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Economics of milk production and cost elasticity analysis in Sirsa district of Haryana

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ABSTRACT

Haryana was purposively chosen for the study, in which Sirsa district which falls in the western zone was selected. A predetermined sample of 140 milk producers of the dairy co-operative societies was drawn randomly from all eight societies and was post stratified into three categories on the basis of total SAU's in each household. To estimate cost and returns of milk production budgeting technique was used and it was concluded from the analysis that rearing of crossbred was most profitable one as compared to buffalo and local cows. The return per litre was found highest for crossbred cows since the productivity was more as compared to buffalo and local cows. By analysis of cost elasticity it was found that cost and yield had negative relation, since economies of scale was found and increase in yield leads to decrease in cost. It was found that in case of medium farmers the decrease in cost was the highest.

Keywords: Sirsa, budgeting, cost and returns, cost elasticity

Indian agriculture is predominantly a mixed crop-livestock farming system, where the livestock segment, particularly the dairy sub-sector supplements the farm income mainly by providing employment. The importance of dairying in a country like India hardly needs accentuation. The dairy sector contributes 3.9 per cent (at constant prices) of total GDP and a large share of 26.1 per cent (at constant prices) of the agricultural gross domestic product (GDP) of India. The programme 'Operation flood' generated rippling effects in the country's dairy sector to transform it from milk deficient to highest milk producing country in the world. This has led to a vast successful network of cooperative system in the country. The same is evident from the fact that the milk chilling capacity created in cooperative dairy sector is 2200 TLPD (thousand litres per day) during 2015-16.

The progress in dairy and dairy cooperatives is not uniform throughout the country. There have been two major determinants of dairy progress in the country; agricultural development and another cooperative. Punjab and Haryana are two agriculturally progressive

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states but cooperatives are not much successful while Gujarat and Rajasthan are the states where cooperatives has received overwhelming support of the people leading to dairy development in these states. The major strengths of cooperatives were the bridging of producers and consumers, reducing transaction costs of smallholder producers, providing necessary services and ensuring remunerative prices. To investigate the later issue, the present study estimates the costs and returns of milk production across the households supplying milk to the cooperatives and conducts cost elasticity analysis to determine relationship between yield and the cost.

Haryana state was purposively selected for the study because it is not only progressive in the field of agriculture, but also ranks among the top ten milk producing state in the country. It is the home of best breeds of cattle. But the profit in dairy as an enterprise depends upon not only the biological and genetic factors of the animals but also the institutional, infrastructural and policy support systems. To meet the demand of milk and milk products, the profitability of milk production is the major determinant of growth in future.

Materials and Methods

Sampling plan

The study was based on the survey conducted in 2014-15 in Sirsa district of Haryana state. The district falls in the western zone of the state and represents peculiar agro-climatic conditions. It has Sirsa cooperative milk union with a milk plant located in Sirsa town and four chilling plants located at Jiwan Nagar, Patli Dabar, Gusiana and Gori Wala. These chilling plants were made bases for selecting the dairy cooperative societies. Under each chilling plant, two societies having highest number of member suppliers were selected purposively. The societies were selected in such a way that one society is selected with bulk milk cooler (BMC) and another without the cooler and supply milk to the chilling plant. Hence forth these societies are termed as society with BMC and without BMC, respectively.

Data Collection

A predetermined sample of 140 milk producers was drawn from the eight dairy co-operative societies according to probability proportional allocation to the total milk suppliers. These 140 households were then post stratified into three herd-size categories namely Small (1-4 SAUs), Medium (5-6 SAUs) and Large (≥7 SAUs) using Cumulative Square Root Frequency Method on the basis of total standard animal units (SAUs) in each household. Primary data were collected by personal interview method from head of the households using a well-structured pre-tested schedule.

Analytical Framework

Budgetary technique was used to estimate cost and returns of milk production. The total cost was divided into fixed and variable costs. These costs when compared with returns to indicate economic efficiency of milk production and the profitability of the enterprise. The various components of fixed cost are depreciation and interest on fixed capital. Capital Recovery Cost (CRC) was used to calculate the fixed cost. The formula for estimation of CRC is:

$$R = Z\left[\frac{(1+r)^n r}{(1+r)^n - 1}\right]$$

Where, R, Z, r and n are the capital recovery cost (₹ per annum), initial/ current value of the capital asset (₹), interest rate (per cent) and useful life of assets (years).

In case of practical difficulties in getting the information on initial outlay at the field level, the current value of asset was considered. When the asset was purchased from borrowed capital the actual interest rate charged by the bank was taken as 'r', while in case of owned funds, the interest on term deposit of 1-5 years was taken. The useful life of assets was assumed to be 50 years for pucca cattle shed, 10 years for katcha shed, 6 years for manual chaff cutter, 10 years for power operated chaff cutter. The useful life of milch animals also varied with the type of animal. In case of milch animals the productive life left was taken into account. The total CRC was then apportioned to the individual animal in accordance with the Standard Animal Units (SAUs).

The variable costs include three major items i.e. feed and fodder cost, labour cost and veterinary and miscellaneous expenditure. The feed and fodder cost was comprised of dry fodder, green fodder and concentrates to animals. In case of purchased feed and fodder, the cost was worked out as product of quantity fed to animal and purchase price of respective feed. In case of home-grown feed and fodder, the relevant prices were the farm-harvest prices and if farm-harvest prices were not available, the imputed value of crop was taken at prevailing price in the village. When the concentrate feed was prepared at home, its cost was computed by taking the weighted prices of ingredients used in the concentrate. The labour cost included cost of family as well as paid labour (hired labour). The cost of hired labour was calculated considering type of work allotted and wages paid whereas, family labour costs were determined on the basis of existing wage rate of permanent farm labour.

The expenditure on breeding and health care of the animals was covered under the veterinary expense. It included, cost of artificial insemination (AI), natural service, vaccination, medicines, fee of veterinary doctor and other related expenses. The miscellaneous expenditure included expenses on repair of fixed assets, water and electricity charges, insurance premium and any other incidental charges. These being joint costs, apportionment of the same were based on SAU.

Considering the differences in regional endowments of animal wealth and species, the dairy animals have been converted into SAUs using factors suggested by Sirohi *et al.* (2015) for the Northern region (Table 1).

Table 1: Standard animal units for Northern regions of India

Type of Animal	Buffalo	Cross Bred Cattle	Local Cow
Adult Male (≥3 years)	1.25	1.23	1.08
Adult Female (≥3 years)	1.35	1.27	1.00
Young stock male (<1 year)	0.43	0.41	0.39
Young stock female (<1 year)	0.41	0.41	0.39
Young stock male (>1 year)	0.65	0.61	0.54
Young stock female (>1 year)	0.51	0.52	0.46
Heifer	0.79	0.78	0.73

Source: Sirohi *et al.* (2015)

Other Cost & return Concepts used in the study were gross cost, net cost, gross return, net return and cost of milk production. The gross cost is the sum of fixed and variable costs while dung value was deducted from gross cost to estimate the net cost of maintaining an animal per day. The gross return was calculated as quantity of milk produced multiplied by the price received and net cost was deducted from gross return to estimate net return per animal per day. The net cost per kilogram of milk indicates the cost of milk production.

Cost elasticity was estimated by functional analysis when average cost was regressed upon yield using double log functional form of the following form to get direct estimates of elasticity.

$$C = \alpha Y^{\beta}$$

Where C is the average cost of maintaining an animal in rupees per day and Y is the average milk yield of animal in Kilograms per day. β coefficient directly indicates the percentage change in average cost with one per cent change in yield.

Results and Discussion

An analysis of costs 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. The income flowing from the dairy enterprises is well spread over the entire year. There is desirability as well as scope for developing dairy enterprise both as a specialized or a supplementary enterprise. Keeping this in view, an effort was made to estimate cost and returns of different types of milch animals in this section. In order to draw better picture of the economic aspects of milk production for different species of milch animals based on per day milk production, cost and returns was worked out for different herd size categories.

Cost and Returns of Milk Production from Local Cow

Table 2 shows the costs and returns from local cow. On perusal of the Table 2 shows that the overall average maintenance cost per day of local cow was found to be ₹ 144.48 which varies from ₹ 139.82 for small herd size category to ₹ 152.09 for large herd size category. The overall total variable cost was found to be ₹ 115.89. Thus, fixed cost accounted for about 21.13 per cent and variable cost accounted for about 80.21 per cent of the gross cost. Feed and fodder cost accounted for about 67.35 per cent of the gross cost followed by labour cost (11.92 per cent).

Table 2: Costs and Returns of Milk Production from Local Cows

₹/animal/day

Cost Components	Herd size Category			
	Small	Medium	Large	Overall
Total Fixed Cost (TFC)	28.32 (20.26)	29.79 (20.00)	26.90 (17.70)	30.53 (21.13)
Green Fodder (F1)	20.28 (21.92)	23.00 (22.82)	23.66 (22.04)	21.64 (22.24)
Dry Fodder (F2)	23.93 (25.86)	24.55 (24.35)	25.36 (23.63)	24.33 (25.01)
Concentrate (F3)	48.32 (52.22)	53.24 (52.82)	58.32 (54.33)	51.33 (52.76)
Feed & Fodder Cost (V1=F1+F2+ F3)	92.53 (66.18)	100.79 (67.69)	107.34 (70.61)	97.30 (67.35)
Labour Cost (V2)	17.32 (12.39)	17.20 (11.55)	16.30 (11.11)	17.22 (11.92)
Veterinary cost (V3)	0.33 (0.23)	0.27 (0.18)	0.29 (0.19)	0.31 (0.21)
Miscellaneous (V4)	1.32 (1.17)	0.84 (0.57)	0.58 (0.38)	1.06 (0.74)
Total Variable Cost (TVC=V1+ V2+V3+V4)	111.50 (79.75)	119.10 (79.99)	125.11 (82.30)	115.89 (80.21)
Gross Cost (A= TFC+ TVC)	139.82 (100.00)	148.89 (100.00)	152.01 (100.00)	144.48 (100.00)
Value of Dung (B)	5.23	6.19	5.71	5.61
Net Cost (C=A-B)	134.59	142.7	146.31	138.87
Price of milk	33.23	33.30	33.33	33.29
Average milk production (litres/ animal/day (E))	3.98	4.30	4.43	4.14
Gross Return (D)	132.50	143.19	147.65	138.10
Net Return (D-C)	-2.09	0.50	1.35	-0.77
Cost of milk production (₹ per litre)	33.82	33.19	33.03	33.50
Return (₹ per litre)	-0.53	0.12	0.30	-0.20

Figures in parentheses indicate the percentages with gross totals

Overall per litre cost of milk production was worked out to be ₹ 33.50 for local cow. The net return per litre per animal was found negative for small herd size category and positive for medium and large herd size categories. The net return per litre of milk was highest for large category (₹ 0.30) and lowest for small category (₹ -0.53). Though the net return was less as compared to crossbred and buffalo but people in the study area reared descript indigenous cows because they are easily adaptable to the prevailing climate. Moreover they also reared indigenous cow because the maintenance cost was less as compared to crossbred and buffalo. The small holders are more benefitted because of this. Therefore in order to encourage farmers to adopt local cows, subsidies were also given to the farmers. Sahiwal breed, which is known for its high fat content and high milk yield among other indigenous varieties, was the mostly reared in the study area.

Cost and Returns of Milk production from Crossbred cows

Table 3 shows the costs and returns from crossbred cows. It was found that the overall gross maintenance cost for crossbred was worked out to be ₹ 210.29 per day which varies from ₹ 209.00 per day for medium category to ₹ 212.56 per day for medium category. Feed cost of large herd size category (₹ 144.27) was higher as compared to small herd size category (₹ 127.15). This is in conformity with earlier studies carried out by Rao and Singh (1995), Tanwar *et al.* (2012) and Kumari, (2015). The reason behind this could be increased awareness among the members regarding the importance of proper feed for animals. The overall fixed cost was found to be ₹ 33.20 which varies from ₹ 30.58 for large herd size category to ₹ 34.16 for small herd size category. The overall fixed cost accounted for 15.95 per cent of the total gross costs. The percentage of fixed cost was highest for small herd size category (16.49 per cent) and lowest for large herd size category (14.84 per cent). This is in conformity with the findings of earlier studies (Kalra *et al.*, 1995 and Kumari, 2015). The overall total variable cost was found to be ₹ 177.08

which varies from ₹ 174.84 for small herd size category to ₹ 179.44 for large herd size category.

Table 3: Cost and Returns of Milk production from Crossbred cows

₹/animal/day

Cost Components	Herd size Category			
	Small	Medium	Large	Overall
Total Fixed Cost (TFC)	34.16 (16.49)	32.77 (15.56)	30.58 (14.84)	33.20 (15.95)
Green Fodder (F1)	34.92 (27.46)	34.98 (25.68)	34.41 (23.85)	34.86 (26.31)
Dry Fodder (F2)	20.15 (15.84)	23.67 (17.38)	27.48 (19.05)	22.33 (16.85)
Concentrate (F3)	72.08 (56.68)	77.56 (56.94)	82.37 (57.09)	75.31 (56.83)
Feed & Fodder Cost (V1=F1+ F2+F3)	127.15 (60.84)	136.22 (64.08)	144.27 (68.69)	132.51 (63.01)
Labour Cost (V2)	40.36 (19.31)	35.23 (16.57)	24.53 (11.68)	36.45 (17.33)
Veterinary cost (V3)	1.22 (0.58)	2.21 (1.04)	2.45 (1.17)	1.71 (0.82)
Miscellaneous (V4)	6.11 (2.92)	6.13 (2.88)	8.19 (3.90)	6.41 (3.05)
Total Variable Cost (TVC=V1+V2 +V3+V4)	174.84 (83.66)	179.79 (84.58)	179.44 (85.44)	177.09 (84.21)
Gross Cost (A= TFC+TVC)	209.00 (100.00)	212.56 (100.00)	210.02 (100.00)	210.29 (100.00)
Value of Dung (B)	5.94	6.13	6.23	6.04
Net Cost (C=A-B)	203.05	206.43	203.78	204.24
Price of milk	25.96	26.04	26.09	26.00
Average milk production Litres/ animal/day (E)	9.52	10.11	10.33	9.83
Gross Return (D)	247.14	263.26	269.51	255.52
Net Return (D-C)	44.09	56.83	65.73	51.27
Cost of milk production (₹ per litre)	21.33	20.42	19.72	20.81
Return (₹ per litre)	4.63	5.62	6.36	5.20

Figures in parentheses indicate the percentage of gross totals

Thus, fixed cost accounted for about 15.95 per cent and variable cost accounted for about 84.21 per cent of the gross cost. This is in conformity with the findings of earlier studies (Kalra *et al.*, 1995, Desai, 2005 and Kumari, 2015). Feed and fodder cost accounted for about 63.01 per cent of the gross cost followed by labour cost at 17.33 per cent. The per cent share of feed cost increased with increase in herd size while labour cost decreased with increase in herd size. On the appraisal of per litre cost of milk production it was found that the per litre cost of milk production was found to be ₹ 20.80 which varies from ₹ 19.73 per day for large category to ₹ 21.33 per day for small category. Therefore it can be concluded that the cost of milk production was highest in case of small herd size categories this is in conformity with earlier studies of Vani (2013). Though the total cost was highest for large herd size category but the cost per litre was highest for small herd size category. The overall net return per litre of milk was found to be ₹ 5.20 which varies from ₹ 4.63 for small herd size category to ₹ 6.36 for large herd size category. The net return per litre was highest for large farmers and was least for small farmers in the study area.

Costs and Returns of Milk Production from Buffalo

Cost and Returns from Buffalo is presented in Table 4. On perusal of the Table 4 shows that the overall average maintenance cost per day of buffalo was found to be ₹ 203.98 which varies from ₹ 200.86 for small herd size category to ₹ 208.40 for medium herd size category. It was found that the fixed cost was highest for small herd size category and least for large herd size category.

Table 4: Cost and Returns of Milk production from Buffalo

₹/animal/day

Cost Components	Herd size Category			
	Small	Medium	Large	Overall
Total Fixed Cost (TFC)	41.43 (20.62)	36.92 (17.72)	36.11 (17.55)	39.22 (19.23)
Green Fodder (F1)	34.06 (26.71)	34.22 (24.99)	33.76 (25.86)	34.07 (26.01)
Dry Fodder (F2)	20.54 (16.11)	24.06 (17.57)	21.87 (16.75)	21.86 (16.69)
Concentrate (F3)	72.94 (57.19)	78.63 (57.43)	74.90 (57.38)	75.04 (57.30)

Feed & Fodder Cost (V1=F1+F2+F3)	127.55 (63.50)	136.91 (65.70)	130.52 (63.44)	130.98 (64.21)
Labour Cost (V2)	23.54 (11.72)	25.62 (12.29)	27.36 (13.30)	24.76 (12.14)
Veterinary cost (V3)	1.36 (0.68)	1.89 (0.91)	2.64 (1.28)	1.73 (0.84)
Miscellaneous (V4)	6.98 (3.48)	7.06 (3.39)	9.10 (4.42)	7.31 (3.58)
Total Variable Cost (TVC=V1+V2 +V3+V4)	159.43 (79.37)	171.48 (82.28)	169.63 (82.44)	164.76 (80.77)
Gross Cost (A=TFC+TVC)	200.86 (100.00)	208.40 (100.00)	205.73 (100.00)	203.98 (100.00)
Value of Dung (B)	8.01	8.29	8.04	8.11
Net Cost (C=A-B)	192.84	200.11	197.69	195.87
Price of milk	35.94	36.26	36.39	36.11
Average milk production Litres/ animal/ day (E)	5.90	6.12	6.40	6.04
Gross Return (D)	212.05	221.88	232.90	218.19
Net Return (D-C)	19.21	21.77	35.21	22.32
Cost of milk production (₹ per litre)	32.68	32.70	30.89	32.43
Return (₹ per litre)	3.26	3.56	5.50	3.67

Figures in parentheses indicate the percentages with gross totals

The overall total variable cost was found to be ₹ 164.76. Thus, fixed cost accounted for about 19.23 per cent and variable cost accounted for about 80.77 per cent of the gross cost. Feed and fodder cost accounted for about 64.21 per cent of the total variable cost followed by labour cost (19.23 per cent) which is consistent with the earlier studies carried out by Singh *et al.* (1994), Vani, (2013), Singh, (2015).

Overall per litre cost of milk production was worked out to be ₹ 32.43 per buffalo. A net return per litre per milch animal was found to be positive for all the categories. It was highest for large category (₹ 5.50) and lowest for small category (₹ 3.26). Return per litre of milk was more for crossbred cow when compared with that of buffalo. Hence, Crossbred cow is more profitable than buffalo in the study area. This is in conformity with the earlier studies carried out by Gill and Singh (1986), Vashist and Katiha (1988), Pundir (1996), singh (2015) and kumari (2015).

Cost Elasticity of Milk Production for Different Herd Size Categories

Cost elasticity was estimated taking double log function for cost and yield. The result of cost elasticity of milk production is presented in the Table 5.

Table 5: Cost Elasticity of Milk Production

Herd Size Category	Cost Elasticity
Small	-0.52
Medium	-0.72
Large	-0.62
Overall	-0.59

From the table it can be concluded that the overall cost elasticity of milk production among herd size categories was found to be -0.59 which means that with one per cent increase in yield, the average cost will decrease by more than half per cent. The cost elasticity was found to be smallest in small herd size category (-0.52) followed by large herd size category (-0.62). It was the highest in case of medium herd size category (-0.72). The results of cost elasticity proved negative relationship between per unit cost and the yield. One per cent increase in yield reduced cost to the extent of 0.52, 0.72, and 0.62 per cent on small, medium, large herd size category farms, respectively.

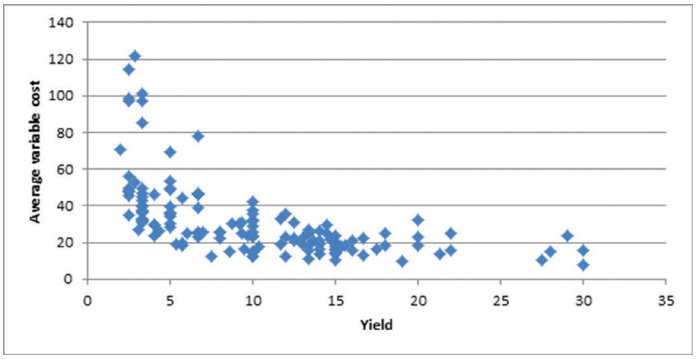

Fig. 1: Scatter diagram between average variable cost and milk yield

Figure 1 shows the scatter diagram between average variable cost and yield. From the scatter diagram it can be interpreted that there existed economies of scale. Therefore, as the yield increases the average variable cost is going to decrease.

Conclusion

From the analysis of cost and returns it was found that the overall gross maintenance cost per day was found highest for crossbred cow (₹ 210.29) followed by buffalo (₹ 203.98) and least for local cow (₹ 144.48). The overall percentage of fixed cost for local cow was 21.13 per cent, for crossbred it was found to be 15.95 per cent and for buffalo it was 19.23 per cent. The proportion of total variable cost was found to be highest for crossbred 84.21 per cent, followed by buffalo 80.77 per cent and least for local cow 80.21 per cent. Overall per litre cost of milk production was highest for local cow (₹ 33.50) followed by buffalo (₹ 32.43) and least for crossbred cow (₹ 20.81). Overall per litre return of milk production was highest for crossbred (₹ 5.20) followed by buffalo (₹ 3.67) and it was least for local cow and was negative (₹ -0.20). Therefore it can be concluded that rearing of crossbred cows was beneficial for the farmers. Moreover, if proper nutrition was given to the cattle, the productivity of animals can be increased and thus the returns can be increased. It was also seen that in all the animal types the returns were highest for large herd size categories, therefore it can be concluded that they adopted better feeding and management practices for rearing the cattle. Thus, proper training of the farmers by specialists is very much important to cover up the gap in the knowledge of farmers. The results of cost elasticity proved negative relationship between per unit cost and the yield. One per cent increase in yield reduced cost to the extent of 0.52, 0.72, and 0.62 per cent on small, medium, large herd size category farms, respectively.

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