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Production and Profitability Analysis of Local Breed and Cross Breed Milch Cows: An Empirical Study of Sirajganj District

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Abstract

In the rural setting of Bangladesh, dairy farming is considered as one of the most traditional livelihood earning occupations. It provides employment opportunities and serves as a source of nutrition for both farm and non-farm families. Therefore, rearing milch cows of both local and cross breed by rural people is found all over the country. Sustenance of the dairy farmers of both category cows depends heavily upon the volume of milk production as well as profit earning from it. The contribution of various factor inputs in milk production is also crucial in this regard. Regrettably, this sector has received less attention of the academics for a comprehensive study. Thus, the objectives of this study are to investigate the technical relationship between output and inputs and to examine the relative profitability of milk production from the local breed and cross breed milch cows reared by farmers in the Sirajganj district of Bangladesh. To pursue the objectives, primary data have been used that are collected from 180 dairy farmers, of which 90 are local breed raisers and 90 are cross breed raisers. A multi-stage random sampling technique is applied to select the sample farmers.The well familiar Cobb-Douglas production function and a linear profit equation are employed to perform the analyses in the study. The estimation results of the production function revealed that only green grass and concentrate feed have a positive and statistically significant impact on milk yield in the case of local breed milch cows. On the other hand, in the case of cross-breed milch cows, all inputs (except for veterinary inputs) have a positive and highly significant impact on milk yield. It is found that the total annual cost of rearing a local breed milch cow is Tk.55920 while it is Tk.104412 for a crossbreed milch cow. It is also found that feed cost comprises 60.89% and 65.30% of the total costs for the local breed and cross breed milch cows, respectively. The estimated gross return per milch cow per year stands at Tk.68490

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for the local breed while it amounts to Tk.157742 for the crossbreed. The estimated benefit-cost ratio (BCR) for the local breed and cross breed milch cows are found to be 1.22 and 1.51, respectively, indicating that rearing of both categories of milch cows is profitable. Therefore, the government and NGOs should come ahead to support the dairy farmers towards promoting sustainable livelihood in the study area.

Keywords: Milch Cow, Milk Yield, Input-Output Relationship, Benefit-Cost Ratio, Bangladesh.

1. Introduction

Agriculture sector contributes significantly to provide income and employment opportunities, reduce poverty, and ensure food and nutrition security for about four-fifths of the world's population living in rural areas (World Bank, 2019). Livestock is an important sub-sector of agriculture. Globally, the contribution of the livestock sub-sector in agricultural GDP is around 40 percent, and when the developing countries are taken into account, its contribution is about 30 percent to the total agricultural GDP (World Bank, 2019; FAO, 2006). Dairy farming constitutes the main components of the livestock sub-sector which achieved one of the prominent places in rural life and provides not only the main and subsidiary occupation but also a significant source of nutrition, draught power, and organic manure (Kumawat *et.al*, 2014*).*

Bangladesh, having a population of around 165 million, is considered to be one of the world's most heavily populated countries (BBS, 2019). About 63% of the total population of the country lives in rural areas and depends on agriculture. The agriculture sector provides employment opportunities for about 40.6%population of the country(BBS, 2019). In the fiscal year 2018-19,the contribution of the agricultural sector to the country's GDP is 13.6%. The contribution of the livestock sub-sectorto agricultural GDP is 13.85% where dairy farming accounts for 12% of the agricultural GDP(FAO, 2010).Dairy farming, which is a traditional occupation of the rural people in Bangladesh, has been practiced on a small scale for a long period. As theactivity requires a very small piece of land, even landless farmers can easily involve with it. According to Rahman *et al*. (2003), dairy farming is an occupation, way of life, and 365 days-a-year jobs.

Milk is considered as an ideal and nutritious food that significantly contributes to the dietary requirements of the people of our country. However, there is an acute shortage of milk and milk products, despite the huge potential of dairy production in Bangladesh. Although milk production in Bangladesh has been slightly showing an upward trend in recent years, the growth rate of milk production is not satisfactory and it is only 1.32% in the year 2017-18 (DLS, 2018). The availability of milk per person per day in Bangladeshis 158.19 ml, which is far below the suggested requirements of milk of 250 ml per person per day suggested by the World Health Organization (DLS, 2018). The growth rate of per capita milk consumption in

Bangladesh is 4 percent per year, whereas the growth rate of milk production is 3.6 percent (Uddin *et al*. 2011), resulting in an increasing gap between demand and supply of milk, which is mostly met by bulk imports of milk powder and cream mainly from Australia, New Zealand, Holland, Denmark, and Poland. This increases the spending of hard-earned foreign currency and badly pressurizes Bangladesh's foreign currency reserve (Hamid *et al.*, 2014).

In Bangladesh, the rise in income of people, rapid population growth, and urbanization are considered to be the main drivers of the faster growth of milk demand (Delgado *et al.*, 1999; Uddin *et al*. 2010). This faster growth of milk demand has made an enormous market opportunity for the small-scale dairy farmers who produce about 70 to 80 percent of total milk in Bangladesh (Jabber*et al.*, 2005). Although rearing of local breed cows in the rural areas has been the traditional norm, at present, farmers are more interested in rearing hybrid milch cows, which emerge from cross-breeding of local cows with non-traditional breeds such as Sahiwal, Australian, Holstein, Jersey, Friesian, etc. Crossbreed cows are more productive in terms of milk and meat. Pabna, Sirajganj, Manikgonj, Faridpur, Kishoreganj, Rangpur, and Tangail districts are known as the milk pocket areas of Bangladesh, and the dairy farmers of these areas rear cross breed as well as the existing local breedmilch cows to ensure higher return from their dairy activity.

Although dairy farming in Bangladesh has been growing fast, it faces the problem of high input costs and low output prices which badly affect the profitability of the dairy farmers. It is observed that in recent years, prices of dairy inputs increased remarkably which caused the production costs to rise and finally reduce the profitability of the dairy farmers. On the other hand, due to market channel inefficiencies and different types of business manipulations, farmers have to sell their products at low prices. Thus, growing input costs combined with low milk price in the market drives the milk producers into a more worrying condition (Uddin *et al*., 2009). Research studies indicate that an unorganized marketing system, low productivity of dairy animals, insufficient artificial insemination (AI) and veterinary services, lack of technological facilities, and elementary infrastructure is badly affecting the economic condition of dairy farmers (Uddin *et al.*, 2010).

To keep dairy farming as a viable rural economic activity, dairy farmers must get supports that should help them in reducing costs, increasing output, and making more profit. Taking note of the importance of this sector, the Government of Bangladesh has, therefore, given high priority to the expansion of the dairy sector, and taken several measures such as to train the dairy farmers, arrange various workshops about vaccination programs, provide subsidy and soft loan for purchasing feeds and fodder, provide high yielding fodder seeds, etc. to encourage the dairy farmers so that they can stay with this sector. However, these supports and policies are often found to be less outcome-oriented than expected, which is attributable to less understanding of the empirical facts related to the dairy sector in the study area, and gaps in the policies. It is generally held that expansion of dairy farming is heavily dependent on milk productivity as well asfarm profitability, which are in turn dependent on various factors like the proper organization of the feeding system, management of cattle

diseases, awareness about the proper timing of vaccination, inoculation, de-worming of milch cows, diversity of the breed and others factors. Therefore, information on these particular parameters is badly needed to boost the competitiveness in both the product and factor markets related to the dairy sector. There is a dearth of research in Bangladesh on these issues, especially on evaluating the effects of breed types on milk production and farm profitability of smallholder dairy farmers. This substantiates the necessity of conducting further research and this study undertakes the objective of estimating the effects of various inputs on milk production and the profitability of dairy farming in Bangladesh, taking both local and cross breed milch cows.

The paper is structured into five sections. Section 1introduced the issue with setting the research objectives. Section 2 presents a brief literature review and Section 3 describes the methodology which is adopted to achieve the research objectives. Section 4 presents the estimated results focusing on the production and profitability of local and cross breed milch cows. Finally, section 5 concludes the study.

2. Literature Review

Several studies are conducted on different aspects of the dairy sector in the contexts of Bangladesh and other countries. The analyses in the studies covered an array of issues about dairy farming including input-output relationship in milk production, input and output markets of dairy production, demand for dairy produce, costs and benefits of dairy activity, and policy aspects related to supports for growth of the sector. Venkatesh and Sangeetha (2011), Pandain *et al.* (2013), and Pandian *et al.* (2012) conducted separate studies using primary data in the Tamil Nadu state of India. All the studies estimated Cobb-Douglas production function to examine the input-output relationship in milk production. Pandain *et al.* (2012), showed that concentrates, green fodder, dry fodder, and veterinary charges had a significantly positive influence on milk production, while the labour input had a negative impact on milk production. Again, Pandain *et al.* (2013) showed that concentrate, green fodder, and labour had a positive and highly significant impact on milk production. Venkatesh and Sangeetha (2011) found that green fodder, concentrates, dry fodder, and health care have a significantly positive impact on milk production.

The study of Kumar and Shukla (2017) also used Cobb-Douglas production function to estimate the input-output relationship in milk production in diverse groups of rural and urban dairy producers of Uttar Pradesh, India. The study stated that in the case of both rural and urban milk producers, concentrates and green fodder have a positive significant impact and dry fodder had a negative impact on milk production. Dolewikou *et al.* (2016) used a multiple linear regression model to estimate the technical relationship between inputs and output in milk production of the Semarang Regency. Green grass, concentrate, feed pulp, and labour were considered as inputs for this study. The study informed that concentrate feed and feed pulp had no significant impact on milk production but green grass and labour had a significant impact on milk production.

Focusing on the economic viability of the dairy sector, Rangnath *et al.* (2015) and Babar *et al.* (2010) conducted separate studies to determine the cost and return of

milk production for cross breed cows and buffaloes in the Western Maharashtra scarcity zone and Parbhani district of Maharashtra, respectively. In these studies, interests in fixed capital, depreciation of animals, cattle shed, and dairy equipment were included as fixed costs. The considered variable costs were feed, labour, veterinary and miscellaneous costs. The study estimated the per day maintenance cost of a milch buffalo and cross breed milch cow as well as the net return earned from per milch buffalo and cross breed milch cow. Thus, the findings imply that the profitability of cross breed milch cows was higher than the profitability of milch buffaloes in the study area. A similar study conducted by Babar *et al.* (2010) found that net return per cross breed cow was Rs.17742.4 per year which was Rs.13219 per buffalo, indicating that cross breed cow rearing was more profitable in the study area. Islam *et al.* (2008) collected primary data from 60 cross breed cattle owners, 18 indigenous cattle owners, and 20 mixed cattle owners of West Bengal to estimate the relative profitability of them using simple statistical techniques. The study found that the profitability of cross-breed cattle is more than the local breed and mixed cattle.

Qadir *et al.* (2016), and Anwar and Younas (2000) tried to find out the profitability of rural subsistence (including 1-3 dairy animals), semi-commercial (including 4-10 dairy animals), and commercial dairy (including more than 10 animals) farmers in Peshawar district and Toba Tek Singh district of Pakistan. The study of Qadir *et al.* (2016) found that the yearly average fixed cost of a milch cow was Rs.9485.76, Rs.17382.51, and Rs.19070.57 and the estimated variable cost was Rs.49741.07, Rs.70492.74, and Rs.76559.57 for the above categories of farmers, respectively.The study concluded that all categories of dairy farming were profitable in the study area. Besides the estimated BCR of 1.15 implies that commercial dairy farming was more profitable compare to semi-commercial (BCR: 1.09) and rural subsistence (BCR: 1.04) dairy farming. Again, the study of Anwar and Younas (2000) found that total cost was Rs.17020, Rs.15941.04, and Rs.15607.96for rural subsistence, semi-commercial, and commercial dairy farming, respectively, and the estimated Benefit-cost ratio was 1.1, 1.06, and 1.19, respectively for the same. The estimated BCR for the overall category was 1.08 which implies that dairy farming was profitable in the study area.

Focusing on the context of Bangladesh, Datta *et al.*, (2019) conducted a study to perform an economic analysis of dairy farming in Bangladesh and used Cobb-Douglas production function to assess the input-output technical relationship. The study found that dairy farm size, concentrate feed, capital cost, breeding cost, and farmer's training had a positive and significant impact while labour cost had a negative impact on dairy productivity. Barua *et al.* (2017) and Mandate *et al.* (2009) conducted separate studies- both used profit equation and simple descriptive statistics to calculate the profitability of dairy farming in Bangladesh. In both studies, the researchers had considered the value of milk, price of calf, and value of cow dung as revenues accrued to farmers. Housing cost, costs of capital, and interest on operating capital were considered as fixed costs as well as feed cost, labor cost, veterinary expenses, electricity cost, and miscellaneous cost were considered as variable costs. While Barua *et al.* (2017) estimated the net margin per milch cow per year to be

Tk.30262 and the benefit-cost ratio to be 1.41, Mandate *et al.* (2009) found them as Tk. 30585 and 1.41 respectively. Moreover, Mandate *et al.* (2009) found that variable costs of rearing milch cow occupied 88.7% of the total cost while the fixed costs comprise nearly 11.3% of the entire cost.

Alam *et al.* (1994) and Hossain *et al.* (2005) conducted separate studies to evaluate the economies of scale of dairy farming practices in a selective areas of Bangladesh. A similar study was conducted by Kumawat *et al*., (2014) as well on the economic analysis of sample dairy farms in the Bikaner district of Rajasthan, India. The study of Alam *et al.* (1994) found that total cost and return were higher in large dairy farms compared to those for medium and small dairy farms, although the benefit-cost ratio indicates that mini dairy farming is economically profitable. Hossain *et al.* (2005) estimated that per day rearing cost of a cross breed milch cowsis Tk. 67.5, whereas the total return obtained from a cross breed milch cows is Tk. 85. The net return became Tk.17.7 and BCR value of 1.26 indicating economic viability of investment in dairy sector. In a similar vein, Kumawat *et al*. (2014) estimated that the annual maintenance cost is Rs.1769350.03 per dairy farm and Rs.57075.81 per animal. The study concluded that Holstein Friesian cow produced more quantity of milk than local cows. Hafeez and Rahman (2012) made an effort to assess the economic performance of small-scale dairy farms in two selected urban areas- Gazipur and Dinajpur, and observed that the average number of animals reared was 2.25 and 2.88 for Dinajpur and Gazipur, respectively. The total cost was estimated at Tk.169.91 per farm per day in Dinajpur whereas in Gazipur it was Tk.262.90, and net return per day per animal was Tk.51.53 in Dinajpur and Tk.79.28 in Gazipur. The Benefit-Cost Ratio (BCR) showed that profitability is higher in Gazipur district than in Dinajpur district. Another study was conducted by Rashid *et al.* (2015) to determine the profitability of both traditional and commercial dairy farms. Gazipur and Sirajganj districts of Bangladesh were selected for this purpose. The study found that average total cost of milk production for both traditional and commercial farms was Tk.63853 and Tk.74045, respectively, while the total return of traditional and commercial dairy farms was Tk.51631 and Tk.98996, respectively. Thus, the study indicates that commercial dairy farming is profitable while the traditional is a losing concern for the farmers.

3. Methodology

3.1 Selection of Sample and Study Area

The present study is mainly based on primary data collected from dairy farmers of six villages from Shajadpur and Ullaphara upazilas of Sirajganj district. Few areas of Bangladesh are known as the milk pocket areas and Sirajganj is one of them. This is why this district is selected purposively for this study. The district consists of 9 upazilas and 82 unions. After selecting the district, two upazilas are selected randomly. Then three villages from each upazila are selected at a random basis and from the villages, 180 dairy farmers are chosen at random from the lists of dairy farmers. Of the 180 dairy farmers, 90 are local breed rearers and the other 90 are cross breed raisers. The data are collected on various aspects of dairy farming

focusing on the target variables linked to the objective of the study. Besides the primary data, secondary data on various aspects of dairy farming and the functioning of dairy cooperatives are collected from various published sources.

3.2 Production Analysis

The most popular definition of a production function is that it shows a purely technical relationship between inputs and output, and the widely used production function is the Cobb-Douglas production function. This production function has some speciality compared to other general production functions. As milk production is a complex variable that is influenced by several explanatory variables, the Cobb-Douglas production function is the best fit to estimate the input-output relationship in milk production. Several researchers have used this function to explain the input-output relationship in milk production (Datta *et al.,* 2019, Pandain *et al.,* 2013, Ghosh *et al.,* 2015, Mondal *et al.,* 2010).The Cobb-Douglas production function which is used in this study is as follows:

$$Y = \beta_0 \ {X_1}^{\beta 1} \ {X_2}^{\beta 2} \ {X_3}^{\beta 3} \ {X_4}^{\beta 4} \ {X_5}^{\beta 5} e^{u} \ \ldots (1)$$

Equation (1) is an exponential function. This function can be transformed into a linear function by taking logarithm to both sides as follows:

$$lnY = ln\beta_0 + \beta_1 \, lnX_1 + \beta_2 \, lnX_2 + \beta_3 \, lnX_3 + \beta_4 \, lnX_4 + \beta_5 lnX_5 + u \ldots (2)$$

Where, Y is the value of mean milk yield, $X_1$is the cost of dry fodder (Tk.), X_2 is the cost of green grass (Tk.), $X_3$is the cost of concentrates (Tk.), X_4 is the cost of labour (Tk.), $X_5$is the cost of veterinary items or services (Tk.). All variables are measured against per milch cow per year. The terms β_0, β_1, β_2, β_3, β_4,and β_5 are regression coefficients of the respective variables to be estimated and u is the stochastic error term. Equation (2) is estimated using the OLS method, and being in the logarithmic form, the estimated coefficients give the production elasticity with respect to each factor. The entire sum of the input coefficients gives the returns to scale of milk production.

3.3 Profitability Analysis

The term profitability is defined as the ability of a particular investment to make a net positive return for its usage (Alrabei, 2013). In the present study, a profit equation is used to measure and compare the relative profitability of raising local breed and cross breed milch cows. Profitability analysis is done based on the measures of total revenue and total cost. Total cost is the sum of the total variable cost and total fixed cost. Fixed cost includes housing cost, tools and equipment costs, and cost of capital. On the other hand, variable cost includes feed cost, labour cost, veterinary expenses, transport cost, and miscellaneous costs. The total revenue or gross return is obtained from the sale of milk, calf, cow-dung, and empty gunny bags. Then, profit or net farm income is obtained by subtracting the total cost from the total

return. Thus, the general measure of profit from rearing local breed and cross breed milch cows can be written as:

$$\Pi = TR - TC$$

Where,Π = Profit or net return,TR = Total revenue, andTC = Total cost. The disaggregated form of the above profit equation can be written in the following way(Barua *et al.*, 2017):

$$\Pi = \{(P_m + Q_{m)} + P_C + V_{bd} + R_g\} - \{\sum(P_{xi} \times X_i) + \text{TFC}\} \ldots \quad (3)$$

Where,Π is the profit or net return of the milk producer, $P_m$is per unit price of milk (Tk/Litre), Q_m is the quantity of milk (Liter), $P_c$is the price of the calf (Tk), V_{bd} is the value of by-product such as cow dung (Tk), R_g is revenue from gunny bags, P_{xi} is the per-unit price of i-th input (Tk.), and X_i is the quantity of i-th input. TFC is the total fixed cost. Here, all revenue and costs are measured with respect to per milch cow per year. In the profitability calculations, Gross margin (GM) is a significant factor considered by the farmers which is defined as the gap between total revenue and total variable costs (TVC), generally expressed as:

$$GM = TR - TVC$$

Average rate of return (ARR) is another aspect of concern to the dairy farmers which is derived by dividing the total gross margin by total cost of production expressed in percentage term:

$$ARR = \frac{GM}{TC} \times 100$$

The benefit-cost ratio (BCR) is an alternative measure of profitability which enables one to justify as to whether the economic activity can be undertaken viably. It is a discounted measure as some of the variables adds up the flow of values over more than one year. The BCR in its simple form is as follows:

$$BCR = \frac{TR}{TC}$$

If BCR >1, then the dairy activity of milk production is economically viable. If BCR <1, then the profit from milk production is negative and the dairy activity is not economically viable.

In the measure of total fixed costs depreciation or the loss in the value of assets as a result of its use, wear and tear, accidental damage, and time obsolescence is considered (Nagrale, 2011). The depreciation on cow sheds and dairy equipment is worked out by using a straightline method considering their useful economic life. Annual depreciation of 5 percent on 'pucca' shed and fodder stores and 10 percent on 'kaccha' shedis assumed. The depreciation on equipment like milking cans, water cans, and buckets is assumed to be 20 percent. The depreciation rates for consumable items like gunny bags, the rope was taken as 100 percent considering that the farmer replaces the above items annually (Singh, 2012).

4. Results and Discussions

4.1 Mean and Mean Difference of Key Variables for Local Breed and Cross Breed Cows

In the study area, two types of milch cows are available- local breed (indigenous) and cross breed. In this section, the information of key variables owing to both types of cows is shown. The difference in the mean values of the key variables between local breed and cross breed milch cows are shown by the two-sample t-test results in Table 1.

Table1: Mean and Mean Difference of Key Variables of Cross Breed and Local Breed Cows

Variables	Cross Breed Milch Cow		Local Breed Milch Cow		Mean Difference
	Mean	Std. Deviation	Mean	Std. Deviation	
Milk Yield (liter/ cow/day)	9.83	1.63	3.89	1.36	5.94***
Milk Price (Per liter)	39.62	1.59	39.98	1.41	-0.356
Lactation Period (days)	270	24.44	210	32.45	60.0***
Feed Cost (Tk./cow/day)	186.78	31.82	93.28	33.08	93.50***
Labour cost (Tk./cow/day)	32.59	5.14	23.89	4.34	8.69***
Veterinary cost (Tk./cow/day)	5.11	1.69	2.47	1.34	2.640***
Transport cost (Tk./cow/day)	4.57	3.26	2.85	3.49	1.720**
Housing cost (Tk./cow/day)	5.31	2.81	3.08	4.42	2.23***

Note**:*****, ***** and* indicates 1%, 5% and 10% significance level

Source**:** Field survey data, 2019

In the above table, it is observed that the per day mean milk yield of a cross-breed milch cow is 9.83 kg but the mean milk yield of a local breed milch cow is 3.89 kg. Table 1 also shows that the mean lactation period of a cross-breed milch cow is 270 which is 210 days for a local breed milch cow. The mean difference is 60 days which is significant at a 1% level of significance. Similarly, the table exhibits that there is a difference between the mean feed costs between cross and local breed milch cows, and it is statistically significant at a 1% level of significance. On average, a cross breed milch cow requires almost double feeds compared to that needed by a local breed milch cow. It is estimated that the per day mean labour costfor a cross breed milch cow is Tk.32.59, on the other mean labour cost of a local breed milch cow is Tk.23.89 with a mean difference of Tk.8.69 which is statistically significant at a 1% level. On average the veterinary cost of a cross breed milch is Tk.5.11 per day and it is Tk.2.47 for a local breed milch cow which indicates that there is a significant difference between these two means. Againthe mean difference in transport cost between these two groups is Tk.1.72 per day which is statistically significant at a 1% level of significance. Table 1also observes that on average per day housing cost for a

cross breed milch cow is Tk.5.31 but this cost is TK.3.08 for a local breed milch cow. The mean difference of housing costs between the two groups is 2.23 which is significant at 1% level of significance.

4.2 Production Analysis

OLS estimation of the Cobb-Douglas production function is performed separately for the local breed and cross breed milch cows and the results are shown in this section. Since the input-output relationship may differ between breed categories, the results can give different insights about milk production by the dairy farmers for either breed category. The OLS estimation results of the Cobb-Douglas production function are presented in Table 2.

Table 2: Estimation Results of the Cobb-Douglas Production Function

	Local Breed Cow			**Cross Breed Cow**		
Variables (In terms of cost)	Coefficient	Robust Std. Err	p>|t|	Coefficient	Robust Std. Err	p>|t|
Constants	5.323***	1.272	0.000	1.584**	0.667	0.020
Dry fodder (X_1)	0.129	0.113	0.255	0.127***	0.025	0.000
Green grass (X_2)	0.286***	0.044	0.000	0.187***	0.033	0.000
Concentrate (X_3)	0.291***	0.033	0.000	0.581***	0.066	0.000
Labour (X_4)	0.122	0.082	0.142	0.105**	0.045	0.021
Veterinary (X_5)	0.024	0.031	0.429	0.012	0.022	0.577
F(5, 84)=105.57; Prob.>F=0.000				F(5, 84)=76.47; Prob.>F=0.000		
R^2=0.809; Returns to scale=0.608				R^2=0.829; Returns to		
Note: *** and** indicates 1% and 5% significance level						

Source**:** Field survey data, 2019

The estimation results of the Cobb-Douglas production function which are provided in Table 2, serve to understand the technical relationship between milk production and its determinant inputs in the case of local and cross breed milch cows. In the case of local breed, the regression results show that the coefficient of green grass is 0.286 which statistically significant at a 1% level of significance. The value of this coefficient interprets that, other things remain constant, 1% increase in the cost of green grass will increase milk production by 0.286 percent. Another important variable of this model is concentrate feed. The value of the coefficient associated with this variable is 0.291 and this value is statistically significant at1% level of significance. This result implies that 1% increase in concentrate feed, remaining other factors constant, will increase milk yield by 0.291 percent. Similarly from Table 2, it is also observed that the variables-dry fodder, veterinary input and labour have statistically insignificant impact on milk production.

In the case of cross breed milch cows, the result of OLS estimation revealed that all explanatory variables have positive and significant impacts on milk yield except for

the veterinary input. The coefficient of dry fodder is 0.127 which implies that if other inputs remain constant then 1% increase in dry fodder increase the milk yield by 0.127 percent. Again there is a positive significant relationship between the value of milk yield and the cost of green grass. The value of the coefficient associated with this variable is 0.187 which is significant at 1% level of significance. This means that the value of milk yield will be increased by 0.187 percent, remaining other inputs constant, if the cost of green grass increase by one percent. Concentrate feed is one of the most important feeds of the milch cow which is also more expensive compared to other feed and fodder. So, the contribution of this factor is also higher. The result of OLS shows that the coefficient of concentrate feed is 0.581 which is significant at 1% level significance. If other inputs remain fixed, then a 1% increase in the cost of concentrate feed increases milk production by 0.581 percent. Finally, labour input has positive and significant effect on milk production, and the coefficient of labour input interprets that, if other inputs remain constant, then a 1% increase in the cost of labour will increase milk production by 0.105 percent. Although the veterinary input (vaccines, medicine, vitamins, etc.) are very important to protect dairy cows from various diseases and to keep their proper growth up, it has less impact on milk production. The coefficient of veterinary input implies that it has a positive but insignificant impact on milk production in the study area.

If we make a comparison of the OLS estimation results between local breed and cross breed milch cows, then it can be concluded that the production relation is not similar for the two categories of milch cows. The above results show that in the case of local breed milch cows, dry fodder has positive but insignificant impact on milk yield whereas it has highly significant impact on milk yield for a cross breed milch cow. Though the green grass and concentrate feed have positive and significant impact on milk yield in both categories of milch cow, the response of output is different. In both categories of milch cows, veterinary input has insignificant impact. Finally, the labour input shows diverse impacts between these two categories of milch cows. In the case of rearing cross breed milch cows, more care in terms of employing more laboris needed as these category of milch cows has less adaptable capacity to an adverse situation whereas the local breed milch cows do not require more care and more labour employment has benign impact onmilk production from them. Finally, it is found that the production function exhibits decreasing returns to scale for local breed milch cows and increasing returns to scale for cross breed milch cows.

4.3 Profitability Analysis

4.3.1 Costs Analysis

The item-wise costs of rearing a local breed and cross breed milch cow are described in Table 3. The table showed that the total annual cost of rearing a local breed milch cow is Tk.55920. Here, the total variable cost and total fixed costs are Tk.45240 and Tk.10680, respectively. On the other hand, the total annual cost of rearing a cross breed milch cow is Tk.104412, where the total variable costs and total fixed costs are Tk.84397 and Tk.20015, respectively.

Table 3: Total Cost of Raising a Local Breed and Cross Breed Milch Cow Per Year

	Local Breed		**Cross-Breed**	
Cost Item	Total Cost	% of Total Cost	Total Cost	% of Total Cost
A. Variable Cost	**45240**	**80.90**	**84397**	**80.83**
Feed cost	34048	60.89	68177	65.30
Labour cost	8720	15.59	11895	11.39
Veterinary cost	900	1.61	1865	1.79
Transport cost	1042	1.86	1670	1.59
Miscellaneous cost	530	0.95	790	0.76
B. Fixed Cost	**10680**	**19.10**	**20015**	**19.17**
Housing cost	1125	2.01	1940	1.86
Tools & equipment cost	945	1.69	1420	1.36
Cost of Capital	8610	15.40	16655	15.95
Total Cost (A+B)	**55920**	**100.00**	**104412**	**100.00**

Source**:** Field survey data, 2019

Feed cost is one of the major cost items. The cost includes the costs of dry fodder, green grass, and concentrates (which consists of rice bran, salt, vitamin, maize bran, pulse bran, molasses, oil cake, wheat bran, and others). From Table 3 it is observed that feed cost occupied about 60.89% and 65.30% of the total cost for the local breed and cross breed milch cows, respectively. It had also appeared from the table that on average total labour cost is estimated at Tk.8720 for local breed and Tk.11895 for cross breed milch cow per year which are 15.59% and 11.39% of the total cost, respectively. The veterinary cost of a local breed milch cow per year is Tk.900 which constituted 1.61% of the total cost. On the other hand, the veterinary cost of a cross breed milch cow is Tk.1865 per year which constituted 1.79% of the total cost. The reason is that cross breed milch cow is more sensitive to different diseases compared to local breed milch cows. Most of the local breed raising farmers used the local traditional breeding system to inseminate their cows by local bull at a free cost or sometimes paid the lower cost. The yearly transport cost for a local breed cow and cross breed cow is Tk.1042 and Tk.1670, respectively which shared 1.86% and 1.59% of the total cost. The annual miscellaneous cost of local breed milch cow is Tk.530 which occupies 0.95% of the total cost. On the other hand, the annual miscellaneous cost for a cross breed cow is Tk.790 which occupies 0.76% of the total cost.

The housing cost is comprised of Tk.1125 and Tk.1940 per milch cow per year for the local breed and cross breed, respectively, which are 2.01 percent and 1.86 percent of the total cost, respectively. From the study, it is also found that the housing cost of a cross breed milch cow is higher than the local breed milch cow. The annual tools and equipment cost of local breed milch cow is Tk.945 and it is Tk.1420 for cross breed milch cow which shared 1.69 percent and 1.36 percent of the total cost for the local breed and cross breed milch cow, respectively. Finally, the annual capital cost per milch cow is Tk.8610 and Tk.16655 for a local breed and cross breed milch cow,

respectively, and the respective shares of the capital cost of the total cost are 15.40 percent and 15.95 percent for a local breed and cross breed milch cow respectively.

4.3.2 Return Analysis

Table 4 reveals that the estimated gross return per milch cow per year stands at Tk.68490 for a local breed milch cow while it amounts to Tk.157742 for a cross breed milch cow where the share of milk is 82.87% and 85.49% of total return, respectively. The yearly return from a calf is Tk.10200 and Tk.20615 for the local breed and cross breed milch cows, respectively.

Table 4: Gross Return of Raising a Local Breed and Cross Breed Milch Cow Per Year

	Local Breed		**Cross-Breed**	
Items	Total Revenue	% of Total Revenue	Total Revenue	% of Total Revenue
Milk	56760	82.87	134855	85.49
Calf	10200	14.89	20615	13.07
Cow dung	1180	1.72	972	0.62
Empty gunny bag	350	0.52	1300	0.82
Gross return	**68490**	**100.00**	**157742**	**100.00**

Source: Field survey data, 2019

Besides, the yearly return from cow dung is Tk.1180 and Tk.972 for a local breed and cross breed milch cow, respectively. The return from empty gunny bags for the local breed and cross breed milch cow is Tk.350 and Tk.1300 per year respectively. The highest shares of total returns for all categories of milch cow come from the sale of milk and followed by the sale of the calf.

4.3.3 Gross Margin, Net Income and BCR Analysis

The analysis of gross margin, net farm income, and benefit-cost ratio of raising a milch cowsis described briefly in Table 5.

Table 5: Gross Margin, Net Return, and Benefit-Cost Ratio Per Milch Cow Per Year

	Local Breed	Cross Breed
Margins and Returns	**Amount (Tk.)**	**Amount (Tk.)**
A. Gross Return	68490	157742
B. Total Variable Cost	45240	84397
C. Total Cost	55920	104412
D. Gross Margin (A-B)	23250	73345
E. Net return (A-C)	12570	53330
F. Average rate of return (%)	41.57	70.24
G. Benefit-Cost ratio (A/C)	1.22	1.51

Source**:** Field survey data, 2019

From Table 5 it is found that the gross margin per milch cow per year is Tk.23250 for a local breed and Tk.73345 for a cross breed milch cow. It is also observed that the net returns of a local breed milch cow per year stand at Tk.12570 and Tk.53330 for a cross breed milch cow per year. Table 6 showed that the investment in the selected dairy farming gave the return of 1.22 and 1.51 for the local breed and cross breed milch cows, respectively. The value of BCR interprets that both categories of milch cow rearing are profitable in the study are but the profitability of cross breed milch cow is more than others.

5. Conclusion

Dairy farming is one of the emerging sectors all over the developing world and this sector contributes to promote sustainable economic development in the rural areas as it enhances employment generation and income creation of the people.The present study is intended to evaluate the effects of inputs in milk production and the profitability of dairy farming. The finding of this study concludes that difference in breeds of milch cow has different outcomes for profitability of dairy farming. The productivity of milk in case of both category cows depends on both natural and artificial feeds along with the conventional factors. The core message observed from this study is that profitability of the cross breed milch cow is higher because of its higher productivity of milk. To ensure the higher profit, the dairy farmers can rear high productive cross breed milch cows rather than low productive local breed cows. Most of the dairy farmers in the study area are continuing to rearing local breed milch cows because of insufficient capital and other facilities.

The findings of the study provide important policy implications for the government, the NGOs, and concerned others.The government of Bangladesh has the scope to provide substantial support to the dairy farmers so that they can buy and rear high yielding cross breed milch cow. It is also suggested that to ensure profitability of the dairy farmers, the government can take initiatives to keep the price stable and reasonable all through the year and give subsidies to feed industries so as to enable the dairy farmers to buy feeds at fixed price recommended by prescribed authorities. Besides, government can provide free of charge vaccination against common epidemic diseases of dairy cattle and allow good entrepreneurs to import semen for breeding development. Government can also increase the facilities of AI centers and sub-centers. NGOs and other concerned agencies can train the dairy farmers so that the farmers can adopt cost-reducing management strategies.

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