SOCIOECONOMIC CHARACTERISTICS OF BORROWERS CAUSING CROP LOAN DEFAULT: A DISCRIMINANT ANALYSIS.

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ABSTRACT

This paper attempted to identify the socioeconomic characteristics of borrowers causing crop loan default by applying a discriminatant function analysis. The study shows that live c socioeconomic characteristics of borrowers make them defaulters. These include family size. per capita consumption expenditure, size of operated holdings, amount of loans taken from other sources and percentage of total expenditure to total income. These characteristics are usually possessed by large farmers. Thus the study implies that large farmers are generally defaulters of crop loans. These findings have great implications for credit policies in Bangladesh as policies of hanks favour large farmers in advancing credit.

I. INTRODUCTION

Recovery of agricultural credit, which is often considered as the major yard-stick to measure the Performance of credit institutions, is unsatisfactory in Bangladesh. In 1990, only 17.6% of due loans were recovered (Bangladesh Bank 1991).

The poor recovery of agricultural credit may affect the supply of credit and viability of credit and cooperative institutions. The annual disbursement of agricultural credit gradually increased to Tk.1149.84 crores in 1984-85 which fell abruptly to Tk. 564.62 crore in the next financial year. This dramatic retrenchment was due to government and donor concern over poor recovery (BASR 1990). Additionally, credit institutions depend heavily upon government refinancing to meet their annual credit target. Refinancing was about 79 percent of the total agricultural credit disbursed in 1988-K9 (Bangladesh Bank 1990).

A host of reasons have been identified for poor recovery of agricultural credit which have complex social, political, economic arid other dimensions. Ali (1990) forcefully argues that political interventions in credit management i.e., institution building, politicisation of the delivery system, occasional waiver of overdue loans etc. have contributed to poor recovery performance. High default rate was also due to other reasons like, crop failure, absence of effective sanctions against default, injudicious target-driven lending, etc.

In the analysis of causes and problems of agricultural credit recovery, little attention has been placed upon the identification of prospective borrowers. In agricultural finance literature, great emphasis has been placed upon the identification of borrowers on file basis of their character; capacity to repay, equity etc. (Nelson, Lee and Murray, 1973; Singh 1988). These factors definitely affect the loan repayment behaviour of borrowers.

Thus, in analysing the problems of crop loan recovery and default, the brrowers should be classified on the basis of their socioeconomic characteristics. For this type of problem discriminant analysis is appropriate. So in the present study, discriminant function was used to classify crop loan borrowers into defaulters and non defaulters. The paper has been organized as follows. Section II discusses the analytical technique of the study. Socioeconomic variables which discriminate between defaulter and nondefaulter borrowers are discussed in section III. In Section IV, results of the estimated discriminant function and critical zone of Z are discussed. The last Section provides the conclusions.

II ANALYTICAL TECHNIQUE

Discriminant function is a statistical tool used to assign an unknown object or person in one of two or more groups of objects or persons on the basis of combined effect of a set of factors.

The analysis determines the relative importance of variables in the study in regards to their power to discriminate between two groups of respondents, say defaulters and non-defaulters (George, Namasivayam and Ramachandriach, 1984). The model may be described as follows:

$$Z = \Sigma L_i X_i$$

where, Z = total discriminant score for defaulters and non-defaulters

X_i = socioeconomic variables

L_i = Coefficient of linear discriminant function which measure the net effect of each variable.

The coefficients L_i's are so determined as to maximize the ratio of the variance of Z between groups to the variance of Z within groups. The score Z is an optimum linear discriminator between the groups. In applying the score a critical value of Z (Z in Box-1) is established in the middle of the means of Z for the two groups. Any borrower having the same variables in the study receives a score (Z_i) after substituting the values in the discriminant function. The next step is to compare this with the critical value, Z. If $Z_i > Z$, the borrower in question is most likely a non-defaulter; if $Z_i < Z$, he is most likely a defaulter.

The discriminant function is tested for significance to know whether all variables taken together were sufficiently discriminating the two groups using the following F-statistic (Roy and Mukherjee 1964; Rao 1948).

$$F = \frac{n_1\ n_2\ (n_1+n_2-p-1)}{p(n_1+n_2)\ (n_1+n_2-2)}\ D^2 \text{ with df. } p \text{ and } (n_1+n_2-p-1).$$

where

p   =   Number of characteristics

n_1 =   Number of non-defaulters

n_2 =   Number of defaulters

D^2 = $\Sigma L_i\ d_i;$ d_i = Mean Difference.

III. SOCIOECONOMIC VARIABLES DISCRIMINATING DEFAULTERS AND NONDEFAULTERS

Although few studies on discriminant analysis have been done in Bangladesh, several studies have been completed in India and other countries (Balakrishna and Rudha, 1968; Brandow and Potter, 1953; Chand and Shidue, 1985; Pandey and Muralidharan, 1977; Pandey and Kaushal, 1980; Pradhan and Sharma, 1981; Parsad, Ramanna and Achoth, 1987; Singh and Pandey 1981). The present study selected the variables based upon those studies.

The study was conducted in Baira Union of Mymensingh district. A list of all crop loan borrowers of the BKB branch at the Bangladesh Agricultural University was prepared. Then defaulters and nondefaulters were identified and 99 borrowers were selected of which 50 were nondefaulters and 49 were defaulters.

The socioeconomic variables selected for the study are given in Table 1 with their theoretical impact upon loan repayment. A positive sign indicates that a higher value of the variable may increase income which will in turn increase loan repayment capacity. Thus the borrower will be a nondefaulter. The opposite is indicated by the negative sign.

Out of eighteen variables, eleven variables which indicate that they may have favourable impact on repayment capacity, have positive signs. These variables are: percentage of farm income to total income (3), per capita income from crop production (4), size of operated holding (5), percentage of farm expenditure to total expenditure (6), percentage of bank loan used for production (7), percentage of irrigated area to total area (8), cropping intensity (9), per capita total income (10), per acre fertilizer used (14), Percentage of irrigation cost to total cost (15) and total expenditure on production (18). The rest of seven variables have negative signs which are: family size (1), per capita consumption expenditure (2), expenditure on education (11), medical expenditure (12), percentage of nonfarm income to total income (13), amount of loans taken from other sources (16) and percentage of total expenditure to income (17).

Table 2 shows differences in mean values between non-defaulters and defaulters. A positive difference indicates that average value of the variable is higher in nondefaulter group, while a negative difference indicates the opposite.

Comparing Tables 1 and 2, it may be observed that out of eighteen variables, twelve variables have consistent signs. Thus six variables have inconsistent signs. Of seven negative signs, five variables have consistent signs. The five variables which have consistent signs are: family size, medical expenditure, percentage of nonfarm income to total income, amount of loans taken from other sources and percentage of total expenditure to income. Two variables which do not have consistent negative signs are: per capita consumption expenditure and expenditure on education.

Out of eleven variables which have positive theoretical signs, seven variables have consistent signs. The seven variables are: percentage of farm income to total income, per capita income from crop production, size of operated holding, percentage of irrigated area to total area, cropping intensity, per capita income and total expenditure on production. Variables which do not have consistent signs are: percentage of farm expenditure to total expenditure,

percentage of bank loans used for production, per acre fertilizer used and percentage of irrigation cost to total cost.

Table 1.   Socioeconomic Variables Selected for the Study with their Theoretical Impact on Loan Recovery.

Serial	Variables	Theoretical impact
1	Family size	-
2	Per capita consumption expenditure	-
3	Percentage of farm income to total income	+
4	Per capita income from crop production	+
5	Size of operated holding	+
6	Percentage of farm expenditure to total expenditure	+
7	Percentage of bank loan used for production	+
8	Percentage of irrigated area to total area	+
9	Cropping intensity	+
10	Per capita total income	+
11	Expenditure on education	-
12	Medical expenditure	-
13	Percentage of nonfarm income to total income	-
14	Per acre fertilizer used	+
15	Percentage of irrigation cost to total cost	+
16	Amount of loans taken from other sources	-
17	Percentage of total expenditure to income	-
18	Total expenditure on production	+

IV. ESTIMATION OF DISCRIMINANT FUNCTION AND CRITICAL ZONE OF Z

Estimation of Discriminant Function

The coefficients of discriminant function fitted to the data are presented in Table 3. The value of D^2 and F- ratio calculated were 2.4877 and 3.331 respectively. Referring to F- table with df. 18 and 80, the function is found to be highly significant. This means that 18 characteristics considered together are useful in classifying the borrowers in two groups: defaulters and non-defaulters..

However, Student's t- test applied further to test the significance of the mean differences of the selected variables for the two groups, shows that only nine variables are significant with respect to mean differences (Table 2). These variables are: family size (1), per capita consumption expenditure (2), per capita income from crop production (4), size of operated holding (5), cropping intensity (9), per capita total income (10), amount of loans taken from

other sources (16), percentage of total expenditure to income (17) and total expediter on production (18). Therefore, the discriminant function was rerun only with the significant variables. The new coefficients are presented in Table 4. The table shows that out of nine variables, four variables have positive signs which are: per capita income from crop production, cropping intensity, per capita total income and total expenditure on production. These are the variables which make a borrower non-defaulter. On the otherhand, five variables have negative signs which include: family size, per capita consumption expenditure, size of operated holding, amount of loans taken from other sources and percentage of total expenditure to total income. These characteristics make a borrower defaulter.

Table 5 shows that out of nine variables, only one variable-size of operated holding- has inconsistent sign. This has great implication for credit policy. The study shows variables which make a borrower a defaulter are related to larger farm sizes. Large farmers have large family sizes and higher per capita expenditure. They also have higher percentage of total expenditure to total income and large amount of loans taken from other sources. Thus, the study implies that large farmers are more defaulters than small farmers. Many studies agree with these findings (Elahi, Hakim and Haq 1990).

Critical Zone of Z

The mean Z- score for non-defaulters and defaulters are calculated as $Z_1 = 1.3592$ and $Z_2 = -0.6584$ respectively. The critical value, Z for the two groups came out to be 0.3504.

A critical zone of Z ($Z_2 = -.6584$ to $Z_1 = 1.3592$) can then be established as a region within which borrowers are sensitive to shift in classification between those of defaulters and non-defaulters. The critical value Z=.3504 divides the zone into two exclusive regions as defaulters and non-defaulters. If the value of Z score of a farmer is more than .3504 he is predicted to be a non-defaulter, otherwise he is likely to be a defaulter. The results from computing a Z for each of 99 borrowers are summarized in Box 1. This Box shows the effects of the 9 variables in determining the margin of reclassification. The area on either side of Z(between Z & Z_1 and between Z & Z_2) are crucial areas in this example. Borrowers falling into these zones are sensitive and susceptible to reclassification.

The upper and lower part of the box represent the classification of defaulters and non-defaulters into three categories, each on the basis of their calculated Z values. These categories in both cases may be cahracterised as follows:

Category I : Borrowers which can unquestionably be classified as defaulters or non-defaulters.
Category II: Borrowers which approach the critical value but still possess their own group.
Category III: Critical cases which are characterised as susceptible to reclassification.

It is clear from Box I that 4.08% of defaulters overlap into category II of non-defaulters and 6% of non-defaulters overlap category II of defaulters. The difference suggests that the sensitive borrowers shifted more to defaulters than to non-defaulters. Overall, the function is seen to have classified about 96% of borrowers into defaulters and non-defaulters.

Table 2.   Means and Differences Between Means for Eighteen Characteristics of Crop Loan Borrowers.

Variables	Mean values			
Xi	Non-defaulters (n₁ = 50)	Defaulters (n₂ = 49)	Overall (n = 99)	Difference (t - value)
1	5.1200	6.2857	5.6970	-1.1657** (4.107)
2	4365.1080	3756.7245	4063.9889	608.3835** (3.03)
3	62.6378	56.3329	59.617	6.3049 (1.17)
4	5352.2420	2912.8878	4144.8849	2439.3540** (4.308)
5	3.5494	1.1184	2.3462	2.4310* (1.99)
6	14.6788	39.1651	26.7983	-24.4860 (0.84)
7	26.6508	29.3508	27.9872	-2.7 (0.32)
8	108.8900	88.9571	99.5227	20.9330 (1.12)
9	178.3256	153.5445	166.0602	24.7810** (2.49)
10	8246.4000	5292.6898	6783.9677	2954.7100** (4.99)
11	1174.0000	779.5918	978.7879	394.4100 (0.909)
12	2388.0000	2959.1837	2645.4546	-621.1840 (1.465)
13	37.3622	55.9669	46.5706	-18.6050\ (1.275)
14	403.3540	435.0082	419.0212	-31.6540 (0.536)
15	12.6532	14.2986	13.4676	-1.6454 (0.772)
16	2396.4200	2922.9590	2657.3333	-526.5390* (2.278)
17	95.1998	118.2704	106.6185	-23.0704** (4.241)
18	6791.5400	3978.8370	5399.3939	2812.7033* (6.713)

* Significant at 0.05 level of significance.
** Significant at 0.01 level of significance.

Table 3. **Precent Contribution of the Individual Characteristics to the total Distance Measured.**

Variable	Cofficient Li	Lidi	Percentage of contribution
1	-0.2536	0.2956	11.88
2	-0.00045	-0.2738	-11.00
3	0.0275	0.1734	6.97
4	0.00025	0.6098	24.51
5	-0.1532	-0.3724	-14.97
6	-0.00132	0.0323	1.30
7	-0.03929	0.1061	4.26
8	-0.001945	-0.0407	1.64
9	0.14561	0.3608	14.50
10	0.00014	0.4137	16.63
11	0.000552	0.2177	8.75
12	-0.000369	0.2292	9.21
13	0.00175	-0.0326	-1.31
14	0.006604	-0.2091	-8.41
15	-0.00901	0.0148	0.59
16	-0.00563	0.2967	11.93
17	-0.00937	0.2162	8.69
18	0.00016	0.4500	18.09
		$D^2 = 2.4877$	

Table 4. **Precent Contribution Individual Characteristics to the Total Distance Measured (only for the significant Variables).**

Variable	Coefficient Li	Lidi	Percentage of Contribution
1	-0.1651	0.1925	9.45
2	-0.00019	-0.1156	-5.73
4	0.00022	0.5367	26.60
5	-0.0734	-0.1784	-8.84
9	0.0140	0.3469	17.19
10	0.00012	0.3546	17.57
16	-0.00056	0.2946	14.60
17	-0.00956	0.2206	10.93
18	0.00013	0.3657	18.12
		$D^2 = 2.0179$	

Table 5. Comparison of Theoretical Signs with the Signs of mean Difference and Discriminant coefficiens.

Variable	Description	Theoretical sign	Sign of mean difference	Sign of discriminant coefficient
1	Family size	-	-	-
2	Per capita consumption expenditure	-	+	-
4	Per capita income from crop production	+	+	+
5	Size of operated holding	+	+	-
9	Cropping intensity	+	+	+
10	Per capita total income	+	+	+
16	Amount of loan taken from other sources	-	-	-
17	% of total expenditure to total income	-	-	-
18	Total expenditure in production	+	+	+

Box 1. **Classification of 99 Crop Loan Borrowers on the Basis of Their Z- Values.**

Classification of defaulters			
I	II	III	
39	8	2	$n_2 = 49$
(79.59%)	(16.33%)	(4.08%)	
1) 6.35	6.19	5.316	
2) 3805.52	3575.56	3530.89	
4) 2776.93	3200.20	4498.12	
5) 1.13	1.10	0.99	
9) 151.80	153.65	155.79	
10) 5075.70	5789.65	7123.50	
16) 2954.75	2856.03	2556.59	
17) 119.20	119.53	96.05	
18) 3000.93	4313.89	6009.81	
z = -0.8100	z = -0.4134	z = 0.8356	

			Classification of non-defaulters
	III	II	I
	3	23	24
	(6%)	(46%)	(48%)
$n_1 = 50$			
	1) 5.5	5.3	4.92
	2) 4800.00	4450.02	4230.00
	4) 4025.93	5297.83	5668.40
	5) 6.03	3.85	2.96
	9) 145.61	150.07	208.40
	10) 5497.80	7498.30	9337.75
	16) 2687.90	2499.50	2265.70
	17) 115.57	97.75	90.23
	18) 5001.95	6791.50	7014.75
	z = -0.6385	z = 0.6765	z = 2.2336

Mean z-score for defaulters, $Z_2 = -0.6584$ Critical value $Z = 0.3504$ Mean z-score for non-defaulters $Z_1 = 1.3592$

V. CONCLUSION

The discriminant analysis indicated that higher family size (1), per capita consumption expenditure (2), operated size of holding (5), amount of loan other than crop loan (16) and percent of total expenditure to total income (17) placed the borrowers in defaulters group. Whereas, higher per capita income from crop production (4), cropping intensity (9), per capita total income (10) and total expenditure in production (18) contributed to non-defaulters. These findings have great policy implications. The study implies that large farmers possess the characteristics to be defaulters. These farmers have larger family sizes and higher consumption expenditure. They may also take large loans from various sources and have expenditure whose percentage is high. These findings indicate that agricultural credit policies are not in the right track. In various ways, banks favour large farmers; small farmers' access to bank loans is limited. The study indicates that this policy should be changed to improve the loan recovery performance.

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