

The Scenario of Buffalo Production and Research in Bangladesh

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Abstract: *Background:* This study aimed to characterize the scenario of buffalo production in the northern part of Bangladesh and review the published scientific literature on buffalo from Bangladesh.

Methods: The study was conducted from August to December 2022. A draft questionnaire was prepared and modified before the final one based on the study's objectives. Data were collected through personal interviews with individual respondents. In addition, the review article was collected on buffalo from Google, Google Scholar, Research Gate, Scopus, Bangladesh Journal-Online (BJO), and PubMed.

Results: Data was collected from 1099 animals from the northern part of the Natore and Lalmonirhat districts of Bangladesh. Most of the farmers were illiterate, and the age was above 40 years. Regarding the purpose of buffalo production, 69.16% (n=83) of the farmers narrated that they are motivated to milk with calves selling. The average herd size was about 9 and consisted of indigenous and crossbred buffaloes. Most of the farmers kept their buffalo in the Bathan. The coat color was predominantly black, with brown hair. Farmers 94.16% (n=113) practice de-worming, and the frequency was thrice a year. Wallowing is performed at least once a day in the pond or river for the thermal regulation of the buffalo. Among the farmers, 67.50% (n=81) have no training in rearing buffalo. Farmers practice natural mating by their own or neighbor bull to serve the heated cow. Sometimes it's free, or sometimes, with payment on an average of BDT 400-500 or 3.79-4.73 US dollars. In some areas, AI is being practiced in buffalo under different organizations (LAL Teer, BRAC), and the cost of AI was recorded as about BDT 600-700 or 5.68-6.63 US dollars per cow. The average daily milk yield was 3.0 liter, whereas the lactation length was recorded at 179.9±3.84 days. The major constraints were high feed price 91.66% (n=110), shortage of land 41.08% (n=51), and lack of suitable marketing facilities 50.82% (n=62). 100% of farmers stated that they need improved grass production technology and reduced feed and medicine price; 24.16% (n=29) need good quality semen. From 2004 to 2022, 51 studies were found related to buffalo, where the highest 27.45% (n=14) belonged to performance studies, and 54.90% (n=28) studies were carried out in the southern part of Bangladesh.

Conclusion: It can be concluded that buffalo has great potential with different areas of improvement. Therefore, more research is needed from different perspectives on production, reproduction, nutrition, quality of milk/meat/products, health, and sustainability of buffalo farming in Bangladesh.

Keywords: Buffalo, production, performance, management.

INTRODUCTION

Buffaloes are members of bovine animals that are classified into African wild buffaloes and Asian buffaloes [1], which are considered the most tamed than African [2]. Asian buffaloes are further classified into river and swamp buffalo [3]. Domesticated buffaloes of Bangladesh belong to *Bubalus Bubalis* [4]. Bangladeshi Buffaloes are either indigenous or migrated from India and Myanmar. Indigenous buffaloes are found in coastal areas and marshy land. In Bangladesh, there is no recognized buffalo breed, and these are mainly indigenous non-descriptive types [5]. However, some crossbred between the swamp and river types are found in the coastal area [6]. In the rural areas of Bangladesh, buffalo are reared. However, buffaloes are primarily found in coastal regions, sugarcane belts, and plains regions used for paddy cultivation because of the availability of feeds and

wallowing facilities in those areas. The buffalo is recognized as both "Black gold" and "Asian Animal". Buffaloes are versatile animals used for plowing, transporting, and threshing sugarcane and oilseed crushing in some rural areas of Bangladesh.

Moreover, farmers could be used as "small tractors" in agricultural farming. Farmers prefer buffaloes to cattle due to more disease resistance and survivability in the worst environment. Buffalo can convert all kinds of feed into high-quality milk and meat, dung as fuel, and organic fertilizer [7]. Buffalo meat is considered safe meat among red meats for human consumption because it contains higher protein, β carotene, minerals, and lower cholesterol calories than beef [8-12]. Buffalo milk is also abundant in protein, calcium, vitamin E, which is known to be a natural antioxidant, and saturated fatty acids [13]. Despite many important roles of buffalo in the people's livelihood, buffaloes are a neglected species and are not getting much importance in our country [14]. However, the government of Bangladesh has taken some initiatives for the development of buffalo, like the Buffalo Development Project. A buffalo development and

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conservation program was initiated in 2009 and funded by the Government of Bangladesh (GoB). Now the second phase is going on, and the associate partners are the Department of Livestock Services (DLS), Bangladesh Livestock Research Institute (BLRI), and different universities.

Regarding buffalo farmer's socio-economic status and farming practices, many papers and publications have been published [15-24] in southern regions of Bangladesh. However, a few pieces of literature are available regarding the socio-economic status of the buffalo farmers along with buffalo management practices in the Northern region of Bangladesh. Therefore, the present study was undertaken to investigate buffalo research in Bangladesh as well as to assess the socio-economic status of the buffalo farmers and existing buffalo management practices in the Northern part of Bangladesh.

MATERIALS AND METHODS

Application of Survey

The study was conducted at Lalpur Upazila of Natore district and Hatibandha Upazila of Lalmonirhat district, Bangladesh, from August to December 2022. A draft questionnaire was prepared and modified before the final one based on the study's objectives. The questionnaire was designed with different sections such as the socio-economic status of the farmers, feeding, and management of buffalo, herd inventory, performance study, constraints, suggestions from the farmers, etc. Data were collected through personal interviews with individual respondents. A total of one hundred and twenty buffalo farmers were selected randomly from the study area based on their experience of buffalo rearing, having at least five buffalo.

Buffalo Research in Bangladesh

The search period was from 2004 to 2022. The information search was carried out with the following keywords: buffaloes, buffalo, Bangladesh, phenotypic or morphometric characterization, socio-economic status, feeding and management, productivity, production, reproduction, artificial insemination (AI), milk and meat quality, semen quality, and diseases. Databases such as Google, Google Scholar, Bangladesh Journal-Online (BJO), Research Gate, Scopus, and PubMed on the scientific literature published about buffaloes in Bangladesh were

reviewed. Review articles and meta-analyses published by Bangladeshi researchers on buffalo were excluded.

Data Analysis

After collection, the data sheets were checked again, then transferred to the Microsoft Excel sheet, where editing and coding were performed for further processing and summarizing. After that, the productive and reproductive data were analyzed with the help of the SPSS-Version 16 computer package program. The tabular technique mainly analyzes the data and derives meaningful findings using simple statistical measures like mean percentage and ratio.

RESULT AND DISCUSSION

Socio-Economic Condition

Table 1 shows the socio-economic condition of the farmers in the study area. Most of the farmers were illiterate, and the age was above 40 years. In the country context, most of the farmers were involved with agriculture, and their cultivable land varied from 1- 3 acres above. Hossain *et al.* [25] showed that land size was marginal (1 acre), small (1-3 acres), medium (3-8 acres), and large (>9 acres), in which the small class was 40% which was close to this study. According to Siddiki *et al.* [26], marginal, small, and medium farmers have 16, 42, and 42% land sizes, respectively. These results have some significance for the present research. Particularly the middle-aged farmers were well-experienced and more acquainted with buffalo production. That statement is similar to [21, 27]. Saha *et al.* [28] Found 73% of the farmers are uneducated and occupied in agriculture (78%) in the coastal region of Bangladesh. Education has a significant role in adopting new technology, making a man more capable of managing resources and maximizing profit. Uddin *et al.* [29] reported that most of the farmers were male in both households (90%) and Bathan farming (99%).

Population Demography

Table 2 shows the number and percentage distribution of the buffalo. Males represent 46.50% (n=511), while females represent 53.50% (n=588). Regarding the purpose of buffalo production, 69.16% (n=83) of the farmers narrated that they are motivated to milk with calves selling, 12.50% (n=15) to fattening, 11.67% (n=14) to dual-purpose production and 6.67% (n=8) exclusively to draught. The average herd size was observed to be about 9 and consists of indigenous and crossbred buffaloes. According to Haque *et al.*

Table 1: Socio-Economic Condition of the Farmers

Characteristics	Scoring unit	Categories	Percentage (N=120)
Age	Years	Young (20-30)	11.67 (14)
		Middle (31-40)	28.33 (34)
		Old (above 40)	60.00 (72)
Sex	Gender	Male	93.33 (112)
		Female	6.67(8)
Education	Level	Illiterate	70.83 (85)
		Primary	12.50 (15)
		Secondary	10.83 (13)
		Higher education	5.83 (7)
Occupation	Type	Agriculture	77.50 (93)
		Business	14.16 (17)
		Service	5.00 (6)
		Others	3.33 (4)
Cultivable land	Acre	0-1	56.67 (68)
		2-3	34.17 (41)
		3- above	9.16 (11)

The figure in the parenthesis indicates the number of observation.

[27], the majority of farmers raised crossbred buffaloes with herd sizes of 4–10 buffaloes. Most of the farmers kept their buffalo in the Bathan.

Table 2: Distribution of Buffaloes according to their Category

Category	Number	Percentage
Male		
Adult	144	28.18
steers	212	41.49
Calves	155	30.33
Total	511	100
Female		
Adult	168	28.57
Heifer	251	42.69
Calves	169	28.74
Total	588	100

Physical Appearance

The coat color was found to be predominantly black with brown hair, which is supported by [30], who observed the black coat (78.57%) color of buffaloes in Mymensingh. The body condition of the buffalo was

deep massive frame, short head, broad back 38.32% (n=297), broad and elongated head, light neck 40.90% (n=317) and broad, elongated, or short head and neck 20.77% (n=161) among the buffalo. The horn pattern was found to be 50.71% (n=393) long and sickle-shaped, downward and upward, and 49.29% (n=382) short, sickle-shaped backward and upward. The eye color was noticed at 81.53% (n=896) black and 18.47% (n=203) dark brown. The muzzle and hoof color were black, 62.60% (n=688), whereas black and white, 37.40% (n=411).

Feeding and other Management Practice

In the study area, 47.54% (n=58) of farmers cultivate different types of seasonal and perennial fodder like *Zea mays*, *Pennisetum purpureum*, (*Pennisetum glaucum* × *P.*), *Lathyrus sativus*, *Vigna mungo*, and *Sesbania bispinosa*. For the cultivation of fodder, 73.33% (n=88) farmers utilized own plus public land, whereas 16.67% (n=20) utilized own plus lease and 10% (n=12) only lease land. As concentrate supplementation, they supply maize crush, rice polish, wheat bran, and commercial feed twice a day @1-2 kg per head. Moreover, the most interesting thing is that all the farmers of Natore district can supply sugarcane bagasse to the buffalo. Farmers use both fields and homesteads for grazing, where the average grazing

time was recorded as 6-8 hours per day. Faruque *et al.* [31] reported that the farmers grazed their buffalo for 8 to 12 hours per day. Farmers of 94.16% (n=113) practice de-worming, and the frequency was three times a year. Rahim *et al.* [21] Stated that the farmers of the Subarnachar area practiced vaccination (40%) and de-worming (67%). In the present study area, it was observed that 87.50% (n=105) of farmers do not vaccinate their buffalo. Moreover, Faruque *et al.* [31] stated that 98% of farmers practice vaccination and de-worming program regularly for their buffaloes. Wallowing is performed at least once a day in the pond or river for the buffalo's thermal regulation, which is similar to the findings of [22]. Hand milking was performed by the farmer once a day in the morning, and 71.82% (n=79) of farmers sold, 1.82% (n=2) only home consumption, and 26.36% (n=29) preferred both. They sold the raw milk in the local market at BDT 60-70 or 0.57-0.66 US dollars per liter. Rahman *et al.* [14] experimented with dairy buffalo production under an intensive system in a semi-arid area of Bangladesh. They reported that the average price per unit of milk was 55, 71, and 41 BDT or 0.52, 0.67, and 0.39 US dollars in coastal, River basins, and semi-arid areas. Milk prices vary due to milk fat (%), demand, and supply in that area. Some research findings indicated that buffalo milk might be more suitable for human health than cow's milk because it belongs to the A₂ classification [32], and β -lactoglobulin is less allergenic than cow's milk proteins. Farmers of 79.22% (n=79) sell at the local markets at 24-36 months of age, and 17.5% (n=21) of farmers sell 3-4 buffalo per year. The price of meat in the local market was noticed at BDT 600-700/kg or 5.68-6.63 US dollars, and people buy it occasionally. [33] Stated that the price of buffalo meat (buffer) varies from 478 to 586 BDT or 4.52-5.55 US dollars in the Bhola district, and the average price was 523 BDT or 4.95 US dollars per kg. However, the price may vary due to consumer demand and supply in a particular area. Buffalo meat contains low cholesterol and lipids but a higher percentage of unsaturated fatty acids and iron than beef, pork, and rabbit [34-36]. As a result, buffalo meat has been highly appreciated by human beings. Therefore, the demand for buffalo meat gradually increases among health-conscious consumers [37]. Foot and mouth disease, anthrax, black quarter, lumpy skin disease, bloat, external parasites, and pneumonia in calves were recorded from the study area. Sarkar *et al.* [22] noticed foot and mouth followed by black quarter, anthrax, and hemorrhagic septicemia, whereas [38] found diarrhea, mastitis hemorrhagic septicemia, and calf pneumonia

as major disease prevalence. Several authors [17, 31, 39-41] also reported that infectious diseases like FMD, BQ, and HS in buffaloes rearing as the main problem. Among the farmers, 67.50% (n=81) have no training in rearing buffalo, whereas 32.50% (n=39) received training from organizations such as DLS, BRAC, etc. Farmers 75.83% (n=91) have no idea about record keeping, whereas 24.16% (n=29) have ideas but are not maintaining the record in the record book. According to Rahim *et al.* [21], about 97% of farmers did not keep livestock records, and only 3% kept their livestock records.

Breeding of Buffalo

Farmers of 91.15% (n=103) are not facing any difficulties in detecting the heat of buffalo, whereas 8.85% (n=10) farmers are facing problems. Farmers practice natural mating by their own or neighbor bull to serve the heated cow. Sometimes it's free, or sometimes with payment on an average BDT 400-500 or 3.79-4.73 US dollars. In some areas, AI is being practiced in Buffalo under organizations like LAL Teer (LTL), and the cost of AI was recorded as about BDT 600-700 or 5.68-6.63 US dollars per cow.

Productive and Reproductive Performance

Table 3 shows the productive and reproductive performance of buffaloes. The minimum and maximum value for daily milk yield was found 2-5 liter, whereas the lactation length was recorded as 180 days. From the hypothalamus, the secretion of a gonadotropin-releasing hormone (GnRH) is the fundamental requirement for the onset of puberty. The results of the present study vary from the findings of [16], who recorded the age at first heat as 38.79±4.07 months. The average daily milk yield was 3.01±0.21 liter which is close to the findings of [16, 18, 31, 42], and their

Table 3: Productive and Reproductive Performances

Parameters	(Mean±SE)
Daily milk yield (lit)	3.01±0.21 (110)
Lactation length (d)	179.9±3.84 (110)
Age at first heat (m)	29.45±0.97 (115)
Service per conception (no.)	1.71±0.16 (117)
Gestation length (d)	300.92±1.08 (110)
Calving interval (d)	478.78±10.57 (96)
Postpartum heat period (d)	90.92±3.28 (103)

The figure in the parenthesis indicates the number of observation.

Table 4: Characteristics of the Published Research about Buffaloes in Bangladesh

Research area	Year	Aims	Location	Observation	References
Performance	2004	Compare the productive performance of Nili-Ravi and cross-bred (Nili-Ravi × Local) dairy buffalo	Bagerhat	60 Buffaloes	[48]
Genetic Diversity	2007	Karyotyping of Bangladeshi buffalo	BAU	33 Buffaloes	[49]
Meat Quality	2009	Drying effect on the quality of buffalo meat	BAU	6 Buffaloes	[50]
Performance	2010	Productive and reproductive performance	Trishal and Companiganj	52 Buffaloes	[30]
Milk Quality	2010	Effect of feed supplement on the yield and composition of milk	Trisal and BAU	12 Buffaloes	[51]
Health	2011	Prevalence of gastrointestinal parasites	Kurigram	236 Buffaloes	[52]
Health	2011	Prevalence of brucellosis	Bagerhat, Bogra, Gaibangha, Mymensingh and Sirajgonj	105 Buffaloes	[53]
Reproduction	2011	Evaluate the buffalo ovaries, follicles, and cumulus-oocyte complexes with the view of <i>in vitro</i> production of embryos.	BAU	136 Buffalo Ovaries	[54]
Reproduction	2012	Explore the maturation of buffalo oocytes using bovine follicular fluid and bovine serum albumin.	BAU	71 Buffalo Ovaries	[55]
Performance	2013	Performance and management system of buffalo	Pirojpur and Borguna	50 Buffaloes	[20]
Management	2013	Socio-economic status of the buffalo farmers and the management practices	Bagerhat	60 Buffaloes	[22]
Reproduction	2014	Quality of COCs and the effects of BSA supplementation on <i>in vitro</i> maturation and fertilization rate of buffalo oocytes	BAU	134 Ovaries	[56]
Performance	2015	Productive and reproductive feature	Pirojpur and Barguna	50 Buffaloes	[15]
Characterization	2015	Determine the breeds or types of buffaloes	Trishal	120 Buffaloes	[57]
Characterization	2015	To characterize the indigenous buffalo	Sylhet	120 Buffaloes	[58]
Economic	2015	Socio-economic status of buffalo farmers, productive and reproductive performances, and management practices	Natore	100 Buffalo farmers	[26]
Performance	2016	Productive reproductive performance of indigenous buffaloes	Pirojpur	161 Buffaloes	[42]
Performance	2016	Scenario of buffalo production and reproduction under different farming systems	Noakhali	1142 Buffaloes	[18]
Characterization	2016	Compare the morphological characteristics	BLRI and Lal Teer farm Ltd.	87 Buffaloes	[59]
Health	2016	Diseases prevalence in buffalo	Chittagong, Sylhet, Rajshahi, Barishal, and Rangpur	72 Fecal and 114 Milk Samples	[38]
Economic	2016	Potentiality and constraints of buffalo	Tangail, Jamalpur, Bogra, Sirajganj, Pabna and Thakurgaon	90 Buffalo farmers	[29]
Economic	2016	Economic benefit of small-scale dairy buffalo farming	Bhola	315 Buffaloes from 35 small farms	[24]
Performance	2017	Productive and reproductive performances of buffaloes	Patuakhali and Bhola	90 Buffaloes	[16]
Economic	2017	To estimate the income from buffalo farming	Mymensingh, Jamalpur, Bhola, Moulvibazar, Potuakhali, Noakhali, Laxmipur, Chittagong, Tangail and Sirajgonj	500 Buffalo farmers	[60]

(Table 4). Continued.

Research area	Year	Aims	Location	Observation	References
Health	2017	Prevalence of major gastrointestinal parasites	Sylhet	947 Fecal samples	[61]
Performance	2018	Potentialities of buffalo production	Noakhali	30 Buffaloes	[21]
Characterization	2018	Types of buffaloes available in the coastal area	Barishal, Patuakhali, and Bhola	3828 Buffaloes	[28]
Reproduction	2018	Effect of Showering on buffalo semen quality	BLRI	6 Buffaloes	[62]
Health	2018	Prevalence of buffalo diseases	Sylhet	1057 Buffaloes	[63]
Reproduction	2018	Evaluate the insemination time and pregnancy rate	Lal Teer Livestock Breeding and Research Farm	30 Cyclic Buffaloes	[64]
Performance	2018	Productive and reproductive performance	Sylhet	80 Buffaloes	[23]
Performance	2019	Productive and reproductive performances	Mymensingh, Jamalpur, Noakhali, Madaripur, and Bagherhat	1241 Buffaloes	[44]
Management	2019	Management system of intensive buffalo farming	Dinajpur	60 Milking Buffalo	[14]
Performance	2019	Milk production performances of buffaloes	Noakhali	100 Buffaloes	[31]
Marketing	2019	Current marketing approaches of buffalo milk	Bhola, Mymensingh, and Dinajpur	106 Buffaloes	[65]
Nutrition	2020	Impact of concentrate supplementation on the productive performance of buffalo	BAU	6 Buffaloes	[43]
Performance	2020	Effect of parity on reproductive and productive status of buffaloes	Barishal, Patuakhali, and Bhola	220 Buffalo	[19]
Performance	2020	Reproductive and productive performance of Indigenous and Nili-Ravi crossbred dairy buffalo	Rajshahi	200 Buffalo	[66]
Meat Quality	2020	Meat quality of buffalo	BLRI	5 Buffalo Bulls	[67]
Management	2020	Farmers' socio-economic status and management practices of buffaloes	Jamalpur	60 Buffaloes	[27]
Health	2020	Prevalence and associated risk factors of subclinical mastitis in dairy buffaloes	Bhola	200 Buffalo	[68]
Management	2020	Existing management practices in the coastal area of Bangladesh	Bhola and Patuakhali	80 Farmers	[69]
Nutrition	2021	Effects of supplementation of high and low energy diets on the body weight	Noakhali	15 Buffaloes	[70]
Reproduction	2021	Compare the potentialities of the single and double doses of PGF ₂ α for estrus synchronization	BAU	66 Buffaloes	[71]
Management	2021	Scenario of the present condition of production and management system	Sylhet	60 Farmers	[17]
Economic	2021	Socio-economic profile of the buffalo farmers and livelihood improvement	Jamalpur	90 Farmers	[72]
Marketing	2021	Demographic characteristics of buffalo traders, current buffalo business status	Bhola	16 Buffalo Traders	[33]
Health	2021	Prevalence and severity of GI parasites in buffalo calves	Sylhet	200 Fecal Samples	[73]
Performance	2021	Production status and management practices of crossbred buffaloes between small-scale and commercial farms	Mymensingh and Gazipur	135 Buffaloes	[74]
Dairy product	2021	To look into the fatty acid (FA), amino acid (AA), cholesterol, and other chemical characteristics of doi and rasomalai prepared from buffalo milk.	BAU	Milk from 3 Indigenous buffalo	[75]
Reproduction	2022	Fresh and frozen semen quality and fertility potentialities of Murrah, Nili-Ravi and Indigenous buffalo bulls	BLRI	6 Breeding Bulls	[76]

corresponding value was 2.79 ± 0.31 , 2.3 ± 0.703 , 3.14 ± 0.23 and 2.29 ± 0.56 liter respectively. But inconsistent with the results of Habib *et al.* [43], who found 5.68 ± 0.33 and 6.79 ± 0.33 liter in control and supplemented groups. The lactation length was found to be 179.9 ± 3.84 days, whereas [15] noted 286.12 ± 11.27 and 290.44 ± 10.92 days, respectively, in Pirojpur and Barguna. The calving interval of 580.86 ± 37.02 days was recorded by Momin *et al.* [18] under a semi-intensive Bathan farming system which is higher than the present findings. The gestation length of 307.92 ± 1.08 days was calculated from the data and is comparable with the results of [18, 16, 44, 45]. Habib *et al.* [43] found the post-partum heat period 94.33 ± 2.33 and 81.67 ± 3.18 days respectively, in control and a supplemented group of buffalo which collaborated with the results of the present study. However, inconsistent with [16, 18], they reported 147.91 ± 19.96 and 129.75 ± 9.16 days, respectively. The number of services per conception was noted at 1.71 ± 0.16 , which is indistinguishable from the results of [45], who found 1.78 ± 1.26 , but the present findings are dissimilar with the study of [46, 47], who reported 2.82 and 2 services per conception in cross breed buffalo and Murrah buffalo cows. The variation may be due to improper heat detection, time of AI, semen quality, and skill of the technician.

Constraints and Recommendations

The major constraints were high feed price 91.66% (n=110), shortage of land 41.08% (n=51), lack of suitable marketing facilities 50.82% (n=62), scarcity of feed and fodder 30.33% (n=37), lack of medical support 57.38% (n=70), and face financial problem 18.18% (n=22) among the farmers in the study area. Farmers 100% stated that they need improved grass production technology and reduced feed and medicine price; 24.16% (n=29) need good quality semen.

Buffalo Research in Bangladesh

A total of 51 scientific papers were published between 2004 and 2022 (Table 4), belongs to characterization 7.84% (n=4), 9.80% (n=5) on management practice, 27.45% (n=14) on performance study, 13.72% (n=7) on health, 15.68% (n=8) on reproduction, 9.80% (n=5) on socio-economic analysis, 7.84% (n=4) on milk and meat quality, 1.96% (1) on the molecular study, and 3.92% (n=2) on nutrition, respectively. Of these studies, 54.90% (n=28) was carried out in the southern, 7.84% (n=4) in the northern, 9.80% (n=5) in both parts of Bangladesh, as well as 25.49% (n=12) in the different institutes.

CONCLUSIONS

The primary purpose of keeping buffalo in the household has been concentrated in meat and milk production. Buffalo has a high potential to meet the demand for milk and meat in Bangladesh. However, it is necessary to establish more efficient market channels to diversify meat and milk consumption. On the other hand, the high-impact research paper published in scientific journals is very limited. Therefore, it is high time to do more research on different aspects associated with improving different areas related to the production, quality, and sustainability of buffalo farming in Bangladesh.

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