Economic analysis of milk production in peri-urban dairy farms of Odisha

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Abstract: East and South-eastern coastal plain zone of Odisha was purposively selected for conducting study. After complete enumeration, farms were categorized into small, medium and large categories on the basis of milch animals using cumulative square root frequency method. A total of 120 peri-urban dairy farms were selected from two towns namely Bhubaneswar town (Khorda district) and Cuttack town (Cuttack district). Budgeting technique was used to estimate costs and returns. Capital recovery cost method was used to evaluate fixed costs and variable costs were also evaluated for estimation. From the analysis it was concluded that crossbred cows were more profitable as compared to buffaloes. Milk productivity and returns from per litre milk of crossbred cow were more than buffalo. Concentrate feeding constitute major share in total feeding expenditure. Among different herd size categories of dairy farms, large farms were getting more profit per litre of milk than medium and small farms. Cost elasticity was estimated using Cobb-Douglas production function showed a negative relationship between per unit cost and milk yield.

Keywords: Budgeting, Capital recovery cost, Cobb-Douglas, Cumulative square root frequency

Introduction

Milk production is playing an important role in the economy and socio-economic development of the country. Dairy farming has always been looked upon as a subsidiary occupation and not as a primary occupation. The share of livestock in agricultural gross domestic product has risen from 17 per cent to 25.6 per cent from 1970 to 2018 (NDDB). It shows a sustained growth in milk production for meeting growing demand of population. Increasing demand for milk in the urban area has led to market oriented dairy farming which is providing both profit and self-employment to the urban youth. So, dairy farming is gaining importance in and around urban centres. The reason for increasing demand for milk and milk products are due to increasing urbanization, rising per capita income and other related factors. Changing lifestyle and food habits of people in urban areas makes them more conscious towards more nutritious and healthy foods. Milk is an important constituent of most of these healthy diets. So, it is adding extra demand for milk in urban areas.

Profitability of dairy enterprises can be increased by either reducing cost or increasing milk production. When sale price of milk does not cover the total cost of milk production, farmers make loss. Economic analysis of dairy farming provides the basis for delineating the possibilities of controlling costs of milk production and increasing the returns to make it a potential dairy enterprise (Bhowmik and Sirohi, 2008). In order to evaluate and explore the possibilities of dairy farming as a profitable enterprise in Odisha, a study was undertaken in 2018-19 with focus on estimation of the cost and returns of milk production.

Materials and Methods

Sampling plan

The sampling design consisted of selecting the ultimate sampling unit, i.e., peri-urban dairy farms using stratified random sampling method. The study was based on the survey conducted in 2018-19 in East and South-eastern coastal plain zone of Odisha. Odisha has been selected purposively because despite of lowest dairy development among all the states (Kale et al. 2016), the per capita milk productivity is increasing over the years and currently it was 132 gm/day (NDDB, 2018-19). State is promoting dairy

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through Dairy Entrepreneurship Development scheme. The east and south-eastern coastal plain zone was selected for the study because it is having highest milk producing potential (NDDDB Odisha report, 2016). East and south-eastern coastal plain zone of Odisha consists of 6 districts namely Kendrapara, Khordha, Jagatsinghapur, Cuttack, Puri and Nayagarh. Out of 6 districts 2 districts Cuttack and Khordha was selected randomly.

Data collection

Data was collected from two towns namely Cuttack town of Cuttack district and Bhubaneswar town of Khordha district. After complete enumeration, three potential areas of each town namely Nayabazar, Baxi Bazar and Chauliaganj (Cuttack town) and Saheed Nagar, Rental Colony and Kalinga Nagar (Bhubaneswar town) has been selected. These areas are having a total of 195 dairy farms out of which 120 dairy farms have been selected based on probability proportional to size. The selected 120 peri-urban dairies were stratified into three categories using Cumulative Square Root Frequency Method on the basis of number of milch animals. The peri-urban dairy farms were thus categorized into three herd size categories namely small (up to 18 milch animals), Medium (18-24 milch animals) and large (above 24 milch animals). The distribution of sampled peri-urban dairy farms in the small, medium and large herd size categories were found to be 49, 41 and 30, respectively. Primary data was collected from owners of the dairy farms using a well-structured pre-tested schedule.

Analytical framework

To achieve the objectives of the study, the data collected from 120 peri-urban dairy farms were scrutinized, tabulated and analyzed by employing various analytical tools. Budgetary technique was used to estimate cost and returns of milk production. The total cost was divided into fixed and variable costs. Components of fixed costs are depreciation and interest on fixed capital. Capital recovery cost (CRC) method was used to calculate the depreciation. The formula for estimation of CRC is given by:

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

Where,

R	=	Capital recovery cost
Z	=	Initial value of the capital asset
r	=	Interest rate
n	=	Useful life of the assets

When the asset is purchased from borrowed capital the actual interest rate charged by the bank will be taken as 'r', while in the case of owned funds, the interest on term deposit of 1-5 years will be taken. Equipment's for durable assets having productive life more than one year but not unlimited, depreciation was charged on the value of the assets by using straight line method. 2, 5, 10, 20 & 20 percent depreciation was considered for pucca building, semi pucca building, chaff cutter, milk can and bucket, respectively. The useful life of the animal or in other words its productive life was considered as 8 years for crossbred cow and 10 years for buffalo. The total CRC was then apportioned to individual animal in accordance with Standard Animal Units (SAUs).

Variable costs are those costs which are incurred on the variable factors of production and can be altered in the short run. It includes feed cost, labour cost, and miscellaneous cost. The information on the quantity of dry fodder, green fodder and concentrate fed to milch animals was recorded. Although the guess estimate provided by the farmers stems from his day to day experience in dairy activity, but to ensure maximum possible accuracy of data, as a counter check, personal observation was also made on size of the animal and total quantity of feed and fodder consumed. 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 labour utilized per standard animal unit in terms of adult male units (both hired and family) was converted into appropriate number of hours of adult male units for different categories of animals. The standard man hours of labour employed per animal per day was converted into monetary terms by multiplying with the corresponding wage rate. Miscellaneous cost included the cost of breeding for AI or service charge of bull as well as cost of vaccination and medicines, cost of repair, electricity, water charges, ropes, buckets etc. They were calculated on the basis of per milch animal per day for different types of milch animal kept by the sample households. Interest on working capital was not calculated as there is regular flow of income from sale of milk to the producer.

Considering the differences in regional endowments of animal wealth and species, the SAUs have been formulated by Sirohi et al. (2015) at regional level for five regions viz; Eastern (including north-east), Western, Southern, Northern plains and Hills. As the study area falls in the Eastern region so standard animal units for this region was given in Table 1. Other cost concepts used in the study were gross cost, net cost, cost per litre of milk, gross returns from sale of milk, net returns and net returns per litre of milk. These costs were calculated as

- Gross Cost = Total Fixed Cost + Total Variable Cost

- Net Cost = Gross Cost – Value of the Dung
- $\text{Cost per liter of milk} = \frac{\text{Net Cost Per Animal}}{\text{Milk yield of animal}}$
- Gross Returns from sale of milk = (Milk produced/ household /day) * Price of Milk
- Net returns = Gross returns – Net cost

$$\text{Net returns per liter of milk} = \frac{\text{Net returns per animal per day}}{\text{Milk produced per animal per day}}$$

To get direct estimates of cost elasticities average cost was regressed upon yield using Cobb-Douglas functional form.

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

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

To know whether the farm is getting remunerative price or not, it is important to calculate cost and returns from milk production of dairy enterprise. It provides a suitable basis for taking various decisions for making profit of farm business. 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 of milk production and returns from crossbred cow

The results provided in Table 2, revealed that total fixed cost accounted for 13.09 per cent of total cost. Out of total variable cost feed and fodder cost accounted for highest (51.56 %) followed by labour cost (45.72 %) and miscellaneous cost (2.70

%). So, out of total cost, total variable cost for crossbred cow constitute 86.90 per cent. Comparing farms of different herd size categories, it was found that total fixed cost was highest in case of large farms (17.51 %) followed by medium (13.94 %) and small farms (9.89 %). This is in conformity with the findings of earlier studies (Vishnoi, 2014). Similarly, total variable costs were highest in case of small farms (90.10 %) followed by medium (86.05 %) and large farms (82.48%). It shows economies of scale was operating in these farms. Total variable cost constitutes feed and fodder cost, labour cost and miscellaneous cost. Labour cost was found to be minimum in case of large farms (40.94 %) followed by medium (46.89 %) and small farms (47.23 %). It means large farms were efficiently utilizing labour hour. Feed and fodder cost were the highest in case of large farms (55.58 %). This is in conformity with earlier studies carried out by Kumari, (2015) and Lal, (2016). Medium and small farms were found to have almost equal share for feed and fodder. Among green fodder, dry fodder and concentrate, concentrate was having highest share of costs. Costs for green fodder was low followed by dry fodder. Due to less availability of fodder farmers are mainly dependent on concentrate feeding of animals. Total net cost was found minimum for large farms (₹ 240.80) followed by small (₹ 266.97) and medium (₹ 271.64) farms. Due to higher fixed cost medium farms were having higher net costs. Economics of scale was observed for variable costs i.e., with increase in herd size costs were decreasing.

Overall average milk price of the study area was ₹ 38.13/litre and overall cost per litre of milk production was ₹ 28.29 /litre. Considering this the overall net return from per litre of milk was calculated as ₹ 9.83 /litre. The overall net return from crossbred cow was ₹ 91.83. Comparing across different herd size categories of peri-urban dairy farms, it was observed that highest net return from crossbred cow was obtained in case of large farms (₹ 129.12) followed by small (₹ 83.97) and medium farms (₹ 73.94). Similarly, net return from per litre of milk was highest in case of large farms (₹ 13.20) followed by small (₹ 9.22) and medium farms (₹ 8.09). It was found that per litre cost of milk production was lowest in case of large farms (₹ 24.62 /litre) which is due to operation of economies of scale. Farmers were getting total share in consumer rupees because peri-urban dairy farms are directly selling milk to consumer without involving middlemen.

Cost of milk production and returns from Buffalo

Table 1 Standard Animal Units for Eastern regions in India

	Cross bred cattle	Buffalo	Local Cow
Adult male (≥ 3 years)	1.07	1.02	0.92
Adult female (≥ 3 years)	1.20	0.86	1.00
Young stock male (<1 year)	0.25	0.25	0.27
Young stock female (<1 year)	0.24	0.23	0.24
Young stock male (>1 year)	0.51	0.42	0.41
Young stock female (>1 year)	0.38	0.38	0.37
Heifer	0.71	0.63	0.64

Perusal of the Table 3, it was observed that total fixed cost accounted for 12.76 per cent of total cost. Out of total variable cost, feed and fodder cost accounted for highest (53.36 %) followed by labour cost (44 %) and miscellaneous cost (2.62 %). So, out of total cost total variable cost for buffalo constitute 87.23 per cent. Comparing farms of different herd size categories, it was found that total fixed cost was highest in case of large farms (14.57%) followed by medium (13.25%) and small farms (10.91%). The reason for this may be due to more investment in infrastructure by large farms. Similarly, total variable costs were minimum in case of large farms (85.42%) followed by medium (86.74%) and small farms (89.08%). Total variable cost constitutes feed and fodder cost, labour cost and miscellaneous cost. It was found that miscellaneous cost is very low. Labour cost was found

Table 2 Cost and returns of milk production from crossbred cow (₹ /animal/day)

Cost component	Small	Medium	Large	Overall
Total fixed cost (TFC)	26.99(9.89)	39.00(13.94)	43.82(17.51)	35.30(13.09)
Green fodder*	9.03(7.29)	8.77(7.21)	8.18(7.13)	8.73(7.23)
Dry fodder*	27.03(21.83)	26.37(21.68)	25.00(21.79)	26.30(21.77)
Concentrate*	87.71(70.86)	86.44(71.09)	81.54(71.06)	85.74(70.99)
Feed & fodder**	123.78(50.34)	121.59(50.53)	114.74(55.58)	120.77(51.56)
Labour cost**	116.14(47.23)	112.83(46.89)	84.51(40.94)	107.10(45.72)
Misc cost**	5.96(2.42)	6.20(2.57)	7.17(3.47)	6.34(2.70)
Total variable cost (TVC)	245.89(90.10)	240.63(86.05)	206.43(82.48)	234.23(86.90)
Gross Cost (TVC+TFC)	272.88	279.64	250.25	269.53
Value of Dung	5.90	7.99	9.45	7.50
Net Cost (Gross cost-value of dung)	266.97	271.64	240.80	262.02
Price of milk (Rs/litre)	38.57	37.82	37.83	38.13
Avg milk/animal/day	9.09	9.13	9.77	9.28
Gross return	350.94	345.59	369.92	353.86
Net Return	83.97	73.94	129.12	91.83
Cost (₹ /litre)	29.34	29.73	24.62	28.29
Return (₹ /litre)	9.22	8.09	13.20	9.83

Figures in parentheses indicate percentage to the total, * indicate Figures in parentheses indicate percentage to total feed and fodder, ** indicate Figures in parentheses indicate percentage to total variable cost

Table 3 Cost and returns of milk production from Buffalo (₹ /animal/day)

Cost component	Small	Medium	Large	overall
Total fixed cost (TFC)	26.99(10.91)	39.00(13.25)	43.82(14.57)	35.30(12.76)
Green fodder*	6.98(7.09)	9.70(7.00)	12.13(7.34)	9.19(7.14)
Dry fodder*	22.14(22.51)	30.00(21.65)	35.98(21.80)	28.29(21.97)
Concentrate*	69.22(70.38)	98.87(71.34)	116.95(70.85)	91.28(70.88)
Feed & fodder**	98.35(44.67)	138.58(54.27)	165.07(64.28)	128.77(53.36)
Labour cost**	115.85(52.62)	110.53(43.29)	84.51(32.91)	106.20(44.00)
Misc cost**	5.96(2.70)	6.20(2.42)	7.17(2.79)	6.34(2.62)
Total variable cost (TVC)	220.17(89.08)	255.32(86.74)	256.76(85.42)	241.33(87.23)
Gross Cost (TVC+TFC)	247.16	294.32	300.58	276.63
Value of Dung	5.90	7.99	9.45	7.50
Net Cost (Gross cost-value of dung)	241.26	286.32	291.13	269.12
Price of milk (₹ /litre)	49.61	52.12	50.83	50.77
Avg milk/animal/day	5.59	6.01	6.97	6.08
Gross return	277.36	313.72	354.65	309.11
Net Return	36.10	27.39	63.51	39.98
Cost (₹ /litre)	43.15	47.56	41.72	44.30
Return (₹ /litre)	6.45	4.55	9.10	6.46

Figures in parentheses indicate percentage to the total, * indicate Figures in parentheses indicate percentage to total feed and fodder, ** indicate Figures in parentheses indicate percentage to total variable cost

Table 4 Cost elasticity of milk production

Dairy farm Category	Cost Elasticity
Small	-0.47
Medium	-0.66
Large	-0.68
Overall	-0.38

to be minimum in case of large farms (32.91%) followed by medium (43.29%) and small farms (52.62%). Feed and fodder cost were highest in case of large farms (64.28%) followed by medium (54.27%) and small farms (44.67%). Among green fodder, dry fodder and concentrate, concentrate was having highest share of costs which is consistent with the earlier studies carried out by Vishnoi, (2014), Kumari, (2015) and Lal, (2016). Costs for green fodder was low followed by dry fodder. Total net cost was found highest for large farms (₹ 291.13) followed by medium (₹ 286.32) and small (₹ 241.26) farms.

Overall average milk price of the study area was ₹ 50.77 /lit and overall cost per litre of milk production was ₹ 44.04 /lit. Considering this the overall net return from per litre of milk was calculated as ₹ 6.46 /lit. The overall net return from buffalo was ₹ 39.98/lit. Comparing across different herd size categories of peri-urban dairy farms, it was observed that higher net return from buffalo was obtained in case of large farms (₹ 63.59) followed by small (₹ 36.10) and medium farms (₹ 27.39). In case of large farms higher milk productivity of the animals by performing better dairy management practices leads to higher net returns. Similarly, net return from per litre of milk was highest in case of large farms (₹ 9.10) followed by small (₹ 6.45) and medium farms (₹ 4.55). It was found that per litre cost of milk production was lowest in case of large farms (₹ 41.72 /litre) which is due to operation of economies of scale.

Cost elasticity of milk production for different herd size categories

The cost elasticity was estimated taking Cobb-Douglas functional form for average cost and yield. The result of cost elasticity of milk production is presented in the Table 4. From the Table 4 it was observed that overall cross elasticity of milk production was -0.38 which means that with one per cent increase in milk production, the average cost decreases by 0.38 per cent. The cost elasticity was found to be highest in case of large farms (-0.68) followed by medium farms (-0.66) and small farms (-0.47). The reason for this may be due to better dairy management practices followed by large farms and a greater number of crossbred cows. There was a negative relationship between per unit cost and milk yield. One per cent increase in yield reduced cost to the extent of 0.47, 0.66, and 0.68 per cent on small, medium, large farms, respectively.

Conclusions

The study shows that net return per litre of milk for crossbred cow (₹ 9.83) was more than buffalo (₹ 6.46). Therefore, it can be concluded that rearing of crossbred cow was beneficial for the farmers. Farms were mainly dependent on concentrate feeding which accounts for highest (about 70%) among feeding costs. So, dairy farmers should be encouraged for cultivation of green fodder and feeding proper nutrition for improving productivity of the animals. Labour cost was found to be higher in case of small and medium farms. It means there is a requirement of efficient utilization of labour hour for decreasing cost. Cost elasticity was found to be -0.47, -0.66 and -0.68 in case of small, medium and large farms, respectively. It was found that large farms were getting more returns on per litre of milk which may be due to better dairy management practices followed by these farms. Thus, there is a requirement of training for creating awareness about good dairy farming practices which will helpful in increasing net returns of the dairy farms.

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