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Research note

Determinants of dairy farmers' choice of marketing channels in Bihar, India[§]

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Abstract In the past one and half decade, milk production in Bihar has increased substantially, from 2.7 million tons in 2001-02 to 8.7 million tons in 2016-17 lifting the per capita daily milk availability in the state from 88g to 228g. However, dairy sector is dominated by small farmers, and because of their small scale they are forced to sell milk to informal buyers who often exploit them by paying less than the market price. This paper analyses farmers' sale pattern of milk and identifies factors influencing their choice of market channels. Results indicate that small farmers prefer selling milk directly to consumers because of the higher offer prices and nearness to the production centres. Large and educated farmers sell to formal buyers. However, if the payments from formal buyers are delayed, farmers tend to switch over to informal buyers. The likelihood of selling to informal buyers increases if farmers find it difficult to sell directly to the consumers located far away from the production centres.

Keywords Smallholder dairy producers, Market choice, Determinants

JEL classification C01, E21, E23, Q13

1 Introduction

India's dairy sector witnessed substantial growth in the past one and half decade. Milk production almost doubled, from 84.4 million tons in 2001-02 to 165.4 million tons in 2016-17 (GoI 2006; 2017), causing a sustained rise in the availability of milk and milk products for the growing population. The per capita daily availability of milk increased from 225g in 2001-02 to 355g in 2016-17. However, due to lack of access to remunerative markets, a large proportion of milk is marketed through informal channels, depriving farmers of the benefits of expanding demand for milk and milk products.

The milk marketing system in Bihar is no different. In the past one and half decade, milk production in Bihar has increased tremendously, from 2.7 million tons in 2001-02 to 8.7 million tons in 2016-17, tripling the

per capita daily milk availability in the state from 88g to 228g. However, it is still far below the national average of 355g (GoI 2006; 2017). Due to lack of efficient marketing systems, small dairy farmers are forced to sell their produce in informal markets that are dominated by middlemen who often pay farmers less than the market price. Some studies have examined milk marketing system in Bihar (Kumar 2010), but these have not identified the factors that influence farmers' choice of market channels. This paper fills this gap, and maps channels for milk through which farmers dispose it. Besides, it identifies factors that influence dairy farmers' choice of market channels.

2 Data and Methodology

2.1 Data

This study is based on primary data collected from dairy farmers of three districts, viz. Samastipur, Katihar and Nawada in Bihar, India (figure 1). The selection of the districts is guided by the intensity of dairying activity and the type of milk disposal channels.

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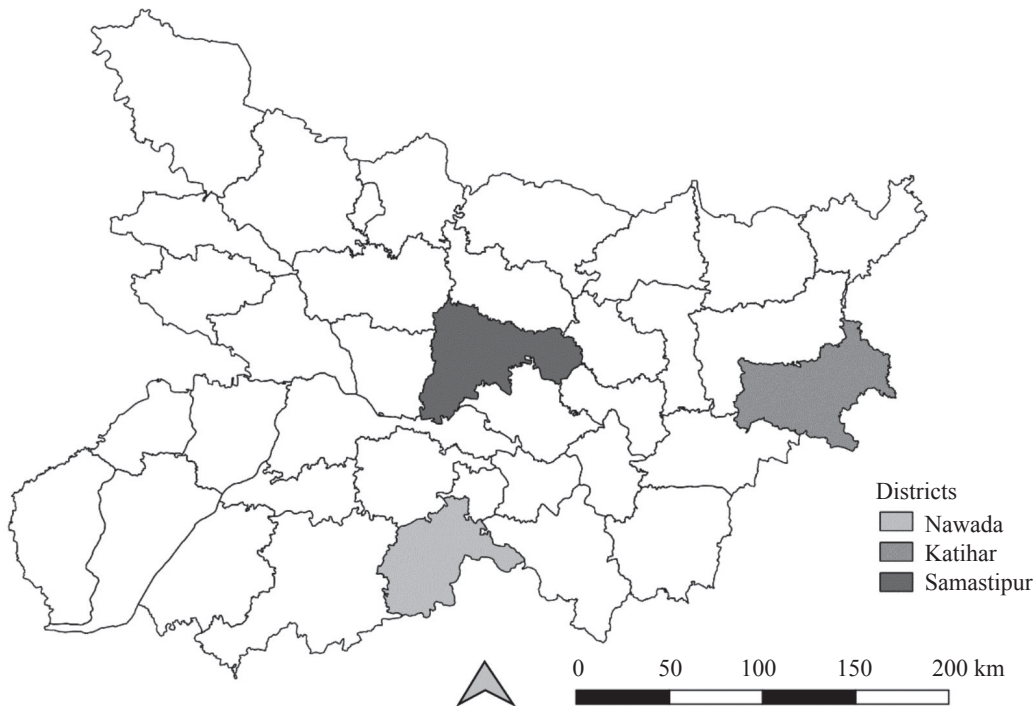


Figure 1. Location map of surveyed districts of Bihar

Source: Survey of India.

Average landholding size in Samastipur is smaller than in other districts, but dairying is practiced intensively and is based on crossbred cows (table 1). Milk yields are higher, and milk market is dominated by formal buyers, mainly Bihar State Milk Co-Operative Federation Ltd. (COMFED). In Katihar, dairying is dominated by local cows with a small proportion of crossbred cows. Farmers dispose their produce through informal channels (raw milk traders and milk product processors (sweet shops, tea shops etc.)). Buffaloes dominate the milk production structure in Nawada, but milk market is highly fragmented.

At the next stage of sampling, two blocks from each district and two villages from each block were selected randomly. From each village a sample of 20 dairy farm households was drawn randomly, making a total sample of 240 households. The respondents were surveyed using direct questionnaire method. The survey instruments were tested before undertaking the survey. The survey was conducted in January-February 2013.

2.2 Method

Multinomial logit model (MLM) is applied to identify factors influencing farmers' choice of milk marketing

channels. Multinomial logit model is used when the dependent variable is categorical representing more than two categories. Each category is compared with the reference category (Jobson 1992; Lesschen et al. 2005; Kumar et al. 2007).

There are three channels through which farmers dispose of their produce: (i) direct sales to consumers, (ii) informal buyers, like raw milk traders/raw milk processors (sweet shops, tea shops), and (iii) formal buyers, mainly the Bihar State Milk Co-Operative Federation Ltd. (COMFED). The factors that are expected to influence the choice of market channels include the age and education level of the household-head, number of family workers, operational size of landholding, quantity of milk produced, milk price, milk tests (e.g., lactometer, fat, SNF and boiling) to check milk quality, time duration of receiving payment, distance to the sale point, contract with buyer and support services received. The multinomial logistic regression for the choice of a channel can be written as:

$$P(Y_i = j) = e^{\beta_j X_i} / \sum_{k=0}^2 e^{\beta_k X_i} \quad j = 0, 1, 2 \quad \dots(1)$$

Where, Y_i is the probability of household participation in market channel, j is the indicator variable of market

Table 1. Key characteristics of the districts, 2011-12

	Nawada	Katihar	Samastipur
Urban population (%)	2.1	8.9	3.5
Area (sq. km.)	2494	3057	2904
Population density (No./sq.km.)	890	1005	1465
Male literacy (%)	70.0	59.4	73.1
Female literacy (%)	48.9	44.4	53.5
Average size of landholding (ha)	0.39	0.49	0.28
Net area sown (000 ha)	92.5	168.5	163.8
Gross cropped area (000 ha)	107.2	192.1	165.0
Gross cropped area irrigated area (%)	64.2	73.9	9.6
Cropping intensity (%)	115.9	114.0	100.7
Breedable female livestock ('000)			
Crossbreed cows	13.1	11.5	245.7
Local cows	108.5	245.6	16.2
Buffaloes	65.6	46.8	132.0
Milk production (lakh kg)			
Crossbreed cows	65.2	23.2	1855.5
Local cows	751.7	806.9	427.7
Buffaloes	640.6	172.1	928.4
Veterinary hospitals and dispensaries (No.)			
Hospitals	1	1	1
Dispensaries	23	22	32

Source: GoI 2011 & GoB 2012.

channel (0=formal channel, 1=direct to consumer and 2=informal channel), X_{is} denotes the vector of explanatory variables and β_s are the regression coefficients estimated by the maximum likelihood method. The base category here comprises of the households selling milk to formal channels. The specification and measurement of these explanatory variables have been explained in the section on results and discussion. The interpretation of coefficients is less straightforward in the multinomial logit model. Usually, a positive coefficient on the independent variable is associated with a greater probability of its positive influence on the dependent variable. However, the marginal effects of the explanatory variables on the probabilities are not equal to the regression coefficients. Further calculations are required to estimate the marginal effects of the explanatory variables.

$$\delta p(Y) / \delta X_i = \beta X_i * \exp [z] / [1 + \exp(z)]^2 \quad \dots(2)$$

The estimating equation provides an estimate β_s of the effect of the determinants X_i on the market channel Y.

Where, z is the sum of coefficients multiplied by the means of the respective variables plus the constant term.

3 Results and discussion

3.1 Milk production and yield

Scale of production plays an important role in the choice of a market channel. The average milk production is 3.9 litre/day/household (table 2). It, however, varies across districts. In Samastipur, where dairying is comparatively a developed activity, average milk production is 5.9 litre/day/household; more than double of that in other two districts. Likewise, milk yield is also higher in Samastipur. Cooperatives comprise the most important market channel in this district, indicating that markets do act as catalyst in improving milk yield.

3.2 Choice of market channel

To understand the choice of market channel, it is necessary to consider the uses of milk at the household

Table 2. Milk production, yield, milk use, production, sales and sales by type of buyer, 2013

	□	Nawada	Katihar	Samastipur	All
Average milk production and yield	Milk production (kg/day/hh)	2.8	2.8	5.9	3.9
	Yield (kg/day/animal)	2.6	2.0	4.8	3.1
Milk use (%)	Sold	22.7	46.4	69.7	46.4
	Consumed	76.8	52.1	29.0	52.5
	Processed	0.5	1.4	1.3	1.1
Households producing and selling milk (%)	Producers	87.5	87.5	88.8	87.9
	Sellers	33.8	52.5	80.0	55.4
Milk sales by type of buyer (%)	Consumer	59.0	17.0	8.5	15.8
	Informal	41.0	83.0	1.9	26.4
	Formal	0.0	0.0	89.6	57.8

Source: Field survey.

level. In Nawada, 77% of the milk produced is consumed within the households, leaving only a small quantity to be marketed (table 2). In contrast, in Samastipur 70% of the milk produced finds way to markets. Milk processing at household level is negligible in all the districts.

Table 2 also presents proportion of households producing and selling milk. Of the total households, close to 88% had in-milk animals at the time of survey, and this ratio is almost similar across the districts. As expected, the proportion of farmers selling milk is much higher in Samastipur than in other two districts. These findings clearly indicate that commercialization of dairying is closely associated with demand for milk and milk products.

Table 2 also shows surplus milk marketed to different buyers. Milk market in the low-producing Katihar is dominated by informal buyers and 83% of milk is sold to them while it is the formal buyers such as dairy cooperative that dominate the high-producing Samastipur. In Nawada, 59% of the surplus milk is sold directly to consumers, and the rest is sold to informal buyers, such as sweet shops and tea stalls nearer to the production points. Milk vendors are not an important channel in this district.

3.3 Determinants of choice of channel

The descriptive statistics of the variables used in estimating the multinomial logit model is presented in table 3. The age of the household decision-maker is treated as proxy for the experience of the household that is expected to influence the choice of milk-market

channel. The more experienced farmers can switch from one channel to another depending on the market conditions. Likewise, more educated farmers are expected to have a greater probability of accessing the formal market channels. Further, we expect that the household with more number of workers prefer selling milk to informal channels. Likewise, the households with larger landholdings have less probability of participation in an informal market channel.

The variables related to scale of milk production and sale, milk price, milk tests, payment duration, distance to selling point, contract with market channel and support services provided by buyers are expected to exert a greater influence on dairy farmers' participation in a particular channel.

Table 4 presents results of the multinomial logit regression. The base category that we chose is the formal channel. The coefficient on milk price is positive and significant in the case of direct sales to consumers, indicating that dairy producers are price sensitive and prefer selling milk directly to consumers because of the higher prices from them. However, those with larger scale of production choose to sell to formal buyers probably because of the assured offtake of produce. It could be argued that small dairy producers try to maximize their profitability by selling directly to consumers, but if the consumers are located at a distance, then they are more likely to sell milk to formal buyers because selling in distant urban consumers is costlier than selling at door-step to formal buyers. If the duration of payment is higher, which is likely in the case of formal channels, then they switch from formal to other market channels. Further, if milk is

Table 3. Descriptive statistics of variables by market channels, 2013

	Consumer	Informal channel	Formal channel	All channels
Age of head (years)	48.60 (14.20)	50.00 (11.07)	49.66 (13.53)	49.43 (12.98)
Education of head (years)	3.98 (3.90)	3.37 (4.47)	6.31 (4.43)	4.68 (4.45)
Workforce (15-59 years, number)	5.26 (10.31)	3.88 (2.40)	3.89 (1.84)	4.31 (6.01)
Female labour (%)	26.72 (29.49)	22.12 (31.50)	26.17 (32.62)	25.10 (31.20)
Cultivated land (acres)	1.11 (0.94)	1.15 (1.74)	1.80 (1.90)	1.39 (1.63)
Milk production (litres)	792.53 (569.30)	851.03 (675.71)	2,089.50 (1,630.39)	1,319.50 (1,285.44)
Milk price (Rs. /litre)	20.50 (2.50)	19.13 (2.48)	18.89 (1.82)	19.47 (2.35)
Milk tests (yes=1, no=0)	0.18 (0.39)	0.73 (0.45)	0.93 (0.25)	0.64 (0.48)
Payment duration (days)	24.48 (10.75)	21.45 (13.12)	21.49 (9.24)	22.41 (11.03)
Distance to sell point (km)	0.10 (0.35)	0.35 (0.99)	0.73 (0.81)	0.42 (0.81)
Contract (yes=1, no=0)	0.16 (0.37)	0.39 (0.49)	0.20 (0.40)	0.24 (0.43)
Benefits from services (Rs.)	1.20 (8.49)	0.00 (0.00)	20.25 (35.58)	8.09 (24.33)

Source: Field survey.

Note: Figures in parenthesis show the standard deviation of variables.

tested for its quality, then farmers do not choose consumers and informal channels. One of reasons for this could be that quality milk fetches higher price from formal channels and these also provide an assured market to farmers.

Relatively older household-heads prefer sales to informal channels. However, the household-head with higher level of schooling prefer selling to formal channels. On the other hand, the households with a higher endowment of workforce prefer direct sales to consumers and informal channels. This is expected because of low opportunity cost of excess labour. The coefficient on landholding size is negative suggesting that the households with larger landholdings prefer formal channels over other channels for disposal of their produce.

Table 5 presents the average marginal effects associated with choice of market channels. The probability of choosing direct sales to consumers decreases by 0.42%

with a one-unit increase in the age of household-head. Similarly, the household-heads with higher education are less likely to use consumer channel for disposal of their produce. The probability of using consumer channel increases by 5.1% for a 1% increase in milk prices.

On the other hand, if milk sale undergoes quality tests then the probability of selling milk directly to consumers declines by 25%. Also, in case the distance of selling point increases by one unit, the probability of selling milk directly to consumers goes down by 29%. The time duration of receiving payments does not have much influence on the choice of the channel.

The average marginal effect associated with informal marketing channel shows that if milk sales undergo a quality milk test then the probability of sales to this channel decreases by 13%. Likewise, if the distance of selling point increases by one unit the probability of using this channel is 20%.

Table 4. Multinomial logistic regression, 2013

	Consumer		Informal	
	Coefficient	Standard error	Coefficient	Standard error
Age of head (years)	-0.1710**	0.0807	-0.1369*	0.0800
Education of head (years)	-0.5827**	0.2492	-0.5153**	0.2483
Workforce (number)	1.0348**	0.5151	0.9630*	0.5057
Female labour (%)	-0.0282	0.0212	-0.0330*	0.0201
Cultivated land (acre)	-1.6962**	0.8675	-1.6248*	0.8530
Milk production (litres)	-0.0008	0.0011	-0.0005	0.0010
Milk price (Rs. /litre)	1.2156***	0.4829	0.7002	0.4678
Milk tests (yes=1, no=0)	-6.2038***	2.2503	-3.6695*	2.2079
Payment duration (days)	0.1412**	0.0725	0.1058	0.0708
Distance to sell point (km)	-5.2533***	1.8729	-2.0455**	0.9706
Contract (yes=1, no=0)	-0.6493	1.5361	-0.1329	1.4746
Benefits from services (Rs.)	0.0268	0.0264	-0.5511	105.0819
District dummy				
Nawada=1, otherwise=0	34.4164	2016.9600	35.7433	2016.9590
Katihar=1, otherwise=0	11.5876***	4.3558	12.4535	4.1751
Constant	-12.4232	8.9803	-5.8682	8.9994
Number of Observation	153			
LR chi2(28)	232.74			
Prob > chi2	0			
Pseudo R2	0.70			
Log likelihood	-50.51			

Source: Estimated by author based on field survey data.

Note: ***significant at 1%, **significant at 5% and *significant at 10%.

The base category is the formal channel.

Table 5. Average marginal effect of multinomial logit, 2013

	Consumer		Informal		Formal	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Age of head (years)	-0.004**	0.002	0.000	0.002	0.004**	0.002
Education of head (years)	-0.011*	0.007	-0.003	0.008	0.014***	0.005
Workforce (number)	0.016	0.013	0.010	0.013	-0.026**	0.012
Female labour (%)	0.000	0.001	-0.001	0.001	0.001*	0.000
Cultivated land (acre)	-0.023	0.022	-0.021	0.023	0.044**	0.019
Milk production (litre)	0.000	0.000	0.000	0.000	0.000	0.000
Milk price (Rs. /litre)	0.051***	0.017	-0.027	0.017	-0.024**	0.011
Milk tests (yes=1, no=0)	-0.254	0.050	0.129**	0.053	0.125***	0.047
Payment duration (days)	0.004	0.003	-0.001	0.003	-0.003*	0.002
Distance to sell point (km)	-0.294**	0.127	0.204*	0.114	0.089***	0.028
Contract (yes=1, no=0)	-0.045	0.063	0.036	0.064	0.009	0.038
Benefits from services (Rs.)	0.043	7.770	-0.052	9.449	0.009	1.679
District dummy						
Nawada=1, otherwise=0	0.271	21.634	0.669	32.236	-0.940	53.869
Katihar=1, otherwise=0	0.060	0.084	0.263***	0.073	-0.323***	0.064

Source: Estimated by author based on field survey data.

Note: ***significant at 1%, **significant at 5% and *significant at 10%.

In contrast, the probability of choosing formal channel increases by 0.36% with a one-unit increase in the age of the household-head, and 1.4% with his level of education. The probability of choosing a formal channel, however, increases by 3.36% with one-unit increase in landholding size, and declines by 2.6% with increase in number of workforce in the family.

The probability of disposing milk through formal channels decreases by 2.37% with a 1% increase in milk prices in the wet market. While the compliance with food safety standards increases the probability of farmers' participation in formal market by 12.5%. Likewise, the probability of choosing formal channels increases by 8.9% with increase in the distance of selling point.

4 Conclusions

In this paper, we have tried to understand the determinants of dairy farmer's choice of milk marketing channels. Our results indicate that commercialization of dairying is closely associated with the demand for milk and milk products. Milk market in low-producing districts is dominated by direct sales to consumers while it is the formal buyers that dominate the milk market in high-producing districts.

Our results show that household-heads with more experience and higher education prefer to sell their produce through formal channels. On the other hand, the household with a larger workforce tend to sell directly to consumer and/or to informal channels. The coefficient on landholding size is negative suggesting that the households with larger landholdings prefer formal channels over other channels for sale of their produce. High milk price is an important factor for dairy farmer's for choosing direct sales to consumer. Dairy farmer's choice to sell to formal channel increases if consumer or informal channel use milk quality tests. It is evident from the paper that improving formal markets may create competition among buyers, that may encourage farmers produce more and realize better prices.

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