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varieties can only improve the productivity. It is not the case with the overall productivity of HYVs, which is diminishing over time. This fact is revealed by some studies[11] conducted in this field. In a search for the factors causing this decline, Vidya Sagar[12] has tried to establish a relationship between the spread of the new varieties and productivity. Without going into details and taking the declining productivity for granted, we find that while the spread of HYVs is pushing the overall productivity upwards, the declining productivity of HYVs is pulling it downwards. The path followed by the productivity would then depend on the resultant of these forces. Without any loss of generality, let us assume that the spread of HYV is exponential. Three possible cases may occur. Firstly, the growth trend of area is more powerful than the impact of diminishing productivity of HYV, in which case the growth of overall productivity would be slowed down although it would still be growing exponentially. In the second case, both the forces balance each other so that the growth of productivity is constant. Thirdly, the declining yield rate of HYVs may have a more powerful impact, making the resultant productivity path lose its slope gradually.

It is this third case which may be applicable in the case of Rajasthan during the latter period. One cannot, however, make conclusive statements on the basis of limited data. Further investigations into the problems along with the causes of growth differentials will be attempted in another study.

VIDYA SAGAR AND KANTA AHUJA*

AN APPLICATION OF DISCRIMINANT FUNCTION IN AGRICULTURAL FINANCE*

INTRODUCTION

In the flow of co-operative credit to agriculture, overdues at any level of the credit system can constitute a leakage. In recent years, co-operative overdues have increased at all levels to such an extent as to dry up the credit stream to agriculture. There is urgent need to find the causes of accumulation of overdues in co-operative credit institutions so that remedial measures to check further growth in overdues can be taken. In order to check in-

11. See, for instance, S. K. Raheja, "Yield Trends and Spread of High-Yielding Varieties of Important Cereals..... during the Fourth Plan," Presented in the Annual Workshop of Sample Surveys for Methodological Investigations into High-Yielding Varieties Programme held at the Institute of Agricultural Research Statistics (ICAR), New Delhi-12.

12. Vidya Sagar, "Declining Productivity of High-Yielding Varieties: An Explanatory Hypothesis," *Rajasthan Economic Journal*, Vol. I, No. 1, January, 1977, pp. 77-84.

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* This paper is a part of the first author's Ph.D. thesis entitled "A Study on Overdues of Co-operative Credit in Banda District of Uttar Pradesh" submitted to the Post-Graduate School, Indian Agricultural Research Institute, New Delhi-12.

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creasing overdues there is need for a cautious lending policy. This implies that the lending institutions should know the relative risks involved in lending to different types of borrowers. The present study attempts to develop criteria for classifying the borrowers according to their willingness to repay the loans on the basis of differences in their socio-economic characteristics. Specifically, the objectives of the study are (*i*) to classify the borrowers into non-defaulters and defaulters on the basis of differences in their socio-economic characteristics; and (*ii*) to further classify the defaulters into non-wilful and wilful defaulters on the basis of differences in their socio-economic characteristics.

METHODOLOGY

Sampling Design and the Collection of Data

In the matter of co-operative overdues, Uttar Pradesh has been one of the worst affected States in India. Among the districts in Uttar Pradesh, Banda has been one of the badly affected districts. Hence, Banda district has been purposively selected to represent a case study. Of the 272 co-operative credit societies in the district, 25 per cent were randomly selected to represent the sample. From these selected societies, 150 borrowers were randomly selected, proportionate to the total borrowers. Cross-section data from these selected borrowers were collected for the year 1973-74.

Two groups are required to be of roughly equal size for the application of the linear discriminant function.[1] Thus, in the present study, the sample size for non-defaulters and defaulters were 41 and 50, respectively. Similarly, there were 44 non-wilful defaulters and 50 wilful defaulters.

A borrower who does not repay the loan in time is defined as a defaulter. A non-wilful defaulter is one who defaults unwillingly, mostly for reasons beyond his control. On the other hand, a wilful defaulter defaults willingly and has no other reason to default. He has sufficient income to repay the loan but he is not repaying it deliberately. In the present study, a wilful defaulter is defined as one who does not repay even half of the total loan borrowed, although his repaying capacity indicates that he can repay at least half of the total amount borrowed. A non-wilful defaulter, on the other hand, has no sufficient means to repay even half of the total amount borrowed.

Analytical Model

With the discriminant function, it is possible to measure the net effect of the variables, that is, the effect of the variable by holding other variables constant. The relative importance of the variables in regard to their power to discriminate between the groups of non-defaulters and defaulters or non-

1. S. Balakrishna and B. Radha Iyer, "A Discriminant Function Approach," *Behavioural Sciences and Community Development*, Vol. 2, No. 1, March, 1968.

wilful and wilful defaulters can also be known with the help of discriminant function. Discriminant function used for the analysis is as follows:

$$Z = l_1x_1 + l_2x_2 + l_3x_3 + l_4x_4 + l_5x_5 + l_6x_6 + l_7x_7 + l_8x_8 + l_9x_9 + l_{10}x_{10} + l_{11}x_{11}$$

where,

Z = total discriminant score for non-defaulters and defaulters or non-wilful and wilful defaulters,
x_1 = per capita income from crop production in rupees,
x_2 = literacy, literate = 1, illiterate = 0,
x_3 = caste, high caste = 1, low caste = 0,
x_4 = percentage of income from sources other than crop production to the total income,
x_5 = operated size of holdings in acres,
x_6 = percentage of irrigated area to the total area,
x_7 = total amount of loan borrowed from co-operative credit societies in rupees (size of loan),
x_8 = amount of loan put under production purposes in rupees (utilization of loan),
x_9 = per capita consumption expenditure in rupees,
x_{10} = percentage of cash expenditure to the total expenditure,
x_{11} = percentage of earning adults to the total adults.
l_k = ($k = 1, 2, \ldots\ldots\ldots\ldots 11$) are the coefficients of linear discriminant function.

The method seeks to obtain coefficients (l_k's) such that the squared difference between the mean Z-score for the one group and the mean Z-score for the other group is as large as possible in relation to the variation of the Z-scores within the groups.

The calculation of the discriminant function involves the solution of the following eleven equations shown in matrix notation.[2]

$$\underline{S}\ \underline{L} = \underline{D}$$

$$\underline{S} = \begin{bmatrix} S_{11} & S_{12} \ldots\ldots\ldots & S_{1k} \\ S_{21} & S_{22} \ldots\ldots\ldots & S_{2k} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ S_{k1} & S_{k2} \ldots\ldots\ldots & S_{kk} \end{bmatrix} \quad \underline{L} = \begin{bmatrix} l_1 \\ l_2 \\ \cdot \\ \cdot \\ l_k \end{bmatrix} \quad \text{and} \quad \underline{D} = \begin{bmatrix} d_1 \\ d_2 \\ \cdot \\ \cdot \\ d_k \end{bmatrix}$$

where, $k = 11$

2. G. E. Brandow and A. K. Potter, "An Application of the Linear Discriminant Function," *Rural Sociology*, Vol. 18, No. 4, December, 1953.

"l_{kx1}" is the vector of the coefficients of discriminant function, "S^*_{kxk}" is the pooled dispersion matrix and "D_{kx1}" is the vector of elements representing differences between the means of the two groups.

This discriminant function is tested for significance to examine whether or not the variables considered together are sufficiently discriminating between the groups of non-defaulters and defaulters or non-wilful and wilful defaulters. The Mahalanobis D^2 statistic has been used to measure the distance between the two groups. After transformation this D^2 statistic becomes an F statistic of the following form which is then used to see if the two groups are different from each other.

$$F = \frac{N_a N_b (N_a + N_b - P - 1)}{P (N_a + N_b)(N_a + N_b - 2)} D^2,$$

$$D^2 = \sum_{i=1}^{11} \sum_{k=1}^{11} C_{ik} \quad d_i \quad d_k$$

where, C_{ik} = inverted matrix for the coefficients,

$d_i \quad d_k$ = a matrix for the product of mean differences.

where,

P is the number of characteristics. This value of F is tested for its significance with (P) and $(N_a + N_b - P - 1)$ degrees of freedom.

RESULTS AND DISCUSSIONS

The discriminant function considering the above-mentioned socio-economic characteristics fitted to the data for defaulters and non-defaulters is as follows:

$$Z = -0.0003\, x_1 + 0.5096\, x_2 + 0.1137\, x_3 - 0.0176\, x_4 + 0.0037\, x_5 - 0.0064\, x_6 + 0.0000\, x_7 + 0.0282\, x_8 + 0.0015\, x_9 + 0.0294\, x_{10} - 0.0060\, x_{11} \quad \text{(I)}$$

*for example,

Non-defaulters or non-wilful defaulters — Defaulters or wilful defaulters

$$S_{11} = \frac{1}{(N_a + N_b - 2)} \left[\Sigma x_1^2 - \frac{(\Sigma x_1)^2}{N_a} + \Sigma x_1^2 - \frac{(\Sigma x_1)^2}{N_b} \right]$$

$$S_{12} = \frac{1}{(N_a + N_b - 2} \left[\Sigma x_1 x_2 - \frac{(\Sigma x_1)(\Sigma x_2)}{N_a} + \Sigma x_1 x_2 - \frac{(\Sigma x_1)(\Sigma x_2)}{N_b} \right]$$

N_a = Number of non-defaulters or non-wilful defaulters.

N_b = Number of defaulters or wilful defaulters.

Other references are listed below.

3. Daniel J. Dunn and Thomas L. Frey, "Discriminant Analysis of Loans for Cash Grain Farms," *Agricultural Finance Review*, Vol. 36 (Annual), April, 1976.

4. Donald G. Morrison, "On the Interpretation of Discriminant Analysis," *Journal of Marketing Research*, Vol. VI, May, 1969.

5. Kenneth R. Krause and Paul L. Williams, "Personality Characteristics and Successful Use of Credit by Farm Families," *American Journal of Agricultural Economics*, Vol. 53, No. 4, November, 1971.

6. John E. Overall and C. James Klett: Applied Multivariate Analysis, McGraw-Hill, Inc., New York, 1972.

7. S. Rami Reddy, "Factors Discriminating Defaulters from Non-defaulters in Primary Credit Co-operatives," *Indian Co-operative Review*, Vol. XIV, No. 1, October, 1976.

D^2 and variance ratio were worked out to be 2.0318 and 2.5912, respectively. Since the tabulated value of $F_{11,79}$ at one per cent level being 2.48, the discriminant function was highly significant. This means that the eleven characteristics considered together were useful in classifying the borrowers into the groups of non-defaulters and defaulters.

To indicate the relative importance of the characteristics in their power to discriminate between the two groups of borrowers, the percentage to the total distance measured was calculated and is given in Table I.

TABLE I—PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS TO THE TOTAL DISTANCE MEASURED

Sr. No.	Socio-economic characteristics of the borrowers	Coefficients (lk)	Mean difference (dk)	Coefficient × mean difference (lk × dk)	Percentage
1.	Per capita income from crop production (Rs.)	—0.0003	236.09 (1.42)	—0.070827	—5.0325
2.	Literacy	0.5096	0.15 (1.87)	0.076440	5.4313
3.	Caste	0.1137	0.06 (1.00)	0.006822	0.4847
4.	Percentage of income from sources other than crop production to the total income	—0.0176	—15.04 (2.09)*	0.264704	18.8081
5.	Operated size of holdings .. (acres)	0.0037	6.98 (1.66)	0.025826	1.8350
6.	Percentage of irrigated area to the total area	—0.0064	4.31 (0.59)	—0.027584	—1.9590
7.	Total amount of loan borrowed from co-operative societies (Rs.) (size of loan)	0.0000	250.40 (1.09)	—	—
8.	Amount of loan put under production purposes (Rs.) (utilization of loan)	0.0282	24.04 (3.93)***	0.677648	48.1491
9.	Per capita consumption expenditure (Rs.)	0.0015	125.30 (2.43)**	0.187950	13.3545
10.	Percentage of cash expenditure to the total expenditure ..	0.0294	8.77 (2.38)**	0.257838	18.3202
11.	Percentage of earning adults to the total adults	—0.0060	—1.43 (0.50)	0.008580	0.6095
	Total			1.407397	100.00

Figures in parentheses are the calculated "t" values.
*** Significant at 1 per cent level.
** Significant at 5 per cent level.
* Significant at 10 per cent level.

Table I indicates that the utilization of loan, percentage of income from sources other than crop production to the total income, percentage of cash expenditure to the total expenditure, consumption expenditure and literacy are the major characteristics which classify the borrowers into the two groups, *i.e.*, defaulters and non-defaulters and their respective discriminating powers are 40.15, 18.81, 18.32, 13.35 and 5.43 per cent. However, the test of significance of the mean differences among these eleven characteristics

showed that only the mean differences of percentage of income from sources other than crop production to the total income, utilization of loan, per capita consumption expenditure and percentage of cash expenditure to the total expenditure for the two groups are significant. Hence, these are the major characteristics which discriminate the borrowers into defaulters and non-defaulters. Therefore, the following discriminant function was re-run taking only these four characteristics in the equation to see whether these characteristics alone can discriminate the defaulters from non-defaulters significantly:

$$Z = -0.0148\, x_4 + 0.0243\, x_8 + 0.0009\, x_9 + 0.0233\, x_{10} \ldots\ldots\ldots\ldots \quad (II)$$

The above equation indicates that lower the income from sources other than crop production to the total income (x_4) and higher the levels of utilization of loan (x_8), per capita consumption expenditure (x_9), percentage of cash expenditure to the total expenditure (x_{10}) would contribute to high values of Z and, therefore, placing the borrower into the non-defaulter group and vice versa.

D^2 and variance ratio were worked out to be 1.2491 and 6.0823, respectively. Since the tabulated value of $F_{4,\,86}$ at one per cent level being 3.55, the discriminant function was highly significant. This means that the four characteristics considered together were useful in classifiying the borrowers into the groups of non-defaulters and defaulters. In order to know the relative importance of the characteristics in their power to discriminate between the two groups of borrowers, the percentage to the total distance measured was calculated and is given in Table II.

TABLE II—PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS TO THE TOTAL DISTANCE MEASURED

Sr. No.	Socio-economic characteristics of the borrowers	Coefficients (lk)	Mean difference (dk)	Coefficient × Mean difference (lk × dk)	Percentage
1.	Percentage of income from sources other than crop production to the total income (x_4)	—0.0148	—16.19	0.2396	21.66
2.	Amount of loan put under production purposes (Rs.) (utilization of loan (x_8)	0.0243	22.88	0.5559	50.26
3.	Per capita consumption expenditure (Rs.) (x_9)	0.0009	121.27	0.1091	9.86
4.	Percentage of cash expenditure to the total expenditure (x_{10})	0.0233	8.65	0.2015	18.22
	Total			1.1061	100.00

Table II indicates that the amount of loan put under production purposes is the major characteristic which discriminates one group from the other followed by the percentage of income from sources other than crop production to the total income, percentage of cash expenditure to the total expenditure and per capita consumption expenditure. These characteristics have their respective discriminating powers to the total distance measured as 50.26, 21.66, 18.22 and 9.86 per cent.

The discriminant function can now be used to predict whether a borrower is likely to be a non-defaulter or defaulter. The mean value (Z_1) for non-defaulters was calculated by dividing the means of the variables x_4, x_8, x_9 and x_{10} by their respective standard deviations and then multiplying these weighted values with their respective coefficients. Similarly, the mean value (Z_2) for defaulters was calculated by dividing the means of the variables x_4, x_8, x_9 and x_{10} by their respective standard deviations and then multiplying these values with their respective coefficients. The mean value (Z_1) for non-defaulters is 2.0409 whereas the same for defaulters (Z_2) is 0.9346. The critical mean value ($\bar{Z}$) for the two groups is 1.4878 and has the same variability for both the groups. Now for any individual borrower, his "Z"-score can be calculated by utilizing his data on variables x_4, x_8, x_9 and x_{10}, multiplying with their respective coefficients (as indicated in Table II) and adding them. If this value is more than 1.4878, he is predicted to be a non-defaulter, otherwise he is likely to be a defaulter. Thus, high values of "Z" correspond to non-defaulters and low values to defaulters. This can be shown as below:

Mean "Z"-score for defaulters (0.9346)	"Z"-score separating the two groups (1.4878)	Mean "Z"-score for non-defaulters (2.0409)
←——Defaulters——→	←——Non-defaulters——→	

Wilful and Non-wilful Defaulters

The same analysis has been done to further classify the defaulters into wilful defaulters and non-wilful defaulters on the basis of differences in their socio-economic characteristics. The discriminant function considering the eleven socio-economic characteristics fitted to the data for non-wilful defaulters and wilful defaulters is as follows:

$$Z = -0.0008\,x_1 - 0.4694\,x_2 - 0.9646\,x_3 + 0.0106\,x_4 - 0.0140\,x_5 + 0.0037\,x_6 + 0.0007\,x_7 - 0.0080\,x_8 - 0.0009\,x_9 - 0.0417\,x_{10} + 0.0093\,x_{11}, \quad \text{(III)}$$

D^2 and variance ratio were worked out to be 2.2908 and 2.8702, respectively. Since the tabulated value of $F_{11,\,82}$ at one per cent level being 2.48, the discriminant function was highly significant. This means that the eleven characteristics considered together were useful in classifying the defaulters into the groups of non-wilful and wilful defaulters.

To indicate the relative importance of the characteristics in their power to discriminate between the two groups of defaulters, the percentage to the total distance measured was calculated and is given in Table III.

TABLE III—PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS TO THE TOTAL DISTANCE MEASURED

Sr. No.	Socio-economic characteristics of the borrowers	Coefficients (lk)	Mean difference (dk)	Coefficient × Mean difference (lk × dk)	Percentage
1.	Per capita income from crop production (Rs.)	—0.0008	—603.91 (1.39)	0.483128	33.01
2.	Literacy	—0.4694	—0.21 (2.50)**	0.098574	6.40
3.	Caste	—0.9646	—0.08 (1.16)	0.077168	5.10
4.	Percentage of income from sources other than crop production to the total income	0.0106	20.14 (2.72)**	0.213484	14.60
5.	Operated size of holdings (acres) ..	—0.0140	—11.83 (3.45)***	0.165620	11.30
6.	Percentage of irrigated area to the total area	0.0037	— 1.90 (0.24)	—0.007030	—0.0048
7.	Total amount of loan borrowed from co-operative societies (Rs.) (size of loan)	0.0007	56.86 (0.42)	0.039802	2.20
8.	Amount of loan put under production purposes (Rs.) (utilization of loan) ..	—0.0080	1.46 (0.50)	—0.011680	—0.0080
9.	Per capita consumption expenditure (Rs.)	—0.0009	—68.29 (1.63)	0.061461	4.20
10.	Percentage of cash expenditure to the total expenditure	—0.0417	—7.34 (2.62)**	0.306078	20.90
11.	Percentage of earning adults to the total adults	0.0093	3.75 (1.15)	0.034875	2.30
	Total			1.461480	100.00

Figures in parentheses are the calculated "t" values.
**Significant at 5 per cent probability level.
***Significant at 1 per cent probability level.

Table III indicates that the per capita income from crop production, percentage of cash expenditure to the total expenditure, percentage of income from sources other than crop production to the total income, operated size of holdings and literacy are the major characteristics which classify the defaulters into wilful defaulters and non-wilful defaulters. The respective weights to the total distance measured for these characteristics are 33.01, 20.90, 14.60, 11.30, and 6.40. However, the test of significance of the mean differences among these eleven characteristics showed that literacy, percentage of income from sources other than crop production to the total income, operated size of holdings and percentage of cash expenditure to the total expenditure for the two groups are significant. Hence, these are the major

discriminating characteristics of the borrowers which discriminate the wilful defaulters from non-wilful defaulters.

The discriminant function was re-run taking only these significant characteristics in the equation to see whether they by themselves were sufficiently discriminating. The new discriminant function is as follows:

$$Z = -0.3694\,x_2 + 0.0117\,x_4 - 0.0333\,x_5 - 0.0374\,x_{10} \quad .. \quad \text{(IV)}$$

The above equation indicates that with illiteracy (x_2), lower the levels of operated size of holdings (x_5) and percentage of cash expenditure to the total expenditure (x_{10}) and higher the income from sources other than crop production to the total income (x_4) would contribute to high values of Z and, therefore, placing the borrower into the non-wilful category and vice versa.

D^2 and variance ratio were worked out to be 1.1822 and 5.7457, respectively. Since the tabulated value of $F_{4,89}$ at one per cent level being 3.53, the discriminant function was highly significant. This indicates that the four characteristics considered together were useful in classifying the borrowers into the groups of wilful and non-wilful defaulters.

In order to know the relative importance of the characteristics in their power to discriminate between the two groups of borrowers, the percentage to the total distance measured was calculated and is given in Table IV.

TABLE IV—PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS TO THE TOTAL DISTANCE MEASURED

Sr. No.	Socio-economic characteristics of the borrowers	Coefficients (lk)	Mean difference (dk)	Coefficient × Mean difference (lk × dk)	Percentage
1.	Literacy (x_2)	—0.3694	—0.21	0.0775	7.13
2.	Percentage of income from sources other than crop production to the total income (x_4)	0.0117	23.14	0.2707	24.89
3.	Operated size of holdings (acres) (x_5)	—0.0333	—12.83	0.4272	39.29
4.	Percentage of cash expenditure to the total expenditure (x_{10})	—0.0374	—8.34	0.3119	28.69
	Total			1.0873	100.00

Table IV indicates that operated size of holdings is the major characteristic of the borrowers which discriminates them into two groups followed by the percentage of cash expenditure to the total expenditure, percentage of income from sources other than crop production to the total income and literacy. These characteristics have their respective weights of 39.29, 28.69, 24.89 and 7.13 per cent.

Thus, it is the lack of will and discipline among the cultivators which is responsible for the default of loan repayment rather than his ability to repay the loans. In other words, it is the willingness to repay the loan which is mostly responsible for the repayment of the borrowed loan.

The discriminant function is used in order to predict whether a borrower is likely to be a wilful or non-wilful defaulter. The mean value (Z_1) for non-wilful defaulters was calculated by dividing the means of the variables x_2, x_4, x_5 and x_{10} by their respective standard deviations and then multiplying these weighted values with their respective coefficients. Similarly, the mean value (Z_2) for wilful defaulters was calculated by dividing the means of the variables x_2, x_4, x_5 and x_{10} by their respective standard deviations and then multiplying these values with their respective coefficients. The mean value (Z_1) for non-wilful defaulter is 9.4831 whereas for wilful defaulter the same is 8.5015. The critical mean value ($\bar{Z}$) for the two groups is 8.9923 and has the same variability for both the groups. Now for any individual borrower his "Z"-score can be calculated by utilizing his data on variables x_2, x_4, x_5 and x_{10}, multiplying with their respective coefficients (as indicated in Table IV) and adding them. If this value is more than 8.9923, he is predicted to be a non-wilful defaulter, otherwise he is likely to be a wilful defaulter. Thus, high values of "Z" correspond to non-wilful defaulters and low values to wilful defaulters. This can be shown as below:

Mean "Z"-score for wilful defaulters (8.5015)	"Z"-score separating the two groups (8.9923)	Mean "Z"-score for non-wilful defaulters (9.4831)
←——Wilful——→		←——Non-wilful defaulters——→

CONCLUSIONS

The discriminant function analysis indicated that the percentage of income from sources other than crop production to the total income, amount of loan put under production purposes (utilization of loan), per capita consumption expenditure and percentage of cash expenditure to the total expenditure were the major characteristics which classified the borrowers into defaulters and non-defaulters. Similarly, literacy, percentage of income from

sources other than crop production to the total income, operated size of holdings and percentage of cash expenditure to the total expenditure were the major characteristics which classified the defaulters into wilful and non-wilful groups. However, the utilization of loan and operated size of holdings were the major characteristics which classified the borrowers into defaulters and non-defaulters and into wilful and non-wilful defaulters, respectively.

The discriminant function would be useful to the financial institutions in order to assess the degree of risks involved (credit-worthiness) with the loan applicants. A lendee can with confidence put his application for the loan on the basis of characteristics (especially those characteristics which make a lendee non-defaulter or non-wilful defaulter) which he possesses. For a public policy-maker, however, the function could indicate the factors which reduce the credit-worthiness of individuals (especially those contributing to the non-wilful defaults) and which, therefore, need to be suitably altered to improve their credit-worthiness and, thus, ensure a larger flow of credit to such individuals.

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APPLICATION OF LINEAR PROGRAMMING MODELS IN INDIAN AGRICULTURE—SOME FALLACIES

Programming models are by now a master tool in production economics. The property of these models to enable the users to conveniently handle several hundred or several thousand variables and constraints explains, in itself, the tremendous success of their first appearance 30 years ago. In principle, almost any economic problem can fit with the general formulation of the programming problems:

$$\text{Maximize } f(X),\ X = \{ X_1 \ldots\ldots X_i \ldots\ldots X_m \} \ / \ g_j(X) \leqslant 0,\ j = 1,2..n.$$

The above is termed as a linear programming (LP) model if the f and g's are of degree one in X and the components of X are all real variables. Because of the popular and widespread availability of computer routines for solving LP models, this sub-class of programming models has become very popular all over the world. These have been widely used by the agricultural economists interested in farm planning and development. In India also, since the first use of LP models to farm planning by Desai(1), many researchers have widely used such models in varying conditions all over the country. In the majority of the applications, LP has been used to work out optimum farm plans, with and without borrowing of capital and hiring of labour, and to indicate the departures between the existing and optimum farm plans with

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