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RESEARCH ARTICLE

EFFECT OF SIZE OF DAIRY UNITS ON ECONOMICS OF MILK PRODUCTION IN GARO HILLS OF MEGHALAYA

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ABSTRACT

The present investigation was carried out in Garo Hills District of Meghalaya. The objective of the study was to find out the variation in the cost of milk production due to the variation in the size of dairy units. There were 142 annual varieties, 31 alternate variety, 24 crossbred and only 3 combine breed cattle samples out of 200 samples selected by stratified random sampling technique. The milk producing dairy units were classified into small (1-3), medium (4-6) and large (7 and above) herd size category using cumulative square root frequency method. The average milk yield per day in litres for NDLC- Annual type, NDLC- Alternate type and Combine Breed for both milking and milch cows was found to be highest in small herd size category with 1 to 3 animals. But for milking Crossbred it was highest in large herd size category with ≤ 7 animals. For milch Crossbred it was highest with 4-6 animals in medium herd size category. The net return was positive only for small herd size category with `1.71 in NDLC- Annual type and negative for all the herd size of NDLC-Alternate type cows.For Crossbred it was positive and highest for medium herd size category with `263.76 and for Combine breed it was also highest for small herd size category with net return of `82.32 per milch cow per day.

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INTRODUCTION

Milk Production in hilly areas are generally considered as a subsidiary occupation rearing one or two local cow depending on agricultural waste and open grazing in the field (Singh and Agarwal, 2007) or hilly jungle and forest areas. This provides subsidiary occupation in semi-urban areas and more for people living in the hilly tribal and draught prone areas (Rao *et al*., 2004). The milk production and per capita availability in less milk producing areas especially the Northeast Region had a dismal figure. These less producing area are also the non-operational flood areas where dairy development has not gained momentum and dominated by traditional dairy farming practices (Singh *et al*., 2014) and Meghalaya is one of them (Singh and Chauhan, 2015). In Meghalaya, the total milk production during 2007-2008 was 76,500 tonnes, of which the total milk production in the Western part of Meghalaya i.e., Garo Hills was 20,005 thousand tonnes. Indigenous and crossbred cattle contribute 15,030 and 3,072 thousand tonnes respectively and a negligible contribution of only 1,003 thousand tonnesis are recorded from the buffaloes (Statistical Handbook Meghalaya, 2009).

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As per livestock census 2003, Garo Hills has a cattle population of 4, 16,736, of which only 3,207 comprises crossbred cattle and rest indigenous cattle. Keeping in view, the enormous dominance of indigenous cattle breed population (99.42%) over cross breed population (0.58%) according to livestock census 2007, also as the demand for milk is more than the production, further, since, very less and negligible studies have been conducted in the study area, the Garo Hills of Meghalaya was undertaken to study the economics of milk production due to the variation in the size of the dairy units since dairy farming on scientific lines offers great opportunities for increasing farm income and employment, particularly to the weaker sections, of the rural community, who are illiterate and ignorant on the economic aspects of milk production (Ganeshkumar *et al*., 2000).

MATERIALS AND METHODS

The present study was conducted in Garo Hills region of Meghalaya State in all the three districts viz. South Garo Hills, East Garo Hills, and West Garo Hills respectively before the splitting and formation of the latest two more new districts, South West and North Garo Hills. Data were collected during 2011 to 2013 covering the entire three districts which include twelve blocks and thirty-six villages, collected from a total number of two hundred dairy owners selected through

stratified random sampling procedure with the help of pre-tested schedule by personal interview method of sampling and actual field observation.

Construction of research instrument

For this purpose a schedule was prepared containing questions and columns to record information about description of the unit, herd statistics, animal housing, feeding, breeding, milking, milk production performance, various dairy operations viz., cleaning of sheds, health care and hygiene, farm sanitation, veterinary work, daily working schedule of the unit and about the member or personnel employed and cost incurred on all these items was prepared

Identification of category of different breeds

Three categories of cattle breeds were identified for the study of economics of milk production in the study area which are as follows:

- Local Breed (Non-Descript Local Cattle): It has again been classified into two. They are-
  - Non- Descript Local Cattle Breed Annual Variety: Farmers rearing local cattle calving annually (Group-I): 142 numbers.
  - Non- Descript Local Cattle Breed Alternate Variety: Farmers rearing local cattle calving alternate years (Group-II): 31 numbers.
- **Crossbred:** Farmers rearing crossbred cattle i.e. *Holstein friesian* crossbred and *Jersey* crossbred (Group-III): 24 numbers.
- **Combine breeds:** Farmers rearing both the Non-Descript Local Cattle breed and Crossbred cattle combined together in the farm (Group-IV): 3 numbers.
  Out of total 200 stratified random sampling samples, 173 samples were Non-Descript Local Cattle breed samples, 24 samples were Crossbred samples and only 3 samples were found out to be under Combine breeds samples that have been selected randomly. The milk producing dairy unitswere classified into small (1-3), medium (4-6) and large (7 and above) herd size category using cumulative square root frequency method.

Processing and analysis of data include -

- Conversion of different categories of cattle into Standard Animal Units (Ghule *et al.*, 2012)
- Conversion of women and child labour to Standard man – hour (Pandey *et al.,* 2004) and
- Tabular analysis
  The following estimations were taken into consideration for tabular calculation based on actual field observations for Non- Descript Local Cattle breed since the rearing practises were traditionally indigenous.

The average body weight of a Non- Descript Local Breed cattle was work out to be 185 kg. Therefore, the estimated average total body weight was calculated as;

*Estimated average total body weight = Converted Standard Animal Unit X 185

The Dry matter requirement per 100 kg body weight of Non-Descript Local Breed cattle was worked out to be 2.5 Kg per day. On this basis, the estimated dry matter requirement was calculated as;

- Estimated dry matter requirement = Estimated average total body weight/100 X 2.5
- Estimated Total Roughages requirement is 2/3 of Dry Matter. Therefore,
- Estimated Total Roughages requirement = 2/3 X Estimated dry matter requirement
- Estimated Dry Roughages (paddy straw) is 2/3 of Total roughage. Therefore,
- Estimated Dry Roughages (paddy straw) = 2/3 X Estimated Total Roughages requirement
- Estimated paddy straw Quantity in KG per day = 100/90 X Estimated Dry Roughages (paddy straw)
- Cost of paddy straw per day was calculated by multiplying with the prevailing market rate of `0.50 per kg (annually paddy straw was calculated for 120 days since paddy straw was available only for four months)
- Estimated green fodder is 1/3 of total roughages. Therefore,
- Estimated green fodder = 1/3 X Estimated Total Roughages requirement
- Estimated green fodder Quantity in KG per day= 100/32.5 X Estimated Green Fodder
- Cost of green fodder per day was calculated by multiplying with the prevailing market rate of ` 2.00 per kg (annually green fodder was calculated for 120 days since green fodder was available only for eight months)

Cost of concentrate feed for Non- Descript Local Cattle breed was calculated by the observed quantity of concentrate feed (rice bran) in kg with the prevailing market rate during the period of study. It was calculated for 6 months annually. However, is was calculated as;

*Cost of concentrate feed for Non- Descript Local Cattle = observed quantity of rice bran X market rate
*Cost of salt for Non- Descript Local Cattle = observed quantity of salt X market rate

The different cost components that were used for the study are as follows:

Fixed cost: Fixed cost is those cost that includes depreciation and interest on fixed capitals that includes herd animals, total covered area of the farm and dairy machineries. It was apportioned on the basis of Standard Animal Units (Patel *et al*., 1983)

Variable cost: Variable costs are those cost, which are incurred during production and can be altered in the short run. It includes feed, labour, veterinary and miscellaneous costs.

Gross cost: It was obtained by adding total variable cost and the total fixed cost

Net cost: The net cost was reckoned by deducting the imputed income earned through dung from the gross cost.

Cost per litre of milk production: The cost per litre of milk was obtained by dividing the net cost per house hold by the average milk yield per household per day.

Gross returns: Gross returns were obtained by multiplying milk yield of an individual animal with respective prevailing prices in the study area.

Net returns: Net returns were calculated by subtracting net cost from gross returns.

RESULTS AND DISCUSSION

The percentage of milking cows was highest 47.73 % and 41.18 % in medium herd size category ranging from 4 to 6 animals for both the NDLC –Annual and Alternate type breeds, where as it was highest 82.61 % and 94.12 % in large herd size category ranging from ≤ 7 animals for Crossbred and Combine breed respectively. The observation level of milch cows among all categories of cows were same as milking cows except that, in the percentage of NDLC-Alternate type, it was highest in large herd size category with 48.11% (Table 1).

Table 1. Number of milking and milch cows based on herd size

Breed	TYPE	CATEGORY	Herd size category			Overall
			Small (1-3)	Medium (4-6)	Large (≤ 7)	
Non-Descript Local Cattle Breed	Annual	Total number of milking cows	19 (10.80)	84 (47.73)	73 (41.48)	176 (100)
		Total number of milch cows	20 (9.66)	94 (45.41)	93 (44.93)	207 (100)
	Alternate	Total number of milking cows	17 (20)	35 (41.18)	33 (38.82)	85.00 (100)
		Total number of milch cows	17.00 (16.04)	38.00 (35.85)	51.00 (48.11)	106.00 (100)
Crossbred		Total number of milking cows	6 (5.22)	14 (12.17)	95 (82.61)	115 (100)
		Total number of milch cows	7 (4.73)	15 (10.14)	126 (85.14)	148 (100)
Combine breed		Total number of milking cows	1 (5.88)	. .	16 (94.12)	17 (100)
		Total number of milch cows	2 (6.67)	. .	28 (93.33)	30 (100)

Note: The figures in the parenthesis indicate the percentages

Table 2. Average milk yield per cow per day in litres

Breed	Type	Category	Herd Size Category			Overall
			Small (1-3)	Medium (4-6)	Large (≤ 7)	
NDLC	Annual	Milking	0.45	0.39	0.32	0.38
		Milch	0.43	0.34	0.25	0.34
	Alternate	Milking	0.37	0.35	0.31	0.35
		Milch	0.37	0.33	0.20	0.30
Crossbred		Milking	10.83	10.55	12.33	11.24
		Milch	9.29	9.85	9.30	9.48
Combine Breed		Milking	9.64	.	3.55	6.60
		Milch	4.82	.	2.03	3.43

It was found that the average milk yield per day in litres for NDLC- Annual type, NDLC- Alternate type and Combine breed for both milking and milch cows was found to be highest in small herd size category with 1 to 3 animals. But for milking Crossbred it was highest in large herd size category with ≤ 7 animals. For milch Crossbred it was highest with 4-6 animals in medium herd size category. The average daily milk yield per milch cow per day was 0.34, 0.30, 9.48 and 3.34 litres for NDLC-Annual, NDLC-Alternate, Crossbred and Combine breeds respectively (Table 2). Table 3 presents the average gross maintenance cost per milch NDLC-Annual type and NDLC- Alternate type. In unveiling the average gross maintenance cost per milch NDLC-Annual type in table 3, the total feed cost increased from small, medium to large herd size category. Labour and miscellaneous expenditure was highest for small, followed by medium and lowest for large herd size category. Both the total variable and fixed cost was worked out and it was highest for small herd size category. The cost per litre of milk was highest in large herd size category (`43.29). After working out the gross cost, net cost, cost per litre of milk production and gross return, the net return was positive only for small herd size category with `1.71. It was negative for both medium and large herd size category with `-0.63 and `-1.46 respectively. The average gross maintenance cost per milch NDLC-Alternate type was worked out. The percentage of total feed cost was highest (16.92%) in medium herd size category, followed by large herd size category (15.35%) and small herd size category (11.26%) respectively. Labour and miscellaneous expenditure was also highest for small herd size category. Both the total variable and fixed cost was worked out and it was observed to be highest for small herd size category like NDLC-Annual Type. The cost per litre of milk was worked out to be highest in large herd size category (`74.24). However, after working out the gross cost, net cost, cost per litre of milk production and gross return, the net return for all the three herd size category was found to be negative for all the herd size of NDLC-Alternate type cows. The average gross maintenance cost per milch Crossbred is worked out in table 4. In Crossbred, the total feed cost percentage was found to be highest (65.58%) in medium herd size category to the total gross cost. Labour cost was worked out to be highest with `71.19 for large herd size category. Miscellaneous expenditures were calculated to be highest with `19.52 for medium herd size category. The total variable cost was found highest ` 143.15 (92.52%) for large herd size category and total fixed cost was highest `11.84 (8.04 %) for medium herd size category. But total fixed cost was highest `10.97 (11.08 %) for medium herd size category when percentage is considered to

gross cost. The gross cost increased with the increase in herd size. The cost per litre of milk was worked out to be highest `16.48 in large herd size category. After working out the daily maintenance average gross cost, the net return for the all the three herd size category for Crossbred was positive and highest for medium herd size category with `263.76 followed by large and small herd size category with `246.92 and `231.56, respectively.

Table 3. Gross maintenance cost of per milch cow per day in `for Non-Descript Local Cattle breed (NDLC)

Cost Component	Herd Size category					
	NDLC- Annual Type			NDLC- Alternate Type		
	Small (1-3)	Medium (4-6)	Large (≤ 7)	Small (1-3)	Medium (4-6)	Large (≤ 7)
Cost of Green Fodder	2.99	3.08	3.18	2.98	3.11	3.24
	(15.09)	(18.15)	(21.38)	(12.93)	(17.58)	(16.08)
Cost of Dry Fodder	0.27	0.28	0.29	0.27	0.28	0.29
	(1.36)	(1.64)	(1.93)	(1.17)	(1.59)	(1.45)
Cost of Concentrate Feed (Rice Bran)	0.28	0.38	0.38	0.08	0.37	0.40
	(1.39)	(2.27)	(2.52)	(0.34)	(2.08)	(1.98)
Cost of Salt	0.08	0.09	0.10	0.10	0.10	0.06
	(0.41)	(0.52)	(0.65)	(0.42)	(0.55)	(0.31)
Total Feed cost	3.61	3.83	3.94	2.59	2.99	3.09
	(18.26)	(22.57)	(26.48)	(11.26)	(16.92)	(15.35)
Labour Cost	10.61	8.45	6.20	15.18	10.06	12.43
	(53.59)	(49.78)	(41.65)	(65.89)	(56.81)	(61.68)
Miscellaneous Expenditures	0.80	0.58	0.40	0.85	0.53	0.32
	(4.06)	(3.41)	(2.68)	(3.69)	(2.99)	(1.60)
Total Variable Cost	15.03	12.86	10.54	18.63	13.58	15.85
	(75.91)	(75.77)	(70.80)	(80.84)	(76.71)	(78.64)
Depreciation on Fixed Capital	3.51	2.99	3.11	3.25	2.97	3.07
	(17.71)	(17.64)	(20.92)	(14.09)	(16.75)	(15.22)
Interest on Fixed Capital	1.26	1.12	1.23	1.17	1.16	1.24
	(6.38)	(6.60)	(8.28)	(5.07)	(6.54)	(6.15)
Total Fixed Cost	4.77	4.11	4.35	4.42	4.12	4.31
	(24.09)	(24.23)	(29.20)	(19.16)	(23.29)	(21.36)
Gross Cost	19.80	16.97	14.88	23.04	17.70	20.15
	(100)	(100)	(100)	(100)	(100)	(100)
Net Cost	16.74	13.74	10.78	20.02	13.79	14.82
Milk yield Per Milch cow in litres	0.43	0.34	0.25	0.37	0.33	0.20
Cost Per Litre of Milk	39.14	39.84	43.29	53.46	42.24	74.24
Gross Return	18.45	13.11	9.32	15.92	12.81	6.46
Net Return	1.71	-0.63	-1.46	-4.11	-0.98	-8.36

Table 4. Gross maintenance cost of per milch cow per day in `for Crossbred

Cost Component	Herd Size category		
	CROSSBRED		
	Small (1-3)	Medium (4-6)	Large (≤ 7)
Cost of Green Fodder	12.73	23.21	7.59
	(12.86)	(15.76)	(4.91)
Cost of Dry Fodder	3.85	19.29	7.39
	(3.89)	(13.10)	(4.78)
Cost of Concentrate Feed (Rice Bran)	34.91	52.91	42.96
	(35.26)	(35.92)	(27.77)
Cost of Salt	1.44	1.19	0.42
	(1.46)	(0.81)	(0.27)
Total Feed cost	52.93	96.60	58.36
	(53.47)	(65.58)	(37.72)
Labour Cost	29.90	19.34	71.19
	(30.20)	(13.13)	(46.01)
Miscellaneous Expenditures	5.19	19.52	13.61
	(5.24)	(13.25)	(8.79)
Total Variable Cost	88.02	135.46	143.15
	(88.92)	(91.96)	(92.52)
Depreciation on Fixed Capital	6.99	7.26	7.19
	(7.06	(4.93)	(4.65)
Interest on Fixed Capital	3.97	4.58	4.38
	(4.02)	(3.11)	(2.83)
Total Fixed Cost	10.97	11.84	11.57
	(11.08)	(8.04)	(7.48)
Gross Cost	98.99	147.29	154.72
	(100)	(100)	(100)
Net Cost	98.40	144.10	153.23
Milk yield Per Milch cow in litres	9.29	9.85	9.30
Cost Per Litre of Milk	10.60	14.63	16.48
Gross Return	329.96	407.86	400.15
Net Return	231.56	263.76	246.92

Table 5. Gross maintenance cost of per milch cow per day in `for combine breeds

Cost Component	Herd Size category		
	COMBINE BREEDS		
	Small (1-3)	Medium (4-6)	Large (≤ 7)
Cost of Green Fodder	Small (1-3)	Medium (4-6)	Large (≤ 7)
Cost of Dry Fodder	11.05 (17.34)	. .	4.93 (22.65)
Cost of Concentrate Feed (Rice Bran)	4.69 (7.36)	. .	0.94 (4.32)
Cost of Salt	10.23 (16.06)	. .	2.88 (13.24)
Total Feed cost	0.44 (0.69)	. .	0.00 (0.00)
Labour Cost	26.40 (41.45)	. .	8.75 (40.21)
Miscellaneous Expenditures	24.03 (37.72)	. .	3.43 (15.76)
Total Variable Cost	4.73 (7.43)	. .	2.11 (9.68)
Depreciation on Fixed Capital	55.16 (86.59)	. .	14.28 (65.65)
Interest on Fixed Capital	4.50 (7.07)	. .	4.37 (20.11)
Total Fixed Cost	4.04 (6.34)	. .	3.10 (14.23)
Gross Cost	8.54 (13.41)	. .	7.47 (34.35)
Net Cost	63.70 (100)	. .	21.75 (100)
Milk yield Per Milch cow in litres	62.33	.	19.84
Cost Per Litre of Milk	4.82	.	2.03
Gross Return	12.93	.	9.78
Net Return	144.66	.	68.53

Table 5 draws the average gross maintenance cost of Combine breed cattle. Medium herd size category of Combine breed was null in the selected dairy herds of the study area. The total feed cost and percentage was highest `26.40 and 41.45 % for small herd size category with 1-3 animals. Labour cost, miscellaneous expenditures, total variable cost, total fixed cost, gross cost, net cost, cost per litre of milk, gross return and net return was also highest for small herd size category with net return of `82.32 per milch cow per day with cost per litre of milk being `12.93. Similar findings was worked out by Singh and Agarwal (2007) where they observed that two-thirds of the total cows maintained in their study were in milk and the remaining one third were in dry. The percentage of cows in milk was highest for large category of dairy units followed by medium and small. Milk yield which ultimately brings out returns to the milk producers depends upon the number of factors such as breed, order and stage of lactation, season of calving, quality of feeds and fodders etc. They worked out the overall average daily milk yield per milking local and Crossbred cow to be 1.59 litres and 9.91 litres respectively, whereas per milch Local and Crossbred cow was worked out to be 1.15 litres and 6.48 litres respectively.

They came to conclusion that daily milk yield per milch cow was highest for large herd category followed by medium and small both for Local and Crossbred. However, milk yield per milking Crossbred cow did not differ much among herd size category though it was the highest with 10.42 litres for large category and lowest with 9.62 litres for small category. The cost per litre of milk for local milch cows range from `13.02 (large) to `24.81 (small) with negative net returns per milch local cow except for large category and for Crossbred milch cows it was highest (`12.71) for small and lowest (`9.74) for large herd size category. Net return was `14.84 for Crossbred which showed an increasing trend with increase in herd size. In another finding by Sanders in 1980 presented the results of 50 farms classified by size: 0-1, 1-2, 2-3, 3-4 and over 4 ha, found out that on an average the number of animals (buffaloes and cows) kept for milk increased from 1.04 to 2.99 as farm size increased, and the labour time spent on milking increased from 36.4 to 96.0 days/year, of which most was family labour. Average annual costs of maintaining an animal for milk were Rs 1280.6 for a cow and Rs 1609 for a buffalo; 60-70% of this was accounted for feed costs. For cows and buffaloes, respectively, milk yield averaged 864.35 and 961.53 kg with a value of Rs 1512 and Rs 2163 and concluded that maintenance costs and milk yield tended to increase with size up to 3-4 ha and then decrease.

However, Tripathi in 1995 planned a study where he estimated the variation in the cost structure of cow milk production on different sizes of high-hills, mid-hills and valley farm. He found out that on an overall average, milk production was 223 litres per cow and provided `781 per year to the farmers. The gross return varied from `852 in valley to `1257 per cow per year in high- hill farms. Income received from dung and calves were` 291 per cow per year which varied from `273 on high-hills to ` 320 on valleys. Also the maintenance cost was higher than the gross income received in all the sizes of the farm that he studied. The loss varied between `1363 in valleys to `2109 in high-hills with an overall average of `1803 per cow per annum. The benefit- cost ratio ranged from 0.22 to 0.66 which indicated a net loss of `0.88 to ` 0.40 per cow per year over each rupee invested on cow milk production. He also found out that on an overall average the cost per litre of milk production was also too high in all the sizes of the sample farms being `12.89.

Conclusions

From above findings, it has been drawn that Non-Descript Local Cattle were not productive from the view point of any herd size category. It also had negative outcome from economic point of view of milk production except for NDLC-Annual type in small herd size category with 1-3 animals with only a meagre net return per milch cow per day. This finding is almost equal to negative result. The milk productivity of Crossbred was higher than Combine Breed and was highly productive and positive in all the three herd size categories with acceptable net returns. Since the study area is dominant with 99% indigenous Non-Descript Local Breed cattle, awareness, upgrading of breed and liaising is required between local agencies and national institution and donors for business and man power training and dairy development programmes.

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