



ASSESSMENT OF THE PRESENT STATUS OF MILK HANDLING AND MANAGEMENT PRACTICES IN SOME AREAS OF BANGLADESH

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ABSTRACT: *Milk contamination by dairy workers' spoiled hands, unclean utensils, microbes, and polluted water has caused many milk-borne epidemics. Most milk-borne zoonoses are also contracted by drinking infected milk. Bangladesh lacks milking hygiene and farmer awareness, and the milk cleanliness of dairy farmers awareness and practices in different regions was accessed. This study was aimed at documenting the present milking and management practices of dairy producers in particular districts of Bangladesh. From June 2020 to June 2022, 300 small dairy cow owners in twelve areas were surveyed using a preset questionnaire. Results revealed that male respondents (59.5%) outnumbered female respondents (41.33%) across various age categories. Most farmers milked animals at the shed and washed their hands before milking. Over half of dairy farmers cleansed the udder and teat before milking. More than two-thirds of farmers let the calf suckle before and after milking, while 98.02 percent used concentrate feed for teat massage. Most farmers (95.58%) manually milked cows twice daily. The majority of farmers sold their milk (77.25%) rather than drink it (10.17%). The study found that 93.92 percent of milkmen cleaned the milking pail using water, while 3.5-2.5 percent utilized sand, ash, or detergent. Only 53.66% of dairy farmers washed their cows' udders and teats after milking, which may not be aware of potential contamination from dipping teats in sterile cream. Mastitis prevention was not practiced by 85.42 percent of the respondents. Four to eight percent of producers know about antibiotics, milk adulteration, milk safety, and food safety issues. The application of scientific management approaches to milking is still lacking in the study areas. Therefore, training programs on improved milking management procedures can help farmers produce clean milk, increase dairy animal production, and increase farming income.*

KEYWORDS: Milking Practice, Dairy Farm, Milk, Management, Survey, Livestock.



INTRODUCTION

Among the essential components of agriculture, livestock is a closely related and interlaced part, where 80% of the rural population in Bangladesh is employed in the raising of dairy cattle (Rahim et al., 2018) mostly with the aim of augmenting economic prospects. Rapid population growth, rising nutritional awareness, extensive education, and advanced consumer buying power have amplified the demand for milk in urban, rural, and small-town areas (Rashid et al., 2015). The Department of Livestock Services (DLS, 2022) reports that the average daily milk consumption per individual is around 250 ml, but the available supply is only 208.61 ml, highlighting the need for sufficient future production. In recent times, milk and other dairy products have been considered significant sources of animal protein that can even help satisfy the growing nutritional needs and ensure food safety in Bangladesh (Khan, 2021). Furthermore, most of the milk produced in our nation comes from rural homes (Siddique & Amin, 2013), which still plays a significant role in promoting the overall health of the nation (Uddin et al., 2022).

In practical situations, farmers in developing countries are driven to generate a substantial volume of milk; hence, there is still a major concern about producing quality milk that is hygienic and free from foodborne pathogens (Rahman, 2020). Furthermore, milk-borne zoonoses, which are primarily acquired through the intake of contaminated milk, pose significant challenges for both public health and the economy (Islam et al., 2020). Moreover, our dairy farms have several difficulties, particularly when they seek to produce high-quality milk. Enhanced milking procedures, sterile milk production, and healthier milk letdown are examples of scientific milking management strategies that might increase overall milk output and milk quality as well (Leone et al., 2022). Although it seems that cattle have a large economic impact on both the agricultural and overall national economies, dairy producers are still not aware of scientific management techniques. Furthermore, food safety regarding dairy and its related products is a major concern in the modern world, even in developing countries like Bangladesh. Therefore, the objective of the current investigation was to gather information about the various milk production, milk handling, and milking management techniques used by dairy producers throughout Bangladesh.

MATERIALS AND METHODS

A Systematic Survey

A total of 12 districts in Bangladesh, classified as high milk-producing areas (HMA) and low milk-producing areas (LMA), were the subject of an extensive survey. Out of 12 districts, 4 districts of Sirajganj, Pabna, Satkhira, and Mymensingh were included in the study under the HMA category, whereas the 8 districts in the LMA category were Chattogram, Narayanganj, Sunamganj, Manikganj, Kushtia, Savar, Barishal, and Rajshahi. Between June 2021 and June 2022, from 12 districts, a total sample of 300 farmers participated in this study. The survey primarily centered around gathering fundamental information pertaining to farmers, as well as their milking management procedures. The main emphasis was placed on assessing the quality of milk and the use of clean production methods. The questionnaires utilized a systematic and straightforward format, consisting of a total of 40 questions. The members of the household



were actively engaged in the process of collecting information, and subsequent verification of the findings was conducted independently following each meeting.

Personal Information of the Respondents

Both male and female respondents participated in this survey. The respondents' families were given three categories with their family members like 2-3, 4-5, and 6-7 members. The educational backgrounds of participants were categorized as primary, secondary, upper secondary, and none. Both a main business and a side business for dairy farming were designated. The respondents were asked if they had gotten any training, and either yes or no was selected as the answer. The dairy cattle herd sizes of responders were sorted into five categories as farmers having 6-10, 11-16, 17-21, 22 and more than 22 cattle per category.

Milk Handling Practices in Dairy Farm

The investigation surveyed respondents on their milking systems, methods, foot baths, dairy equipment washing, animal shed cleaning, milking place, pail type, cleaning, calf suckling, milk letdown, frequency of milking, complete milking, wiping udders, teat dipping, mastitis test, milk consumption, sales, sources, and food safety information. The respondents were categorized as hygienic and unhygienic, with foot baths marked as yes or no. Dairy equipment washing was marked as warm water and normal water. Animal shed cleaning was marked as regular and irregular. The respondents also allowed calf suckling before, after, and both times. The respondents also indicated their practices of wiping udders and teats after milking. The respondents' milk consumption was categorized as family consumption and sold in the market. The sources of milk were marked as government and private institutes.

Milk Management Practices in Dairy Cattle

The study examined the management procedures used on dairy farms. Milk was either noted as being frozen or not being stored. There were three categories of wait times before milk transfer: 0.5-1 hour, 1-2 hours, and 2-4 hours. The three types of water sources were pond, tube wells, and water supplies. Deworming and vaccination were classified as regular or irregular. Use of antibiotics was categorized as routine or irregular. Adulteration knowledge was categorized as either yes or no. Safety test milk parameters were graded as occurring consistently or erratically. The study examined the availability of clean water for animals, well drainage systems, the distance between the home and the animal shed, hand washing methods, and udder cleaning procedures.

Statistical Analysis

Microsoft Excel 2019 (Microsoft Corporation, USA) was used to analyze, code, transfer, summarize, categorize, and enter the collected data into a database after the questionnaire responses were entered into a computer spreadsheet. The IBM SPSS-22 (IBM, New York, NY, USA, 2023) statistical program was used to perform additional descriptive data analysis, such as average and percentage.



RESULTS

General and Dairy Information of Participant Farmers

The study found that male and female farmers were prevalent in the study areas. In this study, the other 50% do farming besides their other businesses. The surveyed results indicated that 21-23% had a higher educational background (Figure 1-c). The respondents in the research area had dairy herd sizes ranging from 6 to 22, the numerical category with the highest proportion, whereas the lowest proportion was a herd size with more than 22 individuals (Figure 1-d). In the HMA, farmers possess 6-10 numbers of cattle with slightly higher percentages (61%) compared to LMA.

Milking and Milk Handling and Management Practices Adopted by Dairy Farmers

The general milking and milk handling and management practices during milking are presented in Table 2. The general practices include milking, milking methods and frequency of milking, milking places and utensils, milk consumption, sale, and storage and food safety information regarding milking.

Milking Hygiene, Methods, Places, and Scientific Milking

The results showed that about 77-83% with an average 80% of farmers milked their cows by maintaining hygienic conditions, and 19-23% with an average 20% did not follow in both HMA and LMA. However, in LMA, farmers were found to have practiced more hygienic milking (83%) than farmers of HMA (77%). These results might have fluctuated due to the highest male farmers with low cattle herd sizes in LMA than HMA (Figure 1), resulting from maximum efforts for hygienic practices. The findings indicated that farmers in the examined areas used both manual and automated milking methods, with the majority allowing physical milking (92.17%) rather than automated one (7.83%). In the studied areas, the farmers used both milking at the place of tethering and milking at a separate dry place. This study observed that most of the farmers (96-98%) milked the animals at the place of tethering, whereas only 2-4% milked in separate dry places. However, farmers of HMA practice more milking at separate and dry places (4%) than farmers of LMA (2%). The farmers studied used open-mouth buckets and scientific milking pails for milking their cows. Though the scientific milking pails have more benefits for obtaining hygienic milk, only 3.17% of farmers used them, whereas most of the dairy farmers (96.83%) used an open-mouth bucket during milking. Nevertheless, farmers of HMA practice used more scientific milking pails (4%) than LMA (2.88%). However, farmers from HMA regions (97%) used more scientific milking pails compared to others.

Frequency of Milking, Total Milking, and Calf Suckling

There was a marginally greater proportion of male dairy farmers (53.66%) who milked their cows compared to female dairy farmers (46.34%). The present study aimed to examine the calf suckling allowance in relation to milking procedures, specifically focusing on the periods before milking, after milking, and both before and after milking. The findings of the study indicate that a significant proportion, specifically over 71%, of dairy milkmen were observed to allow calf suckling both prior to and following milking. Nevertheless, in the current research, many dairy farmers in the selected areas (95.75%) did not complete milking their cows after each individual milking. Sreedhar and Sreenivas (2015) noted comparable results, with total milking being practiced (15.83%) and not practiced (84.17%). A significant proportion



(95.58%) of the farmers from HMA and LMA were observed to engage in the practice of double draining their cows within a single day (4.25).

Milk Consumption, Storage, and Handling

The study analyzed milk distribution for household consumption and market sales. Only 10% of milk producers used it for domestic consumption, while most farmers sold it in the market (90%); the rest of the farmers sold it in their surroundings (6%). The results suggest that a significant number of farmers are actively seeking to generate more income through milk sales. However, farmers of HMA were found to be more concerned (98%) about food safety issues compared to LMA (95%). This survey assessed the freezing storage and time of milk transfer from farm to market channels. Only 8.25% of the farmers used storage systems under freezing conditions, where the maximum number of farmers was not stored (91.75%).

Hygienic Milking Management and Handling Practices in Dairy Farm Premises

To obtain hygienic milk, the milking management and handling practices followed in dairy farm premises in the selected HMA and LMA are presented in Table 2. The study aims to examine management practices in dairy farms, specifically focusing on hygienic practices in milking equipment and utensils, washing animals and their body parts, washing hands of milkmen before milking, cleaning udders and teats before milking, mastitis care, clean water sources, milk adulteration, antibiotic use, vaccination, and deworming practices in the dairy farm premises.

Cleaning of Equipment and Utensils

Results revealed that only 8.89% of the farmers washed their dairy equipment with warm water, and 91.50% were washed with normal water. The present investigation exposed that approximately 94% of the farmers used clean water to freshen the milking pail, followed by sand and ash (3.5%) and detergent (2.58%). However, the farmers from HMA were found to use detergent (3%) for cleaning their milking pails, perhaps due to their more uplifted socioeconomic conditions.

Cleaning Animals, Their Body Parts before Milking and Milkmen Hygiene

In the case of farm hygiene, the results show that only 32.08% of farmers have washed their animals before milking, indicating that they usually do not follow proper hygienic milking practices during milking. In the summer, most farmers (67.92%) do not consistently bathe their cows before milking. The majority of farmers (96.92%) have not used this method, whereas just a small minority (3.08%) have washed the hind quarter before milking. Additionally, just 53.66% of dairy farmers have cleansed the udders and teats of cows before milking, whereas 46.34% have not. However, more LMA farmers (56%) were found to clean the udders and teats of cows before milking compared to HMA farmers (50 %).

The study assessed the practice of wiping the udder and teats after milking among farmers, with 88% expressing a preference for it, while 11.88% did not adhere to this system, indicating a significant preference for this practice among farmers. However, farmers of HMA practice more cleaning systems (90.75%) than farmers of LMA (88.25%). Only 0.67% of dairy farmers report teats dipping in sterile cream after milking. Many farmers asserted that sanitizers are costly, particularly when one has numerous milking animals, and they require trained personnel



to use. In HMA, milkmen were more likely to wash their hands before milking (94%), but this was less common with farmers in LMA (91%).

Awareness of Hygienic Care and Management on Cows and Milk

In the areas examined, the mastitis tests for the dairy cows of the respondents were categorized as regular and irregular. Most farmers (85.92%) were unaware of regular mastitis testing, while very few (14%) were willing to test. Nevertheless, in HMA, farmers were more likely to test for mastitis (15%), but this was less practiced by farmers in LMA (12%). The cleaning of dairy premises by using water from different sources, such as supply water, tube wells, and ponds, was evaluated in this survey. The maximum farmers from the responding areas used supplied water (87.50%), followed by 8.33 and 4.17 in tube wells and ponds, respectively. The study also analyzed the care against mastitis, vaccination, deworming, and antibiotics using pattern, adulteration using pattern and milk analysis among the dairy farmers in the selected areas in Bangladesh. Only 14.58% of the farmers who responded to the survey took precautions to prevent mastitis, compared to 85.42% of farmers who took no such precautions. In the studied regions, above 87.33% of the farmers maintained regular vaccination and deworming practices, while the vaccination and deworming were regularly practiced more for the farmers of HMA (90%) compared to the farmers in LMA (85%). Few farmers (7.58%) consistently utilized antibiotics in the responsive areas, while 92.42% of farmers did not regularly practice any form of antibiotics in their farms. Only a small percentage of farmers (7.92%) were aware of milk adulteration, while most farmers (92.08%) remained unaware of this issue. Furthermore, very few farmers (3.67%) in the investigated areas regularly test their milk safety parameters associated with its quality.

DISCUSSIONS

General and Dairy Information of Participant Farmers

The general descriptions of the 300 respondents of two surveyed broad areas in Bangladesh are depicted in Figure 1 (a, b, c, d). In these investigations, in two broad areas, there was significant gender distribution were found, where male participants (58.5%) surplus the female ones (41.50%) (Figure 1-a). Figure 1-b shows that, in both high and low milk producing surveyed areas, the highest number of respondents were observed in families with 45 members. The present findings were also more supportive of the results obtained by Marufatuzzahan et al. (2018) who found that 52% and 48% of males and females respectively were associated with dairy farming, and 43.44% of the people were family members ranging from four to five members. The present finding contradicts the results of some previous findings (Demissie et al., 2017), which indicated that approximately 94.2% of milk handling and marketing activities in the Gursum district of the Oromia Region, Ethiopia was predominantly carried out by women. The study found that male and female farmers were prevalent in the study areas. According to a study by Njarui et al. (2012), most farm families are headed by males over the age of 52, showing that young people make little contribution to dairy farming. Since dairy farming is a rather costly endeavor, it is possible that a portion of the low young participation can be attributable to a lack of access to capital (Wangalwa et al., 2016). In this study, the other 50% do farming besides their other businesses. Marufatuzzahan et al. (2018) provided evidence in support of those conclusions, and their findings were that main income, seasonal



business, main business, and family nutrition were 34.78, 21.74, and 43.48%, respectively. The surveyed results indicated that 21-23% had a higher educational background (Figure 1-c). The results are in line with those of Kuma et al. (2013), who claimed that the majority (58.3%) of milk producers in the pastoral community of Borana areas lacked education.

Farmers of LMA had slightly higher (23%) secondary educational background than HMA (21%). Marufatuzzahan et al. (2018) substantiated the aforementioned findings, wherein the observed outcomes were categorized as primary (26%), secondary (17%), higher (22%), and none (35%). This could be since everyone now has access to education (Wangalwa et al., 2016). The respondents in the research area had dairy herd sizes ranging from 6 to 22, the numerical category with the highest proportion, whereas the lowest proportion was a herd size with more than 22 individuals (Figure 1-d). In the HMA, farmers possess 6-10 numbers of cattle with slightly higher percentages (61%) compared to LMA. Marufatuzzahan et al. (2018) discovered a similar conclusion for herd size (2-6) with 69.57%, which corroborated the present findings. In a study conducted by Sayeed et al. (2020), it was found that there were variable outcomes regarding the herd size of milch cows on farms. Specifically, approximately 37.2% of farms had a herd size ranging from 3 to 4, 35.9% of farms had a herd size of 2 or less, and 26.9% of farms had a herd size of 5 or more, which is significantly less than the study conducted by Sayeed et al. (2020) and higher than the study conducted by Hossain et al. (2005), which found that 44% and 17% of dairy farmers, respectively, received training while farmers from LMA received the least, with only 12.5% having a good income. Previous research by Marufatuzzahan et al. (2018) found that low, middle, and high income were 43.48, 34.78, and 21.74%, respectively.

Milking and Milk Handling and Management Practices Adopted by Dairy Farmers

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Milking Hygiene, Methods, Places, and Scientific Milking

The results showed that about 77-83% with an average 80% of farmers milked their cows by maintaining hygienic conditions, and 19-23% with an average 20% did not follow in both HMA and LMA. However, in LMA, farmers were found to have practiced more hygienic milking (83%) than farmers of HMA (77%). These results might have fluctuated due to the highest male farmers with lower cattle herd sizes in LMA than HMA (Figure 1), resulting from maximum efforts for hygienic practices. The findings indicated that farmers in the examined areas used both manual and automated milking methods, with the majority allowing physical milking (92.17%) rather than automated one (7.83%). The findings of Sreedhar et al. (2017) align with the results obtained in this study. The milking technique employed in their research involved three different methods: full hand milking, knuckling, and striping. The distribution of milking percentages for each method were as follows: full hand milking (21.66%), knuckling (78.34%), and striping (Sreedhar et al., 2017). In the studied areas, the farmers used both milking at the place of tethering and milking at a separate dry place. This study observed that most of the farmers (96-98%) milked the animals at the place of tethering, whereas only 2-4% milked in separate dry places. However, farmers of HMA practiced more milking at separate and dry places (4%) than farmers of LMA (2%). Consistent with this study, Sreedhar et al.



(2017) observed that the farmers milked their dairy at the place of tethering and milked at the separate and dry places at 65.83% and 34.17%, respectively.

Regarding cleanliness of the milking area, the investigation by Wangalwa et al. (2016) showed that only 22.2% had a clean milking area and 18.2% milked from very dirty areas. Since the shed remains dry and clean, farmers prefer to milk the animals there, although space constraints may also be a contributing factor (Sreedhar et al., 2017). The farmers studied used open-mouth buckets and scientific milking pails for milking their cows. Though the scientific milking pails have more benefits for obtaining hygienic milk, only 3.17% of farmers used them, whereas most of the dairy farmers (96.83%) used an open-mouth bucket during milking. Nevertheless, farmers of HMA practice used more scientific milking pails (4%) than LMA (2.88%). Similar findings were reported by Patbandha et al. (2015) and Sreedhar et al. (2017), who found that most farmers (98.33%) milked their animals using open mouth buckets. Scientific milking pails have a top through which milk may easily pass into the pail, and through such a passageway, it is tense; hence, it is a healthier possibility for sterile milk making (Sreedhar et al., 2017). However, farmers from HMA regions (97%) used more scientific milking pails compared to others.

Frequency of Milking, Total Milking, and Calf Suckling

There was a marginally greater proportion of male dairy farmers (53.66%) who milked their cows compared to female dairy farmers (46.34%). The present study aimed to examine the calf suckling allowance in relation to milking procedures, specifically focusing on the periods before milking, after milking, and both before and after milking. The findings of the study indicated that a significant proportion (specifically over 71%) of dairy milkmen were observed to allow calf suckling both prior to and following milking. The phenomenon of parallel discoveries has been documented by Sreedhar and Sreenivas (2015), as well as Meena et al. (2007). However, it is noteworthy that a comparatively smaller percentage (only 15%) permitted calf suckling exclusively before milking, while an even smaller percentage (specifically 12%) allowed it solely after milking, whereas milkers of HMA were used more (73%) for allowing calf in both times compared to LMA (70%). Nevertheless, in the current research, many dairy farmers in the selected areas (95.75%) do not complete milking their cows after each individual milking. Sreedhar and Sreenivas (2015) noted comparable results with total milking being practiced (15.83) and not practiced (84.17%). A significant proportion (95.58%) of the farmers from HMA and LMA were observed to engage in the practice of double draining their cows within a single day (4.25%). Islam et al. (2020) observed similar findings and that all dairy farmers from HMA like Sirajgonj district of Bangladesh engaged in twice-a-day hand milking. According to Yilma and Faye (2006), more than 83% of crossbred cows received two daily milkings. The current results were approved by the findings of Duguma and Janssens (2015), and showed that all respondents practiced manual milking, with a frequency of two (88.9%), three (7.4%), and one (3.7%) milking per day.

Milk Consumption, Storage, and Handling

The study analyzed milk distribution for household consumption and market sales. Only 10% of milk producers used it for domestic consumption, while most farmers sold it in the market (90%); the rest of the farmers sold it in their surroundings (6%). The results suggest that a significant number of farmers are actively seeking to generate more income through milk sales. Bereda et al. (2013) reported inconsistent results, and 47-69% of the farmers in Ethiopia's Ezha



district claimed to consume milk for personal consumption. The food safety information provided by the respondents was categorized as either they were informed or not. Only 4% of individuals possessed knowledge regarding food safety issues, while a significant majority of 96% lacked any understanding pertaining to this subject matter. However, farmers of HMA were found to be more concerned (98%) about food safety issues compared to LMA (95%). This survey assessed the freezing storage and time of milk transfer from farms to market channels. Only 8.25% of farmers used storage systems under freezing conditions, where the maximum number of farmers were not stored (91.75%). In contrast to the current findings, Singh and Ramachandran (2020) reported that every consumer reported drinking milk after boiling and that nearly 70% of consumers refrigerated milk. However, due to the lack of storage, 89.58% of farmers sold milk within one hour after milking, followed by 6.58% and 3.83%, who sold milk within 1-2 and 2-4 hours, respectively. Uddin et al. (2022) supported our study, and the findings were about the storage and transportation of milk to the milk market.

Hygienic Milking Management and Handling Practices in Dairy Farm Premises

To obtain hygienic milk, the milking management and handling practices followed in dairy farm premises in the selected HMA and LMA are presented in Table 2. The study aims to examine management practices in dairy farms, specifically focusing on hygienic practices in milking equipment and utensils, washing animals and their body parts, washing hands of milkmen before milking, cleaning udders and teats before milking, mastitis care, clean water sources, milk adulteration, antibiotic use, vaccination, and deworming practices in the dairy farm premises.

Cleaning of Equipment and Utensils

Results revealed that only 8.89% of farmers washed their dairy equipment with warm water, and 91.50% were washed with normal water. The majority of the respondents, according to Singh and Ramachandran (2020), cleaned the barn twice daily and routinely scrubbed the utensils with supply water. Since the shed remnants were clean and dry, the farmers preferred to milk their animals in the same place. The other possible motive might be space limitations. As mentioned by Bonfoh et al. (2003) and Goksoy et al. (2020), milk quality is greatly influenced by the sanitary condition of the milking area and containers. According to Getachew (2003), the production of milk with good sanitary quality for customers involves proper hygienic practices (clean milking tools, washing milkers' hands, cleaning udders) during milking and handling, before distribution to consumers or processors. Using clean water, detergent, sand, or ash to clean milking pails is another method of keeping farm premises clean. The farmers in the study areas employed the aforementioned cleaning supplies. The present investigation exposed that approximately 94% of the farmers used clean water to freshen the milking pail, followed by sand and ash (3.5%) and detergent (2.58%). According to Amentie et al. (2016), milk handling equipment were commonly washed using warm water, detergent, and sand. A possible cause of the cleaner's less frequent operation might be the price of detergent. However, the farmers from HMA were found to use detergent (3%) for cleaning their milking pails, perhaps due to their more uplifted socioeconomic conditions.

Cleaning Animals, Their Body Parts before Milking and Milkmen Hygiene

In the case of farm hygiene, the results show that only 32.08% of farmers have washed their animals before milking, indicating that they usually do not follow proper hygienic milking



practices during milking. In the summer, most farmers (67.92%) do not consistently bathe their cows before milking. Similar findings were stated by Depiazzi and Bell (2002), and the pre-milking udder preparation and teat sanitation play an important part in the microbial load of milk, infection with mastitis, and environmental contamination of raw milk during milking. The washing of the udder, teats, and hindquarters before milking in the questioned areas was assessed. The majority of farmers (96.92%) have not used this method, whereas just a small minority (3.08%) have washed the hind quarter before milking. Similar results were found in previous research (Ahirwar et al., 2010; Patbandha et al., 2015; Sreedhar et al., 2017), which revealed that most farmers skipped washing the hind quarter before milking. This suggested that the farmers are unaware of the potential for contamination from urine, feces, and vaginal discharges (Sreedhar et al., 2017). Additionally, just 53.66% of dairy farmers have cleansed the udders and teats of cows before milking, whereas 46.34% have not. However, more LMA farmers (56%) were found to clean the udders and teats of cows before milking, compared to HMA farmers (50%). Similar results were found in a previous study by Shanta et al. (2021) which found that 32.9% of the respondents used ordinary water to wash their udders and teats and that 67.0% of the respondents did not wash their udders before milking. In contrast with the present findings, Ahirwar et al. (2010) and Islam et al. (2012) also reported that more than ninety percent of farmers practiced washing the udder and teats before milking. The production of milk of good hygienic quality for consumers requires good hygienic practices, such as clean milking utensils, washing milker's hands, cleaning udder, and use of individual towels during milking and handling, before delivery to consumers or processors (Azeze & Haji, 2016). These results were alike with the earlier findings by Duguma and Janssens (2015) and Yilma and Faye (2006), and the findings were that 79-90% of the farmers washed the udder before milking. Consistent with this study, Wolde and Jimma (2014) reported that 93% and 77% of the farmers in Wolayta Sodo, Ethiopia, washed their hands and udders before milking, respectively.

The study assessed the practice of wiping the udder and teats after milking among farmers, with 88% expressing a preference for it, while 11.88% did not adhere to this system, indicating a significant preference for this practice among farmers. However, farmers of HMA practice more cleaning systems (90.75 %) than farmers of LMA (88.25 %). In contrast to the present findings, Singh and Ramachandran (2020) reported that only 80% of the respondents cleansed the udder before milking and only 2% of the respondents dipped the teats after milking. Deng et al. (2015) in Ethiopia showed that washing udder was not practiced by 95.17% of the households, which increases the susceptibility of infection. The application of antiseptic lotion to the teats following the milking process was observed to be both practiced and not practiced among the respondents. Only 0.67% of dairy farmers report teats dipping in sterile cream after milking. This shows that many dairy farmers may not be aware of the consequences of teat dipping in sterile cream, such as bacterial or virus contamination. These results concur with those of Wangalwa et al. (2016), who noted that a notably high proportion of milkers do not use any hand sanitizer when washing their hands before milking and when cleaning the udder. This might lower the quality of milk produced in those circumstances. Many farmers asserted that sanitizers are costly, particularly when one has numerous milking animals, and they require trained personnel to use. Additionally, cleaning would be a time-consuming and hard operation (Wangalwa et al., 2016). Before milking, milkmen were observed either washing their hands or not, which is another aspect of milkmen's well-being. Approximately 92.92% of dairy farmers engaged in the practice of hand washing prior to milking, whereas a little over 7.08% abstained from this hygienic measure. These results were like the earlier findings by Duguma



and Janssens, (2015), and the findings were that 85.9% of the farmers washed their hands before milking. In HMA, milkmen were more likely to wash their hands before milking (94%), but this was less common with farmers in LMA (91%).

Awareness of Hygienic Care and Management on Cows and Milk

In the areas examined, the mastitis tests for the dairy cows of the respondents were categorized as regular and irregular. Most farmers (85.92%) were unaware of regular mastitis testing, while very few (14%) were willing to test. Nevertheless, in HMA, farmers were more likely to test for mastitis (15%), but this was less practiced by farmers in LMA (12%). Wangalwa et al. (2016) reported that a high proportion of farmers (77.5%) did not test the milk for mastitis, which is similar to the present findings. This might be due to the higher price of the mastitis test kits and reagents. Contrary to this study's findings, Stanly (2012) and Duguma and Janssens (2015) found that farmers in Ethiopia and Malawi were less concerned about mastitis than they were about other milk-borne illnesses, while Shanta et al. (2022) surveyed dairy farmers in Bangladesh's Bhaghabarighat Milk Shed areas, high milk producing areas, and reported that among the respondents, knowledge levels for milk-borne zoonoses for brucellosis, anthrax, tuberculosis, mastitis, and diarrhea were 4.5%, 9.2%, 17.4%, 54.84%, and 82.1%, respectively. Ensuring a sufficient and uncontaminated water supply is a crucial requirement for maintaining proper hygiene in milk production and farm sanitation. The cleaning of dairy premises by using water from different sources, such as supply water, tube wells, and ponds, was evaluated in this survey. The maximum farmers from the responding areas used supply water (87.50%), followed by 8.33 and 4.17 in tube wells and pond, respectively. In a study by Shanta et al. (2021), similar results were found and it was reported that 66.7% and 33.3% of dairy producers used piped water and tube well water to their dairy sheds, respectively. Similar findings were made by Wolde and Jimma (2014), as well as Duguma and Janssens (2015), who stated that 70-80% of dairy farmers in Ethiopia have access to clean water for cleaning dairy establishments. A study by Hasan et al. (2022) found that tube wells were the safest water source, accounting for 86.67% of the total, while harmful sources like ponds and rivers constituted 13.33%. The primary water source used in milking was springs due to their high availability, as supported by Njarui et al. (2012) and other studies.

The study also analyzed the care against mastitis, vaccination, deworming, and antibiotics using pattern, adulteration using pattern and milk analysis among the dairy farmers in the selected areas in Bangladesh. Only 14.58% of the farmers who responded to the survey took precautions to prevent mastitis, compared to 85.42% of farmers who took no such precautions. Duguma and Janssens (2015) reported that 42.6% farmers were aware of mastitis as a cattle zoonosis. The supply of fresh water and the maintenance of regular vaccination and deworming practices are very essential for good dairy farming. In the studied regions, above 87.33% of the farmers maintained regular vaccination and deworming practices, while the vaccination and deworming were regularly practiced more for the farmers of HMA (90%) compared to the farmers in LMA (85%). Quddus (2013) supported our study, and the findings were that 50% farmers took preventive measures and vaccination, and 30% farmers used veterinary doctors to treat their cows. The prohibition of antibiotic usage on farm premises primarily stems from the growing concern about the emergence of antimicrobial drug-resistant microorganisms. The utilization of adulterants in milk poses a significant challenge to ensuring the safety and quality of the product for consumers. Few farmers (7.58%) consistently utilized antibiotics in the responsive areas, while 92.42% of farmers did not regularly practice any form of antibiotics in their farms. Only a small percentage of farmers (7.92%) were aware of milk adulteration, while



most farmers (92.08%) remained unaware of this issue. Furthermore, very few farmers (3.67%) in the investigated areas regularly tested their milk safety parameters associated with its quality. Rahman et al. (2012) observed that about 34.7% farmers used beef fattening tablets in the rural area of Dinajpur district. Islam et al. (2012) reported that among the respondents, 70.6% used anabolic steroids as a growth promoter and the rest of them did not use any kind of growth promoter.

CONCLUSIONS

In conclusion, the dairy farming sector is dominated by men (57-60%), having family size 4-5, with most farmers aged 52-62 and 35-45 years old, and farming is their principal source of income. A significant portion of farmers lack formal schooling, but at least half have completed high school, giving them a moderate level of education. Herd sizes range from six to ten animals in 56-61% of cases. In the study, only 22.67% of farmers received training before starting a dairy farm. Over two-thirds of farmers make a modest living, and 77-83% milk their cows by hand. Most milkers use an open-mouth bucket when milking, and a significant percentage double-drain their cows in a single day. Farmers in high milking areas are more concerned about food safety issues than those in low milking areas. In freezing conditions, only 8.25% of farmers use storage methods, and 89.58% sell milk within an hour of milking due to storage shortages. Milking pails are cleaned using clean water, detergent, sand, or ash. Most farmers do not wash their cows before milking, suggesting they do not follow hygienic milking procedures. The cleanliness of the udder, teats, and hindquarters prior to milking is not followed by most farmers, with 96.22% not trying this strategy. Only 53.66% of dairy farmers wash their cows' udders and teats after milking, who may not be aware of potential contamination from dipping teats in sterile cream. Regular mastitis testing is unknown to many farmers, with only 15% testing for mastitis in low milking areas. However, there were gaps in practices, such as mastitis prevention and knowledge about antibiotics and milk safety. The study suggests that training programs on improved milking management procedures can help farmers to produce clean and hygienic milk, increase dairy animal production, and enhance farming income to meet the changes regarding food safety issues.

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FIGURES

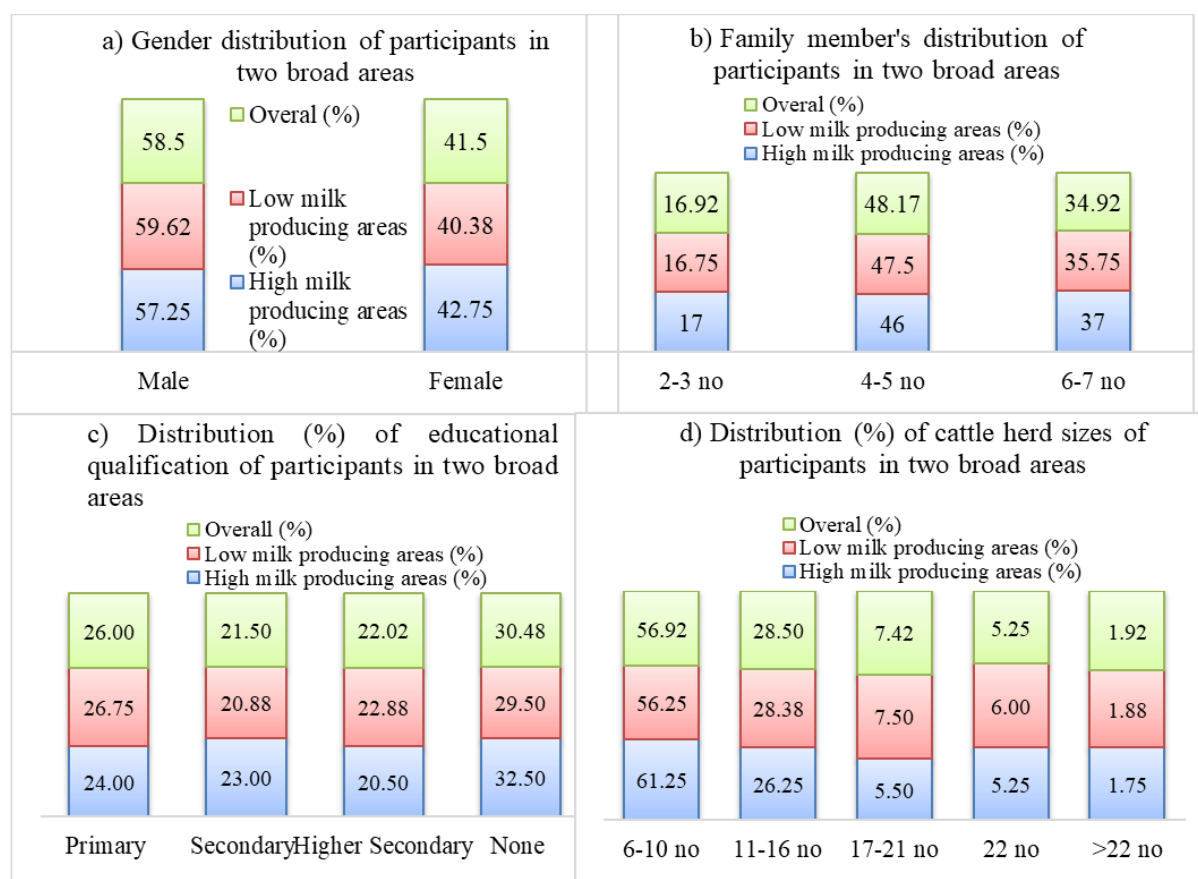


Figure 1: General description (%) of the farmers participated in the survey of selected areas of Bangladesh. There were 300 participants from 12 districts categorized two broad high and low milk producing areas. The figure depicted gender (a), family members (c), educational qualification (d), and cattle herd size (d) distribution of farmers those were given their farming information.

Table 1: Milk and hygienic milking and handling practices adopted by dairy farmers in different regions of Bangladesh

Items	Categories	HMA % (n)	LMA, % (n)	Overall, % (n)
Milking	Hygienic	76.75(77)	82.87(165)	80.77(242)
	Unhygienic	23.25(23)	18.37(35)	19.23(58)
Milking method	Manual	92.25	92.13	92.17
	Machine	7.75	7.875	7.83
Place of milking	Milking at the place of tethering	96.25(96)	97.75(195)	97.25(292)
	Milking at the separate and dry place	3.75(4)	2.25(5)	2.75(8)



Type of milking pail	Open mouth bucket	96.25(96)	97.13(194)	96.83(290)
	Scientific milking pail	3.75(4)	2.88(6)	3.17(10)
Allowing calf suckling	Before milking	17.00(17)	14.00(28)	15.00(45)
	After milking	10.00(10)	13.00(96)	12.00(36)
	Both times	73.00(73)	70.50(141)	71.33(214)
Frequency of milking	Once	4.25(4)	4.50(9)	4.42(13)
	Twice	95.75(96)	95.50(191)	95.58(287)
Complete milking	Practiced	3.75(3)	4.50(8)	4.25(12)
	Not Practiced	96.25(97)	95.50(192)	95.75(288)
Milk consumption	Family consumption	9.50(9)	10.50(21)	10.17(31)
	Sold in market	90.50(91)	89.50(179)	89.83(169)
Wait before milk transfer	0.5-1 hour	88(88)	90.375(181)	89.58(269)
	1-2 hour	6.5(7)	6.625(13)	6.58(20)
	2-4 hour	5.5(6)	3(6)	3.83(11)
Sale of milk	Local market	77.50(77)	75.63(153)	76.33(231)
	Sweet maker	8.75(9)	9.00(18)	8.92(27)
	Home service	8.75(9)	8.50(17)	8.58(26)
	Local market	5.00(5)	5.6(12)	5.40(16)
Storage at milk	Freezing	9(9)	7.875(16)	8.25(25)
	Not stored	91(91)	92.125(184)	91.75(275)
Test milk safety	Regularly	2.25(2)	4.375(9)	3.67(11)
	Irregularly	97.75(98)	95.625(191)	96.33(289)

HMA (High Milk Producing Areas); LMA (Low Milk Producing Areas)

Table 2: Milk and milking management practices in different regions of Bangladesh

Items	Categories	HPA, % (n)	LMA, % (n)	Overall, % (n)
Washing dairy equipment	Warm water	8.00(8)	9.88(20)	8.89(27)
	Normal Water	92.00(92)	91.38(183)	91.11(273)
Cleaning of milking pail	Clean water	94.50(95)	93.63(187)	93.92(282)
	Detergent	2.00(2)	2.88(6)	2.58(8)
	Sand or ash	3.50(3)	3.50(7)	3.50(11)
Washing animals before milking	Yes	23.75(24)	36.25(73)	32.08(96)
	No	76.25(76)	63.75(128)	67.92(204)
Washing of hind quarter before milking	Followed	2.75(3)	3.25(7)	3.08(9)
	Not Followed	97.25(97)	96.75(194)	96.92(291)
Cleaning of udder and teats before milking	Yes	49.75(50)	55.625(111)	53.66(161)
	No	50.25(50)	44.375(89)	46.34(139)
	Practiced	94(91)	90.625(185)	92.92(279)



Washing the hands of milkman before milking	Not Practiced	6(9)	9.125(12)	7.08(21)
Wiping udder and teats after milking	Yes	88.25(91)	88.25(177)	88.25(265)
	No	11.88(9)	11.88(23)	11.06(35)
Teat dipping in antiseptic lotion after milking	Practiced	0.75(1)	0.63(1)	0.67(1)
	Not Practiced	99.25(99)	99.38(199)	99.33(299)
Care against mastitis	Followed	15(15)	14.375(29)	14.58(44)
	Not Followed	85(85)	85.625(271)	85.42(256)
Mastitis test	Regularly	15.00(15)	13.63(27)	14.08(42)
	Irregularly	85.00(85)	86.38(173)	85.92(258)
Water source	Water supply	88.75(89)	87(174)	87.5(263)
	Tube well	7.5(8)	8.75(18)	8.33(25)
	Pond	3.75(4)	4.375(9)	4.17(13)
Vaccination and Deworming	Regularly	90.25(90)	85.875(172)	87.33(262)
	Irregularly	9.75(10)	14.125(28)	12.67(28)
Antibiotics use	Regularly	9.5(10)	6.625(13)	7.58(23)
	Irregularly	90.5(90)	93.375(187)	92.42(277)
Adulteration	Yes	10.25(10)	6.75(14)	7.92(24)
	No	90.25(90)	93.25(186)	92.08(276)

HMA (High Milk Producing Areas); LMA (Low Milk Producing Areas)