

Buffalo Milk Yield, Quality, and Marketing in Different Agro-Climatic Districts of Bangladesh

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Abstract: The study was aimed at assessing the productive performance of dairy buffalo and milk marketing approaches in different agro-climatic districts of Bangladesh. Three (03) districts of Bangladesh viz. *Bhola*, *Mymensingh*, and *Dinajpur* were chosen from the coastal, river basin and semi-arid region, respectively. A triangulation method of survey was used to collect the data and the components of the triangle were buffalo farms, buffalo farmers and buffalo herdsmen. The investigation duration was twelve (12) months. The study revealed that the highest milk yield (5 L/h/d; $p=0.010$) was found in the river basin and semi-arid region. Lactation yield was also recorded double in the river basin and semi-arid districts compared to coastal districts ($p=0.000$). In the case of lactation length, the river basin buffaloes possessed 33 and 36% longer than coastal and semi-arid districts, respectively. All the chemical components were found significantly different ($p\leq 0.050$) but fat. Among different agro-climatic districts, about 92% of milk was traded in the coastal region after meeting the household's need but it was noted that the farmers from the semi-arid region kept more than 21% of milk for family consumption ($p=0.000$). The highest unit price (BDT 72/L) of milk was observed in the river basin district ($p=0.011$). In conclusion, the current situations of buffalo farming and milk marketing approaches in Bangladesh, varies considerably.

Keywords: Agro-climatic, dairy buffalo, milk yield, marketing.

INTRODUCTION

For years, buffaloes are extensively used for the agricultural production system in Bangladesh. Native buffaloes of Bangladesh belong to the *Bubalus bubalis* with most of the population are the riverine type with exception of some swamp type in the eastern part of the country. The crosses of Murrah, Nili-Ravi, Surti, and Jaffrabadi are frequently available around the Indian border of Bangladesh due to border migration [1,2]. However, the farmers keep buffaloes under extensive, semi-intensive and intensive management systems in coastal, river-basin and semi-arid areas in Bangladesh focus on the production of milk and meat along with drought power. Buffaloes are being considered as less prioritized dairy species in Bangladesh despite their important role in the national economy [3]. It is an important animal resource in the agricultural economy of many tropical and subtropical countries [4].

The world buffalo population (194.29 million) is dominated by Asia, representing 92.52% (179.75 million) of the total buffalo population [5,6]. South Asian countries represent about 79.74% of buffaloes and the rest of 20.26% in other countries. In Bangladesh, the total buffalo population is about 1.464 million of which coastal regions possess about 40% [1,7].

Milk composition is considered as an important attribute for both dairy farmers and the dairy industries with regards to payment and processing quality of the milk, respectively [4]. Milk yield and quality are influenced by different feed regimes, breeds, and environments. Feeding unfavorably affects not only the productivity, health, and welfare of animals, but also the milk composition. According to [6], milk composition attributed to breed, physiology of animal, environment, and management system. It was stated by [7] that various non-genetic factors like stage of lactation, season and parity in Surti buffaloes influenced the milk components. Milk production and reproductive performances of buffaloes are negatively impacted by temperature rise during summer and also by sharp temperature decline in winter. The high temperature causes stress due to increased body heat leading to low heat dissipation from the body surface. High heat load in lactating buffaloes reduces their milk production and shorten the duration of lactation periods [5].

Economic returns from dairy buffaloes depend on its lifetime performance [8]. But the productive performance of buffaloes could not reach its potential due to inadequate knowledge on husbandry practices, high feed cost and low milk price as those are regarded as first, second and third-ranked problems in Bangladesh with respect to buffalo milk production [9].

There are several investigations in Bangladesh demonstrated productive and reproductive

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performances, and management system of dairy buffalo under the extensive and semi-intensive system. However, to the best of our knowledge, there is very few information available about milk yield and quality under the different agro-climatic conditions as well as their marketing approach. Therefore, the present study was undertaken to envisage the productive performances of dairy buffalo and reveal the current marketing approaches of buffalo milk.

MATERIALS AND METHODS

Study Areas

Based on buffalo population density, three districts of Bangladesh viz. *Bhola*, *Mymensingh*, and *Dinajpur* were selected. These districts are from coastal, river basin and semi-arid agro-climatic region of Bangladesh, respectively. Geographical information of the study areas has been depicted in Table 1.

Data Collection

A triangulation method of survey was used to collect the data. The components of the triangle were buffalo farms, buffalo farmers other than those farms and buffalo herdsmen. A predesigned questioner was used to collect data on milk yield, lactation yield, lactation length, household consumption as well as milk marketing approach from 30 buffalo farms of each selected district. These were cross-checked and validated by using the obtained information from the other two components, buffalo farmers and herdsmen.

Milk Sampling and Chemical Analysis

Morning milk samples (15, 16 and 18 individual buffalo samples from coastal, river basin and semi-arid area, respectively) were collected and transferred to the laboratory maintaining a cold chain and placed the

samples at -20°C until analyzed. Only the samples from *Mymensingh* (river basin) were analyzed freshly. The milk composition was analyzed by using a Lactoscan milk analyzer (Milktronic Ltd., Bulgaria). All the samples were analyzed in triplicate.

Statistical Analysis

One way ANOVA was employed on milk yield, composition, price and use pattern to elucidate the regional variation. Data on milk marketing approach in different districts are presented by using descriptive statistics. For all these, SPSS (version 16) was used.

RESULTS AND DISCUSSION

Milk Yield

Variation in daily milk yield, lactation yield, lactation length stage of lactation, and lactation number, of the dairy buffaloes with regards to different agro-climatic districts (ACDs) of Bangladesh are summarized in Table 2. The buffaloes in coastal districts significantly ($p=0.010$) produce (2 L/h/d) less than half of the milk produced daily by buffaloes in the river basin (5.4 L/h/d) and semi-arid district (5.3 L/h/d; $p\geq 0.050$). Likewise, lactation yield of the river basin and semi-arid buffaloes ranged 1007 – 1085 L/h and differ non-significantly ($p>0.050$) but significantly ($p=0.000$) 2.3 times more than that of the coastal buffaloes. However, the lactation length of the buffaloes in the coastal and semi-arid area was statistically found similar (188 – 197 d; $p>0.050$), which was 96 - 105 days less than that of the buffaloes in river basin district ($p=0.021$). Milk yield in response to the stage of lactation also showed significant differences among the ACDs. The maximum yield was recorded in the river basin region in all three stages and at the third stage semi-arid area shares the ranking with river basin district. The peak milk yield was

Table 1: Agro-Climatic Information of the Study Areas

Items	<i>Bhola</i> (Coastal)	<i>Mymensingh</i> (River Basin)	<i>Dinajpur</i> (Semi-arid)
Location	22.6903°N 90.6525°E	24°34.5'N 90°23.5'E	26°0'0"N 88°35'0"E
Human population density	480/km ²	990/km ²	560/km ²
Type of farm	Extensive and Semi-intensive	Extensive and Semi-intensive	Intensive
Buffalo density* (% of total population)	40	30	25
Average Temperature (°C)	27.66	26.11	26.11
Relative humidity (%)	71	76	79
Climatic condition	Tropical wet and dry	Tropical wet and dry	Humid subtropical climate

*Indicates the buffalo density of coastal, river basin and semi-arid regions. Source: [1,7,31].

found in the second stage of lactation where the yield endured high from 90 to 180 days and then declines in the later stage of lactation. Notably, the average daily milk yield regarding the stage of lactation was recorded 4.28 L/h/d which is in agreement with the findings of [13]. It is evident that the lactation yield in the crossbred buffalo cows range of 800 to 1000 L [34]. It is worth to mention that similar results were obtained from the current investigation. Considering the number of lactation, the milk yield was varied among the ACDs. Milk production gradually increased as per the lactation number and the decreasing trend was noted for the advancement of lactation stages. Amongst the ACDs, the length of lactation varied from 188-197 days. The lactation length in dairy buffaloes is speckled from 279-282 days which was within the range of our findings (189-294) [9]. In addition, it was found that 286 days of lactation period in a similar type of buffaloes under extensive production system in *Mathbaria* and *Pirozpur* which was 290 days in *Pathorghata* and *Barguna* districts of Bangladesh [10]. The findings of this study are also supported by [11,12].

Chemical Composition of Milk

The proximate components of buffalo milk in different agro-climatic districts are presented in Table 3. The results revealed that the total solids (TS), solids-not-fat (SNF), lactose, protein and ash content significantly differed ($p < 0.05$) among the Agro-Climatic districts (ACDs). The highest TS (17%) was found in the semi-arid region compared to others. Fat content

was found non-significant ($p > 0.05$) among the ACDs and recorded within the range of 6.5 to 7.5%. A higher fraction of SNF was noted for the semi-arid region and river basin districts which were 1% higher than the coastal districts. But lactose and ash were found higher in the river basin (4.92% and 0.7%, respectively) region. The highest mean value for protein was found in the semi-arid area (4%) followed by others (3.64-3.72%). The present investigation regarding fat per cent was agreed with [14]. They recorded the fat content of buffalo milk within the range of 7.18 to 8.16% in *Noakhali Sirajgang*, *Potuakhali* and *Bagerhat* districts which were similar to our results. The protein, lactose, SNF and ash content of buffalo milk collected from different agro-climatic districts might be varied due to different feed regimes, breeds, and environments [13]. On feeding a balanced ration, milk fat increased by 6.3% to 6.6% in buffaloes [15]. Besides, the supplementation of minerals to the diet of lactating cows and buffaloes has been reported to enhance milk production and milk composition [16].

Buffalo Milk Marketing Approach and Household Consumption

The results relevant to milk marketing approach and household consumption were stated in Tables 4 and 5. The data obtained from milk trading, household consumption and unit price of milk were found significantly different ($p < 0.05$). The highest share of milk trading (92%) was found in the coastal region and the second highest in the river basin region. Therefore,

Table 2: Buffalo Milk Yield under Different Agro-Climatic Districts of Bangladesh

Variables	Coastal (n = 38)	River basin (n = 33)	Semi-arid (n = 35)	p-value
Daily milk yield (L/h/d)	2.18±0.63 ^b	5.41±1.92 ^a	5.25±1.33 ^a	0.010
Lactation yield (L/h/lactation)	428.91±124.28 ^b	1085.16±568.53 ^a	1007.28±252.36 ^a	0.000
Lactation Length(day)	197.44±29.06 ^a	293.93±18.22 ^b	188.67±13.06 ^a	0.020
Stage of lactation				
First stage (1 to 90 days)	2.38±0.68 ^c	5.53±1.24 ^a	5.29±1.69 ^b	0.000
Second stage (91 to 180 days)	2.60±0.93 ^c	7.23±1.71 ^a	6.85±2.11 ^b	0.001
Third stage (181 to 270 days)	1.57±0.70 ^b	3.47±0.93 ^a	3.62±1.30 ^a	0.001
Number of lactation				
First	2.10±0.71 ^c	3.27±1.95 ^b	4.80±1.69 ^a	0.021
Second	2.22±0.37 ^c	3.32±1.89 ^b	5.40±1.40 ^a	0.031
Third	2.02±0.47 ^c	4.08±2.00 ^b	5.40±1.25 ^a	0.012
Fourth	2.35±0.65 ^c	3.84±2.08 ^b	4.76±1.13 ^a	0.020

Means with different superscripts are significantly different. n, number of observations.

Table 3: Effect of Different Agro-Climatic Districts of Bangladesh on Buffalo Milk Composition

Variables (%)	Coastal area (n=45)	River basin (n=48)	Semi-arid (n=54)	p-value
TS	15.60 ^c ±2.55	15.91 ^{bc} ±1.47	17.08 ^a ±1.22	0.050
Fat	7.30 ±2.66	6.55 ±1.53	7.55 ±1.10	0.100
SNF	8.30 ^b ±0.54	9.35 ^a ±0.57	9.43 ^a ±0.32	0.011
Lactose	4.03 ^b ±0.32	4.92 ^a ±0.48	4.60 ^{ab} ±0.20	0.000
Protein	3.64 ^b ±0.41	3.72 ^b ±0.26	4.12 ^a ±0.37	0.051
Ash	0.62 ^b ±0.06	0.70 ^a ±0.07	0.69 ^a ±0.02	0.021

Mean with different superscripts are significantly different. n, number of observations.

Table 4: Buffalo Milk Prices and Farmers Household Consumption in Different Agro-Climatic Districts of Bangladesh

Parameters	Coastal (n=45)	River basin (n=45)	Semi-arid (n=55)	p-value
Milk trading (%)	92.00 ^b ±9.73	90.77 ^b ±5.78	78.60 ^a ±12.11	0.021
Household consumption (%)	8.00 ^a ±9.73	8.23 ^a ±5.41	21.43 ^b ±12.15	0.001
Unit price (BDT/L)	55.00 ^b ±9.71	71.96 ^c ±2.83	41.10 ^a ±5.16	0.011

The data represented as Mean±SD. n, number of observations.

Table 5: Milk Marketing Approach in Different Agro-Climatic Districts of Bangladesh

Parameters	Coastal (n=45)	River basin (n=45)	Semi-arid (n=455)
Milk buyer (%)	<i>Ghosh</i> * (100)	Local market (35) and <i>Ghosh</i> (65)	Local market (100)
Milking method (%)	Hand milking (100)	Hand milking (100)	Hand milking (100)
Product manufacturing (%)	None	11	None
Advanced payment (%)	57.89	None	None
On-site payment (%)	42.11	None	None
Advanced amount (Tk.,000)	3-10,	None	None

**Ghosh*, local term means sweetmeat makers.

rightly, significantly highest household consumption was recorded in semi-arid districts (21%). However, maximum milk price (Tk.72.0) was found in the river basin region. All of the farmers sold milk directly to *Ghosh* in coastal areas. In river basin areas producers sold milk both to the local market and sweetmeat shops but for semi-arid areas it was only the local market. Among the study area, hand milking was found as the sole milking method. As far the milk processing is concerned, the farmers didn't produce milk products in coastal and semi-arid district but 11% of farmers produced milk products in river basin district. About 58% of farmers received advance money (BDT 3000-10000) every month from the *Ghosh* and 42% farmer practised on-site payment. The higher milk selling price was BDT 72/L for the farmer who didn't take advanced money from *Ghosh* but the selling price was relatively

low (BDT 55/L) who had taken advanced payment in coastal areas. Milk price was comparably low in the case of advanced payment in coastal areas. Milk market was more volatile concerning the farmers who didn't take advanced from *Ghosh* in coastal areas. The current finding is in agreement with [25] and reported that the price of milk was set below by BDT 55/L in advanced payment. Buffalo rearing in the coastal areas of Bangladesh is highly profitable which a crucial pathway for poverty alleviation [26]. However, even more lower price (BDT 41/L) was found in semi-arid area indicating a poor marketing system there. The cost-benefit ratio was 1.31 [27], indicating that buffalo rearing was profitable in Bangladesh [9,28]. A total of 25% of the cow milk consumed by the household [29] but in our study, home consumption of buffalo milk was varied from 8-21% of total milk yield. It was reported by

[30] that milk supply chain in Bangladesh had a mixed picture as milk is not consumed by farm household and mainly supplied to the traditional local market (>80%). It was also mentioned that farmers sold about 95% of the milk produced directly to Ghosh, the local market and local sweetmeat shop as well but none to the formal distribution channel [30].

CONCLUSION

It can be concluded that a considerable variation is prevailing among the selected districts from different agro-climatic regions with regards to milk yield (daily, total lactation, according to stage of lactation and number of lactation) and composition. Milk yield and quality in the different agro-climatic districts varied owe to several factors that could not be altered only by farm management practices. The milk marketing approach, milk price and mode of using milk were also found different among the agro-climatic districts. The amount of milk selling was more than the household consumption in the coastal region. It indicates that buffalo farming was highly emphasized for household income for farmer's livelihoods..

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