



## Research Article

## Assessment of Dairy Farm Hygiene Manners linked to Sub-clinical Mastitis in a Selected Dairy-belt of Bangladesh

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Milk is an integrated dietary concern in Bangladesh because of nutritional and socioeconomic initiatives. Sub-clinical mastitis (SCM) is one of the major challenges in drying management due to multidimensional obstacles. Proper dairy hygiene is one of the best initiatives to minimize the risk of SCM. This cross-sectional study was designed to understand the dairy hygiene status in Bangladesh linking to SCM epidemiology. A total of 382 dairy farm data from Baghabari milk belt of Bangladesh were analyzed to understand hygiene practicing pattern, gap from standard and challenges for it. 61.5% of medium-sized farms outperformed others in terms of biosecurity. Around 50% farms were monitored by veterinarian but few practiced cattle hygiene (46.1%) and milkers' hygiene (49.5%) respectively. Among the environmental factors, above 95% farms were moderate to well-ventilated and lightened where most of the farms were highly humid with satisfactory waste management and fly controlling measures. In correlation analysis, a strong association was noted in the sociodemographic characteristics of dairy cow hygiene and very strong association among dairy cattle hygiene, milkers' hygiene and environmental factors. An effective and sustainable code of conduct for dairying management is highly needed not only for reducing sub-clinical mastitis but also promoting safe milk production in Bangladesh.

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## Introduction

Milk is recognized as a complete diet around the world due to its balanced nutritional composition (Bekuma and Galmessa, 2018) which is secreted from mammary glands composed with special types of secretory cells (Youssif et al., 2020). Mastitis is the pathological state that results from inflammation of the mammary gland caused by both internal and external factors (Kumar et al., 2020). Mastitis is a worldwide challenge not just in dairying but also finances (Contreras and Rodríguez, 2011). Mastitis is classified into two major forms as clinical and sub-clinical (Cobirka et al., 2020). In sub-clinical mastitis (SCM), no visual changes in udder but dramatically decreasing the milk yield was noted, which affect health, production performances, animal welfare, veterinary cares as well as farm economy (Ebrahimie et al., 2018; Haxhij and Wishart, 2022). Milk yield decreasing rate is about 100-500 kg per lactation per

animal in SCM and the incidence rate is more prominent in developing countries than the developed nations (Suárez 2017; MK 2017; Hossain et al. 2017).

Introduction of good dairy hygiene procedures are critical not just for managing SCM but also for addressing public health concerns. It improves the nutritional status with animal welfare standards and economic growth with the safe and quality milk production (Ebrahimie et al., 2018; Mogotu et al., 2022; Pal et al., 2018). Farm cleanliness can be described as being either quickly done but not perfectly or being done carefully and accurately. This includes checking the health of animal's udders and legs (Ibrahim et al., 2021).

In Bangladesh, now a days 221.89 ml/day/head milk is obtained where 250 ml/day/head is required (Ministry

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of Fisheries and Livestock, 2023). To meet up the gap, dairy industry in a uprising trend of entrepreneurship in Bangladesh (Akter et al., 2020). Mastitis, specially sub-clinical mastitis is one of the major obstacles in draying in Bangladesh as other developing nations (Hasan, 2021). In Bangladesh, few scientific research have been reported in recent years on the prevalence and risk factor identification, pathogen isolation, identification and molecular characterizations, understanding the detecting tool and therapeutics of sub-clinical mastitis (Siddiki, 2019; Sayeed et al., 2020; Bhuiyan et al., 2020; Islam et al., 2019; Arman et al., 2018; Meher et al., 2018; Nahian et al., 2018; Kabir et al., 2022; Hasan et al., 2022). But very few published literatures were focused on farm hygiene practice and its association with sub-clinical mastitis. Therefore, this study was carried out to determine the impact of farm hygiene practices with sub-clinical mastitis (SCM) in a major milk belt of Bangladesh.

## Materials and Methods

### Study design

This study was designed to conduct a cross-sectional questionnaire survey at Baghabari co-operative unit of Bangladesh Milk Producers' Co-operative Union Ltd. (BMPCUL) belongs to the bank of Baral river area under the Sirajgonj and Pabna district of Bangladesh. A well-organized questionnaire was prepared focusing on farm hygiene practices for face-to-face interview and piloted before conducting the survey for May to August, 2023.

### Sample size

The sample size was determined using the Raosoft sample size calculator (Raosoft, 2004) where minimum 378 respondent was needed with a 95% confidence interval.

### Scoring

The questionnaire was prepared focusing on major hygienic points of dairy farm after reviewing existing literature containing four sections as socio-demographics, cattle hygiene, milkers' hygiene and environmental factors.

The Socio-demographics section was made up of six questions comprising dairy farming involvement (self=1, others= 0), experience ( $\geq 16$  yrs= 3, 11-15 yrs = 2,  $< 10$  =1 and  $\leq 5$  yrs= 0), farm size based on cattle number (Jabbar et al. 2005) as small (1-3 cows)=0, medium (4-5 cows)= 1 and large ( $\geq 5$  cows)=2 respectively, biosecurity levels were scored as good (ensuring 81% or above of observing points) = 2, moderate (61-80%) = 1 and low = 0 (below 60%) in structures, conceptions and operations as well as regular vet care in disease management policy scored as 2 followed by self=1,

others=0. In this biosecurity section, good and moderate scores were considered as satisfactory where vet regulated farms were considered only. Overall satisfactory level was calculated by securing at least 60% (8.4 $\approx$  9 out of 14). The cattle hygiene section was embodied with six questions on udder health as well as hind leg hygiene (Erdem and Okuyucu 2019) as appearance (very clean=3, clean=2, dirt=1 and very dirt= 0), cleaning and drying in both udder and hind leg for pre and post milking (yes=1, no=0). Milkers' hygiene portion had six queries on hygienic manner in pre and post milking process (yes=1, no=0) and lubricant (yes=1, no=0). Environmental hygiene section focused on the environmental factors (ventilation, temperature, humidity, cleanliness of farm premises etc.) of dairy farms. Scoring as good = 2, moderate = 1 and low = 0 in ventilation (good= natural air flow+ sufficient number of fans, moderate= natural air flow+ limited number of fans, low= only natural air flow), light factors (good= sufficient natural light+ sufficient number of electric lights, moderate= sufficient natural lights, low= insufficient natural lights) and waste management (good= well-structured waste pit, moderate= waste pit without cover, low= a hole in the ground only) where temperature humidity index (high = THI  $\geq$  86, moderate =76-85 and low =  $\leq$  75 THI) scoring according to Karmakar and Das,2020 with slight modification (Karmakar and Das 2020). The temperature and humidity of surveyed farms were measured by a digital temperature humidity meter (UNI-T UT333S). More than trice scored highest (3) in waste disposal frequency followed by trice (2), twice (1) and rest (0) but fly trap with protective net surrounding the farm was considered as high score (3) in fly control abide by fly trap (2) in moderate and none in low. A cumulative satisfactory score for each section was determined by comprising all the responses of queries where 60% score was the minimum requirement for considering as satisfactory output.

### Mastitis (clinical and sub-clinical) detection

Clinical mastitis cases were diagnosed by the presenting of typical inflammatory lesions such as swelling, heat, hardness, redness, or pain with watery appearance of milk, flakes, clots, or pus at udder and teats during the survey period. Sub-clinical mastitis cases were diagnosed by the protocol and interpretations stated by Kabir et al. (2022), where California Mastitis Test (CMT) was used to diagnose the cases ( Kabir et al., 2022).

### Data analysis

Data from questionnaire survey were entered and analyzed by using Statistical Package for the Social Sciences (SPSS) version 21 (International Business Machines Corporation, New York, United States).

**Results**

Socio-economic characteristics is the initial components of hygiene management of a farm. It's a broad term consisting of multidimensional activities including animal, associated human, biosecurity status, environmental affairs etc. Each component also includes a lot of target points. Data were collected from 382 dairy farms. The analysis showed that all the farms were semi-intensive with cross-bred cows that produce an average of 5. 24 liters of milk. Around 63% farmers were completely dependent on dairying with a longer period (35.1%, >16 years). Here medium sized farms were prominent (61.5%) with moderate level biosecurity practices. Out of all the farms that were asked, about half of them got help from veterinarians to take care of their animals, while the other half relied on their own knowledge and other farmers to look for and treat mastitis. In all the cases, mastitis was detected through physical changes of udder and intramuscular infusion of antibiotic was treatment strategy they followed where they (100%) were willing to complete

the course duration of antibiotics instead of maintaining of withdrawal period. The descriptive data was represented in Table 1.

Dairy cattle hygiene includes a lot of points such as udder hygiene, hind leg hygiene, milking hygiene etc. Udder and hind leg hygiene were scored according to four scale (Schreiner and Ruegg, 2003; Patel et al., 2020; Ibrahim et al., 2021) where data were representing in 56.5% clean for udder and leg respectively. Only 49.2% of udders were cleaned before milking with water or cleaning agent like chlorine water. None were practicing udder drying before milking and post milking hygiene manners as udder cleaning and drying as well as hind leg hygiene practices. Cattle were not allowed to sit in the ground for half an hour after milking. Milkers' hygiene means the hygienic management of milkers' hand in pre and post milking process. Around 50% milker wash their hands before milking. Nearly 95% of farms using lubricants where mustard oil (81.9%) ranked top. The hygiene status of cattle and milkers were presented in Table 2.

**Table 1. Socio-economic characteristics of dairy farms (N=382)**

Socio-economical characteristics	Variants with score	Descriptives (f, %)	95% CI	References
Dairy farm management	Full time involvement (1)	241, 63.1	57.9-67.3	
	Dependent with labor or family (0)	141, 36.9	32.7-42.1	
Dairy farming experience	≥ 16 years (3)	134, 35.1	30.1-40.1	
	11-15 years (2)	112, 29.3	24.5-34.0	
	6-10 years (1)	62, 16.2	12.8-23.7	
	1-5 years (0)	74, 19.4	16.0-23.7	
Farm size	Large (2)	95, 24.9	21.1-29.1	(Jabbar et al., 2005)
	Medium (1)	235, 61.5	56.3-66.1	
	Small (0)	52, 13.6	10.1-17.1	
Biosecurity status	Good (2)	84, 22	18.2-26.3	(Renault et al., 2021)
	Moderate (1)	232, 60.7	55.8-65.4	
	Low (0)	66, 17.3	13.6-21.5	
Structural biosecurity	Good (2)	129, 33.8	29.3-39	
	Moderate (1)	195, 51.0	46.1-55.9	
	Low (0)	58, 15.2	11.6-18.8	
Operational biosecurity	Good (2)	123, 32.2	27.7-36.8	
	Moderate (1)	202, 52.9	48.1-58.1	
	Low (0)	57, 14.9	11.3-18.3	
Regular veterinary care for mastitis detection and management	Vet. (2)	185, 48.4	43.3-53.7	
	Self (1)	102, 26.7	22.3-30.6	
	Other (0)	95, 24.9	20.4-29.1	

\* f= frequency, %= percentage, CI= confidence interval

**Table 2. Status of dairy cattle and milkers' hygiene in the surveyed farms (N=382)**

Hygienic status	Observing points	Variants with score	Descriptives (f, %)	95% CI
Cattle hygiene	Udder appearance	very clean (3)	0	-
		Clean (2)	216, 56.5	51.6-61.5
		Dirt (1)	108, 28.3	24.2-33.1
		very dirt (0)	58, 15.2	11.4-18.8
	Hind leg appearance	very clean (3)	0	-
		Clean (2)	216, 56.5	51.6-61.5
		Dirt (1)	108, 28.3	24.2-33.1
		very dirt (0)	58, 15.2	11.4-18.8
	Udder cleaning before milking	Yes (1)	180, 47.1	42.3-52.0
No (0)		202, 52.9	48.0-57.7	
Milkers' hygiene	Hand cleaning before milking	Yes (1)	188, 49.2	44.4-54.6
		No (0)	194, 50.8	45.4-55.6
	Lubricating agent before milking	Commercial lubricant (1)	32, 8.4	5.7-11.4
		Mustard oil (1)	313, 81.9	77.5-85.9
		Coconut oil (1)	21, 5.5	3.4-7.9
		None (0)	16, 4.2	2.4-6.3

\* f= frequency, %= percentage, CI= confidence interval

Farm environment involves taking care of the air, water, and waste on the farm. This includes making sure there is enough air and light for the animals, keeping the water clean, and managing waste properly. Information about the environment was gathered in Table 3. In this place, 54. 5% of farms had some air flow, but the air was very wet (52. 9%) and not very bright (58. 6%). The waste management system followed was fairly well,

with different frequencies of waste disposal. Therefore, the control point for flying objects like mosquitoes, flies were not good enough (50. 7%).

Only subclinical mastitis was detected in 67% of farms whereas, in 23% of farms showed both clinical and subclinical mastitis (Table 4).

**Table 3. Environmental factors in dairy farm hygiene manners (N=382)**

Environmental points for farm hygiene	Variants with score	Descriptives (f, %)	95% CI
Ventilation	Good (2)	168, 44.0	38.9-49.2
	Moderate (1)	208, 54.5	49.5-59.7
	Low (0)	6, 1.6	0.5-2.9
Temperature humidity index (THI)	High (2)	202, 52.9	47.6-57.9
	Moderate (1)	51, 13.4	9.7-16.9
	Low (0)	129, 33.8	29.2-38.5
Light	Good (2)	96, 25.1	21.1-29.2
	Moderate (1)	224, 58.6	53.6-63.7
	Low (0)	62, 16.2	12.6-19.7
Waste management	Good (2)	90, 23.6	19.4-28.1
	Moderate (1)	252, 66.00	60.9-70.7
	Low (0)	40, 10.5	7.5-13.6
Waste disposal frequency	More than trice (3)	52, 13.6	10.0-16.8
	Trice (2)	265, 69.4	64.9-74.3
	Twice (1)	33, 8.6	5.8-11.6
	Not specific (0)	32, 8.4	5.8-11.0
Fly control	High (2)	84, 22.00	17.8-25.9
	Moderate (1)	148, 38.7	34.0-43.6
	Less (0)	150, 39.3	34.4-44.5

\* f= frequency, %= percentage, CI= confidence interval

**Table 4. Status of mastitis in surveyed dairy farms (N=382)**

Mastitis status	Variants	Descriptives (f, %)	OR (95% CI)	Standard
Prevalence of mastitis	CM along with SCM	87, 22.8	18.3-27.0	(Kabir et al. 2022)
	SCM (>30%)	208, 54.5	49.5-59.4	
	SCM (<30%)	87, 22.8	18.8-27.1	

\* f= frequency, %= percentage, CI= confidence interval

\* \* All the farms (100%) are suffering from SCM.

In the scoring of surveyed dairy farms, 27.7% of farms scored as satisfactory output for socio-demographics. 46.1% farms followed measures on cattle hygiene and 49.5% farm owners were concerning on matters related to milkers' hygiene. In environmental factors, around 91% farms were secured for favorable conditions for

dairying. Satisfactory level scale was fixed with considering positive approaches of farmers to strengthening the hygienic components such as farm structure, animal welfare, milking patten, waste management and related factors of dairying practices in Bangladesh (Table 5).

**Table 5. Farm hygiene scoring of surveyed dairy farms (N=382)**

Observation results	Socio-demographics (f, %, 95% CI)	Cattle hygiene (f, %, 95% CI)	Milkers' hygiene (f, %, 95% CI)	Environmental hygiene (f, %, 95% CI)
Satisfactory	106, 27.7, 23.3-31.9	176, 46.1, 41.5-50.9	189, 49.5, 44.7-54.6	347, 90.8, 88.2-93.5
Unsatisfactory	276, 72.3, 68.1-76.7	206, 53.9, 49.1-58.5	193, 50.5, 45.4-55.3	35, 9.2, 6.5-11.8

\* f= frequency, %= percentage, CI= confidence interval

## Discussion

Effective strategies for mastitis control must include methods of preventing the onset of new infections and eradicating existing infections. The key sources of exposure for environmental mastitis infections include moisture, mud, and manure present in the cow's environment, and cleanliness scores of cows provide obvious indications of exposure to these possible sources. A good hygiene practice in dairy farm initiates the safe and high production of milk (Mogotu et al., 2022; Singh and Ramachandran, 2020). Poor hygiene practice introduces a suitable environment for introducing and multiplying of pathogens of different diseases (Deshpriya et al., 2017; Debela, 2015).

In our observation, very few dairy farms in Bangladesh followed the proper hygiene manners where all have good knowledge. Traditional milking patterns, sub-tropical climatic effect, improper cattle-milker ratio, communication drawback. May initiate obstacles to maintain the good standard of dairy hygiene. Recent research on the same trend were revealed the similar observations maintaining and leg hygiene, feeding and watering, milkers hygiene, milking techniques, farm environment, waste management and etc.(Biswas and

Sarker, 2017; Kabir et al., 2017; Arman et al., 2018; Hasan et al., 2017; Meher et al., 2018; Shanta et al. 2021; Hasan et al., 2022) To produce safe and appropriate milk and milk products, effective handling techniques during milking are a crucial and essential component. Failing to uphold proper sanitation procedures has been proven to play a part in the contamination of milk with harmful microorganisms, chemicals, or physical risks. Though a number of factors can easily affect the quality of dairy products, the performance of milking operations and the cleanliness of the milking utensils and equipment are the two main ones (Gonfa et al., 2001). Because of the additional bacteria introduced by poor cleanliness, milk spoils very quickly.

The correlation table (Table 6) represents the mathematical association among the different hygiene components of dairy farms in terms of correlation coefficients (<sup>a</sup>). In two tailed test results, <sup>b</sup> expressed the level of significance of correlation coefficient (<sup>a</sup>) results. All the farms had cows with a mild form of mastitis, so we couldn't include this data in our calculations because it would cause a statistical error.



**Table 6. Pearson correlation among different dairy hygiene components**

Criteria considered	Scores			
	1	2	3	4
1. Socio-demographics	1			
2. Cattle hygiene	0.107 <sup>*a</sup>	1		
	0.036 <sup>b</sup>			
3. Milkers' hygiene	0.217 <sup>**a</sup>	0.934 <sup>**a</sup>	1	
	0.00 <sup>b</sup>	0.00 <sup>b</sup>		
4.Environmental hygiene	0.197 <sup>**a</sup>	0.294 <sup>**a</sup>	0.314 <sup>**a</sup>	1
	0.00 <sup>b</sup>	0.00 <sup>b</sup>	0.00 <sup>b</sup>	

<sup>a</sup> Correlation co-efficient <sup>b</sup> level of significance \*Correlation is significance at 0.05 level \*\*Correlation is significance at 0.01 level (two tailed test)

In correlation analysis, a strong relation has been expressed in between cattle hygiene and socio-demographics at 5% level of significance where milkers' hygiene and environmental hygiene sections were highly associated with cattle hygiene and milkers' hygiene respectively at 1% level of significance. All the hygienic components were intercorporate with each other.

In our observation, strong socio-demographics of farms initiated better hygiene practices which is fully merged (Raihan et al., 2017; Usman, 2018). In cattle and milkers hygiene concerns, good hygiene practice has no alternatives to combat against sub-clinical mastitis (Lamsal, 2018; Neculai-Valeanu and Ariton, 2022). In Geo-climatic factors, waste management and fly control may play a key role for reducing the occurrence of mastitis (Vieira et al., 2022; Zaki et al., 2010; Cheng and Han, 2020; Sato et al., 2008). High temperature humidity index can create a favorable environment for the growth of mastitis-causing bacteria. The heat-stress experienced by cows can weaken their immune systems, making them more susceptible to infections (Messeri et al., 2023; Vitali et al., 2020; Mandal et al., 2023). Proper waste management practices in dairy farms can reduce the environmental load of mastitis-causing pathogens. Clean and well-maintained housing and manure management systems can help minimize bacterial contamination (Kumar and Grover, 2017; De Vlieghe et al., 2018). Flies can act as mechanical vectors, transferring bacteria between cows and introducing pathogens into teat ends, increasing the risk of mastitis. Fly infestations can stress cattle, leading to immune system suppression and increased vulnerability to infections (Adeyemi and Oluyo, 2023; Arsenopoulos et al., 2018)

Reports interpret that improving of hygiene can be a good control strategy to prevent the incidence of sub-clinical mastitis in farm (Youssif et al., 2020; Lamsal, 2018; Neculai-Valeanu and Ariton, 2022; Fávero et al., 2015; Mukhamadieva et al., 2022). Generally, farm hygiene practice is described in the national code of

dairy farming. FAO have prepared a standard dairy farm guidelines focusing on the animal welfare and farm hygiene manner to promote safe milk production (Food and Agriculture Organization and International Dairy Federation 2011). Among the Indian subcontinent, India and Pakistan have the code of hygiene manners in dairying except Bangladesh (Kamboj et al., 2014) (IUCN Pakistan 2004). Though guidelines for farm waste management, Biosecurity guidelines for poultry species and approaching on judicial use of antibiotics have been existed in Bangladesh but monitoring activity is not visible across the country (Ministry of Fisheries and Livestock 2015, 2011; Ministry of Food, 2016). Farmers were not concerned about the guideline due to regulatory incoordination.

Dairy farm hygienic practices are directly linked to animal and consumers' health point of view as well as for further processing of milk and milk products. In general, the result of this study indicated that urgent measures are needed for a sustainable policy of good hygienic practices in dairy farms focusing on environmental factors. Veterinary extension service should be expanded from farm to farm for implementation of standard draying hygiene management not only to minimize SCM and associated diseases risk but also to promote safe milk.

#### *Limitation and strength of the study*

This study had several limitations. Firstly, the questionnaire survey was conducted within a small part of a division of the country for a specific period of the year. Secondly, the sample size was comparatively small. Fourthly, All the surveyed farms were suffering from sub-clinical mastitis. At best of our knowledge, this study was one of the first in Bangladesh, exploring the dairy farm hygiene components in relation to sub-mastitis management of the farms. It was the key strength of our study.

#### **Conclusion**

Dairy farms of Bangladesh are severely suffering from sub-clinical mastitis (SCM) due to lack of practicing

required dairy cattle and farmers' hygiene. Policy makers and regulatory authority should take proper steps for prepare the code of hygiene practice in dairy farms in context of Bangladesh and actions to implement it over the country for safe milk production.

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