Article

Productive and reproductive performance of indigenous buffaloes in four selected upazillas under Mymensingh district of Bangladesh

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Abstract: The present study aimed to examine the productive and reproductive performance of Indigenous buffaloes in the Mymensingh district of Bangladesh. Buffalo husbandry plays a crucial role in the livelihoods of numerous farmers across various upazilas in Mymensingh. A total of 100 indigenous buffaloes were selected for the study, representing four upazilas: Trishal, Haluaghat, Muktagachha, and Sadar upazilla in Mymensingh district. The findings of this study revealed that the average lactation length of indigenous buffaloes was 273.04±4.75 days. Furthermore, the average milk yield of indigenous buffaloes was measured at 2.33±0.77 litres. The average birth weight, gestation period, age at first calving, calving interval, and post-partum heat period for indigenous buffaloes were observed to be 19.44±3.24 kg, 313.04±6.40 days, 52.53±3.10 months, 558.43±60.05 days, and 142.33±29.32 days, respectively. Based on the results obtained from all the parameters studied, it can be concluded that the productive and reproductive performance of Indigenous buffaloes in the Trishal upazilla surpassed that of the other three upazilas.

1. Introduction

According to the Department of Livestock Services (DLS, 2019-20) report for the year, Bangladesh has a population of 24.39 million cattle and 1.49 million buffaloes. Although the buffalo population has shown a relatively higher growth rate (2.20%) compared to cattle (0.44%) in recent years, buffalo milk production has not made a significant contribution to the national production in Bangladesh (Islam, 2017).

In Bangladesh, the majority of buffaloes are raised by small-scale farmers using traditional systems. Farmers predominantly practice free-grazing systems for feeding buffaloes, although stall feeding is also common (Sarker *et al*., 2013). Numerous reports have been published on the management practices of buffaloes in various regions of Bangladesh (Faruque and Amin, 1995; Sarkar *et al*., 2013; Amin *et al*., 2015; Hasan *et al*., 2016; Uddin *et al*., 2016; Kabir *et al*., 2020; Haque *et al*., 2020). Buffalo rearing under controlled farm conditions is not widely practiced in Bangladesh, although a small number of indigenous, exotic, and crossbred buffaloes are maintained in institutional farms such as the Bangladesh Agricultural University Dairy Farm in Mymensingh, Bangladesh Livestock Research Institute in Savar, Dhaka, and the Buffalo Breeding and Development Farm in Bagerhat. Additionally, some commercial farms, including American Dairy Limited in Gazipur and Lal Teer Ltd. in Valuka, Mymensingh, also maintain buffaloes. However, the productivity of

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buffaloes largely depends on genetic improvement, proper rationing, good management practices, and environmental factors (Saadullah, 2012).

The buffalo species has contributed only 2.0% to the total milk production and 0.94% to the total meat production in Bangladesh (DLS, 2015). Despite being popular in South-East Asia and South Asia, buffalo farming has been neglected in Bangladesh and has not received the attention it deserves from policymakers and researchers. The rearing of buffaloes, particularly by women, has the potential to improve the livelihoods of farmers and serve as a pathway for alleviating rural poverty (Sarkar *et al*., 2013; Amin *et al*., 2015). Buffaloes are primarily raised under extensive or semi-intensive systems across all regions of the country. However, there have been minimal efforts to increase farm-level output by implementing better feeding and management practices, as well as breeding and selection programs. The development of a buffalo breeding program in Bangladesh would be a logical strategy to enhance the productivity and efficiency of this indigenous genetic resource. Presently, the buffalo development program primarily focuses on increasing the population and improving the productive quality of buffaloes to enhance farmers' income, power supply, milk production, and meat production. To achieve these objectives, the policy emphasizes the development and adoption of appropriate technologies (Mahadevan, 1986).

Despite their significant economic role and tremendous production potential, which have been fully realized in various Asian countries and are being explored elsewhere, buffaloes have been neglected in Bangladesh and are still referred to as non-descriptive types (Cockrill, 1974). However, the productivity of indigenous buffaloes, particularly in terms of milk production, is low, similar to indigenous cattle. They exhibit low reproductive efficiency, with the common occurrence of only two calves in three years (Faruque *et al*., 1990; Faruque and Amin, 1994, 1995). Consequently, indigenous buffaloes are unable to produce high-quality milk. Studies have been conducted to characterize and evaluate indigenous buffaloes in certain areas by Amano *et al*. (1987) and Faruque and Amin (1994, 1995). Hasnath (1985) and Hussen (1990) have examined the characterization and evaluation of exotic improved buffalo breeds such as Nili-Ravi and Murrah, as well as their crossbred progenies, in specific localized regions and commercial farms. These breeds generally exhibit higher milk production and may contribute more effectively to meet the demand. Therefore, there is a need to study the phenotypes, productive and reproductive potentials, and genetic merits of buffaloes before considering them as dairy animals in Bangladesh.

Based on the aforementioned facts, it is imperative to immediately undertake efforts to characterize and document the indigenous buffaloes in Bangladesh. Cattle and buffalo play a vital role in providing draft power for ploughing, transportation, sugarcane threshing, and oilseed crushing. Moreover, they contribute to the production of animal protein through milk and meat, while their dung serves as a valuable resource for fuel and manure. This sector possesses the potential to become a viable commercial industry and a source of income for the landless rural population. There exists a significant opportunity to study the phenotypic characteristics, productive and reproductive potentials, and genetic qualities of buffaloes before considering them as dairy animals in Bangladesh. Given the above circumstances, it was necessary to conduct the present research, which aimed to investigate the productive performance of indigenous buffaloes in terms of lactation length, daily milk yield, and birth weight. Additionally, the reproductive performance of indigenous buffaloes was assessed in terms of gestation period, age at first calving, post-partum heat period, and calving interval. By conducting this research, the state of affairs regarding buffalo husbandry could be better understood, leading to informed decision-making and potential improvements in the management and productivity of indigenous buffaloes.

2. Materials and Methods
2.1. Ethical approval
This study did not require any ethical approval.

2.2. Selection of the study area
The study focused on four specific upazillas in the Mymensingh district of Bangladesh, namely Trishal, Haluaghat, Muktagachha, and Sadar upazillas. These upazillas were selected randomly for the purpose of the study. Data pertaining to indigenous buffaloes were collected from these selected upazillas. A total of 100 buffaloes were included in the study, with 30 buffaloes selected from Trishal upazilla, 28 from Haluaghat upazilla, 25 from Muktagachha upazilla, and 17 from Sadar upazilla. Several factors influenced the selection of these specific upazillas for the study. Firstly, these areas were known to have a significant population of indigenous buffaloes. Secondly, no previous studies of similar nature had been conducted in these particular upazillas, making them a valuable area of investigation. Thirdly, the study areas were well-connected and easily

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accessible, facilitating data collection for the researcher. Lastly, it was anticipated that the respondents in these upazillas would exhibit a high level of cooperation, contributing to the overall success of the study.

2.3. Preparation of the survey schedule

The survey schedule was carefully designed to align with the research objectives. Its purpose was to gather accurate information from the farmers in a straightforward manner. Initially, a preliminary schedule was developed, taking into consideration the specific objectives of the study. Subsequently, the final schedule was prepared. The schedule included several key items of information to be obtained from the respondents. Firstly, it covered general identification and background information of the selected livestock owners. This aimed to establish a comprehensive profile of the farmers. Secondly, the schedule collected data on the lactation length of the indigenous buffaloes, which refers to the duration of their milk production cycle. Thirdly, it recorded the daily milk yield of the indigenous buffaloes, providing insights into their milk production capacity. Fourthly, it gathered information on the gestation length of the indigenous buffaloes, indicating the duration of their pregnancy. Additionally, the schedule included a section to record the birth weight of the calves born to these buffaloes. Furthermore, it captured data on the age at first calving of the indigenous buffaloes, shedding light on their reproductive development. The schedule also sought to document the calving interval, which is the time between successive calvings of the buffaloes. Lastly, it included a section to gather information on the post-partum heat period, which refers to the period after calving when the buffalo is receptive to mating. Additionally, respondents were asked about their general farm management practices.

2.4. Methods of data collection

During the study period, every household in the selected area was included in the survey. The researchers employed a direct interview method to collect information from the farmers. This approach involved conducting face-to-face interviews with the respondents. The researchers used an interview schedule to guide the conversation and systematically record the information provided by the farmers. The completed schedules were then carefully stored and preserved for future analysis.

2.5. Data analysis

The collected data from this study underwent rigorous processing, tabulation, and analysis in line with the study's objectives. The analysis primarily involved the use of tabular and statistical techniques, including the calculation of percentages, mean values along with standard deviations, and the determination of LSD values.

3. Results and Discussion
3.1. Lactation length

The lactation length of indigenous buffaloes in Trishal, Haluaghat, Muktagacha, and Sadar upazillas, which were recorded as 274.63±4.24, 273.54±4.06, 272.32±4.91, and 270.47±5.46 days, respectively (Table 1). Among the upazillas, Trishal had the highest lactation length of indigenous buffaloes (274.63±4.24 days), while Sadar had the lowest (270.47±5.46 days). The least-square analysis of variance revealed a significant ($P<0.05$) variation in lactation length across different upazillas. The findings of this study align with previous research conducted by Ranjhan *et al*. (1989), who reported lactation lengths of 272 and 275 days for Murrah and Nilli-Ravi buffaloes, respectively. Faruque *et al*. (1990) also found a lactation length of 275 days for indigenous buffaloes, while Faruque and Amin (1994) reported a lactation length of 270 days for indigenous buffaloes in the coastal area. El-Kirabi (1995) mentioned a lactation length of 210 to 280 days for Egyptian buffaloes, and Charlini and Sinniah (2015) reported a lactation length of 268 ± 2.55 days for buffaloes in Sri Lanka.

3.2. Milk yield

The average daily milk yield of buffaloes in Trishal upazilla, Haluaghat upazilla, Muktagacha upazilla, and Sadar upazilla were recorded as 2.67±0.88, 2.43±0.70, 1.98±0.66, and 2.08±0.56 liters per day per head, respectively (Table 1). Trishal upazilla had the highest milk yield, while Muktagacha upazilla had the lowest. The least-square analysis of variance revealed a significant ($P<0.01$) variation in daily milk yield across different upazillas. The average daily milk yields in this study were consistent with the findings of Jainuddin (1988), who reported a milk yield of 1.94 kg for local buffaloes, with the highest yield reaching 5.5 kg per day. Similar studies conducted by Hussen (1990) in Tangail district reported an average daily milk yield of 2.3±0.631 liters for indigenous buffaloes. In contrast, Shabade *et al*. (1993) found an average daily milk yield of 3.5 kg, and Faruque (1994) reported an average daily milk yield of 2.32±0.63 liters for indigenous buffaloes. However, there was a wide range of variation in milk yield among indigenous buffaloes, indicating the potential

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for selection and improvement of milk yield within the indigenous stock. Charlini and Sinniah (2015) observed that the milk yield of Sri Lankan indigenous buffaloes was 4.42±1.4 liters per day, which was higher than the yields observed in the upazilas of Mymensingh district. Improved nutrition and genetic upgrading were identified as contributing factors to the higher milk yields in Sri Lanka.

Table 1. Productive and reproductive parameters of indigenous buffaloes in four Upazillas of Mymensingh district, Bangladesh.

Parameters studied	Name of upazillas (Mean±SD)				Level of significance	LSD Value
	Trishal	Haluaghat	Muktagacha	Sadar		
Lactation length (days)	274.63[a]±4.24	273.54[a]±4.06	272.32[ab]±4.91	270.47[b]±5.46	*	2.352
Milk yield (liters)	2.67[a]±0.88	2.431[ab]±0.70	1.98[b]±0.66	2.08[b] ±0.56	**	0.4954
Gestation period(days)	311.10±4.87	314.750±6.95	312.08±6.21	315.06 ±7.27	NS	--
Birth weight (kg)	20.67[a]±3.29	19.643[ab]±2.83	18.76[bc]±3.67	17.94[c]±2.38	*	1.608
Age at first calving (months)	52.20±3.13	52.536±2.53	52.24±3.71	53.53±2.98	NS	--
Calving interval (days)	576.63±50.61	542.179±66.04	567.40±54.57	539.88±65.37	NS	--
Post-partum heat period (days)	140.53±30.46	137.11±30.68	147.48±29.21	146.53±25.61	NS	--

[a,b,c]Means with different superscripts on the same column differ significantly: *Significant at 5% level; **Significant at 1% level; NS = Non-significant.

3.3. Gestation period
The average gestation period of indigenous buffaloes in the study was 313.04±6.40 days. The highest recorded gestation period was 315.06±7.27 days, while the lowest was 311.10±4.87 days. The average gestation periods for Trishal, Haluaghat, Muktagacha, and Sadar upazillas were 311.10±4.87, 314.75±6.95, 312.08±6.21, and 315.06±7.27 days, respectively (Table 1). Statistical analysis revealed no significant differences in the gestation period among indigenous buffaloes in different upazillas. Several studies have reported similar findings regarding the gestation period of buffaloes. Hadi (1965) conducted an experiment on Marathwada buffaloes and found an average gestation period of 309.60±2.11 days. El-Sheik and Mohamed (1967) observed a gestation period of 316.70±0.19 days for Egyptian buffaloes. Joshi *et al*. (1968) reported an average gestation length of 308±9.6 days for Indian buffaloes. Singh *et al*. (1973) compared the gestation periods of farm-bred and purchased buffaloes in India, finding average durations of 314.02±1.53 and 308.53±1.83 days, respectively. Kerun *et al*. (1973) conducted an experiment on Juffri buffaloes in India, stating a gestation period of 315.79 days. El-Azab (1974) reported a gestation length of 306 to 314 days for buffaloes in Egypt. Xiao (1989) mentioned that Chinese buffaloes have an average pregnancy length of 321 days, with a range of 306-331 days. Therefore, the findings of the present study align closely with those of previous authors mentioned above.

3.4. Birth weight
The birth weight of indigenous buffaloes in Trishal, Haluaghat, Muktagacha, and Sadar upazillas was 20.67±3.29, 19.64±2.83, 18.76±3.67, and 17.94±2.38 kg, respectively (Table 1). The average birth weight of indigenous buffalo calves across all upazillas was 19.44±3.24 kg. The highest recorded birth weight was 20.67±3.29 kg in Trishal upazilla, while the lowest was 17.94±2.38 kg in Sadar upazilla. Statistical analysis indicated a significant effect ($P<0.05$) of different upazillas on birth weight. The average birth weight of indigenous buffalo calves in this study aligns closely with the findings of previous studies. Chantalakhana *et al*. (1984) reported the average birth weight of swamp male and female buffalo calves as 28.60 and 26.97 kg, respectively, in Thailand. Hussen (1990) found that the average birth weight of indigenous buffaloes in Tangail district was 26.74±2.4 kg. Faruque and Amin (1994) mentioned an average birth weight of 22.00±3.50 kg for indigenous buffaloes in the coastal areas of Bangladesh, which is similar to the present study. Similarly, Faruque and Amin (1995) stated an average birth weight range of 18 kg to 26 kg for indigenous buffaloes in the coastal area, while the present study observed an average range of 14 kg to 27 kg. However, Charlini and Sinniah (2015) found that the least square mean for birth weight in Sri Lankan indigenous buffaloes was 27.7 ± 0.13 kg with a coefficient of variation of 10.84%, which was higher than the values found in the Mymensingh district.

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3.5. Age at first calving
In the study conducted, the age at first calving of indigenous buffaloes in Trishal, Haluaghat, Muktagacha, and Sadar upazillas were reported as 52.20±3.13, 52.54±2.53, 52.24±3.71, and 53.53±2.98 months, respectively (Table 1). The average age at first calving for indigenous buffaloes was found to be 52.53±3.10 months. The highest age at first calving was observed in Sadar upazilla with a value of 53.53±2.98 months, while the lowest average age at first calving was recorded in Trishal upazilla at 52.20±3.13 months. Statistical analysis indicated that there was no significant difference in the age at first calving among the different upazillas. The findings of this study align with previous research. Fadzil (1969) conducted an experiment on swamp buffaloes in Malaysia and reported a minimum age at first calving of 3 years, 3 months, and 26 days. Cuong (1983) found that the average age at first calving of local Murrah buffaloes and their crosses in Vietnam ranged from 48-54, 36-42, and 42-48 months, respectively. Shah *et al.* (1987) reported an average age at first calving of 45.84±0.19 months for rural Nili-Ravi buffaloes in Punjab. Abeygunawardena *et al.* (1995) conducted an experiment that revealed the average age at first calving for Surti, Murrah, Nili-Ravi, and local Lankan buffaloes to be 51.8, 55.0, 52.1, and 44.9 months, respectively. In the present study, it was observed that the age at first calving of heifers in Sadar upazilla was higher compared to the other three upazillas. This difference may be attributed to genetic factors, as well as poor feeding and management practices followed by the farmers. In a population of Sri Lankan buffaloes, the least square mean for age at first calving was reported as 48.2±0.30 months, with a coefficient of variation of 16% (Charlini and Sinniah, 2015).

3.6. Calving interval
The average length of the calving interval for indigenous buffaloes in the study was 558.43±60.05 days. The specific calving intervals observed at Trishal, Haluaghat, Muktagacha, and Sadar upazillas were 576.63±50.61, 542.18±66.04, 567.40±54.57, and 539.88±65.37 days, respectively. The highest calving interval was recorded in Trishal upazilla, while the lowest was observed in Sadar upazilla (Table 1). However, statistical analysis showed no significant variation in the length of the calving interval among indigenous buffaloes in different upazillas. The findings of the present study are generally consistent with previous research. El-Sheikh and Mohamed (1967) reported a first calving interval of 484.74±2.86 days for Egyptian buffaloes. Fadzil (1969) found a calving interval of 639 days for swamp buffaloes in Malaysia under village conditions. Parera *et al.* (1987) documented an average calving interval of 384.9±62.9 days for indigenous buffaloes in Sri Lanka, with a range of 329 to 816 days. Xiao (1989) reported an average first calving interval of 556.1 days for Chinese buffaloes. The variations in calving intervals among indigenous buffaloes in different upazillas could be attributed to various factors, including genetic factors, environmental conditions, feeding practices, and management approaches. It's worth noting that the calving interval reported by Charlini and Sinniah (2015) for Sri Lankan buffaloes (470±4.87 days) was lower than the calving interval observed in the present study.

3.7. Post-partum heat period
The post-partum heat period refers to the duration from calving to the first onset of estrus. In the case of indigenous buffaloes, the post-partum heat period observed at Trishal, Haluaghat, Muktagacha, and Sadar upazillas were 140.53±30.46, 137.11±30.68, 147.48±29.21, and 146.53±25.61 days, respectively (Table 1). The average post-partum heat period for indigenous buffaloes was 142.33±29.32 days. Among the four upazillas, Muktagacha upazilla had a higher post-partum heat period compared to the others, which could be attributed to genetic factors, poor feeding practices, and managemental issues by the farmers. However, statistical analysis revealed no significant variation in the post-partum heat period among indigenous buffaloes in different upazillas. The findings of the present study align with previous research conducted by various authors. Fadzil (1969) conducted an experiment on swamp buffaloes in Malaysia and reported that the first post-partum natural estrus typically occurred within 36.22 days. El-Wishy and El-Sawaf (1971) found that the first post-partum estrus in buffaloes occurred at around 146.2 days. Rao *et al.* (1973) described the mean post-partum estrus interval as 125.73 days, ranging from 21 to 349 days. Janakiraman (1982) concluded that post-partum conception in water buffaloes in Thailand occurred on average at 95 days. Liu *et al.* (1985) reported varying post-partum heat periods for different breeds, with triple crossbred buffaloes having a period of 70.0±27.8 days, Nili-Ravi buffaloes at 127.9±107.2 days, Murrah buffaloes at 94.7±82.7 days, and Indigenous buffaloes ranging from 30 to 169 days. Parvez *et al.* (1994) found a post-partum estrus interval of 171.79±4.01 days, while Tailor *et al.* (1997) reported an interval of 119.53±5.25 days. Therefore, the findings of the present study are consistent with the observations made by various authors mentioned above regarding the post-partum heat period in indigenous buffaloes.

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3.8. Genotype, farm management and rearing related risk

In the region described, the buffalo genotype primarily consists of nondescript indigenous types, with some indications of Murrah and Nili-Ravi crosses observed, possibly originating from other parts of the country. However, the productivity of the indigenous buffalo is generally low due to several factors, including a lack of genetic potential, poor management practices, and inadequate health care. To address these challenges and meet the future demand for buffalo, it is necessary to implement an appropriate breeding program. Such a program would aim to improve the buffalo genotype by selectively breeding individuals with desirable traits, such as higher milk production, better disease resistance, and improved overall productivity. Through strategic breeding efforts and the use of modern breeding techniques, it is possible to enhance the genetic potential of buffalo herds in the region. This can lead to the development of more productive and economically valuable buffalo breeds, better suited to meet the growing demands of the country's agriculture and dairy sectors. In addition to breeding programs, it is crucial to address other aspects of buffalo management, including improved nutrition, proper healthcare, and effective farm management practices. These measures, combined with selective breeding, can contribute to the overall improvement of buffalo productivity and help meet the future needs of the country. The information regarding genotype, farm management and rearing related risk of indigenous buffaloes in four Upazillas of Mymensingh district, Bangladesh are presented in Table 2.

Table 2. Information regarding genotype, farm management and rearing related risk of indigenous buffaloes in four Upazillas of Mymensingh district, Bangladesh.

Parameters	Yes	No
1. Buffalos/Cows are washed regularly	80%	20%
2. Presence of proper drainage facility in the barn	10%	90%
3. Ensured supply of quality inputs for buffalo (feed, semen, vaccine, medicine, etc.)	20%	80%
4. Buffalo get proper treatment against diseases	40%	60%
5. The buffalo is provided with green grass	70%	30%
6. Buffalo shed/killa is properly designed	20%	80%
7. Death of buffalo on farm	40%	60%
8. Occurrence of severe diseases	30%	70%
9. High feed cost	50%	50%
10. Shortage of medicine	80%	20%
11. Labor unrest	40%	60%

4. Conclusions

Considering the socio-economic aspects of Bangladesh, improving the productive and reproductive performance of indigenous buffalo cows is crucial as these parameters are currently below the optimum level. Enhancing these aspects would not only increase the profits of poor farmers but also contribute to a sustainable farming system. To achieve this, initiatives should be taken to upgrade the local buffalo stock through artificial insemination using semen collected from superior buffalo bulls from renowned breeds like Murrah and Nili-Ravi. Long-term planning and a comprehensive breeding scheme should be implemented, with a special focus on the indigenous buffalo population. Simultaneously, it is important to provide training to farmers on modern buffalo farming systems, ensuring they have the knowledge and skills to manage improved buffalo breeds effectively. This includes aspects such as nutrition, healthcare, and overall farm management. To facilitate the improvement of buffalo genetics, an initiative should be undertaken to import high-quality proven bulls and distribute their semen through a well-organized artificial insemination program. This would help to disseminate superior genetic traits among the local buffalo population. While introducing improved breeds, it is essential to preserve the germplasm of native buffalo as they possess valuable traits such as hardiness and disease resistance. Establishing a nucleus stock of native buffalo could be accomplished with the assistance of institutions like Bangladesh Agricultural University (BAU), Bangladesh Livestock Research Institute (BLRI), and the Buffalo Breeding Farm at Bagherhat under the Department of Livestock Services (DLS).

Data availability
All relevant data are within the manuscript.

Conflict of interest
None to declare.

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Authors' contributions

Mohammad Rezaul Karim collected data and drafted manuscript. Abdul Wadud and Raihan Habib contributed in data analysis and editing the manuscript. Mohammad Imam Hossain supervised the work. All authors have read and approved the final manuscript.

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