



Research Article

Feeding Practices and Management System Impacting Milk's Nutritive Content of Primiparous Holstein Friesian Cow at the South-Western Part of Bangladesh

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Abstract | The current study was undertaken to assess the present status of feeding practices, milk production, and quality of milk in 42 selected farms from the South-western part of Bangladesh. A total of 80 Holstein Friesian cows who are in first parity (primiparous) were grouped, and milk samples were taken both in the morning and afternoon. The average milk production was 1.63 times higher in the morning than in the afternoon production. In the farms, the tethering grazing system was higher (43%) than the zero grazing (36%) and extensive grazing (21%) systems. 43% of farms relied upon local and natural grasses, whereas 21% produced their own fodder, and 36% supplemented fodder by purchasing. 71% of farms were found feeding raw fodder to the cattle without any kind of processing, and only 29% of farms used chopped fodder before feeding. In feeding concentrate feed, almost 50% of farms mixed the feed ingredients manually, the rest (21%) farms used commercial feed, 29% of farms were found using both commercial and hand-mixing feed. 71% of farmers were found to formulate ration on their own, whereas only 29% of farmers did ration formation by a technically skilled person. In for milk's nutritive content, Total Solids content was higher at 12.46 ± 0.51 in morning milk in the farms where commercial feed was provided with no significance, but the percentage of fat, SNF, and protein showed significant variation ($p < 0.005$). Feeding methods by implementing new technological approaches, farmers can improve milk quality and gain more profit by minimizing feed costs.

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Introduction

The economy of Bangladesh is mainly based on agriculture. Here about 80% of people directly and indirectly depend on agriculture. Livestock plays an important role in the national economy of Bangladesh, with a direct contribution of around 1.47% (2018-19) to the agricultural GDP and providing 20 % of total employment directly in the economy (DLS, 2020). Dairy cattle are an integrated part of smallholder in the livestock industry. The milk industry is ranked third for production, and in value terms, it was recognized as the topmost agricultural product in 2013 (FAOSTAT, 2016). Currently, around 1 billion people are dependent on dairy farms worldwide for their livelihood, and 7 billion people are consumers of the dairy world (Wyrzykowski *et al.*, 2020). Dairy farming is marginally profitable, and farmers have ample opportunities to increase output by using more of aggregate feed and hired labor inputs (Sikder *et al.* 2001). In Bangladesh, over ninety percent of 24.39 million (DLS, 2020) cattle in the country are indigenous zebu type, and the remaining 10 percent are exotic pure breeds (Shahiwal, Sindhi, Holstein Friesian, and Jersey), and their crosses with indigenous. Domestic milk production from these animals' accounts for around 70 percent of the total requirement (DLS, 2020), which furnishes approximately 175.63 ml milk per person per day against the requirement of 250 ml. The dairy farms in Bangladesh are broadly belonging to private ownership as a business, way of life, and 365 days-a-year job (Rahman *et al.*, 2003). Many unemployed, educated youths have invested in livestock and taken up programs on rearing cows, and beef cattle for milk and meat production in rural and urban areas. In addition, increasing urbanization, availability of disposal incomes, and changing food consumption patterns have enlarged the demand for various livestock-origin foods, including dairy products (Sharma 2007; Kumar *et al.*, 2011). Generally, three types of nutritional management systems are typically used in dairy production (Thomas, 2014). Local cows are fed to a maximum limit of 1 kg concentrate daily, usually rice polish from farmer's own source. The crossbred cows are supplied with concentrate in amounts 2-3 times higher than local cows and composed of rice polish, wheat bran, brans of legumes, and oil cakes. The low productivity of dairy cattle is the result of several ecological, technical, and socio-economic obstacles, which limit the farm's profitability (Herbut *et.al.*, 2018).

Dairy cattle production mainly depends on the feeding management system of farms. Feeding practice is one of the important parts of feeding management. In our country, Dairy cattle production is characterized by low productivity levels due to genetic and nutritional constraints. The classical approach to increasing dairy production is through genetic means by crossing with improved breeds. Unless feeding practice is improved, these animals may be limited to fully expressing their potential genetic superiority. The most common and healthiest options include grain supplements, hay, concentrates, pasture, and forage (Arrowquip, 2017). It is a fundamental approach to provide good quality diets with appropriate approaches to dairy cattle in sufficient amounts to maximize production. But in our country, there is a heavy shortage of feed both in quantity and quality. Apart from this, the feeding practice is not up to the mark to increase the productivity of these cows. The traditional feeding system for dairy cattle is based on the use of rice straw, and natural grasses supplemented with little or no concentrates. The major differences between the feeding practices of two types of animals, local Vs crossbred, are the intake of green fodders and concentrates. The crossbred cows are usually stall fed while the local cows are generally sent out for grazing the whole day and fed rice straw ad-libitum basis. The grass is offered to the crossbred cows composed of roadside grass, own production fodder, weeds of crop fields, aquatic weeds, tree leaves and another browse which varies from season to season. Most of our farmers are ignorant about the latest and scientific process of feeding practices in dairy farms. In South-western city of Bangladesh, the development of dairy farms and industries is increasing remarkably. There are many studies that have been done before about different feeding management and nutritional status of farms around the country, but no research has been found specifically on the feeding practices of dairy farms here. So, an investigation has been carried out around 42 farms in South-western part to know different feeding practices such as types of fodder used in feeding, the feed processing system of the grasses, usage of concentrate (hand mixing or commercial feed) as well as number of milking cows, milk production rate, milk nutritional component etc. were also studied. The main objective of this study was to assess different types of feeding practices and management systems of dairy farms in the South-western part of Bangladesh as well as to analyze their impact on milk's nutritive content.

Materials and Methods

The study was done in the South-western part of Bangladesh, and 42 dairy farms were selected. The study has a total duration of Six months, and both survey-based questionnaires about the existing management practices of dairy along with milk and feed sample was collected. The questionnaire included information about owners' socio-economic condition, knowledge about the management of farms, number of total animals, number of milking animals, feeding practice of roughage and concentration, grazing system, source of fodder and concentration, frequency of feeding, history of antibiotic medication have been taken by making a direct interview. To compare the nutritive value of feed and milk, two farms were chosen where the feeding type was different: hand-mixed feed and commercial cattle feed. A total of 80 Holstein Friesian cows who are in first parity (primiparous) and duplicate milk samples both morning and afternoon were collected. The milk sample was stored in an ice box and transported immediately to the laboratory to analyze milk quality. The Lactoscan SP ultrasonic analyzer machine was used to determine the nutritive content of milk. The nutritive value of the hand-made mixed feed was also analyzed by following AOAC (1999) method. Data has been arranged in the Microsoft Excel sheet, after which SPSS (Version-18) statistical software was used for the calculation of mean, standard error, and statistically significant value.

Results and Discussion

Farm demographics

All farms were categorized into 3 categories according to their herd size less than 15 cows farm, 15-50 cows farm, and more than 50 cows' farms depending on the real situation of the area. From farm demographic (Table 1), 36% of the farms had a small number of cows (<15) cows, whereas 57% of farm's herds ranged from 15-50 cows though Saadullah *et al.* (2000) estimated that over 70 percent of the dairy farms would have an average of 3.5 bovines. In this study area, large herd-size farms are very rare, because of the socio-economic status of the farmers and the availability of forages are limited in the south-western part due to the salinity of soil and different natural calamities that affect the overall forage cultivation. Whereas the average herd size in the US is just over 200, and in Canada, it is around 80, as reported by

Hurtgen (2015). On the Farm, 49.8 % of cattle were milking cows along with 22.79% of bull. Only 21.42% of farm owners had good knowledge about the management of the feeding system, which they learned from training given by the veterinarians. But most of them (42.86%) had a moderate knowledge and they got it by self-learning through their experience. Half of the housing system followed the standard pattern and only 21.42% provided a good housing facility.

Table 1: *Demographics of farms of the South-western part of Bangladesh.*

Variable	Level	Frequency	Percentage
Farm Herd size	<15 cows	15	36
	15-50 cows	24	57
	>50 cows	3	7
Types of cattle N = 781	Dairy cow	389	49.8
	Bull	178	22.80
	Calves	214	27.40
Farmer's knowledge	Poor	15	35.72
	Moderate	18	42.86
	Good	9	21.42
Housing condition	Poor	12	28.58
	Moderate	21	50
	Good	9	21.42

Milk production of the study farms

In this study, we observed that, a total number of 389 milking cows produce a total of 4017.6 L of milk per day (Table 2). It also showed the differences of milk yield in different farm. The factors related to this variation is due the variation in breed, age of the animal, lactation stages, and management system. Milking was done two times daily in all the farms specifically, the morning and the afternoon. Result showed that, the rate of milk production in the morning is 1.61 times higher (62.02%) than in the afternoon (37.52%), which is support the study of Tona *et al.* (2016), who stated that the morning milk yield was between 1.47 and 4.03 times greater than that of the evening milk yield and is also similar in research which observed that, morning milking gave significantly higher ($P < 0.05$) quantity of milk than evening milking in Jersey cows managed in a dairy farm situated in Edu Local Government, Kwara State, Nigeria (Van Soest *et al.*, 1991). Farmers also think that the cows get more time and proper rest before morning milking to produce more milk.

Table 2. Milk production of the farms.

	Milking cows	Avg. morning Milk production (L/cow/D)	Avg. afternoon Milk production (L/cow/D)
Handmade	198	13.91	8.43
Mixed	108	13.69	8.24
Commercial	83	15.64	10.11

L=Liter, D=Day

Feeding practice

Feeding practice is one of the most important factors in dairy farming. Because the cost of feed in farm constitutes the highest amount, around 60-70% (Nimbalkar *et al.*, 2022). Moreover, normal growth, health status, and production performance of the animal largely depend on proper feeding practices and nutritional management. Among the farms, only 29% farms did their ration formulation by a technical person, but the rest, farms used their own idea for formulating ration which is in accordance to a recent study by Kamal *et al.* (2019) also estimated that 72.4% of farmers did ration formulation by their own. The nutritional requirement of dairy cow depends on both body weight and milk yield (Garamu, 2019). For this reason, most animals don't get proper nutrition for maintenance and production.

Roughages

Three significant roughages feeding or grazing systems were discovered in the research area. Tethering entailed tying the cow to a rope and relocating it from time to time to a new grazing spot. Under zero grazing, cattle were completely confined with limited movement, and farmers provided water and feed to the animals housed in enclosures, whereas under the vast system, animals were herded and left to roam in the wilderness in search of pastures and water, returning home at a set time. It is found that, tethering system (43%) is followed by the most farms rather than zero grazing (36%) and extensive grazing (21%) (Table 3). However, both the tethered and extensively grazed cattle were occasionally supplemented with other feed resources to the cattle upon returning to their resting areas. Around 43% of farms depend on different local grass, and the rest of farms use mixed grass containing both local and other grasses (German, Napier, Para, Pakchong Para). Almost 43% of feed is from natural resources that are available around their open land or roadsides, which is also found to be higher (61.3%) in another study by Kamal *et al.* (2019). Farmers are not willing to cultivate

other fodder on their soil due to the availability of forage. Shortage of land is another vital factor for their unwillingness. In the case of additional supplement, 36% of farms purchased grass from the local market, whereas 21% of farms cultivated high-yielding fodder grass. Where in another part of Bangladesh, Hossain *et al.* (2016) reported that most of the farmers (83%) used cultivated fodder. It is also observed that most of the farmers are not aware of the proper processing of grass. Though chopped grass would be beneficial to farmers to avoid feed loss and extra feed costs, around 71% of farms did not use chopped grass; rather they fed grass without any processing.

Table 3: Types of grazing and source of fodder in feeding the dairy cows of the farms (n=42).

Variable	Level	Frequency of farm	Percentage
Grazing system	Tethering	18	43
	Zero grazing	15	36
	Extensive grazing	9	21
Type of Fodder	Local grass only	18	43
	Mixed grass (local grass, para, Napier, German, pakchong)	24	57
Feeding style	Chopped	12	29
	Not chopped	30	71
Source of fodder	Natural	18	43
	Purchased	15	36
	Cultivated	9	21

Concentrates feed

For efficient livestock, concentrates are usually needed in addition to good roughage. It contains a small amount of crude fiber and more than 60% TDN, which constitutes an essential part of the ration for growing, producing, and working animals (Verma, 2006). All the farms of this study use concentrated feed along with green fodder either manually mixing the ingredients or commercial feed. This study showed that 21% of farms used commercial feed, which is closely associated with another recent study by Kamal *et al.* (2019); in their study, 18.8% of farms used commercial feed pellets, and 33.8% of farms used hand-mixing feed, which is made by different raw materials found locally. They also reported that 47.5% of farms used both commercial and hand-mixing feed, whereas this study showed a different result, with 50% of farms using various feed ingredients (wheat bran, broken rice, rice polish, oil cake, etc.) for

preparing a mixture of feed in their farm premises and 29 % of the surveyed farms used both hand mix and commercial feed. Farmers who did not use commercial feed had an unwillingness to use commercial feed as they preferred to reduce their feed cost. Only 7% percent of herds fed once daily, 64% fed twice daily, and 29% fed 3 times daily (Table 4). It was expected that farms that fed their cows only once daily would have a higher frequency of feed push-ups throughout the day. Some might expect that pushing up feed will increase feeding activity. However, DeVries *et al.* (2003) did not find differences in feeding activity when 2 extra push-ups were implemented during the late evening and early morning hours in a free stall herd fed twice daily. They concluded that fresh feed delivery and milking process were more important in stimulating the feeding activity of dairy cows. In another study, DeVries and von Keyserlingk (2005) concluded that the feed delivery effect was more important than the milking effect. However, it is essential to push up feed to the cows at various times during the day to provide them access to the feed. It was observed that the hand-mixed feed is basically mixed of different local ingredients, had the lower CP %, but crude fiber and fat% was more than commercial feed (Table 5). All the feeding in the supplied farms was done manually by the laborer or by the owner himself but nowadays there is a few small as well as large scale commercial enterprises working on automatic cattle feeding systems, most of them in the developed nations. Trioliet is a manufacturing company in Holland which has developed an automated robotic feeding system. (Scharpe, 2017). In a study, Khan *et al.* (2009) suggested about five phases of dairy cow feeding which should be followed to attain optimum productivity as nutrient requirement varies with the stage of lactation and gestation. But in the current study, no farms were found maintaining such phases of feeding. This may be hampering their farm milk production which can be improved.

Table 4: Concentrate feed used in the feeding of dairy cows of the farms (n=42).

Variable	Frequency	Percentage
Only Hand made	21	50
Only Commercial feed	9	21
Both (Mixed)	12	29
Frequency of feeding	Once	7
	Twice	64
	Trice	29

Table 5: Nutritional value of the supplied feed to the farms.

Ingredients	Handmade feed (Inclusion rate, %)	Commercial feed
1. Maize	28.17	Commercial dairy cattle feed
2. Rice Polish	23.86	
3. Soybean meal	16.32	
4. Cowpea	14.44	
5. Rice husk	5.90	
6. Urea	0.35	
7. Mustard oil cake	2.74	
8. Premix	8.22	
Total	100	
Nutritive Value (DM basis)	(mean \pm SE)	(mean \pm SE)
Crude protein (%)	17.0 \pm 0.22	21.0 \pm 0.15
Crude Fiber (%)	11.0 \pm 0.11	9.0 \pm 0.21
Crude Fat (%)	5.0 \pm 0.17	4.0 \pm 0.12
Ca (%)	0.69 \pm 0.31	1.50 \pm 0.13
Phosphorus (%)	0.31 \pm 0.15	0.65 \pm 0.15
TDN (%)	69.0 \pm 2	71.0 \pm 5

Ca= Calcium, TDN= Total Digestible Nutrients, SE= Standard Error

Milk quality

While fat, SNF, and protein concentrations varied significantly ($p < 0.05$), the average total solid, lactose, and mineral contents of morning and evening milk among the farms where different concentrate feed was fed revealed no significant differences (Table 6). This finding is in accordance with other studies by Menajovsky *et al.* (2018) and Bach *et al.* (2007), who observed no effect on the yield of milk total solids of different concentrations. Milk from cows fed commercial feed had a high proportion of total solids (12.46 \pm 0.51) and other nutrients, apart from SNF, which was found to be high (7.65 \pm 0.27) in the milk from farms that fed hand-mixed feed during morning milking. The nutritional composition of evening milk almost followed the same pattern. The observation suggests that commercial feed has a more balanced diet for dairy cattle but it is expensive than the mixed one. Though farmers get benefitted in economical view but mix feed are not in the right formulation, which affects the overall nutritional value of cow's milk produced on the farm.

Table 6: *Nutritional composition of morning and evening raw milk of different farm.*

Parameters	Morning Milk (mean ± SE)		P-Value	Evening Milk (mean ± SE)		P-Value
	Hand Mixed Feed	Commercial Feed		Hand Mixed Feed	Commercial Feed	
Total Solid	12.19± 0.34	12.46± 0.51	0.281	12.72± 0.29	12.81± 0.28	0.171
Fat	3.72± 0.01	3.87± 0.04	0.001***	4.76± 0.11	5.05± 0.275	0.001***
SNF	7.95± 0.27	7.60± 0.19	0.001***	8.02± 0.18	8.15± 0.37	0.001***
Protein	2.96± 0.11	3.29± 0.07	0.05*	3.07± 0.07	3.19± 0.12	0.05*
Lactose	4.11± 0.15	4.61± 0.15	0.53	4.43± 0.12	4.47± 0.22	0.61
Mineral	0.72± 0.01	0.74± 0.03	0.29	0.61± 0.01	0.65± 0.01	0.35

SNF= Solid Not Fat, SE= Standard Error, (*P value ≤0.05, **P value ≤0.01, ***P value ≤0.001).

Conclusion

To conclude, it is obvious that proper feeding practices and advanced management systems are crucial for optimizing milk yield and quality in dairy farming in the South-western part. The nutritional composition of milk in commercial feed is better which also increased the milk yield. While commercial feeds offer better nutritional balance, they are costlier, leading many farmers to rely on less optimal hand-mixed feeds. The mostly use conventional feeding processes should be improved. By improving the feeding practices according to body weight and milk yield, they could get more profit. Furthermore, chopped grass would be a solution to decrease the wastage of extra fodder along with the chances of disease contamination among cattle. Factors such as breed, age, lactation stage, and milking time significantly affect production. It also concludes that the technical expertise in ration formulation and the potential benefits of adopting modern feeding systems is very crucial to get more profit from Holstein Friesian cows. Further research is needed to work on different feeding strategies to improve the milk yield along more profit from dairy cow.

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Author's Contribution

Mahfuza Ferdous contributed to the concept development, directed surveys, conducted field work, collected samples, carried out laboratory analyses, investigated findings, administered the project, and written

both the original draft and the review and editing of the manuscript. Sabuj Kanti Nath contributed to survey work, data analysis, supervision, validated results, and participated in the review and editing of writing in the project. Mustasim Famous contributed to experimental design, conducting investigations, developing methodologies, managing project tasks, allocating resources, providing supervision, and writing, reviewing, and editing the original draft.

Novelty Statement

The study is conducted on the South-western part of Bangladesh and the Holstein Friesian cow breed was selected who were in first parity and popular for their milk production.

Competing Interest

Authors declare that there is no conflict of interest.

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