

SUBJECT IV
AGRICULTURE AND FARM LIVELIHOOD IN DISADVANTAGED AREAS:
INTROSPECTION OF SOCIO-ECONOMIC ISSUES

**Participation Behaviour of Dairy Farmers in Dairy
Co-operative Societies in Manipur: A Double Hurdle Approach**

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ABSTRACT

The study has used the double hurdle approach to assess the factors that influence a dairy farmer's participation in Dairy Co-operative Societies (DCS) as well as the intensity of participation in Manipur state. The first hurdle is estimated through a binomial probit model and a truncated regression is used in the second hurdle. In order to reap the benefits of dairy co-operatives, young and enterprising individuals should be motivated to take up dairying and join the co-operatives. Locally suitable exotic breeds should be popularized and made easily available to the farmers through various measures. This will also enable higher milk production which is also a factor having positive correlation with the decision to participate. The results of the truncated regression indicated that while age and technical efficiency coefficients were positively related to the proportion of milk sold by the member farmers to DCSs, dairy farming experience and milk production had a negative influence. Farmers should be given more awareness about the ways to raise the technical efficiency of their farms through various trainings on dairy farming. Training on milk processing activities may serve as an important tool to counter the risk arising due to unstable socio-political situation of the state which leads to frequent *bandhs* and blockades.

Keywords: Dairy co-operative societies, Milk production.

JEL: C24, Q13, Q16

I

INTRODUCTION

The entire breakthrough in the Indian dairy sector was due to the launching of the Operation Flood Programme by the Government of India and National Dairy Development Board (NDDB) in the year 1970. Dairy co-operative societies were the backbone of this programme and the number of dairy co-operative societies increased from 13.28 thousand in 1980-81 to 165.79 thousand during 2014-15 registering more than a twelve-fold increase. During the same period increase in the number of producer members was from 1.74 million to 15.40 million and milk procurement from 2.56 thousand litres per day to 37.94 thousand litres per day. The expansion of the dairy cooperative network in India can be deemed as the most significant factor in the remarkable increase in milk production in India. The country which was an

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importer of milk and milk products in the 1950s is now the largest producer of milk in the world with 146.3 million tonnes produced during 2014-15.

Despite a substantial horizontal expansion of dairy co-operatives, changes in the average size and scale of a village level dairy co-operative is not significant. Also, in spite of the potential inherent in dairy co-operatives to bring dairy farmers within its ambit and effectively link them to markets, their performance and impact have not been uniform across all the regions of the country (Bardhan *et al.*, 2012). Several studies such as that of Kumar and Sharma (1999), Meena (2008) and Singh (2012) in some parts of the country, on comparing the economic benefits of members of dairy co-operatives and non-members, found that dairy farmers have benefitted from joining dairy co-operatives. It poses a question as to why some dairy farmers do not join the dairy co-operatives even though it is found to be advantageous. Hence, it is necessary to analyse the factors that influence the decision of dairy farmers to participate in dairy co-operatives. Such a study also assumes critical importance especially in the north eastern region of the country which is characterised by difficult terrain and small scale production. Though, consumption of milk and milk products is lower due to food habits and less availability of milk, increase in per capita income and changes in life style have led to an increase in demand for milk and milk products. The region has witnessed a steady increase in milk production over the years. The small size of landholdings and limited scope of other livelihoods renders dairy and other livestock enterprises more significant in this part of the country.

Among all north-eastern states, Manipur has an encouraging number of dairy co-operative societies (National Co-operative Union of India, 2007-08). However, literature relating to factors influencing the dairy producers to participate in dairy co-operatives and also the extent of their participation in the north eastern region of the country is very limited. Hence, the present study attempts to assess the determinants of participation by dairy farmers in dairy co-operative societies in the state as well as those that affect the quantity of milk sold to the co-operatives by the members.

II

METHODOLOGY OF THE STUDY

Sampling, Study Area and Data

The empirical analysis is based on a household survey data collected from dairy farmers in plain and hill regions of Manipur during 2014-15. The study was confined to four districts, two each from plain (Bishnupur and Thoubal) and hill (Senapati and Churachandpur) selected purposively from the state on the basis of number of functioning dairy co-operative societies (DCS). A complete enumeration was done of all the dairy farmers who participate as members of co-operative societies and non-member dairy farmers from the same and adjoining villages. The households were then categorised into three herd size categories, viz., small (1-3 milch animals),

medium (3-6 milch animals) and large (> 6 milch animals) through cumulative square root frequency method. The sample consisted of 240 dairy farm households with 120 members of DCS and 120 non-members selected using a multistage sampling technique. The survey questionnaire included information on demographic particulars of milk producing households, farm characteristics, economics of dairy farms consumption and disposal pattern of milk. Table 1 presents the herd-size category wise distribution of households selected across member and non-member groups.

TABLE 1. DISTRIBUTION OF DIFFERENT HERD SIZE CATEGORY OF SAMPLE MEMBER AND NON-MEMBER HOUSEHOLDS

Category (1)	No. of milch animals (2)	Members (3)	Non-members (4)
Small	1-3	68	81
Medium	4-6	36	28
Large	> 6	16	11
Total		120	120

Analytical Framework

The logit, probit and tobit models have been frequently used to analyse the participation decision to farmers' organisations. Logit and probit models are used if the dependent variable is binary but since we are interested in understanding both the factors affecting the probability as well as the intensity of participation and hence the analysis goes beyond the use of binary dependent variable models. Tobit model can be used in this case but this model assumes the decision to participate and extent of participation to be the same (Wooldridge, 2002). The limitation of the Tobit model can be overcome with the double-hurdle model (Cragg, 1971) which is a two-tiered process, i.e., participation decision with the probability of participation and the intensity of participation are being determined by separate processes.

The double hurdle considers the possibility of zero realisations (outcomes) in the second hurdle arising from the individual's deliberate choices or random circumstances. The model is designed to analyse the instances of an event that may or may not occur, and if it occurs, takes on continuous positive values. In this study, the decision to participate or not is made first, followed by the decision on how much to sell to DCSs.

First Hurdle: Explaining Dairy Co-operative Membership

A Probit model was formulated in an attempt to explain the factors that are associated with dairy co-operative membership. The dependent variable is a dummy variable, dichotomous in nature (assuming a value of 1 in case a producer sells to DCS and 0 otherwise). The model is of the form:

$$D_i = \alpha X_i + v_i$$

$$D_i = 1, \text{ if } D_i^* > 0 \text{ and } 0 \text{ if } D_i^* < 0$$

where, D_i^* is a latent variable that takes the value 1 if the farmer participates in a DCS and zero otherwise, Z is a vector of household characteristics and α is a vector of parameter.

Second Hurdle: Explaining Intensity of Participation

A truncated regression model was used to assess the extent of participation by members of DCSs in the DCSs. The model is of the form:

$$Y_i^* = \beta_i X_i + u_i$$

$$Y_i = Y_i^* \text{ if } Y_i^* > 0 \text{ and } D_i^* > 0$$

$$Y_i = 0, \text{ otherwise}$$

where, Y_i^* and Y_i are latent and the observed levels of participation in DCSs respectively, X_i is a vector of variables influencing how much milk member households sell to DCSs and β is a vector of parameters to be estimated. If both decisions are made by the individual farmer independently, the error terms are assumed to be independently and normally distributed as:

$$v_i \sim N(0, 1) \text{ and } u_i \sim N(0, \sigma^2)$$

where Y_i = Proportion of milk sold to DCSs out of total milk sold (Litre)
 X is the vector of explanatory variables and β 's are the coefficients.

Data and Descriptive Statistics

Based on the literature and conceptual model, a set of explanatory factors were derived for analysing the decision for participation and extent of participation decisions. Table 2 presents description of the factors, hypothesised relation with decision for participation.

Estimation of Technical and Economic Efficiency

The study also examined whether technical and economic efficiency of the each farm influences the decision to participate and intensity of participation in a co-operative society. The non-parametric approach introduced as Data Envelopment Analysis (DEA) by Charnes *et al.* (1978) has been used for the study. It does not assume any functional form and the efficiency of a dairy household is measured relative to all other households with the simple restriction that all households lie on or below the efficient frontier. In our study, DEA is applied as constant returns to scale,

TABLE 2. DESCRIPTIONS OF EXPLANATORY FACTORS AND DESCRIPTIVE STATISTICS

Variable (1)	Description (2)	Measurement (3)	Hypothesised relation (4)
Age	Age of household-head	Years	-
Education	Educational level of household-head	0-Illiterate, 1-Primary, 2-Middle, 3-High School & Intermediate, 4-Graduation and above	+
Land holding	Size of landholding of household	Hectares (ha)	-/+
Distance to market	Distance from farm to nearest market	Kilometres	-/+
Farming experience	Experience of dairy farming of household head	Years	+
Extension contact	Whether has regular contact with extension functionaries	1= Yes 0= No	+
Milch animal holding	Number of milch animals owned by household	Measured as standard milch animal units-(SAU) (1 indigenous cow = 1.2 crossbred cow) (Sirohi <i>et al.</i> , 2015)	+
Proportion of exotic to total milch cow	Exotic milch cow out of total milch cow owned	Measured ratio of number of exotic milch cow to total number milch cow	+
Total milk production	Total milk production per annum	Litres	+
Technical efficiency	Ability of the farm to minimise inputs keeping output fixed	Technical efficiency of each farm calculated using DEA	+
Economic efficiency	Ability of the farm to produce output at lowest possible cost	Economic efficiency of each farm calculated using DEA	+

which was put forward by Charnes *et al.* (1978). Data envelopment models can be classified into two groups as input-oriented and output-oriented. An input-oriented model has been used in this case which calculates the optimal input combinations to obtain a given output level.

The quantity of milk produced (litres/household/annum) was used as the output variable and inputs, viz., quantity of green fodder (kg/household/annum), quantity of dry fodder (kg/household/annum), quantity of concentrate (kg/household/annum) and labour (man-days/household/annum) were used for estimating the technical and economic efficiency of the dairy farms by using DEAP Version 2.1.

III

RESULTS AND DISCUSSION

Characteristics of Milk Producers

A summary of the various socio-economic variables considered in the present study is given in Table 3. It is observed that there is a significant difference (at 1 per cent) between the average distance to market of the member and non-member households. Also, average values of proportion of exotic to total milch cows, total milk production and coefficient of technical efficiency showed a significant

difference (at 1 per cent) between the two groups. Educational status and access of contact with extension functionaries were significantly different.

TABLE 3. DESCRIPTIVE STATISTICS OF THE EXPLANATORY FACTORS USED IN THE PARTICIPATION BEHAVIOUR MODEL

Variable (1)	All (all)		Member (120)		Non-member (120)		Pearson Chi ² (8)	t- value or ratio (9)
	Mean (2)	Std. dev (3)	Mean (4)	Std. dev (5)	Mean (6)	Std. dev (7)		
Age	44.13	9.71	43.53	10.29	44.73	9.10	-	- 1.76
Education							26.13***	-
Land holding	0.61	0.68	0.66	0.79	0.57	0.56	-	1.09
Distance to market	6.78	2.72	5.65	2.15	7.92	2.76	-	- 7.83***
Farming experience	16.87	8.41	17.54	9.47	16.20	7.17	-	1.64
Extension contact							86.40**	-
Milch animal holding	5.31	3.09	5.64	2.90	4.98	3.24	-	1.66
Proportion of exotic to total milch cow	0.53	0.37	0.69	0.32	0.36	0.33	-	7.62***
Total milk production	3932.99	3570.80	5281.02	4011.16	2584.97	2419.52	-	6.14***
Technical efficiency	0.80	0.15	0.83	0.10	0.76	0.17	-	3.73***
Economic efficiency	0.63	0.14	0.65	0.09	0.62	0.17	-	1.82

*** denotes significance at 1 per cent level.

Disposal Pattern of Milk

Members of DCSs sold milk to multiple buyers, mainly to the DCS, directly to local consumers and local markets (tea shop, bakery etc.) as presented in Table 4. Their tendency to diversify the selling points was to minimise the risk that arises due to frequent bandhs in the state. Selling of milk to middleman was found to be negligible. Proportion of milk sold to DCSs to total milk sold showed their degree of participation in the co-operative society.

A perusal of Table 4 revealed that member group disposed largest share of the marketed surplus *i.e.*, 68.65 per cent to DCS followed by local market (21.93 per cent) and the remaining 9.4 per cent to local consumers. In case of small herd size category, the percentage share of milk sold to local consumers was higher than that sold to market. The disposal pattern of milk was the same for both the medium and large herd size categories in the group.

TABLE 4. MILK DISPOSAL PATTERN OF MEMBER HOUSEHOLDS

Category (1)	(litres /household/ day)			
	DCS* (2)	Local consumer (3)	Local market (4)	Total milk sold (5)
Small (1-3 Milch animals)	5.65 (72.5)	1.24 (15.86)	0.91 (11.62)	7.79 (100)
Medium (4-6 Milch animals)	14.10 (64.93)	1.53 (7.05)	6.08 (28.01)	21.72 (100)
Large (> 6 Milch animals)	27.91 (70)	2.77 (6.94)	9.19 (23.05)	39.87 (100)
Overall	11.15 (68.65)	1.53 (9.4)	3.56 (21.93)	16.24 (100)

DCS*- Dairy Co-operative Society, Figure in parentheses indicate percentage to total.

Factors Influencing Decision to Participate and Intensity of Participation

The results of the double hurdle model are presented in Table 5. The table reveals that age, landholding, distance to market and herd size had a negative and significant effect on the probability of participation. This implies that farmers who are younger are more likely to be members of DCS. Similar result was obtained by Sharma *et al.* (2009) and Bardhan *et al.* (2012) who reported that younger farmers are more enterprising and inclined towards participation in DCSs. The negative relation of participation probability and landholding can be attributed to the possibility of farmers engaging in dairy farming instead of crop cultivation due to less land available at his disposal. Also, as the distance to market increases, the probability of being a member decreases. This result is contradictory to that found by Bardhan and Sharma (2012) who found the relation to be positive. This may be due to poor road conditions in areas far from the market area and therefore procurement of milk poses a problem. The marginal effect of the coefficient for the co-operatives indicates that as the distance to the market increases by 1 km, with other variables at the mean level, the probability of supplying milk to the co-operative decreases by 0.08.

TABLE 5. FACTORS AFFECTING DAIRY FARMER'S PARTICIPATION AND INTENSITY OF PARTICIPATION IN DAIRY CO-OPERATIVES

Variables (1)	1st Hurdle (decision to participate)		2nd Hurdle (intensity of participation)
	Coefficient (Std. Error) (2)	Marginal effects (3)	Coefficient (Std. Error) (4)
1. Age (Year)	-0.033* (0.02)	-0.01	0.924*** (0.308)
2. Education	-0.110 (0.099)	-0.04	1.576 (1.282)
3. Land holding (acre)	-0.578*** (0.199)	-0.23	3.063 (1.939)
4. Distance to market (km)	-0.208*** (0.039)	-0.08	-0.807 (0.529)
5. Dairy farming experience (Year)	0.036 (0.023)	0.01	-0.778*** (0.343)
6. Extension contact	-0.067 (0.254)	-0.03	1.486 (2.73)
7. Herd Size (SAU)	-0.225*** (0.064)	-0.09	0.300 (0.759)
8. Proportion of exotic or crossbred to total milch animal	0.925*** (0.36)	0.37	5.376 (4.143)
9. Milk Production (litres/household/ annum)	0.000*** (0.000)	0.00	-0.002*** (0.000)
9. Technical Efficiency	-0.040 (1.450)	-0.02	48.862** (22.314)
10. Economic Efficiency	-0.438 (1.493)	-0.17	-15.983 (24.301)
Constant	2.522** (1.107)		17.558 (17.149)

***, **, * denotes significance at 1, 5 and 10 per cent level respectively.

Further, dairy farmers with lower herd size tend to participate more in dairy co-operatives. The results of the probit model also shows that proportion of crossbred to total milch animals and household milk production have a positive and significant effect (at 1 per cent) on the decision to participate. The farmers who have a higher proportion of crossbred cows and higher milk production have higher probability to become a member due to surplus milk production.

The results of the truncated regression indicated the factors influencing the extent of participation by members in the DCSs is also shown in Table 5. Age and technical efficiency coefficient were positively related to the proportion of milk sold by the member farmers to DCSs implying that older farmers and also those having relatively higher technical efficient farms sell more of the milk produced to the co-operatives. Experience in dairy farming and milk production had a negative influence on the extent of participation. This suggests that farmers with more experience in dairy farming and those who have higher milk production compared to other member farmers have less probability of selling less quantity of the milk produced to the dairy co-operatives because these farmers with higher milk production tend to diversify their point of sale. This can be attributed as a means to minimise the risk that arises due to frequent bandhs and blockades due to the unstable socio-political situation in the state.

IV

CONCLUSION AND POLICY IMPLICATIONS

In order to reap the benefits of dairy co-operatives, the young and enterprising individuals should be motivated to take up dairying and join the co-operatives. Locally suitable exotic breeds should be popularised and made easily available to the farmers through various measures like artificial insemination. This will also enable higher milk production which positively influence the decision to participate in DCSs. Distance to market negatively influences the likelihood of producers' decision to participate. However, once households decide to join DCSs, this variable does not significantly impact their intensity of participation. The findings suggest that there is utmost need to invest heavily in road infrastructure to effectively link the dairy farmers to the market. Efforts should be made to raise more awareness among farmers about the ways to raise the technical efficiency on their farms through various trainings on dairy farming. Training on milk processing activities may serve as an important tool to counter the risk arising due to unstable socio-political situation of the state which lead to frequent *bandhs* and blockades.

REFERENCES

- Bardhan, D. and M.L. Sharma (2012), "Determinants and Implications of Smallholder Participation in Dairy Co-operatives: Evidence from Uttarakhand State of India", *Indian Journal of Agricultural Economics*, Vol.67, No.4, October-December, pp.565-684.

- Bardhan, D., M.L. Sharma and R. Saxena (2012), "Market Participation Behaviour of Smallholder Dairy Farmers in Uttarakhand: A Disaggregated Analysis", *Agricultural Economics Research Review*, Vol.67, No.4, pp.565-584.
- Charnes, A., W.W. Cooper and E. Rhodes (1978), "Measuring the Efficiency of Decision Making Units", *European Journal of Operational Research*, Vol.2, pp: 429-444.
- Cragg, J.G. (1971), "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods", *Econometrica: Journal of the Econometric Society*, pp.829-844.
- Kumar, R. and A.K. Sharma (1999), "Impact of Dairy Cooperatives on Rural Economy in Nalanda District", *Journal of Dairying Foods and Home Sciences*, Vol. 18, No.2, pp.92-97.
- Meena, G.L. (2008), "Impact of Dairy Cooperatives on the Economy of Rural Households in Alwar District of Rajasthan", Ph.D. Thesis submitted to ICAR-National Dairy Research Institute (Deemed University), Karnal, Haryana.
- National Cooperative Union of India (2007-08), Retrieved from www.indiastat.com
- Sharma, V.P., K. Kumar and R.V. Singh (2009), *Determinants, Costs, and Benefits of Small-scale Farmer Inclusion in Restructured Agrifood Chains: A Case Study of the Dairy Industry in India*, Working Paper No. 2009-02-01, Indian Institute of Management, Ahmedabad, India.
- Singh, K.R. (2012), "Economic Impact of Integrated Dairy Development Project on Rural Households in Meghalaya State", Ph.D. Thesis submitted to ICAR-National Dairy Research Institute (Deemed University), Karnal, Haryana.
- Sirohi, S., D. Bardhan. and P. Chand (2015), "Cost and Returns in Milk Production: Developing Standardized Methodology and Estimated for Various Production Systems", Project Report Submitted to Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India.
- Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*, The MIT Press, Cambridge, MA, U.S.A.