISTPROX: The distance from the borrower's area to the nearest Agricultural Bank branch is used to estimate the transactions costs associated with loan repayment (actual expenditure on transport costs and time) spent by borrowers. Farmers from more distant areas probably have higher transactions costs and hence are more likely to be in arrears (transactions costs higher are relative to the penalty for default).

3. Results

Discriminant analysis, with prior probabilities of group membership equal to group size, was performed by direct and step-wise procedures, imposing the condition that only variables with coefficients statistically significant at the 15 % level or below enter the estimated model. The selected variables were not highly correlated and hence no problems associated with multi-collinearity were expected. Wilk's lambda (the ratio of within-group variance to the total sum of squares) was monitored, to show the proportion of the total variance in the discriminant scores not explained by differences among groups. Small Wilk's lambda values indicate finite mixtures between groups and little variability within groups, implying effective classification ability. The estimated LDA was

\[
D = 0.009 \times (A T L - 0.59) \times P R V N L \times 0.59^
\]

where * and ** denote statistical significance at 5% and 10% levels respectively. Based on the standardised coefficients, PRVNL (credit history) is the major factor associated with agricultural loan success, followed by PROD (repayment ability proxy), ATL (collateral proxy) and lastly GENDER (gender proxy). All signs agree with a priori reasoning. Seasonal loan repayment is more likely to be associated with individual borrowers who have repaid past loans, obtained loans before optimum planting time, are more solvent, and who are part-time farmers (less off-farm income). The LDA model correctly identified 76 % of failed loans and 69 % of successful loans. The overall classification accuracy of the LDA was 74%, while the relatively high Wilk's lambda of 0.72 indicates that a considerable amount of discriminatory information had not been accounted for by the selected variables. The D_j estimated for successful loans were univariate normally distributed, while those for default loans were positively skewed.

4. Conclusion

A proven credit history was the major characteristic of successful loan applicants. These borrowers are probably well aware of the importance of the seasonal agricultural cycle. The policy of the Agricultural Bank of Transkei (application procedures, deposit requirements before loan approval and implementation), have an established principal-agent relationship and know repayment dates and the consequences of non-payment. Loans approved by the end of September (or up to the second week of October) were relatively more successful (in time for optimum maize planting date).

The Agricultural Bank of Transkei does not approve late seasonal agricultural loans, as late planting results in poor maize yields. Bank policy, therefore, should be to advise farmers through extension officers, field staff or agricultural media services to apply for seasonal loans by the correct dates. Loan success was also positively associated with the assets to liability ratio, a collateral proxy. Lack of accurate information about the borrower's repayment abilities could result in the Agricultural Bank of Transkei lending to non-credit-worthy borrowers. Reliable information on borrowers' debt with other financial or trading institutions could reduce Bank default rates by enabling proper evaluation of seasonal loan client solvency.

Off-farm income improved the repayment ability of Agricultural Bank clients, supporting the Lyne and Ortmann and Goyal et al studies which found a positive association between off-farmers and off-farm income. The Agricultural Bank of Transkei's seasonal loans policy should thus not necessarily exclude part-time farmers from the facility. The inclusion of the above variables will probably not be sufficient to reduce potential seasonal default rates. However, it is an important first step.


1. Introduction

With human beings, as with their sciences, the primary aim of thought and action is to satisfy needs and to preserve life. The agricultural economists' profession appeared relatively late on the scene and is currently active involved in the agrarian sector. Framing of the place of agricultural economists in the twenty-first century requires a more pliant perspective on the discipline than is current in fashion (Libby, 1994). Agricultural economists have the responsibility to relieve the macro and micro problems in agriculture and related sectors. The professions' teaching, research, extension and attitudes must adjust to mutability, from precise mathematical solutions to a more valid holistic approach, and from atomistic behaviour to co-operation. These required adjustments do not require a new profession, but a critical international differential evaluation of the existing profession in order to acquire a future vision, which will in turn address changes in the training of agricultural economists.

2. A critical international evaluation of the profession

Leontief (1971) once called agricultural economics "a profession maintaining a healthy balance between theoretical and empirical analysis and readiness of professional economists to cooperate with experts in the neighbouring disciplines". Close collaboration with agriculturalists provides agricultural economists with direct access to information of a technological kind including aspects like crop rotation, fertilizer, or alternative harvesting techniques. Preoccupation with the standard of living of the rural population has led agricultural economists into collaboration with home economists and sociologists, that is, with social scientists of the "softer" kind. While concentrating their interest on a single aspect of the economic system, agricultural economists demonstrated the effectiveness of a systematic combination of a theoretical approach with detailed factual analysis. They were the first among economists to make use of the advanced methods of mathematical statistics. However, in their hands, statistical inference became a complement to, not a substitute for, empirical research.

Without dispute, agricultural economics was developed historically within a specific institutional framework modelled by the politics of interest groups as represented in the profession, but a critical international differential evaluation of the existing profession in order to acquire a future vision, which will in turn address changes in the training of agricultural economists.

ARE SOUTH AFRICAN AGRICULTURAL ECONOMISTS ADEQUATELY SKILLED TO FACE FUTURE CHALLENGES?

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The agricultural science establishment experiences growing pressure from an unimpressed public. Like other agricultural scientists, agricultural economists should determine how to face future challenges. Agricultural economists appear not to be open minded, adaptable and willing to push the boundaries of their discipline to be able to cope with secondary activities. An increasing number of limitations hampers the effectiveness of the profession and the agricultural economist should signal a need for curriculum revision. Departments of Agricultural Economics should reconsider the importance of producing economically literate graduates who can function and perform in external environments. Curricular changes must incorporate the inclusion of imaginative deviations that will be able to connect economic rationality with changing perceptions. Services of academic institutions should involve inter alia, focusing their traditional efforts also on non-traditional market, this provides some challenges of its own.

Is Sud-Afrikanse Landbou-ekonome Toereikend Opgelei Om Toekomsige Uitdagings Die Hoof Te Bied?

Die landbouwetenskaplike professies ondervind toenemende druk van 'n onwieldlike publiek. Soos ander landboudeelkundiges moet die landbou-economie bepaal hoe hul toekomsige uitdagings sal aanspreek. Die professie soos weëslik het veronstdra, is ekonomiese nadere te wees om hul dissiplinêre grense te verwy; toeneemend sekondêre aktiviteite aan te spreek nie. 'n Toekomslike gestap beperkings belemmer die effektiviteit van die professie en dit mag 'n nodigheid vir verskillende toekomsige uitdagings wees.

Die landbou-economie se profession se speelveld het verander. Dit mag 'n nodigheid vir kurrikulumveranderings aandui. Landbou-economie departemente behoort erkenning te gee aan die be/angrikheid daarvan om ekonomies geletterde graduandi op te /ewer wat kon funksioneer en presteer in ekserente omgewings. Kurrikulêre verandering moet die inlasting van verhoudingsgrye eie-onafskeidig inkopereer, waar ekonomiese rationaliteit kon verbind met veranderende perspekte. Diere van die akademiese inligtingsbehoorde behoort onder die nood te behels wat hulle tradisionele diensies ook op nie-tradisionele marke toepas; dit stel uitdagings op sy confrontasie met die toekomsige uitdagings.