J Bangladesh Agril Univ 18(2): 463–470, 2020 https://doi.org/10.5455/JBAU.82409

ISSN 1810-3030 (Print) 2408-8684 (Online)

Journal of Bangladesh Agricultural University

Journal home page: http://baures.bau.edu.bd/jbau

Dairy farmers' milk selling options in major milkshed areas of Bangladesh: A comparative analysis

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ARTICLE INFO

Article history:
Received: 26 January 2020
Accepted: 07 June 2020
Published: 30 June 2020

Keywords:
Selling option,
Marketing cost,
Farmer's share,
Binary logistic model,
MilkVita,
Milkshed area

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ABSTRACT

Dairy farmers' profit is relatively low compared to the end user milk purchase price of Bangladesh. A lengthy debate has been running to pinpoint the reasons for this phenomenon. However, one of the trigger reasons is the milk farm gate price. Milk farm gate prices vary depending on the selling options used to flow the milk from producer to consumer. It also affects the farmers' share with the consumers spending. An attempt was made to analyze the farmers' share in existing selling options and factors of choosing the selling options in Sirajganj district of Bangladesh. The mathematical analysis of farmers' share to consumer price and binary logistic regression method was used to make comparisons among different selling options of milk in peak and lean seasons. Primary data were collected from 130 commercial dairy farmers from major milkshed areas (Sirajganj district). A purposive sampling technique and survey questionnaires were followed to collect data from the dairy farmers in the research area. The major findings of the study showed that the dairy farmers did not use local breed for producing milk for business purpose and MilkVita was the major player of absorbing a major share of produced milk, although the farmers' share was the highest for the Option-III (selling at the farmyard) where milk directly goes to the ultimate consumer without adding much utility to the product. In the peak and lean season, the model showed the variable of 'amount of milk sold per day' had a positive influence on the choice of milk selling option of MilkVita. The study concluded that MilkVita, other milk processors (Akij, BRAC, PRAN) and *ghosh* (middlemen) were popular milk selling options in the area because of guaranteed milk selling and several support services provided to dairy farmers. Thus, the policymakers can plan a policy to benefit the dairy farmers by setting up a mechanism of smoothly selling of produced milk ensuring reasonable farm gate price.

Introduction

Bangladesh is predominantly an agrarian economy with the majority of its population living in villages and depending on agriculture and allied activities for their livelihood (MoF, 2017). The dairy sector is an excellent source of income for the small and marginal farmers in our country (Hasan and Khan, 2012). Development in the dairy sector has assumed a position of paramount importance in the present rural economy of Bangladesh. The dairy sector like every other sector of tropical agriculture should give more effort to make more developed, productive and modernized as quickly as possible. Efficient dairy marketing plays an important role in reducing asymmetries of information between traders and producers, lowering transportation costs, and enhancing farmers' ability to produce more and providing reasonable prices of their product. By understanding milk market price and efficient channel for dairy farmers they will be able to select the right way for selling milk at a reasonable price which has a direct impact on milk production.

Linked with milk as the single source of dairy farm revenue with increasing input prices for feed (a major cost for the dairy farms), the milk market is seen as dual characterization and access to milk market and the price is highly influenced by the nature of market (formal *versus* informal) and regions where milk is produced. This study revealed that farmers in the major milkshed areas facing the problem of dairy marketing to the formal sector. The major processors receive milk based on their daily market demand at retailer level, but not based on the contract with the farmers. In most cases, the processors stop to collect milk from the farmers in the evening, when there is scanty of the farmers can sell their milk to the spot market. Because of lack of storage facilities, milk is not possible to store and also not possible to further process. In the informal market channel, the *ghosh* (middlemen) dominates the milk market (Heifer International, 2013) and has influenced the price, and in most of the cases, this gives unjustified prices to the farmers that might lead to inefficient market.

Cite this article

Sarna, S.F., Palash, M.S., Uddin, M.M. 2020. Dairy farmers' milk selling options in major milkshed areas of Bangladesh: A comparative analysis. *Journal of Bangladesh Agricultural University*, 18(2): 463–470. https://doi.org/10.5455/JBAU.82409

Dairy marketing in major milkshed areas

The formal marketing channel (Co-operative society) was the most popular channel in Rajasthan and controls the milk flow (52.8%) of total milk production. Marketing through milk producer's co-operative society was preferred because of timely and assured payment, payment at small intervals, and precise measurement (Chand *et al*., 2009).

Several marketing agents interact in different channels at various levels in carrying milk from the production point to the consumption point. The farmers' share in consumer's price is an assessment of the relative bargaining position, farmers' access, and integration in the market (Kumar *et al*., 2010). There is a positive relationship exists between the farmers' share and marketing efficiency. Higher the farmers' share greater would be the marketing efficiency or vice versa (Narasalagi and Shivashankar, 2018). The farmers' share in consumer's price of milk in different parts of India was reported from 50 percent to 90 percent (CALPI, 2006). Farmer's share and efficiency of milk marketing depend on the different selling options used by dairy farmers. Dairy farmers always try to choose the selling option that return a higher share of consumer's price and increases the marketing efficiency. Although some selling options may yield a higher share in consumer's price or/and higher marketing efficiency, that option may not have the capability of consuming all production of a certain period. Therefore, farmers choose the selling option considering different relevant factors.

The study was intended to address the seasonal based selling option analysis to identify suitable intervention for increasing market access and to increase the income to make dairy farming profitable. Without being profitable, dairy farmers will not continue their business. The reasons for conducting this study in the major milkshed areas (Sirajganj) because this region has been producing the highest amount of milk which contributes to the highest milk to the national milk production. Developing an efficient market mechanism is highly linked with developing the dairy sector which will then be transformed into the improvement of the dairy farmers and their livelihood.

Materials and Methods

Study area and data

Sirajganj district was formerly a sub-division of Pabna district. In 1762, a severe earthquake changed the flow of the Jamuna river and created a new river named *Baral*. On the west bank of this *Baral* river, new land emerged, and most of the land of surrounding it belonged to *Zamindar* Siraj Ali Chowdhury. So, after his name gradually this area got its recognition as Sirajganj (BBS, 2017). The present study was conducted in the selected areas of Sirajganj district. Shahjadpur and Ullapara upazilas were selected for collecting necessary information through a structured questionnaire because these areas are the most suitable for getting valuable information related to the objectives of this study. Data were collected from 35 villages of selected upazilas in Sirajganj district from different types of dairy producers. The study was based on primary data for the analysis of selling options. Primary data were collected during the month of April 2018 through the face-to-face interview method. Purposive sampling method was used to select the sample for collecting data and information from the responsive farmers. A total number of respondents were 130 who were the commercial dairy producer having different herd sizes.

Seasonal effect of production and price

Because of the higher green grass availability, the highest milk production was observed during January to April (Winter and Spring) followed by moderate milk production from September to December (Autumn and Late Autumn). The lowest milk production was observed from May to August (Summer and Monsoon) (Uddin *et al*., 2013). Uddin *et al*. (2013) also stated that after monsoon disappears, farmers cultivate fodder on their own fellow land and embankments of the riversides. Therefore, in this study, the month from September to April was considered as a 'peak season' and the month from May to August was considered as a 'lean season' for milk production. The variability in milk production during these two seasons has direct effects on the consumer price of milk and farmers' share as well.

Analytical tools

Marketing cost and farmers' share

Although the main focus of the research was to identify the farmers' share in consumer's price of milk, but to get the deeper information of marketing, a graphical presentation of different selling options of milk in the study areas was also identified. A tabular presentation was made to show the marketing cost of milk producers in peak and lean seasons using the following formula,

$$MC = TC + SC + MT + CC + PE$$

Where, MC= Marketing cost, TC= Transportation cost, SC= Storage cost, CC= Container cost, and PE = Personal expenses

The farmers' share does not remain constant in different selling options even it varies in the same selling option also, because the milk is a highly perishable product and the consumer price of milk changes in the floating market every day. It refers to the price received by the milk producer and is expressed as a percentage of the ultimate consumer's price (Acharya and Agarwal, 2004). It has been determined by using the following formula:

$$F_s = \frac{F_p}{C_p} \times 100$$

Where, Fs = Farmer's share, Fp= Farmer's price, Cp= Consumer's price

Choices of dairy farmers' milk selling options

There are five selling options available in the study areas for dairy farmers such as milk selling to MilkVita, other milk processors, *ghosh*, local market, and selling at the farmyard. Among these selling options, the major share of milk passes through the option of MilkVita, and remaining portion goes through other selling options. To identify the reasons for choosing the major share of selling options (MilkVita), a logistic regression model was used. The logit model is widely used in identifying the binary choice of an outcome. Several researchers used the logit model in dairy sectors to decide among different alternatives (Pulina, 2010; Chirstopher *et al*., 2011; Moser and Raffaelli, 2012; Aprile *et al*., 2012 and Santhi, 2016). The estimated coefficients showed the effect of the explanatory variables on the probability of choosing the selling option of MilkVita over other milk selling options. The mathematical form of the model is:

$$Y_i = \beta_0 + \beta_1 X_1 + \ldots\ \ldots\ \ldots + \beta_9 \ln X_9 + \mu_i$$

Here, Y_i = Binary dependent variable (selling options), β_0 = Intercept and β_1 – β_9 = Regression coefficient of the independent variables X_i and U = Error term, nine variables were included in the model based on literature review. The logit model has the following form:

$$Logit\ (P) = Log\left[\frac{P}{1-P}\right]$$

The term within the bracket [P/ (1-P)] is the odds of an event occurring. The logit scale changes the scale of a proportion to plus and minus infinity and also, logit (P) = 0 when P=0.5.

$$Let, P_i = P_\gamma(Y = 1 \mid X = X_i)\ Where\ X_i = 1,2,3,....9$$

Then we write the model as,

$$Log\left[\frac{P_i}{(1-P_i)}\right] = Log\ P_i = (\beta_0 + \beta_1 X_i)$$

Here, P_i is the probability of selling milk using the option of MilkVita and X_i is the independent variables (Tsuang *et al*., 2011).

Variables identification

In the logistic regression, some influencing variables are qualitative. These qualitative variables are called dummy variables. While constructing dummy variables the values 1 and 0 were assigned for the presence or absence of these variables, respectively. Table 1 shows the variables considered in the model estimation process. Dummy variables require special attention in regression analysis, they cannot be entered into the regression equation just as they are. Instead, they need to be recoded into a series of variables that can then be entered into the regression model (Gujarati, 2004). In the model, there is a categorical variable of education. Farmer's education level data were collected in five categories; therefore, it is necessary to use one category as a reference category. The results are then interpreted regarding the category. We consider no formal education is the reference category.

Table 1. Description of dependent and independent variables

Notations	Variables	Types	Values
Dependent variable			
Y_i	Selling options of milk	Dummy	1= Selling milk to MilkVita; 0= Other selling options
Independent variables			
X_1	Quantity of milk sold	Continuous	Number of liters/day
X_2	Marketing cost of the farmer	Continuous	Tk/liters
X_3	Farmer's milk price	Continuous	Tk/liters
X_4	Age of the farmer	Continuous	Number of years
X_5	Herd size of the farmer	Discrete	Number of cattle/HH
X_6	Education level of the farmer	Categorical	1 = Primary School; 0 = Otherwise
X_7	Education level of the farmer	Categorical	1 = Secondary school; 0 = Otherwise
X_8	Education level of the farmer	Categorical	1 = Vocational school; 0 = Otherwise
X_9	Education level of the farmer	Categorical	1 = College/University; 0 = Otherwise
μ_i	Disturbance term; i= 1, 2, 3, …..n		

Results and Discussion

Cattle with different species

Different breeds of cattle were found in the study area. Cattle were categorized into 2 species i.e. local and crossbred. These were divided into 5 groups- Milk cows, Dry cows, Heifer, Male calf (<12 months), and Female calf (<12 months). A crossbreed is an organism with purebred parents of two different breeds, varieties, or populations. Crossbreeding, sometimes called "designer crossbreeding", is breeding such an organism, often intending to create offspring that share the traits of both parent lineages, or producing an organism with hybrid vigor (MSU, 2008). From Table 2, it could be summarized that 130 respondents had 652 cattle in total among which only 1 was a local milk cow and the rest of 651 was crossbred. In Sirajganj district, dairy farmers did not use local species for producing milk for business purpose. Farmers used crossbred cattle to get more milk as these cattle give more milk than local cattle, which

was more beneficial. The average number of milking cows was 2.66 per farm and among the total herd size of the respondents, 38.34% was milk cow. The average number of dry cows was 0.89 and 12.88% was dry cow among the total herd size of the respondents. The average number of male calf (<12 months) was 1.26 and among the total herd size of the respondents, 18.10% was male calf. The average number of female calf (<12 months) was 1.38 and among the total herd size of the respondents, 19.94% was the female calf.

Table 2. Number of cattle of the respondents with different species

Categories	Local	Crossbred	Total	Average cattle	%
Milking cows	1	249	250	2.66	38.34
Dry cows	0	84	84	0.89	12.88
Heifer	0	70	70	0.74	10.74
Male calf (<12 months)	0	118	118	1.26	18.10
Female calf (<12 months)	0	130	130	1.38	19.94
Total Herd number	1	651	652	6.94	100

Source: Field survey, 2018

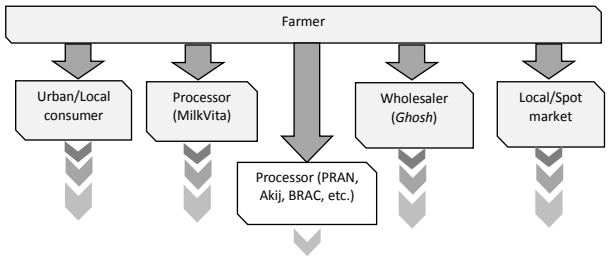

Fig. 1. Milk selling options of milk in Sirajganj district

Milk selling options

The traditional dairy marketing model is characterized by high variability in milk price, low milk quality, poor market access, and poor access to veterinary services and extension as well as to artificial insemination services. In the traditional milk market model, smallholder milk producers sell their milk directly to spot markets, *ghosh* (middlemen), and consumers or neighbors without written contracts. Usually, in this kind of market, a tiny volume of milk (less than 100 liters per day) is traded (Staal, 2006). Farmers in remote areas get approximately 60% lower prices than urban farmers (Uddin *et al*., 2014). Middlemen (*ghosh*) may provide loans to smallholders in some areas, at interest rates of up to 20% per month and sometimes middlemen (*ghosh*) paid the smallholders in advance, though in return the farmers were obliged to sell their milk at a discount of US $3 per 100 liters (Haque, 2009). Private dairies which are owned by different NGOs (such as Akiz, BRAC and PRAN) usually operate through milk supplier in the locality. Milk suppliers (middlemen) are called *Goala*, *Ghosh*, or *Dudhwala*. They collect milk from the dairy farmers, and they do not receive any value-added benefit, just the basic price for their milk. The price of milk is set on the basis of its fat content (Hamid and Hossain, 2014). Milk selling options as found in the study area were presented in Figure 1.

Milk marketing cost incurred by milk producers

The marketing cost of the product represents all the cost items performing various forms of marketing functions to move a product from the point of production to the point of consumption (Kohls and Uhl, 2005). In this research work, marketing cost was represented by the cost incurred by transportation, storage cost of milk, market toll, container cost, and personal cost of dairy farmers. The nature and extent of marketing cost is not the same for all but vary from one to another. The lower the marketing cost is better for farmers. In the peak season (September to April), total marketing cost for selling milk was the lowest for selling milk to the *Ghosh* among others, and it was Tk. 0.23 per liter. The next lowest marketing cost was for selling to MilkVita which was Tk. 0.36 per liter. The highest marketing cost was incurred by the farmer when they sold milk at the farmyard of the research area (Table 3).

Table 3. Marketing costs for selling milk to different channels in the peak season

Costs items	Average costs (Tk. per liter)				
	Milkvita	Local market	*Ghosh*	Farmyard	Other milk processors
Transportation cost	0.07	0.49	0.02	0.47	0.56
Storage cost	-	-	0.01	0.08	0.003
Market toll	-	-	0.01	-	-
Container cost	0.05	0.05	0.07	0.13	0.09
Personal expenses	0.24	-	0.12	0.18	0.27
Total cost	0.36	0.54	0.23	0.86	0.91

Source: Field survey, 2018

In the lean season (May to August), the total marketing cost for selling milk was the lowest for the local market and it was Tk. 0.31 per liter. The next lowest marketing cost was for selling to *Ghosh* which was TK. 0.56 per liter. The highest marketing cost was incurred by farmers when they sold milk to different processors of the research area (Table 4).

Relative share of dairy farmers

Farmer's share in consumer price is a dynamic concept and can be performed better when the most marketing service is performed incurring the lowest cost. The efficient selling option can be defined as the movement of goods from producers to the middlemen/ultimate consumers with the provision of a service that consumer desires. According to Kohls and Uhl (2005) marketing efficiency is the ratio of market output (satisfaction) to market input (cost of resources). An increase in the ratio represents improved efficiency. Likely, an increase in the ratio of farmers' share represents the wellbeing of the farmers.

Farmer's shares in the peak season

Table 5 shows that Option-III was the most efficient channel with the highest farmers' share of 91.03 for the peak season. The above-mentioned selling option is the lowest level of the marketing channel or called direct channel among five selling options where milk directly goes to the ultimate consumer without adding much utility to the product. Therefore, per liter, milk price is the lowest (Tk. 45/litre) in this selling option.

A major portion of the milk is selling through the Option-I where farmer' share is only 54.48 to consumer price, but it creates more utility to the consumer and ready to pay Tk. 65 for a per liter of milk. The farmers who choose the selling Option-1 get the lowest price of milk (Tk. 35.41/litre). So, it could be concluded that for the peak season, MilkVita (Major buyer of milk in these regions) may increase the farmers' milk price slightly to improve their profitability from dairy farming.

Table 4. Marketing costs for selling milk to different channels in the lean season

Costs items	Average costs (Tk per liter)				
	Milkvita	Local market	*Ghosh*	Farmyard	Other milk processors
Transportation cost	0.12	0.28	0.04	0.82	1.05
Storage cost	-	-	0.03	0.19	0.005
Market toll	-	-	0.001	-	-
Container cost	0.10	0.03	0.16	0.23	0.19
Personal expenses	0.48	-	0.33	0.64	0.64
Total cost	0.70	0.31	0.56	1.88	1.89

Source: Field survey, 2018

Table 5. Farmers' share of milk selling in the peak season

Particulars	Milk Vita (Option I)	Local market (Option II)	Farmyard (Option III)	Other processors (Option IV)	*Ghosh* (Option V)
Farmers' selling price (Tk/liter)	35.41	35.86	40.96	36.53	35.75
Farmers' marketing cost (Tk/liter)	0.36	0.54	0.86	0.91	0.23
Consumer price of milk (Tk/liter)	65.00	60.00	45.00	65.00	55.00
Farmers' share (Tk/liter)	54.48	59.76	91.03	56.21	65.00

Source: Field survey, 2018

Farmers' share in the lean season

In the lean season, Option-III enjoys the highest farmers' share (Table 6) and creates less utility to the consumers. Dairy farmers are comparatively getting higher milk prices from the Option-I (MilkVita) because of less production during the period. All parameters such as farmers' selling price, per liter marketing cost of farmers and consumer price of milk, show the higher trend in the lean season.

Table 6. Farmers' share of milk selling in the lean season

Particulars	Milk Vita (Option I)	Local market (Option II)	Farmyard (Option III)	Other processors (Option IV)	*Ghosh* (Option V)
Farmers' selling price (Tk/liter)	39.61	38.29	42.12	41.36	36.27
Farmers' marketing cost (Tk/liter)	0.70	0.31	1.88	1.89	0.56
Consumer price of milk (Tk/liter)	70.00	65.00	50.00	65.00	60.00
Farmers' share (Tk/liter)	56.59	58.90	84.23	63.63	60.44

Source: Field survey, 2018

But it should be kept in mind that milk buyers in the Option-III purchase the lowest amount of milk among all other channels and the sale was also uncertain. In the lean season, Option-IV was more attractive considering farmers' share and volume of milk sold. The result shows that other milk processors such as Akij, PRAN, BRAC provide higher milk prices to the farmers which increases their share to consumer taka. The MilkVita authority can revise the milk pricing policy at farmers' level to help the farmers and at the same time, to keep

the market position in the dairy processing market. Ghosh (2002) found that cooperative marketing channels were more efficient and preferred than the other channels. The situation has changed over the period in major milkshed areas, which urges further intensive research on why cooperative marketing channel is losing their fame.

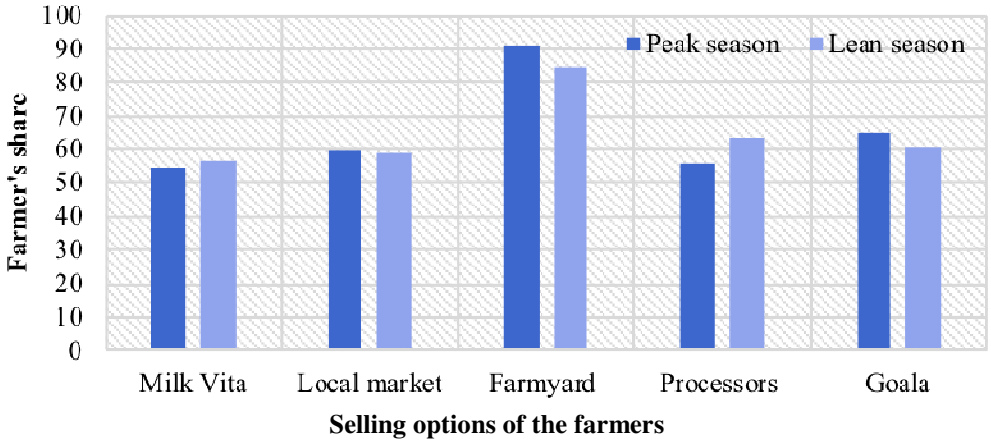

Fig. 2. Graphical presentation of farmers' share in two seasons

Factors affecting farmers' milk selling options

To identify different variables that had an actual effect on choosing the milk selling option, a binary logistic regression model was formulated. The defined model was giving priority of selling milk to MilkVita (binary coding 1, if selling to MilkVita; otherwise 0, if selling to other options) because about 40% of the farmers sold their milk to MilkVita (Jabbar *et al*. 2005). Two separate models were applied to address the effect of two separate (peak and lean) seasons of milk selling. The values of LR Chi^2 show the robustness (Prob > Chi^2, 0.0002 and 0.0017) of the model estimation that means included variables are appropriate to explain the relationship between regressor and regress variables. The values of *pseudo* R^2 (peak: 0.29 and lean: – 0.26) were used to analyze how the differences of dependent variables could be explained by the included independent variables. The estimated coefficient indicated the effect of the explanatory variables on the likelihood of choosing the selling option of MilkVita over other selling options (Akij, PRAN, BRAC, *ghosh,* and local market) in peak and lean seasons (Table 7).

Table 7. Logistic estimate of household choice of milk selling options

	Peak season			Lean season		
Variables	β	SE	z	β	SE	z
Constant	0.126	2.518	0.05	-4.085	2.227	-1.83
Quantity of milk sold (X_1)	0.031**	0.013	2.32	0.052**	0.021	2.47
Marketing cost (X_2)	-0.027	0.377	-0.07	0.011	0.178	0.06
Farmer's milk price (X_3)	0.113*	0.061	-1.85	0.006	0.049	0.14
Age of the farmer (X_4)	0.027*	0.016	1.65	0.030*	0.016	1.87
Herd size (X_5)	0.013	0.070	0.19	0.014	0.068	0.22
Education level (X_6)	1.586*	0.897	1.77	1.222	0.875	1.40
Education level (X_7)	1.552*	0.892	1.74	1.376	0.881	1-56
Education level (X_8)	2.491	2.285	1.09	1.725	1.989	0.87
Education level (X_9)	0.087	1.032	0.08	-0.016	1.029	-0.02
LR $Chi^2(9)$		31.71			26.45	
Prob > Chi^2		0.0002			0.0017	
Pseudo R^2		0.299			0.266	
Dependent variable: Selling options of milk (1= MilkVita; 0= Otherwise)						

**Significant at 5 percent significance level, * significant at 10 percent significance level; β = Coefficient, SE = Standard Error, z = Z score

In the peak season, the model showed that out of nine variables, five were significant. The variable 'quantity of milk sold (liter/day)' had a positive and significant influence on choosing the milk selling option positively in both seasons. It implies if a farm can produce more milk, then the probability of selling milk to MilkVita is higher than selling to other options. Among the options where the major amount of milk disburses, the marketing cost is comparatively lower in MilkVita selling option, therefore, a higher quantity of milk sold incurred lower marketing cost (per unit) of dairy farmers which would increase the farmers' share to the consumer price of milk. The variable of 'farmers' milk price' had also a positive significant effect of choosing a selling option in the peak season, but it was not significant in the lean season. Table 5 and 6 show the farmers' received comparatively higher milk price in the lean season, therefore milk price had no significant effect on choosing the selling option in the lean season. In the peak season, the positive coefficient implies that if the milk price at farmers' level increases then the possibility of choosing the selling option of MilkVita will increase

significantly. The coefficient of the age of the farmer was found positive, and it was significant at 10% level of significance for both seasons. That means the milk selling option of the farmer was found to be influenced by the age of the farmer. In the lean season, because of the scarcity of sufficient milk production, dairy farmers did not need to apply the strategic decision of choosing the milk selling options. In contrast, farmers made the decision of selling milk strategically because of lower milk prices and the availability of more liters of milk per day. Therefore, the variables of 'education of primary level' and 'education of secondary level' had a positive significant effect on choosing the milk selling option in the peak season. The farmers who have these two levels of education had the probability of choosing the MilkVita selling option in compared with the farmers who have no formal education in the study areas.

Conclusion

Milk can provide a regular supply of the most critical nutrients to the most vulnerable sections of society. For dairy producers, it also provides a daily source of income with a relatively low-risk factor. Sirajganj is the major milkshed area of Bangladesh where dairy farmers did not use local breeds for producing milk for business purposes. Farmers used crossbred cattle as these cattle give more milk than local cattle which was more beneficial. There were many options for the farmers for selling their milk. Among them, MilkVita was the major player in absorbing the major share of produced milk, similarly, some other options such as selling milk from the farmyard, selling to the local market, *ghosh*, other milk processors (Akij, BRAC, PRAN) were also available. In the peak season (September to April), total marketing cost for selling milk was the lowest for selling milk to the *ghosh* among others. In the lean season (May to August), it was the lowest for the local market option. The farmers' share was the highest for Option-III (selling at farmyard) where milk directly goes to the ultimate consumer without adding much utility to the product and less amount of milk passed through this option. In the lean season, dairy farmers are comparatively getting higher milk prices from the Option-I (MilkVita) and Option-IV (other milk processors) because of less production during the period. In the peak and lean season, the model showed the variable of 'amount of milk sold per day' had a positive influence on the choice of milk selling option of MilkVita; and in the peak season, the variable of 'farmers' milk price' had the positive impact. Thus, the policymakers can formulate a policy to benefit the dairy farmers by setting up a mechanism of determining farmers' milk prices at the farm level.

Acknowledgement

The research work was funded by National Science and Technology Fellowship, Ministry of Science and Technology, Bangladesh.

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