Economic Affairs, Vol. 67, No. 05, pp. 761-767, December 2022
DOI: 10.46852/0424-2513.5.2022.10

Research Paper

An Economic Analysis of Milk Production in Rural-urban Interface of Bengaluru

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Received: 12-09-2022 **Revised:** 19-11-2022 **Accepted:** 02-12-2022

ABSTRACT

Study was carried out in the rural-urban interface of Bengaluru to address the rapid urbanization of the rural areas surrounding Bengaluru urban. Data from 240 dairy sample respondents, 120 non-dairy sample respondents were also drawn from different layers of South and North transects. Thus, the total sample size was 360. The results revealed that per day net maintenance cost for indigenous and cross-bred cows was ₹ 58.34 and 104.34, respectively, with corresponding yields of 2.39 lt and 5.13 lt. The cost of production of milk and gross returns realized were comparatively higher among cross-bred cows (₹ 77.66 and ₹ 127.56) than local cows (₹ 58.34 and ₹ 124.08). Milk marketing practices, the highest proportion of respondents followed marketing channel-II (54 %) and marketing channel III (48 %) in the marketing of milk produced by local cows and cross-bred cows, respectively. The per liter total cost of milk marketing was more in channel-III (₹ 1.26 and 0.61) than the channel-II (₹ 0.62 and 0.37) and channel-I (₹ 0.37 and 0.38) in the case of milk produced by both local as well as cross-bred cows.

HIGHLIGHTS

- The cost of milk production was more in cross-bred similarly, yield also high compared to indigenous cows.
- Selling of milk through the middleman (channels-II) was more practiced than the other practice.

Keywords: Crossbreed & Indigenous cow, cost & return and channels

Expenditure on feed, fodder, labor, health care and other cost components constitute the bulk of the cost of rearing dairy animals. Their judicious use can be managed to accrue handsome profit even in a situation of meager resource endowments. This endeavor requires the essence of the economics of milk production, which in addition to catering to the above interest, also serves as a base for an important policy resolution in milk pricing. This section is devoted to the presentation of estimated costs and returns from milk production.

The cost of milk production is presented under heads of maintenance costs, which include variable and fixed costs, as delineated in the methodology chapter. The gross returns were calculated by taking the milk price and quantity. The estimation of the cost of milk production across the milch species forms an essential aspect in the economic analysis of dairy farming

Analysis of cost of milk production provides clues to the decision making bodies and helps the decision support system to understand whether or not farmers get remunerative prices. Generally, dairy farmers can increase their family income in two ways, *i.e.*, by increasing milk production or reducing the cost of milk production. The first alternative is limited as productivity enhancement of the individual milch animal is influenced by

How to cite this article: Shivagangavva, P.D., Gaddi, G.M. and Chinnappareddy, B.V. (2022). An Economic Analysis of Milk Production in Rural-urban Interface of Bengaluru. *Econ. Aff.*, **67**(05): 761-767.

Source of Support: None; **Conflict of Interest:** None

certain biological (genetic) as well as climatic factors such as the genetic potential of the animal, climatic parameters like temperature, rainfall, relative humidity, etc., which cannot be controlled by farmers easily. The second alternative can be achieved through the judicious use of various factors of production.

This study attempt to analyze the cost and returns of cross-breed & indigenous cow in the rural-urban interface of Bengaluru. India is the largest milk producer, ranked 1st in milk production, contributing to 23 percent of global milk production. Milk production in the country has grown at a compound annual growth rate of about 6.2 percent to reach 209.96 mt in 2020-21 from 146.31 mn tonnes in 2014-15 .The average cost of production per liter of milk was ₹ 14.27, and the average net return per liter of milk was ₹ 8.28 (Economic Survey 2021-22).

In the following section efforts have been made to estimate costs and returns from milk production for different types of milching animals maintained in the study layer.

METHODOLOGY

This study was conducted during 2016-2017 at University of Agriculture science Bengaluru. The blue contours indicate the Northern and Southern research transects the star mark indicates the reference point (Vidhana Soudha) in the city center. The methodology adopted by project "Effects of urbanization on value chains and livelihoods of farmers and other stakeholders". Who considered the percent of build-up area and distance from the city center using GIS analysis of satellite images and combining basic measures of building density and distance. The correlation of the two parameters and discontinuities in the frequency distribution of the combined index indicate highly dynamic stages of transformation, spatially clustered in the rural-urban interface (Ellen *et al.* 2017).

Sampling frame consist of dairy farmers from the two transects, north and south Bengaluru, representing three layers (rural, transition, and urban). A sample size of 50 households of dairy farmers from the transition and rural layer and 20 from urban was selected randomly from the two transects to constitute a total sample of 240 households. In addition, 20 non-dairy farmers from each layer of the transect we select. Thus, the total sample size was 360, and sample farmers were interviewed personally using a structured pre-tested schedule.

The Northern and Southern transects were treated as separate populations when calculating the SSI (Survey Stratification Index) and allocating them to the six arbitrary strata for random sampling. In the North transect 21 villages, and in the South transect 22 villages were selected. The information elicited from the respondent farmers pertained to the cost and returns of milk production, channels of marketing, and yield of milk. Descriptive statistics were used to analyze the issues.

RESULTS AND DISCUSSION

Maintenance cost per animal

The result of per animal breed-wise maintenance cost across different regions is presented in Table 1. A perusal of the table reveals that the per day net maintenance cost for local and cross-bred cows was ₹ 58.34 and ₹ 104.34, respectively. For local cows, higher maintenance cost was observed in the transition (₹ 60.03 in the north transept and ₹ 58.97 in the south transect) layer than in rural (₹ 56.01) layer in the north transect. Where as in the case of cross-bred cows, higher expenditure was seen in the case of urban (₹ 106.81 and ₹ 106.07) layers than in transition (₹ 103.20 and ₹ 105.93) and rural (₹ 102.74 and ₹ 98.27) layers in North transect and South transect, respectively.

The quantum of both the variable cost and fixed cost were more in the case of cross-bred cows (₹ 87.85 and ₹ 13.98)) than for local cows (₹ 45.25 and ₹ 10.10); contrary to this, marketing cost incurred by the farmers was more in the case of local cows (₹ 2.99) than cross-bred cows (₹ 2.51).

The average herd size was more in cross-bred cows (₹ 4.86) than the local cows (2.07). The item-wise analysis revealed that among items of variable cost, the proportion of fodder cost (₹ 18.03) was more in the case of local cows, whereas in the case of cross-bred cows, feed cost (₹ 28.01) was the primary item. The cost of milk production was more in the urban layer compared to the transition and rural layers. This is due to the easy availability and cheaper resources in rural and transition layers, as they grow fodder, wages are low and more involvement of family members in maintaining dairy animals.

Table 1: Cost of milk production from different breeds of milchanimals across different layers and transect of study area (₹/day/animal)

Sl. No.	Particulars	Local cows			Pooled	Cross-breeds cows						Pooled
		North transect (n=10)		South transect (n=15)		North transect (n=110)			South transect (n=105)			
		Transition	Rural	Transition		Urban	Transition	Rural	Urban	Transition	Rural	
1	Herd size	2.67	1.50	2.05	2.07	4.00	4.50	5.05	4.95	5.83	4.81	4.86
2	Fodder	22.85	12.82	18.42	18.03	28.98	25.35	23.92	22.98	27.07	20.57	24.81
		(38.06)	(22.89)	(31.24)	(30.73)	(27.13)	(24.56)	(23.06)	(21.66)	(25.08)	(20.93)	(23.74)
3	Feed	10.86	15.25	12.66	12.92	29.78	29.14	27.82	27.66	28.82	24.84	28.01
		(18.09)	(27.23)	(21.47)	(22.26)	(27.88)	(28.24)	(26.82)	(26.08)	(26.70)	(25.28)	(26.83)
4	Labour	8.11	9.25	8.59	8.65	28.34	28.44	28.67	26.69	26.73	23.58	27.08
		(13.51)	(16.51)	(14.57)	(14.86)	(26.63)	(27.56)	(27.64)	(25.16)	(24.77)	(24.00)	(25.94)
5	Miscellaneous	4.87	5.71	6.35	5.64	7.24	6.95	8.73	7.06	8.95	8.78	7.95
		(8.11)	(10.19)	(10.77)	(9.69)	(6.78)	(6.73)	(8.42)	(6.66)	(8.29)	(8.93)	(7.64)
6	Total Variable Cost	46.69	43.03	46.02	45.25	94.34	89.88	89.14	84.39	91.57	77.77	87.85
		(77.78)	(76.83)	(78.04)	(77.55)	(88.33)	(87.09)	(85.43)	(79.56)	(84.84)	(79.14)	(84.15)
7	Total Fixed Cost	9.65	9.86	10.78	10.10	10.54	11.42	10.90	17.40	12.27	18.36	13.98
		(16.08)	(17.60)	(18.28)	(17.32)	(9.87)	(11.07)	(9.73)	(16.40)	(11.42)	(18.68)	(13.45)
8	Marketing Cost	3.69	3.12	2.17	2.99	1.93	1.90	2.70	4.28	2.09	2.14	2.51
		(6.15)	(5.57)	(3.68)	(5.13)	(1.81)	(1.84)	(2.60)	(4.04)	(1.94)	(2.18)	(2.40)
9	Total Cost	60.03	56.01	58.97	58.34	106.81	103.20	102.74	106.07	105.93	98.27	104.34
		(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Note: *Figures in parenthesis is the percentage to the column total and analysis was done only for the available.*

Table 2: Milk yield and gross returns realised from different breeds of milch animals across different layers and transect of study area

Sl. No.	Particulars	Local cows			Pooled	Cross-breeds cows						Pooled
		North transect (n=10)		South transect (n=25)		North transect (n=110)			South transect (n=105)			
		Transition	Rural	Transition		Urban	Transition	Rural	Urban	Transition	Rural	
1	Yield (Lt/day)	2.00	2.50	2.66	2.39	5.00	5.06	5.17	4.83	5.98	4.77	5.13
2	Gross Returns (₹/day/Animal)											
(a)	Main Product-Milk	52.00	60.00	61.18	57.73	124.08	131.56	125.00	114.48	149.50	120.75	127.56
		(96.74)	(85.11)	(96.83)	(92.40)	(97.52)	(97.39)	(92.94)	(96.00)	(96.33)	(96.40)	(96.09)
(b)	By product-FYM	1.75	10.5	2	4.75	3.15	3.53	9.49	4.76	5.7	4.51	5.19
		(3.26)	(14.89)	(3.17)	(7.60)	(2.47)	(2.61)	(7.10)	(3.99)	(3.67)	(3.60)	(3.91)
	Total	53.75	70.50	63.18	62.48	127.23	135.09	134.49	119.24	155.20	125.26	132.75
		(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Note: *Figures in parenthesis is the percentage to the column total and analysis was done only for available data.*

Hence they could able to reduce the cost of milk production. This conforms with earlier studies by Tanwar *et al.* (2012) and Kumari (2015) where the cost of milk production was more for cross-bred cows than the local cows.

Breed wise milk yield and Gross returns of local and cross-bred cows

The average milk yield of local and cross-bred cows across different layer is presented in Table 2. The results indicated that the average milk yield from crossbreds' cows (5.13 lt.) was significantly higher

than the local cows (2.39 lt.). The per day per cow gross return was found to be higher in crossbred cows (₹ 132.75) than the local cows (₹ 62.48).

In the case of farmer rearing local cows, among three layers in South transects transition layer (₹ 63.18) showed more returns than the North transects transition layer (₹ 53.75). Further, irrespective of the transect, the gross return was the highest in the rural layer (₹ 70.50). As per as the crossbred cows are concerned, the transition layer (₹ 135.09 and ₹ 152.20) ensured the higher returns, followed by the rural (₹ 134.49 and ₹ 125.26) and urban layer (₹ 127.23 and ₹ 119.24) in both North and South transects. Disregarding the nature of cows, the returns from the FYM were more in rural and transition layers than the urban layer. The milk returns from cross-bred cows (₹ 127.56) were more than the local cows (₹ 57.73). Further, there existed a significant difference in total returns across the urban, transition, and rural layers due to the reduction in maintenance cost, reduced milk production, and smaller herd size in the rural and transition layer. This is in conformity with the findings of earlier studies (Kalra *et al.* 1995; Kumari, 2016).

Economic feasibility of dairy farming

The evaluation of the economic feasibility of dairy farming is essential as it helps in decision-making regarding continuing the business, investment in the business, size of herd size, marketing of the milk, *etc.* Having realized the above things, the economic feasibility of dairy farming has been worked out, and the results are presented in Table 3.

The average herd size maintained by a farmer is significantly more than double in cross-bred cows than in local cows. The cost of production of milk and gross returns realized was higher among cross-bred cows (₹ 77.66 and ₹ 127.56) than local cows (₹ 58.34 and ₹ 124.08). This clearly revealed that maintaining the dairy industry with cross-bred cows is more economically feasible than local cows. The average price realized by farmers was ₹ 25 and ₹ 24 for cross-bred and local cows, respectively. Among the three layers, the rural and transition layer more return rate than an urban layer, indicating that dairy farming is more profitable in the rural and transition layer than the urban layer. These findings are comparable with similar findings reported by Singh JK *et al.* (2017), where gross returns, and cost of production are dependent on herd size.

Marketing channels prevailed in the study area

Milk marketing channels followed by respondents in the study region are presented in Fig. 1. and farmers followed the three channels in the marketing of milk *viz.*, Channel–I where milk producers sell milk directly to the consumer, In channel-II dairy producers selling milk to middle man and from middle man it sold through to ultimate consumers In Channel-III milk was disposed to co-operatives and from co-operative to processing units, from there to retailers and from retailers to ultimate consumers

Disposal pattern of milk to various agencies

The results of distribution of households accordingly to choose of different marketing channel are presented in Table 4. A perusal of Table 4 revealed that the highest proportion of households followed marketing channel-II (54%) and marketing channel III (48%) for marketing milk produced from local

Table 3: Economic feasibility of dairy farming in study region Bengaluru (₹/day/animal)

Sl. No	Particulars	Local cows				Cross-breeds cows						
		North(n=10)		South(n=25)	Pooled	North transect (n=110)			South transect (n=105)			Pooled
		Transition	Rural	Transition		Urban	Transition	Rural	Urban	Transition	Rural	
1	Herd Size	2.67	1.5	2.05	2.07	4	4.5	5.05	4.95	5.83	4.81	5.02
2	Cost of production	60.03	56.01	58.97	58.34	106.81	103.2	103.74	106.07	107.93	98.27	77.66
3	Gross Return	52	60	61.18	57.73	124.08	131.56	125	114.48	149.5	120.75	127.56
4	Rate of Returns	0.87	1.07	1.04	0.99	1.16	1.27	1.2	1.08	1.39	1.23	1.64
5	Average Price	26	24	23	24	25	26	24	25	25	24	25

Note: *Analysis was done only for available data.*

Table 4: Distribution of sample respondents across different marketing channels in study area (Numbers)

Sl. No.	Particulars	Local cows				Cross-breeds cows						
		North transect (n=10)		South transect (n=25)	Pooled	North transect (n=110)			South transect (n=105)			Pooled
		Transition	Rural	Transition		Urban	Transition	Rural	Urban	Transition	Rural	
1	Channel-I	1(13)			1(2.86)		5(12)	9(18)		6(18)	8(16)	28(13)
2	Channel-II	2 (25)	2(100)	15(60)	19(54.29)	2(10)	17(43)	30(60)	5(25)	18(53)	12(23)	84(39)
4	Channel-III	5(63)		10(40)	15(42.86)	18(90)	18(45)	11(22)	15(75)	10(29)	31(61)	103(48)
	Total	8(100)	2(100)	25(100)	35(100)	20(100)	40(100)	50(100)	20(100)	34(100)	51(100)	215(100)

Note: *Figures in parenthesis is the percentage to the column total and analysis was done only for available data.*

cows and cross-bred cows, respectively. Further, there was a significant difference with respect to the proportion of households that followed marketing channel-I between local cows (2.86%) and cross-bred cows (13 %). In the case of local cows, across layers, channel-II (25 % and 60 %) and channel-III (63 % and 40 %) were the predominant or primary marketing channels in both north and south transects due to input service and no middlemen. With respect to the cross-bred cows, in the north transept, marketing channel-III was predominant in the urban (90%) and transition layer (45%), while in a rural layer, it was channel-II (60%). In contrast, in the south transept, marketing channel III was predominant in urban (75%) and rural layers (61%), while it was channel II in the transition layer (53%). In the urban layer, most of the milk is marketed through to channel III, which may be because of higher prices and short-distance remunerative prices, loan facilities, incentives. While in rural and transition layers, most of the milk is sold through the middleman, this may be due to rapport with the middleman and longer distance of co-operatives milk collection canter, timely settlement, fair price, doorstep collection, traditional practice, fraudulent practice. Reasons for selecting Milk Vendor for distribution of milk. These findings are in line with the results of Saikia B (2020) in Assam, which heighted the various reasons behind selecting the channel's by the respondents.

Marketing Practices

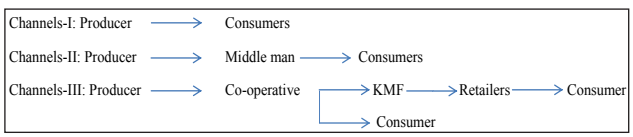

Fig. 1: Major Marketing channels faced by respondents in different study region Bengaluru district, Karnataka

Marketing cost incurred and net price realised across different marketing channels

The total marketing cost of milk per liter in the table 5 was more in channel-III (₹ 1.26 and 0.61) than the channel-II (₹ 0.62 and 0.37) and channel-I (₹ 0.37 and 0.38) in the case of milk production from both local as well as cross-bred cows marketing. We can notice here that in channel-III, marketing cost was more as the number of samples for testing the milk, but milk testing was also considered a cost while does not exist in other channels. Hence, this may be one of the reasons for higher marketing costs in channel III. The average milk price realized by dairy sample households was more for local cows in channel-I (₹ 26.00), whereas for milk of cross-bred cows, it was more in channel-III (₹ 25.17).

Among the three layers and between the channels, variation was noticed in the average price realized by farmers. In local cows, the average price realized was more in channel-II in both transition and a rural layer of the North transect, while in the South transect, channel-III fetched the higher price. With respect to cross-bred cows, the average price realized was more in channel-III in the urban layer (₹ 27), while for channel-I it was more in the transition layer (₹ 26) and for channel-III in the rural (₹ 27) layer in North transect, In South transect, it was higher in Channel-III (₹ 26) in urban, Channel-I in transition (₹ 25) and channel-I in rural (₹ 25) layer. The average net price realized by farmers after deducting the marketing cost was higher in Channel-I (₹ 25.63) followed by Channel-II (₹ 24.05) and Channel-III (₹ 23.24) in local cows, while in the case of cross-bred cows, it was higher in Channel-III (₹ 24.55) followed by Channel-II (₹ 24.46) and Channel-I (₹ 24.37). The overall results revealed

Table 5: Marketing cost and net price across the different marketing channels in study region of study area (₹/lt.)

Sl. No.	Particulars	Local cows				Cross-breed cows						
		North transect (n=10)		South transect (n=25)	Pooled	North transect (n=110)			South transect (n=105)			Pooled
		Transition	Rural	Transition		Urban	Transition	Rural	Urban	Transition	Rural	
(A)	**Total marketing cost**											
1	C-I	0.37	—	—	0.37	—	0.19	0.34	—	0.75	0.24	0.38
2	C-II	0.30	0.89	0.67	0.62	0.20	0.20	0.19	0.41	1.07	0.16	0.37
3	C-III	1.72	—	0.80	1.26	0.38	0.38	0.62	0.84	1.12	0.33	0.61
(B)	**Average price**											
1	C-I	26	—	—	26.00	—	26.00	23.00	—	25.00	25.00	24.75
2	C-II	27	24	23	24.67	26	25.00	26.00	25	23.00	24.00	24.83
3	C-III	24	—	25	24.50	27	24.00	27.00	26	24.00	23.00	25.17
(C)	**Net price over marketing cost**											
1	C-I	25.63	—	—	25.63	—	25.81	22.66	—	24.25	24.76	24.37
2	C-II	26.70	23.11	22.33	24.05	25.80	24.80	25.81	24.59	21.93	23.84	24.46
3	C-III	22.28	—	24.20	23.24	26.62	23.62	26.38	25.16	22.88	22.67	24.55

Note: Analysis was done only for available data

Table 6: Government intervention for sustainable of dairy farming in study area (₹/lt.)

Sl. No.	Particulars	Local cows				Cross-breed cows						
		North transect (n=10)		South transect (n=25)	Pooled	North transect (n=110)			South transect (n=105)			Pooled
		Transition	Rural	Transition		Urban	Transition	Rural	Urban	Transition	Rural	
(A)	Cost of Production	30.02	22.40	22.18	24.87	21.36	20.40	20.09	21.98	18.06	20.59	20.41
(B)	**Price Realised by the farmers**											
	C-I	26.00			26.00		26.00	23.00		25.00	25.00	24.75
	C-II	27.00	24.00	23.00	24.67	26.00	25.00	26.00	25.00	23.00	24.00	24.83
	C-III	24.00		25.00	24.50	27.00	24.00	27.00	26.00	24.00	23.00	25.17
(C)	**Net Returns over total cost of production**											
	C-I	-4.02			-4.02		4.60	4.91		5.94	3.41	4.72
	C-II	-3.02	1.60	0.82	-0.20	4.64	3.60	5.91	3.02	4.94	4.41	4.42
	C-III	-6.02		2.82	-1.60	5.64	4.60	5.91	4.02	6.94	5.41	5.42
(D)	**Net impact of Govt**											
	C-I											
	C-II											
	C-III	4.00		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
(E)	**Total Returns**											
	C-I	-4.02			-4.02		4.60	4.91		5.94	3.41	4.72
	C-II	-3.02	1.60	0.82	-0.20	4.64	3.60	5.91	3.02	4.94	4.41	4.42
	C-III	-2.02		6.82	2.40	9.64	8.60	9.91	8.02	10.94	9.41	9.42

Note: *Analysis was done only for available data.*

that the average and net price realized was more in channel III than in other channels. Similar results were reported by Saikia B (2020) in Assam.

Sustainability of dairy farming

The average cost of production of milk per litre was ₹ 24.87 in local cows and ₹ 20.41 for cross-bred cows. Table 6. In local cows, the average price realized was more in channel-II in both transition and a rural layer of the North transect, while in South transect, channel-III price realized was higher. Whereas in the case of cross-bred cows, the average price realized was more in channel-III in the urban layer (₹ 27), followed by Channel-I in Transition (₹ 26) and Channel-III in rural (₹ 27) layer in North transect, In South transect price realized was more in Channel-III (₹ 26) in urban layer followed by, Channel-I in transition (₹ 25) and Channel-II in rural layer (₹ 25). The average net price realized by the farmer after deducting the total cost of production of milk was negative across all the three-marketing channel in local cows while, positive returns were observed in all the three marketing channels for cross-bred cows.

In local cows, net returns were negative in transition layer, positive in channel-II in rural layer (₹ 1.60) of North transect, while in South transect, positive net returns were observed for milk when marketed through channel-II (₹ 0.82) and channel-III (₹ 2.82) in the transition layer. In cross-bred cows, the highest net returns were found for channel-III (₹ 5.64) in the urban layer, for channel-I and channel-III (₹ 4.60) in the transition layer, and also for channel-II and III showing (₹ 5.91) in a rural layer of North transect. In contrast, South transect, net return realized was found to be highest in channel-III in urban (₹ 4.02), transition (₹ 6.94), and rural layer (₹ 5.41).

In order to support and incentivise the dairy farming, cooperative/state government has extended the support of ₹ 4 per liter of milk sold through co-operatives. In general, the total returns realized were less from local cows compared to the cross-breed cows due to productivity. Further, farmers rearing cross-bred cows, realized more returns were in Channel-III (₹ 9.42) followed by Channel-I (₹ 4.72) and Channel-II (₹ 4.42) while, farmers rearing local cows, the total returns were positive only when they marketed in Channel-III (₹ 2.40). Higher returns in channel-III were due to state government support to a dairy farmer to continue dairying and help sustainable dairy farming in the state.

CONCLUSION

From this study, we can find that maintenance cost per day/animal was highest in crossbred than local cows, farmers were preferred to sell their milk through a middleman and primary dairy co-operative societies as they would get a timely settlement and remunerative prices, also other facilities. The average and net price realized was higher in channel-III in other channels. Among the three layers, rural and transition layers having more rate of returns than the urban layer, which reveals that dairying was more profitable in the rural and transition layers than the urban layer. The significant cost contribution in milk production was of variable costs. This has been completely ignored while fixing the milk price. Therefore, the cost of milk production should be considered for fixing the price and providing incentives.

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