STATUS OF MILK PRODUCTION AND SUBCLINICAL MASTITIS IN DAIRY COWS ALONG WITH SOCIOECONOMIC CONDITION OF THE FARMERS

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ABSTRACT

A cross sectional study was conducted to characterize the present situation of milk production, to identify the existing socioeconomic status of dairy farmers, and to determine the prevalence of subclinical mastitis (SCM) in dairy cows. A total of 229 smallholder dairy farms in the surrounding areas of Bangladesh Agricultural University were investigated during January to March 2015. Direct interview with farmers, and physical examination of the cows were done to collect farm and cow level data. It appeared that all of the farmers were involved in other occupations besides dairying, in which almost half of them (48.29%) belong to agricultural cultivation. Educational level of the most of the farmers was illiterate to primary level (68.5%). The average annual income of farm owners was Tk. 219109.17, of which around half of the total income comes from livestock. Average milk production of the farms was 7.73 L/day with a range of 0.5 to 305 L. Milk samples were collected from randomly selected 101 milking cows and were subjected to somatic cell count (SCC) by automatic nucleocounter machine. The overall prevalence of subclinical mastitis was 20.79%. The prevalence of subclinical mastitis was comparatively higher in Sahiwal cows (42.86%), cows that yield >5 to 10 L milk per day, and in late lactation stage (>180 days).

Keywords: Subclinical mastitis, somatic cell count, prevalence, dairy, socioeconomic status

INTRODUCTION

Agricultural economy of Bangladesh largely depends on livestock. Livestock contributes about 1.66 percent to national GDP (Gross Domestic Product) and shares 14.21 percent of agricultural GDP in 2015-16 (DLS, 2016). The smallholder dairy, through its economic contributions shares 18.6% of the animal farming GDP. Farmers get more than 50% of their annual income through dairy farming irrespective of their gender or land ownership, and on average milk of 0.85 L/day are available for a family that keeps dairy stock (FAO, 2013). The milk production in Bangladesh is 72.75 lakh metric ton whereas the demand is 146.91 lakh metric ton and deficiency is 74.16 lakh metric ton (DLS, 2016). Several disease problems occur in dairy animals which impede its milk production (Shamsuddoha *et al.*, 2000). Among these, mastitis is one of the most important diseases hampering the growth of the dairy sector by causing huge economic loss in dairy animals because of lower milk production, milk withdrawal following treatment, high treatment costs, labor, premature culling and death (Miller *et al.*, 1993).

Mastitis is a multi-etiological and complex disease, which is defined as inflammation of parenchyma of mammary glands. It is characterized by physical, chemical and usually bacteriological changes in milk, and pathological changes in glandular tissues (Radostits *et al.*, 2000). Major mastitis causing organisms are *Staphylococci* spp., *Streptococci* spp. and other gram-negative bacteria (Mubarack *et al.*, 2012). It is mainly categorized into clinical mastitis (CM) and subclinical mastitis (SCM). The signs of CM are inflammation of the udder and changes in milk (Kader *et al.*, 2003). In SCM, there are no visible abnormalities in the udder tissues and milk except an elevated somatic cell count (SCC) (MacDougall *et al.*, 2001). Subclinical mastitis is 15 to 40 times more prevalent than clinical mastitis and causes high economic losses in most dairy herds, and responsible for much greater loss to the dairy industry in Bangladesh (Kader *et al.*, 2003). Tripura *et al.* (2014) reported that the overall prevalence of SCM in lactating cows was 51.8% and 51.4% at Mymensingh sadar while Sarker *et al.* (2013) recorded 20.2% prevalence in the same region. The identified risk factors that influence the occurrence of SCM are age, parity, lactation stage, milk yield, breed, previous mastitis record, floor type, disinfection of fingers, teat dipping, etc (Doherr *et al.*, 2007; Karimuribo *et al.*, 2008; Madut *et al.*, 2009; Sarker *et al.*, 2013).

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For the diagnosis of SCM, various methods based on physical and chemical changes of milk are used (Batra and Mcallister, 1984; Emanuelson *et al.*, 1987). Among them, California mastitis test (CMT), and milk somatic cell count (SCC) are the effective indirect and direct screening tests, respectively (Sarker *et al*., 2013). SCC is a useful evocator of intramammary infection as well as an important component of milk quality assessment, hygiene and mastitis control. However, there is a huge lack of awareness among the dairy farmers about the proper control and management of SCM. Moreover, insufficient information is available about the prevalence of SCM and association of potential risk factors in dairy cows of Mymensingh area. In Mymensingh district, small and large scale dairy farms have been raising constantly. Especially, small income group of people has taken dairying as commercial enterprise. It is needful to know details about the performances of dairy breeds and management practices as well as the socioeconomic status of the dairy farmers to settle a future plan for dairy development in this region. Hence the study was conducted (i) to identify the present status of milk production along with the management aspects of small scale dairy farmers in surrounding areas of Bangladesh Agricultural University, (ii) to investigate the socioeconomic status of dairy farmers in that area, and (iii) to estimate the prevalence, and to find out the risk factors of subclinical mastitis in dairy cows of that area.

MATERIALS AND METHODS

Study area, animals and management
A cross sectional study was carried out during the period of January to March of 2015 at Mymensingh district, the north-east part of Bangladesh; which is located at longitude 90.45°E, latitude 24.70°N and altitude 15.52 m. In this study a total of 229 household dairy farmers having 365 milch cows were selected by random sampling from 9 villages. The dairy cattle were kept under different housing and management practices in the rural areas selected in, and surroundings of Bangladesh Agricultural University area. In this region, dairy cattle are mainly reared for milk and economic purpose.

Data collection
A semi structured questionnaire was developed to gather information on dairy management approaches and socioeconomic condition of dairy farmers at the selected areas. During the study, information about different variables (i.e. age, breed, lactation stage and milk yield) from individual animal was recorded by a questionnaire through farmers interview. The data were collected by *Magpi* android data collection application (Version-5.4.1) with Global Positioning System (GPS).

Sample collection
From the data of 365 lactating cows, 101 were selected randomly for subclinical mastitis test. The tip of a teat was mopped several times with sterile gauge soaked in 70% alcohol and allowed to dry. A few streams of fore-milk were discarded and 5-10 ml of milk sample from each cow was collected aseptically in sterilized screw-capped test tubes with tag. Milk samples were transported to the laboratory of the Department of Medicine, Bangladesh Agricultural University in ice boxes (approximately 4 ℃) and preserved at 4 ℃ until further laboratory analysis (usually within 24 hours of collection). The milk samples were prepared for somatic cell count according to the procedure described by Sumon et al. (2017) on the next day of sampling.

Detection of subclinical mastitis
In a study, it was appeared that SCC was the most reliable test and closest to the bacteriological results (Badiuzzaman *et al.*, 2015). So this study used SCC technique to test subclinical mastitis. The SCC (cells/ml) for the milk samples was determined using Nucleo Counter SCC-100 (Coulter electronic–Chemometec A/s, Denmark) following the protocol of Saleh and Faye (2011). In brief, mixing of the representative cell sample (milk) was done with equal volume (50µl) of lysis buffer. The Nucleo Cassette was loaded with the lysate solution after 30 seconds vortexing and then placed in the instrument, then pressed the "Run" key. After 30 seconds, the cell count was presented on the instrument display. The cows had SCC>200×10^3/ml were considered as SCM positive.

Data Analysis

The data were extracted from *Magpi* server as MS Access file. Data analysis was carried out using Epi Info™ (Epi Info™ is a trademark of the Centers for Disease Control and Prevention (CDC) used version 7.1.5.2) to generate descriptive statistics (frequencies/proportions) related to the farmer's education, occupation, annual income, dairy management, milk production status, treatment, disease prevalence, etc.

RESULTS AND DISCUSSION

Social attributes of farmers

The social status of the dairy farmers has been recorded at the time of investigation and presented in Table 1. It is observed that, almost half of the farmers (48.29%) involved in agricultural farming and additionally reared dairy cattle in small scale, and the rest were businessmen, labor, govt. employee, teacher and others (boatman, bricklayer, potter, tailor, shopkeeper and driver) and their proportion were 16.24%, 14.53%, 11.11%, 0.43% and 9.40% respectively. Farmers were further categorized based on their academic qualification in which 35.4% farmers had no formal education and of the rest farmers the percentage of primary level, secondary level, higher secondary level, diploma, degree and honors were 33.1%, 18.8%, 7.9%, 1.7%, 0.9% and 2.2 respectively. Previous researchers reported that 58-60% farmers were engaged in agriculture with livestock rearing (Siddiki *et al.*, 2015; Varaprasad *et al.*, 2013) and 57% of the farmers had business as their principal occupation (Khan *et al.*, 2010). Other studies found that 45% farmers were not educated (Siddiki *et al.*, 2015), but 17.62% (Hossain *et al.*, 2012) and 76% (Kabir, 1995) had primary level education. However, other studies revealed that nobody was found illiterate and 60% of the farmers had higher secondary level education (Khan *et al.*, 2010). These statistics may have been different because of geographical location and education facilities of the studied area.

The annual average household income was estimated to be Tk. 219100 of which, contribution of livestock was 50.53% whereas another study found only 17.59% from their livestock (Hossain *et al.*, 2012). The contribution of livestock to total household income for agricultural farmers, businessmen, labors, govt. employees, teachers and other farmers were 63.57%, 46.46%, 36.49%, 37%, 50% and 18.5%, and their annual gross average income were Tk. 218690, Tk. 325320, Tk. 133230, Tk. 232230, Tk. 120000 and Tk. 159450 respectively which expressed that agricultural farmers got maximum income from their dairy. A study reported that maximum farmers were belonged to medium income (Tk. one to four lac) categories (Amin *et al.*, 2015) that reveled to our finding.

Table 1. General information of small household dairy cattle farmers

Occupational status						
Occupation	(%)	Annual income ('000 Tk.)		Annual income from livestock ('000 Tk.)		
		Total	Average	Total	Average	%
Farmer (Agril.) (n=108)	48.29	23618	218.69	15015	139.02	63.57
Businessman (n=38)	16.24	12362	325.32	5743	151.13	46.46
Labour (n=34)	14.53	4530	133.23	1653	48.62	36.49
Govt. employee (n=26)	11.11	6038	232.23	2234	85.92	37.00
Teacher (n=1)	0.43	120	120.00	60	60.00	50.00
Others (n=22)	9.40	3508	159.45	649	29.50	18.50
Overall (n=229)		50176	219.10	25354	110.71	50.53
Educational status						
Qualification		No. of farmers		**%**		
No formal education		81		35.4		
Primary		76		33.1		
Secondary		43		18.8		
Higher secondary		18		7.9		
Diploma		4		1.7		
Degree		2		0.9		
Honours		5		2.2		

Overall farm management system

The study found that all farmers milked their cows manually and they cleaned their cattle house regularly except only one farmer. Majority of the farmers complained that poor availability of feeds and fodders was the principle problem in the area. That's why more than half of the respondents (56.8%) were found supplying a combination of concentrate (rice polish, wheat bran, broken rice, rice gruel, oil cake, til oil cake, mustard oil cake), grass and rice straw to their cattle, and 28.8% farmers added feed additive to increase milk production, though 57.64% farmers grazed their cattle in field. From Table 2, it is revealed that 53.3% farmers kept their cattle in concrete floor and the rest kept in soiled. Among them, 27.9% farmers used no bedding materials and majority (57.3%) used straw as bedding. However, gunny bag, saw-dust and ash also were used for bedding. All of the dairy farmers bath their cows at least once in a weak, and the cows were milked once a day in case of 79.5% farmers. The survey found that only 3 farmers who had no idea about colostrum feeding to calf, and only 6 farmers faced dystocia during the study time and at one year before. In the study area, artificial insemination was practiced by 83.4% of dairy farmers, but only 46.3% farmers met with Veterinary Surgeon for treatment purpose. About 21.8% of the farmers did vaccination against important diseases such Anthrax, Hemorrhagic Septicemia, Black Quarter, Tetanus, FMD and Rabies to keep the cattle free from disease outbreak. Overall management system of the farmers studied in this research is fully supported by (Khan *et al.*, 2010). Farming management is important because, higher prevalence of SCM is associated with dirty floor condition, cows bathed by pouring water, dirty udder and overall poor hygienic management which was reported by Islam *et al.* (2011). In our experiment, farms having earthen floor had considerably higher risks of subclinical mastitis than cows reared on concrete floor that corresponds with Kayesh *et al.* (2014).

Table 2. Overall management system in the selected small holder dairy farms

Parameter	Farmer (n)	(%)	Parameter	Farmer (n)	(%)
Feeding			Milking frequency		
Concentrate	01	0.4	Once daily	182	79.5
Grass	03	1.3	Twice daily	47	20.5
Straw	06	2.6	Colostrum feeding		
Concentrate + Grass	01	0.4	Yes	226	98.7
Concentrate + Straw	48	21.0	No	3	1.3
Grass + Straw	40	17.5	Floor Type		
Concentrate + Grass + Straw	130	56.8	Soiled	107	46.7
Bedding materials			Concrete	122	53.3
Gunny bag	21	9.2	Feed additive		
Saw-dust	01	0.4	Yes	66	28.8
Straw	131	57.3	No	163	71.2
Saw-dust + straw	06	2.7	Grazing		
Gunny bag + Straw	03	1.3	Yes	132	57.6
Ash + gunny bag	01	0.4	No	97	42.4
Ash + straw	01	0.4	Dystocia		
Ash + gunny bag + Straw	01	0.4	Farmer faced	6	2.6
No material	64	27.9	Farmer didn't face	223	97.4
Bathing frequency (weekly)			Service provided		
Once	163	71.2	Natural	38	16.6
Twice	27	11.8	Artificial	191	83.4
Thrice	08	3.5	Vaccination		
4 Times	05	2.2	Yes	50	21.8
5 Times	03	1.3	No	179	78.2
6 Times	00	0.0	Farmers go for treatment		
7 Times	23	10	Chemist	01	0.4
			Quack	100	43.7
Shed cleaning (daily)			Veterinary Surgeon(VS)	106	46.3
Once (regular)	167	72.9	Himself	03	1.3
Twice (regular)	43	18.7	Quack + VS	15	6.5
Thrice (regular)	18	7.8	Himself + VS	02	0.9
Irregular	1	0.4	Chemist + Quack	02	0.9

Milk production status

Demographic information of cattle population with milk status in the selected area are reported in Table-3. Total number of 1060 cattle population were found in the area at study period including calves (35.6%) followed by lactating cows (34.4%), dry cows (13.6%), heifers (10.9%) and bulls (5.2%). Cow milk production of BAU surrounding area was about 1770.75 L/day and average milk production of a household was 7.73 L/day, of which 88.85% of total milk were sold to local market at a price of about Tk. 50 per litre and daily total income of the farmers from selling milk was Tk. 81405. Most of the farmers (72.92%) have been used to both selling and consuming milk. Some farmers (14.41%) were rearing dairy cattle only to sell their milk and some (12.67%) only for consuming, and almost all of the farmers (94.3%) wanted to continue their small dairy farming. However, the average milk yield of SCM positive cows was 3.7 L while 3.8 L was in negative cows, which is in agreement with the findings of Sarker *et al.* (2013).

Table 3. Information of cattle and milk status in selected area

Distribution of cattle in selected area (n=1060)					
	Lactating cow	Dry cow	Calf	Heifer	Bull
n	365	144	380	116	55
%	34.4	13.6	35.9	10.9	5.2
Milk production Status					
	Milk yield (L/day)	Milk selling (L/day)	Milk consumed (L/day)	Income from selling milk daily (Tk.)	
Maximum	305	300	5	15000	
Minimum	0.5	0	0	0	
Average	7.73	6.87	0.86	355.48	
Total	1770.75	1573.25	197.5	81405	
Utilization of milk					
	Milk sell only	Milk consume only	Both sell & consume milk	Continue dairy farming	
Farmer (n)	33	29	167	216	
%	14.41	12.67	72.92	94.3	

Overall prevalence of SCM

Regarding SCC, results of subclinical mastitis are shown in Table-4. The association in prevalence of SCM in relation to difference among age, breed, amount of milk production and lactating stage was not significant (P>0.05) in our study. It appears from Table-4, the overall prevalence of subclinical mastitis was 20.79% in lactating cows which is strongly supported by the result of 19.9%, 20.2% and 21.9% overall prevalence of subclinical mastitis in lactating dairy cows which are reported respectively by Rahman *et al.* (2009), Sarker *et al.* (2013) and Qayyum *et al.* (2016). Lower prevalence that 16.3% was also reported in smallholder dairy farms of Zimbabwe (Katsande *et al.*, 2013). Other studies reported the overall prevalence was in range of 27.5% to 55% (Barua *et al.*, 2014; Kayesh *et al.*, 2014; Islam *et al.*, 2010; Islam *et al.*, 2011; Kathiriya *et al.*, 2014; Rabbani *et al.*, 2010; Ayano *et al.*, 2013; Rahman *et al.*, 2010; Siddiquee *et al.*, 2013; Tripura *et al.*, 2014; Shrestha *et al.*, 2012; Sanotharan *et al.*, 2016). On the basis of SCC the result of the study is not in conformity with the earlier findings of Badiuzzaman *et al.* (2015) and Östensson *et al.* (2013) who reported the prevalence of SCM was 66.67%, 71.9% and 88.6% respectively. These prevalence rates of SCM might be different due to geographical locations, difference of breeds of animals, management practices and the tests used for screening of the milk samples (Rabbani *et al.*, 2010; Barua *et al.*, 2014).

Table 4. Distribution of SCM in lactating cows in relation to different variables

Variables	No. of cows tested	No. of positive cows	Prevalence (%)	OR (95% CI)	P-value
Age (year)					
3-5	47	10	21.28	Reference	-
>5-10	48	11	22.92	1.1 (0.42-2.90)	0.847
>10	6	0	-	-	-
Breed					
Holstein Friesian	26	6	23.07	1.7 (0.37-7.84)	0.493
Jersey	2	0	-	-	-
Sahiwal	7	3	42.86	4.25 (0.61-29.45)	0.127
Cross	20	3	15.00	Reference	-
Indigenous	46	9	19.57	1.38 (0.33-5.74)	0.658
Milk Yield (Litre)					
<3	59	12	20.34	1.79 (0.20-15.95)	0.598
3-5	23	5	21.74	1.94 (0.19-19.74)	0.568
>5-10	11	3	27.27	2.62 (0.22-31.35)	0.435
>10	8	1	12.50	Reference	-
Lactating stage (days)					
0 to 60	30	4	13.33	Reference	-
>60 to 120	21	3	14.28	1.08 (0.21- 5.43)	0.922
>120 to 180	19	5	26.31	2.32 (0.53-10.06)	0.252
>180	31	9	29.03	2.66 (0.72-9.83)	0.134
Overall	101	21	20.79		

Prevalence of SCM in different ages

In this study, 21.28% cows of 3 to 5 years of age were positive to SCM test. This result corroborates with previous researches where 22.9%, 22.22% and 22.22% was reported as the prevalence of SCM in up to 5 years of aged cows (Siddiquee *et al.*, 2013; Islam *et al.*, 2011 and Kathiriya *et al.*, 2014). But at the same time, these findings are contradictory to our result because of almost same prevalence (22.92%) were recorded in cows between >5 to 10 years of age. However, several studies published earlier which reported the prevalence of SCM was increased with the advancement of age of cows (Islam *et al.*, 2010; Sarker *et al.*, 2013; Kayesh *et al.*, 2014 and Tripura *et al.*, 2014).

Prevalence of SCM in different breeds

It is observed from Table-4 that Sahiwal breeds were more vulnerable for SCM than the other breeds, and 23.07%, 15.00% and 19.57% prevalence were recorded in Holstein Friesian, Indigenous cross and Indigenous breed respectfully. Though highest prevalence (42.86%) was reported in Sahiwal breed the association of breed with SCM was non-significant in our study. Several studies were in agreement with this findings in past (Barua *et al.*, 2014; Islam *et al.*, 2010). Indigenous cows had prevalence of 19.57% in our study which was supported by other findings which reported 22.45% and 24.6% prevalence in local breed in Bangladesh (Kayesh *et al.*, 2014; Islam *et al.*, 2011). On the other hand, this study reported cross breed cows having 15% prevalence of SCM, but another study found 88.7% prevalence in cross breed (Sarker *et al.*, 2013) which is controversial.

Prevalence of SCM on the basis of milk production

The highest prevalence of subclinical mastitis based on daily milk yield was 27.27% that found in the cows produced milk within a range of >5 to 10 L daily, followed by less than 3 L (20.34%), 3 to 5 L (21.74%) and more than 10 L (12.50%). In the study, the prevalence of SCM was increased with higher milk production but lowest prevalence (12.50%) found in cows milked more than 10 L of milk which is consistent with the finding of 14.29% SCM (Rabbani *et al.*, 2010). Nevertheless, the results contradict to another study which revealed that the prevalence of SCM was significantly (p<0.05) higher (37.12%) in high (>10 L) yielding cows than low to medium yielders (Islam *et al.*, 2010).

Prevalence of SCM at different stages of lactation

It appears from the Table-4 that all the stages of lactation in dairy animals affected with SCM. The prevalence of SCM was recorded as 13.33%, 14.28%, 26.31% and 29.03% during the stages of <60 days, >60 to 120 days, >120 to 180 days and >180 days of lactation respectively. The highest prevalence (29.03%) of SCM was recorded during late lactation (>180 days) stage in dairy cows than early and mid-lactation which is in conformity with the earlier findings in which maximum prevalence (68.75%) was reported in last lactation stage in Holstein Friesian Cross cows (Rabbani *et al.*, 2010). The prevalence of SCM could be high at late stage of lactation due to long exposure time (Rabbani *et al.*, 2010) and followed with relaxed teat sphincters (Qayyum *et al.*, 2016). However, these results are contradicted that the highest prevalence (76.47%) of SCM was found at early lactation stage by SCC and lowest in mid and late lactation (Badiuzzaman *et al.*, 2015; Kayesh *et al.*, 2014; Ayano *et al.*, 2013)).

In conclusion, this study showed that the overall prevalence of subclinical mastitis was 20.79% in lactating cows and their breeds, level of milk yield and stages of lactation are the important host factors associated with the prevalence of SCM in cows. Considering all the studied parameters, it can be concluded that dairy farming is a profitable practice that may improve socioeconomic status. Hence, this study suggests that proper operation should be directed to develop management practices as well as awareness of SCM among the dairy farmers with a view to increase milk production.

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