Indian Journal of Animal Sciences **88** (6): 749–754, June 2018/Article
https://doi.org/10.56093/ijans.v88i6.80899

How profitable is dairying in tribal Chhattisgarh?

PREM CHAND[1], SMITA SIROHI[2], RAKA SAXENA[3] and ANUPAM MISHRA[4]

ICAR-Agricultural Technology Application Research Institute, Jabalpur, Madhya Pradesh 482 004 India

Received: 2 November 2017; Accepted: 22 January 2018

ABSTRACT

The study estimated the costs, returns and determinants of milk production in tribal region of Chhattisgarh using household level data from 300 farmers of two tribal districts namely Koriya and Surguja. Study found that dairy animals, particularly indigenous animals were maintained poorly, largely feeding on poor quality common property resources. Cost of milk production was estimated to be highest in buffalo (₹ 29.12/litre) and lowest in crossbred cow (₹ 20.97/litre). The rearing of local cows and buffalo for milk production as business was not profitable due to low productivity. However, higher opportunity costs of rearing these animals (₹ 14.51/litre in buffalo and ₹ 18.58/litre in local cow) may generate significant employment opportunity and additional income among the tribal farmers. The crossbred animals are economically viable at least in the short-run. But if the productivity of these animals does not increase it is likely that in the times to come, the returns will not be even sufficient to cover the rising feed and fodder costs. Positive and significant coefficients of concentrates and green fodder with respect of milk production indicate high priority to be given on these aspects by various ways like availability of seed on improved fodder, creating awareness on balance feeding, institutional arrangement for improving quality of common property resources etc.

Key words: Capital recovery cost, Chhattisgarh, Cost and return in milk production, Opportunity cost, Tribal region

Dairying is an important livelihood enterprise in tribal dominant state of Chhattisgarh. Milk and milk products accounts second highest in total value of output contributing around 7% to total value of output from agriculture and allied sector of the state (CSO 2017). The small holdings further necessitate the complementarity between crop and livestock enterprise for sustainable income of tribal farmers. Dairying not only provides additional income but also improves dietary standards of family of the poor tribals. Though state holds country's 3.75% of total bovine, 5.14% of total cattle and 6.37% of indigenous cattle population, its share in milk production is <1% (GoI 2017). As a result, the per capita availability of milk is considerably low at 141 g/day as against the national average of 352 g/day (GoI 2017). Livestock economy of the state is dominated by indigenous cattle contributing nearly 2/3rd of total milk production of 1.37 million tonnes in the state and the share is continuously increasing over the years from 56% in 2001–02 to 63.39% in 2016–17.

The cost and returns in dairy enterprise are important concern for milk producers, consumers and policy makers to provide an effective linkage among them to make rational economic decisions (Kumar and Pandian 2003). The rationality of conducting studies on economics of dairying further increase with increasing input costs in the sector and changing cropping patterns/farming systems over the years. Though number of attempts have been made on estimation of cost and returns in dairying in the country (Nagrale *et al.* 2007, Singh and Agrawal 2007, Bhowmick and Sirohi 2008, Bardhan and Sharma 2012, Chand and Sirohi 2012, Singh *et al.* 2012, Sinha *et al.* 2012, Gupta *et al.* 2014, Kumari *et al.* 2016), studies pertaining to Chhattisgarh in general and tribal areas of state in particular are lacking in the literature. Though, Jaiswal and Singh (2015) conducted a district specific study of Raipur district, there is dearth of literature on estimation of costs and returns from milk production of households representing tribal area of the state.

Use of standard methodology is another weak linked aspect in estimation of costs and returns in dairying. Unlikely to crop sector where a planned and systematic methodology is used under the comprehensive scheme on 'Cost of Cultivation Scheme of Cost and Agricultural Price Commission', no standard methodology is available in dairy sector. In view of the above, the present study was carried out with the specific objectives to estimate the cost and return from different species of dairy animals using standard methodology developed under the project, and to identify what are the major determinants of milk production in tribal areas of Chhattisgarh.

Present address: [1]Scientist (prem_mahala@yahoo.com), [3]Principal Scientist (rakasaxena@gmail.com), ICAR-National Institute of Agricultural Economics and Policy Research, Pusa, New Delhi. [2]Principal Scientist (smitasirohi@yahoo.com), ICAR-National Dairy Research Institute, Karnal, Haryana. [4]Director (amishra1958@yahoo.co.in), ICAR-ATARI, Jabalpur.

MATERIALS AND METHODS

Chhattisgarh has highest percentage of tribal population (>30%) after northeastern states. Thirteen out of 18 districts are having tribal population more than 25% and more than 1/3rd of the districts are under the category of districts having >50% tribal population. Two districts namely Surguja and Koriya were selected randomly among the 13 tribal districts of the state. From each selected district, three tehsils were selected. One tehsil was selected purposively with maximum number of milch animals and other two tehsils were selected randomly. From each tehsil, five villages were selected randomly. In order to give representation to both, the peri-urban and rural areas in the sample, out of five, three villages were selected from rural areas (viz. distance of the village from nearest town/district centre >10 km) and two from peri-urban area (viz. distance of the village from nearest town/district centre <10 km). The ultimate sampling unit was dairy farm household. Ten households owning at least one lactating animal each were selected randomly from each selected village. Total 300 households were surveyed during the agricultural year 2012–13 (July 2012 to June 2013) and seasonality was captured by collecting the data in different rounds.

Analytical tools: The methodology for estimation of costs and return in dairying is quite old, particularly the computation of capital cost and standardization of animal units. With the improved breeding practices, and changing management practices and labour use pattern, conversion factor for standardization of animal units also needs to be revised. Keeping the above factors in view, Smita *et al.* (2015) revisited the methodology for estimation of costs and return in milk production and the same was used in this paper. The broad steps and major refinement made are discussed in Sirohi *et al.* (2015).

Cost of milk production: The overall cost of milk production is an aggregate of expenditure incurred on the fixed and variable items. The fixed items are durable assets with productive life of more than a year, eg. animals sheds, store for feed and fodder, manger, machinery and equipment used in dairy, and the animal itself. To estimate the cost of durable assets as well as of animals, capital recovery cost (CRC) method was used instead of straight-line depreciation method usually followed by researchers. Another major improvement done in the methodology was construction of region specific conversation coefficients [Standard Animal Units (SAUs)] by giving appropriate weight to body weight as well as labour utilisation. The components of variable cost are: cost of feed and fodder, labour expenses, expenditure on veterinary and health care, other recurring expenditure such as repairing of shed, equipment, machinery, electricity and water charges, cost of artificial insemination (AI), natural service etc.

In order to understand the feed-milk relationship, regression analysis was carried out. Milk production is affected by genetic, environmental, feed and managerial factors like breed, order and stage of lactation, inherent potential of the animal, preceding dry period, quality and quantity of feed and fodder, labour, health care etc. Dependent variable was milk yield and independent variables were dry matter intake (DMI) from dry fodder, green fodder, concentrates and grazing, labour input, and other inputs (eg. veterinary expenses). Regression analysis was carried out for the annual data. The functional form is given below.

$$MY = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})$$

where, MY, Milk yield (l/day/animal); X_1, Labour cost (₹/day/animal); X_2, Dry fodder DMI (kg/animal/day); X_3, Concentrate DMI (kg/animal/day); X_4, Green fodder DMI (kg/animal/day); X_5, Grazing DMI (kg/animal/day); X_6, Veterinary and miscellaneous expenditure (₹/animal/day).

RESULTS AND DISCUSSION

Though livelihood systems are primarily dependent on various combinations of agriculture, forests and labour, agriculture was the principal occupation for majority of farmers (>80%), predominantly monoculture of paddy. Due to seasonality of crop enterprises and lack of irrigation facilities (90% of area was un-irrigated), a considerable proportion of households (12%) casual agricultural labour for their earnings. Livestock rearing is closely integrated in the tribal farming systems in the state as a survival enterprise. For 2/3rd of households, dairying was subsidiary occupation. However, they were largely maintaining either a small and low productive '*Kosali*' breed and unproductive and non-decriptive cattle population in their herd.

Heard size and important traits of dairy animals: The average herd size in Chhattisgarh was <3 animals (2.59

Table 1. Average herd size and important traits of dairying in tribal areas of Chhattisgarh

(Number of animals in SAUs)

Category of animal	Indigenous	Crossbred	Buffalo	All
In milk and not pregnant	0.42	0.15	0.08	0.65
In milk and pregnant	0.29	0.08	0.10	0.47
Dry and pregnant	0.40	0.07	0.08	0.55
Dry and not pregnant	0.15	0.03	0.01	0.19
Dry and unfit for breeding	0.05	0.05	0.00	0.1
Not calved even once	0.05	0.00	0.01	0.06
Pregnant heifer	0.08	0.02	0.03	0.13
Calves <1 year male	0.09	0.02	0.01	0.12
Calves <1 year female	0.15	0.02	0.02	0.19
Calves >1 year male	0.06	0.01	0.00	0.07
Calves >1 year female	0.04	0.01	0.01	0.06
Adult male	0.02	0.01	0.01	0.04
Total no. of SAU	1.78	0.45	0.36	2.59
Milch animals above 3rd lactation (%)	32.72	36.17	33.90	33.20
Age at first calving (In months)	43.65	38.71	43.9	–
Inter calving period (In months)	15.05	12.84	13.89	–
Lactation length (In months)	7.72	9.62	8.74	–

Source: Authors estimation based on survey data.

Table 2. Feed consumption pattern for different categories of animals (DMI in kg/animal/day)

DMI source	Summer	Rainy	Winter	Overall
		Local cattle		
Dry fodder	1.52	1.44	1.72	1.54
Green fodder	0	0.02	0.05	0.02
Concentrates	0.39	0.48	0.5	0.46
Grazing	2.71	2.82	2.47	2.68
Total	4.62	4.76	4.75	4.71
		Crossbred cattle		
Dry fodder	6.02	5.81	4.76	5.35
Green fodder	0.61	0.1	0.1	0.24
Concentrates	1.77	2.13	1.55	1.74
Grazing	0	0.16	3.07	1.54
Total	8.4	8.2	9.47	8.87
		Buffalo		
Dry fodder	3.81	3.6	2.91	3.36
Green fodder	0	0	0.08	0.03
Concentrates	1.14	1.2	0.72	0.99
Grazing	3.5	3.37	3.98	3.65
Total	8.45	8.17	7.7	8.04

Table 3. Grazing, condition and charge of grazing in study area

(% of households)

Grazing of animals	Koriya	Surguja	Overall
Site of grazing (%)			
Road side	1.64	12.71	7.08
Post harvesting field	20.49	11.86	16.25
Canal land	20.49	19.49	20.00
Government land	47.54	48.31	47.92
Pasture	9.84	7.63	8.75
Condition of grazing land (%)			
Good	4.10	3.39	3.75
Fair	32.79	38.98	35.83
Poor	63.11	57.63	60.42
Grazing charges paid (₹)	Free	Free	Free

Source: Authors estimation based on survey data.

SAU) and average milch animals per household was around 1.9 SAU. In a study of Raipur district of Chhattisgarh, Jaiswal and Singh (2015) found average size of milch animal at 1.97 SAU/household. Most of the animals belonged to two categories, i.e. in-milk & not pregnant and dry & pregnant (Table 1). Around 2/3rd of the animals were found in second and third order of lactation.The average age at first calving of cattle (both indigenous and crossbred) was higher in the study area than the desired age for high life time production performance.

Though the difference between two inter-calving period was not too long, the lactation length of indigenous cow, buffalo and crossbred cow was significantly low at 7.72 months, 8.74 months and 9.6 months, respectively. Almost similar results of lactation length were observed by Gupta *et al.* (2014) in Chhattisgarh based on data collected from Durg and Rajnandgaon districts of state. In a tribal area based study of Chota Nagpur Plateau of Jharkhand, Sinha *et al.* (2012) also found average lactation length of crossbred

Table 4. Productivity of milch animals in tribal area of Chhattisgarh

(l/day/animal)

Animal type	Rainy	Winter	Summer	Annual
		Koriya		
Local cow	0.89	1.7	1.31	1.3
Crossbred cow	-	8.75	3.94	6.35
Buffalo	2.20	2.28	2.26	2.25
		Surguja		
Local cow	0.94	1.45	3.78	2.06
Crossbred cow	4.77	6.55	5.88	5.73
Buffalo	2.41	2.48	3.00	2.63
		Overall		
Local cow	0.93	1.51	3.15	1.86
Crossbred cow	4.77	6.86	5.61	5.82
Buffalo	2.37	2.44	2.84	2.55

Source: Authors estimation based on survey data

cattle at 288 and 303 days, respectively among non-beneficiary and beneficiary household of micro-finance which comes around 9.6 months to 10 months.

Feeding pattern: DMI per animal was estimated as 4.71 kg, 8.87 kg and 8.04 kg/animal/day for local cattle, crossbred cattle and buffalo, respectively (Table 2). Surprisingly low intake, particularly in case of local cattle in the region may be attributed to small size of animals maintained by the farmers. As mentioned earlier, *Kosali* is the main breed of the region and the average bodyweight of female is around 160 kg. The major source of feed and fodder was through grazing as stall-feeding was limited in the study area. Paddy and wheat straw was used as dry fodder. In winter season, maize stalk was fed to animals. The cultivated green fodder was limited to maize in summer and winter season. Also some farmers cultivated oats. Concentrates that were fed to pregnant and in-milk animals only comprised cottonseed cake, mustard cake and also broken grains of rice and wheat.

Majority of the households (around 48%) grazed their animals on the government land (Table 3). The condition of the grazing land was poor and no charges were found prevailing for grazing. Fodder intakes estimated by Jaiswal and Singh (2015) also confirm the result. For local cattle, they estimated 9.08 kg of green fodder and 2.34 kg of dry fodder on fresh matter basis and converting it to dry matter basis considering average 20% and 95% DMI in green fodder and dry fodders, respectively, the quantity roughly comes to around 4.2 kg/animal. As given in Table 2, the ratio of roughage to concentrate was as higher as 90 : 10 in local cow and buffalo. Though the ratio was low in case of crossbred cow (80:20), it was still very low as compared to recommended ratio of 70:30 (Beyero *et al.* 2015, Garg *et al.* 2012). The roughage to concentrate ratio may even go up to 40% for enhancing yield, provided the animal has genetic potential to give more milk (TNAU Undated).

Cost of milk production and income from dairying: Cost and returns from milk production are directly related to productivity of animals. Higher cost leads to low cost of

Table 5. Maintenance cost of animal and milk production—Local cow

(₹/animal/day)

Cost component	Rainy	Winter	Summer	Annual
CRC on fixed assets	5.31	3.37	2.51	3.73
CRC on animal	5.35	7.48	14.37	9.06
Land rent	0.01	0.01	0.00	0.01
Total fixed cost	10.67	10.86	16.88	12.80
Dry fodder	3.09	5.45	7.86	5.47
Green fodder	0.21	0.84	0.84	0.63
Grazing	12.85	9.06	12.56	11.49
Concentrate and supplements	3.99	9.53	9.21	7.58
Total feed cost	20.13	24.89	30.47	25.17
Hired labour	8.46	2.24	1.71	4.14
Family labour	25.37	28.02	27.17	26.85
Veterinary and miscellaneous expenses	1.51	1.16	0.59	1.09
Total variable cost	55.48	56.32	59.94	57.25
Gross cost	66.16	67.17	76.82	70.06
Value of dung	19.38	16.14	16.65	17.39
Net cost	46.78	51.04	60.17	52.66
Milk yield (litre/day)	0.93	1.51	3.15	1.86
Cost of milk production (₹/litre)	50.46	33.71	19.13	29.00

Table 6. Maintenance cost of animal and milk production—Crossbred cow

(₹/animal/day)

Cost component	Rainy	Winter	Summer	Annual
CRC on fixed assets	3.03	2.24	4.63	3.23
CRC on animal	28.57	41.38	24.14	32.09
Land rent	0.01	0.00	0.01	0.01
Total fixed cost	31.61	43.62	28.78	35.33
Dry fodder	18.50	20.75	22.08	20.19
Green fodder	3.82	2.33	0.71	2.27
Grazing	0.61	13.33	0.00	6.08
Concentrate and supplements	35.50	23.12	39.09	31.41
Total feed cost	58.43	59.53	61.89	59.95
Hired labour	0.00	2.94	25.71	9.80
Family labour	34.87	35.89	8.17	26.02
Veterinary and miscellaneous expenses	1.33	1.31	1.38	1.30
Total variable cost	94.63	99.66	97.14	97.07
Gross cost	126.23	143.29	125.92	132.40
Value of dung	11.89	11.73	7.86	10.49
Net cost	114.34	131.55	118.06	121.91
Milk yield (litre/day)	4.77	6.86	5.61	5.82
Cost of milk production (₹/litre)	23.97	19.19	21.04	20.97

milk production and high return with the given prices. The average productivity of milch local cow in the region was lowest (1.86 litre/day) followed by buffalo (2.55 litre/day) and crossbred cow (5.82 litre/day) (Table 4). It is interesting to note that the milk yield of indigenous animals, particularly in local cow was higher in summer season indicating that indigenous cattle are more stress tolerance and may be sustainable under stress conditions.

The average gross maintenance cost for local cow was worked out to ₹ 70.06/animal/day (₹ 62.04 and ₹ 72.31/animal/day in Koriya and Surguja districts, respectively) out of which more than 80% were variable costs (Table 5). Labour cost accounted highest (44% of gross cost) followed by cost of feed and fodders (36%). Higher share of labour cost in local cow as compared to crossbred cow and buffalo was also reported by Jaiswal and Singh (2015). The net maintenance cost was estimated ₹ 52.66/animal/day. The maintenance cost was lower in rainy season than winter and summer seasons. The average cost of milk production was estimated to ₹ 29/litre (₹ 26.08/litre in Koriya and ₹ 35.72/litre in Surguja).

The average maintenance cost per milch crossbred cow is given in Table 6. The daily gross maintenance cost per crossbred animal was much higher (₹ 132.40/day/animal) than local cow. Unlikely to local cow, feed cost accounted highest in total cost (45.28%) followed by labour cost (27.05%) and CRC of animals (26.68%). Cost of concentrates and feed supplements alone contributed nearly 1/4th of the total cost. Similarly, the absolute amount as well as relative share of hired labour was also higher than the local cow. High CRC, higher share of feed and hired labour cost indicate that farmers are willing to invest in dairy in the region. Despite the higher maintenance cost, the cost of milk production of crossbred cow was significantly lower (₹ 20.97/litre) than the local cow due to better production performance. Lower cost of milk production from crossbred cattle as compared to buffalo and local cattle was also reported by Gauraha (2007).

Table 7. Maintenance cost of animal and milk production: Buffalo

(₹/animal/day)

Cost component	Rainy	Winter	Summer	Annual
CRC on fixed assets	3.09	0.90	4.72	2.91
CRC on animal	10.15	24.64	14.10	16.30
Land rent	0.01	0.00	0.01	0.01
Total fixed cost	13.25	25.55	18.83	19.21
Dry fodder	13.39	13.89	12.19	13.16
Green fodder	1.93	1.80	0.00	1.24
Grazing	10.27	17.78	11.41	13.15
Concentrate and supplements	19.02	15.41	20.52	18.32
Total feed cost	44.62	48.88	44.12	45.87
Hired labour	0.00	0.70	24.98	8.57
Family labour	25.78	28.79	16.49	23.69
Veterinary and miscellaneous expenses	0.99	0.52	0.46	0.65
Total variable cost	71.39	78.90	86.05	78.78
Gross cost	84.63	104.45	104.88	97.99
Value of dung	21.53	23.08	25.86	23.49
Net cost	63.11	81.37	79.02	74.50
Milk yield (litre/day)	2.37	2.44	2.84	2.55
Cost of milk production (₹/litre)	26.68	33.39	27.81	29.12

The average gross and net maintenance cost of buffalo were estimated to be ₹ 98/animal/day and ₹ 74.50/animal/

day, respectively (Table 7). Maintenance cost was comparatively low in rainy season than winter and summer season. The cost of milk production was ₹ 29.12/litre ranging from 26.68/litre in rainy season to ₹ 33.39/litre in winter season. Cost of buffalo milk production was significantly lower in Koriya (₹ 25.57/litre) than in Surguja district (₹ 30/litre).

The tribal region of Chhattisgarh is characterized by predominance of indigenous dairy animals maintained largely on poor common property resources. The productivity of indigenous cattle and buffalo was very low in the region. The cost of milk production of local cattle and buffalo just covered or even crossed the sale price of milk and hence the net economic margin turns out to be negligible or negative in the region. However, as the operating cost was low, the net profit margin per litre of milk for local cattle and buffalo was ₹ 18.58 and ₹ 14.5 litre, respectively (Table 8). The animals were heavily dependent on common property resources for their subsistence and hence the out-of-pocket expenses for the farmers were low. The crossbred cows were very profitable (net economic margin of ₹ 5.89/litre) in the region as in case of other parts of the country reported by several authors (Nagrale *et al.* 2007, Singh and Agrawal 2007, Bhowmick and Sirohi 2008, Bardhan and Sharma 2012, Chand and Sirohi 2012, Jaiswal and Singh 2015).

Determinants of milk production: Estimates of coefficients of milk production function of local cattle, crossbred cattle and buffalo are given in Table 9. Concentrate was major determinant of milk production in the region irrespective of animal. As mentioned earlier, the concentrate fed to animals was very low and lowest in case of local cow (0.46 kg/animal/day on dry matter basis) followed by buffalo (1 kg/animal/day on dry matter basis). The responsiveness of milk yield to concentrate feeding was very high. A 1% increase in concentrate feeding from its mean level would increase milk yield by 2.46% in local cow, 2.03% in crossbred cow and 0.33% in buffalo. The results were in conformity with earlier studies (Bhowmik *et al.* 2006, Sharma *et al.* 2014, Venkatesh and Sangeeta 2011, Deshetti *et al.* 2017).

Table 8. Annual cost and returns from milk production in tribal areas of Chhattisgarh

Particular	Local cow	Crossbred cow	Buffalo
Operating cost (₹/day)	18.90	64.97	41.93
Capital cost (₹/day)	12.80	35.32	19.21
Opportunity cost (₹/day)	38.36	31.11	36.85
Gross cost (₹/day) (A+B+C)	70.06	132.40	97.99
Gross returns (₹/day) [(H×G) + value of dung)]	66.36	166.64	98.12
Cost of milk production (₹/litre) [(D-value of dung)/H]	29.00 (4.65)	20.97 (0.55)	29.12 (2.26)
Sale price of milk (₹/litre)	26.27	26.86	29.22
Milk yield (litre/day)	1.86	5.82	2.55
Cash farm income (₹/day) (E-A)	47.45	101.67	56.18
Farm income (₹/day) (I-B)	34.66	66.34	36.97
Entrepreneurs' profits (₹/day) (J-C)	–3.70	34.24	0.12
Gross margin (₹/litre) (I/H)	25.45	17.48	22.04
Net margin (₹/litre) (J/H)	18.58	11.41	14.51
Net economic margin (₹/l) (K/H)	–1.98	5.89	0.05

Table 9. Estimated coefficients of milk production function

Parameter	Local	Crossbred	Buffalo
No. of observation	413	47	58
Intercept	–0.2351	3.2644	–0.4016
	(0.423)	(1.761)	(1.003)
Labour cost	–0.007	–0.0128	0.0417*
(₹/day/animal)	(0.008)	(0.031)	(0.017)
Dry fodder DMI	0.3667**	–0.3456	0.0953
(kg/animal/day)	(0.096)	(0.247)	(0.114)
Concentrate DMI	2.459**	2.0325**	1.3330**
(kg/animal/day)	(0.155)	(0.266)	(0.184)
Green fodder DMI	0.7078	0.8519	2.5424*
(kg/animal/day)	(0.700)	(0.678)	(1.017)
Grazing DMI	0.197**	0.4283**	–0.0756
(kg/animal/day)	(0.070)	(0.096)	(0.097)
Vet. & misc. expenditure/	–0.1171	0.3904	0.1731
animal/day	(0.083)	(0.514)	(0.236)
R^2	0.47	0.69	0.71

*P<0.05, **P<0.01. Figures in parenthesis are standard errors.
Source: Authors estimation based on survey data.

The regression coefficients of dry fodder also come out to be significant in case of local cow indicating that the quality of grazing sites is very poor and animals are even not getting minimum required quantity of dry fodders from grazing. Stall fed crossbred animals supplemented by grazing performed better as coefficient of grazing come out to be significant in case of crossbred cow. The regression coefficient of the veterinary expenses was not significant due to the reason that overall veterinary expenses are very low in the region. In fact capturing the variable through expenses on preventive medicine or number of preventive vaccines against the diseasescan be more relevant rather than total veterinary expenses.

Based on the survey results from 300 households from tribal region of Chhattisgarh, study concluded that rearing of local cows, a dominant bovine species in tribal area was not profitable due to low productivity. Thus, to increase the income of farmers, strategies aimed at up-gradation of nondescript cattle with superior germplasm should be intensified by the concerned state department. A very high opportunity cost of rearing indigenous dairy animals (ranging from 1/3rd to more than ½ of the total cost) indicates that dairying may generate significant employment opportunity and additional income among the tribal farmers to sustain their livelihood. However, the poor quality of common property, a major source of feed and fodders need to be addressed on priority basis through different strategies such as institutional arrangement, controlled grazing,

rotational grazing, etc. The livestock support services were very poor in the state. Despite having country's 3.75% of bovine population, breeding, healthcare, marketing and extension institutions were very low. Therefore, there is need to strengthen the livestock support services, specially improving performance of artificial insemination for upgradation and network of cooperative societies.

The crossbred animals were economically viable at least in the short-run. But if the productivity of these animals does not increase it is likely that in the times to come, the returns will not be even sufficient to cover the rising feed and fodder costs. In fact the extrapolation of the prices of milk vis-a-vis major inputs eg. fodder, oil cakes for a shorter period from 2012–13 (period of study) to 2016–17 using Whole Sale Price Indices substantiates the findings of the study as the relative increase in prices of milk is much slower than the increase input prices. Therefore, steps are needed to increase the productivity of these animals. Concentrates were found to be major determinants of milk production. Very high roughage to concentrate ratio (90: 10 for local cow and buffalo and 80 : 20 for crossbred cow) also point towards the need of balance ration approach by making availability of concentrates, supplying quality seed of fodders as area under cultivated fodder crops is very minor in the region and creating awareness among the farmers.

REFERENCES

Bardhan D and Sharma M L. 2012. Economics of milk production in Kumaun region of Uttarakhand. *Indian Journal of Dairy Science* **65**(5): 416–22.

Beyero N, Kapoor V and Tewatia B S. 2015. Effect of roughage to concentrate ratio in the diet on milk production and fatty acid profile of milk in crossbred cows. *Indian Journal of Animal Nutrition* **32**(4): 373–78.

Bhowmik P and Sirohi S. 2008. Cost of milk production and returns from dairying in South Tripura. *Indian Journal of Dairy Science* **61**(4): 303–07.

Bhowmik P, Sirohi S and Dhaka J P. 2007. Gains from crossbreeding of dairy cattle in the North East: Micro evidence from Tripura. *Indian Journal of Agricultural Economics* **61**(3): 305–13.

Chand P and Sirohi S. 2012. Dairying in semi-arid eastern zone of Rajasthan: Input productivity and net returns. *Indian Journal of Dairy Science* **65**(1): 79–83.

Chand P, Sirohi S, Mishra A and Chahal V P. 2017. Estimation of costs and returns from dairying in Malwa region of Madhya Pradesh. *Indian Journal of Animal Sciences* **87**(3): 381–86.

CSO. 2017. *Statewise and item-wise estimates of value of output from agriculture and allied sectors*. Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India.

Deshetti M B, Teggi M Y and Hosamani S V. 2017. Milk production and resource use efficiency of dairy farming under stall-fed condition in Karnataka. *Indian Journal of Dairy Science* **70**(4): 466–70.

Garg M R, Kannan A, Phondba B T, Shelke S K and Sherasia P L. 2012. A study on the effect of ration balancing for improving milk production and reducing methane emission in lactating buffaloes under field conditions. *Indian Journal of Dairy Science* **63**(3): 250–55.

Gauraha A K. 2007. Economics of milk marketing in Chhattisgarh.*Indian Journal of Agricultural Economics* **62**(3): 463–64.

Government of India. 2017. Basic Animal Husbandry and Fisheries Statistics 2017. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Krishi Bhawan, New Delhi.

Gupta J J, Singh K M, Bhatt B P and Dey A. 2014. A diagnostic study on livestock production system in eastern region of India. *Indian Journal of Animal Sciences* **84**(2): 198–203.

Nagrale B G, Datta K K and Singh S R. 2007. Cost of milk production in Vidarbha region of Maharashtra. *Indian Journal of Dairy Science* **64**(6): 514–19.

Jaiswal P and Singh R K. 2015. Economics of milk production and determinants of market participation for small holder dairy farmers in Raipur district of Chhattisgarh. *Indian Journal of Dairy Science* **68**(6): 619–28.

Sharma A. 2013. 'Economic viability of commercial dairy farms in Jabalpur district of Madhya Pradesh.'M.Sc Dissertation, National Dairy Research Institute, Karnal.

Singh K R, Agarwal S B and Malhotra R. 2007. Resource-use efficiency in milk production and disposal of milk in Imphal West district of Manipur. *Indian Journal of Dairy Science* **60**(3): 213–17.

Singh R K and Agarwal S B. 2007. Economics of milk production in Imphal west district of Manipur. *Indian Journal of Dairy Science* **60**(6): 441–46.

Sinha M K, Dhaka J P and Meena M S. 2012. Milk production economics and micro financing impacts in Chhotanagpur plateau of Jharkhand. *Indian Journal of Animal Sciences* **82**(7): 757–61.

Sirohi S, Saxena R, Chauhan A K, Dhaka J P, Sirohi S K, Kumar N, Sharma D, Pal K, Agrawal P, Sharma A, Kumar S, Feroze S M, Burdhan D, Kumar S, Chand P and Fulpagare Y G. 2015. Costs and returns in milk production: Developing standardized methodology and estimates for various dairy production systems. Project report submitted to Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, New Delhi.

TNAU. *Cattle Feed Management*. Tamil Nadu Agriculture University, Coimbatore, Tamil Nadu. Available at http: // agritech.tnau.ac.in/animal_husbandry/animhus_cattle_ %20feed%20management.html. Accessed on 22.10.2017.

Venkatesh P and Sangeeta V. 2011. Milk production and resource use efficiency in Madurai district of Tamil Nadu: An economic analysis. *Journal of Community Mobilization and Sustainable Development* **6**(1): 025–030.