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Analysis of various costs, breakeven point (BEP) and factors affecting costs of a dairy enterprise in eastern region of India

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Abstract

The present study was undertaken with a sample of 300 dairy households in the eastern region of India with an aim to study the various cost structures and determine the optimum and breakeven output level. It was observed that the variable costs (Rs. 733.31) were about eight times higher than the fixed costs (Rs. 96.30) incurred on a dairy herd. All the average cost curves slope downward from left to right showing diseconomies of scale. It was observed that out of a decrease of Rs. 0.189 in average total cost due to one litre increase in milk output, Rs. 0.168 increment was that in average variable cost and Rs. 0.021 in average fixed costs. Thus, 88 per cent increase in average total cost was due to increase in average variable cost while remaining 12 per cent was due to increase in average fixed cost, making the average variable cost more elastic than average fixed cost. At the prevailing input and milk output prices in the market, the optimum milk output obtained after equating marginal cost to marginal revenue was 6.97 litres. Among all the variables affecting total cost of milk production on a dairy herd, only off farm income and milk output in a dairy household had a positive and significant impact. Also, with a daily milk output of 11.91 litres, the dairy business in the eastern region will break even given the prices per litre of milk in the region as Rs. 27.39.

Keywords: average cost, total cost, breakeven point

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Introduction

Dairy farming is the subsidiary source of income for most of the households in the rural India [1&2]. Farmers' income, agriculture and rural economy are dependent on dairy farming such that providing socio-economic benefit to rural India [3]. Due to advent of Operation Flood (1970 – 1996), milk production in the nation has witnessed tremendous growth during the past few decades [4]. With the phenomenal success of Operation flood, government started focusing more on dairy development activities. In India, almost all the rural household whether, landed or landless, owns livestock to utilise the by-products from agriculture

rather than with an aim of making profits from them. It is not that only livestock benefit from agriculture, but agriculture also derives organic manure and draught power from livestock. Thus, livestock are closely linked with crop production.

The livestock sector contributes about 4.9 per cent of total Gross Value Added. Also, for doubling farmers' income by 2022, livestock sector is supposed to play a very crucial role [5]. Henceforth, it is very important to make more and more farmers take up dairy farming. More and more farmers would be motivated to take up dairy farming as a primary enterprise if they derive more profits from it. Profit from milk is dependent on two things, i.e., cost of milk production and price of milk. Higher prices and low cost of milk production ensure higher profits. Mostly, prices are dependent on market forces of demand and supply. Thus, farmer can aim to reduce cost of milk production to enhance the profits. Livestock rearing mostly involves few cash expenses as animals are mostly fed with crop residues and grasses from common grazing lands. Also, the labour involved in their maintenance were mostly own labour. Production cost is likely to decrease with increase in herd size. Inclusion of more of crossbred animals in herd would increase the total cost but average per litre cost would be reduced owing to their higher productivity.

With the above background, the present study was undertaken in the eastern region of the country as the region has tremendous scope for dairy development. The study aims to discover the various dairy related costs prevailing in the study area. The trendline for relationship between various average costs of a dairy herd and level of milk output and the equations related to them is also estimated in the study. Optimum level of milk output has also been determined in the study by equating the marginal cost and marginal revenue equations. Farmers must strive to lower the cost of milk production if they must increase their net income. Cost of milk production can be lowered if we are aware of the factors affecting the total daily cost of maintaining a dairy herd in the study area. Even if the dairy enterprise is not making profits, yet the amount of milk which should atleast be produced in the farm so as there is no loss is determined in the study by estimating breakeven point for the enterprise [6 &7].

Materials and Methods

The eastern region of India comprises of the states of West Bengal, Odisha, Chhattisgarh, Bihar, Assam, Eastern Uttar Pradesh, and Jharkhand. Based on the per capita availability of milk, (Bihar (195 gm/day), Jharkhand (146 gm/day), West Bengal (145 gm/day), Chhattisgarh (130 gm/day), Odisha (122 gm/day) and Assam (69 gm/day)), the states of Bihar, West Bengal and Jharkhand were selected. From each state, one district was selected based on highest livestock population density. Hence, the districts of Madhepura (0.88), Deoghar (0.37) and Hooghly (0.49) were selected from the states of Bihar, Jharkhand, and West Bengal, respectively (The values in parentheses being the livestock population density of the districts). From each district, one tehsil was selected randomly from which two villages were randomly selected. 300 respondents were selected according to probability proportional allocation from these six villages.

Using the structured interview schedule, primary data were collected from the respondents and first the herd size was converted into Standard Animal Units (SAUs) and further calculations were done considering these SAUs. The following table shows conversion for the eastern regions. (Table 1).

Table 1: Standard Animal Units for eastern region in India

Region		Adult male	Adult female	Young stock male (<1 yr)	Young stock female (<1 yr)	Young stock male (>1 yr)	Young stock female (>1 yr)	Heifer
East	Crossbred	1.07	1.20	0.25	0.24	0.51	0.38	0.71
	Local cow	0.92	1.00	0.27	0.24	0.41	0.37	0.64
	Buffalo	1.02	0.86	0.25	0.23	0.42	0.38	0.63

Using the data collected from the respondents, different costs, viz., Total Fixed Cost (TFC), Total Variable Cost (TVC), Total Cost (TC), Average Fixed Cost (AFC), Average Variable Cost (AVC), Average Total Cost (ATC) and Marginal Cost (MC) were worked out using the following formula.

$$TC=TFC+TVC \quad \ldots (1)$$

$$AFC=TFC/OUTPUT \quad \ldots (2)$$

$$AVC=TVC/OUTPUT \quad \ldots (3)$$

$$AC=AFC+AVC \quad \ldots (4)$$

$$MC=(\partial(AVC))/(\partial(OUTPUT)) \quad \ldots (5)$$

Further, regression was run to get various average cost equations along with trend lines. Quadratic functional form was found to be the best fit. Also, the factors affecting the total daily cost required to raise a dairy herd were analysed using regression analysis. Different functional forms were tried and the best fit was chosen based on highest R-square and lowest root mean square error. The structural form of the cost function was as follows:

TC = f (X1, X2, X3, X4, D1, D2)

Where,

TC = Total per day cost of raising a dairy herd

X1 = Herd Composition (number)

X2 = Off farm Income (Rs.)

X3 = Family size capable of working (number)

X4 = Milk output in a dairy household (litre)

D1 = Training received dummy (D1 = 1, if training received and D1= 0, otherwise)

D2 = Co-operative membership dummy (D2= 1, if member and D2= 0, otherwise)

Herd composition implied the ratio of crossbred in a herd to total herd size. It was hypothesised that maintenance cost of crossbreds was more and hence, total per day cost incurred on a dairy herd increased with increase in number of crossbred in a herd. Regarding off farm income it was expected that with increase in off farm income, farmers have more money available with them for spending

it on the herd, thereby, increasing the total cost. If more family members can work in the dairy farm, then all of them indulge in dairy farming. As it is own family labour hence, farmers do not realise the cost that are incurring. When imputed value of family labour is taken then the total cost increases considerably with increase in number of members involved in dairying. Theory suggests that cost is a function of output, hence, milk output was included in the function with an expectation that with increase in output, the total cost increases. The impact of training on total cost was expected to be positive because if the dairy farmer receives training, then he understands the importance of good farming practices and spends money on scientific practices and veterinary services which increases the cost of raising a dairy herd. Co-operative membership was expected to have a negative impact on cost as the cooperative societies provide many services and inputs at subsidised rate to its members, thereby, reducing the costs.

The paper also analysed the break-even point for the dairy enterprise in the study area. The break-even point can be defined as a point where total costs (expenses) and total sales (revenue) are equal. Break-even point can be described as a point where there is no net profit or loss.

Break Even point =(Total fixed costs)/((Selling price per unit-Variable cost per unit))… (6)

Results and Discussion

A perusal of Table 2 reveals that the average herd size in the region was 3.54 standard animal units. For an average herd of 3.54 SAU, the fixed cost was found to be Rs. 96.30 and total variable cost was Rs. 733.31 which made the total cost add up to Rs. 829.61. With a milk output of 37.98 litres, the average fixed cost, average variable cost and average total cost worked out to be Rs. 2.53, Rs. 19.30 and Rs. 21.83, respectively. The variable costs were about eight times higher than that of fixed costs. Similar observations regarding share of variable and fixed costs in total costs was made by [8] and [9] in their study.

Table 2: Particulars of various cost of an average dairy herd in eastern region of India

Particulars	Unit	Value
Average herd size	SAU	3.54
Total Fixed Cost (TFC)	Rs.	96.30
Total Variable Cost (TVC)	Rs.	733.31
Total Cost (TC)	Rs.	829.61
Total Milk Output (Q)	Litre	37.98
Average Fixed Cost (AFC)	Rs. /litre	2.53
Average Variable Cost (AVC)	Rs. /litre	19.30
Average Cost (AC)	Rs. /litre	21.83

Note: SAU= Standard Animal Unit

The trend lines depicting the various average costs were plotted. Fig 1a shows the trend line for average total cost. The curve falls downwards from left to right. The average cost starts off relatively high, because at low level of output, total cost is dominated by the fixed cost; mathematically speaking, the denominator is so small that the average total cost is large. Here, the average total cost still lies in the left wing (declining part) of the standard ATC curve ("U" shaped). This means that if the output is increased further then minimum ATC would be achieved. The equation for the curve suggests that any increase in output by one litre would decrease the average total cost by Rs. 0.189.

Fig 1b shows the trend line for average variable cost with increase in total output of the herd. It is a falling curve from left to right which may be visualised as the left wing of the standard "U" shaped AVC curve. Thus, even with the maximum milk production of the household in the region, minimum cost level is not reached, although it is declining with increase in milk output of the household. Thus, the dairy enterprise in the region is still having diseconomies of scale and is yet to reach to the level of economies of scale which could be achieved by enhancing the output in the region. The equation for the curve suggests that any increase in output by one litre would decrease the average variable cost by Rs. 0.168.

Fig 1c shows the trend line for average fixed cost with total output of the herd. The curve falls downward from left to right and is continuously declining. The rate of decline was more in the beginning and later the rate got reduced. Also, increase in output by one litre decreases the per litre fixed cost by Rs. 0.021.

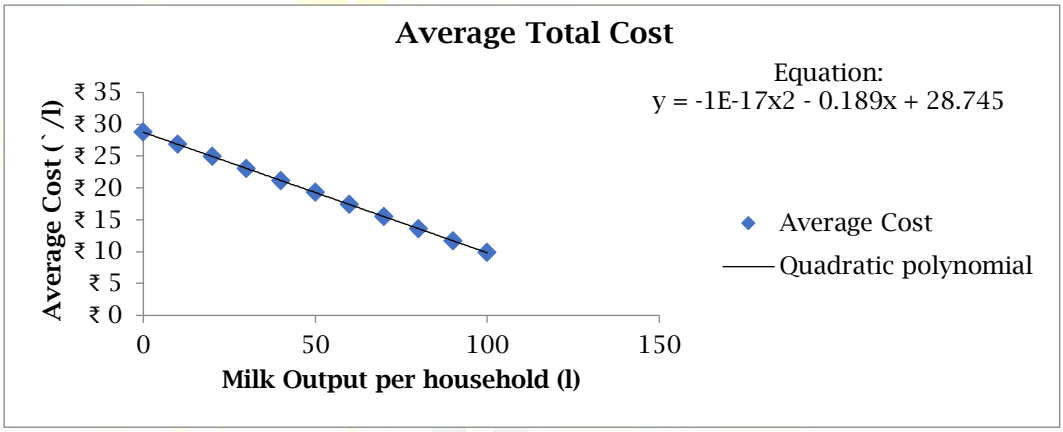

Fig 1a: Average Cost Curve

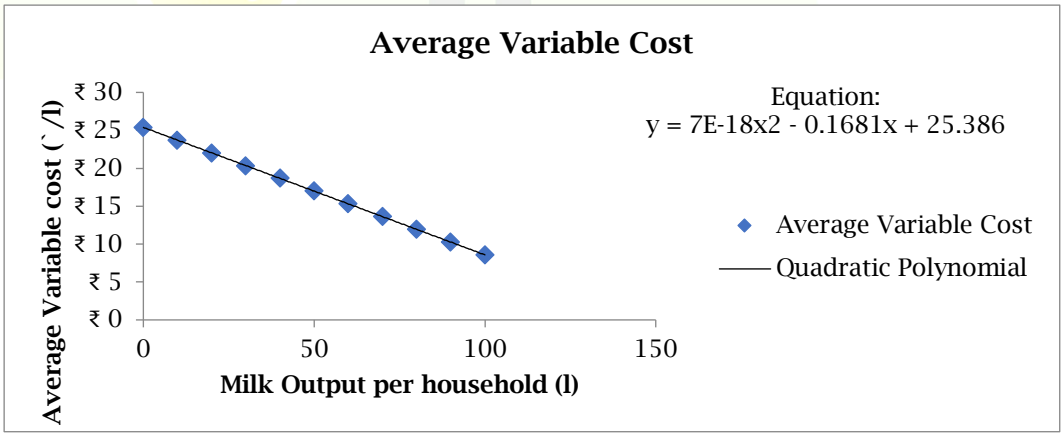

Fig 1b: Average Variable Cost

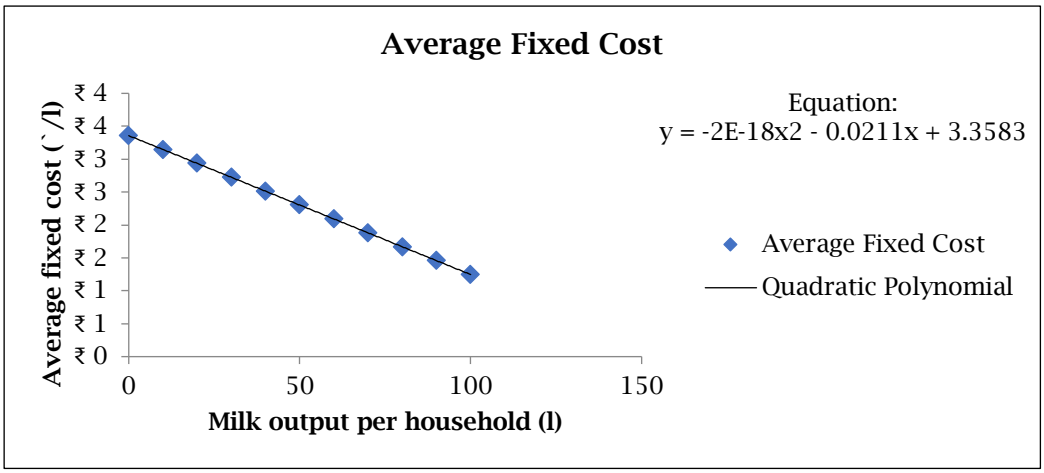

Fig 1c: Average Fixed Cost

Fig 1: Average cost curves of milk production in eastern region of India

It was observed that out of a decrease of Rs. 0.189 in average total cost due to one litre increase in milk output, Rs. 0.168 increment was in average variable cost and Rs. 0.021 in average fixed cost. Thus, 88 per cent increase in average total cost was due to increase in average variable cost while remaining 12 per cent was due to increase in average fixed cost, making the AVC more elastic than AFC.

The equation for total variable cost was found to be:

TVC=-87.35+28.25X-0.15X^2

It was differentiated with respect to milk output in order to find out the marginal cost which worked out to be:

MC=-0.30X+28.25

The marginal cost was equated to marginal revenue in order to get the optimum level of output. Marginal revenue was found by differentiating total revenue with respect to milk output. Total revenue equation was found to be as follows:

TR=39.12+25.88X+0.02X^2

Thus, marginal revenue equation works out to be:

MR=0.04X+25.88

After equating the marginal revenue with marginal cost, the optimum milk output is worked out to be 6.97 litres at the prevailing input and output prices.

Regression analysis was done to find out the factors affecting the cost involved in raising a dairy herd. Different functional forms were tried and finally quadratic form was chosen as it had the highest R square, least RMSE and maximum number of significant variables. The parameter estimates of the regression analysis of total cost function is presented in Table 3. 70.4 per cent of changes in total cost of milk production were due to the variables included in the cost function. Among all the variables chosen, only off farm income and milk output in a dairy household had a positive and significant impact on total cost of milk production. With one rupee increase in off farm income, the total cost increased by Rs. 0.002 whereas, with one litre increase in milk output in a dairy household, the total cost increased by Rs. 26.643. Herd composition, family size capable of working and training received by dairy farmer had a positive and non-significant

impact whereas membership in co-operative society had a negative and non-significant impact on total cost of milk production. Thus, milk output by dairy household was the most important factor among all the factors.

Table 3: Parameter estimates of total cost function of a dairy herd in eastern region of India

Parameters	Coefficients
Intercept	20.018 (95.645)
Herd Composition (X_1)	43.148 (154.089)
Off farm Income (X_2)	0.002** (0.001)
Family size capable of working (X_3)	23.996 (24.529)
Milk output in a dairy household (X_4)	26.643** (2.821)
Training received dummy (D_1)	2.574 (19.332)
Co-operative membership dummy (D_2)	-15.042 (22.844)
X_1^2	-140.687 (116.619)
X_2^2	-1.2×10^{-8}* 5.6×10^{-9}
X_3^2	-1.524 (2.215)
X_4^2	-0.131** (0.028)
R-square	0.704
Number of observations	300

Note: The values in the parentheses are the standard errors; *significant at 5 per cent level of significance; **significant at 1 per cent level of significance

The rate of increase in total cost and milk output was also analysed. It was observed that the rate of increase in total cost was higher than that of rate of increase in total output, the rates being 0.1462 per cent and 0.0790 per cent, respectively.

A perusal of Table 4 reveals that with a daily milk output of 11.91 litres, the dairy business in the eastern region will break even given the prices per litre of milk in the region as Rs. 27.39. With the given cost structure prevailing in the area, there would be no profit and no loss to the farmers if they produce at least about 12 litres. At this level of milk production, the total revenues from selling of milk equals the total expenses incurred on producing it.

Table 4: Break Even Point (BEP) for milk production for an average herd in eastern India

Particulars	Unit	Value
Total Fixed Cost (TFC)	Rs.	96.30
Price per litre of Milk	Rs. /litre	27.39
Total Variable Cost (TVC)	Rs.	733.31
Total Milk Output (Q)	Litre	37.98
Average Variable Cost (AVC)	Rs. /litre	19.30
Break Even Point (BEP)	Litre	11.91

Conclusions

The study witnessed that for an average herd of 3.54 SAU, the fixed cost was found to be Rs. 96.30 and total variable cost was Rs. 733.31 which made the total cost add up to Rs. 829.61. Thus, the total daily cost of maintaining one dairy animal was over Rs. 200. All the average cost curves showed the decline from left to right showing that diseconomies of scale prevailed in the area. The average cost equations suggest that average cost decreases with increase in milk output. Out of a decrease of Rs. 0.189 in average total cost due to one litre increase in milk output, Rs. 0.168 increment was in average variable cost and Rs. 0.021 in average fixed cost. Thus, the policy makers should aim to increase milk output and achieve economies of scale. Also, among the factors affecting the total cost, milk output and off farm income showed a positive and significant impact. With the prevailing milk selling price and costs, the dairy enterprise will break even at 11.91 litres of milk production. There would be no profit and no loss to the farmers if they produce at least about 12 litres.

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