



Research in

AGRICULTURE, LIVESTOCK and FISHERIES

ISSN : P-2409-0603, E-2409-9325

An Open Access Peer-Reviewed International Journal

Article Code: 0350/2021/RALF

Res. Agric. Livest. Fish.

Article Type: Research Article

Vol. 8, No. 3, December 2021: 301-310.

STATUS OF THE BUFFALO MILK TRADE AND DAIRY MANUFACTURING BUSINESS AT BHOLA DISTRICT OF BANGLADESH, AND OPPORTUNITIES FOR BUFFALO MILK PRODUCTS BRANDING

Md. Rezwanul Habib, Md. Mehedi Hasan Khandakar, Md. Ariful Islam, Md. Moznu Sarkar¹, Mohammed Khorshed Alam², Md. Khalilur Rahman³, Mst. Mamuna Sharmin⁴, Mohammad Mazedul Hannan⁵ and Mohammad Ashiqul Islam*

Department of Dairy Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh; ¹Palli Karma-Sahayak Foundation (PKSF), Agargaon, Dhaka; ²Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh; ³Grameen Jano Unnayan Sangstha (GJUS), Altajer Rahman Road, Charnoabad, Bhola-8300; ⁴Department of Dairy and Poultry Science, Hajee Mohammad Danesh Science and Technology University, Dinajpur 5200, Bangladesh; ⁵MH Associates, Chief Consultant, Udyan School Road, Mollartec, Uttara, Dhaka-1230.

*Corresponding author: Dr. Mohammad Ashiqul Islam ; E-mail: m.a.islam@bau.edu.bd

ARTICLE INFO

ABSTRACT

Received

29 October, 2021

Revised

19 November, 2021

Accepted

21 November, 2021

Online

31 December, 2021

Key words:

Buffalo milk
Dairy products
Traders
Processors
Price

The objective of this study was to know the existing buffalo milk trade and dairy products production status along with scope for buffalo milk product branding. Hence, a face-to-face interview with eighteen milk traders and processors were performed through simple random sampling method. Milk traders and processors were above 25 years old (94%) and above 5 years (89%) experienced in dairy business. The findings exposed that 11% of the participants were involved in milk collection and selling, 39% were directly involved in product manufacturing, and 50% were engaged in milk collection and processing. Among the manufactured dairy products, traditionally made fermented doi was the best-selling dairy product in the Bhola district. About 47% participants desired to incorporate fat-rich dairy products into their production processes. In general, milk traders sold the maximum amount of milk monthly to doi manufacturers (1453 L), followed by local customers (1175 L), sweetmeat manufacturers (1000 L), restaurants (257 L), and household consumers (250 L). Results showed that buffalo milk prices varied significantly ($P < 0.001$) over the year. The peak buffalo milk price (122 BDT/L) was recorded between November and December, and the off-peak price (82 BDT/L) was between March to May. Data indicated that about 43-50 BDT profit derived through per kg doi and sweetmeat selling. Milk traders and processors mentioned that studied areas had greater shortage of milk preservation facilities. Overall, the findings of this study may give some context for developing sustainable buffalo milk and dairy products value chain in Bangladesh.

To cite this article: Habib M. R., M. M. H. Khandakar, M. A. Islam, M. M. Sarkar, M. K. Alam, M. K. Rahman, M. M. Sharmin, M. M. Hannan and M. A. Islam, 2021. Status of the buffalo milk trade and dairy manufacturing business at Bhola district of Bangladesh, and opportunities for buffalo milk products branding. Res. Agric. Livest. Fish., 8 (3): 301-310.



Copy right © 2021. The Authors. Published by: AgroAid Foundation

This is an open access article licensed under the terms of the Creative Commons Attribution 4.0 International License



www.agroaid-bd.org/ralf, E-mail: editor.ralf@gmail.com

INTRODUCTION

Buffalo is one of the most important livestock species and holds an important place in the overall livestock economy of Bangladesh (Sarkar et al., 2013). The native buffaloes of Bangladesh are *Bubalus bubalis*, with most of the population being riverine, except for some swamp buffaloes in the eastern part of the country. Farmers reared buffaloes under extensive, semi-intensive, and intensive management systems at coastal, river-basin, and semi-arid areas of Bangladesh, focusing on milk and meat production (Habib et al., 2017). The total buffalo population in Bangladesh is approximately 1.493 million, with coastal regions accounting for ≈40% (DLS, 2020). Dairy buffalo production has been a tradition in Bangladesh, especially in the Bhola district. Bhola is the largest island known as buffalo concentrated belt in Bangladesh owing to the coastal region (Habib et al., 2021). Bhola Sadar and Char Fasson Upazilas have 800 and 35000 buffalo, respectively, and their monthly milk production is 16000 and 36000 L, respectively. Cattle, buffalo, sheep, and goats contribute to national milk production (10.67 MMT) in Bangladesh, where buffalo share 4-5% of the national milk grid (DLS, 2020).

The choice of milk type and additional ingredients is essential for making dairy products with desirable characteristics, viz. sensory attributes and nutritional quality. The diversity of dairy products around the globe largely depends on the type of milk used, consumer preference, and processing variables (McCarthy et al., 2017). Bovine milk is frequently used as elementary material for dairy products in Bangladesh; whereas, ovine, caprine, or buffalo milk are limitedly utilized. Generally, the composition of buffalo milk varies from the milk of other mammals and contains higher fat, protein, calcium, and less cholesterol than cow's milk (Islam et al., 2014). Buffalo milk is popular because it is high in nutrients and can make dairy products like cheese, doi, or curds and rasomalai (Asif et al., 2021). Higher total solids and fat in buffalo milk make it more economically viable than cow milk for producing butter, butter oil, soft and hard cheeses, condensed or evaporated milk, ice cream, and buttermilk. Generally, 1 kg of cheese production requires 8 L of cow milk and 5 L of buffalo milk. One kg butter production needed 14 L of cow and 10 L of buffalo milk (FAOSTAT, 2012).

Milk composition is an essential attribute for dairy farmers and industries in relation to payment and milk processing quality (Dos Reis et al., 2013). The value chain and supply chain regarding buffalo milk and dairy products in Bangladesh has remained stagnant due to the absence of any milk improvement program. According to Uddin et al. (2014), remote area farmers get ≈ 60% lower prices than urban farmers. In Bangladesh, few dairy companies give milk price based on the volume and compositional quality (butterfat content). In remote coastal areas, dairy companies do not go for milk collection. Farmers are obliged to sell their milk to the *Ghosh* (middleman and sweetmeat processor) and local goals at minimum cost. Besides, farmers take a loan from goala and product manufacturers with a condition of selling milk to them that limits the efficient milk marketing system (Rahman et al., 2019). The consumption pattern of milk and dairy products influences the processors and manufacturers to develop a particular type of product in their business. Fermented dairy products and indigenous sweetmeats like rasogolla, rasomalai, chamchom and kalojam etc. are top-rated dairy products among the consumers of Bangladesh. The food habits of the general people are changing day by day, and the demand for milk products is increasing due to more per capita income and consumer health consciousness (Ahmed et al., 2016). Consumers generally prefer lower cholesterol content milk, and buffalo milk has lower cholesterol than cow milk (Asif et al., 2021).

Efficient dairy marketing plays an essential role in reducing asymmetries of information between traders and producers, lowering transportation costs, and enhancing farmers' ability to produce more and provide reasonable product prices (Sarna et al., 2020). By understanding the milk market price and efficient channel for dairy farmers and processors, they will be able to select the right way for selling and/or buying milk and dairy products at a reasonable price that significantly impacts milk production and marketing. As Bhola district has a large number of dairy buffalo, many persons are traditionally involved in milk trade and processing business to utilize buffalo milk. In addition, many entrepreneurs have already stepped forward to deal with milk trade and the dairy manufacturing business (Islam et al., 2017). Still, no research has been conducted regarding the buffalo milk trade and processing business status at Bhola district and opportunities for buffalo milk products branding in Bangladesh. Therefore, the current study was undertaken to know the socio-economic characteristics of buffalo milk traders and processors, frequency of production and selling of buffalo milk products, future prospects of buffalo milk products, and incorporation of new dairy products in the dairy business. Also, the response from milk traders and processors was recorded regarding the market demand of milk, loan, amount of milk purchase, and income. To the best of our knowledge, this study will provide the first report on buffalo milk trade and dairy manufacturing business from the Bhola district in Bangladesh. Data from this study will be helpful to develop sustainable buffalo milk and dairy products value chain in Bangladesh.

MATERIALS AND METHODS

Study areas and participants

The study was conducted at Bhola district (area 3737.21 km²) of Bangladesh. The latitude and longitude of this district range over 22.69°N and 90.6525°E, respectively. This study included 18 milk traders and processors from the different Upazilas of Bhola district, including Burhanuddin (n=2), Lalmohan (n=2), Char Fasson (n=11), and Bhola Sadar (n=3); (Figure 1).

Questionnaires

A face-to-face interview was conducted through random sampling of 18 milk traders and processors from the Bhola district of Bangladesh. A questionnaire was used as the instrument for collecting information and divided into seven sections: 1) demographic information of the respondent 2) production and best-selling of buffalo milk products 3) potentiality of buffalo milk products and incorporation of new development in the dairy business 4) quantity of buffalo milk products produced and sold 5) fluctuation of buffalo milk price over the year 6) market demand, availability, price giving mode and preservation of buffalo milk and milk products, and 7) information on loan, amount of milk purchase, income, and supply of buffalo milk. The questionnaire was created according to the objectives of the study. Before deploying the final questionnaire, we conducted a pilot survey with five participants to assess the questions' clarity, the correctness of response options, use of scientific vocabulary, and overall survey flow.

Statistical analysis

Collected data were compiled and tabulated using Microsoft Office Excel version 2010 (Microsoft Corp., Redmond, WA), and quantitative data were represented as mean \pm standard deviation. Categorical and ordinal data were shown as frequencies and percentages. One way analysis of variance was performed for buffalo milk price fluctuation using SPSS software, and significance was declared at $P < 0.05$.

RESULTS AND DISCUSSION

Characteristics of milk traders and processors

Characteristics of buffalo milk traders and processors from different Upazilas of the Bhola district of Bangladesh are reported in Table 1. It was found that all respondents were male, and 94% of respondents' ages were above 25 years. That indicates mature males were more likely to conduct this profession. In Burhanuddin, Lalmohan, and Char Fasson Upazillas, all participants were above 25 years of age, except for Bhola Sadar, where 33% were under 25. Overall, the educational level of the respondents was relatively high as 55% had a primary level and 27% an SSC level. Almost 89% of individuals had more than five years of business experience, reflecting those participants in the Bhola district are more likely to engage in milk trading and processing. Results revealed that 11% of participants were involved in milk collection and selling, 39% were directly associated with product manufacturing, and 50% were involved in milk collection and processing. This finding is similar to Rahman et al. (2019), who reported that most of the coastal buffalo farmers sold buffalo milk directly to sweetmeat makers or *Ghosh* (middleman). However, 83% of family's income is derived from milk trading and processing business, whereas only 6% of participants' income comes from agriculture sources (Table 1).

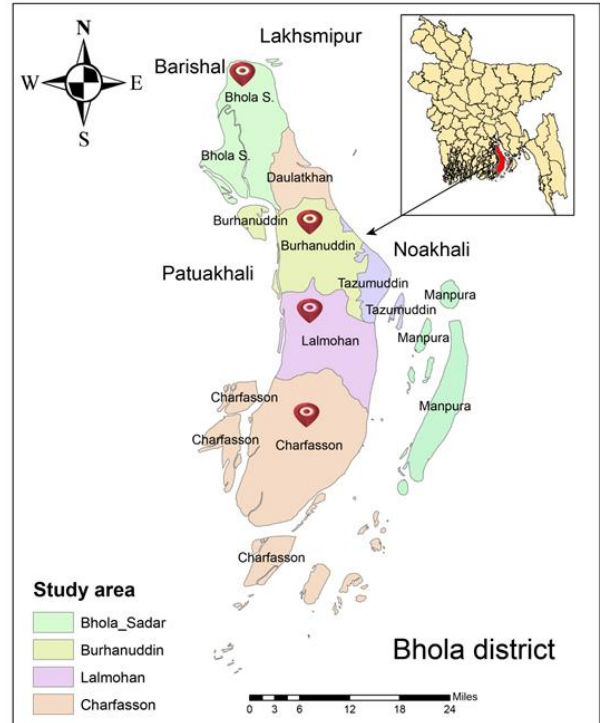


Figure 1. Map showing the studied areas of Bhola district in Bangladesh

Production frequency and best-selling products

Table 2 shows the current production status of buffalo milk products in the study areas. Doi produced the most (50%), while ghee produced the least (5.5%) compared to other buffalo dairy products in the Bhola district. Results indicated that the preferences and attitudes of consumers heavily influence the production status of various milk products in this region. In terms of selling, doi is dominant (73.69%) in the Bhola district, followed by sweetmeats (10.52%) and ghee (5.27%). It is generally recognized that the selling of any products increases due to differences between consumed products and the actual purchasing behavior of the consumers (Bennett et al., 2002; Verbeke, 2009). In addition, the selling of milk products largely depends upon the price of products, place, and personal values of the seller. According to Homer and Kahle (1988), personal values have been the underlying determinants of various aspects of selling products to consumers.

Table 1. Characteristics of milk traders and processors from the Upazila of Burhanuddin, Lalmohan, Char Fasson and Bhola Sadar of Bhola district in Bangladesh

Characteristic	Participants, no (%)				
	Total (n=18)	Burhanuddin (n=2)	Lalmohan (n=2)	Char Fasson (n=11)	Bhola Sadar (n=3)
Age					
<25 years	1 (6)	0 (0)	0 (0)	0 (0)	1 (33)
>25 years	17 (94)	2 (100)	2 (100)	11 (100)	2 (67)
Sex					
Male	18 (100)	2 (100)	2 (100)	11 (100)	3 (100)
Female	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Highest level of education achieved[†]					
Illiterate	1 (6)	1 (50)	0 (0)	0 (0)	0 (0)
Primary	10 (55)	1 (50)	0 (0)	9 (82)	0 (0)
SSC	5 (27)	0 (0)	2 (100)	1 (9)	2 (67)
HSC	1 (6)	0 (0)	0 (0)	1 (9)	0 (0)
Above HSC	1 (6)	0 (0)	0 (0)	0 (0)	1 (33)
Experienced in business					
<5 years	2 (11)	0 (0)	0 (0)	2 (18)	0 (0)
>5 years	16 (89)	2 (100)	2 (100)	9 (82)	3 (100)
Types of business					
Collection of milk and selling	2 (11)	1 (50)	0 (0)	1 (9)	0 (0)
Product manufacturing	7 (39)	0 (0)	2 (100)	4 (36)	1 (33)
Both	9 (50)	1 (50)	0 (0)	6 (55)	2 (67)
Major family income sources					
Agriculture	1 (6)	0 (0)	0 (0)	1 (9)	0 (0)
Business	15 (83)	2 (100)	2 (100)	8 (73)	3 (100)
Job	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Others	2 (11)	0 (0)	0 (0)	2 (18)	0 (0)

[†] Illiterate, do not know how to write and read; Primary, primary education; SSC, secondary school certificate; HSC, higher secondary certificate.

Table 2. Production and best-selling of buffalo milk products at study areas

Production of milk products			Best-selling milk products		
Dairy products	Frequency	%	Dairy products	Response no.	%
Sweetmeat	2	11.11	Sweetmeat	2	11.11
Doi	9	50.0	Doi	13	72.22
Both doi and sweetmeat	4	22.22	Both doi and sweetmeat	0	0
Ghee	1	5.56	Ghee	1	5.56
Do not any product	2	11.11	Do not sell	2	11.11
Total	18	100	Total	18	100

Buffalo milk products potentials

Buffalo milk products potential and incorporation of new development in the dairy business are mentioned in Table 3. The highest frequency for the potentiality of buffalo milk doi was about 77.78%, whereas remarkably less response for sweetmeats (5.55%). These might be due to the production of buffalo doi through natural fermentation and more consumer preferences due to nutritional and health benefits (Asif et al., 2021). Data indicated that manufacturers (47.37%) soon incorporated a new buffalo product (ghee). Though buffalo milk is rich in butterfat, no potentiality was found in this study area for butter production that indicates interventions are needed to popularize butter manufacturing. According to Habib et al. (2017), buffalo milk can be used to make butter, butter oil, soft and hard cheeses, condensed milk, evaporated milk, ice cream, doi, and many other milk products. However, mozzarella (soft Italian cheese) is the most well-known of these products due to the more fat content of buffalo milk and desirable fat to protein ratio, 2:1 (Addeo et al., 1993).

Table 3. Future prospects of buffalo milk products and incorporation of new dairy product

Potential milk products			Incorporation of new product		
Dairy products	Frequency	%	Dairy products	Response no.	%
Sweetmeat	1	5.55	Sweetmeat	1	5.56
Doi	14	77.78	Doi	1	5.56
Do not respond	3	16.67	Cheese	1	5.56
Total	18	100	Ghee	9	50.00
			Do not	6	33.33
			Total	18	100

Production of buffalo milk products, selling, and price fluctuation

The average quantity and selling price of individual buffalo milk products, and their production cost and profit are given in Table 4. Results revealed that doi (avg. 1914.17 kg/month) and sweetmeats (avg. 216.67 kg/month) were primarily manufactured but ghee (avg. 90 kg/month) produced a little bit. The average selling price of doi, sweetmeat, and ghee was about 186, 250, and 1200 BDT/kg, respectively, in study areas. These products' prices were slightly higher than other districts of Bangladesh due to the more precious nutrient (milk fat) content in buffalo milk. In another study, Ahmed et al. (2016) mentioned that the prices of cow milk doi, sweetmeats, and ghee in the Mymensingh district were 130, 140, and 809 BDT/kg, respectively. However, such product price variations might be due to the advancement of year, buffalo milk availability, cow milk effect, live animal price, cost of shade, feed investment, grazing availability, etc. In addition, 200 BDT profit was obtained more through per kg ghee selling than other dairy products.

Table 4. Quantity of buffalo milk products produced and sold monthly in a sweetmeat shop

Products	Quantity (kg)	Selling price (Tk/kg)	Production cost (Tk/kg)	Profit (Tk/kg)
Doi (n=12)	1914.17	185.83	142.50	43.33
Sweetmeat (n=3)	216.67	250.00	200.00	50.00
Ghee (n=1)	90	1200	1000	200.00

Figure 2 depicts the distribution of buffalo milk to different types of consumers of the Bhola district in Bangladesh. It was noted that the highest amount of milk was sold to the product manufacturers (1453.33 L/month), followed by the local customer (1175.45 L/month), sweetmeat manufacturers (1000 L/month), restaurant (257.50 L/month), and household (250 L/month) consumers.

Fluctuation of buffalo milk price over the year at Bhola district of Bangladesh is represented in Figure 3. The price of buffalo milk fluctuated significantly ($P < 0.001$) over the seasons, and the peak price was recorded from November to December (122.31 Tk/L). In contrast, the off-peak price was found from March to May (82.31 Tk/L). However, price fluctuations were statistically similar ($P > 0.05$) in studied areas between the off-peak (March- May) and average period (June-October). This study provides a complete picture of price fluctuation for buffalo milk over the range of BDT 30-40 Tk. These can be elucidated by the facts that availability of buffalo milk in a particular season and receiving advance payment from *Ghosh* (middleman and sweetmeat makers). This finding is consistent with Haque (2009), who reported that *Ghosh* may provide loans to smallholders in some areas at interest rates of up to 20% per month and that *Ghosh* sometimes paid

the smallholders in advance, in exchange for the farmers agreeing to sell their milk at a discount of US \$3 per 100 liters. Similarly, Rahman et al. (2019) mentioned those farmers did not take advance money from Ghosh or money lenders; farmers got higher milk prices. In addition, those farmers accept advance payment for the rearing of buffalo gets lower milk price. However, the average buffalo milk price for public consumption from June to October was 98.46 BDT/L. In general, raw milk price fluctuations influence the cost of manufactured dairy products, and this is in line with Ahmed et al. (2016), who reported that milk and dairy product prices in Mymensingh municipality did not remain constant over the year due to raw milk price fluctuations.

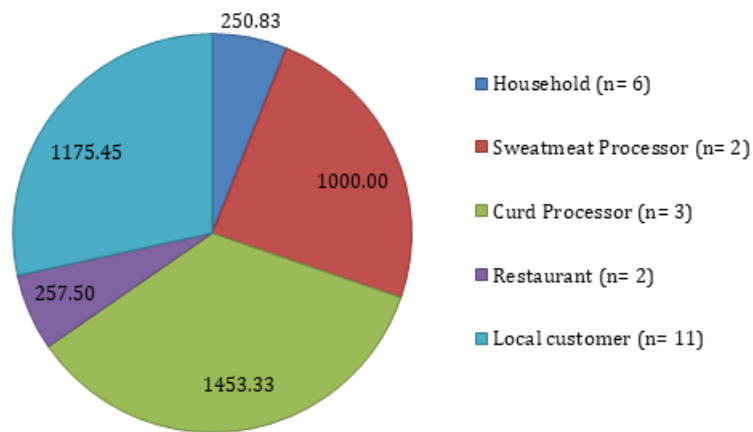
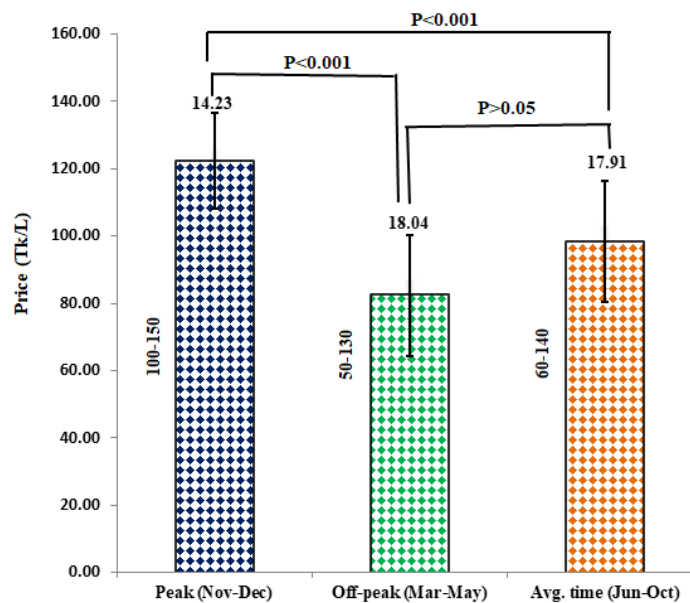


Figure 2. Quantity of buffalo milk sold (L/month) to different consumers. Curd means coagulated mass like doi.



Value at the top of the error bar indicates the standard deviation of the mean price of that bar; Values alongside each bar indicates minimum and maximum price range of that bar. Peak price occurs at November-December months, Off-peak price occur at March-May months and average milk price remains between June to October months.

Figure 3. Fluctuation of buffalo milk price over the year at Bhola district of Bangladesh. Mar, March; Jun, June; Oct, October; Nov, November; Dec, December.

Table 5. Response from milk traders and processors regarding the market demand, availability, price giving mode and preservation of buffalo milk and milk products

Features	No. of respondent (n)	% of the total respondent
Fulfillment of market demand by buffalo milk or milk products		
Yes	4	22.22
No	14	77.78
Getting milk from farmers according to market demand		
Yes	8	44.44
No	10	55.56
The price of collected milk is fixed all year		
Yes	4	22.22
No	14	77.78
Determination of milk price during purchasing (n=18)		
Producer	0	0
Yourself	3	16.67
Your customer	0	0
Market demand-supply factor	15	83.33
Determination of milk or milk products price during selling (n=18)		
Producer	3	16.67
Yourself	6	33.33
Your customer	2	11.11
Market demand-supply factor	7	38.89
Price giving to producer mechanism (n=18)		
Cash	13	72.22
Credit	5	27.78
Payment mode (n=18)		
Daily	4	22.22
Weekly	2	11.11
Monthly	12	66.67
Price taking to customer mechanism (n=18)		
Cash	18	100
Credit	0	0
Payment mode (n=18)		
Daily	16	88.88
Weekly	1	5.56
Monthly	1	5.56
Loan/advance money given to buffalo farmers (n=18)		
Yes	9	50.0
No	9	50.0
Supply of buffalo milk according to demand (n=18)		
Increased	12	66.67
Decreased	6	33.33
Right now, selling of milk production increased or decreased (n=18)		
Increased	15	83.33
Decreased	3	16.67
Receiving supports from the GJUS project (n=18)		
Yes	12	66.67
No	6	33.33
Type of supports receiving from the GJUS project (n=12)		
Training	3	25.0
Promotional support	0	0
Linkage support	1	8.33
Above all	8	66.67

Table 5. (Contd.)

Features	No. of respondent (n)	% of the total respondent
Procurement of excess milk when supply is suddenly increased (n=18)		
Yes	15	83.33
No	3	16.67
Preservation of milk (n=18)		
Yes	3	16.67
No	15	83.33
Access to the right technology for milk preservation (n=18)		
Yes	5	16.67
No	13	83.33
Market opportunities for buffalo milk products (n=18)		
Products variation	9	50.0
Size of market	3	16.67
Future growth	1	5.55
Both products variation and market size	2	11.11
Do not respond	3	16.67

GJUS, Grameen Jano Unnayan Sangstha

Market demand, payment methods, opportunities, and the preservation of milk and milk products

The present market demand, availability, price setting mode, and preservation of buffalo milk and milk products in the Bhola district are summarized in Table 5. The majority of the respondents (77.78%) believed that buffalo milk and milk products' demand is not being met. The remaining 22.22% thought that consumer demand could be met through existing buffalo milk production. Furthermore, there has been very little response from milk traders and processors (44.44%) regarding milk acquisition from farmers based on existing market demand. About 77.78% of manufacturers mentioned that the price of collected milk is not fixed all year round in the Bhola district. The open-ended question revealed that milk price's principal determination during purchasing (83.33%) and selling (38.89%) largely depends on the market demand-supply factors. However, market demand-supply factors are considered significant price determiners of milk in the studied district. According to Rabbani and Sene (2017), the milk supply chain in Bangladesh had a mixed picture, with farmers selling 95% of their milk directly to Ghosh, the local market, and a local sweetmeat shop, but none to the formal distribution channel.

About 72.22% of milk processors gave the price of milk through the cash payment and offered monthly basis (66.67%), followed by daily (22.22%) and weekly (11.11%). Most of the participants (83.33%) declared that both selling and supply of milk were increased in 2021 compared to 2016-2020. These are due to loans, advance money, or other supports viz. training, promotional, and linkage support from buffalo rearing through an improved management system project taken by PKSf, different GO's and NGO's. In another study, Rahman et al. (2019) mentioned that 58% of buffalo farmers received advance payment from the Ghosh, and 42% received on-site payment.

In 2021, the supply of buffalo milk in the Bhola district increased by 66.67% based on the demand than in 2016-2020. Simultaneously, the selling of buffalo milk has been increased by 83.33% due to procurement of excess milk (83.33%) in the studied district due to intervention of buffalo rearing project at Bhola district taken by PKSf, different GO's and NGO's. These organizations gave supports to the milk traders and processors (66.67%), and they received training (25%), linkage supports (8.33%), and a combination of both (66.67%). However, Bhola district had greater scarcity of milk preservation facilities. The majority of the traders (83.33%) mentioned that they did not try to preserve the milk and have no access to appropriate milk preservation technology. The facts can explain that milk traders collect milk from buffalo keepers with a view to doi making in a natural manner. They believed that incorporating preservatives in milk would interfere with the coagulation of milk during doi making. Consequently, preservative added milk does not settle coagulation within a stipulated time and creates difficulties to make traditional buffalo doi. However, respondents were firmly believed that grass fed buffalo milk and milk products had an excellent future market opportunity for product variation (50%), market size (16.67%), and future dairy industry growth (5.55%) at Bhola district of Bangladesh.

Table 6. Information on loan, amount of milk purchase, income and supply of buffalo milk

Features	Mean \pm SD
Avg. loan per buffalo per month (Tk)	1937.50 \pm 1327.53
Increased supply of buffalo milk	24%
Amount of milk purchase from GJUS project farmers (L/month)	2005.56 \pm 1575.95
Avg. income from milk trading business (Tk/month)	35970.59 \pm 11415.58

GJUS, Grameen Jano Unnayan Sangstha

Information on loans, milk supply, and income

Data regarding the loans, amount of milk purchase, income, and supply of buffalo milk in the Bhola district are given in Table 6. Generally, loans were given based on the buffalo population, and survey results indicated that avg. 1937.50 BDT/month was given as a loan to the buffalo rearer for each buffalo keeping. This is in line with Rahman et al. (2019), who reported that 58% of the buffalo farmers of Bhola district received BDT 3000-10000 per month as an advance payment or loan for each buffalo rearing. In the Bhola district market, buffalo milk supply rose by around 24% in 2021 compared to 2016-2020. The average amount of monthly purchased milk was 2005 L by the milk traders and processors from the PKSf, GO's and NGO's interventional project farmers. In this district, an average of 35970 BDT per month is derived from the milk trade business.

CONCLUSIONS

It is concluded that most of the traders and manufacturers were involved in the milk collection, manufacturing of products, and both. Among the dairy products, doi was the most popular as well as best-selling dairy product, and buffalo milk doi was produced alone comprising 50% of the total dairy products produced in the Bhola district. About 78% of the traders firmly believed that buffalo doi could be more potential dairy product based on existing market demand, and 47% of the processors wished to incorporate ghee in their dairy business. The price of buffalo milk was fluctuated over the seasons, with the peak price recorded from November to December (122 BDT/L) and the off-peak price recorded from March to May (82 BDT/L). Still, there is a shortage of fluid milk availability that limits manufacturing of desired amounts dairy products. Data from this survey may be helpful to develop a sustainable dairy production chain considering the various stakeholders, viz. farmers, traders, processors, and dairy companies, in determining how to ramp up buffalo milk and its products in a profitable manner. Aside from that, milk storage and processing facilities should be developed. A better solid market link needs to be created with dairy companies for buffalo milk and products branding.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

ACKNOWLEDGMENTS

This study was supported by the Palli Karma-Sahayak Foundation (PKSF), Dhaka, Bangladesh, and Grameen Jano Unnayan Sangstha (GJUS), Bhola, Bangladesh.

REFERENCES

1. Addeo F, L Chianese and P Masi, 1993. The influence of processing conditions on the quality of water buffalo mozzarella cheese. *European Association for Animal Production*, 62: 214-224.
2. Ahmed AK, MR Habib, S Afrin, MA Islam and MH Rashid, 2016. Uses of milk in sweetmeat shops and consumer preferences to milk products at Mymensingh municipality in Bangladesh. *Asian Journal of Medical and Biological Research*, 2(2): 266-273.
3. Asif AHM, GK Deb, MR Habib, MH Rashid, MAH Sarker, UF Shahjadee, SA Lisa, S Ahmed, D Ekeberg, E Vargas-Bello-Pérez and MA Islam, 2021. Variations in the fatty acid and amino acid profiles of doi and rasomalai made from buffalo milk. *Journal of Advanced Veterinary and Animal Research*, 8(3): 511–520.
4. Bennett RM, J Anderson and RJP Blaney, 2002. Moral intensity and willingness to pay concerning farm animal welfare issues and the implications for agricultural policy. *Journal of Agricultural and Environmental Ethics*, 15: 187–202.
5. DLS, 2020. Livestock Economy at a Glance, Yearly updates on livestock production, Department of Livestock services, Ministry of Fisheries and Livestock, Dhaka, Bangladesh.
6. Dos Reis, CBM, JR Barreiro, L Mestieri, MA de Felício Porcionato and MV dos Santos, 2013. Effect of somatic cell count and mastitis pathogens on milk composition in Gyr cows. *BMC Veterinary Research*, 9(1): 1-7.
7. FAOSTAT, 2012. FAO statistical database. Available at: <http://faostat.fao.org/>. Accessed 21 September 2012.
8. Habib MR, MM Sarkar, MSI Sojib, MZ Islam, MK Alam, MK Rahman and MA Islam, 2021. Characteristics of buffalo traders and their business status at Bhola district in Bangladesh. *Journal of Agriculture, Food and Environment*, 2(3): 21-24.
9. Habib MR, MN Haque, A Rahman, M Aftabuzzaman, MM Ali and M Shahjahan, 2017. Dairy buffalo production scenario in Bangladesh: a review. *Asian Journal of Medical and Biological Research*, 3(3): 305-316.
10. Haque SAM, 2009. Bangladesh: Social Gains from Dairy Development, in *Animal Production and Health Commission for Asia and the Pacific and Food and Agriculture Organization (APHCA-FAO) Publication on Smallholder Dairy Development: Lessons Learned in Asia*, RAP publication 2009/2, FAO, Rome.
11. Homer P and LR Kahle, 1988. A structural equation test of the value-attitude-behavior hierarchy". *Journal of Personality and social Psychology*, 54: 638-646.
12. Islam MA, MK Alam, MN Islam, MAS Khan, D Ekeberg, EO Rukke and GE Vegarud, 2014. Principal milk components in buffalo, holstein cross, indigenous cattle and Red Chittagong Cattle from Bangladesh. *Asian-Australasian Journal of Animal Science*, 27: 886-897.
13. Islam S, TN Nahar, J Begum, GK Deb, M Khatun and A Mustafa, 2017. Economic Evaluation of Buffalo Production in Selected Regions of Bangladesh. *Journal of Stock and Forex Trading*, 6: 177.
14. McCarthy KS, M Parker, A Ameerally, SL Drake and MA Drake, 2017. Drivers of choice for fluid milk versus plant-based alternatives: What are consumer perceptions of fluid milk? *Journal of Dairy Science*, 100: 6125-6138.
15. Rabbani MG and M Sene, 2017. Dairy and meat sector development of Bangladesh: Strategy and approaches. P 65 Annual Report. Department of Livestock Services. Farmgate Dhaka.
16. Rahman SR, MN Islam, MH Rashid, NR Sarker, MSR Siddiki, MZ Islam and MA Islam, 2019. Buffalo Milk Yield, Quality, and Marketing in Different Agro-Climatic Districts of Bangladesh. *Journal of Buffalo Science*, 8(3): 62-67.
17. Sarkar S, MM Hossain, MR Amin, DV Bainwad, BR Deshmukh, BM Thombre and DS Chauhan, 2013. Socio-economic status of buffalo farmers and the management practices of buffaloes in selected areas of Bagerhat District of Bangladesh. *Bangladesh Journal of Animal Science*, 42: 158- 164.
18. Sarna SF, MS Palash, MM Uddin, 2020. Dairy farmer's milk selling options in major milkshed areas of Bangladesh: A comparative analysis. *Journal of Bangladesh Agricultural University*, 18(2): 463–470.
19. Uddin MM, Brummer B, Peters KJ 2014. Technical efficiency and meta-tehnology ratios under varying resource endowment in different production systems: A stochasticmeta frontier model in Bangladesh dairy farms. *China Agricultural Review*, 6(3): 485-505.
20. Verbeke W, 2009. Stakeholder, citizen and consumer interests in farm animal welfare. *Animal Welfare (South Mimms, England)*, 18: 325–333.