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Predicting risk of credit default using discriminant approach: Case of tribal dairy farmers of Jharkhand Platue

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Livestock husbandry is an integral part of India's agricultural economy, contributing 28% to agricultural gross domestic product and only source of livelihood for about 100 million rural people (Bhatt 2012) as over 80% of production being carried out by small scale and marginalized farmers. Empirical studies also suggested its significant impact on equity in terms of income and employment generation and poverty reduction in the rural areas (Abdou 2009, Enoma 2010, Sinha *et al*. 2012) as the distribution of livestock is more egalitarian compared to land (Ahuja *et al*. 2000). The credit and technical support to smaller farmers through animal husbandry is an important policy intervention to create better livelihood options and production practices. More the livelihood options the borrowers have, the less are they vulnerable to crisis. Hypothesis behind the study is that sanctioning credit to the production process will provide sufficient additional resources to meet the repayment obligations and generate a reasonable surplus for the producers. For credit institutions the factors influencing the loan repayment assume significance and identifying the potential defaulters based on their social and economic criteria is of immense importance. The study is step forward in this direction.

Multi stage stratified sampling design used to select 240 farmers, covering 120 beneficiaries and 120 non-beneficiaries of dairy loan from 3 clustered villages spread across 3 blocks of the Ranchi district. To examine the relative importance of different factors discriminating between non-defaulters and defaulters of the loan repayment, discriminant function analysis was carried out. The coefficient of discriminant function measures the net effect of an individual variable, includes size of operational holding (X_1), number of milch animals (X_2), per-capita crop income (X_3), per-capita dairy income (X_4) and per-capita income from off-farm activities (X_5), expenditure to income ratio (X_6), investment in dairying (X_7), percentage earning adults (X_8), per-capita food expenditure(X_9), per-capita expenditure on dairy products (X_{10}), and educational level (X_{11}) of family head in schooling years. The discriminant matrix notation solved as sugeested by Brandow and Potter (1953). The Mahalanobis D^2 test was used to measure the distance between the two groups.

The social attributes of the borrowers together with the means and their mean differences for the 2 groups of non-defaulters and defaulters were analyzed. The results revealed that the characteristics of per-capita income from crop production (17.32%), per-capita income from dairying (19.39%), per-capita off-farm income (15.62%), percentage of expenditure in total income (19.79%) and the percentage of earning adults (11.29%) were the major characteristics, which led to classifying the loan borrowers into 2 groups of defaulters and non-defaulters. The discriminant function was re-run by taking only those 5 significant variables in the equation to see whether these characteristics alone could discriminate the defaulters and non-defaulters significantly. It was concluded that these characteristics were very useful for measuring distance in the discriminating power. The new discriminating function, taking only the significant factors, was estimated as follows:

$$Z = 0.0023\ X_3 + 0.0011\ X_4 + 0.0038\ X_5 - 0.0636\ X_6 + 0.0212\ X_8$$

Again, the discriminant function was tested to examine attributes together could significantly discriminate between the groups of defaulters and non-defaulters. The D^2 and variance ratio were worked out to be 4.6241and 5.3154, respectively. Since the tabular value of $F_{(5,62)}$ at 5% level is 4.43, the discriminant function was significant. This means that the 5 characteristics considered together were useful in classifying the borrowers into the groups of non-defaulters and defaulters of loan-repayment. Thus, the difference in the groups was mostly oriented towards per-capita income, percentage expenditure in total income and percentage of earning adult in the family. These discriminating variables obtained were quite contrary to the variables reported by Gandhimathi (2012) and Lekshmi *et al.* (1998), while the result was in conformity with the findings of Bandyopadhyay (2006) and Nawai and Shariff (2010).

The magnitude of coefficient of a function is an indicator

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Table 1. Relative importance of significant characteristics for defaulters and non-defaulters of loan-repayment

Socio-economic variable (X_{is})	Coefficient (I_K)	Mean difference (d_k)	Contribution of variable ($I_{K\ x}\ d_{k)}$	Factor contribution (%)
X_3	0.0023	167.556	0.3853	38.72
X_4	0.0011	285.970	0.3146	31.62
X_5	0.0038	16.850	0.0640	6.43
X_6	–0.0636	–2.640	0.1679	16.87
X_8	0.0212	2.990	0.0633	6.36
Total			0.9951	100.00

of the relative importance of an individual variable. The coefficients in the Z equation suggested that higher per-capita income from crop production, higher income from dairying, percentage of expenditure in total income, off-farm income sources and more earning adults in the family contributed high value of Z, explained a major share in discriminating the non-defaulters from defaulters followed by the percentage earning adults and off-farm income (Table 1). The weights associated with these characteristics to the total distance measured were obtained as 38.72, 31.62, 16.87, 6.43 and 6.36, respectively. The mean discriminant score, Z_1 for the non-defaulters and Z_2 for defaulters were found to be 0.316 and –1.322, respectively. The critical mean discriminant score (Z) for the 2 groups was –0.503. This implies that, if the discriminant score for a respondent on the basis of significant variable for his data is more than –0.503, he can be predicted to be a non-defaulter, otherwise he is likely to be a defaulter. The high value of Z corresponds to a non-defaulter and low value to a defaulter. This can be shown as:

Discriminating score for non-defaulter (Z_1)	Separating mean score (Z)	Discriminating score for defaulter (Z_2)
0.316	–0.503	–1.322
← Non-defaulter →	♦	← Defaulter →

It was interesting to see as to what proportion of respondents considered in the study was classified rightly by the function. With this view, the whole sample of 120 respondents was classified into defaulters and non-defaulters. Then, it was compared with the actual classification. It is called as derived classification analysis.

The percentage of cases classified correctly is the productive power of fitted discriminant function. It is also important to consider the observed misclassification rate to that by chance, while evaluating the measure. It was seen from the Table 2 that 50 out of 83 defaulters (60.2%) and 32 out of 37 non-defaulters (86.5%) were classified rightly in the Z function. The number of wrongly-classified respondents was 38 in 120 respondents. Therefore, grouped cases classified correctly were 68.3%. Thus, the model was found to be valid to predict whether a borrower is likely to be a defaulter or non-defaulter, more precisely.

Table 2. Classification results (Confusion matrix) of loan borrower groups

Loan repayment group	Number of cases	Predicted group membership			
		Defaulters	%	Non-defaulters	%
Defaulters	83	50	60.2	33	39.8
Non-defaulters	37	5	13.5	32	86.5

SUMMARY

The credit support to the smallholder tribal families for the dairy development is an important source of viable mix of livelihood options and improving quality of life. The study has investigated the localized social factors that can be used by the credit institutions in risk rating a farmer-customer. The study has suggested that lower income from crop production, dairy and off-farm activities coupled with high expenditure proportionate to income and smaller number of earning adults in the family leaves only a smaller surplus with farmers making them to be a defaulter. The derived classification analysis has cross-verified the predicted variable and has found that the group classified correctly by 68.3% as factors of default. Thus, model was found valid in predicting a defaulter of loan-repayment based on the localized factors precisely. The study will address the concern of the credit institution in advance to assess the credit risk capital and risk adjusted outcome for serving a larger group of smallholders' community.

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