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RESEARCH ARTICLE

Economic Analysis of Unorganized Dairy Cattle Farms in Jorhat District of Assam, India

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ABSTRACT

Dairying in India, over the years, apart from insuring nation's nutrition, has been recognized as an instrument for social and economic development. Its role in improving the economic condition of rural population has also been well recognized. In spite of the government efforts to strengthen the organized dairy sector, unorganized dairy farms continues to dominate the sector. Present study is an attempt to study the economics of unorganized dairy cattle farms in Jorhat district of Assam. The study was done by selecting 100 farmers engaged in dairy farming for commercial purposesunder unorganized dairy sector in Jorhat district of Assam. The sample selection was done through multistage random sampling technique.In the study area eight dairy farmer found to be small category, 42 dairy farmers were identified to be in medium category and 50 dairy farmers were in large category of dairy farmer. The total milk production in 100 sample dairy farms was reported as 8460.00 litres per day with average milk production of 9.74litres per day per milch animal. The total milk production per day per farm in small category was observed as 42.75litres, in medium category 67.71 litres and in large category 105.48litres. Overall the average milk production per farm in 100 sample households was estimated to be 84.60litres per farm per day. With more than 96 percent of the investments the dairy cattle's especially the cross breed and Indian breed accounted for the maximum share of the investments.Areturn of Rs. 1626.25 per farm per day in small category of dairy farms, Rs. 2584.88 per farm per day in medium category of dairy farms and Rs. 4022.10 per farm per day in large category of dairy farms was observed. The income from sale of milk constituted the maximum proportion of the income (more than 98 percent) in all the categories of the dairy farm. The returns from sale of manure/cow dung and male calves also contributed to the total income but in minimal way. It was observed that the profit per farm per day increased from Rs. 177.52 from small farms to Rs. 273.48 in medium farms to Rs. 464.21 in large dairy farms.Feed cost influence was positive and significant. Hence, increase in the use of feed would increase the revenue from dairy farms by 1.78 percent.

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Introduction

Dairying in India is as old as the Indian civilization with milch animals like cattle and buffalo considered as a symbol of purity and motherhood in the Hindu religion and domesticated as an integral part of the Indian social system. Dairying in India, over the years, apart from insuring nation's nutrition, has been recognized as an instrument for social and economic development.

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Its role in improving the economic condition of rural population has also been well recognized (Dhanabalan, 2009). The research over the years have proved that among the different allied enterprises, the dairy farming has emerged as one the major enterprise in supporting and increasing income of farmers (Singh and Joshi, 2008; Ramakrishnappa, 2006). The contribution of dairy sector in creating employment opportunities, supplementing the income of marginal and small farmers as well as creating food security have also been very well documented by the researchers (Kakaty and Gogoi, 2001). Thus, dairy

development has assumed significant importance in the rural economy of India due to its immense potential for supplementing income and employment generation for the rural people. As a result, the milk production in India, which was around 17-22 million tonnes in the 1960s, has increased to 165.40 million tonnes in 2016-17. India's milk production is estimated to have increased by 6.6 per cent from 165.40 million tonnes during 2016-17 to 176.35 million tonnes during 2017-18 (GoI, 2018). Among the milk producing countries, India ranks first in terms of milk production. Though the importance of dairy cooperatives and private sector has been highlighted at important forums, the milk procurement through cooperatives/private sector still remains low. Further, the distribution of dairy cooperatives/private sector in terms of volumes of milk handled, installed processing facilities and marketing infrastructure is highly skewed in favour of few states viz. Gujarat, Maharashtra, Karnataka and Tamil Nadu (Birthal et al., 2006). Kurup (2003) reported that from the informal sector the farmers realized price of Rs. 9.50 to Rs. 10.00 per litre. From the cooperatives the farmers realized price between Rs. 8.00 and 8.50 per litre. The middlemen used to make instant cash payments in comparison to cooperatives where it took 12- 15 day for realization of payments. Thus, it is not surprising to find evidences on selling of milk to middleman despite the existence of cooperatives in area (Samajdar et al., 2003).

With 2.4 per cent of the country's total geographical area and 2.6 per cent population of the Country, the State of Assam is situated in the North-Eastern region of India. Though agriculture is considered as the mainstay of the economy of Assam and agriculture and allied activities in Assam do continue to be the dominant sources of livelihood for majority of its people, it is also a fact that agriculture in the State is characterized by low level of productivity due to recurring natural calamities, low level of mechanization, inadequate availability of quality inputs, poor soil health, low level of assured irrigation and inadequate marketing infrastructure. This necessitates the importance of allied sectors like dairy in States economy (Kakaty and Das, 2017). Interestingly, in the state of Assam, organized development of dairy processing infrastructure was initiated even before the launch of OF (Operation Flood) Phase-I. The first processing plant in the state was established at Jorhat in 1966 with daily milk processing capacity of 5000.00 litres (Sirohi*et al.*, 2009). However, in spite of that, the present estimated production of milk in the district is about 70000.00 litres per day as against the total demand of 160000.00 litres per day and this gap is bridged by importing milk from Dimapur and other places (Government of Assam, 2013). Present study is an attempt to study the economics of unorganized dairy cattle farms in Jorhat district of Assam. The findings of this study shall help in the formulation of a comprehensive dairy development plan which may lead to bridge the existing demand-supply gap of milk in the district.

Materials and Methods

Jorhat district in State of Assam was purposively selected as in spite of the first processing plant of the State being established in 1966 (Sirohi*et al.*, 2009), there is still huge demand supply gap in the district (Progress report of dairy development in Jorhat and Golaghat District, Town Milk Supply Scheme, Jorhat, 2013). Total geographical area of Jorhat district is 2859.35 sq km. equivalent to 3.63 percent of the State. The district consists of 3 civil subdivisions, 8 development blocks and 111 Gaon panchayats with 866 revenue villages. Jorhat district consists of one municipality and 6 towns. The farmers engaged in dairy farming for commercial purposes in Jorhat district of Assam constituted the sample for the present study. A sample of 100 dairy farmers was selected through multistage random sampling technique. Using the method of cumulative square root frequency of stratification (Jaiswal and Singh, 2015), the milk producers were divided into three categories as small (having 1-5 milch cows), medium (6-10) and large having (11 and above milch cows). Though there is some variations in literatures regarding number of milch animals under each classification (i.e. small, medium and large), the present finding is nearly similar to the classification given by Jaiswal and Singh (2015) who in their study categorized dairy farmers into viz. small (having 1 milch animal), medium (having 2 to 3 milch animals) and large (having 4 and above milch animals). As per 19th Livestock Census, Jorhat district has 11893 number of crossbred cattle (3.00% of total crossbred cattle of Assam), 479602 indigenous cattle (4.84% of total indigenous cattle of Assam) and 26449 buffalo (6.07% of total buffalo of Assam) (GoI, 2012).

To achieve the specific objectives of this study, necessary data were collected from dairy farmers through personal interviews by using schedules. The data were collected during July to December, 2018.The schedules were constructed after following an extensive review of literature, discussion with experts and pilot survey. Information was sought on the milk production practices adopted by the milk farmers in the study area and the average price farmers received for the milk. Secondary data was collected from various websites and report of various committees etc.

Both tabular and functional analyses with econometrical tools were utilized for the analysis of the data and logical interpretation of the different aspects and results of the study.The Cumulative Square Root frequency procedure of stratum construction (Daleniusand Hodges,1959) was carried out for the division of dairy farmers into L strata. To understand the changes in milk production, growth rate and stability examination was done by working out compound annual growth rate, standard deviation and coefficient of variation. The interest on the fixed capital was worked out based on prevailing rate of interest i.e. 7 percent per annum (Reserve Bank of India, 2017). Depreciation on fixed asset was calculated separately for milch animals, cattle shed (the cowsheds found in the study area were semi pucca-buildings in nature), machinery and equipments (Ghule*et al.*, 2012) as given below:

Crossbred cows- 8 per cent (productive life 12.5 years)

Local cows-10 percent (productive life 10 years)
Depreciation rates forsemi- pucca building was worked out as 5 percent, for Bicycle was 8.33 percent, for Chaff-cutter as 10 percent and for Milk cans and patty items as 20 percent.

The resource-use efficiency of the inputs used by the dairy farms was estimated using Cobb-Douglas (CD), formula given by Charles Cobb and Paul Douglas in 1928 production function, as given below.

$$Y = a\ X1^{b1}\ X2^{b2}\ X3^{b3}$$

Where, Y is the revenue from farm (income from selling of milk and male calf and cow dung in rupees per day); X1, X2 and X3 denotes feed cost, miscellaneous expenditure and labour cost in rupees per day.

The estimated coefficients of significant independent variables were used to compute the marginal value products (MVP).

Where

$$MVP_i = \beta i \frac{\overline{Y}}{\overline{X_i}}$$

Here, MVPi = Marginal value product of the i^{th} input, $\overline{Y}$ = Geometric mean of the value of output, $\overline{X_i}$ = Geometric mean of the i^{th} input, βi = Estimated co-efficient (or) elasticity of the i^{th} input.

The economic efficiency of resource use was estimated as

$$r = \frac{MVP}{MFC}$$

Where, MFC_i= Marginal Factor Cost (i.e. cost of one unit of a particular resource)

Decision rule: If r = 1, resource is efficiently utilized; r> 1, resource is underutilized and r <1, resource is over utilized

Economic optimum was taken place where MVP= MFC. If r is not equal to 1, it is suggested that resource are not efficiently utilized. Adjustments could be therefore, be made in the quantity of input used and costs in the production process to restore r= 1.

Results and Discussion

Distribution of Sample Dairy Farms: As mentioned earlier, data were collected from 100 sample farmers engaged in dairy farming for commercial purposesunder unorganized dairy sector. Based on Cumulative Square Root frequency of stratification (Jaiswal and Singh, 2015), the sample dairy farms were grouped into three categories viz. small (up to 5 milch animals), medium (6-10 milch animals) and large (11 milch animals and above). Though some researchers' viz. Singh, Singh, Singh, Mishra, Kumar and Raghuvanshi (2017) classified the livestock owner having 1, 2-3 & 4 and above number of cows and buffaloes as small, medium and large livestock owners, respectively; the Cumulative Square Root frequency (Jaiswal and Singh, 2015) was found to be more scientific and thus used for the purpose of classifying sample dairy farms. From the sample respondents, eight dairy farmers were found to be in small category, 42 dairy farmers were identified to be in medium category and 50 dairy farmers were observed to be in large category (Table 1). It was observed that most of the dairy farmers under this category were second or third generation dairy farmers. As mentioned earlier, all the selected sample dairy farmers were doing dairy farming for commercial purpose (similar selection of farmers engaged in dairy farming for commercial purposes was also done by Ghule, Verma, Cahuhan and Sawale (2012).

Table 1. Distribution of Sample Dairy Farms

Sl. No	Category of Dairy Farmers	Sample Size (in numbers)
1	Small (up to 5 milch animals)	8
2	Medium (6-10 milch animals)	42
3	Large (11 milch animals and above)	50
4	**All**	**100**

Sub: Authors Calculations Based on Field Survey

Distribution of Cattle in Sample Dairy Farms: In this sector 31 milch cows, 6 dry cows, 2 heifer and 16 calves were observed for small category of dairy farms. Medium category of dairy farms reported 302 milch cows, 71 dry cows, 47 heifer and 145 calves. Large category of dairy farms reported 536 milch cows, 158 dry cows, 117 heifer and 242 calves. In the entire 100 dairy farms 869 milch cows, 235 dry cows, 165 heifer and 403 calves were observed. A total of 1672 cattle were observed in 100 dairy farms with 55 in small category, 565 in medium category and 1053 in large category of dairy farms respectively (Table 2).

Table 2. Distribution of Cattle in Sample Dairy Farms in Unorganized Dairy Sector

Sl. No.	Cattle	Categories of Dairy Farms			
		Small	Medium	Large	Total
1	Milch Cow	31	302	536	869
2	Dry Cow	06	71	158	235
3	Heifer	2	47	117	165
4	Calf	16	145	242	403
	All	**55**	**565**	**1053**	**1672**

Distribution of Cattle Breeds in Sample Dairy Farms: In small category of dairy farms 37 cows of crossbred (31 in milch and 6 in dry) were reported. In medium category of dairy farms 60 cows of local breed (53 cows in milch and 7 cows in dry) and 304 cows of crossbred (240 in milch and 64 in dry) were reported. In large category of dairy farms 143 cows of Indian breed (117 in milchand 26 in dry) and 560 cows of crossbred (428 in milch and 132 in dry) were reported. Overall in 100 sample dairy farms 203local(170 in milch and 33 in dry), and 901 crossbred (699 in milch and 202 in dry) were reported(Table 3).

Table 3. Distribution of Cattle Breeds in Sample Dairy Farms in Unorganized Dairy Sector

Sl. No.	Breeds	Category of Sample Dairy Farms							
		Small		Medium		Large		Total	
		Milch	Dry	Milch	Dry	Milch	Dry	Milch	Dry
1	Local (Non-Descript)	0	0	53	07	117	26	170	33
2	Indian Breed	0	0	0	0	0	0	0	0
3	Crossbred	31	06	240	64	428	132	699	202
	Total	**31**	**06**	**293**	**71**	**545**	**158**	**869**	**235**

Sub: Authors Calculations Based on Field Survey

Milk Production by Sample Dairy Farms: The total milk production in eight samples of small dairy farms was reported as 342.00 litres per day with average milk production of 11.03litres per day per milch animal. The total milk production in 42 samples of medium dairy farms was reported as 2844.00 litres per day with average milk production of 9.71litres per day per milch animal. The total milk production in 50 samples of large dairy farms was reported as 5274.00 litres per day with average milk production of 9.68 litres per day per milch animal. The total milk production in 100 sample dairy farms was reported as 8460.00 litres per day with average milk production of 9.74litres per day per milch animal. The total milk production per day per farm in small category was observed as 42.75litres, in medium category as 62.36litres and in large category as 105.48litres. Overall the average milk production per farm in 100 sample households was estimated to be 82.35litres per farm per day. The total milk production from crossbred per day per farm in small category was observed as 342litres, in medium category as 2735.00 litres and in large categoryobserved as 5020.00 litres. Overall the total milk production from crossbred per day per farm in 100 sample households was estimated to be 8097.00 litres per day. The average milk yield from crossbred per day per milch animal in small category was observed as 11.03litres, in medium category as 11.40litres and in large category as 11.73litres. Overall the average milk production from crossbred per day per milch in 100 sample households was estimated to be 11.58 litres per milch animals. The total milk production from non descript per day per farm in medium categorywas observed as 109.00 litres and in large category as 254.00 litres. Overall the total milk production from non descript per day per farm in 100 sample households was estimated to be 363.00 litres per day. The average milk yield from non descript per day per milch animal in medium category was observed as 2.06litres, in large category as 2.17 litres. Overall the average milk production from non descript per day per milch in 100 sample households was also estimated to be 2.14litres per milch animals(Table 4).

Table 4. Milk Production by Sample Dairy Farms in Unorganized Dairy Sector

Sl. No.	Dairy Farms	Number of Dairy Farms	Total Milk Production/Day				Average Milk Production per Day per Farm	Average Milk Yield/Day/Milch Animal			
			CB	IB	ND	Total		CB	IB	ND	Total
1	Small	8	342	0	0	342	42.75	11.03	0.00	0.00	11.03
2	Medium	42	2735	0	109	2844	67.71	11.40	0.00	2.06	9.71
3	Large	50	5020	0	254	5274	105.48	11.73	0.00	2.17	9.68
4	Total	100	8097	0	363	8460	84.60	11.58	0.00	2.14	9.74

Note: C.B= Crossbred; IB= Indian Breed; ND= Non Descript

For calculation of average milk production/day/milch animal, only milch animals under lactation were considered and the dry animals were not considered.

The above findings on milk production, is different from the findings of the Saxena (2002) where he reported that most of the total milk production in the country comes from indigenous cows (27%), crossbred cows (15%) and buffaloes (54%). In the sample dairy farms, it was observed that maximum milk production was from crossbred cows. This is again different from the State data (Assam data) where it was reported that maximum milk production in the State comes from Indigenous cattle. This difference may be possibly because, the sample dairy farms of the study were only composed of farmers engaged in dairy farming for commercial purposes.

Investment Pattern on Dairy Farms: The investments were presented in terms of rupees per farm per day for small, medium and large categories of dairy farms. With more than 94 percent of the investments the dairy cattle's especially the crossbred and Indian breed accounted for the maximum share of the investments.Previous studies also reported that the share of investment on animal always remains the highest followed by buildings and equipment. For example the share of dairy animals in total investment was found to be 61.15 percent by Sharma (2019), 56.40 percent by Ghule et al (2012), 74.70 percent by Vinod (2005) and 78.01% by Pant and Karanjkar (1965).Taking productive life of cattles into consideration, the investment per farm in cross and Indian breed was estimated to be Rs. 1127.71 per

farm per day in small category, Rs. 1676.45 in medium category per day and Rs. 2859.15 per day in large category of dairy farms. Investment in local breed was observed to be only Rs. 67.14 per farm per day and Rs. 140.08 per farm per day in medium and large category of dairy farms. In terms of percentage of total investment, it was observed that investment in crossbred and Indian breed was 94.70 percent of total investment in small dairy farms, 92.83 percent of total investment in medium dairy farms and 92.15 percent in large dairy farms(Table 5).

Table 5. Investment Pattern on Commercial Dairy Farms in Unorganized Dairy Sector

(Rupees per Farm per Day)

Sl No	Items	Category of Dairy Farms			
		Small	Medium	Large	Pooled
A)	**Animals**				
	i) Crossbred and Indian Breed	1127.71	1676.45	2859.15	2223.9
		94.70	92.83	92.15	92.47
	ii) Local Breed	0	67.14	140.08	98.24
		0.00	3.72	4.51	4.08
	Total (i& ii)	1127.71	1743.59	2999.23	2322.14
		94.70	96.55	96.66	96.55
B)	**Building (Cattle Shed and Stores)**	26.03	21.59	32.00	27.15
		2.19	1.20	1.03	1.13
C)	**Machinery, Equipments and Others**				
	(i) Bicycle	11.99	9.13	12.47	11.03
		1.01	0.51	0.40	0.46
	(ii) Chaff-cutter	0	0.98	9.04	4.93
		0.00	0.05	0.29	0.20
	(iii) Milk Cans and Petty Items	25.1	30.62	49.99	39.86
		2.11	1.70	1.61	1.66
	Total (i to iii)	37.09	40.73	71.49	55.82
		3.11	2.26	2.30	2.32
	Total Investment or Fixed Capital or Non-Recurring Expenditures (A+B+C)	**1190.82**	**1805.91**	**3102.72**	**2405.11**
		100.00	**100.00**	**100.00**	**100.00**

Note: Figures in parentheses are the percentage to total investment.

Overall it was observed that 92.47 percent of total investment was in crossbred and Indian breed in the sample of 100 dairy farms in unorganized dairy sector. The investment in local breed was 3.72 percent of total investment in medium category and 4.51 percent of total investment in large category. This is seriously higher from the findings of Ghule et al (2012) where they reported the share of dairy animals in total investment as 51.28 percent on small category, 55.19 percent on medium category and 70.12 percent in case of large category farms. Overall it was observed that 4.08 percent of total investment was in local breed in the sample of 100 dairy farms in organized dairy sector. Taking building (cattle shed and stores) into consideration, the investment per farm was estimated to be Rs. 26.03 per farm per day in small category, Rs. 21.59 in medium category per day and Rs. 32.00 per day in large category of dairy farms. Overall investments in buildings were estimated as Rs. 27.15 per farm per day. In terms of percentage of total investment, it was observed that investment in buildings was 2.19 percent of total investment in small category, 1.20 percent of total investment in medium category and 1.03 percent in large category. Overall it was observed that 1.13 percent of total investment was in buildings in the sample of 100 dairy farms in organized dairy sector. About 2.32 percent of the total investment accounted for machinery, equipment and other similar items. In small dairy farms category this investment accounted for 3.11 percent, in medium this investment accounted for 2.26 percent and in large dairy farms this investment accounted for 2.30 percent of total investment. The above finding was found to be in contrast with the observations of the previous studies where share of investment on equipment was found to be lower than that of buildings. For example the share of building and equipments was found to be 33.48 percent and 5.36 percent respectively by Sharma (2019), 36.92 percent and 6.68 percent respectively by Ghule et al (2012), 22.68 percent and 2.62 percent respectively by Vinod (2005) and 15.28 percent and 1.21 percent respectively by Pant and Karanjkar (1965). This may be because the sample dairy farmers normally constructed *kutcha* cowsheds made of locally and cheaply available material.The total investment in small category was calculated as Rs. 1190.82, in medium category Rs. 1805.91and in large category Rs. 3102.72 (Table 5).

Economics of Milk Production: The various cost components were categorized into two categories- operational fixed cost or overhead cost per day and working capital or recurring expenditure. The operational fixed cost or overhead cost per day per farm was found to be Rs. 180.89 in small category, Rs. 275.31 in medium category and Rs. 473.47 in large category of dairy farms. Overall for the entire sample Rs. 366.83 found to be spent as operational fixed cost or overhead cost per day per farm. The depreciation on crossbred& Indian breed accounted for the majority of the share of operational fixed cost or overhead cost per day per farm with Rs. 90.22 in small, Rs. 134.12 in medium, Rs. 228.73 in large category of dairy farms. As far as working capital or recurring expenditure is concerned, it was observed that Rs. 1284.47 was spent by small dairy farms per day, Rs. 2067.99 by medium dairy farms per day, Rs. 3136.28 by large dairy farms per day. The pooled recurring expenditure was estimated as Rs. 2539.45 per farm day. The expenditure on feed accounted for the majority of the share of recurring expenditure per day per farm with Rs. 899.71 in small, Rs. 1605.08 in medium, Rs. 2574.42 in large category of dairy farms. Taking both the categories of costs together, the total operational cost per day per farm was

found as Rs. 1465.37 in small category of dairy farms, Rs. 2343.30 in medium category of dairy farms, Rs. 3609.75 in large categories of dairy farms. The pooled expenditure taking all the samples together was calculated as Rs. 2539.45 per farm per day (Table 6).

Table 6. Cost on Different Categories of Commercial Dairy Farms in Unorganized Dairy Sector

(Rupees per Farm per Day)

Sl. No	Cost Components	Herd Size category			
		Small	Medium	Large	Pooled
A	**Operational Fixed Cost or Overhead Cost per Day**				
a)	Depreciation on Crossbred & Indian Breed	90.22	134.12	228.73	177.91
b)	Depreciation on Local Breed	0.00	6.71	14.01	9.82
c)	Depreciation on Building (Cattle Shed and Stores)	1.30	1.08	1.60	1.36
d)	Depreciation on Machinery, Equipments and Others				
	Bicycle	1.00	0.76	1.04	0.92
	Chaff-Cutter	0.00	0.10	0.90	0.49
	Milk Cans and Petty Items	5.02	6.12	10.00	7.97
	Total Depreciation on Equipment	6.02	6.98	11.94	9.38
e)	Interest on Fixed Capital	83.36	126.41	217.19	168.36
	Total Operational Fixed Cost Per Day	**180.89**	**275.31**	**473.47**	**366.83**
B	**Working Capital or Recurring Expenditure**				
a)	**Expenditure on Feed**				
	Feeding During Lactation Period (Green Fodder, Dry Fodder and Concentrates)	723.48	1203.79	1867.11	1497.03
	Feeding During Dry Period(Green Fodder, Dry Fodder and Concentrates)	75.51	161.60	295.14	221.48
	Feed of Heifers (Green Fodder, Dry Fodder and Concentrates)	24.27	108.63	227.16	161.14
	Feed of Calf's (Green Fodder, Dry Fodder and Concentrates)	76.45	131.06	185.01	153.66
	Total Expenditure on Feed	899.71	1605.08	2574.42	2033.32
b)	Expenditure on Veterinary Services	47.09	90.51	145.48	114.52
c)	Expenditure on Labour	300.00	300.00	300.00	300.00
d)	Miscellaneous Expenses	37.67	72.41	116.38	91.62
	Total Recurring Expenditure	**1284.47**	**2067.99**	**3136.28**	**2539.45**
C	**Operational Cost Per Day**				
a)	Total Operational fixed cost per Day	180.89	275.31	473.47	366.83
b)	Total Recurring Expenditure per Day	1284.47	2067.99	3136.28	2539.45
	Total Operational Cost Per Day	**1465.37**	**2343.30**	**3609.75**	**2906.29**

Source: Authors Calculations Based on Field Survey

Return per Farm per Day: A perusal of the table shows a return of Rs. 1642.89 per farm per day in small category of dairy farms, Rs. 2616.78 per farm per day in medium category of dairy farms, Rs. 4073.96 per farm per day in large category of dairy farms in the organized dairy sector. The pooled income taking the entire sample together was estimated as Rs. 3267.46 per farm per day. The income from sale of milk constituted the maximum proportion of the income (more than 98 percent) in all the categories of the dairy farm. The returns from sale of manure/cow dung and male calves also contributed to the total income but in minimal way. It can be suggested, at least for the large dairy farms, to go for preparation of vermicompost or similar products, which will help them to derive more income from the cow dung. The earning from the sale of milk can also be increased if the dairy farmers go for some sort of processing or value addition, which was found negligible in the sample dairy farms. The above observation is very different from the Integrated Sample Survey Report, 2004-15 which reported 22 percent of milk converted into milk products in entire Assam in 2014-15 (Table 7).

Table 7. Return per Farm per Day across Different Categories of Commercial Dairy Farms in Unorganized Dairy Sector

Sl. No.	Return Components	Herd Size category			
		Small	**Medium**	**Large**	**Pooled**
a)	Sale of Milk	1626.25	2584.88	4022.10	3226.80
		(98.99)	(98.78)	(98.73)	(98.76)
b)	Sale of Manure/Cow dung	13.56	26.07	41.90	32.98
		(0.83)	(1.00)	(1.03)	(1.01)
c)	Sale of Male Calves	3.08	5.83	9.96	7.68
		(0.19)	(0.22)	(0.24)	(0.24)
d)	**Total**	**1642.89**	**2616.78**	**4073.96**	**3267.46**
		(100.00)	**(100.00)**	**(100.00)**	**(100.00)**

Note: Figures in parentheses are the percentage of gross cost.

Source: Authors Calculations Based on Field Survey

Cost and Return Analysis: It was observed that the profit per farm per day increased from Rs. 177.52 from small farms to Rs. 273.48 in medium farms to Rs. 464.21 in large dairy farms. This is obvious considering the increased of herd size. The pooled profit per farm per day was estimated as Rs. 361.17. It was also observed that the profit per farm per year increased from Rs. 64794.8 from small farms to Rs. 99820.2 in medium farms to Rs. 169436.65 in large dairy farms. The pooled profit per farm per day was estimated as Rs. 131827.05. Here it is to be mentioned that except the medium category of farmers engaged in dairy farming for commercial purposes, rest of the categories generate less net surplus than that of Maharashtra where small category farmers generated a net surplus of Rs. 192898.00 per annum and the medium category generated a net surplus of Rs 67216.00. Even the large categorywith net profit of Rs. 312178.00 per year found to be better in Maharashtra (Ghule et al., 2012). The situation is different from the organized category of dairy farms of Jorhat district possibly because of the subsidy of Rs. 58480.00 per farm under scheme for two animals were taken by the farmers Jorhat district which will not be available for purchase of cows in unorganized sector (Priyamvada & Mishra, 2019). The less net surplus of medium and large farms in Jorhat than Maharashtra necessitates adoption of better farm management techniques by the dairy farmers in the district (Table 8).

Table 8. Cost and Returns across Different Categories of Commercial Dairy Farms in Unorganized Dairy Sector

Sl. No.	Cost and Return Components	Herd Size category			
		Small	**Medium**	**Large**	**Pooled**
a)	Number of Farms	8	42	50	100
b)	Total Operational Cost/Farm/Day (in Rupees)	1465.37	2343.30	3609.75	2906.29
c)	Total Return/Farm/Day(in Rupees)	1642.89	2616.78	4073.96	3267.46
d)	Profit/Farm/Day (in Rupees)	177.52	273.48	464.21	361.17
e)	Profit/Farm/Year(in Rupees)	64794.8	99820.2	169436.65	131827.05

Source: Authors Calculations Based on Field Survey

Resource Use Efficiency of Dairy Farms in Unorganized Dairy Sector:. In small dairy farms the R^2 value was 0.92 which indicates that 92 per cent of the variations in income from dairy farms were influenced by the explanatory variables included in the model. The miscellaneous expenditure influence was positive and significant(Table 9). As all the dairy farms reported to use one family labour with opportunity cost of Rs. 298.00 (minimum wage), due to lack of variation was not considered as a variable. The MVP of miscellaneous expenditure was calculated as 192.288 (Table 10).

Table 9. Resource Use Efficiency in Milk Production in Unorganized Dairy Sector

Variables	Categories of Dairy Farms							
	Small		Medium		Large		Pooled	
	Coefficients	*t Stat*	Coefficients	*t Stat*	Coefficients	*t Stat*	Coefficients	*t Stat*
Intercept	2.644	1.289	-2.947	-2.639	-3.702	-4.382	-3.115	-5.242
Feed Cost	-1.657	-1.923	1.760	6.216**	1.816	7.620**	1.787	10.043**
Miscellaneous Expenditure	4.409	3.759**	-0.864	-3.011**	-0.933	-3.984**	-0.942	-5.631**
Labour	-	-	0.258	2.377**	0.359	3.647**	0.309	4.235**
Sample size	8		42		50		100	
Sum of Elasticities	2.753		1.154		1.242		1.153	
R^2	0.92		0.73		0.82		0.88	
F	29.668		33.799		71.471		241.001	
Standard Error	0.095		0.133		0.138		0.139	
Cobb-Douglas Production Function	P(F,M) $=14.067M^{4.409}$		P(F,M, L) $= 0.052F^{1.760}M^{-0.864}L^{0.258}$		P(F,M) $=0.025F^{1.816}M^{-0.933}L^{0.359}$		P(F,M,L)= $0.044F^{1.787}M^{-0.942}L^{0.309}$	

** Significant at 0.05 level of significance

* Significant at 0.10 level of significance

Table 10. Economic Efficiency of Resource Use in Milk Production in Unorganized Dairy Sector

Variable	Categories of Dairy Farms																			
	Small					Medium					Large					Pooled				
	GM	RC	MVP	MFC	MVP/MFC	GM	RC	MVP	MFC	MVP/MFC	GM	RC	MVP	MFC	MVP/MFC	GM	RC	MVP	MFC	MVP/MFC
Income (Rs/Farm/Day	1642.89	-	-	-	-	2616.78	-	-	-	-	4073.96	-	-	-	-	3267.46				
Feed Cost (Rs/Farm/Day	899.71	-1.657	-3.026	1.83	-1.66	1605.06	1.760	2.869	1.63	1.76	2574.417	1.816	2.874	1.58	1.82	2033.32	1.787	2.872	1.61	1.78
Miscellaneous Expenditure (Rs/Farm/Day	37.67	4.409	192.288	43.61	4.41	72.41	-0.864	-31.224	36.14	-0.86	116.3836	-0.933	-32.659	35.00	-0.93	91.62	-0.942	-33.595	35.66	-0.94
Labour (Rs/Farm/Day	-	-	-	-	-	351.59	0.258	1.920	7.44	0.26	426.6667	0.359	3.428	9.55	0.36	385.00	0.309	2.622	8.49	0.31

GM: Geometric Mean; RC: Regression Coefficients; MVP= Marginal Value Product

In medium dairy farms the R^2 value was 0.73 which indicates that 73 per cent of the variations in income from dairy farms were influenced by the explanatory variables included in the model. The feed cost and labour influence was positive and significant and miscellaneous expenditure was negative and significant(Table 9). Hence, increase in the use of feed would increase the revenue from dairy farms by 1.76 percent, increase in the use of labour would increase the revenue from dairy farms by 0.26 percent and increase in miscellaneous expenditure decreases the farm revenue by 0.86 percent. The MVP of feed was calculated as 2.87, MVP of miscellaneous expenditure was calculated as (-) 31.22 and MVP of labour was calculated as 1.92 (Table 10).

In large dairy farms the R^2 value was 0.82 which indicates that 82 per cent of the variations in income from dairy farms were influenced by the explanatory variables included in the model. The feed cost and labour influence was positive and significant and miscellaneous expenditure was negative and significant(Table 9). Hence, increase in the use of feed would increase the revenue from dairy farms by 1.82 percent, increase in the use of labour would increase the revenue from dairy farms by 0.36 percent and increase in miscellaneous expenditure decreases the farm revenue by 0.93 percent. The MVP of feed was calculated as 2.87, MVP of miscellaneous expenditure was calculated as (-) 32.66 and MVP of labour was calculated as 3.43(Table 10).

The pooled R^2 value was 0.88 which indicates that 88 per cent of the variations in income from dairy farms were influenced by the explanatory variables included in the model. The feed cost and labour influence was positive and significant and miscellaneous expenditure was negative and significant(Table 9). Hence, increase in the use of feed would increase the revenue from dairy farms by 1.79 percent, increase in the use of labour would increase the revenue from dairy farms by 0.31 percent and increase in miscellaneous expenditure decreases the farm revenue by 0.94 percent. Kaware & Yadav (2014) reported that with respect to dairy farms in Western Maharastra (India), increase in the use of feed would increase the revenue from dairy farms by 0.38 percent and increase in the use of labour would increase the revenue from dairy farms by 0.03 percent. The MVP of feed was calculated as 2.87, MVP of miscellaneous expenditure was calculated as (-) 33.57 and MVP of labour was calculated as 2.62 (Table 10). Vinod (2005) reported MVP of feed as 5.37 for crossbred cows. He did not report MVP for labour. Kaware&Yadav (2014) reported MVP of feed as 13.85 and MVP of labour as 21.32.

Conclusion

In a sample of 100 farmers engaged in dairy farming for commercial purposes under unorganized sector in Jorhat district of Assam, eight dairy farmer found to be small category, 42 dairy farmers were identified to be in medium category and 50 dairy farmers were in large category of dairy farmer. The total milk production of sample dairy farms was reported as 8460.00 litres per day with average milk production of 9.74 litres per day per milch animal. The total milk production per day per farm in small dairy farms was observed as 42.75 litres, in medium dairy farms as 67.71 litres and in large as 105.48 litres. With more than 96

percent of the investments the dairy cattle's especially the cross breed and Indian breed accounted for the maximum share of the investments. A return of Rs. 1626.25 per farm per day in small category of dairy farms, Rs. 2584.88 per farm per day in medium category of dairy farms, Rs. 4022.10 per farm per day in large category of dairy farms was observed. The income from sale of milk constituted the maximum proportion of the income (more than 98 percent) in all the categories of the dairy farm. The returns from sale of manure/cow dung and male calves also contributed to the total income but in minimal way. It was observed that the profit per farm per day increased from Rs. 177.52 from small farms to Rs. 273.48 in medium farms to Rs. 464.21 in large dairy farms. Feed cost influence was positive and significant. Hence, increase in the use of feed would increase the revenue from dairy farms by 1.78 percent.Since labour influence was also found to be positive, it is recommended to hire some specialist labour as per the need or train the existing labour for better efficiency. The miscellaneous expenditure was found to be negatively influencing the revenue, thus it is recommended to reduce unnecessary miscellaneous expenditures.

Compliance with Ethical Standards

a) Authors' Contributions

Shweta Priyamvada: Designed the study and interpreted data.

B K Mishra: Did calculation and drafted the paper.

Deepak Bhagat: Drafted and finalized the paper.

b) Conflict of Interest

The authors declare that there is no conflict of interest.

c) Statement on the Welfare of Animals

Not Applicable

d) Statement of Human Rights

This study does not involve human participants.

References

Birthal, P.S., and Taneja, V.K., 2006. *Livestock sector in India: Opportunities and challenges.* In: Birthal PS, Taneja VK and Thorpe W (eds) Smallholder Livestock Production in India: Opportunities and Challenges. National Centre for Agricultural Economics and Policy Research, New Delhi and International Livestock Research Institute, Nairobi.

Cobb, C.W., and Douglas, P.H., 1928. A theory of production. *The American Economic Review*, 18(1): 139-165.

Dalenius, T., and Hodges, J.L., 1959. Minimum variance stratification. *Journal of the American Statistical Association*, 54(285): 88-101.

Dhanabalan, M., 2009. Productive efficiency of milk production in Tamil Nadu. *Indian Journal of Marketing*, 39(12): 57-61.

Ghule, A.K., Verma, N.K., Cahuhan, A.K., and Pravin, S.P., 2012. An economic analysis of investment pattern, cost of milk production and profitability of commercial dairy farms in Maharashtra. *Indian Journal of Dairy Science*, 65(4): 329-336.

GoI., 2012. 19th Livestock Census-2012 (All India Report). Ministry of Agriculture Department of Animal Husbandry, Dairying and FisheriesKrishi Bhawan, New Delhi.

Government of Assam. (2013). *Progress report of dairy development in Jorhat and Golaghat District, Town Milk Supply Scheme, Jorhat*.

Jaiswal, P., and Singh, Kh. R., 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): 619–628.

Kakaty, G., and Das, A.K., 2017. *Assessment of the status of dairying and potential to improve socio-economic status of the milk producers and convergence of all central and state schemes at district level in Assam.* Agro-Economic Research Centre for North-East India, Assam Agricultural University.

Kakaty, G., and Gogoi, M., 2001. Employment and income opportunity in dairy enterprises of Assam - A case study. *Agricultural Situation in India*, 66(2): 69-75.

Kaware, S.S., and Yadav, D.B., 2014. Economic analysis of milk production in Western Maharashtra. *International Research Journal of Agricultural Economics and Statistics*, 5(1): 55-59.

Kurup, M.P.G. (2003). Livestock sector in Orissa. *Indian Journal of Agricultural Economics*, 48: 59.

Pant, S.P., and Karanjkar, S.V., 1965. Economics of dairy enterprise in Jabalpur with special reference to the scale of enterprise. *Indian Journal of Agricultural Economics*, 20(1): 116-121.

Priyamvada, S., and Mishra, B.K., 2019. Economic analysis of dairy cattle farms under town milk supply scheme in Jorhat district of Assam. *Indian Journal of Dairy Science*, 72(3): 1-10.

Ramakrishnappa, V., and Jagannatha, R.R., 2006. Emerging microfinance issues in dairy development: A case study from Karnataka, India. *International Journal of Agricultural Resources, Governance and Ecology*, 5(4): 399-412.

Reserve Bank of India. (2017). Interest Subvention Scheme for Short Term Crop Loans during the year 2017-18. https://rbidocs.rbi.org.in/rdocs/notification/PDFs/NOTI48EA7D9A680B574A57A68535D992A54795.PDF

Samajdar, T., and Chander, M., 2003. Milk production by forest dwellers: A case of Vangujjars of Uttaranchal. *Indian Dairyman*, 55(5): 49-51.

Sharma, S., 2019. Commercial Dairy Farming in Jaipur District of Rajasthan: A Case Study. *Acta Scientific Agriculture*, 3(7): 122-127.

Singh, J.K., Singh, R., Singh, J.P., Mishra, S.K., Kumar, R., and Raghuvanshi, T., 2017. A study of the cost and returns of milk production of cow and buffalo and to find out the break-even point of dairy enterprise in Faizabad district of eastern Uttar Pradesh, India. *International Journal of Current Microbiology and Applied Sciences*, 6(11): 3928-3938.

Singh, M., and Joshi, A.S., 2008. Economic analysis of crop production and dairy farming on marginal and small farms in Punjab. *Agricultural Economics Research Review*, 21(347-2016-16692): 251-257.

Sirohi, S., Kumar, A., and Staal, S.J., 2009. Formal milk processing sector in Assam: Lessons to be learnt from institutional failure. *Agricultural Economics Research Review*, 22(2): 245-254.

Vinod., 2005. *An economic analysis production, utilization and disposal pattern of milk in rural areas of Bidar district of Karnataka.* Unpublished MSc thesis. National Dairy Research Institute, Karnal, Haryana.