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An economic analysis of milk production in Bihar

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ABSTRACT

Dairy farming has emerged as an important source of livelihood, particularly on small holder households. The efficient management of dairy cooperative system has facilitated milk production and marketing in Bihar. An attempt was made to analyze the milk contribution to dairy co-operative, producers' share in consumer rupee and cost of milk production in Bihar. Per litre cost of milk production varied from ₹ 10.12 for crossbred cows to 13.90 and ₹ 13.57 for buffalo and local cows, respectively, which are higher than price paid by co-operatives for standard milk (fat-6% and SNF-21%). Herd size and type of milch animal along with parity had significant influence on cost of milk production. Production cost is likely to decrease with increase in size of unit and in production of crossbred cows in herd. More than two-third of milk produced by co-operative members is marketed through dairy co-operatives in Bihar. The producers' share in consumer rupee is about 58% for all categories of herd since all are marketing their milk through co-operatives only. Dairy farmers should also be advised for meeting the requirements of feed by providing desired nutrients through feeding of green fodder which not only reduces intake of concentrates but also helps in reducing the cost of production. Treatment of dry fodder with urea helps in improving its nutritive value, and such technologies may be popularized to make feeding balanced and cost effective.

Key words: Cost of milk production, Dairy cooperative societies, Dairy farming, Economic analysis, Gangetic plains, Producer's share

In India, milk production offers great opportunities for increasing farm income, employment and provides subsidiary occupation in semi-urban areas and people living in hilly, tribal and drought prone areas (Rao *et al.* 2004). Dairy cooperative societies (DCS) purchase only about one-third of marketed milk in Bihar (Kumar 2010). Milk sold mostly to milk vendors, results in lower price to farmers, so to minimize revenue loss and reduce price spread, network and outreach of DCS should be extended (Gupta *et al.* 2009). The cost and returns in dairy enterprise are important concern for milk producers, consumers and policy makers to provide an effective linkage among them to make rational economic decisions (Kumar and Pandian 2003). In spite of large volume of milk production in Bihar, productivity and per capita milk availability is only 154 g/day compared to national average (241g/day) (Government of Bihar 2006). The present study was undertaken to examine milk contribution by members of DCS, and producer's share in consumer's rupee in Gangetic plains of Bihar, and to find out cost of milk production in study area.

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MATERIALS AND METHODS

The study is based on both primary and secondary data. Out of total 828 dairy cooperative villages, 60 were randomly selected following stratified random sampling with proportional allocation considering milk unions as strata (Snedecor and Cochran 1967). Those dairy farmers having milch animals and supplying milk to their village DCS were listed. Dairy farmers were categorized according to their herd size and 20% farmers from each herd category were surveyed. Data were solicited from 802 rural dairy farmers who were available at the time of interview. Secondary data were collected from records of Bihar Government and 2 oldest Milk Unions namely Khagaria-Begusarai-Barauni Dugdha Utapadak Sahakari Sangh Ltd. (KBBDUSS) and Vaishal Patliputra Dugdha Utapadak Sahakari Sangh Ltd. (VPDUSS) which consist of about 55% of total functional DCS in Bihar. The secondary data were spread over a period of 9 years (1999–2007). Economics of milk production was computed on single year data pertaining to animals completing lactation period during April 2006 to June 2007. For cost of milk production, fixed cost/animal/day was assumed to be 15%

of total cost of milk production. Total variable cost per animal per day comprised sum of feed cost, labour charges, veterinary expenditure and miscellaneous cost. Herd-wise total cost of milk production/animal/day was worked out for precise conclusions.

The producer's share in consumer's rupee (P_s) for marketing chains was calculated using equation:

$$P_S = \frac{P_F}{P_C} \times 100$$

where, P_S is the producer's share in consumer's rupee; P_F is the price received by milk producer; and P_C is the price paid by the consumer.

Data were subjected to least squares analysis (Harvey 1960). A 4-way fixed effect model considering milk union, herd size, period and season of calving as source of variation was formulated to analyze data on average daily milk contribution and producer's share in consumer's rupee. For analyzing cost of milk production, period effect was excluded and type of milch animals as well as their lactation order was included as sources of variation and thus a 5-way fixed effect mathematical model was used. Modified Duncan's multiple range test (Kramer 1957) was applied to carry out the pair-wise comparison of least square means to get significant factors contributing to a particular variable of quantum of milk produced.

Based on climatic conditions and milk production, the year was divided as pre-flush (July to October), flush (November to February) and post-flush (March to June). Cows in first to fifth lactation were only included in this study. Cost of feed and fodder (home grown and purchased), labour (hired and family), cost of veterinary and artificial insemination, fixed expenses and miscellaneous recurring expenditure constituted gross cost of maintenance of a milch animal. Other than milk, cow dung was also considered as a source of income @₹ 3 / animal / day, under the assumption that an adult animal excretes about 20 kg of wet dung / day. Calf was also an additional source of income from a cow but in this study this aspect was not considered as it was assumed that their price would be more or less equal to the expenditure incurred on their raising up during lactation period of milch animal. The numbers of milch animals in different households were classified into 4 herd categories with assumption that variation in data due to size-effect within a group would be negligible and difference among group would be sizeable enough to be measured. To calculate the net cost of maintenance, income from sale of dung was deducted from gross cost of maintenance. The cost of 1 litre of milk produced by an animal has been taken as the ratio of average daily net cost of maintenance for that animal and average daily milk produced during corresponding inter calving period. Cost components were estimated as per Reddy *et al.* (1980).

RESULTS AND DISCUSSION

Economic analysis of dairy farming in mixed farming system provides basis for delineating possibilities of controlling costs of milk production and increasing returns to make it a viable enterprise (Bhowmik and Sirohi 2008). Per litre cost of milk production in urban areas is relatively high in comparison to rural and semi-urban areas, which may be due to higher feed, labour and fixed costs. The profit was estimated higher in semi-urban than urban and rural areas (Dutt *et al.* 2009). Gupta *et al.* (2009) reported that average milk yield per day; peak milk yield and age at first calving were found significantly associated with each other but varied with change in agro-climatic zones. Results of present study have been presented under various sub-headings.

Distribution of milch animals: Milch animals were categorized in 3 groups i.e., local cows, crossbred and buffaloes. Crossbred cows constituted higher proportion of milch animals (43.3%), followed by local cows (29.1%) and buffaloes (27.6%). The proportion of crossbred cows was much higher (74.9%) in large herd size of 10–12 animals than small herd size up to 6 animals (Table 1; Fig. 1). On the

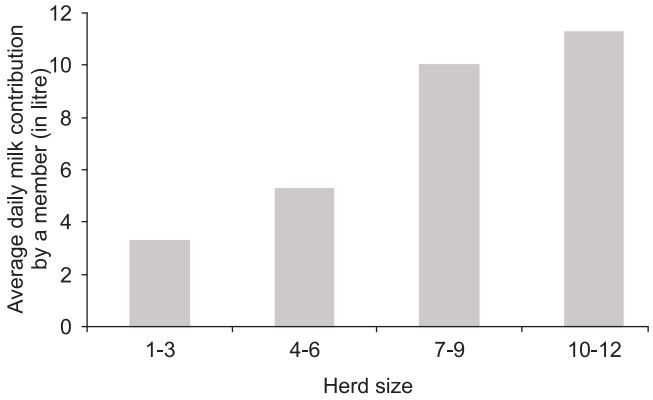

Fig.1. Distribution of average milk contribution/member/day according to herd size.

Table 1. Sampling procedure and distribution of milch animals based on herd size, Bihar, India (N=802)

Herd Size	Household with milch animals	Member of DCS	No. of selected households	Animals in selected households (%)		
				Local cows	Buffaloes	Crossbred cows
1-3	2037	1266	253	38.0	33.4	28.6
4-6	3371	1763	353	33.9	39.7	26.4
7-9	1276	703	141	25.0	20.1	54.9
10-12	562	274	55	15.2	9.9	74.9
Total	7246	4006	802	29.1	27.6	43.3

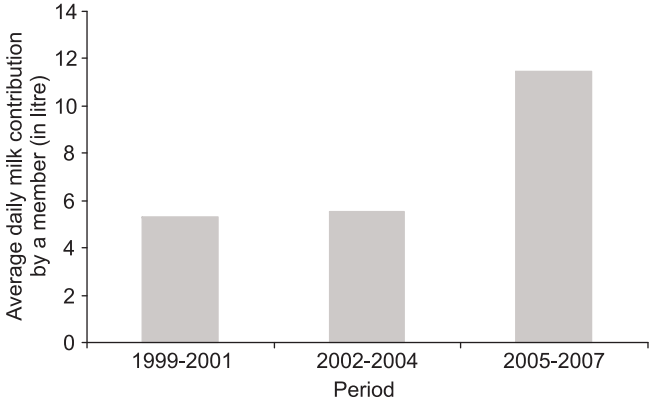

Fig. 2. Distribution of average milk contribution/member/day according to years.

Table 2. Estimate of variables mean across the herd size over 9 years, Bihar, India (N=802)

Herd size	Variables		
	Average daily milk contribution (Litre)	Producer's share in consumer rupee (%)	Cost of milk production (/litre)
1-3	3.27	58.20	14.46
4-6	5.27	58.20	13.55
7-9	10.02	58.17	11.38
10-12	11.27	58.17	10.74

other hand local cows constituted about one-third of total animals on small herd size against only 15.2% on large herd size. Similar trend was observed in buffaloes on different herd categories. This revealed that the large herd owners' preferred crossbred cows while small herd owners preferred local cows and buffaloes, as large herds owners had resources to invest in purchasing and costly maintenance of crossbred cows.

Average daily milk contribution by members: An analysis of data collected from active members of DCS who sold milk to their respective DCS revealed that in 1999–2001, about 63.5% of milk produced was sold to DCS which increased to 66.8% in 2002–04 and further increased to 72.4% in 2005–07. Per member average contribution was comparatively low (5.33 litre) during 1999–2001, which significantly increased during 2002–2004 (5.56 litre) and further increased in 2005–2007 (11.47 litre) (Fig. 2). Farmers' experience in dairy farming and adoption of highly productive crossbred cows with adoption of improved scientific dairy farming practices might be reasons to increased average daily milk production over time which resulted in higher contribution to co-operative marketing system. The other reason may be higher proportion of crossbred cows in total cow population which increased from less than 1% in 1987 to more than 16% in 2010 in Bihar (Singh and Mandal 2005).

Average daily milk contribution was significantly higher ($P \leq 0.05$) in flush season (10.46 litre) followed by pre-flush season (6.14 litre) and post-flush season (5.76 litre), latter 2 being not significantly different from each other (Fig. 3; Table 3). Availability of good quality fodder as well as congenial weather conditions with least physiological stress to the animals during different seasons may be attributed to such seasonal variations in milk contribution. Type of milch animals had significant influence on per-household milk contribution. Fig. 4 revealed that DCS milk pool had highest average daily contribution from crossbred cows (11.07 litre), followed by buffaloes (5.65 litre) and local cows (5.64 litre). However, latter 2 were not significantly different from each other (Table 3). Gangasagare and Karanjkar (2008) stated that landless dairy farmers equally contributed in milk production with those having land. Increase in herd size decreased the productivity; the members of single family maintained dairy animals more carefully than those of joint family. Herd size, period, season and type of animals had significant effect on average daily milk contribution by dairy farmers to DCS milk pool. Least squares constants revealed that larger units were contributing more milk as they produced more (Table 3).

Producer's share in consumer's rupee: Period and season had significant effect on producer's share (Table 3). On an average, 58.81% of selling price of processed fluid milk was paid to milk producers as price of raw milk and 41.19% was retained with milk unions as expenditure incurred on transportation, processing and marketing of milk. Producer's share was least during 1999–2001 (55.70%) which gradually increased over time and was significantly higher during 2005–2007 (66.85%). Analysis of herd size-wise producer's share in consumer's rupee revealed that herd size did not differ with each other with respect to their share in consumer's rupee, but it was significantly lower in flush season (56.70%) than those in pre-flush (57.77%) and post-flush (57.74%) seasons which did not differ significantly from each other (Table 3). This could plausibly be explained that, as the yield of milk increased the percentage of total solids in milk decreased during the flush season leading to a lower realization of prices. The milk unions fix prices based on both fat and solids not fat (SNF) content in milk. This might be the reason for loss in income due to decrease in total solid yield in the flush season of production, which could not be compensated by increase in milk yield.

Cost of milk production: Per litre milk production is one of the components for farm level decision making and it was worked out for 3 types of milch animal under study. Per litre cost of milk production was comparatively low in case of crossbred cows (10.4) than local cows (13.99) and buffaloes (14.34). However, costs of milk production of local cows and buffalo do not differ significantly, though they are significantly higher from cost of milk production in crossbred cows. Hence, it may be said that inclusion of crossbred cows in herd can make milk production enterprise economically

Table 3. Least squares analysis of variance and constants for factors affecting average daily milk contributed by a member, producer's share in consumer's rupee and cost of 1 litre milk production, Bihar, India (N=802)

Source of variation	Average daily milk contribution by a society member (Litres)		Producer's share in consumer's rupee (%)		Cost of milk production (₹ /Litre)	
	df	MSS	df	MSS	df	MSS
Milk unions	1	9.688	1	11.111	1	6.112
Herd size	3	809.517**	3	9.400	3	512.353**
Period	2	785.260**	2	241.219**		
Season	2	86.900*	2	60.110*	2	13.523**
Type of animal	2	80.416*			2	521.533**
Parities				–	4	55.936**
Residual	1547	3.653	1549	4.211	1545	2.305
Overall mean ( )	7.454 0.064	58.813 0.054	12.53 0.051			
Factors						
Herd size						
1–3	–4.187a	0.012	1.927a			
4–6	–2.187b	0.015	1.017a			
7–9	2.562c	–0.014	–1.153b			
10–12	3.812d	–0.013	–1.791b			
Period						
1999–2001	–2.123a	–3.117a				
2002–2004	–1.893b	1.019b				
2005–2007	4.016c	2.098c				
Season						
Pre–flush	–1.312[a]	1.075a	–0.091			
Flush	3.011[b]	–2.115b	0.012			
Post–flush	–1.699[a]	1.040 a	0.079			
Type of animal						
Local cows	–1.811[a]		0.689[a]			
Buffaloes	–1.800[a]		0.885[a]			
Crossbred cows	3.611[b]		–1.574[b]			
Parities						
1			0.298[b]			
2			–0.058[a]			
3			–0.098[a]			
4			–0.096[a]			
5			–0.046[a]			

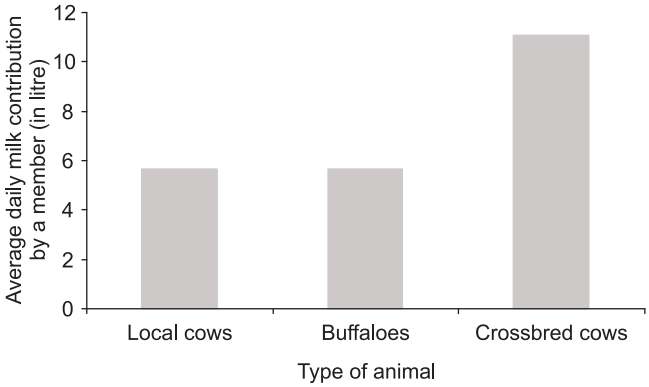

Fig. 3. Distribution of average milk contribution/member/day according to animal species.

Values super scribed by same letter were not significantlyconsumer's different from each other.
*P<0.05, **P<0.01.

more viable than through other 2 types of milch animals under study. Least squares means of different cost components and their relative contributions to the gross cost of milk production in 3 types of milch animals are presented in Table 4. In animals of all 3 different types, feed and fodder formed the major component (68.62–69.33%) of gross costs followed by fixed expenses (14.91–16.03%), labour (10.50–10.90%), miscellaneous recurring expenditure (2.83–3.96%) and veterinary and artificial insemination (AI) cost (1.17–1.82%), respectively. Fodder fed to animals was categorized in 2 groups i.e. dry and green. Value of green fodder constituted about one-fourth in crossbred cows, but in local cows it was only 11% of total fodder fed to local cows and buffaloes. This implies that there was a need to create awareness among dairy farmers about benefits of green fodder in milk production. It is also suggested to include promotion of green fodder production as an important component of strategies in future milk production policies of the state. A comparison of procurement price of dairy co-operative (9.51) to per litre cost of milk production revealed that former was lower than even lowest cost of milk production (10.14) of crossbred cows in Bihar. Hence, it may be said that milk producers were not getting remunerative price of milk through co-operative system in Bihar.

Study revealed that cost of milk production can be considerably reduced, if producers are supplied with relatively cheap balanced ration. It is quite possible by replacing some of the costlier ingredients by relatively cheaper feed like maize, barley, oat, linseed, sunflower cakes and molasses. Secondly, farmers should be motivated to adopt balanced ration for their animals utilizing larger quantities of quality green fodder thereby reducing the quantum of

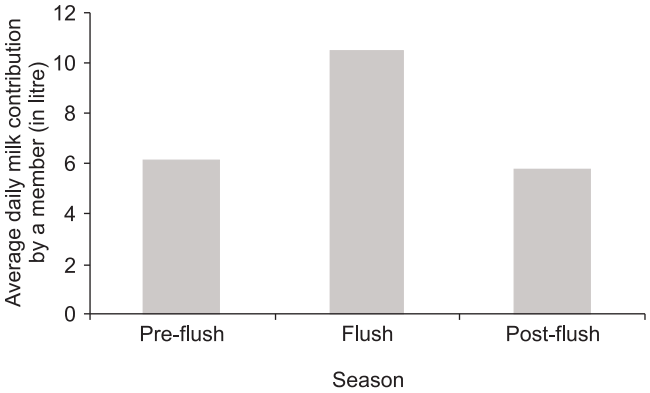

Fig. 4. Distribution of average milk contribution/member/day according to seasons.

Table 4. Cost components and their relative contribution to the gross cost of milk production in different types of milch animals (₹/litre)

Cost items	Mean (₹/litre of milk)		
	Local cows	Buffaloes	Crossbred cows
Dry fodder cost	8.09	8.4	4.46
	–57.82	–58.58	–42.84
Green fodder cost	1.56	1.54	2.69
	–11.11	–10.75	–25.78
Feed cost[1]	9.65	9.94	7.15
	–68.93	–69.33	(68.62
Labour cost	1.5	1.5	1.12
	–10.73	–10.49	–10.77
Cost of AI and	0.25	0.17	0.18
veterinary services	–1.82	–1.17	–1.73
Fixed expenses	2.15	2.2	1.55
	–15.36	–16.03	–14.91
Miscellaneous costs	0.44	0.43	0.41
	–3.17	–2.98	–3.96
Gross cost of	13.99	14.34	10.41
production	–100	–100	–100
Income from dung	0.42	0.44	0.29
	–2.99	–3.04	–2.79
Net production cost	13.57	13.9	10.12

Values in parenthesis are % to respective gross cost;[1]feed cost refers to the total cost incurred on dry and green fodder.

concentrate. Dairy farmers should also be advised for meeting requirements of feed by providing desired nutrients through feeding of green fodder which not only reduces intake of concentrates but also helps in reducing cost of production. Treatment of dry fodder with urea helps in improving its nutritive value, and such technologies may be popularized to make feeding balanced and cost effective. Herd-size and type of milch animal along with parity significantly influenced cost of milk production. Production cost may gradually decrease with increase in size of unit. Least squares constant for herd size of 1–3 and 4–6 animals were positive and not significantly different from each other but differed significantly from constants for units of 7–9 and 10–12 animals which were negative but not significantly different from each other. This means that a dairy unit consisting of 7–9 milch animals would be optimum for economically viable milk production enterprise in rural areas where resources are limited. Higher cost of milk production in the units of smaller size may be attributed to relatively higher per animal establishment cost. In absence of close observation at time of heat detection of individual animals, timely and proper insemination and other sexual health control measures in bigger units' results into longer calving interval, lower average daily yield and thus, higher cost of milk production.

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