# RELATIVE COST, PROFITABILITY AND EFFICIENCY AMONG DIFFERENT TYPES OF DAIRY FARMS AT BHARATPUR, CHITWAN, NEPAL

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## ABSTRACT

*Dairy sector is gradually commercializing and modernizing with the use of improved breeds, processed feeds, cultivated grass, fodders, medicines and additives in Nepal. In this context, this study was designed to evaluate the relative cost, return, resource use efficiency, return to scale and profitability of milk production in different type of dairy farms. Primary data were collected through face-to-face interview using semi-structured interview schedule from a sample of 240 dairy farms selected from simple random sampling technique in 8 wards of Bharatpur Metropolitan City, Chitwan. Data were analyzed using descriptive statistics, cost and profit analysis, linear production function and Cobb-Douglas function. It was found that pure buffalo farms were facing negative profit margin against the profit of Rs. 32565 and Rs. 106627 at cow and mix system of dairy farming, respectively. Average variable cost of per liter milk production was Rs. 93.70, Rs. 54.80 and Rs. 44.73 for buffalo, cow and mix farms, respectively with benefit-cost ratio of 0.99, 1.44 and 1.62 for respective categories of the farms. Green grass, dry fodder, labour, feed, medicines and additives were significantly contributing to milk production in buffalo and cow farms. But, only grass, fodder and labour were contributing to milk production in mix dairy farms. All categories of farms were suffering from decreasing return to scale but they were still profitable over variable cost. Labour was the most contributing factor in all three categories of farms and thus dairy farming seems potential to create productive employment. This is concluded that dairy farming system can be promoted profitably by enhancing the level of use of labour, grass, fodder, medicines and additives.*

**Key words:** Benefit-cost ratio, Cobb-Douglas function, Dairy farms, Profit margin

## INTRODUCTION

Production of crops, livestock, forestry and fisheries are the key sources for natural resource-based income in Nepalese economy. Agriculture alone contributes about 26.2% to the National Gross Domestic Product (NGDP) of which 11.5% of the contribution comes from livestock and poultry sector in Nepal (MoF, 2020). Milk forms a bulk share in livestock products (MOAC, 2017). The total population of cattle and buffalo in Nepal accounts about 7.6 million and 5.3 million, respectively (MOALD, 2020). In spite of this large population, the contribution of livestock sector has not been fully utilized for increasing food and nutritional security, poverty reduction and raising the livelihood of dairy farming communities. Low productivity of Nepalese dairy farming systems has been placed as a primary problem limiting dairy development in the country. The ultimate approach for increase the productivity and profitability of dairy farming system is to enhance the productivity and efficiency of resources using in the production. Nepal is short of about half million liters of milk daily and spends billions of Rupees importing milk or other dairy products annually (FNCCI, 2017). The Nepalese dairy sector faces higher cost of production (10-20%) than several other Asian countries

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including India (NDDB, 2014). The productivity and profitability study of the dairy sub-sector is a subject that has not been fully investigated at farm level with location specific characteristic. Several studies showed high cost of production attributed to low productivity and high input cost (NDDB, 2014). Agriculture Development Strategy (ADS) of Nepal has also prioritized dairy as the second most important commodity after maize for trade and value chain promotion (MOAD, 2015). As envisioned in the ADS, this study was targeted for increasing self-reliance on milk production, sustainability, competitiveness, productivity, as well as reducing cost of production through identification of cost structure, profit conditions, resource productivity, resource use efficiency and return to scale.

Chitwan district lies in inner terai region which is very favorable for livestock promotion. From the record of District Livestock Development Office of Chitwan, milk is the lead production of the district. From the business point of view, Chitwan is the urbanizing district with growing local demand of dairy products. However, dairy sector of the district is in slow motion due to growing remittance economy, fragmentation of land, poor motivation towards dairy business, low yielding dairy animals and poor technological advancement (DLSO, 2016). In the light of these problems and context, commercialization of dairy farming with involvement of youth generation may be possible only after operating the dairy business in viable unit backed by minimized cost of production, maximized productivity and efficiency and, from policy intervention on key economic factors affecting profitability of diary production system. In these contexts, this study was conducted to estimate the cost and profit level, productivity and resource use efficiency of different type of dairy farms in Chitwan district of Nepal. Studying productivity and profitability, and the responsible determining factors are important for farmers, planners, researchers and policy makers. Farmers could use the findings of this type of study for increasing their performance in dairy farms through optimum allocation of resources and policy makers could identify and prioritized the intervention required to increase the productivity and efficiency of dairy farms in the country (Solís et al., 2009).

## METHODOLOGY

### STUDY AREA AND SAMPLING DESIGN

The study was conducted in Bharatpur Metropolitan City of Chitwan district, Nepal. It is one of the potential districts for the promotion of dairy farming characterized by gradual commercialization of different agriculture and livestock-based firms. A total of 8 most commercial wards from the metropolitan city and one Dairy cooperative from each eight wards were selected to frame the sample required for the study. A total of 10 dairy farms from each cow, buffalo and mix farms were selected randomly from each cooperative using simple random sampling technique to make a sample of 240 dairy farming households. Thus, the dairy farms selected for the study are semi-commercial to commercial who sold their milk at the nearby cooperatives.

## DATA COLLECTION

Literature review and preliminary field visit were done to develop coordination schema before design of interview schedule. This coordination schema was used to develop interview schedule required for collecting primary data. Thus, primary data were collected from face-to-face interview of selected respondent households using semi-structured interview schedule. Interview schedule prepared in this manner was pretested in 10 dairy farming households at ward number 7 of the Metropolitan city. Collected data were entered in Microsoft excel sheet and analyzed using STATA and SPSS software wherever applicable.

## ANALYTICAL TOOLS

Socioeconomic and demographic variables were analyzed using the tools of descriptive statistics like mean, frequency and percentage. All variable inputs like human labor, feed, fodder, medicines, additives, breeding cost and others for different dairy production practices were considered and valuated at current market prices to calculate variable cost of production. Similarly, fixed cost incurred in different assets, their depreciation and interest were summed up to estimate total fixed cost.

Total annual variable cost = $C_{labor}$+ $C_{feed}$ +$C_{dry\ fodder}$+ $C_{green\ grasses}$+ $C_{medicines}$+ $C_{additives}$+ $C_{breeding\ cost}$

Total fixed cost= Depreciation + Interest

Where,

$C_{labor}$ = Cost on human labor used (NRs./farm),

$C_{feed}$= Cost on concentrate feed used (NRs./farm),

$C_{dry\ fodder}$ = Cost on dry fodder (NRs./farm),

$C_{green\ grasses}$ = Cost of green grasses (NRs./farm),

$C_{medicines}$ = Cost on veterinary medicines (NRs./farm),

$C_{additives}$ =Cost on additives (NRs./farm),

$C_{breeding\ cost}$ = breeding cost (NRs./farm)

These individual cost items, fixed cost and total cost were compared among buffalo farms, cow farms and mix of cow and buffalo farms. Similarly, variable cost, fixed cost and total costs were also calculated on per liter of milk production basis to derive average cost of milk production.

Gross return was calculated by multiplying the total volume of product from dairy enterprise by the average price of the product (Dillon & Hardaker, 1993). Thus, gross return was calculated by using following formula:

Gross return (NRs.) = Total quantity produced (litre) × Price (NRs./litre)

In addition to main product, the return from by product like manure and sale of calf were also estimated to derive total income of dairy farms. Gross margin calculation was done to have an estimate of the difference between the gross return and variable costs. Net margin on the other side was estimated by deducting total cost from total return.

Gross Margin (NRs./lit) = Gross return (NRs./lit) - Average variable cost (NRs./lit)

Net Margin (NRs./lit) = Gross return (NRs./lit) – Average total cost (NRs./lit)

Furthermore, average cost per litre of production was compared with average revenue received from milk on per litre basis for deriving meaningful comparison of profitability.

Resource productivity of different type of dairy farms were estimated using linear production function of the following form (Shrestha, 2016).

$Y = a+b_1$ grass and fodder+ $b_2$ labour+ $b_3$ feed, medicines and additives+ $b_4$ breeding cost

Similarly, Cobb-Douglas production function of the following form was employed to estimate the resource use efficiency and return to scale from dairy farming systems as adopted from Battese and Coelli (1988).

$LNY=LNa+ b_1$LN grass and fodder+ $b_2$LN labour+ $b_3$ LN feed, medicines and additives

All these dependent and independent variables used in the linear and Cobb-Douglas production functions were estimated at current market price and considered in monetary terms on per farm per year basis.

## RESULTS AND DISCUSSION

### SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

The average age of the household head among dairy farming households was 53.25 years in study area. The study showed all household heads in the study area were economically active population which is higher than national distribution of economically active population in agriculture (64%) (CBS, 2011). As far as educational background of respondents is concerned, it was found average of 8.05 formal years of education. Family size of respondents' household was 5.68 out of which 2.81 were female and 2.87 were male. Majority of the respondents (69.17%) were male respondents whereas percentage of female respondents were 30.83% only. The proportion of female respondents varied by type of farms and was 20.0%, 31.25% and 41.25% in mix, buffalo and cow farms, respectively. The average own land was 17.87 kattha[1] with 12.54 kattha as irrigated land. Out of which, 2.22 kattha was allocated for grass and fodder cultivation, and 2.15 kattha was allocated for pasture. The average number of adult milching cows and buffalos in study area were 3.04 and 2.11, respectively.

### COST, RETURN AND PROFITABILITY

Investment can be considered as one of the important propulsive forces in determining the capital formation, which in turn leads to generate future dividends to the investor. Level of investment reflects the extent of business activity and its income generating capacity in long term. The total capital investment on various purposes by type of study farms is presented in Table 1. As far as investment distribution is concerned, it is seen that in terms of overall distribution, the average capital investment was worked out to be over NRs. 435387 out of which, the buildings/shed alone

[1] 1 kattha=0.033 ha

constituted nearly 33.91 per cent followed by cows (33.16%), buffalos (30.23%) and other items (2.69%). In the cow farm, the average capital investment was worked out to be NRs. 478838, out of which, the buildings/shed alone constituted nearly 38.45%. Whereas the average capital investment in the buffalo farm was NRs. 262655, out of which, the buildings/shed alone constituted nearly 38.56 per cent followed by buffalos 57.15 per cent and other items 4.27 per cent. In mix farm, the average capital investment was worked out to be over NRs. 388782, out of which, the buildings/shed alone constituted nearly 40.25%.

Table 1: Average level of investment for different purposes by type of study farms

| Investment items | Buffalo farm | | Cow farm | | Mix farm | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Buildings/shed | 101299 | 108336 | 184091 | 563432 | 156520 | 228688 | 147628 | 360768 |
| Cows | - | - | 183427 | 371398 | 105817 | 168973 | 144372 | 292304 |
| Buffalos | 150127 | 209573 | - | - | 114007 | 145913 | 131641 | 180687 |
| Other items | 11229 | 21440 | 11570 | 26674 | 12439 | 33295 | 11747 | 27464 |
| Total | 262655 | 115506 | 478838 | 18641 | 388782 | 89604 | 435387 | 104075 |

The average level of different components of variable cost and total variable cost of dairy farming in study area is presented in Table 2. The total variable cost per year was NRs. 165773 in cow farm, NRs. 187559 in buffalo farm and NRs. 222737 in mix farm. The total variable cost in dairy farming comprised cost for concentrate, green grass, dry fodder, water, labour use, medicine and veterinary charge, breeding and additive cost. Cost for concentrate comprised 26.58 per cent, 21.21 per cent and 22.96 per cent of the total variable cost in cow farm, buffalo farm and mix farm, respectively. Sharma (2007) also reported that animal feed is one of the major inputs of production as it shares around 50-60 percent of cost of production of milk. The percentage bearing of feed cost on total cost was lower in this study as the farm family labour cost was imputed while deriving the total cost of production. Cost of green grass comprised 25.64 per cent, 20.43 per cent and 19.21 per cent of the total variable cost in cow farm, buffalo farm and mix farm, respectively. Cost of dry fodder comprised 4.73 per cent, 3.79 per cent and 3.73 per cent of the total variable cost in cow farm, buffalo farm and mix farm, respectively. Cost of labour, taking into account of family labour, comprised 60.57 per cent, 50.14 per cent and 49.13 per cent of the total variable cost in cow farm, buffalo farm and mix farm, respectively. Deshetti, Teggi and Hosamani (2017) also found the paid labour costs accounted to be 28.01 percent and 30 percent in Vijayapura and Bagalakote district of Karnataka, India. Medicine and Veterinary charge comprised 5.44 per cent, 2.48 per cent and 4.22 per cent of the total variable cost in cow farm, buffalo farm and mix farm, respectively. Breeding cost comprised 1.02 per cent, 0.66 per cent and 0.86 per cent of the total variable cost in cow farm, buffalo farm and mix farm. The study revealed that nearly half of the total variable cost is comprised of labour cost only.

Table 2: Average level of different components of variable cost and total variable cost of dairy farming

| Particulars | Type of farms | | | |
|---|---|---|---|---|
| | Buffalo farms | Cow farms | Mix farms | Total |
| Concentrates (kg/day) | 3.40 | 4.09 | 3.86 | 3.78 |
| Concentrate cost (Rs./year) | 39786 | 44065 | 51141 | 44998 |
| Green grass (kg/day) | 27.41 | 29.34 | 29.15 | 28.63 |
| Green grass cost (Rs./yr) | 38330 | 42510 | 42806 | 41215 |
| Dry fodder and straw (kg/day) | 12.93 | 13.65 | 14.09 | 13.55 |
| Dry fodder cost (Rs./year) | 7126 | 7848 | 8328 | 7767 |
| Water (lit/day/animal) | 55.75 | 55.38 | 54.50 | 55.21 |
| Labour use (hrs./day) | 5.59 | 5.79 | 6.86 | 6.08 |
| Labour cost (Rs./year) | 94058 | 100419 | 109444 | 101307 |
| Medicine cost (Rs./year) | 4648 | 9031 | 9400 | 7693 |
| Additive cost (Rs./yr) | 2388 | 4293 | 6755 | 4479 |
| Breeding cost (Rs./yr) | 1253 | 1691 | 1937 | 1630 |
| Total variable cost (Rs./yr) | 187559 | 165773 | 222737 | 192023 |

Different type of cost by categories of farms is presented in Table 3. The total cost was about NRs. 205609 in cow farm, NRs. 209881 in buffalo and NRs. 255032.66 in mix farms. The total variable cost shares 80.62%, 89.36%, and 87.34% of the total cost in cow, buffalo and mix farm, respectively. Gavali (2001) also found that the total cost of milk production composed of working cost (82%) and fixed cost (18%) of the total cost. As far as profitability by type of farms is concerned, it is seen that in terms of overall distribution, the gross margin and net margin were found to be NRs. 69605.18 and NRs. 32273.19, respectively. Similarly, gross margin and net margin was found to be positive for cow as well as mix farms and these were negative for buffalo farms. Thus, the result portrays that both cow and mix farms in the study area are profitable. This study has included the imputed value of all farm produced inputs including labour as cost components in dairy production.

Table 3: Average variable, fix cost, and profitability by type of farms

| Costs | Buffalo farms | Cow farms | Mix farms | Total |
|---|---|---|---|---|
| Fixed cost | 22323.41 | 39836.19 | 32296.13 | 37331.99 |
| Variable cost | 187558.58 | 165773.13 | 222736.53 | 192022.74 |
| Total cost | 209881.98 | 205609.31 | 255032.66 | 229354.74 |
| Gross margin | -2509.08 | 72401.63 | 138922.99 | 69605.18 |
| Net margin | -24832.48 | 32565.44 | 106626.86 | 32273.19 |

In terms of average lactation period (days) of dairy animals by type of farms under study, it is seen that the average lactation period of cow was 291.43 days and that of buffalo was 268.84 days. In the cow farm, the average lactation period of cow was 290.19 days, whereas the average lactation period of buffalo in the buffalo farm was 272.11 days. In mix farm, the average lactation period of cow was 292.66 days and that of buffalo was 265.56 days. The study revealed that cows have consistent longer lactation period as compared to buffalo in all type of farms (Table 4).

Table 4: Average lactation period (days) of dairy animals by type of farms under study

| Type of dairy animal | Buffalo farm | | Cow farm | | Mix farm | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Cow | - | - | 290.19 | 34.77 | 292.66 | 32.90 | 291.43 | 33.77 |
| Buffalo | 272.11 | 61.26 | - | - | 265.56 | 54.84 | 268.84 | 58.05 |

An Attempt was made to understand the average income in dairy farm enterprise in study areas (Table 5). The study revealed that in terms of overall distribution, the total income was NRs. 261628 with 81.01 per cent as milk income. In the cow farm, the total income was NRs. 238175 with 82.55 per cent as milk income, whereas the total income was NRs. 185050 with 75.71 per cent as milk income in Buffalo farm. In mix farm, the total income was NRs. 361660 with 82.61 per cent as milk income. The milk income includes the cow milk and buffalo milk and the non- milk income includes income from manure and sale of calf.

Table 5: Average income in dairy farm enterprise from milk and non-milk sources

| Particulars | Buffalo farm | | Cow farm | | Mix farm | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Cow milk | - | - | 196619 | 84614 | 173651 | 57558 | 185062 | 72959 |
| Buffalo milk | 140112 | 62539 | - | - | 132264 | 54434 | 136263 | 58649 |
| Milk total | 140112 | 62539 | 196619 | 84614 | 298785 | 98156 | 211966 | 105858 |
| Manure | 27775 | 38027 | 41775 | 57542 | 45500 | 45249 | 38350 | 48038 |
| Sale of calf | 17163 | 23225 | 4696 | 13405 | 17375 | 28239 | 13078 | 23164 |
| Total non-milk | 44938 | 30626 | 46471 | 35473 | 62875 | 36744 | 51428 | 35601 |
| Total income | 185050 | 98258 | 238175 | 112525 | 361660 | 127637 | 261628 | 135122 |

The cost of milk by type of farms was presented in Table 6. As far as average cost (Rs./litre) by type of farms is concerned, it can be seen that in terms of overall distribution, the average cost of milk/litre was NRs. 70.33. The total cost of per litre milk production was NRs. 67.97 in cow farm, NRs. 104.86 in buffalo farm and NRs. 51.21 in mix farm. The total variable cost shares 80.62%, 89.35%, and 87.35% of the total cost in cow, buffalo and mix farms, respectively.

Table 6: Average cost of milk production (Rs./litre) by type of farms

| Particulars | Buffalo farm | Cow farm | Mix farm | Total |
|---|---|---|---|---|
| Variable cost (NRs./Lit) | 93.70 | 54.80 | 44.73 | 58.88 |
| Fix cost (NRs./Lit) | 11.15 | 13.17 | 6.49 | 11.45 |
| Total cost (NRs./Lit) | 104.86 | 67.97 | 51.21 | 70.33 |

The average percentage composition of milk and non-milk income is presented in Table 7. It can be seen that in terms of overall distribution, the average composition of milk income was 80.29 per cent and that of non-milk income was 19.71%. The total milk income shares 82.55%, 75.72%, and 82.61% of the total income in cow, buffalo and mix farms, respectively.

Table 7: Average percentage composition of milk and non-milk income

| Particulars | Buffalo farm | Cow farm | Mix farm | Total |
|---|---|---|---|---|
| Milk | 75.72 | 82.55 | 82.61 | 80.29 |
| Non-milk | 24.28 | 17.45 | 17.38 | 19.71 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

As far as average price of cow and buffalo milk in study area is concerned, it is seen that in all type of farms in study area, the average price of cow milk was NRs. 60 that of buffalo was NRs. 70 as shown in Table 8. The study revealed that there was no any price variation with type of farms in study area. These price levels are the price received by dairy farmers from the dairy cooperatives.

Table 8: Average price of cow and buffalo milk in study area

| Particulars | Buffalo farm | Cow farm | Mix farm | Total |
|---|---|---|---|---|
| Cow milk | - | 60.00 | 60.00 | 60.00 |
| Buffalo milk | 70.00 | - | 70.00 | 70.00 |

In terms of average milk yield (litres/day) by type of farms in study area, it is seen that the average milk yield of cow was 10.49 litres/day and that of buffalo was 7.14 litres/day. In the cow farm, the average milk yield of cow was 11.06 litres/day, whereas the average milk yield of buffalo in the buffalo farm was 7.21 litres/day. In mix farm, the average milk yield of cow was 9.91 litres/day and that of buffalo was 7.07 litres/day. The study found that average milk yield of cow was greater than that of buffalo in all type of farms in study area (Table 9).

Table 9: Average milk yield (litres/day) by type of farms in study area

| Farms | Buffalo farm | | Cow farm | | Mix farm | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Cow | - | - | 11.06 | 4.38 | 9.91 | 3.10 | 10.49 | 3.83 |
| Buffalo | 7.21 | 2.26 | - | - | 7.07 | 2.59 | 7.14 | 2.42 |

An attempt was made to understand the BC ratio of dairy farm business in different categories of farms, it was seen that in terms of overall distribution, the average BC ratio was 1.36 which suggest that dairy business in study area was feasible. The average BC ratio was 1.44 and 1.62, respectively in cow and mix farm which suggest that these farms in the study area are profitable. However, commercialization and adoption of technologies can provide a high return in these farms whereas, the BC ratio of buffalo farm was 0.9 which suggest that buffalo farm in existing situation was nearly at breakeven condition.

Table 10: Average BC ratio of dairy farm business in different categories of farms

| Particulars | Buffalo farm | Cow farm | Mix farm | Total |
|---|---|---|---|---|
| Mean | 0.99 | 1.44 | 1.62 | 1.36 |
| SD | 0.40 | 0.75 | 0.75 | 0.73 |

RESOURCE PRODUCTIVITY OF DAIRY FARMING

Productivity of dairy farms in study area was affected by various factors like cost on grass and fodder, labour cost, cost on medicines and additives and breeding cost. Resource productivity of buffalo farms in study area is presented in Table 11. In buffalo farm, cost on grass and fodder, labour cost and cost of feed, medicines and additives significantly affect the productivity of buffalo at 5% level of probability. Osti et. al, (2013) also found that milk production was less (8 kg/day/head) prior to protein based feeding, while higher during protein based feeding (10.0 kg/animal/day) was provided. The feed supply of Nepal is not sufficient to meet the demand of dairy animals. There is shortfall of 38% in crude protein, 42% in metabolizable energy and 33% in dry matter (Osti, 2020). Cost on grass and fodder increases the productivity of buffalo more than other factors of production. The cost on grass and fodder coefficient 0.998 depicts that with Re. 1 increase in the cost of grass and fodder, the income of buffalo farms will be increased by about 99 Paisa.

Table 11: Resource productivity of buffalo farms in study area

| Factors of production | Coefficient | Std. error | t | P-value |
|---|---|---|---|---|
| Cost on grass and fodder (Rs.) | 0.998 | 0.124 | 8.04 | 0.000 |
| Labour cost (Rs.) | 0.339 | 0.082 | 4.09 | 0.000 |
| Cost on feed, medicines and additives (Rs.) | 0.897 | 0.300 | 2.99 | 0.004 |
| Breeding cost (Rs.) | 1.077 | 5.65 | 0.19 | 0.849 |
| Constant | 29854.64 | 11799.24 | 2.53 | 0.013 |

R-squared: 0.6458 Adjusted R-squared: 0.626

Resource productivity of cow farms in study area is presented in Table 12. In cow farms, cost on grass and fodder, labour cost and cost of medicines and additives significantly affect the productivity of buffalo at 5 % level of probability. Cost on grass and fodder, and labour cost had positive relation with output. Vishnoi, Gupta and Pooniya (2015) also found that the expenditure on concentrate and labour were found positive and significant contribution on milk yield. On other hand, productivity of cow was negatively affected by cost on medicines and additives. Cost on grass and fodder increases the productivity of cow more than other factors of production.

Table 12: Resource productivity of cow farms in study area

| Factors of production | Coefficient | Std. error | t | P-value |
|---|---|---|---|---|
| Cost on grass and fodder (Rs.) | 1.301 | 0.187 | 6.93 | 0.000 |
| Labour cost (Rs.) | 0.872 | 0.113 | 7.67 | 0.000 |
| Cost on feed, medicines and additives (Rs.) | -1.265 | 0.420 | -3.01 | 0.004 |
| Breeding cost (Rs.) | 2.846 | 3.675 | 0.77 | 0.441 |
| Constant | 58081.07 | 16299.33 | 3.56 | 0.001 |

R-squared: 0.598 Adjusted R-squared: 0.577

Resource productivity of buffalo and cow mix farms in study area is presented in Table 13. In mix farms, cost on grass and fodder, and labour cost significantly affect the productivity of cows and buffalos at 5% level of probability. Both the afore-mentioned factors affect the productivity of buffalo and cow positively. Cost on grass and fodder increases the productivity of cattle more than

other factors of production. The cost on grass and fodder had coefficient 1.780 depicting that with Re. 1 increase in cost of grass and fodder, the income of cow farms will be increased by NRs. 1.78. Meena et al. (2012) also found that concentrates and roughages influenced the returns of milk from dairy enterprises significantly.

Table 13: Resource productivity of buffalo and cow mix farms in study area

| Factors of production | Coefficient | Std. error | t | P-value |
|---|---|---|---|---|
| Cost on grass and fodder (Rs.) | 1.780 | .357 | 4.98 | 0.000 |
| Labour cost (Rs.) | 1.714 | .276 | 6.21 | 0.000 |
| Cost on medicines and additives (Rs.) | 0.026 | 1.234 | 0.02 | 0.983 |
| Breeding cost (Rs.) | -6.364 | 5.889 | -1.08 | 0.283 |
| Constant | 89527.24 | 28275.29 | 3.17 | 0.002 |

R-squared: 0.468 Adjusted R-squared: 0.440

EFFICIENCY AND RETURN TO SCALE

Income of dairy farms in study area was affected by various factors like cost on grass and fodder, labour cost and cost on medicines and additives. Estimate of efficiency and return to scale from Cobb-Douglas production function for buffalo farms is presented in Table 14. In buffalo farm, all factors of production significantly affect the income at 5% level of significance. Cost on grass and fodder, labour cost, and cost on medicines and additives had positive relation with income and were underutilized. Deshetti and Teggi (2016) also found underutilization of labour and veterinary costs in cattle farming. The sum of coefficients was 0.910 which is less than 1 implied decreasing return to scale; 100% increase in all the factor of production included in this model would result in 91.0% increase in farm income.

Table 14: Estimates of efficiency and return to scale from Cobb-Douglas production function on buffalo farms

| Factors of production | Coefficient | Std. error | t | P-value |
|---|---|---|---|---|
| Cost on grass and fodder (Rs.) | 0.331 | 0.052 | 6.31 | 0.000 |
| Labour cost (Rs.) | 0.534 | 0.078 | 6.78 | 0.000 |
| Cost on feed, medicines and additives (Rs.) | 0.045 | 0.020 | 2.25 | 0.027 |
| Constant | 1.848 | 1.018 | 1.81 | 0.074 |
| Return to scale | 0.910 | | | |

R-squared: 0.606 Adjusted R-squared: 0.590

Estimate of efficiency and return to scale from Cobb-Douglas production function for cow farms is presented in Table 15. In cow farm, all factors of production significantly affect the income at 5% level of significance. Cost on grass and fodder, labour cost, and cost on medicines and additives had positive relation with income. Timsina (2010) also found similar findings that with increase in labour by 100 percent on an average the output goes up by 67 percent. The sum of coefficients was 0.757 which is less than 1 implied decreasing return to scale; 100% increase in all the factor of production included in this model would result in 75.7 % increase in farm income.

Table 15: Estimates of efficiency and return to scale from Cobb-Douglas production function for cow farms

| Factors of production | Coefficient | Std. error | t | P-value |
|---|---|---|---|---|
| Cost on grass and fodder (Rs.) | 0.164 | 0.031 | 5.17 | 0.000 |
| Labour cost (Rs.) | 0.575 | 0.039 | 14.41 | 0.000 |
| Cost on feed, medicines and additives (Rs.) | 0.018 | 0.009 | 2.09 | 0.040 |
| Constant | 3.927 | 0.556 | 7.05 | 0.001 |
| Return to scale | 0.757 | | | |

R-squared: 0.785 Adjusted R-squared: 0.777

Estimates of efficiency and return to scale from Cobb-Douglas production function for buffalo and cow mix farms is presented in Table 16. In mix farms, all factors of production significantly affect the income at 5 % level of significance. Cost on grass and fodder, labour cost and cost on medicines and additives had positive relation with income. The sum of coefficients was 0.716 which is less than 1 implied decreasing return to scale; 100% increase in all the factor of production included in this model would result in 71.6% increase in farm income. Deshetti, Teggi and Hosamani (2017) also found the decreasing return to scale on dairy farming with value 0.85 in Vijayapura district of Karnataka which is similar to the findings of this study. The direction of coefficients for both labour and other capitals items are compatible with the findings of Shrestha (2016) showing the need to expand their level of uses.

Table 16: Estimates of efficiency and return to scale from Cobb-Douglas production function for buffalo and cow mix farms

| Factors of production | Coefficient | Std. error | t | P-value |
|---|---|---|---|---|
| Cost on grass and fodder | 0.078 | 0.040 | 1.95 | 0.054 |
| Labour cost (Rs.) | 0.554 | 0.074 | 7.44 | 0.000 |
| Cost on feed, medicines and additives (Rs.) | 0.084 | 0.039 | 2.15 | 0.034 |
| Constant | 4.901 | o.873 | 5.61 | 0.000 |
| Return to scale | 0.716 | | | |

R-squared: 0.545 Adjusted R-squared: 0.527

## CONCLUSION

This study examined the relative performance of different type of dairy farms in terms of cost, return, profitability, return to scale and resource use efficiency using different concepts of cost and profit; and production function approaches. It was found that overall dairy farming was profitable business in spite of no-profit-no-loss condition in pure buffalo farming. Buffalo milk production was costly as compared to cow milk because of low productivity, shorter lactation period and smaller size of operation. Farmers are still rearing buffalo in the study area because of lower risk in production, easiness in selling the sterile she buffalo and male calf, preferred taste of buffalo milk for home consumption. Similarly, green grass, dry fodder, labour, medicines and additives were significantly contributing to milk production in buffalo and cow farms. All categories of farms were suffering from decreasing return to scale but cow farms and mix farms are still profitable in milk production. It was also found that labour was the most contributing factor in all the three categories of farms based on

the estimation of Cobb-Douglas Production Function and thus they seem to create productive employment to unemployed youth. Promotional activities to increase the level of use of modern inputs like cultivated green grass and fodder, use of trained labour, and medicines and additives could increase the profitability and sustainability of dairy farming in study area irrespective of type of farms.

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