Technical Report

WP 1975/70

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD

AN ECONOMETRIC APPROACH TO EVOLVE VIABLE CATTLE DEVELOPMENT FINANCING SCHEMES

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T. R. No. 70
March, 1975

Indian Institute of Management
Ahmedabad

No. 10

To

Chairman (Research)
IDMA

Technical Re

Title of the report ... An Economic Approach to Evolve a Viable Cattle Development Financing Scheme

Name of the Author ... P.N. Mishra, U.K. Srivastava and Deepak Chandra

Under which area do you like to be classified? ... Economics

ABSTRACT (within 250 words)

This paper attempts to a) arrive at estimates of marketed surplus of milk b) to simplify the computational methods for pooling cross section and time series data; and c) to determine the terms of repayment of loans (particularly the number of years and the percentage of amount to be deducted from the gross proceeds). We believe that the findings would be useful to financial institutions in evolving cattle development scheme

Please indicate restrictions if any that the author wishes to place upon this note ... None

Date March 22, 1975

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AN ECONOMETRIC APPROACH TO EVOLVE VIABLE CATTLE DEVELOPMENT FINANCING SCHEMES*

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1. Introduction

There has been a marked increase in commercial bank advances for agricultural activities after the nationalization of banks in 1969. The agricultural loans of commercial banks have increased from about Rs.45 crores in 1968 to Rs.617 crores in December 1973. This manifold increase in agricultural loans was possible due to the rapid expansion of bank branches and appropriate changes in lending policies. In the initial stages banks generally helped relatively well off farmers because they were easy to contact and could provide security for the loans. But it was soon realized that bank resources would not achieve the desired social objective of increasing income and employment opportunities accompanied by a reduction of inequalities between the rich and the poor in that way. Therefore, it was felt that more and more bank credit should be made available to small and marginal farmers, and this required quality lending and effective supervision over the end-use of such finance. For this purpose various districts in the country were delineated as lead bank districts for commercial banks. The lead bank in each district was expected to identify activities suitable for financing, keeping the social objective in view, and supplement the lending operations with appropriate follow-up measures. Also, the criterion for giving loans was changed from security offered for the loan to economic feasibility of the proposed investment. As Jakhade and Godgil (1, p.56) have indicated, the criterion of feasibility ensures that the investment proposed to be financed is justified on economic grounds and at the same time provides a built-in cover for demonstrating that it is self-liquidating.

The changed approach of agricultural financing was reflected in several specific schemes of financing various agricultural activities which were formulated and implemented in the last few years. One such agricultural financing scheme has been to provide finances to farmers for buying milch cattle. For illustrative purposes, the relevant details

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*We are thankful to Mr. S.N. Chokshi, Research Assistant, Indian Institute of Management, Ahmedabad, for his help in data collection and processing.

of one such scheme formulated and implemented by the State Bank of India, Baroda, in 1972 are given below.

2. A Cattle Development Scheme of the State Bank of India

The objective of this scheme was to enable farmers of the Baroda district to acquire milch animals of better breed and thereby increase their incomes as well as improve the supply of milk in the area. It was expected that in the long run the scheme would also improve the quality of milch cattle in the area. The scheme was designed primarily to provide loans to farmer members of village level cooperative milk societies affiliated to the Baroda dairy (Baroda District Cooperative Milk Producers' Union Limited). The scheme was to cover villages from the Padra, Savli, Baroda, Waghodia, Karjan, Sinor, Dabhoi, and Sankhedo Talukas (of the Baroda district) which were located within a radius of 65 miles from Baroda City. In terms of coverage, the scheme was envisaged to bring under its fold about 100 village societies of the 400 societies affiliated to the dairy within three years.

The scales of finance fixed by the dairy were adopted in granting loans for the purchase of cows, buffaloes, and cross-bred cows. The scales provided the average and upper limit of finance for cattle purchase (Table 1).

Table 1 : Scales of Finance

Animal	Average price (Rs)	Maximum price (Rs)	Number of animals to be financed annually
Cow	1,300	1,500	2,000
Buffalo	1,600	2,000	850
Cross-bred cow	2,200	3,000	150

For determining the actual amount of credit permissible to the farmers for buying various types of animals, the farmers were divided into three categories on the basis of the probable number of cattle they would purchase under the scheme: a) farmers likely to buy up to

two animals; b) farmers likely to buy three to five animals; and (c) farmers likely to buy six to 25 animals. The percentage of credit to the purchase price of the animals was fixed as 100, 80, and 75 for the first, second, and third categories of farmers respectively. In addition to these loans, the scheme also provided for loans for construction of cattle sheds for farmers buying more than 10 milch animals. The animals were to be purchased by farmers after the approval of the veterinary doctors of the Baroda dairy and bank officials.

The farmers were to be charged a flat rate of 10 per cent interest on the loans. The loans were repayable in four years. The loan instalments were to be recovered by village level cooperative societies from the monthly sale proceeds of milk supplied to them. A deduction of 50 per cent of the total sale proceeds was contemplated; this was supposed to take care of repayment obligations during the lactation as well as the dry period.

The scheme was perfectly sound in terms of the criterion of economic feasibility. The only subjective element, however, was the marketed surplus (defined as the quantity of milk supplied by the farmer to the village level cooperative society). The expectation that 50 per cent of the sale proceeds of milk supplied would be enough for improving repayments obligations was based on judgemental estimates by experts. Initially there was no better way to arrive at an estimate of marketed surplus because there was no past data or experience with such schemes. Now that these types of schemes have been in operation for a couple of years it is necessary to confirm the judgemental estimates of marketed surplus with the help of actual data from the farmers under the schemes.

Since the marketed surplus of milk is a very crucial variable in ensuring the repayment of bank loans for cattle purchase, an empirical estimate of marketed surplus would be useful in formulating and implementing viable cattle development schemes in other places.

3. Objectives, Data, and Framework

The objectives of this paper are: a) to arrive at estimates of marketed surplus (defined as above) of milk; b) to simplify computational methods for pooling cross-section and time series data; and c) to determine the terms of repayment (particularly the number of years and the percentage of amount to be deducted from the sale proceeds).

Data on the marketed surplus of milk for selected sample of farmers was collected from records of village level milk societies. Data on the average price of milk[1] received by the farmers and their holding size was also collected from records of milk societies. Data on milk production was collected from the sample farmers themselves. All the data from the records of village level milk cooperatives related to January 1973 to February 1974.

The sample farmers were selected in several stages. At first those milk societies were identified in which the cattle development scheme was in operation at least for one year. The distribution of these societies is given in Table 2.

Table 2: Distribution of Village Level Milk Societies in Baroda District

Taluka	Number of village level milk societies	No. of societies covered by the Cattle Development Scheme	No. of societies in which the scheme had been in operation for a year in March 1974
Padra	77	14	3
Banda	83	12	2
Sinor	26	-	-
Savli	74	28	6
Sankheda	31	6	2
Dabhoi	27	5	2
Waghodia	25	10	1
Karjan	34	3	1
Tilakwada	22	-	-
Chota Udaipur	8	4	-
Jalugaon	4	-	-
	441	82	17

There were 17 such societies where the scheme had been in operation for one year in March 1974. Looking into the geographical spread of these societies, it was decided to select one village each from the talukas, Baroda, Sankheda, Savli and Padra. The milk societies in the selected villages had advanced 195 loans. The details of these loans are given in Table 3.

[1] The prices paid to farmers by the dairy for milk were fixed according to fat content. Only once were they raised upwards. Thus variances in average price were mainly because of differences in fat content.

Table 3 : Details of Cattle Development Loans Advanced to the Selected Societies

Taluka	Selected village Society	No. of loans advanced	Amount of loan (Rs)	No. of cows purchased	No. of buffaloes purchased
Baroda	Kalanpur	37	1,75,000	56	68
Sankheda	Desan	27	52,000	-	30
Savli	Parthanpur	65	1,49,000	33	67
Padra	Mehmadpura	66	1,52,000	-	84

The study was confined to loans granted for the purchase of buffaloes alone. Thus the sample had to be selected from those farmers who purchased buffaloes ; they numbered 142. It was decided to select a sample of about one-third of farmers. These 142 farmers had land holdings of different size and had taken loans at different times. To give adequate representation to farmers in different economic groups and with loans in operation having different time periods durations, the selection of the sample was based on a two way classification of farmers according to the size of their holding and the duration of the loan. From each cell about one-third of the farmers were selected. The distribution of the sample farmers numbering 47 is presented in Table 4.

Table 4 : Distribution of the Sample Farmers

Size of the holding (acres)	Duration of the loan (as on March 15, 1974)			Total
	3 months	6 months	9 months	
. and less	1	3	2	6
.01 to 3.00	8	4	1	13
3.01 to 5.00	2	2	3	7
5.01 to 10.00	5	2	4	11
Above 10	6	1	3	10
Total	22	12	13	47

4. The Model

The marketed surplus of milk (y) sold to village cooperatives may be considered to depend upon the price of milk (x_1), production of milk (x_2), and income of the farmer besides other considerations of relatively minor importance. Information on quantity sold, price, and quantity produced was available, but data on income was not available. However, size of the land holding (x_3) was used as a proxy variable for income on which data was available. The quantity supplied also depends upon a farmer's efficiency in management. To account for this factor a variable has to be considered that differs from farmer to farmer but remains invariant over time. Milk supply may also vary over time in view of the uneven yield of milk from buffaloes. To accommodate this factor a variable that differs over time periods but remains invariant over farmers requires to be incorporated. Data was available on sample farmers over months. The model postulated makes use of these time series and cross-section data besides accounting for the relevant factors mentioned above. A general formulation of this problem can be expressed as:

$$y_i(t) = f\left[x_{1i}(t), x_{2i}(t), x_{3i}(t), \alpha_i, \gamma(t), u_i(t)\right] \quad \ldots (1$$

$i = 1, \ldots\ldots, M$

$t = 1, \ldots\ldots, T$

where $y_i(t)$ = milk sold by the farmer in period t

$x_{1i}(t)$ = price of milk obtained by i-th farmer in period t

$x_{2i}(t)$ = quantity of milk produced by i-th farmer in period t

$x_{3i}(t)$ = size of holding of i-th farmer in period t

α_i = farmer specific effect on milk yield of i-th farmer

$\gamma(t)$ = time specific effect on milk yield in period t

$u_i(t)$ = disturbance term influencing yield of i-th farmer in period t; it also accounts for left over variables if any

M = number of farmers

T = time period.

A linear version of the model can be expressed as :

$$y_i(t) = \beta_o + \alpha_i + \gamma(t) + \beta_1 x_{1i}(t) + \beta_2 x_{2i}(t) + \beta_3 x_{3i}(t) + u_i(t) \quad \ldots\ldots\ldots \quad (2)$$

Any non-linear version of the general form can be approximated by a linear form as in Equation (2); Misra /2/ has provided an efficient method for computing β's, α's and γ's under the assumption that cross-section observations are drawn independently of each other, while time series data may have autocorrelations of all possible orders. Since the present situation exactly conformed to the above model, it was proposed to follow the procedure developed by Misra with the same notations and assumptions. The computational steps which were followed in pooling the cross-section and time series data are described in detail in the subsequent section. These computation steps are general in nature and can be used in any other problem where cross-section and time series data need to be pooled.

5. Empirical Results

While devising the computational steps in the present investigation the problem of varying time series observations for individual farmers was encountered. To resolve this the farmers were grouped according to the duration of the loan, i.e. the time period of loans which had already expired. The groups shown in Table 5 required the minimum deletion of observations.

Table 5 : Farmers in Different Groups

Time series data	No. of farmers
1 - 3 months	22
1 - 6 months	12
1 - 9 months	13

For 22 farmers data was available for three months, for 12 farmers data was available for six months, and for 13 farmers data was available for nine months in all the y and x variables described above. As far as pooling of the available cross-section and time series data was concerned the three groups were treated as independent problems and whatever procedure was adopted for one group was repeated for the others in exactly the same way.

5.1 Use of Cross-section Data

First of all, cross-section data was used for each time period and the ordinary least squares procedure was applied to obtain estimates of unknown coefficients in the following model for each one of the three groups:

$$y_i(t) = \delta_0(t) + \delta_1(t)\, x_{1i}(t) + \delta_2(t)\, x_{2i}(t) + \delta_3(t)\, x_{3i}(t) + v_i(t) \quad \ldots\ldots \quad (3)$$

$$i = 1, \ldots\ldots, M$$

where $v_i(t)$ = error term influencing the marketed surplus of ith farmer in period t.

All other variables are as defined in Equation (2). δs are the unknown parameters to be estimated. The results are given in Table 6.

Table 6: Estimated Marketed Surplus Functions: Monthwise

Group	Month	Estimated model	R^2
1-3 months	1.	$y = 20.97 - 9.41x_1 + .59x_2 - 5.17x_3$ (.7485) (-.4367) (13.1076)* (-1.3917)	0.92
	2.	$y = 60.19 - 22.98x_1 + .63x_2 - 8.17x_3$ (1.0581) (-.4760) (8.982)* (-1.5815)	0.83
	3.	$y = 32.89 - 7.48x_1 + .58x_2 - 5.48x_3$ (.5474) (-.1709) (7.2479)* (-.9931)	0.77

Table 6 contd.

Group	Month	Estimated model	R^2
1-6 months	1.	$y = -33.77 + 3.71x_1 + 0.90x_2 - .57x_3$ (-1.0890) (.09) (9.2897)* (-.4474)	0.95
	2.	$y = -37.28 - 16.44x_1 + 1.08x_2 - 1.67x_3$ (-1.0424) (-.6053) (12.1912)* (-1.4727)	0.95
	3.	$y = -6.36 - 28.92x_1 + .95x_2 + .77x_3$ (-.2306) (-1.3160) (11.2182)* (.7341)	0.95
	4.	$y = -66.81 + 34.47x_1 + .92x_2 + .12x_3$ (-1.1021) (.8759) (9.8571)* (-.1062)	0.93
	5.	$y = -.20 - 17.89x_1 + .95x_2 + .33x_3$ (-.0069) (-1.0094) (18.7636)* (.38.09)	0.98
	6.	$y = -9.83 - 8.99x_1 + .89x_2 + .44x_3$ (-.2735) (-.4118) (14.7229)* (.5249)	0.97
1-9 months	1.	$y = 9.16 - 11.20x_1 + .80x_2 - 1.00x_3$ (.2741) (-.6920) (9.5120)* (-.7676)	0.93
	2.	$y = 13.06 - 31.26x_1 + .89x_2 - 0.09x_3$ (.1757) (-.9996) (7.2322)* (-.0421)	0.93
	3.	$y = -39.68 - 23.15x_1 + 1.00x_2 + .86x_3$ (-.4948) (-.7025) (6.8230)* (.3425)	0.90
	4.	$y = 2.73 - 16.74x_1 + .85x_2 - .17x_3$ (.0375) (-.4528) (5.9638)* (-.0785)	0.87
	5.	$y = 18.75 - 28.48x_1 + .89x_2 - 1.27x_3$ (.2496) (-.8992) (5.4165)* (-.6158)	0.89
	6.	$y = 19.33 - 18.55x_1 + .78x_2 - 1.58x_3$ (.3360) (.6691) (4.1827)* (-.8860)	0.73

Table 6 contd.

Group	Month	Estimated model	R^2
	7.	$y = 11.49 - 1.56x_1 + .85x_2 - 1.98x_3$ (.4951) (-1.6722) (8.1814)* (-1.9151)	0.90
	8.	$y = -16.35 - 7.51x_1 + .97x_2 - 1.08x_3$ (-.6136) (-.8665) (9.9076)* (-.7985)	0.92
	9.	$y = 15.63 - 26.82x_1 + .94x_2 - .03x_3$ (.7162) (-2.1567)* (14.3017)* (-.0031)	0.96

Figures in pareantheses denote t ratios and
* denotes significance of coefficient at 95% level of confidence

The coefficient of the production variable was significant at 95 per cent of level of confidence in all cases, while coefficients of the price and size of the land holding variables were mostly insignificant. The explanatory power of the model as indicated by the square of the coefficient of multiple correlation (R^2) was also quite high in almost all cases. The sign of the coefficient of the production variable was positive in all cases which confirms the hypothesis that high production implies high marketed surplus. A plausible reason for the insignificance of the price variable could be the fact that the village cooperatives enjoyed a nearly monopolistic status in rural areas so that market forces did not play any significant role in influencing the marketed surplus of milk. This does not imply that price was not a relevant variable. What is meant is that the present system of procurement of milk from the farmers does not permit the price variable to play its legitimate role. The insignificance of the size of the holding variable was perhaps due to the tendency among farmers to keep only a manageable number of milk cattle irrespective of the size of their holding. The marketed surplus could better be related to size of the labour force available in the farming households for looking after the milk cattle, provided data was available.

5.2 Use of Time Series Data

Using time series data, the marketed surplus function may be alternatively specified as:

$$y_i(t) = \delta_{oi} + \delta_{1i} x_{1i}(t) + \delta_{2i} x_{2i}(t) + u_{1i}(t) \quad (4)$$

$$t = 1, \ldots\ldots, T$$

where, the x_3 variable is coupled with the constant term δ_{oi} in view of the size of the land holding remaining invariant over the sample months in all cases under study. Here the time series data was used to estimate the coefficients in Equation (4) by ordinary least squares procedure in the first instance. The estimated results are given in Table 7.

Table 7 : Estimated Marketed Surplus Functions : Farmerwise

Group	Farmer	Estimated model	R^2
1-3 months	1	$y = 21.92 + 115.39x_1 - 0.077x_2$	1.00
	2	$y = 38.24 + 16.53x_1 + 0.94x_2$	1.00
	3	$y = -594.79 + 268.42x_1 + 2.41x_2$	1.00
	4	$y = 98.01 - 73.59x_1 + 0.79x_2$	1.00
	5	$y = -34.80 - 2.30x_1 + 0.89x_2$	1.00
	6	$y = -107.92 + 41.67x_1 + 1.07x_2$	1.00
	7	$y = -121.08 + 77.22x_1 + 1.00x_2$	1.00
	8	$y = 187.09 + 31.25x_1 - .83x_2$	1.00
	9	$y = 1740.01 - 3000.01x_1 + 10x_2$	1.00
	10	$y = -2682.52 + 1050.01x_1 + 5.09x_2$	1.00
	11	$y = -92.30 - 80.67x_1 + .90x_2$	1.00
	12	$y = -67.40 + 50.0x_1 + 0.62x_2$	1.00
	13	$y = 6333.62 - 2856.67x_1 - 2.61x_2$	1.00
	14	$y = 1971.17 - 356.67x_1 - 6.68x_2$	1.00
	15	$y = -55.90 + 6.49x_1 + 0.44x_2$	1.00

contd..

Group	Farmer	Estimated model	R^2
1-3 months	16	$y = 276.8 - 180.0x_1 - 3.54x_2$	1.00
	17	$y = 471.27 + 229.21x_1 - 0.18x_2$	1.00
	18	$y = -61.54 - 38.39x_1 + 1.75x_2$	1.00
	19	$y = 437.71 - 379.85x_1 + .15x_2$	1.00
	20	$y = 137.31 - 64.81x_1 + .62x_2$	1.00
	21	$y = 204.57 - 121.43x_1 + .69x_2$	1.00
	22	$y = -259.81 + 123.08x_1 + .89x_2$	1.00
1-6 months	1	$y = -15.26 - 18.64x_1 + .94x_2$ $(-2.0984) \quad (-5.2018)^* \quad (21.389)^*$	0.99
	2	$y = -36.71 - 6.12x_1 + .99x_2$ $(-.9149) \quad (-.1158) \quad (10.364)^*$	0.99
	3	$y = 52.18 - 55.65x_1 + .88x_2$ $(.4222) \quad (-.5982) \quad (9.0308)^*$	0.98
	4	$y = 1.96 + 11.75x_1 + .46x_2$ $(.0850) \quad (1.0259) \quad (5.0247)^*$	0.92
	5	$y = -39.24 + 23.26x_1 + .68x_2$ $(-.2647) \quad (.2916) \quad (2.4072)^*$	0.87
	6	$y = -84.81 + 1.10x_1 + 1.40x_2$ $(4.3294)^* \quad (.1748) \quad (12.2001)^*$	0.98
	7	$y = 4.58 - 1.13x_1 + .71x_2$ $(.1501) \quad (-.09) \quad (5.1058)^*$	0.95
	8	$y = 101.33 - 33.10x_1 + .36x_2$ $(1.8496) \quad (-.7283) \quad (.9731)$	0.26

contd ...

Group	Farmer	Estimated model	R^2
1-6 months	9	$y = 199.85 - 95.54x_1 + .32x_2$ $(4.9709)^* \quad (-4.6532)^* \quad (3.1238)^*$	0.98
	10	$y = -83.78 + 4.38x_1 + 1.25x_2$ $(-1.3389) \quad (.2308) \quad (5.3350)^*$	0.94
	11	$y = -68.07 - 4.27x_1 + 1.10x_2$ $(-.8848) \quad (-.0857) \quad (5.8059)^*$	0.93
	12	$y = 142.57 + 73.26x_1 + 1.00x_2$ $(-1.8653) \quad (1.6886) \quad (7.8853)^*$	0.99
1-9 months	1	$y = -44.31 + 10.87x_1 + 1.00x_2$ $(-.9301) \quad (.4395) \quad (9.7345)^*$	0.97
	2	$y = 13.55 - 8.68x_1 + .73x_2$ $(.2296) \quad (-.2585) \quad (8.1574)^*$	0.93
	3	$y = -2.87 - 9.39x_1 + .86x_2$ $(-.1128) \quad (-.9105) \quad (7.8270)^*$	0.94
	4	$y = 106.05 - 88.20x_1 + .73x_2$ $(.4707) \quad (-.5713) \quad (5.2486)^*$	0.88
	5	$y = -8.12 - 2.32x_1 + 0.070x_2$ $(.2391) \quad (-.3808) \quad (5.2486)^*$	0.95
	6	$y = 113.92 - 97.83x_1 + 0.81x_2$ $(2.1253)^* \quad (-3.2326)^* \quad (4.6925)^*$	0.87
	7	$y = -61.10 - 4.14x_1 + .91x_2$ $(-1.5745) \quad (-.3011) \quad (4.3498)$	0.79
	8	$y = 1385.07 - 571.69x_1 - 1.91x_2$ $(10.6163)^* \quad (-6.1312)^* \quad (-7.3997)^*$	0.93

contd...

Group	Farmer	Estimated model	R^2
1-9 months	9	$y = -222.18 + 59.90x_1 + 2.18x_2$ (-1.7552) (1.2475) (2.9734)*	0.62
	10	$y = 105.44 - 50.64x_1 + 0.31x_2$ (5.6604)* (1.2475) (2.9734)*	0.90
	11	$y = -114.40 + 46.08x_1 + 1.13x_2$ (-3.2961)* (2.2687)* (8.9306)*	0.95
	12	$y = -55.87 + 11.17x_1 + .95x_2$ (-2.4106)* (.6772) (9.7001)*	0.95
	13	$y = -96.21 + 17.68x_1 + 1.16x_2$ (-.5464) (.1349) (5.0949)*	0.82

Figures in parantheses denote t ratios and
*denotes significance of coefficients at 95 per cent level of confidence

The results are similar to those in Table 6. In Table 7 the production variable had significant coefficients in all cases except one. The significance of coefficients was not tested in the case of results for the 1-3 month group because the number of sample observations was equal to the number of unknown coefficients.[2] Our inference in this section is restricted to results obtained from the other two groups only. For these two groups, the estimated coefficients of the production variable were positive except in one case. Therefore, the inference drawn in the case of the cross-section data is almost confirmed by the results obtained from the time series data. The explanatory power of the model as measured by R^2 is quite high in all cases except one.

[2] It is observed from Table 7 that $R^2=1$ for all the relations in the group 1-3 months. This holds true in general. Consider a general linear regression model in matrix form:

$$y = X\beta + u$$

with X being Txn matrix of observations with T=n. In that case X is square non-singular and the least squares estimated value of y is given as:

$$X(X'X)^{-1} X'y = X(X)^{-1} (X^1)^{-1} X' y = y$$

which is the same as the true value of y. This proves that $R^2 = 1$.

5.3 Estimation with Pooled Data

Defining aggregate data on variables over farmers in every group as:

$$y(t) = \sum_i y_i(t),\ x_{ji}(t) = \sum x_{ji}(t),\ x_{1i}(t) = M_i^{-1} x_{1i}(t) \quad \ldots \quad (5)$$

$i = 1, \ldots, M$

$j = 2, 3$

the aggregate marketed surplus function can be defined as:

$$y(t) = \gamma_o + \beta_1 x_1(t) + \beta_2 x_2(t) + u(t) \quad \ldots \quad (6)$$

where the size of the holding variable is combined with the constant γ_o as in Equation (4). The price variable x_1 is defined as the average rather than the agregated sum to keep its meaning intact in the aggregated model. The aggregated data is given in Table 8.

Table 8: Data on Variables Aggregated over Farmers

Group	Month	y	x_1	x_2	x_3
1-3	1	2182	1.30	4090	78.2
months	2	3655.4	1.20	5626	78.2
	3	3042.1	1.27	5320	78.2
1-6	1	1500.2	0.91	2107	53.17
months	2	1680.3	1.07	2250	53.17
	3	1803.4	1.04	2318	53.17
	4	1654	1.20	2075	53.17
	5	1273.9	1.52	1565	53.17
	6	1029.6	1.45	1440	53.17
1-9	1	1664.6	1.17	2887	119.13
months	2	2138.3	1.25	2880	119.13
	3	1885.8	1.32	2490	119.13
	4	1775.7	1.25	2388	119.13
	5	1506.8	1.35	2149	119.13
	6	1215.56	1.36	1892.2	119.13
	7	1018.60	1.69	1595	119.13
	8	1227.5	1.52	1777	119.13
	9	1440.8	1.39	1840	119.13

Data relating to individual farmers is available on request.

The results obtained by applying the ordinary least squares procedure to Equation (6) are given in Table 9.

Table 9 : Estimated Aggregate Marketed Surplus Functions

Group	Estimated model	R^2
1-3 months	$y = 8260.09 - 6385.45x_1 + 0.54x_2$	1.00
1-6 months	$y = -1236.23 + 529.79x_1 + 1.06x_2$ $(-3.55)^* \quad (3.68)^* \quad (11.16)^*$	0.99
1-9 months	$y = 200.44 - 235.01x_1 + 0.77x_2$ $(0.26) \quad (-0.63) \quad (5.15)^*$	0.93

Figures in parantheses denote t-ratios and * denotes significance of coefficient at 95 per cent level of confidence

The estimates of the constant term provided in Tables 6, 7 and 9 may now be used to obtain unbiased estimators of γ's given in equation (2) by using the formula:

$$\hat{\gamma}(t) - \bar{\gamma} = c(t) - M^{-1}c_o \quad \ldots\ldots \quad (7)$$

where $\bar{\gamma}$ = means of γ's

$c(t)$ = constant term for t-th in Table 6

c_o = constant term corrected for the size of the holding variable in Table 9

M = number of farmers in each group (groups as defined in Table 5).

Repeating the calculation by using the formula in Equation (7) for all the three groups the estimates of time specific constants were obtained around their sample mean.

The unbiased estimate of the disturbance term given in Equation (4) can be estimated as:

$$\hat{w}_i(t) = y_i(t) - \hat{\delta}_{oi} - \hat{\delta}_{1i} \; x_{1i(t)} - \hat{\delta}_{2i} \; x_{2i(t)} \quad \ldots\ldots \qquad (8)$$

where $w_i(t)$ = estimate of the disturbance term

$\hat{\delta}_{oi}$, $\hat{\delta}_{1i}$, and $\hat{\delta}_{2i}$ denote ordinary least square estimators of the corresponding coefficients. All other variables are defined as in Equation (1).

Using the estimates in Equation (7) and (8) and the estimates given in Table 9 the elements of the S matrix were computed for use in the generalized least square model. The computation of these elements was done as follows:

$$s_{tt'} = \sum_i \hat{w}_i(t) \; \hat{w}_i(t') + M(M-1) \; \underline{/}\, \bar{c}(t) - M^{-1} c_o \,\underline{\backslash}\, \bar{/}$$

$$\underline{/}\, \bar{c}(t') - M^{-1} c_o \,\underline{\backslash}\, \bar{/} \qquad \ldots\ldots \qquad (9)$$

Where $s_{tt'}$ is the typical element in t-th row and t'-th column of matrix S.

The S Matrix was computed for all the three groups separately. These estimates are provided in Tables 10, 11 and 12.

Table 10: Estimated S matrix for the 1 - 3 months Group

Month	1	2	3
1	56896200	50537300	54963700
2	50537300	44889400	48820900
3	54963700	48820900	53096700

Table 11: Estimated S Matrix for the 1 - 6 Months Group

Month	1	2	3	4	5	6
1	2634830	1309100	2120090	3247600	2005980	2185780
2	1309100	652735	1052470	1612470	996384	1086460
3	2120090	1052470	1711330	2618610	1617660	1762270
4	3247600	1612470	2618610	4010740	2476230	2697000
5	2005980	996384	1617660	2476230	1530940	1666240
6	2185780	1086460	1762270	2697000	1666240	1816500

Table 12: Estimated S Matrix for the 1 - 9 Months Group

Month	1	2	3	4	5	6	7	8	9
1	2508.50	2641.64	-21159.8	-1478.67	4787.62	6793.74	1870.20	-10086.9	4074.24
2	2641.64	8274.65	-49360.8	-3676.17	13790.00	12874.30	6021.50	-23910.5	9804.41
3	-21159.80	-49360.80	331903.0	24955.70	-90499.80	-94147.80	-37485.50	162346.0	-67647.60
4	- 1478.67	-3676.17	24955.7	2385.89	-7166.96	-6953.75	-2910.40	12576.1	-5535.96
5	4787.62	13790.00	-90499.8	-7166.96	26339.8	24624.90	10521.10	-44469.2	18848.20
6	6793.74	12874.30	-94147.8	-6953.75	24624.9	28747.20	10134.00	-46225.6	18922.00
7	1870.20	6021.50	-37485.5	-2910.40	10521.1	10134.00	4779.62	-18622.3	7582.31
8	-10086.90	-23910.50	162346.0	12576.10	-44469.2	-46225.60	-18622.30	80489.9	-33900.10
9	4074.24	9804.41	-67647.6	-5535.96	18848.2	18922.00	7582.31	-33900.1	15421.70

The S Matrix as computed in Tables 10, 11, and 12 can be used to obtain a generalized least squares estimator of coefficients in the aggregate Equation (6) because all the variances and covariances of the error term u(t) are estimated unbiasedly from the corresponding elements of the S matrices reported in Tables 10, 11, and 12. These generalized least squares estimators are reported in Table 13.

Table 13 : Generalized Least Squares Estimates of the Aggregate Marketed Surplus Functions

Group	Estimated model	R^2
1-3 months	$y = 8253.31 - 6363.43x_1 + 0.54x_2$	1.00
1-6 months	$y = -999.04 + 426.69x_1 + 1.03x_2$	0.96
1-9 months	$y = 658.68 - 432.70x_1 + 0.68x_2$	0.93

The explanatory power of the model turned out to be high in each of the three groups. For the 1-3 month group, it was equal to 1 in general for reasons similar to those given in footnote 2. No test of significance was carried out here because the corresponding test statistics was not yet settled. However, since the micro results on which these were based were satisfactory, they may be used without any hesitation. It is also known that the estimates given in Table 13 are best linear unbiased.

6. Economic Viability of the Cattle Development Financing Scheme

The estimated marketed surplus function as given in Table 13 can be used to obtain an estimate of the marketed surplus of milk per buffalo. This estimate in turn can be used to indicate all possible combinations of the time duration of cattle development loans and the percentage of sale proceeds to be deducted to recover the loan in full. Since time duration of loans and percentage of sale proceeds to be deducted are the only control variables in the hands of the banks for ensuring the repayment of loans, banks can choose any one combination depending upon their objectives. One such other objective could be that the banks may want to leave enough cash with the farmers out of the sale proceeds, to meet their out-of-pocket expenses in the maintenance

of cattle bought from the loan. In that case, as will be shown later in this section, the banks will have to fix longer repayment period combined with a smaller percentage of deduction from the sale proceeds. It may, however, be mentioned that the results based upon empirical findings in this paper hold true for the region under study. Any effort to generalize the conclusions to follow should account for regional variation in marketed surplus of milk.

For estimating marketed surplus of milk per month information is required on the average price per litre of milk and the average monthly production of milk. The average price of milk was taken to be Rs.1.50 per litre, although the average price was less (Rs.1.42) during the sample period. This was done in view of general inflation in the recent past. Figures of average monthly production of milk were computed by using data on production of milk given in Table 8 as 5012, 1962.5 and 2135.35 litres respectively for the 1 - 3 month group, 1 - 6 month group, and 1 - 9 month group.[3] By feeding the above values of the average monthly production and a price of Rs.1.50 per litre of milk in the appropriate estimated marketed surplus function as given in Table 13, the estimated monthly marketed surplus was obtained; it was 1432.19, 1652.19, and 1463.79 litres for the 1-3 month, 1-6 month, and 1-9 month groups respectively. The values of the estimated monthly marketed surplus and monthly production can be used to obtain the monthly marketed surplus and monthly production per buffalo for each group by dividing these figures by the number of buffaloes in each group. The number of buffaloes in the 1-3 month, 1-6 month, and 1-9 month groups were 39, 21, and 24 respectively. The monthly estimated marketed surplus and production per buffalo for each group is reported in Table 14.

Table 14: Monthly Marketed Surplus and Production of Milk per Buffalo

Group	Monthly marketed surplus per buffalo		Monthly production per buffalo	
	Quantity (litres)	Value (Rs)	Quantity (litres)	Value (Rs)
1-3 months	36.72	55.08	128.56	192.84
1-6 months	78.69	118.04	93.45	140.18
1-9 months	60.99	91.49	88.97	133.46

[3]These monthly average production figures were worked out by using the total production figures of all the buffaloes in each group. Thus the figures represent the average production of all buffaloes in each group.

Finally, the monthly marketed surplus per buffalo reported in Table 14 can be used to find out the percentage of deduction by the milk corporation to recover the monthly instalment of the loan. In the scheme of the State Bank of India, as described earlier, the average price of a buffalo was given to be Rs.1600 whereas its maximum price was Rs.2,000. Both these prices were used for this study. The price of Rs.1,600 was used for evaluating the scheme as it was implemented by State Bank of India, whereas the price of Rs.2,000 is used for evolving a scheme for the current period. The monthly instalment would depend upon the rate of interest and the repayment period. For the present analysis the rate of interest was taken to be 10 per cent per annum[4] and seven alternative periods of repayment.[5]

Farmers usually buy buffaloes in the second lactation after watching the performance in the first lactation. Thus only six more lactations are left in the productive life of the buffaloes. The intercalving period was observed to be 15 months on an average. This includes nine months of lactation (the period in which the buffaloe is actually in milk) and six months of dry period. On this basis, if the six lactations are converted into calendar years they work out to be seven-and-half years. For the purpose of repayment of the loan and interest, the last six months can be ignored because they are dry months. This implies that the maximum possible repayment period is seven years.

The Estimates for the two groups, --1-6 months and 1-9 months were used for determining the percentage share of the total monthly surplus to be deducted for repayment of loans of a given repayment period. It was decided to ignore the 1-3 month group as the estimated marketed surplus (1432.19) deviated too much from the actual figure. This deviation could be due to small sample size. The estimated monthly marketed surplus per buffalo for the 1-6 months group and the average of the monthly marketed surplus per buffalo for both the 1-6 month and 1-9 month groups was considered. As the marketed surplus from the estimated model for the group 1-9 months is pulled down owing to rise in milk price even though the price coefficients in the micro relations are insignificant, the monthly marketed surplus based upon the average of the two groups may be treated as a lower limit of the estimate. The estimate based upon the marketed surplus function for 1-6 months group may be considered as the normal one.

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[4]The interest stream was calculated on outstanding balance each year and the same was used to work out monthly instalment.

[5]The same procedure should hold good for any other value of the loan and rate of interest.

The average monthly surplus per buffalo corresponding to 1-6 months group is found to be Rs.118.04 from Table 14. This estimate was used to find out percentage of the marketed surplus needed to be deducted to recover the instalments for two alternative purchase prices (loan amounts) per buffalo. The results are reported in Table 15. Seven schemes were considered starting from one year to seven years of repayment. For each one of these the number of lactation months were worked out. The monthly instalments as given in the Table 15 were obtained by dividing total amount due by the number of effective lactation months.

Similar exercise was done by considering the marketed surplus of milk per buffalo as obtained by averaging the two groups. The results are reported in Table 16.

It will be seen that the above calculations relate to a single buffalo. For schemes envisaging more than one buffalo the marketed surplus can be obtained by simple multiplication.[6] Accordingly the State Bank of India's scheme can be evaluated on the basis of above results. This is again to illustrate the use of the present analysis. However, the procedure as such remains applicable to any scheme by any other financial institution.

First of all one may infer from the results reported in Table 16, which are based upon rather low estimate of marketed surpluses, that a rule of 50 per cent deduction of milk would require a scheme to be of minimum seven years duration when the average price for a buffalo is Rs.1,600 and of more than seven years duration when the average price per buffalo is Rs.2,000. Since a repayment period of more than seven years is not possible in view of limited productive life of the animal, it will be reasonable on the part of the bank to consider the proposition of higher than 50 per cent deduction of marketed surplus of milk to get the loan repaid.

Considering the results given in Table 15 which relate to normal level of marketed surplus in view of the discussion above, it is noted that a minimum of six year repayment period is needed to recover the

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[6] It can be argued that when the number of cattle increases there may be some economies of scale, particularly with respect to the cost of labour and cattle sheds. Such calculations could be interesting from the point of farmers to evaluate profitability of alternative sizes provided relevant data were available. From the point of view of financing institutions the marketed surplus is the only relevant variable which remains unaffected by economies of scale consideration.

Table 15: Monthly Instalments to be Paid for Different Schemes using the 1-6 months group

Scheme	Duration of the Scheme (years)	Total lactation months	Price of a buffalo: Rs.1600		Price of a buffalo: Rs.2000	
			Monthly instalment (Rs)	% of instalment to marketed surplus	Monthly instalment (Rs)	% of instalment to marketed surplus
S_1	1	9	**	**	**	**
S_2	2	18	97.78	82.50	**	**
S_3	3	21	88.80	75.20	111.00	94.00
S_4	4	30	72.37	61.31	82.14	69.58
S_5	5	36	63.56	53.85	72.51	61.43
S_6	6	45	53.72	45.51	61.59	52.18
S_7	7	54	47.39	40.15	54.61	46.26

** Denotes that even if all the sales proceeds of the monthly marketed surplus are deducted, the total loaned amount cannot be recovered in the prescribed period of the respective Scheme S.

Table 16 : Monthly Instalment to be Paid for Different Schemes Using the Average for 1-6 month and 1-9 month groups

Scheme	Duration of the scheme (years)	Total lactation months	Price of a buffalo:Rs.1600		Price of a buffalo: Rs.2,000	
			Monthly instalment (Rs)	% of instalment to marketed surplus	Monthly instalment (Rs)	% of instalment to marketed surplus
S_1	1	9	**	**	**	**
S_2	2	18	97.78	93.33	**	**
S_3	3	21	88.80	84.76	**	**
S_4	4	30	72.37	69.08	82.14	78.40
S_5	5	36	63.56	60.67	72.51	69.21
S_6	6	45	53.72	51.28	61.59	58.79
S_7	7	54	47.39	45.24	54.61	52.12

** Denotes that even if all the sale proceeds of the monthly marketed surplus are deducted, the total loaned amount cannot be recovered in the prescribed period of the respective Scheme S.

loan when the average price of buffalo is Rs.1,600 and percentage of deduction is kept at 50. In case average price per buffalo is Rs.2,000, as the case might be in the current buffalo market, the minimum period of loan repayment is seen to be seven years for 50 per cent deduction. Here again a higher level of deduction may be desirable from the point of view of safety. This is important because the present analysis does not account for possible death of the animal within the productive life.[7] From these considerations it appears that the results corresponding to rather lower estimate of marketed surplus may be preferable to work out a suitable strategy in terms of year of repayment and the percentage to be deducted for getting full repayment of the sanctioned loans.

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[7]The reason for excluding this aspect from the analysis is that the milch animals are insured in the scheme under consideration.

REFERENCES

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