Economics of milk production and factors affecting milk yield in Meghalaya: Estimating the seasonal effect

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Received: 27 December 2018 / Accepted: 13 March 2019 / Published online: 22 June 2019
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Abstract: This paper estimated the effect of season on milk yield and cost of milk production in Meghalaya, a state located in the North Eastern hill region of India. Primary data were collected from 300 randomly selected dairy farmers in three different seasons during 2013-14. It was found that a herd was composed of 2.27 crossbreds and 1.20 local milking cows in the study area. The net maintenance cost was highest in the month of winter in case of local cows (₹75) and in the month of rainy season in case of CBs (167) whereas, minimum in summer season for both local (₹68) and CB (₹151) cows. The net returns per litre of milk were negative for local cows whereas, it were positive for crossbreds; highest being in rainy season and lowest in the summer season. The amount of labour and green fodder have positive, but the stage of lactation has negative and significant effect on the milk yield across the seasons. The milk yield in rainy and winter season was significantly higher than the summer season. The ANCOVA model indicated significant effect of season on milk yield of in milk cows in the study area.

Keywords: Cost, Milk, Fodder, Labour, Season

Introduction

Agriculture is mainly of subsistence nature and organic by default in Meghalaya, a state located in the North Eastern (NE) Himalayan region of India. *Jhum* (shifting) cultivation is widely practised in the hilly ecosystem of the state. Livestock is an important component of the mixed farming system due to people's preference of meat in their daily diets. Primarily the landless and marginal households keep livestock in the NE region (NSSO, 2003) and most of the livestock rearers live below the poverty line but the sector has the potential to generate alternate livelihood to them.

The returns from dairy animal comes from sale of milk as processing of milk even at household level is not common among the tribal or Nepali rearers of the state. Gross return from dairy for a household depends on the number of milch animals per household and yield of the animals. As the sizes of dairy farms are very small in the hills, yield becomes the primary determinant of total milk production in a household and it governs the fact that whether the cost of maintenance will be recovered or not. On one hand, the milk yield is function of feed and fodder, labour and expected to be influenced by the season as well. This ultimately affects the return from dairy animal through sale of milk. On the other hand, seasonality also affects the availability of fodder and labour, thus affecting the cost of milk production. Wassena et al. (2015) concluded that seasonality of rainfall had effects on both milk produced and milk prices in Tanzania. Singh et al. (2012) reported that milk yield for CB as well as local cows was maximum in winter season and minimum in summer season. The maintenance cost was higher for CB cows than local cows and cost was highest in winter season whereas, lowest in rainy season. Studies in this direction are not available for NE hill states of India hence, this paper worked out the economics of milk production, factors affecting milk yield across different seasons in Meghalaya state.

Materials and methods

Meghalaya state is situated at 25°02'N to 26°07'N latitude and 89°49'E to 92°50'E longitude in the NE hill region of India at the elevation ranged from 60 m to 1950 m above the mean sea level (msl). The state covers an area of 22429 sq. km. The livestock

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population of Meghalaya is 1.96 m out of which is 0.92 m is bovine (Livestock Census, 2012). Indigenous cows are about 97 per cent of the total cattle population of the state. West Garo Hills, South West Garo Hills and East Khasi Hills (EKH) are the three districts where about 59 per cent of the total cattle of the state are found. Buffalo population in Meghalaya is minimal with only two per cent of the total buffalo population of NE states. The total milk production was 82.16 thousand tonnes in the state as in 2013-14, out of which 97.50 per cent is cow milk; and within the total cow milk, milk from crossbred (CB) contributed 61.95 per cent (GoM, 2016). The average yield of CB cattle in milk in Meghalaya is 7.33 kg/day but the local cows and buffalo are low yielders *i.e.*, 0.34 and 0.96 kg/day, respectively.

Sampling design and data

Two districts *i.e.*, Ri-Bhoi and East Khasi Hills (EKH) of Meghalaya were randomly selected. From Ri-Bhoi all the three community development blocks (tehsils) *i.e.*, Umsning (1), Umling (2) and Jirang (3) were selected and Myllem (1), Mawryngkneng (2) and Shella (3) were selected randomly from EKH. Five villages were selected from each block, out of which two were peri-urban villages. Ten farmers from each village and hence fifty dairy farmers from each of the selected tehsils were selected randomly. Hence, a sample of 300 dairy farmers was selected from two districts (150 farmers per district) of Meghalaya. To capture the effect of seasonality, the sample households were surveyed in three different seasons *i.e.*, rainy season from July to October, winter season from November to February and summer season from March to June. Ten households were covered from Block 1 in the month of July, August and September from each of the three rural villages (V1, V2 and V3) and in October 10 households were surveyed from a peri-urban village (V4). Data were collected from five farmers per month from village 5 (V5) during September - October. In the winter season, in first three months *i.e.*, November, December and January 10 households were surveyed from the three selected rural villages (V6, V7 and V8) and one peri-urban village (V9) of Block 2. From another peri-urban village (V10) in the months of November and December two households per month were covered and in the month of January and February three households per month were covered. The scheme of data collection from Block 3 for summer season was similar as in the case of winter season.

Analytical techniques

Estimation of cost of milk production

The general estimation procedure for cost of milk production is given below:

Gross costs = Total Fixed Cost + Total Variable Costs

Fixed Costs = Depreciation on milch animals + Depreciation on cattle sheds and dairy equipment + Interest on fixed capital investment

Variable cost = Feed and fodder cost + Labour cost + Veterinary cost + Miscellaneous cost

Gross return = (Milk yield * Price) + Value of dung + Value of urine

Net Cost = (Total cost – Value of dung – Value of urine)

Net return = Total return – Total cost

Allocation of joint costs: The joint costs include the cost of cattle sheds, cost of dairy equipment, interest on fixed capital, cost of labour and cost of land. The previous studies used the Standard Animal Units (SAUs) developed by Patel et al. (1983) which largely used for the labour utilization by different categories of animals. Apart from labour utilization, the body weight of the animal was considered to be important for estimation of SAUs. Thus, the SAU were re-estimated based on the body weights of animals (60 % weight) and labour utilization (40 % weight). The estimated SAUs are presented in Table 1.

Fixed costs

For a dairy enterprise, fixed costs specifically include depreciation on fixed assets like animals, cattle sheds and stores and dairy equipment and interest on fixed capital investment. In the study area rental value of land was zero as it's a tribal area.

Capital recovery cost (CRC) of civil structures, machinery, equipments and animals

The formula for estimation of CRC is:
$$R = Z \left[\frac{(1+r)^n \cdot r}{(1+r)^n - 1} \right]$$

Where,

R = Capital recovery cost, Z = Initial value¹ of the capital asset; in case of milch animals it is net current value of the animal *i.e.*, current value – salvage Value, r = Current interest rate, n = Useful life of the assets/animal, if the useful life of the feed manger is 10 years, then n = 10

Variable costs

Variable cost included four items *i.e.*, feed and fodder cost, labour cost, veterinary cost and miscellaneous cost.

Feed and fodder cost

The costs of green fodder, dry fodder and concentrate were worked out by multiplying respective quantities of feeds and fodders consumed by animals with the respective prevailing prices in the study area, if they were purchased. In case the

animal is fed with collected grass and tree leaves from the common property resources, its imputed value is their expected sale price. But in absence of any such market we used the labour cost involved in the activity and accounted in estimating the cost. When the concentrate feed was prepared at home, its cost was computed by taking the weighted prices of ingredients used in the concentrate, the weights being the share of ingredient in the concentrate composition.

Grazing cost

Two components were used for working out the same; the quantity of feed intake from grazing and its imputed price. Imputed price of grazed fodder was considered to be equal to the average prices of green fodder.

Cost of labour

It comprises the cost of permanent labour, family labour and contract labour. The human labour used for the maintenance of the dairy animals was recorded on the basis of actual time devoted to different animals. The cost of hired labour included the payments in cash as well as kind and computed according to the prevailing wage rates for labour in the area. The cost of family labour was imputed on the basis of average wages paid to the agricultural labour in the area. It was assumed that male and female contribute to the dairy enterprise with the same efficiency levels, thus the conversion coefficient of male: female should be used as 1:1.

Veterinary and breeding cost: It included the costs incurred on natural service, artificial insemination, vaccination, medicines, fee of veterinary doctor and other related expenses.

Miscellaneous expenditure

These included the cost of repair, cost of petroleum oil and lubricants (POL) and water, cost of electricity etc.

Returns structure

Income from dung: To estimate the monetary value of dung, weighted price of manure and dung-cakes was considered; weights being the utilization proportion of dung into manure and dung cakes. In case these products used on own-farm, the imputed value based on the prevailing rates in the village was taken.

Returns from milk production: Return from milk production was

Table 1 Standard animal units for Eastern and North Eastern region

Type of animal	Adult male	Adult female	Young stock male<1	Young stock female<1	Young stock male≥1	Young stock female≥1	Heifer
CB	1.48	1.71	0.41	0.72	0.71	1.08	1.24
Local	1.11	1.00	0.29	0.63	0.55	0.82	0.98

calculated by multiplying the milk yield with price. Estimation of milk yield was done on actual weighment of milk drawn in pail at the time of milking usually twice a day, *i.e.*, during morning and evening. For the dry animals, it was based on the peak yield in previous lactation. The thumb rule is: Lactation yield = Peak yield * 200. For the dairy farm households selling milk to more than one agency, the price of milk was weighted price paid by the agencies, weighted by the quantity of milk sold to each agency. In case of the farm households not selling milk, the price has been imputed based on the average farm-gate prices in the village.

Regression model

To understand the factors affecting yield of milking cows, the following regression model was estimated using ordinary least squares (OLS) techniques for each season separately.

$$Y_i = b_0 + b_1 \text{Lact} + b_2 \text{GF} + b_3 \text{DF} + b_4 \text{Conc} + b_5 \text{Lab} + e_i$$

Where, Y = Milk yield per animal per day, Lact = Stage of lactation, GF = Quantity of green fodder fed per animal per day in rupees, DF = Quantity of dry fodder fed per animal per day in rupees, Conc = Quantity of concentrate fed per animal per day in rupees, Lab = Labour used (mandays per animal per day) and e = stochastic error term

To study the effect of seasonality on milk yield following ANCOVA model was estimated.

$$Y_i = b_0 + b_1 \text{Lact} + b_2 \text{GF} + b_3 \text{DF} + b_4 \text{Conc} + b_5 \text{Lab} + b_6 \text{Dr} + b_7 \text{Dw} + \text{Dd} + e_i$$

Where, Y, Lact, GF, DF, Conc, Lab were as specified earlier. Dr = Dummy, Dr=1 if rainy, otherwise = 0, Dw = Dummy, Dw=1 if winter, otherwise = 0, Dd = Dummy, Dd=1 if East Khasi, otherwise = 0

Results and discussion

Herd composition and asset ownership

The average number of dairy animals in milk owned by a sample household was higher in case of crossbred (CB) (2.27) than the local (1.20) cows, but the trend was reverse in case of dry animals and animals not calved once (Table 2). About 24.81% and 17.98 % of sample households reported ownership of animals in milk in case of local and CBs, respectively. Hence, it can be said that it's a small holder milk production system that exists in the hills of Meghalaya.

Fig 1. Investment in dairy by the sample households.

Table 2 Average herd size and percentage of households reporting ownership of cows

Category of animal	SAU/household		% of households reporting ownership	
	Local	CB	Local	CB
In milk	1.20	2.27	24.81	17.98
Dry	1.60	0.94	16.98	7.55
Not calved even once	1.89	0.19	4.72	0.46
Pregnant heifer	0.98	0.62	0.34	0.62
Female calves				
Less than 1 year	0.44	0.71	20.48	22.37
More than 1 year	0.70	0.69	12.29	9.38

Note: SAU = Standard animal unit

Table 3 Feed consumption pattern across different seasons: Stall-fed quantity (kg/day/cow)

Particular	Summer		Rainy		Winter	
	Local	CB	Local	CB	Local	CB
Dry fodder: Hay	8.00	8.20	5.25	9.24	3.99	10.47
Green fodder: Grass & leaves	-	22.91	6.00	22.92	-	25.12
Concentrates	2.13	3.59	1.96	3.09	2.54	3.29
Supplements: Salt	0.10	0.16	0.09	0.15	0.11	0.17

The major investment was made on the purchase of the cows. About 46396 was spent to buy a CB cow which was significantly higher (i.e., 2.6 times) than the amount spent to buy a local cow. All the households have animal sheds but they did not have separate store for feed and fodder and separate mangers. The average investment on civil structure was only 4530/SAU (Fig. 1). Majority of the respondent households owned small equipments such as baskets, feeding trough, milk cans, milking buckets, ropes, water tanks *etc.*

Feed consumption pattern

The CB cows were strictly fed in stall feeding mode whereas, the local cows were allowed to graze freely. Green grass and leaves which were abundant in nearby forest were cut and collected for stall feeding of the CB cows in all the seasons and for local cows during rainy season only (Table 3). Highest quantity of green fodder was fed to CB cows in winter season (25 kg/CB) which was about 2 kg more than other two seasons. The survey in rainy season revealed that the local cows which were in milk but

pregnant or under medical treatment or were in case of dairy farms located in steep slopes also stall fed; though the number of such cases was limited. Hay was the only dry fodder used in stall feeding. The average amount of dry fodder fed was higher for CBs than the local cows and the differences were significant during winter and rainy seasons. In case of CBs the amount of dry fodder fed was highest in winter season (10 kg/CB) and in case of local cows it was in summer season (8 kg/CB). But in winter season the amount (4 kg/CB) of dry fodder fed to local cows was substantially low. The amount of concentrate fed to CBs was comparatively higher than the local animals. In addition, marginal quantity of salt as mineral was also added to the feed of the animals (Table 3).

Labour employment

Family labour constitutes a major chunk of total labour employed in a dairy farm especially in case of small farms. The relatively bigger farms depend on the hired labourers. An adult male from the farm family in a day worked for an average 7.85 hour in his

dairy farm. The time spent by an adult female was not significantly different from the male member but a child from the family worked for on an average 3.75 hours/day (Table 4). About half of the total time was devoted to dairy activities by a man or a child; whereas, a woman family member devoted only 32% of her time to dairy activities as she had to do her household chores too. Mainly male labourers were hired on daily basis by the cow owners. They worked for about 7.29 hours/day in the farm and 63% of their total time was devoted in dairy activities (Table 4). They cleaned the animal sheds, fed and milked the animals, cut and fetched grasses and leaves from nearby forest. The child labourers who grazed the animals and cut the grasses and leaves for the animals were engaged as permanent labourer. In addition to salary, their food, clothing and medical expenses were also provided by the employers. The male permanent labourers spent about 80% of the total time in dairy activities; it was around 69% in case of permanent female and child labourers (Table 4).

Economics of milk production

The gross cost as well as net cost of maintenance per day per animal was significantly higher (i.e., more than double) in case of CBs than the local cows across the seasons as the cost incurred in feed and fodder was significantly higher in case of CBs due to higher level of consumption. The net maintenance cost was highest in the month of winter in case of local cows (₹75) and in the month of rainy season in case of CBs (₹167) whereas, minimum in summer season for both, local (₹68) and CB (₹151) cows. Singh et al. (2012) also reported similar findings from Ajmer district of Rajasthan. The share of variable costs in the gross cost varied from 94 to 95% in case of local cows and 89 to 91% in case of CBs in the study area; remaining being the fixed costs (Table 5). Capital recovery cost (CRC) on animals had the major share in total fixed cost, followed by CRC on civil structures and equipment. No land rent was charged in the study area.

Feed cost was the major cost component within the total variable cost, followed by the cost incurred in labour. Bardhan and Sharma (2012) and Baral and Bardhan (2016) reported similar results from

Uttarakhand, another hill state in North Western India. Studies in other states of India viz., Tamil Nadu (Umamageswari et al. 2017), Maharashtra (Ghule et al. 2012) and Chattishgarh (Jaiswal and Singh, 2015) also revealed the same. The share of feed cost ranged from 65% in rainy season to 79% in summer season in case of local cows whereas it varied from 72% in winter season to 82% in summer season in case of CBs. The share of cost incurred in concentrate was substantial in total feed cost in stall feeding mode; followed by the cost of dry fodder and green fodder (Table 5).

The labour charge was cheaper in summer season in comparison to winter and rainy season (refer Appendix I) as the demand for labour during *kharif* paddy season and *rabi* season was comparatively higher than the summer season. This was the reason for the cost of maintenance of dairy animals being significantly lower in summer season than other two seasons in the study area. The labour cost was lower for local cow than the CBs because of primarily two reasons i.e., i) the CBs are high yielders and require due care the dairy farmers put more labour hours for feeding, cleaning and other regular activities and ii) the child labour were engaged for grazing of local cows whose wage rate was significantly lower than the male and female adults. The imputed family labour cost had the major share in total labour cost which is typical of small dairy farms.

The yield varied from 1.12 l/day to 1.42 l/day in case of local cows and for CB cows it varied from 8.80 l/day to 9.31 l/day. The gross returns per day per animal from milk were significantly higher for CBs than the local cows due to higher yield of CBs across the seasons. The gross return was significantly higher in rainy season than in the winter and summer seasons in case of local cows due to higher milk production in rainy season, but the difference was not significant in case of CB cows. The net returns were negative for local cows for the sample households, which were in agreement with the findings of some other researchers too (Ghule et al. 2012; Jaiswal and Singh, 2015; Umamageswari et al. 2017). The net returns from milk were positive for CBs and calculated to be 17.06/L, 17.70/L and 18.20/L in summer, winter and rainy

Table 4 Labour employment pattern by the dairy farms

Category		Total hours Dairy activities	Worked per day Dairy Operations	Distribution of total Agricultural Operations	Hours work (%) Other (household etc.)
Permanent labour	Man	6.41	80.47	14.85	4.69
	Woman	8.67	69.23	-	30.77
	Child	6.20	68.92	12.16	18.92
Paid labour	Man	7.29	62.50	7.32	10.98
	Woman	-	-	10.17	15.25
	Child	-	-	-	-
Family labour	Man	7.85	51.23	38.55	10.215
	Woman	7.11	32.36	34.765	32.87
	Child	3.75	55.56	-	44.43

season, respectively (Table 5). Similarly, Stall et al. (2003) reported that dairy production was profitable for the

smallholders in Kenya since they occur even after family labour has been paid. Low yield of the local cows makes the enterprise

Table 5 Season wise costs of and returns from milk production

Cost component		Local			CB		
		Summer	Rainy	Winter	Summer	Rainy	Winter
CRC on animals	% to TFC	66.52	52.01	63.62	85.58	81.39	87.90
CRC on civil structures		23.60	34.28	26.76	8.30	5.24	3.30
CRC on equipment		9.89	13.24	9.86	4.18	5.24	3.30
Land rent		0.00	0.00	0.00	0.00	0.00	0.00
TFC		4.45	4.23	4.26	16.51	17.57	20.58
		(5.70)	(5.21)	(4.92)	(10.05)	(9.65)	(11.42)
(/animal/day)							
Green fodder % to feed cost		0.00	0.00	0.00	18.93	20.34	21.81
Dry fodder		24.56	15.11	20.21	20.66	30.99	27.40
Concentrate		73.81	73.14	77.93	59.14	47.54	49.37
others		1.63	1.79	1.86	1.27	1.13	1.43
Total feed cost (/animal/day)		58.15	50.22	56.36	121.67	123.80	115.19
		(79.22)	(65.26)	(68.47)	(82.35)	(75.24)	(72.19)
Labour cost (/animal/day)		13.75	25.14	24.11	23.52	38.03	41.23
		(17.66)	(30.97)	(27.85)	(14.32)	(20.88)	(22.89)
Hired % to total labour cost		20.80	46.82	44.67	20.83	39.76	44.65
Family		79.20	53.18	55.37	79.21	60.11	55.35
Veterinary expenses	% to TVC	0.74	0.68	0.60	0.62	0.54	0.52
Miscellaneous expenses		0.96	1.08	1.36	1.64	1.82	2.32
Total variable cost		73.40	76.95	82.31	147.74	164.53	159.57
		(94.30)	(94.79)	(95.08)	(89.95)	(90.35)	(88.58)
Gross cost (/animal/day)		77.84	81.18	86.57	164.25	182.10	180.15
Value of dung (/animal/day)		10.03	11.20	11.51	13.37	14.93	15.35
Net cost (/animal/day)		67.81	69.98	75.06	150.88	167.17	164.80
Sale price of milk (/L)		34.52	35.05	33.66	34.52	35.05	33.66
Milk yield (L/day)		1.12	1.42	1.15	8.80	8.91	9.31
Gross return (/animal/day)		38.63	50.03	38.7	303.61	312.9	313.38
Net return (/animal/day)		-29.19	-19.96	-36.37	152.73	145.73	148.58
Cost per litre (/L)		60.27	50.11	66.64	17.47	16.84	15.96
Net return per litre (/L)		-25.75	-4.89	-32.99	17.06	18.20	17.70

Note: CB = Crossbred, CRC = Capital Recovery Cost, TFC = Total Fixed Cost, TVC = Total variable cost

non-profitable across season and districts. But it is notable that the tribal people of the state do not rear the local cattle for milk purpose rather they rear these animals for beef purpose. The sales of large and small animals actually generate annual income to the cattle keepers. So, looking into prism of milk production and linking it to the profitability aspect will be misleading.

Milk production function

Season wise milk production functions were estimated to assess the effect of feed and fodder on milk production. The milk yield per cow was regressed on stage of lactation, quantity of green fodder, quantity of dry fodder, quantity of concentrate and labour used.

Table 6 reveals that higher the lactation stage of the cow lower was the milk yield across different seasons ($p < 0.01$). Quantity of dry fodder positively influenced milk yield in summer and winter season, but the effect was significant in summer season ($p < 0.01$) may be due to higher level of dry fodder consumption in summer (Table 3). But contrary to our expectation the effect of dry fodder was found negative ($p < 0.05$) in winter season which is similar to the results reported by Patel et al. (1982). The farmers might have fed excess quantity of dry fodder to the animals at higher lactation

stage when the milk yield of the cow has already reached at the declining stage leading to negative sign for the coefficient of dry fodder (Feroze et al. 2017). The effect of green fodder on milk yield was significantly positive in all seasons whereas, in case of concentrate the effect was positive and significant ($p < 0.01$) during winter and rainy seasons only. A number of studies also reported positive effect of green fodder, dry fodder and concentrate on milk yield in different states of India (Venkatesh and Sangeetha, 2011; Meena et al. 2012; Pandian et al. 2013; Kaware and Yadav, 2014). Similar findings were reported in Pakistan (Shah et al. 2009; Andaleeb and Khan, 2017) as well as in Bangladesh (Mondal et al. 2010).

The management of the dairy unit depends on the amount of labour engaged and their skills, especially in underdeveloped production system where automation and investment is at minimal level. The effect of labour on milk yield was found to be significantly positive in Meghalaya. Visnoi et al. (2015) reported negative effect of green fodder and labour on milk yield at Jaipur of Rajasthan though they have not explained the reason behind it.

To understand the effect of season we have used ANCOVA model and the result is presented in Table 7. The coefficients of season

Table 6 Estimated coefficient of milk production function across different seasons

Parameters	Summer	Rainy	Winter
No. of observation	236	272	267
Dependent variable (physical quantity in L/day)			
Intercept	1.363	0.881	2.00
Stage of lactation	-0.265***(-6.99)	-0.125***(-2.69)	-0.327***(-8.89)
Dry fodder	0.543***(-12.57)	0.002(0.06)	-0.125**(-2.74)
Green fodder	0.044**(-2.68)	0.174***(-10.00)	0.248***(-9.34)
Concentrate	0.004(0.44)	0.465***(-4.01)	0.348***(-3.41)
Labour	12.064***(-4.05)	0.923***(-2.38)	8.654***(-3.46)
R ²	0.88	0.79	0.82

***, ** & * denotes significance at $p < 0.01$, $p < 0.05$ and $p < 0.10$, respectively

Table 7 Effect of season on milk yield (N=775)

Variables	Coefficients	Standard Error	P-value
Dependent variable (physical quantity in L/day)			
Intercept	-5.12	0.435	<0.01
Stage of lactation (month)	-0.25***	0.020	<0.01
Green fodder	0.04***	0.012	<0.01
Dry fodder	0.03	0.022	0.20
Concentrates	0.01	0.010	0.17
Labour	0.59*	0.340	0.08
Rainy Season: Dummy	0.35**	0.160	0.08
Winter Season: Dummy	0.41**	0.160	0.01
Animal type Dummy	6.83***	0.379	<0.01
District Dummy	-0.24*	0.128	0.06
R ²	0.85		

***, ** & * denotes significance at $p < 0.01$, $p < 0.05$ and $p < 0.10$, respectively

dummy variables reveal that the milk yields in rainy and winter seasons were significantly ($p < 0.05$) higher than the summer season. The types of cow is also important as we found the yield of CBs was significantly higher than the local cow ($p < 0.01$). The yield was marginally higher in EKH district than Ri-Bhoi district ($p < 0.10$).

Conclusions

The study revealed that the farmers in the study area were small dairy farm holders. Feed and labour costs were the major cost components in total cost of maintenance of dairy animals. Within the feed cost, shares of concentrate and dry fodder were highest. Primarily family labour was used in the dairy farms in the study area as the scale of operation was small. The net return from milk was negative for local cows whereas, it was positive for the CBs as milk yield for local cows were minimal but it was high for the CBs. The amount of labour and green fodder have positive, but the stage of lactation has negative and significant effect on the milk yield across the seasons in the study area. The effect of quantity of dry fodder was positive in summer season whereas negative in winter. The amount of concentrate has significant effect in winter and rainy season. The study concludes that the seasonality affects the milk yield of cows in milk as well as the cost of milk production in the state. Rearing of CBs is sustainable for the small holders of Meghalaya; so, dairy as livelihood option can be promoted to augment the income of the farmers in the state.

Acknowledgements

The paper is derived from the Department of Animal Husbandry & Dairying, New Delhi funded project entitled "Costs and Returns in Milk Production: Developing Standardized Methodology and Estimates for Various Production Systems". The authors thank to DAHD for funding.

Conflict of Interest

The authors declare that they have no conflict of interest.

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