Market Participation Behaviour of Smallholder Dairy Farmers in Uttarakhand: A Disaggregated Analysis[§]

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Abstract

The study has analyzed the factors that determine dairy farmers' choice of marketing channel and to what degree their market choice influence the level of commercialization or market participation in Uttarakhand. The study has used multinomial logit model to ascertain major factors influencing producers' choice of marketing channels, Chow's seminal test to examine differences between data from diverse regions (plains and hills) and a multivariate regression model to assess the level of market participation. The study has revealed that given the right institutional incentives and market infrastructure, marginal and small landholders are capable of scaling-up milk production and hence commercialize their dairy enterprises. The results of multinomial logit analysis have indicated that increase in the scale of milk production would lead a shift away from cooperatives to market as point of first sale. Milk production and extension contact have emerged as the two most important policy variables favourably influencing intensity of market participation. Distance to market has negatively influenced likelihood of producers' market participation, irrespective of hills or plains. Once the households decide to sell, this variable has been found not to significantly impact their level of participation in the plains. However, distance to market has been observed to negatively impact intensity of market participation in the hills.

Key words: Milk market, multinomial logit model, Chow's seminal test

JEL Classification: Q12, Q13, Q18

Introduction

Dairying is an important segment of India's livestock economy accounting for about 67 per cent of value of output from the livestock sector (GoI, 2008). Despite rapid expansion of production and inherent potential in this sector, there is an apprehension whether smallholder milk producers will be able to take advantage of the emerging opportunities. One of the necessary conditions for the farmers to reap economic benefits from this sector is the provision of assured marketing outlets which are sufficiently remunerative to them. In India, inability of smallholder producers to access markets is one of the major limitations in harnessing opportunities in livestock production. Nearly 45 per cent of the milk produced in the country is retained in villages by the rural households and the remaining 55 per cent is marketed. Milk markets are

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largely informal. About two-thirds of the marketed surplus is sold in informal markets. Important players in informal milk marketing system include village and urban consumers, local sweet shops, restaurants and hotels and milk vendors or middlemen. Informal markets are unstable and often exploitative, particularly during the flush production season. Prices are determined arbitrarily, and under-pricing is common during this season. Organized markets, comprising cooperatives and private sector, share the rest and almost in equal proportion.

Dairy Cooperatives are an important component of organized milk markets in India. In spite of the importance of dairy cooperatives, especially for the smallholder producers, milk procurement through cooperatives still remains low. Despite a considerable horizontal expansion of dairy cooperative societies, no significant changes have occurred in the average size and scale of a village level dairy cooperative. Further, the distribution of dairy cooperatives in terms of volumes of milk handled, installed processing facilities and marketing infrastructure is highly skewed in favour of few states. Only four states, viz. Gujarat, Maharashtra, Karnataka and Tamil Nadu, contribute over two-thirds of milk procurement by cooperatives, while their share in total milk production is 24 per cent (Birthal *et al.*, 2006). With increased market liberalization, coordinated systems like corporate sector entry into food retailing business and contract farming are emerging as important forms of vertical coordination. However, these modern marketing systems are mostly concentrated in selected pockets of the country. Further, there are apprehensions about the capability of smallholder producers to participate in market-oriented production systems owing to strict food safety and quality standards that the small-scale farmers have to comply with (Birthal, 2007).

Problem Statement of the Study

Smallholder dairy producers' market participation is low due to many impeding factors like lack of access to market, lack of access to market information, slow technology adoption and inferior infrastructure in rural areas (NDA, 2005). In this context, it is necessary to analyze the factors that influence the ability of smallholder dairy producers to participate more actively in the markets. Such a study also assumes critical importance especially in hilly states like

Uttarakhand which presents unique challenges like small scale of production and difficult terrain. Livestock activity assumes special significance in Uttarakhand owing to small landholdings and limited scope of other livelihoods. Over 80 per cent of rural households own livestock and more than 80 per cent of all livestock species are owned by marginal and small holders. Livestock is thus considered to have high prospects in enhancing the standard of living of the poorest of the poor. Dairying is the prominent sub-sector as milk contributes about 77 per cent of total value from livestock sector.

The previous studies on market participation in the livestock sector have mainly focused on the analysis of factors influencing amount of marketed surplus (Shah and Sharma, 1993; Arora *et al.*, 1998); decision to participate in marketing (Lapar *et al.*, 2003; Bahta and Bauer, 2007) and intensity of market participation (Holloway *et al.*, 1999; Omiti *et al.*, 2007). However, scant attention has been given on analysing the factors that determine dairy producers' choice of marketing channel and to what degree this choice influences the level of commercialization or market participation. The aim of this study was to analyze dairy producers' market participation through application of Chow's seminal test with the following specific objectives:

- To analyze milk producers' market participation behaviour in the hills vis-à-vis plains
- To analyse the major factors influencing milk producers' choice of agencies for sale
- To analyze the determinants of intensity of market participation (percentage output sold).

Methodology

Study Area and Sampling

Out of 13 districts in Uttarakhand, 7 districts were so selected as to cover different agro-ecological, demographic and economic parameters. Then, two villages were selected from each block, randomly. A complete enumeration of all the farmers in the selected villages possessing at least one milch animal was made and the farmers were categorized as landless (0-0.02 ha), marginal (0.02-1.0 ha), small (1-2 ha), medium (2-4 ha) and large (>4 ha) farmers. A sample comprising 20 per cent of total number of farmers holding milch animals from each village was then randomly selected, having representation from all the categories of

households on a proportionate basis. Thus, a total of 244 households were surveyed. However, 20 households whose responses were inconsistent and unreliable, were dropped and thus, 224 households — 121 from the hills and 103 from the plains — constituted the ultimate sample for this study. Table 1 presents the districts and blocks selected in the study along with information on the different parameters associated with each district.

Primary data were collected by personally interviewing the head of households using a well-structured and pre-tested schedule. Information was collected on such parameters as farm and farmer-specific characteristics, institutional factors (like distance to market, access to information and contact with extension functionaries) and marketing behaviour of farmers (agencies to which sold, amount sold, etc.).

Data Analysis

Descriptive Analysis

Descriptive statistics, in the form of means and proportions, were used to analyse household socio-economic data, institutional variables and milk production parameters and marketing practices.

Multinomial Logit Model

In this study, a multinomial logit model (as used by Pundo and Fraser, 2006) was adopted. It not only focuses on the most important decision (whether the household sells or not), but also on the type of marketing channel chosen as point of first sale. Producers in the study area were found to sell milk

mainly to Dairy Cooperative Societies (DCS), directly to consumers and market (comprising hotels, restaurants and sweet shops). The incidence of selling milk to middlemen being rare, a few households who sold milk to middlemen in the plains were merged with the category of households that sold milk to market. To generate dependent variables, the farmers were classified into four groups: (i) those who did not sell, (ii) those who sold directly to consumers, (iii) those who sold to market, and (iv) those who sold to dairy cooperatives. Given the alternatives before a producer, the probability that an individual i chooses alternative j, therefore can be expressed by Equation (1):

$$\Pr[Y_i = j] = \exp(\beta'_j X_i) / \Sigma \exp(\beta'_j X_j) \qquad \ldots(1)$$

where,

$\Pr[Y_i = j]$ = Probability of choosing either not to sell to market, selling directly to consumers, selling to market and selling to dairy cooperatives

j = 0, 1, 2, 3

i = 1, 2, 3, ….. , 224

X_i = Vector of the predictor variables, and

β_j = Vector of the estimated parameters

The e^β were calculated, which gave the odds ratio (OR) associated with change in the independent variable. The odds mean the ratio of probability of happening of an event to probability of not happening of that event. The odds are expressed as single number to the ratio to 1. The odds of 2 associated with market participation for example means that the likelihood of participating in market is twice that of not participating.

Table 1. District-wise households surveyed and estimated parameters* of each district

District	Name of blocks	No. of households	Density of rural population (No./sq km)	Landholdings less than 0.5 ha ('000 No.)	Net sown area/capita (ha)	Crop output/ rural person (tonne)
Almora	Hawalbagh and Takula	24	124	59.3	0.15	0.18
Bageshwar	Garud and Bageshwar	25	112	36.8	0.10	0.18
Dehrahdun	Vikas Nagar and Doiwala	36	162	37.9	0.08	0.15
Tehri	Chamba and Fakot	43	89	34.0	0.10	0.22
Nainital	Ramnagar and Bhimtal	36	122	24.4	0.10	0.22
US Nagar	Rudrapur and Sitarganj	50	298	27.2	0.18	0.71
Champawat	Lohagath and Pati	30	80	17.1	0.11	0.20

*Authors' own calculations

Data source: *Sankhikiya Patrika*, Directorate of Economics and Statistics, Government of Uttarakhand

Chow Test for Difference in Data Set

The determinants of proportion of output sold (taken as a proxy for intensity of market participation) were analyzed with the help of a multivariate linear regression model. Since, the data used in this study were drawn from two regions, hills and plains, Chow's seminal test (1960) was used. Three linear regressions were fitted to constitute the Chow test: one model for the pooled data and two separate models for the hills and plains data. Chow's 'F' value was then computed as follows:

$$F = [\{\Sigma e_p^2 - (\Sigma e_1^2 + \Sigma e_2^2)\}/K] / [(\Sigma e_1^2 + \Sigma e_2^2)/(T-2K)] \quad \ldots(2)$$

where,

Σe_p^2 = Unexplained variation due to pooled regression function,

Σe_1^2 = Unexplained variation due to regression function in hills,

Σe_2^2 = Unexplained variation due to regression function in plains,

T = Total number of observations in whole sample, and

K = Number of regressors (including intercept).

The F-value thus calculated was compared with the respective values of 'F' at 0.05 level of significance with K and (T-2K) degrees of freedom.

The following multivariate linear regression equation was applied to analyze the factors influencing intensity of market participation:

$$Y_i = \alpha + \beta_i X_i + \mu_i \quad \ldots(3)$$

where, Y_i is the percentage of milk output sold, and X_i is the set of explanatory variables. The specific variables used in this study are described in Table 2.

Table 2. Variables considered in the study

Variable	Description	Measurement
Family size	Number of members in a household	Number measured as adult equivalents (2 adult male=3 adult females=4 children
Age	Age of household-head	Number of years
Education	Educational level of household-head	Number of years of schooling completed
Landholding	Size of landholding of household	Hectares (ha)
Milch animal holding	Number of milch animals owned by household	Measured as standard milch animal units (1 indigenous cow = 1.3 buffalo = 1.4 crossbred cow)
Distance to market	Average distance from farm to market of sale	Kilometres
Access to information	Whether has easy access to information	1 = Yes 0 = No
Regular contact with extension functionaries	Whether has regular contact with extension functionaries	1 = Yes 0 = No
Non-farm income	Whether household-head has non-farm income source	1 = Yes 0 = No
Price of milk received	Weighted average price received for each lire of milk normally sold	Rupees (In several instances, milk of different species and breeds like crossbred cow, indigenous cow and buffalo was sold by individual producer. Thus, the weighted average price of milk, taking quantity of each type of milk as weights, was considered in the study).

Results and Discussion

Scale of Milk Production

Table 3 presents important indications about level of commercialization and scale of milk production across different categories of households based on landholding size. The dominance of marginal and small landholders in milk production can be gauged from the fact that about 72 per cent of households owned up to 1 ha of land, but they accounted for about 60 per cent of total annual milk production. On the other hand, about 18 per cent households owned more than 2 ha of land and contributed only one-fourth of milk produced annually. For 34 per cent households, the scale of milk production was less than 1000 litres/annum. These households contributed only 9.5 per cent to the total milk production. On the other hand, only about 5 per cent households produced more than 5000 litres of milk per annum and their contribution to total milk production was 25 per cent. This clearly indicates that dairying in Uttarakhand is predominantly a small-scale phenomenon. Small-scale dairying is more prominent at the lower end of land distribution. About 48 per cent of landless households and 32 per cent of marginal landholders produced less than 1000 litres milk per annum, respectively. About 24 per cent of each of the above household categories produced more than 2000

litres/annum. On the other hand, only 14 per cent of large landholders produced less than 1000 litres/annum. However, for 73 per cent of this land-size category, scale of production was above 2000 litres/annum.

Although scale of milk production was positively associated with land ownership, a substantial proportion of marginal and small landholders carried out dairy activity on commercial lines. Landless households and marginal landholders were predominant at both ends of the spectrum of scale of milk production. Thus, among households producing less than 500 litres/annum, 95 per cent belonged to these two categories (Table 4). However, what is noteworthy is that among households producing more than 5000 litres/annum, 54.5 per cent belonged to landless and marginal household categories. This phenomenon was also observed at the national level by Birthal (2007). Thus, it can be inferred that smallholders are capable of scaling-up dairy production if given the right institutional incentives and market opportunities.

Marketing Behaviour of Milk Producers

Across regions, milk production per household (both annual and daily) was significantly higher in the plains than in hills (Table 5). The average milk

Table 3. Scale of milk production by landholding-size category in Uttarakhand

Particulars	Landless (0-0.02ha)	Marginal (0.02-1ha)	Small (1-2 ha)	Medium (2-4ha)	Large (>4ha)	Pooled
Distribution of milk producing households (%)	18.30	54.02	10.27	7.59	9.82	100
Share in milk production (%)	13.52	46.35	16.58	8.79	14.76	100
Milk production (litres/household/annum)						
Households (%)						
<500	17.07	10.57	0.00	5.88	0.00	9.05
500-1000	31.71	21.14	13.04	23.53	13.64	25.00
1000-2000	26.83	44.72	65.21	35.29	13.64	38.36
2000-5000	21.95	19.51	13.04	29.41	63.64	22.84
>5000	2.43	4.07	8.70	5.88	9.09	4.74
Share in milk production (%)						
<500	3.66	1.91	0.00	0.62	0.00	1.43
500-1000	15.88	9.27	3.27	7.89	3.31	8.17
1000-2000	25.57	38.05	28.36	25.90	5.48	28.88
2000-5000	45.18	31.30	9.34	44.20	67.75	36.05
>5000	9.72	19.46	59.03	21.39	23.46	25.47

Table 4. Participation of smallholders in subsistence and commercial dairy farming

(in per cent)

Landholding category	Milk production (litres/household/annum)				
	<500	500-1000	1000-2000	2000-5000	>5000
Landless	33.33	26.53	12.22	16.36	9.09
Marginal	61.90	53.06	61.11	43.64	45.45
Small	0.00	6.12	16.67	5.45	18.18
Medium	4.76	8.16	6.67	9.09	9.09
Large	0.00	6.12	3.33	25.45	18.18

Table 5. Households' milk production and marketing pattern in hills and plains

(in litres)

Particulars		Plains	Hills	Pooled
Annual milk production***		2541	1470	1962
Average milk production/household/day***		8.4	4.5	6.3
Average milk retained/ household /day**		3.8	3.00	3.4
Average milk requirement/ household /day@		1.5	1.2	1.3
Milk marketed surplus/ household ***		4.8	1.5	3.1
Milk marketed surplus (%)		58.1	34.2	48.5
Proportion of milk producing households selling milk (%)		59.0	44.6	51.3
Proportion of households selling milk to (%)#	Cooperatives	21.3	42.6	31.3
	Direct	36.1	20.4	28.7
	Open market	42.6	37.0	40.0
Proportion of milk marketed through different channels (%)##	Cooperatives	22.8	55.3	33.0
	Direct	16.4	10.6	14.9
	Open market	60.7	34.1	53.7
Average price (₹/litre) received by farmers across different	Cooperatives	14.5	14.5	14.5
marketing channels	Direct	17.2	14.9	16.5
	Open market	17.6	16.4	17.0
Average price received (₹/litre)***		16.7	15.0	15.9

Notes:

Difference in mean values corresponding to plains and hills are significant at ***1 per cent and **5 per cent levels of significance

Corresponding proportions are significantly dependent upon region (plains or hills) at #10 per cent and ##5 per cent levels of significance

@Milk requirement per households calculated as per ICMR recommendations (300 mL/capita/day)

production per household per day was almost double in plains. Consequently, milk retained for household consumption was higher in the plains than hills. The household consumption of milk in plains as well as hills was more than the requirement (estimated as per ICMR recommendations of 300 mL of milk/capita/ day), Arora *et al.* (1998) had also reported, in a study in north-west Uttar Pradesh that households'

consumption of milk exceeded their nutritional milk requirement.

Marketed surplus, in terms of proportion of milk output sold, was significantly higher in plains (58%) than in hills (34%). The proportion of milk-producing households selling milk was also higher in plains (59%) than in hills (45%). Thus, farmers' market participation

– both in terms of percentage output sold as well as proportion of households selling milk – was higher in plains as compared to hills.

For the aggregate sample, market as a point of first sale received patronage from the highest proportion of farmers (40%), followed by dairy cooperatives (31%), and direct selling to consumers (29%). Disaggregated analyses, however, revealed significant differences in producers' preferences for different agencies for sale of milk in the hills and plains. The dairy cooperatives received patronage of more milk-producers in the hills (43%) than in the plains (21%). The proportions of households selling milk to market and directly to consumers were higher in the plains (43% and 36%, respectively) than hills (37% and 20%, respectively). The greater market participation, in terms of proportion of households selling milk, in the plains could be due to more demand for milk, higher per capita income, greater population density, and better market opportunities and infrastructure. The same factors probably explain the significant variations in producers' preference for marketing channels in hills and plains. Because of limited choice in terms of agencies for sale, milk producers in hills mainly relied on cooperatives which offered them an assured point of sale, ensuring regular cash flows. Similarly, due to higher demand and wider choices, reliance of farmers on cooperatives was much less in the plains. Because of greater patronage from milk producers in the hills, cooperatives accounted for the major proportion (55%) of milk marketed. On the other hand, the major proportion (61%) of milk sold in the plains was channelized through open market.

There was no difference in price of milk offered by the cooperatives in the hills and plains, but it was lower than that offered by other agencies. The fact that a small proportion of households sold milk to the cooperatives than to other channels in the plains ensured that the average price received by the producers in the plains was significantly higher than in the hills. The lower price received by the farmers could also explain the lower intensity of their market participation (proportion of output sold) in the hills.

Characteristics of Milk Producers

The proportion of milk output sold depends upon several factors, viz. farm and farmer-specific variables (e.g., family size, age, education, resource ownership like land and animal holding) and transaction cost variables (e.g., distance to market, information costs). The analysis of transaction cost variables is important as these costs are the embodiment of access barriers to market participation by resource-poor smallholders (Randela *et al.*, 2008). Table 6 provides information on these crucial aspects. The average family size (5 adult equivalents) was significantly higher in the plains than in hills (4 adult equivalents). Farmers in hills, on average, had significantly higher education than their counterparts in the plains. As is obvious, the average landholding per household was significantly higher in plains (2.54 ha) than in hills (0.40 ha). Households in the plains owned a larger number of milch animals (3 standard milch animal units) than in the hills (2 standard milch animal units). Even the main occupation pursued by the respondents was dependent upon region (plains/hills).

A higher proportion of farmers pursued agriculture or worked as agricultural labourers in the hills (68% and 18%, respectively) than in the plains (58% and 13%, respectively). Animal husbandry was being pursued as the main occupation by only 6 per cent of the sample households. The proportion of producers pursuing dairying as the main occupation was higher in plains (11%) than in hills (2%). A larger number of producers in plains had a non-farm income source than their counterparts in the hills. Distance to market – considered as a proxy for transaction cost – was higher in hills than in plains. Although, there was no difference in producers' intensity of contact with extension functionaries in the hills and plains, households in plains had a better access to information than in the hills. This implies that institutional impediment to producers' market participation was substantially more in the hills as compared to in plains. This explains the low level of market participation by producers in the hills.

Factors Affecting Market Participation and Choice of Marketing Channel

Table 7 provides the findings of the multinomial logit regression analysis. The variables significantly associated with no market participation (decision not to sell) were age, landholding size, distance to market and quantum of milk production. The lack of statistical significance of the regional variable coefficient implied that location of households – whether in hills or plains

Table 6. Socio-economic characteristics of milk producers in plains and hills of Uttarakhand

Particulars		Plains	Hills	Pooled
Family size (adult equivalents)/household***		4.88	4.01	4.40
Age (years)^{NS}		48.48	47.73	48.07
Farm experience of household-head (years completed)*		31.12	34.49	33.05
Education of household-head (No. of schooling years)***		6.32	8.63	7.59
Landholding/ household (ha)***		2.54	0.40	1.37
No. of milch animals/ household	Buffalo	1.08	0.76	0.90
	Crossbred cattle	0.90	0.33	0.59
	Non-descript cattle	0.27	0.31	0.29
	Standard Milch Animal Units***	2.94	1.86	2.36
Main occupation of HH head (%)#	Agricultural labour	12.75	18.18	15.70
	Agriculture	57.84	67.76	63.23
	Animal husbandry	10.78	1.65	5.83
	Business	9.80	1.65	5.38
	Services	8.82	10.74	9.87
Distance to market (km)***		3.86	5.04	4.5
Whether has easy access to information (Yes=1/No=0)***		0.90	0.76	0.82
Whether has regular contact with extension functionaries (Yes=1/No=0)^{NS}		0.66	0.61	0.63
Non-farm income (Yes=1/No=0)**		0.25	0.14	0.19

Notes:

Difference in mean values corresponding to plains and hills are significant at ***1 per cent, **5 per cent and *10 per cent levels of significance

Corresponding proportions are significantly dependent upon region (plains or hills) at 1 per cent level of significance

– had no influence on their decision to sell milk. The likelihood of decision to sell declined with increase in age, landholding size and distance to market. This implies that younger producers were more inclined towards market participation than their elder counterparts. With increase in landholding-size, dependence on dairying as a supplementary source of income decreases. This probably explains the negative influence of landholding size on decision to sell milk. The odds ratio indicated that with each additional unit increase in age and landholding size, the likelihood to participate in market decreased by 3 per cent and 20 per cent, respectively. Distance to market, as expected, significantly reduced the likelihood that producers will sell milk. Distance acts as a barrier to market participation by imposing transaction costs, and thus this finding emphasizes upon the need of providing producers easy access to markets in terms of better infrastructural facilities, like road network. As expected, the level of milk production had a positive influence on market participation. The likelihood of participating in the market increased by 42 per cent with each additional unit increase in milk production.

Distance to market significantly and positively increased the likelihood that a milk producer will sell to a dairy cooperative, while its influence on choice of other marketing channels was not significant. This implied that with increase in distance to market, farmers preferred to sell to dairy cooperative societies in their villages or in nearby villages, rather than selling to market and incurring higher transportation costs. Age seemed to significantly reduce the likelihood that a producer will sell to a cooperative, implying that as age advances, producers shift away from cooperatives towards other marketing channels.

Regular contact with extension functionaries had a significant influence on the likelihood that a milk producer will sell to a cooperative (irrespective of hills or plains). The sign of the regression coefficient of this variable was positive, implying that producers mostly had contact with extension functionaries who were from cooperatives. Bahta and Bauer (2007), in a study in South Africa, had also reported that extension visits significantly increased the probability that a small-scale farmer will sell his/her livestock. Increase in landholding-size decreased the probability that a

Table 7. Factors affecting dairy farmers' market participation and choice of marketing channel

Variable	No Participation		Direct		Market		Cooperative	
	β	Odds ratio	β	Odds ratio	β	Odds ratio	β	Odds ratio
Constant	2.610		1.315		-4.060***		-4.469	
	(1.207)		(1.314)		(1.363)		(1.637)	
Family size	0.047	1.048	-0.023	0.977	-0.146	0.864	0.300**	1.349
	(0.097)		(0.100)		(0.117)		(0.126)	
Age of household-head	0.030*	1.030	-0.025	0.976	0.004	1.004	-0.052**	0.949
	(0.016)		(0.019)		(0.016)		(0.021)	
Education of household-head	0.067	1.069	-0.080	0.923	0.037	1.038	-0.061	0.941
	(0.045)		(0.051)		(0.047)		(0.056)	
Landholding size	0.183*	1.201	-0.362*	0.696	0.029	1.030	0.217**	1.243
	(0.100)		(0.186)		(0.074)		(0.088)	
Distance to market	0.103**	0.902	0.003	1.003	0.006	1.006	0.192***	1.212
	(0.053)		(0.065)		(0.057)		(0.056)	
Access to information	-0.585	0.557	0.733	2.081	-0.156	0.856	-0.873	0.418
	(0.575)		(0.697)		(0.668)		(0.845)	
Regular contact with extension functionaries	-0.661	0.517	-0.582	0.559	0.726	2.067	2.167***	8.734
	(0.423)		(0.480)		(0.527)		(0.754)	
Milk production	-0.540***	0.583	-0.004	0.996	0.118***	1.125	0.042	1.043
	(0.089)		(0.030)		(0.039)		(0.028)	
Non-farm income	-0.276	0.759	-0.196	0.822	1.348**	3.848	0.236	1.267
	(0.423)		(0.494)		(0.677)		(0.634)	
Region	0.001	1.001	1.161**	0.313	-0.115	0.891	-1.841***	6.306
	(0.460)		(0.511)		(0.487)		(0.669)	
Correct prediction (%)	78.83		84.30		81.98		86.94	
-2 log likelihood	200.363		164.086		183.414		142.866	
Cox & Snell R²	0.383		0.111		0.156		0.192	
Nagelkerke R²	0.511		0.194		0.247		0.333	
McFadden R²	0.349		0.138		0.170		0.248	

Notes: Significant at ***1 per cent, **5 per cent and *10 per cent levels of significance

Figures within the parentheses indicate standard errors

producer will sell directly to consumer and increased the likelihood of selling to a cooperative. Bernard *et al.* (2007), in a study in Ethiopia, had also reported that poorer households are less likely to participate in dairy cooperatives. The positive influence of landholding-size on the choice of cooperative as a point for first sale has important policy implications, as this indicates that participation in and selling milk to dairy cooperatives was not uniform across all land-size categories. There was a greater inclination on the part of large landholders to participate in cooperatives than their marginal and small counterparts.

Milk production, as an important policy variable, significantly and positively influenced the likelihood that a producer will choose market as point of first sale. This implies that with increased scale of production, producers preferred to sell to market, probably because of offer of higher price as compared to by cooperatives. The variable region had a significant influence on the likelihood that a producer will sell directly to consumers or to a cooperative. While in the case of former, the effect was positive, it was negative in the latter. This implies that there was a tendency on the part of producers in plains to shift away from cooperative to other agencies for sale. This is consistent with the findings of descriptive analyses earlier, where it was observed that a higher proportion of producers in hills sold to cooperatives than in plains. The analysis, thus, has identified milk production, distance to market and extension contact as the important policy variables which influence producers' market participation and also choice of agencies for sale. These variables can

hence be used as policy instruments to enhance producers' likelihood of market participation.

Factors Affecting Intensity of Market Participation

The computed test statistic (F*) – from the Chow test — was greater than the respective F-statistic at 5 per cent level of significance, implying that the two sub-samples (producers in hills and producers in plains) were significantly different with respect to the parameters of the regression equations fitted to analyze the determinants of proportion of output sold. This is the statistical evidence which justifies the decision to estimate separate models for the sub-samples and even make a comparison with the results of the whole sample analysis.

Table 8 reports the results of multivariate linear regression analysis performed separately for the subsamples – hills and plains – as well as that of the whole sample. Milk production and regular extension

contact significantly and positively influenced the percentage output sold in both hills and plains. Both these variables are policy variables and the estimates of responses of these variables in this analysis suggest that they can be used as policy instruments to increase intensity of producers' market participation. The significant and positive influence of milk production on marketed surplus of milk was also reported by Shah and Sharma (1993), Arora *et al.* (1998), Magingxa and Kamara (2003), and Omiti *et al.* (2007; 2009). A positive and significant impact of visits by extension agents on the percentage of milk output sold was earlier reported by Holloway *et al.* (1999).

Price received for milk had a insignificant influence on the percentage output sold in both the hills and plains. However, the 't'-value associated with this parameter was substantially higher in the hills than in the plains. This provides indications that percentage output sold was probably more responsive to price in the hills and hence, price as a policy instrument could

Table 8. Factors influencing intensity of market participation in plains and hilly regions of Uttarakhand

Variable	Plains		Hills		Pooled	
	β	't'	β	't'	β	't'
Intercept	0.565 (0.210)	2.689***	0.770 (0.222)	3.473***	0.602 (0.150)	4.015***
Family size	-0.003 (0.011)	-0.308	-0.018 (0.019)	-0.965	2.342E-03 (0.010)	0.041
Education of household-head	-0.001 (0.005)	-0.249	-0.002 (0.008)	-0.242	-0.003 (0.004)	-0.784
Age of household-head	-0.003 (0.002)	-1.210	-2.59E-03 (0.002)	-0.131	-0.001 (0.002)	-0.955
Landholding size	-0.002 (0.006)	-0.324	0.014 (0.043)	0.328	0.001 (0.006)	0.185
Distance to market	0.007 (0.007)	0.976	-0.013 (0.008)	-1.593*	0.007 (0.005)	1.429
Milk production	0.004 (0.002)	2.363**	0.014 (0.007)	2.157**	0.006 (0.002)	3.735***
Price of milk received	0.003 (0.009)	0.275	0.016 (0.012)	1.365	-0.002 (0.007)	-0.351
Non-farm income	0.008 (0.058)	0.145	-0.061 (0.084)	-0.726	-0.028 (0.048)	-0.592
Access to information	-0.023 (0.076)	-0.306	0.047 (0.083)	0.571	-0.020 (0.056)	-0.363
Regular extension contact	0.132 (0.059)	2.244**	0.148 (0.073)	2.020**	0.008 (0.046)	0.178*
R²	0.271		0.336		0.163	

Notes: Figures within the parentheses indicate standard errors

Significant at ***1 per cent, **5 per cent and *10 per cent levels of significance

be more effective in increasing the producers' commercialization level in the hills than in the plains. However, the lack of significance of the regression coefficient suggests that this inference should be taken with a certain degree of caution.

Distance to market had a significant influence on the percentage output sold only in the case of hills. The negative influence suggested that producers' intensity of market participation decreased with increase in distance from the market. Thus, it could be inferred that distance to market acts as a bigger barrier to market participation, in terms of imposition of transaction costs - in the hills than in plains. Marketing of agricultural produce in the hills becomes an uphill task due to secluded, inaccessible, remote and difficult hilly terrain and lack of roads (Thakur *et al.*, 1997). Thus, distance to market probably becomes a more important determinant of intensity of market participation in the hills than in plains.

To sum-up, the disaggregated analysis has revealed that producers' intensity of market participation was affected by almost the same set of variables (milk production and contact with extension functionaries) in both hills and plains. The benefit of Chow test in this study has been to capture the effect of one important factor (distance to market), which would have been otherwise ignored if pooled sample model was used. This finding emphasizes on the need for region-specific strategy to facilitate producers' increased market participation. Further, the estimates of responses to these variables, viz. milk production, contact with extension functionaries and price are important as these variables are likely to be affected by policy.

Conclusions

The study has revealed that marginal and small landholders figure prominently at the higher end of scale of milk production spectrum. This implies that given the right institutional incentives and market infrastructure, they are capable of scaling-up milk production and hence commercialize their dairy enterprises. Further, there is potential to increase the level of commercialization of dairy producers as the amount of milk retained by milk producing households is in excess of prescribed ICMR limits. Producers' level of market participation is significantly higher in the plains than in hills. The price received by milk producers varied according to the agency to which sold

and region (plains or hills), where sold. The unit price received was highest when sold to market and lowest price was offered by cooperatives. Average price received was higher in plains than in hills. Region (hills/plains) exerted no significant influence on the likelihood that a producer will sell milk or not. However, distance to market, as a barrier to market participation, reduced the likelihood that producers will sell milk.

Cooperatives play a more important role in milk procurement in the hills than in plains. Even though the mandate of dairy cooperatives has always been to organize and link smallholders remuneratively to market, the findings of this study have revealed a definite tendency towards participation in cooperatives, increasing with size of landholdings. Increase in scale of milk production on the other hand has led to a shift away from cooperatives to market as point of first sale. The above findings imply that cooperatives did not provide enough incentives – especially in terms of price offered – to transform smallholder dairying from subsistence to a more commercially-oriented enterprise.

Milk production and extension contact have been identified as the two most important policy variables favourably influencing intensity of market participation and hence can be used as policy instruments in enhancing producers' level of commercialization. Some indications emerged that percentage output sold is more responsive to price in the hills than in plains and hence price as a policy instrument would probably be more effective in enhancing producers' market orientation in the hills. Distance to market negatively influences the likelihood of producers' decision to sell, irrespective of region. However, once households decide to sell, this variable does not significantly impact their level of participation in the plains. On the other hand, distance to market has been observed to negatively impact intensity of market participation in the hills. The findings suggest that there is a dire need to invest heavily in road network in the hills to effectively link the smallholder producers to market.

To sum-up, two sets of policy interventions are being suggested. First, it is necessary to enhance collaboration between extension service providers and farmers. This will enable uptake of improved dairy technologies which in turn will enhance scale of milk production and contribute to increased marketable

surplus. Second, it is required to invest in physical infrastructure like roads, storage and milk processing facilities. It is necessary not only because milk is a highly perishable commodity, but also to tap the commercial potential of excess amount of milk retained by the households.

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