Economics of milk production and Yield Differentials among the marginal women farmers of Jharkhand state in India

ABSTRACT

Aim: To determine the economics of milk production and yield gaps of crossbred cow, buffalo and indigenous cow in Jharkhand State of India.

Study design: the study was designed to cater the scope of production economics in reality by suggesting ways to bridge the yield gaps.

Place and Duration of Study: The present study was conducted using 130 beneficiary farmers in Hazaribagh and Khunti districts of Jharkhand during the 2016-17 agricultural year.

Methodology: As per the technique of the yield gap analysis, developed by Gomez (1977), the total yield gap is the sum of Yield Gap I (YG I) and Yield Gap II (YG II). The various cost components were identified under fixed cost and variable cost. Gross returns and net returns were then calculated accordingly.

Results: The sampled households were post-stratified into two groups: Group 1 abbreviated as G1, having less than or equal to 2 lactating animals and Group 2 as G2, having more than two lactating animals. The proportion of G1 and G2 households were about 79 and 21 per cent, respectively. The results of data analysis reflected that milk yield gap between potential yield and actual yield (YG II) was higher than yield gap between experimental yield and potential yield (YG I) for both household groups across all the type of dairy animals. The YG II in crossbred cow was more than two times higher on G1 farm as compared to G2 farm while it was more than five times higher in local cow. The average productivity of crossbred (9.23 litres/ day) was much higher than the average productivity of buffalo (6.09 litres) and local cow (4.98 litres/day).

Conclusion: Overall value of total yield gap (TYG) entails that if all the constraints regarding the milk production were tackled then the milk yield of the two districts could be increased by about 43 per cent. Buffalo was providing higher net returns per day per animal (Rs. 7.39) in comparison to crossbred (Rs. 5.19). Net returns both for per day and per litre were negative in case of local cow. The study reveals that the marginal farmers can become economically stable by incorporating dairying (crossbred and buffalo) as a component in their farming system.

Keywords: Crossbred, Buffalo, Local Cow, Yield Gap, Cost, Return, Jharkhand.

1. INTRODUCTION

The Green Revolution of the mid-sixties lead to a major technological change in Indian agriculture, transforming India from a food-grain importing country to a food-grain exporting country (Rena, 2004). When the other states had already reaped the benefits of green revolution, Jharkhand was still under existential crisis. Being a newly formed state during 2000, the state lags far behind the other agriculturally advanced states of India. The state is enriched with natural endowments but is lacking in the technical, input and service, breeding and economical aspects (Deka and Wright 2011). Even the prevalent farming system in the state comprises of paddy, legumes and some minor millets. According to the NSS 66th

round, 64.8 per cent of the farmers in Jharkhand state have an average land holding size up to 1 acre against the national average of 1.15 hectare. This marginal and scattered land holding can be taken as the major reasons for Jharkhand's limited agricultural development. While on the other hand, the number of animal's in-milk in cows and buffaloes has increased from 77.04 million to 80.52 million showing a growth of 4.51 per cent that is equivalent to the growth in milk production (19th Livestock census).

According to FAO (2004), the demand and production of high value livestock commodities can grow by 6 to 8 percent annually, whereas it is difficult to sustain growth rates at more than 3 percent in the heavily land based commodities such as cereals. Hence, engagement in livestock production is widely seen as a means of nutritional security, reducing poverty, increasing the income earning and employment generation potential of farm households (Tamou et al., 2018). Warr (2001) concluded that agricultural development in India reduced the incidence of poverty, while industrial growth had reverse effect. The prosperity and growth of a nation, by and large, depends upon the status and development of its women as they not only constitute about half of the population, but also positively influence the growth of the remaining half of the population (Omoruyi et al., 2017). Women are considered as the backbone of nutritional security because they play an important role in the development of agriculture and livestock sector. They have an active involvement in feeding, breeding, management, health care and other operations, constituting around 71 per cent of the labour-force engaged in dairying (ICAR-CIRC, 2015).

Keeping this in view, that majority of the farmers do not even qualify as tenants while the state has shown promising raise in the population of dairy animals and to improve the income and nutritional status of people (Murendo et al., 2018). The state government started a scheme in 2015-16 to distribute Holstein-Friesian cattle to BPL women farmers at 90 per cent subsidy to increase milk production in the state and improve economic condition of the farmers. Considering the important role played by women in livestock production, the scheme was targeted at poor women farmers. The dairy farming is adopted as a subsidiary occupation by majority of the farmers in the state. Despite of only 1.25 per cent compound annual growth rate (CAGR) of livestock over the last five years, share of livestock sector to the total value of output of agriculture and allied sector in Jharkhand was 18.33 per cent in 2015-16. Animal husbandry has a good prospect due to availability of vast stretches of grazing land and limited agricultural activities.

2. METHODOLOGY

The primary data were collected during the 2016-17 agricultural year. A total of 130 beneficiary women farmers were interviewed through conventional survey method based on well-structured schedule.

2.1 Yield gap analysis of milk productivity

This analytical tool was developed by the International Rice Research Institute (IRRI) and was further modified by Gomez (1977). It has been used by a number of researches to analyze similar objectives (Liang *et al.*, 2006; Job, 2006). The strategy of bridging the yield gaps can bring in additional production with lesser efforts at the local level and can improve the efficiency of production. While efforts are being made to raise the yield ceiling, there is even a more pressing need to address the problem of yield gaps. The same technique was used to find yield gaps in milk productivity of various dairy animals. As per the technique of the yield gap analysis, the total yield gap is the sum of Yield Gap I (YG I) and Yield Gap II (YG II), i.e.

Total Yield Gap (TYG) = Yield Gap I + Yield Gap II

Where,

Yield Gap I = Experiment Station Yield (Yr) – Potential Farm Yield (Yp), and

Yield Gap II = Potential Farm Yield (Yp) – Actual Farm Yield (Yf).

Different parameters included in yield gap analysis of milk from crossbred cows, indigenous cows and buffalo were estimated in the following manner:

2.1.1 Experimental Station Yield (Yr)

The data on wet average yield for crossbred cattle were obtained from the experimental stations in the Birsa Agriculture University, Ranchi. The data for wet average of local cow and buffalo were collected from the district breeding farms, located in the premises of district dairy development office of Khunti and Hazaribagh.

2.1.2 Potential Farm Yield (Yp)

The milk yield level of households in a category was arranged in the descending order and the wet average realized by top 10 per cent of the sampled households was considered as 'Potential Farm Yield'.

2.1.3 Actual Farm Yield (Yf)

It is the wet average of the remaining 90 percent of the households of a category which could be increased with little effort made in adoption of improved package of practices and by addressing the technical and socio-economic constraints. The YG I and YG II are caused by different factors/ constraints. The major factors responsible for YG I include the environment, physical and non-transferable components of technology. The YG II is caused by technical and socio-economic factors, which could be addressed through either applied research or transfer of technology.
To determine the quantum of increase in milk yield by managing these yield gaps, yield gap percentages were calculated over the actual farm yield (Yf) in the following manner:
Yield gap (%) = (Yield gap/actual farm yield) × 100
It signifies the percentage increase in actual yield that could be attained by removing the respective yield gap.

2.2 Cost of Milk Production

It is important to study the cost of milk production as it is an indicator of economic efficiency of milk production and indicates the profitability of the enterprise. The various cost components were identified under fixed cost and variable cost.

2.2.1 Fixed costs

The various components of fixed cost are depreciation and interest on fixed capital. Capital recovery cost (CRC) method was used to calculate the depreciation. This method is defined as the annual payment that will repay the cost of fixed input over the useful life of input and provide an economic rate of return on investment. The formula for estimation of CRC is:
Where,

R	=	Capital recovery cost (Rs./annum)
Z	=	Initial value of the capital asset (Rs.)
r	=	Interest rate (Fraction form)
n	=	Useful life of the assets (years)

2.2.2 Variable cost

Variable costs are the costs incurred on various factors that varies with the level of production and can be altered in the short run. Variable cost includes three major items i.e. feed and fodder cost, labour cost and veterinary and miscellaneous expenditure.
Feed and fodder cost: This included the cost of feeding dry fodder, green fodder and concentrates to animals.

2.2.2.1 Grazing Costs:

In case of the local cow and buffalo, the major portion of their fodder intake was from grazing. Therefore, it becomes important to take into account the grazing cost along with other costs in order to make comparison. It not only includes labour cost for taking animals for grazing but it also includes imputed cost of feed intake through grazing. Total number of hours for which the animal was taken for grazing was counted to know the actual amount of feed intake.
An approach to calculate the intake from grazing was estimated as follows:

$$\text{Quantity intake from grazing (GZQTY)} = \frac{\text{Dry matter Intake from Grazing (GZDMI)}}{\text{Av. dry matter content in grazed input (DMGZ)}}$$

Where, GZDMI of an animal = required dry matter intake - dry matter intake from stall feeding
Required dry matter intake for the animals was calculated by employing the following formula:

- For lactating animals: 6 + (Body weight/100) + (Milk yield/5)
- For non-lactating animals: 6 + (Body weight/100)

Imputed Price of grazed fodder = Average prices of green fodder. The average dry matter content in green grasses was taken as 0.50 per cent.

2.2.2.2 Labour cost:

Total time spent was converted to mandays by using the following conversion:
1 day of women labour = 0.67 manday (3 women = 2 men) by assuming 8 working hours a day.

2.2.2.3 Veterinary and miscellaneous costs:

The expenditure on breeding and health care of the animals was covered under the veterinary expense. It included, cost of artificial insemination (AI), natural service, vaccination, medicines, fee of veterinary doctor and other related expenses.

The miscellaneous expenditure included expenses on repair of fixed assets, water and electricity charges, insurance premium and any other incidental charges. These being joint costs, apportionment of the same based on SAU were done.

2.2.2.4 Apportionment of joint costs

Among the various cost items discussed, certain expenses are incurred on the entire herd as a whole. For instance, the fixed assets like cattle shed, stores, mangers, water tub, buckets *etc.,* are jointly used by the entire herd. Also, the information on cost on labour and miscellaneous items were not available animal wise but for the entire herd as a whole. Therefore, for the apportionment of these joint costs the total number of animal were converted into standard animal units.

2.2.2.5 Regional Standard Animal Units (SAUs)

Considering regional differences in size of animal and their feed and fodder requirements, endowments of animal wealth and species, the SAUs have been formulated by Sirohi *et al.* (2015) at regional level for five regions *viz;* Eastern (including north-east), Western, Southern, Northern plains and Hills. As the study area falls in the Eastern region, the standard animal units for this region used are as given below in table 1.

Table 1 : Standard animal units for eastern regions of India

Animals	Crossbred cow	Buffalo	Local cow
Adult male (≥3 years)	1.07	1.02	0.92
Adult female (≥3 years)	1.20	0.86	1.00
Young stock male (≤1 year)	0.25	0.25	0.27
Young stock female (≤1 year)	0.24	0.23	0.24
Young stock male (≤2 year)	0.51	0.42	0.41
Young stock female (≤2 year)	0.38	0.38	0.37
Heifer (2-3 years)	0.71	0.63	0.64

3. RESULTS AND DISCUSSION

The average herd size of the sample households was found to be 1.77 adult animals in-milk. Since majority of the farmers were smallholders and were having less number of dairy animals, a conventional approach was followed to divide them into two group just on the basis of number of animals in-milk kept per household. Looking into the total spread of animal numbers per household, the beneficiary farm households were divided two groups namely, Group-1 (G1) and Group-2 (G2). Group-1 (G1) comprised of farmers owning less than and equal to 2 adult in-milk dairy animals, while Group-2 (G2) comprised of farmers owning more than two adult in-milk animals in their herd, irrespective of the type of animal. The sample was post-stratified according to the herd size maintained by individual farmers. The classification into groups shows that there were 103 households in G1 and 27 households in G2 out of the total sample of 130 farm households. The proportion of the households having less than or equal to 2 animals in-milk per household was about 79 per cent showing clearly targeting of the programme at resource poor farmers.

3.1 Yield gap Differential

According to the technique of yield gap analysis, yield gaps (Yield Gap I, YG I and Yield Gap II, YG II) in milk yield were computed for crossbred cow, local cow and buffalo across the two groups of households and overall. These yield gaps refer to the yield differentials between the experimental yield, potential yield and the actual yield. The extent of yield gaps and their percentage values are given in Table 2.

It can be observed from the table that the experimental station yield for crossbred cow, local cow and buffalo were 12 litres, 6 litres and 8 litres per day, respectively. The overall column shows weighted average of values in the respective row in which weights have been taken as proportion of animals in each column. The weighted average of experimental milk yield means that the maximum yield existed per milch animal in the area was 8.8 litres per day.

From crossbred cow, it was deduced from the table that the potential farm yield for G1 farmers in case of crossbred was low i.e. 9.5 litres per day, raising the yield gap-I (YGI) to 38.46 per cent. For G2 farmers, the potential yield was in consonance with the experimental station yield, therefore there was zero YGI. However, there was vast difference between the potential farm yield and actual farm yield for G1 farmers as the YGII turned out to be 46.15 per cent, which was higher than the YGI. For G2 farmers, total yield gap (TYG) was equal to the YGII as YGI did not exist for this particular group. The extent of yield gaps in G1 was higher than the G2 because of the reason that the former were marginal farmers lacking adequate resources and knowledge to maintain a crossbred animal.

Table 2: Yield gap differentials for different dairy animals across different herd size categories

S. No.	Particulars	Crossbred		Local cow		Buffalo	Overall
		G1	G2	G1	G2		
1	Experimental station yield (L/ day/animal)	12.00	12.00	6.00	6.00	8.00	8.80
2	Potential farm yield (L/ day/ animal)	9.50	12.00	5.25	5.75	7.00	8.68
3	Actual farm yield (L/ day/animal)	6.50	9.95	4.29	5.50	5.50	6.45
4	YG I (1–2)	2.50	0.00	0.75	0.25	1.00	0.12
5	YG II (2–3)	3.00	2.05	0.96	0.25	1.50	2.23
6	Total yield gap (TYG) (YGI+YGII)	5.50	2.05	1.71	0.50	2.50	2.35
7	YG I (%)	38.46	0.00	17.50	4.55	18.18	2.17
8	YG II (%)	46.15	20.63	22.50	4.55	27.27	40.57
9	TYG (%)	84.62	20.63	40.00	9.09	45.45	42.74

Note: G1: Group-1 beneficiary farmers with ≤ 2 in-milk animals, G2: Group-2 beneficiary farmers with > 2 in-milk animals.

In the case of local cow, the yield gap I for G1 and G2 farmers were 17.50 per cent and 4.55 per cent, respectively while the yield gap II for G1 and G2 were 22.5 per cent and 4.55 per cent, respectively. On summing these up, the TYG came out to be 40.00 per cent for G1 and 9.09 for G2, suggesting that G1 has more yield gap than G2 in local cow similar to the results in crossbred. In both the cases i.e. crossbred and local cow, TYG of G1 farmers was approximately four times higher than the G2 farmers because of the reasons explained above. As stated earlier, the results of yield gap II are more relevant in the present context. In this context, it suggests that actual yield of local cow can be increased by 22.50 per cent if the farmers having less than or equal to 2 animals are provided with the improved technical knowledge and resources.

The YG-1 for buffalo was calculated as 18.18 per cent while the YG-II was recorded as 27.27 per cent making it a TYG of 45.45 per cent.

It was quite clear that YG-II exceeds YG-I for both the groups across all the type of dairy animals, except for local cow where G2 farmers face equal YG-I and YG-II. The overall yield gap-I was found to be 2.17 per cent depicting that there was minimal difference between the potential farm yield and experimental station yield, whereas the yield gap-II was calculated as 40.57 per cent, indicating significant difference between potential farm yield and actual farm yield. The TYG came out to be 42.74 per cent which implies that if all the constraints related with milk production were addressed, milk yield in the study area will increase by about 43 per cent.

According to a study conducted by Paul and Chandel (2010) in north-eastern states of India the overall TYG was found to be 81.60 per cent as against the 42.74 per cent in the present study. This study has stated that the TYG was found to comprise a higher magnitude of YG II (65.58 per cent) than YG I (16.02 per cent). Similarly, in the present study also the TYG was found to comprise a higher magnitude of YG II (40.57 per cent) than YG I (2.35 per cent). Both the studies confer to the fact that the physical and environmental factors were the minor hurdles in achieving higher milk yield. This high YG-II was mainly caused by the technical, social and economic factors, which can be addressed by region-specific and proper transfer of technology in the study area. Technologies being adopted by some of the progressive farmers should be transferred with demonstration of benefits to other farmers.

The results of yield gap analysis can be summarized in the sense that, if the constraints are removed, the highest increase in milk yield for crossbred will be realized by G1 farmers, as they face the maximum yield gap of 84.62 per cent, followed by farmers rearing buffalo, with yield gap of 45.45 per cent. In the total yield gap, the quantum of YG II was higher in all the cases which can be abridged by the transfer of available technology at the regional level. The adoption of these technologies also requires improving the socio-economic conditions of the farmers and their access to resources, market and capital.

3.2 Economics of milk production

The economics of milk production from different species of animals have been studied by estimating the cost and returns from milk production. A standard methodology as stated in Chapter 3 has been used in estimating the cost of milk production. The cost of maintenance of animal and milk production were calculated for crossbred and local cow separately for Group-1 (G1) and Group-2 (G2) while for buffalo it was irrespective of group because this animal was found only with G2 farmers.

3.2.1 Cross bred cow

The estimated cost and returns for crossbred cow are shown in Table 3. The costs and returns were computed for a total of 182 crossbred in the study area, out of which 117 belonged to G1 and 65 to G2. Therefore, group-wise as well as overall costs and returns have been calculated for crossbred. The overall net maintenance cost of a crossbred cow was worked out to be Rs. 254.31 per day. The net overall cost for G1 came out to be Rs. 231.99 per day, while for G2 it was Rs. 276.63. The next higher variable cost component was family labour (Rs. 26.77) followed by dry fodder (Rs. 20.70). For G1, family labour cost exceeded (Rs. 36.11) the cost of dry fodder (Rs. 20.57) while it was vice versa for G2 as the cost of dry fodder (Rs. 20.83) has exceeded the family labour cost (Rs. 17. 42).

Table 3: Cost of milk production from crossbred cows on different category of farmers in Jharkhand (Rs./animal/day)

Cost components	Household Group		
	G1	G2	Overall
Green fodder	10.38 (4.47)	10.61 (3.81)	10.50 (4.11)
Dry fodder	20.57 (8.87)	20.83 (7.48)	20.70 (8.11)
Concentrate	123.44 (53.21)	185.22 (66.51)	154.33 (60.46)
Feed & fodder cost	154.39 (66.55)	216.66 (77.8)	185.52 (72.69)
Labour cost	36.11 (15.57)	17.42 (6.26)	26.77 (10.49)
Veterinary cost	13.09 (5.64)	14.05 (5.05)	13.57 (5.32)
Miscellaneous cost	7.03 (3.03)	7.47 (2.68)	7.25 (2.84)
Total variable cost (TVC)	210.62 (90.79)	255.60 (91.78)	233.11 (91.33)
Capital recovery cost of fixed assets (TFC)	24.97 (10.76)	26.82 (9.63)	25.90 (9.78)
Gross cost (TFC+TVC) (A)	235.59	280.57	258.08
Value of dung (B)	3.60	3.94	3.77
Net cost (C= A-B)	231.99 (100)	276.63 (100)	254.31 (100)
Price of milk	28.19	28.25	28.22
Gross return (D)	234.95	285.91	260.43
Net return/ day (D-C)	2.96	7.43	5.19
Average milk production/animal/day(E)	8.33	10.12	9.23
Cost/litre (F= C/E)	27.83	27.52	27.66
Net returns/litre (G)	0.35	0.73	0.56
B:C Ratio (per litre) (F/G)	0.012	0.026	0.020

Notes: Figures in parentheses represent percentage. G1: Group 1 beneficiary farmers with ≤ 2 in-milk animals, G2: Group 2 beneficiary farmers with > 2 in-milk animals. Total number of crossbred was 182 (G1= 117, G2= 65).

The overall expenditures on veterinary and miscellaneous items were estimated as Rs. 13.57 and Rs. 7.25, respectively indicating negligible variations between the two groups of farmers. The overall average cost of milk production per day was computed as Rs. 27.66 per litre. The inter-group variations in cost of milk production were found to be negligible as the G1 incurred Rs. 27.83 per litre while G2 incurred Rs. 27.52 per litre. However, the overall net returns per day per animal were found to be Rs. 5.19 varying from Rs. 2.96 for G1 to Rs. 7.43 for G2 farmers.

3.2.2 Local cow

The item wise expenditure incurred on the maintenance of local cow, cost of milk production and returns are shown in Table 4. The perusal of the table shows that the overall net maintenance cost of a local/ Indigenous cow was Rs. 174.39. The net maintenance cost for G1 was accounted as Rs. 176.06 per animal while it was Rs. 172.71 per animal for G2. The overall total variable cost accounts for 96.16 per cent of the net cost. The variable cost varies from Rs. 151.09 to Rs. 147.74 for G1 and G2, respectively.
The expenditure on concentrate was the major expense made to an extent of 47.61 per cent (Rs. 73.98) per animal. G1 was found to be spending Rs. 77.64 (49.38 per cent) on concentrate in comparison to G2 which was spending Rs. 70.33 (45.8 per cent). The next major overall cost component was green fodder (both stall-fed and grazed) which accounts for 17.41 per cent to the net cost incurred and has exceeded the cost of labour (16.64 per cent) and dry fodder (7.97 per cent) in case of the local cow. Both G1 and G2 were observed to be following this trend.
The overall net returns for local cow was in negative side, making it clear that the farmers were at loss by tending to the local cow. The data suggested that the overall net return/ loss per local cow was to an extent of Rs. 18.20. The study also suggested that the G1 incurred a higher loss of Rs. 36.04 than G2 who were facing a loss of Rs. 0.35 per animal. In case of the G1, the farmers were not even able to cover their variable cost while the G2 farmers were at least capable of covering their variable cost and some of the fixed costs. There are number of studies which have reported loss in milk production from local cow (Singh, 2015).

Table 4: Cost of milk production from local cow on different category of farmers in Jharkhand (Rs./animal/day)

Cost components	Household Groups		
	G1	G2	Overall
Green fodder	25.66 (16.32)	28.44 (18.52)	27.05 (17.41)
Dry fodder	12.08 (7.68)	12.71 (8.27)	12.39 (7.97)
Concentrate	77.64 (49.38)	70.33 (45.8)	73.98 (47.61)
Feed & fodder cost	115.37 (73.38)	111.47 (72.6)	113.42 (73)
Labour cost	25.11 (15.97)	26.61 (17.3)	25.86 (16.64)
Veterinary cost	9.16 (5.83)	8.83 (5.75)	9.00 (5.79)
Miscellaneous cost	1.45 (0.92)	0.83 (0.54)	1.14 (0.73)
Total variable cost (TVC)	151.09 (96.10)	147.74 (96.22)	149.42 (96.16)
Capital recovery cost of fixed assets (TFC)	8.92 (5.67)	8.7 (5.67)	8.81 (5.67)
Gross cost (TFC+TVC) (A)	176.06	172.71	174.39
Value of dung (B)	2.79	2.90	2.85
Net cost (C= A-B)	173.27 (100)	169.81 (100)	171.54 (100)
Price of milk	27.50	27.60	27.55
Gross return (D)	121.17	153.19	137.18

Net return/day (D-C)	-36.04	-0.35	-18.20
Average milk production/animal/day (E)	4.41	5.55	4.98
Cost/litre (F = C/E)	35.68	27.66	31.21
Net Return / litre (G)	-8.18	-0.06	-3.66
B:C Ratio (per litre) (F/G)	-0.229	-0.002	-0.117

Note: Figures in parentheses represent percentage. G1: Group 1 beneficiary farmers with ≤ 2 in-milk animals, G2: Group 2 beneficiary farmers with > 2 in-milk animals. The total number of local cow were 36 (G1= 31, G2= 5).

3.2.3 Buffalo

Since there were no buffalo in the Group-1 herd, instead of going for category wise cost and returns analysis, only the overall calculations for 24 buffalo in the sample households were done. The net maintenance cost incurred for a buffalo was Rs. 194.20. The variable cost accounts for 96.86 per cent of the net cost, out of which the highest contribution was made by the concentrate (63.85 per cent) followed by green fodder (12.47 per cent) and labour cost (8.38 per cent).
The net returns indicate that the farmers were getting a profit of Rs. 7.39 per animal per day. The per litre price of buffalo milk was found to be Rs. 30.56 because of higher fat content in buffalo's milk. The productivity of buffalo stands at 6.09 litres/day. The estimated cost and returns for buffalo has been given in the Table 5.

Table 5: Cost of milk production from buffaloes on different category of farmers in Jharkhand (Rs./animal/day)

Cost components	**Buffalo**
Green fodder	22.29 (12.47)
Dry fodder	9.28 (5.19)
Concentrate	114.15 (63.85)
Feed & fodder cost	145.71 (81.51)
Labour cost	14.98 (8.38)
Veterinary cost	9.42 (5.27)
Miscellaneous cost	3.04 (1.70)
Total variable cost (TVC)	173.15 (96.86)
Capital recovery cost of fixed assets (TFC)	9.54 (5.33)
Gross cost (TFC+TVC) (A)	198.12
Value of dung (B)	3.92
Net cost (C= A-B)	194.20 (100)
Price of milk	30.56
Gross return (D)	186.16
Net return/ day(D-C)	7.39
Average milk production/animal/day (E)	6.09
Cost/litre (F = C/E)	29.34
Net Return / litre (G)	1.21
B:C Ratio (per litre) (F/G)	0.034

Note: Figures in parentheses represent percentage. Total number of buffalo in the sample was 24.

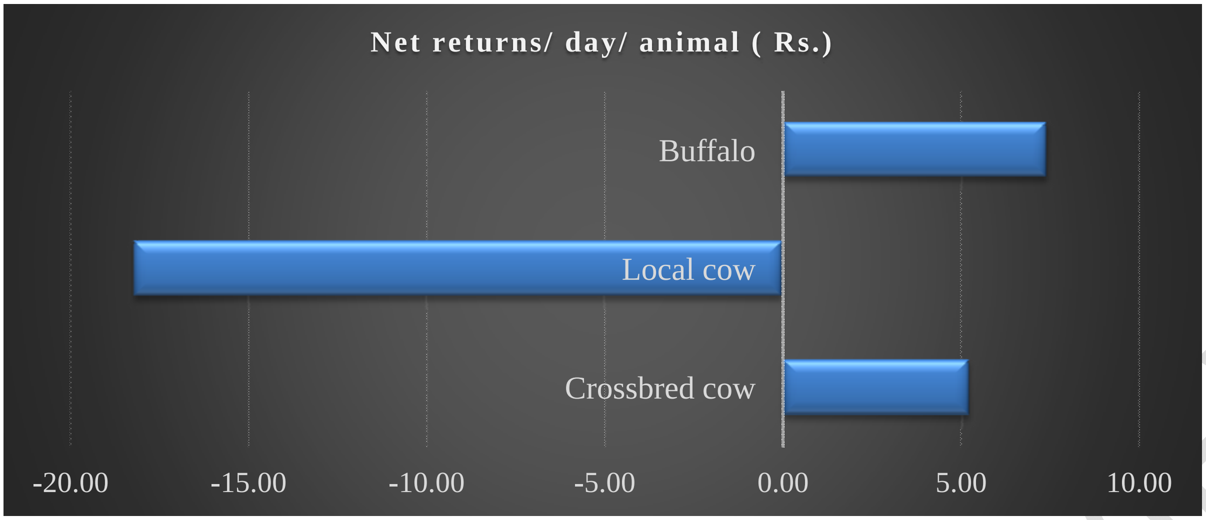

Figure 1: Net returns for different types of animals (Rs. /animal/day)

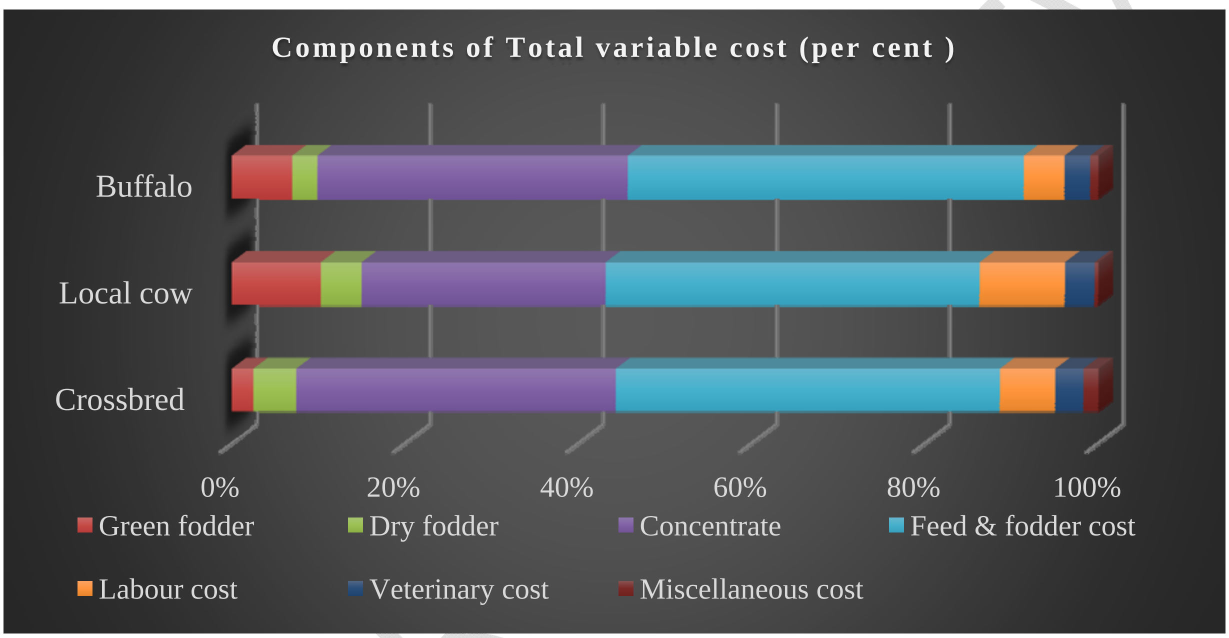

Figure 2: Composition of total variable cost (in per cent terms) for different types of animals

On comparing the results of costs and returns analysis of crossbred cow and buffalo, it was clear that rearing buffalo was much more promising than rearing crossbred, as it was giving higher net returns per day per animal (Rs. 7.39) in comparison to crossbred (Rs. 5.19). The average productivity of crossbred (9.23 litres/ day) was much more than the average productivity of buffalo (6.09 litres/ day) still buffalo milk fetches higher price due to more fat content. The selling price of per kg of milk was directly proportional to the fat content. It was quite evident from the table 3 and table 5 that buffalo milk on an average fetches Rs. 30.56/litre while milk from crossbred cow fetches Rs. 28.22/ litre.

When the other cost components were compared in monetary terms, it was observed that crossbred incurs more cost than buffalo other than green fodder. The reason behind this could be the fact that the crossbred were not taken for grazing in the study area and were mostly stall-fed. The farmers provide more of concentrate and dry fodder to the crossbred instead of green fodder as they consider crossbred to be more yielding and believe in providing better nourishment to the animals that can provide better output. On comparing the same cost components in percentage terms, still crossbred was found to be costlier than buffalo except for the cost of dry fodder and veterinary treatments leading to higher total variable cost than crossbred.

On comparing the results of cost and returns analysis of crossbred and local cow, it was evident that local cow was incurring a loss of Rs. 18.20 per day per animal while crossbred was fetching a profit of Rs. 5.19. The average productivity of local cow (4.98 litres/day) was half of that of the crossbred (9.23 litres/day). The selling price of milk of crossbred (Rs. 28.22/ litre) and local cow (Rs. 27.55) did not varied much, supporting the fact that the loss incurred in rearing the local cow was entirely due to their low productivity and not because of their sale price. However, this selling price in the villages (Rs. 27.55 – Rs. 30.56) remain far low than the purchase price of milk in the adjoining towns (Rs. 40 – Rs. 50 /litre).

Thus, it can be concluded that crossbreeding should be promoted in the state as it was providing higher returns than local cow. It was evident from the study that buffalo was providing higher return than crossbred; therefore efforts should also be made to improve its genetic potential. Local cow and buffalo not only produce milk, but also provide dung and draft which were essential inputs for agriculture. The local cow was incurring loss to the dairy farmers because of their low productivity; therefore it is essential to make efforts to minimize the loss by improving its productivity.

4. CONCLUSION

The total yield gap (TYG) was observed highest in the case of crossbred cow followed by buffalo and local cow. The results of the yield gap analysis revealed that there exists knowledge gap in the adoption of crossbred technology. This gap was lower in case of G2 farmers because of their past experience in rearing the animals. Therefore, future trainings and follow-up activities directed at G1 farmers in use of inputs and management of crossbred animals would improve productivity. The adoption of these technologies also requires improvement in the socio-economic conditions of the farmers and the access to resources, market and capital. The total yield gap was further composed on YG I and YG II. In all the dairy animals, yield gap between the potential yield and the actual yield (YG II) was higher than the yield gap between the experimental yield and the potential yield (YG I) which can be abridged by the transfer of available technology at the regional level. Overall, the YG I and YG II were 2.17 per cent and 40.57 per cent of the actual yield, respectively with TYG of 42.74 per cent. This implies that if all the constraints related with milk production were addressed, milk yield in the study area could be increased by about 43 per cent. The yield gap II (YG II) was also higher for the crossbred cow followed by buffalo and local cow. It was 27.27 per cent in buffalo. A significant difference was found in YG II of crossbred and local cow across farmer groups. The YG II in crossbred cow was more than two times higher on G1 farm as compared to G2 farm while it was more than five times higher in local cow. The higher difference in the yield gap II for local cow across herd size may be attributed to the genetic upgrade of the local animals and better management practices at G2 farms.

The overall net maintenance cost of a crossbred cow was worked out to be Rs. 254.31 per day which was lower for G1 farmers (Rs. 231.99 per day) as compare to G2 farmers (Rs. 276.63 per day). About 91 per cent of this maintenance cost was the total variable costs. The feed and fodder accounted for three fourth of the total variable costs. The overall net returns per day per crossbred animal were found to be positive and it was Rs. 5.19 which varied from Rs. 2.96 for G1 to Rs. 7.43 for G2 farmers. In case of local cow, the overall net maintenance cost was calculated as Rs. 174.39 which was Rs. 176.06 per animal per day for G1 and Rs. 172.71 for G2. The proportion of total variable cost in maintenance of local cow was higher than crossbred animal i.e. 96.16 per cent mainly because of higher expenditure on concentrate. The overall net return per local cow came out to be negative to an extent of Rs. 18.20 per day and this loss was as high as Rs. 36.04 per day and Rs. 8.18 per litre on G1 farm. The negative returns in case of local cow have been reported by various studies in the past. The net maintenance cost incurred for a buffalo was Rs. 194.20 per day. The variable cost accounts for 96.86 per cent of the net cost, out of which the highest contribution was made by the concentrate (63.85 per cent).The net return of Rs. 7.39 per day indicates net profit in case of buffalo. In spite of low productivity (6.09 litres/day), farmers were able to get positive returns in buffalo due higher fat content of the milk fetching per litre price of Rs. 30.56. The overall cost of milk production was highest from local cow (Rs. 31.21 per litre) followed by buffalo (Rs. 29.34/litre). In crossbred, it was lowest at Rs. 27.66 per litre. The cost of milk production was almost same for local cow and crossbred on G2 farms while it was quite high for crossbred cow on G1 farm which was due to lower milk productivity of the animal for the latter group of farmers.

This research was hindered on the ground that it was framed out only for the women dairy farmers who were below poverty line (BPL) and were the beneficiaries of state run dairy development programme. This research work can be extended for the dairy farmers above poverty line, medium and large farmers; irrespective of their genders. This research has paved paths for the future researchers to carry out yield gap analysis for milch animals in Jharkhand. The researchers can even take up the impact assessment of this programme, as it was one of its kind to be launched in Jharkhand.

REFERENCES

19th Livestock census. 2012.

Animal Husbandry for Jharkhand.. From the Vice Chancellor's desk. BAU Newsletter, 3(2&3),1. 2015. Accessed 12 April, 2017.
Available: http://www.bauranchi.org/wp-content/uploads/2016/09/102_BAU_Apr-Sept.pdf

FAO. Pro-Poor Livestock Policy Initiative A Living from Livestock Pro-Poor Livestock Policies Which Poor to Target? PPLPI Research Report. 2004.

Gomez, K.A. On farm assessment of yield constraints: Methodology, problems, constraints to high yields on Asian rice farms. An Interim Report. International Rice Research Institute, Los Banos, Philippines. 1977: 1-14.

Job, E. Yield gap of rice in Alappuzha district of Kerala. Journal of Tropical Agriculture. 2006: 44: 88-90.

Liang, W. *et al*. A preliminary analysis on the yield gap of winter wheat between demonstration plots and farmer's field. Journal of Food, Agriculture and Environment. 2006: 4 (3/4): 143-146.

NSS. Household Consumption of Various Goods and Services in India. NSS 66th Round, Report No. 541 (66/1.0/3), MOSPI, Government of India. 2012.

Paul, D. and Chandel, B.S. Improving Milk Yield Performance of Crossbred Cattle in North-Eastern States of India. Agricultural Economics Research Review. 2010: 23: 69-75.

Singh, P. Economic analysis of traditional milk supply chain in Ranchi district of Jharkhand. M.Sc. thesis submitted to ICAR-National Dairy Research Institute (Deemed University), Karnal, Haryana, India. 2015.

Sirohi, *et al.* Costs and returns in milk production: Developing standardization methodology and estimates for various production systems. Project report submitted to Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Govt. of India, New Delhi. 2015.

Vision 2050. ICAR-CIRC: 3. 2015.

Warr, P. Poverty reduction and sectoral growth: evidence from south-east Asia. Paper presented at the WIDER development conference on growth and poverty, Helsinki. 2001.

Rena, Ravinder (2004) "Green Revolution: Indian Agricultural Experience – A Paradigm for Eritrea", New Jersey, USA: Eritrean Studies Review, Vol. 4, No.1, pp.103-130

Deka, R. and Wright, I.A. 2011. Potential for livelihood improvement through livestock development in Jharkhand. Nairobi, Kenya, ILRI.

Tamou, C., de Boer, I. J., Ripoll-Bosch, R., & Oosting, S. J. (2018). Understanding roles and functions of cattle breeds for pastoralists in Benin. *Livestock Science*, *210*, 129-136.

Omoruyi EMM, Olamide KS, Gomolemo G and Donath OA. Entrepreneurship and Economic Growth: Does Entrepreneurship Bolster Economic Expansion in Africa? J Socialomics 2017, Vol 6(4): 219

Murendo, C., Nhau, B., Mazvimavi, K., Khanye, T., & Gwara, S. (2018). Nutrition education, farm production diversity, and commercialization on household and individual dietary diversity in Zimbabwe. *Food & nutrition research*, *62*, 10.29219/fnr.v62.1276. doi:10.29219/fnr.v62.1276