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Research Paper

Economic Analysis of Milk Production: A Study of South India

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ABSTRACT

An investigation was conducted to study the economic analysis of milk production in Southern India. A total of 240 dairy farmers were selected comprising 80 each from the states of Andhra Pradesh, Karnataka and Tamil Nadu. The study revealed that the average gross maintenance cost of milk production per milch animal per day was higher in crossbred cow (₹ 234.12), followed by buffalo (₹ 163.82) and local cow (₹ 143.54), respectively. The net cost per milch animal per day was observed to be higher in crossbred cow (₹ 227.94), followed by buffalo (₹ 159.67) and local cow (₹ 139.93), respectively. The cost of milk production per litre was higher in local cow (₹ 33.13), followed by buffalo (₹ 31.84) and crossbred cow (₹ 20.99), respectively. The net return per litre was observed to be positive in case of crossbred cow (₹ 5.67) and buffalo (₹ 3.30) for all the herd size categories whereas negative net return per litre of milk was observed in case of local cow (₹ -3.93) for all the herd size categories because of high cost of feed and fodder and also low milk yield.

HIGHLIGHTS

- Average gross maintenance cost of milk production per milch animal per day was higher in crossbred cow followed by buffalo and local cow.
- The net cost per milch animal per day was observed to be higher in crossbred cow, followed by buffalo and local cow.
- The cost of milk production per litre was higher in local cow, followed by buffalo and crossbred cow, respectively.
- The net return per litre was observed to be positive in case of crossbred cow and buffalo for all the herd size categories whereas negative net return in case of local cow for all the herd size categories.

Keywords: Local cow, crossbred cow, buffalo, milk production, , milk yield, cost per litre, profit per litre

India stands first in the milk production with an estimated milk production of 211 million tonnes in 2020-21 (NDDB Report, 2020-21). It also holds top position in consumption and comprises of largest dairy herd at global level. The total livestock population had increased from 512.06 million in 2012 to 536.76 million in 2019, showing 4.82 per cent growth rate (20th Livestock Census, 2019). The share of Gross Value Added (GVA) of livestock sector shows a positive growth of 7.00 per cent during 2019-20 as compared to previous year (Annual Report, 2018-19, DAHD&F). Millions of resource-poor Indian families rely on dairy as a source of income. It's a useful tool for poverty alleviation, creating jobs, and bringing about social transformation. The dairy industry provides a pathway to upward mobility for individuals at the bottom of the socio-economic ladder, leading to large-scale voluntary income distribution without any conflicts as milk flows from all levels of income groups and money flows backwards. Milk production is an important concept as milk is consumed as one of the main dietary supplement by the Indian households. In order to meet country's demand for milk consumption

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and export oriented, dairy farming should be maintained in a profitable way by lowering the production cost or by increasing the productivity of animals and also should ensure remunerative prices to the dairy farmers. The present study was undertaken in southern India as there is a progressive growth in the dairy development and among five states in southern India, four states contributing top fifteen positions in the India's total milk production. There are several studies in Eastern India highlighting the various aspect of milk and livestock production (Singh *et al.* 2020; Kumar and Parappurathu, 2013). Additionally, studies have been carried out to estimate cost and returns of milk production confined to specific states or specific districts (Kumari *et al.* 2016; Lakshmipriya and Raju, 2019; Makarabbi and Chauhan, 2018; Meena *et al.* 2012; Pandian *et al.* 2013; Reddy *et al.* 2019; Satyanarayana *et al.* 2022; Singh 2000; Singh *et al.* 2017; Sunil *et al.* 2016; Singh *et al.* 2012; Venkatesh and Sangeetha, 2011; Umamageswari *et al.* 2017). Hence, in the present paper an attempt has been made to cover the southern India as whole to assess the costs and returns of milk production.

MATERIALS AND METHODS

Sampling plan and data collection

The study was conducted in 2020-21 in southern India. Based on highest per capita availability of milk, the states of Andhra Pradesh (623 gm/day), Karnataka (344 gm/day) and Tamil Nadu (322 gm/day) were selected in southern India. One district was selected from each state based on the highest livestock population (only cow and buffalo population was taken into consideration). Thereby, the districts of Chittoor, Belgaum and Villupuram were selected from the states of Andhra Pradesh, Karnataka and Tamil Nadu, respectively. From each district, one mandal was selected randomly from which two villages were randomly selected. A total of 240 respondents were selected comprising of 80 respondents each from the states of Andhra Pradesh, Karnataka and Tamil Nadu, respectively. Using Cumulative Square Root Frequency Method, the selected respondents were post stratified into three herd-size categories namely Small (1-3 milch animals), Medium (4-6 milch animals) and Large (7 and above milch animals), and details of sample distribution of households in the study area is presented in Table 1.

Tabular Analysis

The collected data were tabulated to compute the costs and returns of milk from various species like local cows, crossbred cows, and buffalo for different herd-size categories in the study area. The various cost components considered in the estimation of costs and returns of milk production are discussed briefly as follows:

Fixed costs

Fixed cost comprises of interest on fixed capital, depreciation on cattle shed, machinery, farm equipments and value of animals. Capital Recovery Cost (CRC) method was used to calculate the depreciation costs. The CRC method is defined as annual payment that will repay the cost of fixed input over the useful life of input and provide an economic rate of return on investment. 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

Table 1: Sample distribution of households in the study area

State	District	Taluk	Village	Small	Medium	Large	Total
Andhra Pradesh	Chittoor	Bangarupalem	Ragimanipenta	17	13	10	40
			Mothagunta	19	12	9	40
Karnataka	Belgaum	Raybag	Handigund	12	17	11	40
			Hidakal	28	7	5	40
Tamil Nadu	Villupuram	Gingee	Alampoondi	20	12	8	40
			Kariyamangalam	26	9	5	40
Southern India				122	70	48	240

of the capital asset, r = interest rate, n = useful life of the assets

In case of asset was purchased with borrowed capital, the actual interest rate charged by the bank was taken as 'r', however when the asset was purchased with owned funds, the interest on a 1-5 years term deposit was taken. The asset's useful life was assumed to be 10 years for *kachcha* cattle shed, 50 years for *pucca* cattle shed, 10 years for power operated chaff cutter and 6 years for manual chaff cutter. The same formula of CRC method was used for cattle but the value of 'n' was ascertained differently based on useful life of milch animals and was taken as 8 years (5 calvings) for crossbred and 10 years (6 calvings) for both local cow and buffalo, respectively.

Apportionment of joint costs

The apportionment of joint costs was necessary because fixed costs like water tub, buckets, store for fodder, cattle shed, feed mangers and labour and miscellaneous costs are different for various categories of animals. Hence, different categories of animals were converted into Standard Animal Units (SAUs) suggested by Sirohi *et al.* (2015). While estimating SAUs, 60 per cent weight to labour utilization and 40 per cent to body weights of animals were assigned in the final estimation. SAUs assigned for different types of animal are given in Table 2 for the area under investigation.

Table 2: Standard animal units (SAU for southern region of India

Type of Animal	Buffalo	Crossbred cow	Local cow
Adult male (≥3 years)	1.04	1.12	0.97
Adult female (≥3 years	1.24	1.62	1.00
Young stock male (< 1 year)	0.24	0.24	0.22
Young stock female (< 1 year)	0.28	0.3	0.27
Young stock male (> year)	0.6	0.63	0.54
Young stock female (> 1 year)	0.51	0.52	0.47
Heifer	0.77	0.86	0.82

Source: *Sirohi et al. (2015).*

Variable costs

The variable costs include feed and fodder cost, labour cost, veterinary cost and miscellaneous expenditure. These costs can be altered in the short run.

Feed and fodder costs

The feed and fodder costs include costs of green fodder, dry fodder and concentrate fed to animals. These costs are calculated by multiplying the quantity of feed and fodder fed to animals with the prices prevailing in the study area.

Labour cost

Labour cost includes both family labour and hired labour. Cost of grazing of animals was also included in this cost.

1 day of women labour = 0.67 man day (3 women = 2 men) by considering one man day as 8 working hours.

Veterinary and miscellaneous expenditure

Veterinary expenses includes cost of natural and artificial insemination, vaccination, medicines, veterinary doctor fee and other related expenses. Maintenance cost of fixed assets, water and electricity charges, insurance premium of animals etc. were included in the miscellaneous expenses. These costs were also apportioned to per animal per day based on SAUs.

Other cost concepts

1. **Gross Cost** = Total Variable Cost + Total Fixed Cost
2. **Net Cost** = Gross Cost – Imputed value of dung
3. **Gross Returns** = Quantity of milk × Market price of milk
4. **Net Returns** = Gross Returns – Net Cost
5. **Cost per litre (₹)** =

$$\frac{\text{Net cost per animal per day}}{\text{Total milk produced per animal per day}}$$

RESULTS AND DISCUSSION

Feeding pattern of milch animals

The assessment of feed and fodder fed and the expenditure incurred on feeding is an essential for dairy farmers to ensure high milk yield. Bazranapier -1, buffalo grass, Co-3 grass, sugarcane tops, jowar, berseem, dhaincha and cowpea tops were used as green fodder in the study area. Dry fodder consisted

of groundnut straw, paddy straw, wheat straw and jowar straw. Concentrate was given in the form of cotton seed cake, rice bran, nandini feed, navadhanya, groundnut cake, coconut oil cake and homemade left over food after human consumption. Quantity of feed and fodder fed per animal per day for local cows, crossbred cows and buffaloes has been presented in Table 3. One crossbred cow was fed with 14.94 kg of green fodder, 4.62 kg of dry fodder and 3.67 kg of concentrate per day. One buffalo was fed with 13.08 kg of green fodder, 6.33 kg of dry fodder and 2.03 kg of concentrate whereas a local cow was fed with 10.64 kg of green fodder, 5.52 kg of dry fodder and 1.62 kg of concentrate per milch animal per day. Green fodder and concentrate was fed in highest quantity for crossbred cow, followed by buffalo and the least was fed to local cow. Dry fodder was fed in highest quantity for buffalo, followed by local cow and the least was fed to crossbred cow. Maximum quantity of green fodder, dry fodder and concentrate was by and large fed by large herd size category, followed by medium herd size and small herd size categories for all the three types of animal species. As compared to crossbred cow and buffalo, local cows are not fed with more feed and fodder because of low productivity of their milk yield. They are just feeding with sufficient proportion.

Labour cost incurred per day per animal

Table 4 shows the labour cost incurred per day per animal across different herd size categories and milch animal species. Labour cost was differentiated into own labour cost and hired labour cost. The total labour cost per animal per day was highest for crossbred cow (₹ 49.99), followed by buffalo (₹ 30.26) and local cow (₹ 24.57), respectively. The own and hired labour costs was ₹ 22.26 and ₹ 2.31, respectively for local cow, ₹ 44.28 and ₹ 5.71, respectively for crossbred cow while, ₹ 27.88 and

Table 3: Quantity of feed and fodder fed to animals (Kg/animal/day)

Feed and fodder	Animal type	Herd size category			
		Small	Medium	Large	Overall
Green fodder	Local cow	10.17	10.87	11.52	10.64
	Crossbred	14.58	15.14	15.56	14.94
	Buffalo	12.63	13.25	13.97	13.08
Dry fodder	Local cow	5.29	5.61	5.95	5.52
	Crossbred	4.35	4.78	5.06	4.62
	Buffalo	6.07	6.50	6.72	6.33
Concentrate	Local cow	1.48	1.70	1.85	1.62
	Crossbred	3.51	3.74	3.95	3.67
	Buffalo	1.84	2.11	2.38	2.03

Table 4: Labour cost according to herd size category and milch animal species (₹/animal/day)

Animal type	Herd size category	Own labour cost	Hired labour cost	Total labour cost
Local cow	Small	23.09 (96.48)	0.84 (3.51)	23.93
	Medium	21.82 (88.30)	2.89 (11.69)	24.71
	Large	20.78 (79.98)	5.20 (20.01)	25.98
	Overall	22.26 (90.59)	2.31 (9.40)	24.57
Crossbred cow	Small	46.12 (93.53)	3.19 (6.46)	49.31
	Medium	42.96 (85.50)	7.28 (14.49)	50.24
	Large	41.55 (80.88)	9.82 (19.11)	51.37
	Overall	44.28 (88.58)	5.71 (11.41)	49.99
Buffalo	Small	28.4 (95.94)	1.2 (4.05)	29.60
	Medium	27.78 (90.10)	3.05 (9.89)	30.83
	Large	26.71 (85.85)	4.4 (14.14)	31.11
	Overall	27.88 (92.13)	2.38 (7.86)	30.26

Figures in parentheses show the percentage of row total.

₹ 2.38, respectively for buffalo. It was also found that for all the three animal species, the cost of own labour was decreased with increase in herd size category, whereas the cost of hired labour was more for large herd size category followed by medium herd size category and small herd size category. Similar findings were reported by Kumari *et al.* (2020). Due to low productivity, local cows are not taken care properly as a result least labour cost was observed for them. About 95 per cent share of own labour cost was observed in small herd size category in case of local cow and buffalo while in case of crossbred cow, it was 93 per cent. Nearly 90 per cent of labour cost was imputed family labour cost because almost all the dairy farming activities are being undertaken by the own family members.

Economics of milk production for local cow

Cost and returns of milk from local cow was presented in the Table 5. As a result, it was observed that out of the total gross cost, share of feed and fodder cost (77.21 per cent) was the highest followed by labour cost (20.10 per cent) and fixed cost (14.84 per cent). Feed and fodder cost was more for large category (₹ 101.17) followed by medium herd size category (₹ 96.33) and small herd size category (₹ 90.58), respectively. This is in conformity with findings of Sunil *et al.* (2016). Overall average gross maintenance cost for milch local cow per day was found to be ₹ 143.54 which varied from ₹ 137.87 for small herd size category, ₹ 146.37 for medium herd size category to ₹ 153.82 for large category.

The overall total fixed cost and total variable cost contributed 14.84 per cent and 85.16 per cent. This is in agreement with similar findings of earlier studies by Kumari *et al.* (2020) found that share of total variable cost was 83.03 per cent and Sunil *et al.* (2016) estimated that share of total variable cost was 87.04 per cent. Further perusal of Table 5 implies that the net cost of milk production was highest for the large herd size category (₹ 149.39) followed by medium herd size category (₹ 142.53) and small herd size category (₹ 134.72), respectively. Similar findings were reported by Umamageswari *et al*. (2017). Overall cost per litre of milk production was worked out to be ₹ 33.13 which was highest for small herd size category (₹ 33.93) followed by medium herd size category (₹ 33.22) and least for large herd size category (₹ 31.32), respectively. Similar findings were worked out by Sunil *et al.* (2016). The net return per litre per milch local cow was observed to be negative for all the herd size categories. Similar findings were observed by Keerthi and Paramsivam (2019), Kumari *et al.* (2020) and Umamageswari *et al*. (2017). The negative net return was highest for small herd size category

Table 5: Economics of milk production for local cow (₹/animal/day)

Cost components	Herd size category			
	Small	Medium	Large	Overall
Total Fixed Cost (TFC)	20.59 (14.93)	21.75 (14.86)	22.46 (14.60)	21.30 (14.84)
Green Fodder (F1)	44.06 (48.64)	46.34 (48.11)	48.34 (47.78)	45.58 (48.30)
Dry Fodder (F2)	13.41 (14.80)	14.93 (15.50)	15.88 (15.70)	14.35 (15.20)
Concentrate (F3)	33.11 (36.55)	35.06 (36.40)	36.95 (36.52)	34.45 (36.50)
Feed & Fodder cost (V1 = F1 + F2 + F3)	90.58 (77.23)	96.33 (77.30)	101.17 (77.02)	94.38 (77.21)
Labour cost (V2)	23.93 (20.40)	24.71 (19.83)	25.98 (19.78)	24.57 (20.10)
Vet. & Misc. expenses (V3)	2.77 (2.36)	3.58 (2.87)	4.21 (3.20)	3.29 (2.69)
Total variable cost (TVC = V1 + V2 + V3)	117.28 (85.07)	124.62 (85.14)	131.36 (85.40)	122.24 (85.16)
Gross cost (A = TFC + TVC)	137.87 (100.00)	146.37 (100.00)	153.82 (100.00)	143.54 (100.00)
Value of dung (B)	3.15	3.84	4.43	3.61
Net cost (C = A-B)	134.72	142.53	149.39	139.93
Price of milk	28.58	29.6	29.99	29.16
Average milk production/animal/day (E)	3.97	4.29	4.77	4.22
Gross return (D)	113.46	126.98	143.05	123.32
Net return (D-C)	-21.26	-15.55	-6.34	-16.61
Cost/litre (C/E)	33.93	33.22	31.32	33.13
Return / litre	-5.35	-3.62	-1.33	-3.93

Figures in parentheses show the percentage of gross cost; ***Note:*** *Small (1-3 milch animals); Medium (4-6 milch animals); Large (7 & above milch animals).*

(₹ -5.35) followed by medium herd size category (₹ -3.62) and least for large herd size category (₹ -1.33), respectively. These negative returns were due to higher feed cost and lower milk yield. Even though farmers are rearing local cows because some of the variable costs like imputed costs (farm grown feed and fodder cost other than concentrate, own family labour cost etc.) are need not be paid out costs. Hence, there might be chances of getting positive returns from local cow milk by the dairy farmers. Kumari *et al.* (2020) found that the net return per litre of local cow milk was positive for all the herd size categories by calculating returns over cash costs. The results of economics of milk production from local cows are in agreement with the findings of Chand *et al.* (2017), Keerthi and Paramsivam (2019) and Kumari *et al.* (2016), Lakshmipriya and Raju (2019).

Economics of milk production for crossbred cow

Table 6 shows the cost and returns of milk from crossbred cow. As a result, it was observed that the overall average gross cost per day per milch crossbred cow was observed to be ₹ 234.12 which varied from ₹ 230.08 for small herd size category, ₹ 236.02 for medium herd size category to ₹ 241.62 for large herd size category, respectively. The overall total fixed cost and total variable cost were ₹ 31.32 (13.38 per cent) and ₹ 202.80 (86.62 per cent), respectively. This is in agreement with similar findings of earlier studies by Kumari *et al.* (2020) and Sunil *et al. (*2016). The share of feed and fodder cost (69.75 per cent) was the highest followed by labour cost (24.65 per cent) and fixed cost (13.38 per cent). Similar findings were reported by Umamageswari *et al*. (2017). Feed and fodder cost was comparatively more for large herd size category (₹ 145.34) followed by medium herd size category (₹ 142.48) and small herd size category (₹ 139.32), respectively. This is in conformity with findings of Sunil *et al.* (2016). Further perusal of Table 6 implies that the net cost of milk production was highest for the large herd size category (₹ 235.08) followed by medium herd size category (₹ 229.71) and small herd size category (₹ 224.11), respectively. Similar findings were reported by Umamageswari *et al*. (2017). Overall cost per litre of milk production was worked out to be ₹ 20.99; it was highest for small herd size category (₹ 21.16) followed by medium herd size category (₹ 20.92) and least for large herd size category (₹ 20.69), respectively. Similar findings were reported by Sunil *et al. (*2016) and Venkatesh and Sangeetha (2011). The net return per litre per milch crossbred cow was observed to be highest for large herd size category (₹ 6.48) and lowest for small herd

Table 6: Economics of milk production for crossbred cow (₹/animal/day)

Cost components	Herd size category			
	Small	Medium	Large	Overall
Total Fixed Cost (TFC)	30.78 (13.38)	31.55 (13.37)	32.36 (13.39)	31.32 (13.38)
Green Fodder (F1)	59.81 (42.93)	60.94 (42.77)	61.89 (42.58)	60.56 (42.81)
Dry Fodder (F2)	10.44 (7.49)	11.73 (8.23)	12.48 (8.59)	11.22 (7.94)
Concentrate (F3)	69.07 (49.58)	69.81 (49.00)	70.97 (48.83)	69.67 (49.25)
Feed & Fodder cost (V1 = F1 + F2 + F3)	139.32 (69.90)	142.48 (69.68)	145.34 (69.45)	141.45 (69.75)
Labour cost (V2)	49.31 (24.74)	50.24 (24.57)	51.37 (24.55)	49.99 (24.65)
Vet. & Misc. expenses (V3)	10.67 (5.35)	11.75 (5.75)	12.55 (6.00)	11.36 (5.60)
Total variable cost (TVC = V1 + V2 + V3)	199.30 (86.62)	204.47 (86.63)	209.26 (86.61)	202.80 (86.62)
Gross cost (A = TFC + TVC)	230.08 (100.00)	236.02 (100.00)	241.62 (100.00)	234.12 (100.00)
Value of dung (B)	5.97	6.31	6.54	6.18
Net cost (C = A-B)	224.11	229.71	235.08	227.94
Price of milk	26.41	26.72	27.17	26.65
Average milk production/animal/day (E)	10.59	10.98	11.36	10.86
Gross return (D)	279.68	293.39	308.65	289.47
Net return (D-C)	55.57	63.68	73.57	61.54
Cost/litre (C/E)	21.16	20.92	20.69	20.99
Return / litre	5.25	5.80	6.48	5.67

Figures in parenthesis shows the percentage of gross cost; ***Note:*** *Small (1-3 milch animals); Medium (4-6 milch animals); Large (7 & above milch animals).*

size category (₹ 5.25), respectively. Similar findings were observed by Kumari (2015), Singh (2015) and Sunil *et al.* (2016). The results of economics of milk production from crossbred cows are in conformity with the findings of Chand *et al.* (2017), Kumari and Malhotra (2018), Keerthi and Paramsivam (2019), Lakshmipriya and Raju (2019), Singh (2015) and Sunil *et al.* (2016), Tanwar *et al.* (2012) and Vishnoi *et al.* (2015).

Economics of milk production for buffalo

Table 7 depicts that overall average gross maintenance cost per day per milch buffalo was found to be ₹ 163.82 that varied from ₹ 160.07 for small herd size category, ₹ 165.63 for medium herd size category to ₹ 170.71 for large herd size category, respectively. The overall total fixed cost was observed to be ₹ 23.87 and total variable cost was ₹ 139.95, respectively. Feed and fodder cost accounted for major share in total gross cost varying from ₹ 110.01 (75.63 per cent) for large herd size category to ₹ 104.41 (76.25 per cent) for small herd size category, respectively. This is in conformity with the findings of Sunil *et al.* (2016).

Overall per litre cost of milk production was worked out to be ₹ 31.84 which was highest in case of small herd size category (₹ 32.73) followed by medium herd size category (₹ 31.46) and lowest for large herd size category (₹ 30.38), respectively. The net return per litre per milch buffalo was found to be highest for large category (₹ 4.97) followed by medium herd size category (₹ 3.82) and lowest for small category (₹ 2.22), respectively. The results of economics of milk production from buffalo are in agreement with the findings of Chand *et al.* (2017), Kumari and Malhotra (2018), Keerthi and Paramsivam (2019), Lakshmipriya and Raju (2019), Singh (2015) and Sunil *et al.* (2016), Tanwar *et al.* (2012) and Vishnoi *et al.* (2015).

Average daily milk yield, cost per litre and profit per litre of milk

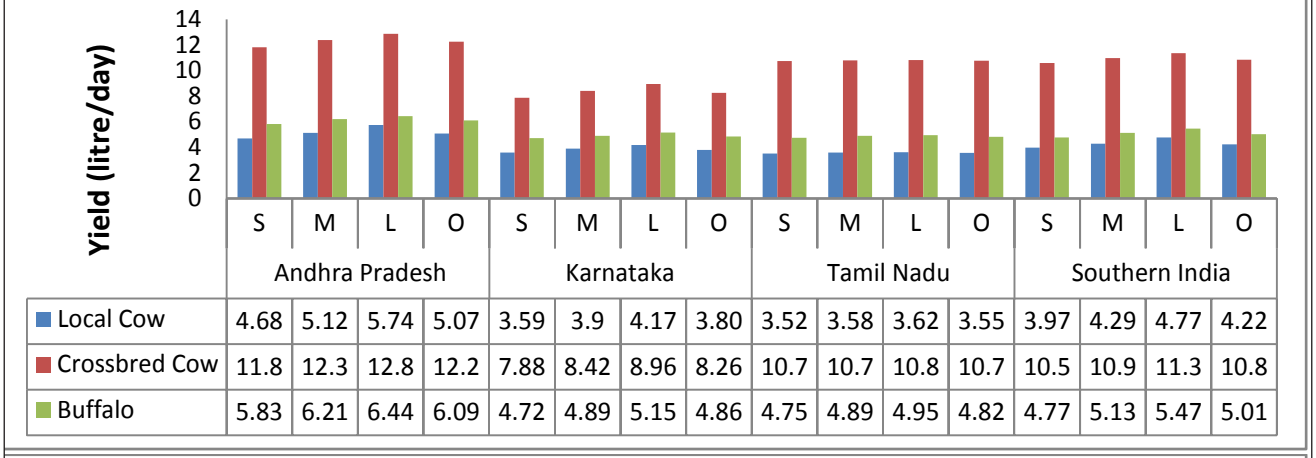
Fig. 1 depicts the graphical presentation of milk yield per day, cost per litre and profit per litre from local cow, crossbred cow and buffalo for three selected states in the study area and also for southern India as a whole. Fig. 1a shows that average milk yield per day from local cow and buffalo was highest in Andhra Pradesh (5.07 litre and 6.09 litre) followed by Karnataka (3.80 litre and 4.86 litre) and Tamil Nadu (3.55 litre and 4.82 litre), respectively. Yield from crossbred cow was also highest in Andhra Pradesh (12.25 litre) followed by Tamil Nadu (10.77 litre) and Karnataka (8.26 litre), respectively. From the Fig. 1b, it was observed that

Table 7: Economics of milk production for buffalo (₹/animal/day)

Cost components	Herd size category			
	Small	Medium	Large	Overall
Total Fixed Cost (TFC)	23.14 (14.46)	24.21 (14.62)	25.25 (14.79)	23.87 (14.57)
Green Fodder (F1)	50.82 (48.67)	51.14 (47.86)	51.91 (47.19)	51.13 (48.13)
Dry Fodder (F2)	17.47 (16.73)	18.49 (17.30)	19.94 (18.13)	18.26 (17.19)
Concentrate (F3)	36.12 (34.59)	37.22 (34.83)	38.16 (34.69)	36.85 (34.68)
Feed & Fodder cost (V1 = F1 + F2 + F3)	104.41 (76.25)	106.85 (75.56)	110.01 (75.63)	106.24 (75.92)
Labour cost (V2)	29.60 (21.62)	30.83 (21.80)	31.11 (21.39)	30.26 (21.62)
Vet. & Misc. expenses (V3)	2.92 (2.13)	3.74 (2.64)	4.34 (2.98)	3.44 (2.46)
Total variable cost (TVC = V1 + V2 + V3)	136.93 (85.54)	141.42 (85.38)	145.46 (85.21)	139.95 (85.43)
Gross cost (A = TFC + TVC)	160.07 (100.00)	165.63 (100.00)	170.71 (100.00)	163.82 (100.00)
Value of dung (B)	3.94	4.25	4.52	4.15
Net cost (C = A-B)	156.13	161.38	166.19	159.67
Price of milk	34.95	35.28	35.35	35.13
Average milk production/animal/day (E)	4.77	5.13	5.47	5.02
Gross return (D)	166.71	180.99	193.36	176.21
Net return (D-C)	10.58	19.61	27.17	16.53
Cost/litre (C/E)	32.73	31.46	30.38	31.84
Return / litre	2.22	3.82	4.97	3.30

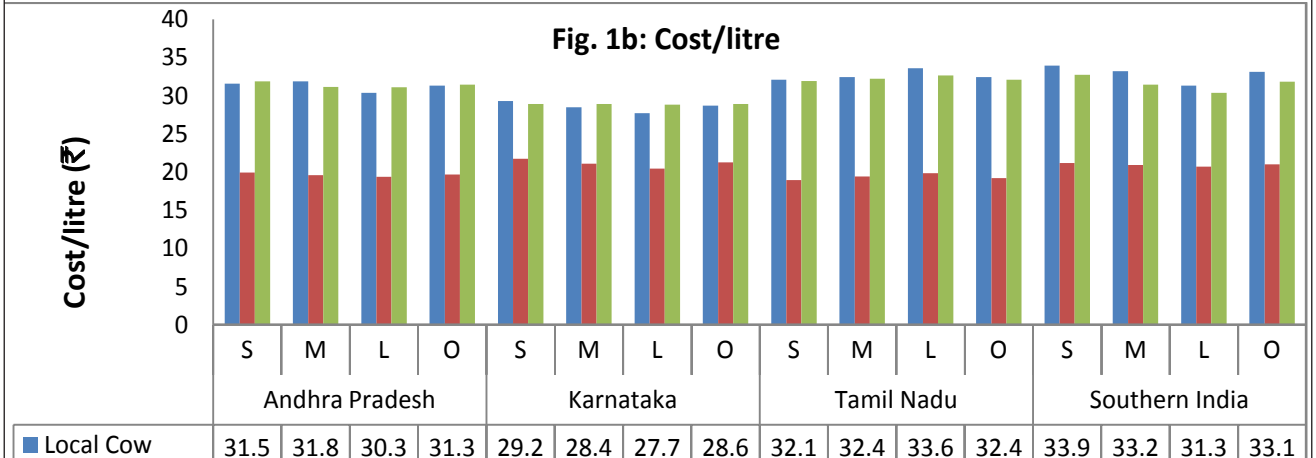
Figures in parentheses show the percentage of gross cost; ***Note:*** *Small (1-3 milch animals); Medium (4-6 milch animals); Large (7 & above milch animals).*

Fig. 1a: Yield



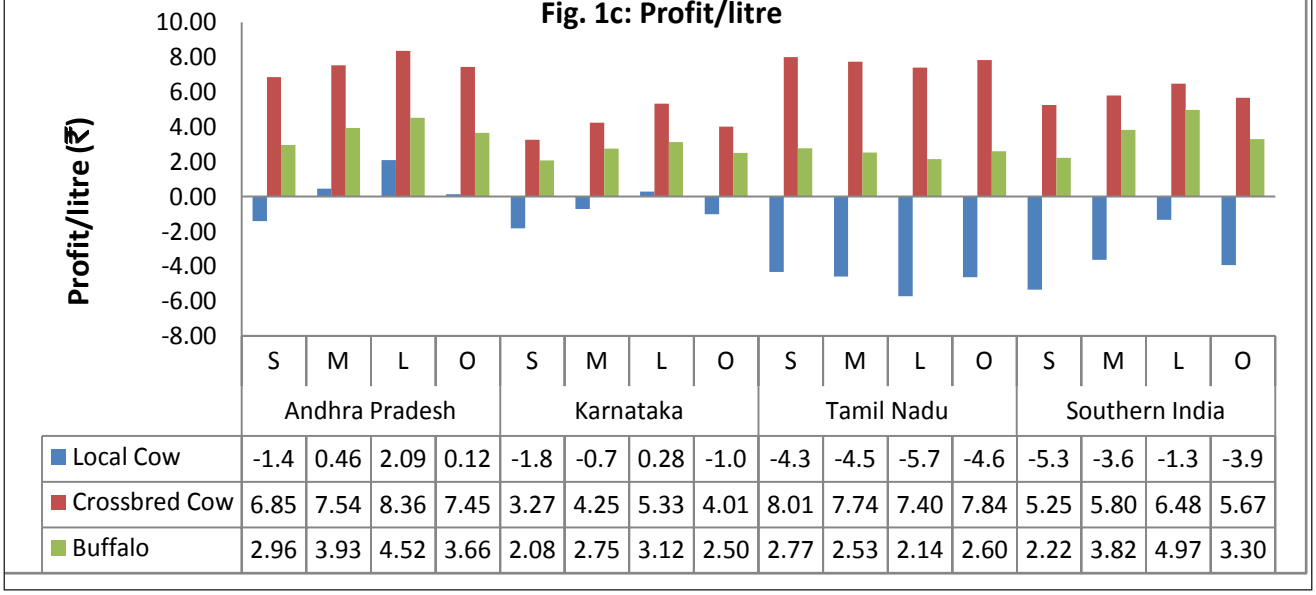
	Andhra Pradesh				Karnataka				Tamil Nadu				Southern India			
	S	M	L	O	S	M	L	O	S	M	L	O	S	M	L	O
Local Cow	4.68	5.12	5.74	5.07	3.59	3.9	4.17	3.80	3.52	3.58	3.62	3.55	3.97	4.29	4.77	4.22
Crossbred Cow	11.8	12.3	12.8	12.2	7.88	8.42	8.96	8.26	10.7	10.7	10.8	10.7	10.5	10.9	11.3	10.8
Buffalo	5.83	6.21	6.44	6.09	4.72	4.89	5.15	4.86	4.75	4.89	4.95	4.82	4.77	5.13	5.47	5.01

Fig. 1b: Cost/litre



	Andhra Pradesh				Karnataka				Tamil Nadu				Southern India			
	S	M	L	O	S	M	L	O	S	M	L	O	S	M	L	O
Local Cow	31.5	31.8	30.3	31.3	29.2	28.4	27.7	28.6	32.1	32.4	33.6	32.4	33.9	33.2	31.3	33.1
Crossbred Cow	19.9	19.6	19.3	19.6	21.7	21.1	20.4	21.2	18.9	19.4	19.8	19.2	21.1	20.9	20.6	20.9
Buffalo	31.8	31.1	31.1	31.4	28.9	28.9	28.8	28.9	31.9	32.2	32.6	32.1	32.7	31.4	30.3	31.8

Fig. 1c: Profit/litre



	Andhra Pradesh				Karnataka				Tamil Nadu				Southern India			
	S	M	L	O	S	M	L	O	S	M	L	O	S	M	L	O
Local Cow	-1.4	0.46	2.09	0.12	-1.8	-0.7	0.28	-1.0	-4.3	-4.5	-5.7	-4.6	-5.3	-3.6	-1.3	-3.9
Crossbred Cow	6.85	7.54	8.36	7.45	3.27	4.25	5.33	4.01	8.01	7.74	7.40	7.84	5.25	5.80	6.48	5.67
Buffalo	2.96	3.93	4.52	3.66	2.08	2.75	3.12	2.50	2.77	2.53	2.14	2.60	2.22	3.82	4.97	3.30

Fig. 1: Yield, cost per litre and profit per litre of milk from all the three milch species

in the states of Andhra Pradesh and Karnataka, the cost per litre of milk was highest for buffalo followed by local cow and crossbred cow. This is in conformity with the findings of earlier studies by Satyanarayana *et al.* (2022). In Tamil Nadu, the cost per litre of milk was highest for local cow followed by buffalo and crossbred cow. The findings are in agreement with the findings of Kumari *et al.* (2020) and Umamageswari *et al*. (2017). Fig. 1c implies that profit per litre from local cow was negative in the states of Tamil Nadu and Karnataka, whereas a positive net return was observed in case of Andhra Pradesh. Profit per litre from crossbred cow was highest in Tamil Nadu (₹ 7.84) while in case of buffalo it was highest in Andhra Pradesh (₹ 3.66).

CONCLUSION

In the background of the above discussion it may be concluded from the fact that average cost per litre of milk production was observed highest in case of local cow as compared to crossbred cow and buffalo due to high cost of feed and fodder and it is decreasing across herd size categories. Nearly 88-90 per cent of the labour cost is the cost of own family labour because family members themselves are undertaking most of the tasks involved in the dairy farming. The net returns per litre of milk was estimated to be highest and positive for crossbred cow and negative in case of local cows due to low productivity of local cow as compared to other milch species. On account of low productivity of local cow, it is not possible to reduce the cost incurred on feed and labour beyond a maintenance level for various barriers. As a result, total gross cost exceeds the gross revenue that led to negative net returns in case of local cow milk production. Further it was emphasized that in case of all the herd size categories of dairy farms, the productivity of crossbred cow was found higher as compared to local cow and buffalo. Hence, there is an urgent need to make efforts to introduce effective breeding technologies in dairy farming and providing quality feed and fodder in affordable prices that would obviously help in increasing the productivity of dairy animals mainly that of buffaloes and local cows. Training and regular updates to the dairy farmers for improving knowledge on dairy management practices should also be provided in order to maintain animal's health, wealth and longevity that would raise the income of dairy farmers on one hand and national exchequer on the other

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