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RESEARCH NOTE

Economics of Milk Production in West Bengal: Evidence from Cooperative and non- cooperative Farms

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Abstract

The article analyzes the cost, return and relative profitability of cooperative and non-cooperative milk producers' in West Bengal of India; it is found that cooperative farms have much higher profitability. Furthermore, non-BPL farms working under both cooperative and non-cooperative dairying are benefited higher than BPL farms.

Key Words: Primary Milk Producers' Co-operative Societies, Co-operative farms, Non-Co-operative farms, BPL farms, Relative profitability analysis.

JEL Classification: Q12, Q13, Q18, C50, A13

Introduction

The three concepts – costs, return and profitability - need to be analyzed while assessing the economics of any production activity. In this perspective the dairy sub sector occupies a very important productive activity in agricultural

economy in India as milk is the second largest agricultural commodity contributing to GNP, next only to rice. It is said that crop husbandry is a land resource based enterprise and provides almost seasonal income and employment to the farmers, whereas dairy provides not only employment to the farmer's family during the off season but also a regular flow of income all the year throughout. So, dairy development is recognized as an important activity suitable for employment generation and value addition in agricultural sector in Indian economy in general and of rural families especially the small and marginal farmers and landless agricultural labourers in particular.

But despite the fact that India occupies the largest milk producing country in the world and as compared with 1998-99 figures, milk production in India has increased by about 40 percent in 2007-08, the per capita availability of milk is only 280 gm. per day which is much below the figure of the world average. Even the per capita availability of milk is different for different Indian states ;for example, per capita availability for West Bengal is 128 gm. / day which is much lower than all India figure (NDDB: 2007-08). Therefore, the estimation of cost, return and profitability of milk production is essential for the dairy farmers for introducing desirable changes in the production, productivity and value addition in its operation at the micro level and for policy makers in formulating plans for improvements in dairy cattle productivity and value addition based on sound economic principles at the macro level. The present study is an attempt in this direction in micro perspective in the area of West Bengal in Indian context.

In India, dairy plants have different systems of milk procurement, namely private plants, milk vendors, contractors and cooperative system. Most importantly, dairy cooperatives account for the major share of processed milk in the country during 2007-08 (NDDB: 2007-08). But needless to say, dairy development in India has been acclaimed as one of the most successful development cooperative programmes under the world's largest dairy development programme – Operation Flood (now we see White Flood). But in spite of major contribution of milk production by the cooperative in our country, many non- cooperative dairy farms have been also simultaneously functioning in our country along with cooperative farms.

Several studies have studied the concepts of cost, return and profitability of cooperative and private dairy cooperative in regional concept in order to improve the efficiency of both the system of dairy plant in Indian perspective (Chauhan,1987; Malik,1989; Rangaswamy, 2001; Sandhu,1980; Ram et al,1987; Shiyani,1996; Mittal,1994; Sharma and Singh,1993; Rangasamy &

Dhaka,2007). Although scant attention has been made to compare in depth the economics of milk procurement by cooperative and non-cooperative dairy plants, there is a great variation in the relative economic efficiency of different cooperative and non-cooperative milk producers' firms in different resource situations due to variations in genetic character, feeding and management practices. Keeping this in view, the present study is an attempt to study the cost, return and relative profitability of some milk producer households under cooperative and non-cooperative dairying in West Bengal. This study also tries to examine the important factors affecting milk yield in producers' households under both cooperative and non-cooperative dairying in West Bengal.

Why is this study important in West Bengal state? As is well known, the growth of dairying cooperative in some states like Gujarat, Maharashtra, Tamilnadu and Karnataka has brought about more economic betterment and well-being of the rural population compared with other states (Benni, 2005:3). However as a later starter, West Bengal Co-operative Milk Producers Federation Limited (WBCMPFL) started its journey on and from 1983 under the debut of government of West Bengal following three tier structure of Anand pattern of milk cooperatives: WBCMPFL at the state level, District Milk Union (DMU) at the district level and Primary Milk Producers' Co-operative Societies (PMPCS) at the village level. But it is worth mentioning that non-cooperative dairying or private dairying, which is the original form of dairying in West Bengal, has been also functioning along with recent expansion of cooperative dairying in west Bengal. As compared with all India figure, West Bengal places 12th position in production (in tones) by contributing only 3.90 percent of total production in 2007-08. West Bengal has established 12678 organized district cooperative societies(cumulative)-2.08 percent of all India figure- and has marketed 673 TLPD-3.56 percent of all India figure- by incorporating 66000 farmers(about 0.5 percent of India's figure) as their members during 2007-08(NDDDB:2007-08). But per capita availability of milk (128 gr. /day) for West Bengal is much lower than all India figure (252 gr. /day). Thus the analysis of relative cost, return and profitability of both cooperative and non-cooperative dairying in the area of West Bengal is expected to provide a synoptic view of the economics of production of dairying industry and thereby contribute to higher employment potential and greater value addition in agriculture.

Sampling design and the collection of data:

Primary data have been collected at the village level from the milk producer households under both co-operative and non co-operative dairying. The sampling design followed in this study is a stratified random sampling design.

The three-tier structure of the dairy co-operatives in West Bengal is WBCMPFL at the state level (an apex body of milk co-operatives in the state of West Bengal), DMU (District Milk Union) at the district level (a representative body of village societies) and PMPCS (Primary Milk Producers' Co-operative Societies) at the village level. In order to select four PMPCSs the following procedure is used. Under the WBCMPFL, there are 14 DMUs. Out of these, two DMUs are selected: one is the highest performance based on the simple arithmetic mean of daily average milk production (in kg.) and daily average milk marketing (in kg.) and the other, the lowest of the same. But for selecting two PMPCSs from each selected DMU, we also selected one for highest performance and the other for lowest performance depending on same procedure we adopted for selecting two DMUs [simple arithmetic mean of daily average milk production (in kg.) and daily average milk marketing (in kg.)]. Thus four PMPCSs selected for final survey are Rukunpur-Balarampara Primary Milk Producers' Co-operative Society Ltd. (RPMPCS), Farashdanga Primary Milk Producers' Co-operative Society Ltd. (FPMPCS), Khar-Radhakrishnapur Primary Milk Producers' Co-operative Society Ltd. (KPMPCS), Sonepur Primary Milk Producers' Co-operative Society Ltd. (SPMPCS). At the final level, 40 (forty) milk producer member households of each PMPCS are selected based on SRSWOR. To make a comparative study with the PMPCSs, equal number of non co-operative milk producer household (40 in number) at the village level are also randomly selected (SRSWOR) based on the proximity of nearest in distance (in K.M) from each sample PMPCS. However, total numbers of milk producer households are 320 – 160 from PMPCS (40*4) and 160 from non cooperative societies (40*4). The required primary data were collected from these 320 milk producer households with the help of specially designed schedule of questionnaire through the survey method during the year 2007-08.

Methodology:

The methodology used to achieve the stated objectives of this study is in the following lines:

A) Profitability Analysis:

i) Cost – return analysis for current period: - The estimation of cost of production is an important item of information necessary for evolving rational price policy and development strategies of milk production. The costs of milk production cover both the variable costs and the fixed costs. The variable costs (in Rs.) include:

Feed costs - Feed costs are the main important constituents of direct costs of milk production. Feed costs include mainly the cost for green fodder, dry fodder and concentrate fodder (CF). Prevalent market prices were used to work out the feed cost per day (in Rs.) to each milich animal.

Labour cost – hired human labour and family labour are the important constituents of milk production. The value of hired labour is evaluated from the money wage (in Rs.) paid by the milk producer farmer. The valuation of family labour is a controversial issue among farm economists. It was imputed at the prevailing market wage rate of casual labour in the selected villages.

Miscellaneous expenses: This includes the expenditure on veterinary and AI expenses, cattle shed & dairy equipment repairing cost, water & electricity charges etc.

Fixed cost (in Rs.) includes:

Interest on capital: Interest on capital (including milich animal) is evaluated at the rate of 10% per annum on the present value of fixed assets. The interest on working capital was not computed as there was regular flow of income from milk, which was utilized for the working expanses (V.P. Sharma & R. V. Singh, 1994).

Deprecation: In case of milich animal, no depreciation was charged up to third lactation. Subsequently, 10% deprecation was charged for animal in fourth & fifth lactation and 20% deprecation was charged for animal in sixth lactation & above (Sharma & Singh, 1994). The deprecation charges of other fixed assets are worked out by the Straight Line Method using the formula:

Deprecation = (Original cost - Junk value) / Life of the asset. (Varghese P.K., 2007)

Rental value of own land : The rental value of owned land is estimated on the basis of prevailing rents in the village for identical type of land.

Test of significance: The problem here is to examine whether there is any significant difference between mean-values of two populations (cooperative member of household and non-cooperative member of household) for average cost and benefit of milk production.

Comparison of two mean-values of same random variable for two different populations – Suppose the random variable x have the means μ_1 and μ_2 in two different populations p_1 (female) and p_2 (male). We want to see if two population-means are equal or not on the basis of a random sample $x_{11}, x_{12}, \dots, x_{1n_1}$ from the probability distribution of x for the first population (cooperative) and an independent random sample $x_{21}, x_{22}, \dots, x_{2n_2}$ from the probability distribution of x for the second population (non-cooperative). For convenience, here we assume (a) two samples of the said random variable are independent because non-cooperative activities may not influence the activities of cooperative or cooperative activities may not influence the activities of non-cooperative, (b) probability distribution of x for each population is normal and (c) two distributions have a common (though unknown) variance σ^2 . An appropriate test procedure, called *Fishers' t-test*, is used to examine these characteristics (Goon *et al.*, 1985:309; Gupta, 1992:1222). The test statistic is given by

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \text{ with df.} = n_1 + n_2 - 2,$$

here

$$\bar{x}_1 = \sum_{i=1}^{n_1} x_{1i} / n_1, \bar{x}_2 = \sum_{j=1}^{n_2} x_{2j} / n_2 \text{ and}$$

$$s^2 = \frac{\sum_i (x_{1i} - \bar{x}_1)^2 + \sum_j (x_{2j} - \bar{x}_2)^2}{n_1 + n_2 - 2} \text{ and the appropriate hypothesis is } H_0:$$

$\mu_1 = \mu_2$ which is tested against the alternative hypothesis $H_1: \mu_1 \neq \mu_2$.

ii) Cost returns analysis for time period or Relative profitability analysis: To analysis the relative profitability of milk production in west Bengal, we made use of financial evaluation measure like Net Present Value (NPV), Benefit – Cost Ratio (BCR), and Internal Rate of Return (IRR) for ten years period, the average life span of milk cattle (Harberger, 1972). In the present study the following discounted measures (Gittinger, 1972) are used.

Net Present worth (NPW) or Net Present Value (NPV): NPV of any project is the difference between the discounted cash benefits and the discounted costs of the project. The discount rate represents the present value of the future costs or benefits.

$$\text{Net present value (NPV)} = \sum_{t=1}^n \frac{B_t}{(1+r)^t} - \sum_{t=1}^n \frac{C_t}{(1+r)^t}$$

where, B_t = benefit in each year, C_t = cost in each year, n = number of year (life period of the cattle),

r = discount rate. With this method we can estimate whether the net value of the project discounted over its anticipated life, will be positive or negative. The investment is profitable if $NPV \geq 0$.

Benefit – Cost Ratio (BCR): when we compare two or more projects with different costs, the BCR method give a correct choice. Benefit – cost ratio is a ratio between discounted cash benefits and the discounted costs of the project. If the BCR is greater than one, the project is worthy of selection. If we compare two or more projects, the projects under consideration can be arranged according to their BCR.

$$\text{Benefit-cost ratio (BCR)} = \frac{\sum_{t=1}^n \frac{B_t}{(1+r)^t}}{\sum_{t=1}^n \frac{C_t}{(1+r)^t}}$$

Internal Rate of Return (IRR): Internal rate of return is the rate of discount at which the NPV of project would be reduced to zero. The purpose underlying this method is to find a rate of discount at which the discounted outflows and inflows would be equal, or that the difference between the two would be zero. The higher the rate better would be the project. It shows the strength of the project. The formula for the IRR can be written as follows:

$$R = r_1 + \frac{PV_1 (r_1 - r_2)}{PV_1 - PV_2}$$

where, R = Internal rate of return, r_1 = rate of discount at which present value of the project is positive,
 r_2 = rate of discount at which present value of the project is negative, PV_1 = NPV at the lower discount rate (r_1), PV_2 = NPV at the higher discount rate (r_2).

Average Annual Margin (AAM): It gives the annuity value from the NPV of investment for comparison with the net return from annual milk production.

$$AAM = \frac{NPV}{\sum 1 / (1+r)^t}$$

A) Factors influencing production of milk:

Consideration has been given to some of the interaction of the factors affecting production of milk per unit. It seems to be important to answer the question like: what are the determinants of output and their extent of influence on output (i.e., the physical and marginal relationship between output and a host of explanatory variables)? Which inputs are significant in explaining variation in output? In order to ascertain the contribution of relevant inputs in milk production, the multiple regression analysis of OLS type has been carried out for cross breed cow of the study area. Cobb – Douglas type model is used to express the relationship between milk output per animal and various factors influencing it. These have been specified in log-linear form. However, before doing so, zero - order correlation matrices are worked out and correlation coefficients are examined for testing the problem of multicollinearity.

In order to capture the effect of different categories of milk producers and different income level of milk producers on milk production, the dummy variables (D & E) are incorporated in the production function. The variables included in the production function are as follows:

i) When number of observation (n) is 320 (overall cooperative & non-cooperative)

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, D_1, E_1)$$

ii) When n = 160 (only cooperative), $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, D_2, E_{11})$

iii) When n = 160 (only non-cooperative), $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, D_3, E_{12})$

iv) When n = 80 (only good cooperative), $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, E_{11g})$

v) When $n = 80$ (only good non-cooperative), $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, E_{12g})$

vi) When $n = 80$ (only bad cooperative), $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, E_{11b})$

vii) When $n = 80$ (only bad non-cooperative), $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, E_{12b})$

Y = Log value of average milk yield per milk cow per day (Rs.)

X_1 = Log value of green fodder used per milk cow per day (Rs.)

X_2 = Log value of dry fodder used per milk cow per day (Rs.)

X_3 = Log value of CF used per milk cow per day (Rs.)

X_4 = Log value of labour used per milk cow per day (Rs.)

X_5 = Log value of veterinary cost per milk cow per day (Rs.)

X_6 = Order of lactation (number)

X_7 = Stages of lactation (months after calving)

X_8 = Current Value of milk cow

$D_1 = 1$, for cooperative members

$= 0$, otherwise

$E_1 = 1$, for BPL members

$= 0$, otherwise

$D_2 = 1$, for good cooperative members

$= 0$, otherwise

$E_{11} = 1$, for BPL co-operative members

$= 0$, otherwise

$D_3 = 1$, for good non co-operative members

$= 0$, otherwise

$E_{12} = 1$, for BPL non co-operative members

$= 0$, otherwise

$E_{11g} = 1$, for BPL good co-operative members

$= 0$, otherwise

$E_{12g} = 1$, for BPL good non co-operative members

$= 0$, otherwise

$E_{11b} = 1$, for BPL bad co-operative members

$= 0$, otherwise

$E_{12b} = 1$, for BPL bad non co-operative members

$= 0$, otherwise

Result and discussion:

Current benefit – cost analysis:

As may be seen in Table-1, variable costs works out the major contribution (around 85%) among total cost components for all categories of cooperative and non-cooperative dairy farms. The contribution of feed cost is the highest

(around 54%) among variable cost components, labour cost having the second highest (around 28%) variable cost components, for all categories of cooperative and non-cooperative dairy farms. This is also important that the contribution of CF cost is the highest (around 55%) among total feed cost component for all categories of cooperative and non-cooperative dairy farms. Similarly, out of fixed cost components, which contribute around 14% of the total cost of all categories of cooperative and non-cooperative farms under our study, interest on capital has the major contribution of all types of fixed cost.

As regards benefit of milk production is concerned, out of total benefits of all categories of cooperative and non-cooperative farms about 90% or more are generated from the sale of milk and milk products. But overall results reveal that, despite the fact the difference of average cost of milk production (Rs. per day per milk cow) between cooperative and non-cooperative farms is not far from uniformity, the average net benefit and benefit-cost ratio (Rs. per day per milk cow) for good cooperative farms in each good cooperative village or all good cooperative villages in aggregate are considerably higher than that either of the bad cooperative or of the good non-cooperative farms or of bad non-cooperative farms individually or in aggregate. Moreover, none but the difference of average net benefit and average benefit-cost ratio (Rs. per day per milk cow) between good cooperative farms for each PMPCS or both PMPCSs in aggregate and bad cooperative farms for the respective outlook is statistically significant. On the other hand, the average net benefit and average benefit-cost ratio (Rs. per day per milk cow) for bad cooperative farms in each bad cooperative village or all bad cooperative villages in aggregate are higher either of the good non-cooperative farms or of the bad non-cooperative farms in respective figures, but the performance of the bad non-cooperative farms does not markedly differ from the performance of latter in respective outlook. Moreover, the performance of good non-cooperative farms is better, if not statistically significant, than bad non-cooperative farms both individually and in aggregate forms.

Relative profitability analysis:

To analyze the relative profitability analysis of different categories of cooperative & non-cooperative farms under our study, we made use of financial evaluation measures like net present value (NPV), benefit-cost ratio (BCR), average annual margin (AAM) and internal rate of return (IRR). Table- 2 represents NPV, BCR & AAM at different rates (12% and 15%) and IRR. The findings portrayed in Table- 2 are also in conformity with that of the results of net benefit presented in Table- 1. Here also the NPV, AAM and BCR at

different rates and IRR are considerably higher for good cooperative farms individually and aggregate as compared with bad cooperative farms or with good or bad non-cooperative farms in respective outlook. But with regard to the good non-cooperative farms either of individual non-cooperative village or of two non-cooperative villages in aggregate, although the performance of NPV, AAM, BCR at different rates & IRR is higher than bad cooperative farms, such financial factors (NPV, AAM, BCR & IRR) of the former (good non-cooperative farms) does not markedly differ from the latter. Similarly, the financial performance between good non-cooperative farms is better, if not markedly, than bad non-cooperative farms which also support the findings of Table-1.

Determinants of milk production:

Multiple regression analysis was carried out in log linear form with aggregate milk yield per milk cow per day as the dependent variable. Categorically for all cooperative farms (160 in numbers) almost all explanatory variables are of expected sign and significant either of 1% or 5% level of significance. The vital significant components of variable cost for cooperative farms are green fodder (X_1), dry fodder (X_2), CF (X_3), veterinary cost (X_5). Excluding labour cost all are of positive sign; both the order of lactation (number) and the stages of lactation (months after calving) are of negative sign & significant; good cooperative farms dummy (D_1 , 80 in number) has positive sign and is significant determinants of average milk yield per milk cow per day. Conversely non-cooperative farms (160 in numbers), dry fodder (X_2), CF (X_3), labour use (X_4), current value of milk cow (X_8) and good non co-operative farms dummy (D_3 , 80 in number) are of expected sign (positive) and are significant.

For good cooperative farms (80 in numbers), the significant components of variable costs are green fodder (X_1), dry fodder (X_2), CF (X_3) and they are of expected sign (positive). The coefficient of the order of lactation (X_6) is of expected sign (negative) and it is significant. For good non-cooperative farms (80 in numbers), the significant components of costs are dry fodder (X_2), CF (X_3), labour use (X_4) and they are of expected sign (positive).

For bad cooperative farms (80 in numbers), the coefficient of cost of dry fodder (X_2), CF (X_3), labour use (X_4), veterinary cost (X_5) and stages of lactation (X_7) are of expected sign & they are significant. For bad non-cooperative farms (80 in numbers), the coefficient of cost of dry fodder (X_2), CF (X_3) and labour use (X_4) and current value of milk cow (X_8) are of expected sign (positive) & they

are significant. The coefficient of the stages of lactation (X_7) is of expected sign (negative) and it is significant.

The common features that emerges out from Table-3 is that for all types of farms (aggregate cooperative / aggregate non-cooperative / good cooperative / bad cooperative / good non-cooperative / bad non-cooperative / all farms) the major component of feed cost $CF(X_3)$ and dry food (X_2) are positive signs and they are significant determinants of average milk yield per milk cow (Rs. per day). This is also in conformity with the findings of Table-1. As shown earlier in Table- 1, CF has the highest contribution of cost for all categories of farms (lying between 44.49 and 55.01 percent of total costs); dry food accounts for the second important components of feed costs for all categories of farms and accounts for third significant contribution of total cost components for all categories of farms (the contribution of dry food of total cost between different categories of farms lies between 14.92 and 16.50 percentage point).

The other common factor of Table- 3 is that for all cooperative and non-cooperative farms in general (320 farms) and cooperative farms (160 farms) and especially good cooperative farms (80 farms) in particular, BPL categories of farms have significant negative impact on the milk yield per milk cow per day (Rs.) on an average. Importantly, all categories of BPL farms (aggregate cooperative / aggregate non-cooperative / good cooperative / bad cooperative / good non-cooperative / bad non-cooperative / all farms) have negative impact on average milk yield per milk cow per day (in Rs.). It implies that, all categories of non BPL farms (both cooperative and non-cooperative) are highly benefited by the production of milk as compared with BPL farms.

Conclusion

While examining the economic issues – cost, return and profitability – between cooperative and non-cooperative dairy farms from the field survey of 320 milk producers' households, this study reveals some important phenomena. As regards the cost components are concerned, the variable cost constitutes the significant major contribution (around 85%) of total cost for all categories of cooperative and non-cooperative dairy farms. Out of total variable cost for all categories of cooperative and non-cooperative dairy farms, feed cost is the major cost component in which CF occupies the highest contribution. Similarly, out of fixed cost component, interest on capital has the major contribution for all types of farms.

However, while judging both benefit and cost for the current year of empirical survey one might observe that although the difference of average cost of milk production (Rs. per day per milk cow) between cooperative and non-cooperative farm is not far from uniformity, the average net benefit and benefit-cost ratio (Rs. per day per milk cow) for all good cooperative farms are considerably higher and statistically significant than that either of the bad cooperative or of the good non-cooperative farms or of bad non-cooperative farms. This is also supported by the relative profitability analysis for 10 years period. Here also the NPV, AAM and BCR at different rates and IRR are considerably higher for all good cooperative farms as compared with other farms. Multiple regression analysis also suggest that for all types of farms (aggregate cooperative / aggregate non-cooperative / good cooperative / bad cooperative / good non-cooperative / bad non-cooperative / all farms) the major cost components are feed cost $CF(X_3)$ and dry food (X_2) which are of positive signs and they are significant determinants of average milk yield per milk cow (Rs. per day). The regression analysis also imply that for all cooperative and non-cooperative farms in general (320 farms) and cooperative farms (160 farms) and especially good cooperative farms (80 farms) in particular, BPL categories of farms have significant negative impact on the milk yield per milk cow per day (Rs.) on an average.

The overall results of this study suggests that variable cost constitute the significant major contribution of total cost (around 85% of total cost) for all category of cooperative and non-cooperative dairy farms, and cooperative farms, which have higher daily performance on milk production and milk marketing (good cooperative farms), under each PMPCS have much higher profitability than other type of dairy farms despite the fact the difference of average cost of milk production (Rs. per day per milk cow) between cooperative and non-cooperative farms is not far from uniformity. Also important is that non-BPL farms working under both cooperative and non-cooperative dairy are highly benefited in relation to BPL farms.

So, in order to make dairy farms more profitable and higher value addition in agricultural sector with higher employment generation, government and other institutional sources should provide special packages immediately to the non-cooperative farms and bad cooperative farms in general and all dairy farms of BPL category in particular.

Table- 1: Average cost and benefit of milk production (Rs.per day per cow) for different categories of milk producers' (cooperative & non-cooperative) societies for the year 2007-08.

Cost components	Milk producers' co-operative members													
	Rukune-pur (good)		Khar-Radhakri-shnapur (good)		Farasdan-ga (bad)		Sonepur (bad)		Good society (Total)		Bad society (Total)		Overall	
	C	NC	C	NC	C	NC	C	NC	C	NC	C	NC	C	NC
1. Variable costs:														
A) Feed costs:														
i) Green food	5.47	5.68	5.42	5.57	4.69	5.36	5.10	5.62	5.45	5.63	4.90	5.49	5.18	5.56
ii) Dry food	16.50	15.83	16.10	16.25	15.75	14.92	15.77	15.29	16.30	16.04	15.76	15.11	16.03	15.58
iii) CF	27.37	26.44	28.58	26.93	24.60	23.65	23.89	24.12	27.98	26.69	24.25	23.89	26.12	25.29
Total feed cost(i+ii+iii)	49.34	47.95	50.10	48.75	45.04	43.93	44.76	45.03	49.73	48.35	44.91	44.49	47.33	46.43
B) Labour Costs (hired + family labour)	25.52	24.58	25.15	24.36	23.40	24.47	23.38	24.25	25.34	24.47	23.39	24.36	24.37	24.42
C) Miscellaneous expenses	2.25	4.05	2.42	3.96	2.23	3.52	2.05	3.72	2.34	4.01	2.14	3.62	2.25	3.82
Total Variable Costs (A+B+C)	77.11	76.58	77.67	77.07	70.67	71.92	70.19	73.00	77.39	76.83	70.44	72.47	73.95	74.67
	(85.06)	(85.29)	(85.29)	(85.35)	(85.36)	(85.23)	(85.26)	(87.09)	(85.17)	(85.31)	(85.79)	(86.15)	(85.47)	(85.71)
2. Fixed Costs:														
a) Interest on Capital	6.25	5.96	6.17	6.05	5.52	5.65	5.02	4.95	6.21	6.01	5.27	5.30	5.74	5.66
b) Depreciation Costs	4.62	4.57	4.35	4.28	4.16	4.36	3.95	3.72	4.49	4.43	4.06	4.04	4.28	4.24
c) Rental value of own land	2.67	2.68	2.88	2.90	2.45	2.47	2.23	2.16	2.78	2.79	2.34	2.31	2.56	2.55
Total fixed Costs (a+b+c)	13.54	13.21	13.40	13.23	12.13	12.46	11.20	10.83	13.48	13.23	11.67	11.65	12.58	12.45
	(14.94)	(14.71)	(14.71)	(14.65)	(14.64)	(14.77)	(14.74)	(12.91)	(14.83)	(14.69)	(14.21)	(13.85)	(14.53)	(14.29)

3. Total Costs (1+2)	90.65 89.79 (100) (100)	91.07 90.30 (100) (100)	82.80 84.38 (100) (100)	81.39 83.83 (100) (100)	90.87 90.06 (100) (100)	82.11 84.12 (100) (100)	86.53 87.12 (100) (100)
4. Benefits:							
d) Milk	114.4 99.85 (91.15) (90.12)	116.9 97.48 (91.33) (89.76)	96.75 89.56 (90.34) (89.56)	91.63 87.65 (89.83) (89.42)	115.7 98.67 (91.25) (90.09)	94.19 88.61 (90.13)	104.9 93.64 (90.67) (89.69)
e) Cow dung	5.87 5.68	5.75 5.82	5.06 5.20	5.20 5.22	5.81 5.75	(89.48)	5.47 5.48
f) Calf + junk value	5.20 5.28	5.35 5.26	5.25 5.26	5.16 5.15	5.28 5.27	5.13 5.21	5.25 5.24
Total Benefit (d+e+f)	125.5 110.8 (100) (100)	128.0 108.6 (100) (100)	107.1 100.0 (100) (100)	102.0 98.02 (100) (100)	126.8 109.7 (100) (100)	5.21 5.20 104.5 99.02 (100) (100)	115.7 104.4 (100) (100)
Net Benefit (4-3)	* 34.87 21.02	* 36.89 18.26	24.26 15.63	20.06 14.19	* 35.88 19.63	22.42 14.90	* 29.12 17.24
Benefit-cost ratio	* 1.39 1.23	* 1.41 1.20	1.29 1.18	1.25 1.17	* 1.40 1.22	1.27 1.18	* 1.34 1.19

Source: Field survey

Notes: i) *Cooperative & non-cooperative differences are statistically significant at 5 per cent level; and
ii) Figures in () represent the percentage share.

Table 2: NPV, average annual margin, B-C ratio and IRR of milk production per milk cattle per year in West Bengal during average life span (1998-99 to 2007-08).

Name of the Societies (cooperatives/non-cooperatives)		NPV of net benefit		Average annual margin (AAM)		Benefit-cost ratio (BCR)		Internal Rate of Return (IRR)
		At 12% discount rate	At 15% discount rate	At 12% discount rate	At 15% discount rate	At 12% discount rate	At 15% discount rate	
Rukunepur	Cooperative	69196.08	59830.90	10400.73	9927.14	1.55	1.53	74.13%
	Non-cooperative	47284.20	39975.40	7107.20	6632.72	1.35	1.33	52.72%
Khar-Radhakrishnapur	Cooperative	67088.27	57870.60	10083.91	9601.89	1.53	1.51	71.63%
	Non-cooperative	45789.49	38675.50	6734.29	6417.04	1.34	1.31	52.08%
Farasdanga	Cooperative	45622.95	38440.20	6857.50	6378.00	1.34	1.32	51.78%
	Non-cooperative	34048.93	28280.10	5117.83	4692.23	1.25	1.23	43.97%
Sonapur	Cooperative	40216.48	33535.20	6044.86	5564.16	1.30	1.28	47.40%
	Non-cooperative	29161.45	23756.50	4383.20	3941.68	1.22	1.20	39.06%

Good Society	Cooperative	68142.18	58850.75	10242.32	9764.52	1.54	1.52	72.88%
	Non-Cooperative	46536.845	39325.45	6920.75	6524.88	1.34	1.32	52.40%
Bad Society	Cooperative	42919.72	35987.70	6451.18	5971.08	1.32	1.30	49.59%
	Non-Cooperative	31605.19	26018.3	4750.52	4316.96	1.23	1.21	41.51%
Overall	Cooperative	55530.95	47419.30	8346.75	7867.82	1.43	1.41	55.49%
	Non-cooperative	37499.40	31174.31	5636.46	5172.44	1.27	1.25	45.09%

Table-3: Estimates of milk production function in West Bengal during 2007-08.

Category of milk producer	Intercept	Regression Coefficients										Value of adjusted R ²
		X1	X2	X3	X4	X5	X6	X7	X8	D ₁ /D ₂ /D ₃	E ₁ /E ₁₁ /E ₁₂	
All Members of cooperative and non-cooperative [320]	0.02647 (0.1236)	0.02632 (0.036)	* 0.33187 (0.056)	* 0.6852 (.054)	* 0.2673 (.071)	0.0368 (.024)	* -0.036 (0.012)	* -0.023 (.008)	** 0.050 (0.022)	* 0.0470 (0.003)	*** -0.008 (0.005)	0.8848
Only co-operative members [160]	* 0.60381 (0.146)	** 0.12703 (0.057)	* 0.31369 (0.072)	* 0.5407 (.071)	0.0811 (.072)	** 0.0693 (.030)	** -0.035 (0.015)	** -0.018 (.011)	0.0153 (0.023)	* 0.0293 (0.005)	* -0.0131 (0.005)	0.9090
Only non co-operative members [160]	* -0.5231 (0.190)	-0.0013 (0.038)	* 0.17109 (0.071)	* 0.6177 (.079)	* 0.4958 (.109)	-0.010 (.026)	-0.014 (0.015)	-0.009 (.009)	* 0.1746 (0.042)	* 0.0351 (0.004)	-0.0056 (0.006)	0.9335
Only good co-operative members [80]	* 1.06941 (0.203)	* 0.22329 (0.076)	* 0.27344 (0.084)	* 0.4760 (.099)	-0.040 (.087)	-0.038 (.038)	* -0.061 (0.024)	-0.002 (.015)	0.0122 (0.019)	-	* -0.0199 (0.007)	0.8679
Only bad co-operative members [80]	-0.0642 (0.361)	0.06621 (0.067)	*** 0.21135 (0.123)	* 0.4113 (.124)	* 0.4770 (.187)	-0.001 (.046)	-0.020 (0.024)	0.013 (.014)	0.0915 (0.089)	-	-0.0116 (0.010)	0.8983
Only bad non co-operative members [80]	-0.0540 (0.353)	-0.0751 (0.092)	* 0.58903 (0.218)	* 0.4529 (.127)	*** 0.2231 (.118)	* 0.1351 (.053)	-0.029 (0.021)	*** -0.027 (.016)	0.1060 (0.094)	-	-0.0056 (0.008)	0.8950

	*		***	*	*			*	*	-		
	-0.6445	0.00414	0.13912	0.5652	0.7397	0.0186	-0.027	-0.027	0.1507		-0.0066	0.9639
	(0.196)	(0.047)	(0.074)	(.100)	(.138)	(.029)	(0.018)	(.010)	(0.045)		(0.006)	

N.B: Figures in the () indicates the standard error and [] indicates the number of observations.

* Significant at 1% level.

** Significant at 5% level

*** Significant at 10% level

References

- Benni, B.S. (2005): *"Dairy Co-operatives: Management and Practice"*, Rawat Publications, New Delhi.
- Chauhan, A.K. (1987): *"An Economic Analysis of Different Milk Procurement System in a Private Sector Dairy Plant in Western Uttar Pradesh"*, Unpublished M.Sc Dissertation, National Dairy Research Institute, Karnal.
- Gittinger, J.P. (1972): *"Economics Analysis of Agricultural Projects"*, The Johns Hopkins University Press, London.
- Harberger, A. (1972): *"Project Evaluation"*, Collected papers, The University of Chicago Press, Chicago.
- Malik, M. (1989): *"Economic Evaluation of Organized Milk Procurement by Haryana Dairy Development Co-operative Federation"*, Unpublished Ph.D. Dissertation, National Dairy Research Institute, Karnal.
- NDDDB (2007-08): Annual Report 2001-02, *National Dairy Development Board*, Anand, India.
- Ram, Kuber and Kulwant Singh (1987): *"Cost of Collection of Milk in a Public Sector Plant"*, *Asian Journal of Dairy Research*, vol.6, No.3, pp.130-134.
- Rangasamy, N. (2001), *"Economics of Milk Procurement in a Co-operative Dairy Plant in Tamil Nadu"*, Unpublished M.Sc Dissertation, National Dairy Research Institute, Karnal.
- Rangasamy, N. and J.P. Dhaka (2007): *"Milk Procurement Cost for Co-operative and Private Dairy Plants in Tamil Nadu – A Comparison"*, *Indian Journal of Agricultural Economics*, Vol.62, No. 4, Oct.-Dec.2007.
- Sandhu, T.S. (1980): *"Milk Production, Procurement and Transport – An Economic Approach"*, *Dairy Science Abstract*, Vol.42, No.2, p.88.
- Sharma, V.P. and R.V.Singh (1993): *"Resource Productivity and Allocation Efficiency in Milk Production in Himachal Pradesh"*, *Indian Journal of Agricultural Economics*, Vol.48, No. 2, April-June 1993.
- Sharma, V.P. and R.V.Singh (1994): *"Economics of Milk Production in Himachal Pradesh"*, *Agricultural Situation in India*, Vol.48, No.10, January, 1994.
- Shiyani, R.L. (1996): *"An Economic Inquiry into the Impact of Dairy Co-operatives on Milk Production"*, *Indian Journal of Agricultural Economics*, Vol.51, No. 3, July- Sept.1996.

- Slawomir Juszczak (2005): "*Milk Production Profitability – Multiple Regression Analysis*", *Electronic Journal of Polish Agricultural University*, Vol.8, Issue 4,2005.
- Varghese P.K. (2007): "*Economics of Cardamon cultivation in Kerala*", *Indian Journal of Agricultural Economics*, Vol.62, No. 1, Jan-March 2007.