Research Article

Socio-economic Status of Buffalo Value Chain at Bhola District in Bangladesh

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Abstract

The aim of the study was designed to investigate the socio-economic status of buffalo farmers, productive and reproductive performance, management practices, and cost-benefit analysis of buffaloes conducted in five Upazilas under Bhola district. Data were collected through interview of randomly selected 90 members of 13 branches of Grameen Jano Unnayon Sangastha (GJUS) who were involved in buffalo farming. The investigation revealed that majority of the buffalo farmers were poor (46.47%) in compared to ultra-poor (8.46%) and non-poor (45.07%), majority of the farmers were below primary (44.43%), and up to primary (31.48%), most of the farmers were over 25 years old (72.27%), about 96.36% farmers were male. Every buffalo farmers had average 5.28 family members. The mortality of buffalo calves, buffaloes and the average mortality of buffalo was 19.08%, 11.75%, 14.62% respectively and the average number of remaining buffalo after death per family was 3.83. In case of buffalo productivity, the average number of buffalo reared per farmers was 3.57 ± 0.34, body weight (kg) of buffalo cows, bulls, calves 239.53 ± 13.20, 229.43 ± 10.11, 17.21 ± 0.84kg, respectively, average lactation period was 169.13 ± 4.49 days and milk production was 264.084 ± 6.34 kg. In this study we found average post-partum heat period 3.55 ± 0.3 days, dry period 5.50 ± 0.6 days, calving interval 22.26 ± 0.97 months, age of first heat 3.1 ± 0.25 years, age of first pregnancy 3.4 ± 0.26 years, numbers of service per conception 1.77 ± 0.26 times, duration between estrus and insemination 10.09 ± 0.70 hours and in-breeding percentage 77.28%, average buffalo production cost was tk. 162445.3 ± 6137.49, income tk. 233493.5 ± 8853.42 and net profit was tk. 71048.13 ± 11693.89. All (100%) of the farmers have no familiar with Grain feed, silage, UMS, fattening, AI technology and regular vaccination. All (100%) of the farmers practice natural insemination technique, where 63.1% farmers have their own bull for breeding. Only 58.57% farmer use de-worming irregularly and 42.43% farmers use de-worming once in a year. No farmer use record keeping system in the farm. 95.18% farmers used own capital and 4.82% receive credit for buffalo rearing. Interviewing person involved in buffalo production it is found that they mainly buy buffalo directly from the farmer. Consumer buy buffalo milk 56 taka per kg. Butcher, dairyman, and dealer (bepari) earned net BDT 21000.0, 37500.0 and 26333.0, respectively. There is a belief that buffalo meat is not good for health that the reason consumer refuse to take buffalo. There is no available market for buffalo meat. This study would help the policy makers to take necessary strategies to improve the socio-economic status of buffalo farmers in this region of Bangladesh.

Keywords: Buffaloes, Socio-economic status, farmers, productivity

INTRODUCTION

Livestock is one of the major sector and 10 million people are directly related with this sector for their income generation in Bangladesh. Among different livestock species, the number of buffaloes in Bangladesh is 1.44 million (BER, 2014). Bhola is a buffalo concentrated area in Bangladesh. Available grazing land and favorable geographical environment make buffalo rearing a popular business in this area. At present the total buffalo population in Bhola is 90,827. In Bhola, normally two methods known as Bathan and are household rearing used for buffalo rearing. In average, 80-100 buffaloes are usually reared in Bathan and most of the families' rear 2-3 buffaloes all year long according to the tradition in this area. They do not know how to rear buffalo in a scientific method. They have lack of proper technical and technological knowledge, and do not know about good management practices like regular vaccination and de-warming, concentrated feed supply, not following proper breeding system, not having proper linkage with inputs like feed, fodder, bull, cow etc. Because of the above mentioned problems, inbreeding rate is high (around 90%). Due to lack of high yielding bull for service, fodder and good management practices, the productivity of buffalo is low (milk production on average: 1.25 litre/day/cow and lactation length on average: 180 days), mortality rate is high (average: 10-12%), sell and income of the beneficiary is low. To improve the condition, it is crucial to be familiar the within the studied areas in Bangladesh. If we consider the above mention problems and take necessary steps only for parasitic infestation and regular vaccination then the productivity of buffalo would be increased (milk production: 50% and lactation length: from 180 to 210 days), mortality rate would be reduced (from 10-12% to below 5%); strong market linkage would be built, sales would be increased, and overall income of the beneficiary would be increased (50%) and at the same time scope of employment generating opportunities would be increased. Therefore, the study was considered to identify the socio-economic profile of the buffalo keeping farmers; to analyze cost-benefit of Buffalo rearing; and to suggest policy implications arising from the findings.

MATERIALS AND METHODS

Study area

The study was conducted in Bhola Sadar, Lalmohon, Charfassion, Borhanuddin, Daulatkhan upazila under Bhola district of Bangladesh during November 2016 to June 2017.

Sample Size Determination

There were 7000 members of Grameen Jano Unnayon Sangstha in which population was grouped as Ultra-poor, poor and non-poor. For data collection, 90 stock holders were selected from the population using the following formula:

$$\text{Sample Size} = \frac{z^2 \times \frac{p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

Where,
N = No. of project members
e = Margin of Error (.05)
z = z Score (1.96 at 95% confidence level)
P = percentage picking a choice (.5)

In case of educational status, we categorized all the farmers into 5 groups (Non-educated, under Primary Education level, primary level, up to higher secondary level, graduate).

Preparation of interview schedule

A structured interview schedule was carefully prepared, keeping the objectives of the study. The questionnaire contained in the schedule was simple, direct and easily understandable by the respondents. The schedule contained a closed and open form of questions. Some scales were included in the schedule, wherever necessary. The draft interview schedule was pre-tested in the study area. After preparation of interview schedule, Field staffs were trained for a day for appropriate data collection.

Data Collection

Data were collected through interview of randomly selected members of 13 branches of Grameen Jano Unnayon Sangastha (GJUS) who were involved in buffalo farming. Before doing the interview, the objectives of the study were explained clearly to the respondents. Then the questions were asked in a very simple manner with explanation wherever necessary. To collect necessary information from the respondents, both interviewing and observation were applied. The relevant data for this study were collected without biasness. Respondents had no specific written documents of their own. So, they had to rely on memory. In order to minimize the

owner's memory bias, two visits were made in a season and questions were asked in a logical sequence so that the respondents could recollect facts easily.

Interviews were normally conducted in the respondent's house during their leisure time. Data were collected on the personal and socio-economic characteristics of the respondents, particularly their sex, age, household size, educational attainment, farm management practices; production and reproduction characteristics of buffaloes, cost and benefits from buffalo's value chains in studied areas.

Statistical analysis

Collected data were coded after ending of data collection and then compiled, tabulated and analyzed the data. The local units were converted into standard units. The qualitative data were transferred into quantitative data by appropriate scoring technique. Data were carefully tabulated and descriptive analysis was performed.

RESULTS

Socio-Economic Status of farmers

Farmers were categorized into three grouped as Ultra-poor, Poor, Non-poor and is presented in Figure 1. We found that 8.56%, 46.47%, 45.07% were Ultra-poor, Poor, Non-poor respectively. Table 1 shows that 47.5% of farmers were below 25 years old and 52.5% of farmers were over 25 years old, which indicated that number of older farmers was higher in experimental area. In case of sex, we observed 96.4% male farmers and 3.6% female farmers (Table 1). Every farmer had 5.28 members on their family.

The educational status of farmers is shown in Table 2. We observed that 3.8%, 44.43%, 31.48%, 16.17%, 5.14% farmers are Non-educated, under primary education level, primary level, up to higher secondary level, graduate respectively.
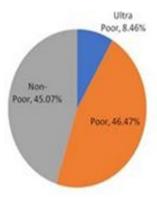

Figure 1: Economic status of buffalo farmers

Table 1: Ages, Sex and households of Farmers

Parameters	Types of Farmers			
	Ultra-poor	**Poor**	**Non-poor**	**Total**
Ages				
<25 years	39 (49.37%)	107 (24.65%)	113 (26.84%)	259 (27.73%)
>25 years	40 (50.63%)	327 (75.35%)	307(73.16%)	675 (72.27%)
Sex				
Male	230 (95.4%)	333 (98.2%)	337 (95.2%)	900 (96.4%)
Female	11 (4.6%)	6 (1.8%)	17 (4.8%)	34 (3.6%)
Households	4.80 (238)	4.94 (322)	5.92 (345)	5.28 (908)

Table 2: Educational Status of Farmer

Educational status	Types of Farmers			
	Ultra-poor	Poor	Non-poor	Total
Non educated	7 (8.3%)	12(2.7%)	7 (1.7%)	26 (3.8%)
Under Primary Education level	28(35.8%)	197(45.4%)	190(45.2%)	415(44.43%)
Primary level	30(37.5%)	145(33.3%)	119(28.2%)	394(31.48%)
Up to Higher Secondary Level	11(14.2%)	65(15.0%)	75(17.8%)	151(16.17%)
Graduate	3 (4.2%)	15 (3.5%)	30 (7.1%)	48 (5.14%)

Table 3: Production parameters (Mean±SE) of buffaloes in studied areas

Characters	Types of Farmers			
	Ultra-poor	Poor	Non-poor	Averages
Number of buffalo reared per farmers	2.80 ± 0.39	3.58 ± 0.48	4.28 ± 0.47	3.57 ± 0.34
Body Weight of buffalo Cow (kg)	221 ± 16.70	242.18 ± 15.04	255.58 ± 13.40	239.53 ± 13.20
Body Weight of buffalo bull (kg)	218.6 ± 10.25	225.4 ± 11.76	244.3 ± 12.88	229.43 ± 10.11
Body Weight of buffalo Calf (kg)	18.59 ± 0.85	16.52 ± 0.95	16.53 ± 0.93	17.21 ± 0.84
Lactation Period (Days)	162.7 ± 4.61	171.5 ± 4.67	173.2 ± 5.62	169.13 ± 4.49
90 days of lactation	1.45 ± 0.15	1.90 ± 0.17	2.09 ± 0.17	1.81 ± 0.14
90-150 days of lactation	1.28 ± 0.18	1.65 ± 0.15	1.49 ± 0.18	1.48 ± 0.15
>150 days of lactation	1.13 ± 0.17	1.65 ± 0.12	1.41 ± 0.11	1.39 ± 0.10
Milk Production per Day (Liter)	1.28 ± 0.11	1.73 ± 0.09	1.66 ± 0.12	1.56 ± 0.10
Total milk production per Lactation period (Liter)	208.26 ± 8.90	296.95 ± 10.19	287.12 ± 12.23	264.08 ± 6.34
Mortality of buffalo calves (%)	19.25	18.50	19.50	19.08
Mortality of buffalo (%)	12.0	11.75	11.50	11.75
Buffalo mortality (%)	15.10	14.25	14.50	14.62

Table 4: Reproductive parameters (Mean±SEM) of buffaloes in study areas

Characters	Types of Farmers			
	Ultra-poor	Poor	Non-poor	Averages
Age of first heat (years)	3.24 ± 0.25	3.0 ± 0.25	3.1 ± 0.26	3.1 ± 0.25
Age of first pregnancy	3.5 ± 0.25	3.3 ± 0.29	3.4 ± 0.27	3.4 ± 0.26
Number of Service per conception	1.8 ± 0.29	1.70 ± 0.26	1.85 ± 0.25	1.77 ± 0.26
Interval between estrus and insemination (hour)	9.24 ± 0.8	11.29 ± 1.04	9.77 ± 0.71	10.09 ± 0.70
Post-partum heat period (months)	3.50 ± 0.41	3.48 ± 0.33	3.68 ± 0.36	3.55 ± 0.36
Dry period (months)	5.5 ± 0.69	5.42 ± 0.65	5.50 ± 0.67	5.46 ± 0.67
Calving interval (months)	23.06 ± 1.30	21.80 ± 1.03	21.90 ± 0.9	22.26 ± 0.97
Inbreeding percentages				77.28%

Table 5: Management Practice of Buffalo in Bhola District

Parameters	Categories	Percentages (%)
Methods of Insemination	Natural Services	100.0
	Artificial Insemination	0.0
Use of Estrus Synchronization	Yes	0.0
	No	100
Sources of Breeding bull	Own farm	63.1
	Neighbor farm	36.9
Use of Grain/Ready feed	Yes	0.0
	No	100
High yielding Grass Cultivation	Yes	0.0
	No	100
Use of Urea Molasses Straw (UMS)	Yes	0.0
	No	100
Silage	Yes	0.0
	No	100
Use of Fattening Program	Yes	100
	No	100
Regular Vaccination	Yes	0.0
	No	100.0
Deworming	Regular	0.0
	Irregular	58.57
	Once in a year	42.43
Record keeping	Yes	0.0
	No	100
Training	Yes	7.71
	No	92.29
Source of training	Govt. Institute	100.0
	NGO	0.0
Carcass management	Float in the river	35.22
	Buried under 6 feet soil	64.78
Treatment availability	Enough	1.61
	Not enough	59.64
	No treatment available	38.76
Selection of dairy buffalo	From experience	45.7
	From training experience under project	54.3

Table 6: Source of capital for buffalo farming

Parameters	Categories	Percentages (%)
Credit for buffalo Farming	Yes	4.82
	No	95.18
Source of Credit for buffalo farming	NGOs	0.0
	Bank	15.56
	Others	84.44

Table 7: Cost (BDT) of Buffalo production according to buffalo farmers

Indication	Types of Farmers			
	Ultra-poor	Poor	Non-poor	Averages
Cost price of buffalo buy	60000 ± 5055.25	96000 ± 10770.33	105000 ± 8660.25	87000 ± 7310.56
Total feed cost	16355 ± 1016.52	21192 ± 1365.20	31946 ± 4439.35	22649 ± 1424.24
Treatment Cost	2029 ± 114.25	3660 ± 849.63	5568 ± 702.28	3752 ± 441.32
Vaccine and Anthelmintic cost	355 ± 62.99	675 ± 98.53	865 ± 99.51	631.67 ± 46.92
Labor Cost	12000 ± 846.56	35445 ± 5657.732	56638 ± 7671.88	34694.3 ± 3150.93
Housing cost	8502 ± 984.21	8420 ± 922.29	20272 ± 2880.19	12398 ± 1138.16
AI cost	00	00	00	00
Others Cost	534 ± 37.36	755 ± 91.00	1125 ± 145.27	804.66 ± 64.16
Total Cost	99775 ± 4869.675	166147 ± 11778.18	221414 ± 8620.49	162445.3 ± 6137.49

Table 8: Income from buffalo production

Indicator	Types of Farmers			
	Ultra-poor	Poor	Non-poor	Averages
Total Number of Buffalo	2.80 ± 0.39	3.6 ± 0.48	4.3 ± 0.47	3.57 ± 0.34
Price value of Lactating Cow (Taka)	80000 ± 11498.79	128000 ± 11085.53	140000 ± 13165.61	116000 ± 7686.76
Total amount of milk (Liter)	208.26 ± 15.60	475.12 ± 35.44	502.46 ± 36.74	395.16 ± 25.67
Price value of milk (Taka)	13481 ± 1348.85	25965.31 ± 3387.87	27459.44 ± 3014.12	22301.8 ± 2388.35
Number of Buffalo Sold per Year	1.20 ± 0.13	1.9 ± 0.34	2.36 ± 0.38	1.83 ± 0.23
Price Value of buffalo (Taka)	50000 ± 7149.20	93500 ± 10653.38	118000 ± 14427.6	87166.67 ± 4198.83
Price value of manure (Taka)	5000 ± 816.50	8000 ± 785.28	11075 ± 1121.79	8025 ± 706.89
Total income (Taka)	148481 ± 18100.56	259115 ± 15231.83	301401.11 ± 18552.5	233493.5 ± 8853.42
Net Profit (Taka)	48706 ± 20934.19	92968 ± 17128.09	79987.11 ± 22059.31	71048.13 ± 11693.89

Production and reproduction characteristics of buffaloes, and their management system practiced in study areas

We observed that the mortality of buffalo calves, buffalo, average buffalo mortality was 19.08%, 11.75%, 14.62%, respectively and the average number of remaining buffaloes after death per family were 3.83, and results are shown in Table 3. Average buffalo mortality was the highest in Ultra- poor family than that of Poor and Non- poor family. The average numbers of buffalo reared per farmers were 3.83. The Average body weight of buffalo Cows, bulls (kg) and calves was 239.53 ± 13.20 kg, 229.43 ± 10.11 kg, 17.21 ± 0.84 kg respectively. The average lactation period was 169.13 ± 4.49 days, average milk production per day is 1.56 ± 0.10 liter and total milk production in lactation period is 264.08 ± 6.34 liters.

Table 9: Information from Dairymen (N=11)

Indications	Answers
Collection of Milk from	
Directly from producer	11 (100%)
local market	0 (0%)
Both	0 (0%)
Selling of Milk	
To whole seller	2 (18.2%)
To shop which produce milk product	9 (81.8%)
Use to produce milk product	0 (0%)
Proper cleaning of milk pan	
Yes	7 (63.4%)
No	4 (36.4%)
Use of cloth or tree leafs to protect milk from dropping during transportation	
Yes	6 (54.5%)
No	5 (45.5%)
Use of modern technology to preserve and transportation of milk	
Yes	7 (63.4%)
No	4 (36.4%)
Milk collection (L) per day	118
Money value of collected milk (BDT)	5990.0
Milk (L) sold per day	118
Money value of sold milk (BDT)	7927.0
Cost for milk collection, processing and transportation	640.0
Net profit in a day	1277.0
Average Net profit in a month	37500.0

Table 4 shows the reproductive parameters of buffaloes. Average age at first heat (3.1 ± 0.25 years), age at first pregnancy (3.4 ± 0.26 years), number of services per conception (1.77 ± 0.26), duration between estrus and insemination (10.09 ± 0.70 hours), post-partum heat period (3.55 ± 0.36 months), dry period (5.46 ± 0.67 months), calving interval (22.26 ± 0.97 months) in buffaloes of the selected areas.

Management Practice of Buffalo in Bhola District

Table 5 shows that the entire farmer reared their buffalo in bathan (Chor) level. The all (100%) of the

farmers have no knowledge of ready feed, UMS, Fattening practice, silage, High yielding grass cultivation and AI practices. 100% practiced with natural insemination technique, 63.1% farmers have their bull for breeding and 36.9% farmers use breeding bull from neighboring farm. The all (100%) of the farmer have no knowledge of regular vaccination, regular de-worming and record keeping.

Table 10: Information from milk product producers (N=15)

Indications	Answers
Collection of Milk	
Directly from producer	6 (40.0%)
From local market	0 (0%)
From both	9 (60.0%)
Selling of Milk	
Local buyer	7 (46.7%)
Buyer from Dhaka	8 (53.3%)
To both	0 (%)
Hygienic measurement of milk factory	
Yes	7 (46.7%)
No	8 (53.3%)
Knowledge on hygienic measurement of milk product	
Yes	6 (40.0%)
No	9 (60.0%)
Amount of collected milk in a day (liter)	137
Money value of collected milk (tk)	8472.0
Amount of sold milk product (liter)	130
Money value of sold milk product (tk)	11303.0
Cost value (tk)	1160.0
Net profit in a day (tk)	1666.0
Average Net profit in a month (tk)	49600.0

Cost-benefit analysis of Buffalo Farming

Table 6 shows that 95.18% of farmers used their own capital and 4.82% receive credit for buffalo rearing. According to the source of capital, farmers are classified into three categories. Table 6 shows that about 00, 15.56 and 84.44% respondents used NGOs, bank and others loan for buffalo production, respectively. Table 7 shows per year cost of feeding, breeding, housing, equipment, medicine and vaccine of buffaloes. Per year cost of housing and equipment was lower than the feed cost.

Table 11: Information collected from the Dealer as Bepari (N=3)

Indications	Answers
Source of buying buffalo	
Directly from farmers	1 (33.33%)
Local market	1 (33.33%)
Both	1 (33.33%)
Source of selling buffalo	
Local butcher	3 (100%)
Local market	0 (0%)
Both	0 (0%)
Total number of buffalo bought in a month	3.7
Money value of buffalo bought in month (BDT)	215,000.0
Total number of buffalo sold in a month	3.7
Money value of buffalo sold in month (BDT)	250,000.0
Total cost in month (BDT)	8666.0
Net profit per month (BDT)	26333.0

Table 12: Information collected from butcher (N=2)

Indications	Answers
Source of buying buffalo	
Directly from farmers	1 (50.0%)
Local market	0 (0%)
Bepari	1 (50.0%)
Source of selling buffalo	
Local consumer	2 (100%)
Others	0 (0%)
Total number of buffalo bought in a month	2
Money value of buffalo bought in month (tk)	120,000.0
Total number of buffalo sold in a month	2
Money value of buffalo sold in month (tk)	150,000.0
Total cost in month (tk)	9,000.0
Net profit in a month (tk)	21,000.0
Ages of slaughtered buffalo	
Over 8 years old	2 (100.0%)
Less than 2 years	-
3-5 years old buffalo	-

Table 8 shows income and profit from buffalo farming in study areas. The annual average income per year per post-weaning male calves, milk, manure, was BDT 116000 ± 7686.76, BDT 22301.8 ± 2388.35 and BDT 8025 ± 706.89, respectively. Average income from buffalo production was BDT 254233493.5 ± 8853.42 and net profit was BDT 71048.13 ± 11693.89.

Table 13: Information collected from consumers (N=14)

Indications	Answers
Do you buy milk for consumption?	
Yes	14 (100%)
No	0 (0%)
Source of buying of milk	
Directly from the farmers	11 (78.6%)
Dairyman	3 (21.4%)
Local market	-
Price of per liter milk (tk)	65.0
Source of buying of milk product such as sweet, yogurt etc.	
Local shop	14 (100%)
Others	-
Price of per liter yogurt from buffalo milk (tk)	118.0
Price of per kg sweet produced from buffalo milk (tk)	250.0
Are you satisfied with the quality of milk product?	
Yes	14 (100%)
No	-
Do you eat buffalo meat regularly?	
Yes	-
No	14 (100%)
Why do you refuse buffalo meat?	
It is not available	14 (100%)
Bad smell from buffalo meat	-
Thick fiber	-
Bleakish color muscle	-
Expensive	-
Poor quality	-
Tasteless	-
What do you think about buffalo meat?	
Not good for health	14 (100%)
Tasteless	-
Average taste	-
Total amount of buffalo meat bought in a month (kg)	3.5

Interviewing of people involved in buffalo production

Interviewing 11 dairymen it is found that all of them collect milk directly from farmer and sold it 18.2% to whole seller 81.8% to milk product producing shop, they do not use proper cleaning procedure for milking and 54.5% dairyman use tree leaves to protect milk during transportation. From information dairyman we found that they earn net profit BDT 37500 every month (Table 9).

Table 10 shows that 40% of the milk product producer collects milk directly from farmer, 60% from both farmer and local market and 46.7% of them sells milk local buyer, 53.3% sells milk to buyer from Dhaka. In case of Hygienic measurement of milk factory 46.7% of producer do not follow hygienic measurement. In case of profit we found that they earn net BDT 49600 per month.

Table 11 shows that 33.33% Bepari (middle man) collect buffalo directly from farmer 33.33% from local market, 33.33% from both and 100% them sells to the butcher. They earn net BDT 26333 per month.

Table 12 shows that 50% of the butcher buys buffalo directly from farmer, 50% from Bepari and they sold 100% buffaloes to local consumer. In case of ages of slaughtered buffalo Table 12 also shows 100% of buffalo are aged over 8 years. In case of profit, we found that they earn net BDT 21000.0 per month.

Table 13 shows that among 100% of the consumer buy milk at the rate BDT 65.0 per liter for consumption, 78.6% of the consumer buy milk directly from farmer and 21.45 from dairyman. Price of per liter yogurt and per kg sweet produced from buffalo milk was BDT 118.0 and BDT 250.0, respectively. We found that 100% of consumers was not satisfied with the quality of the milk and milk product. In case of buffalo meat, we observed that every consumer toke buffalo meat irregularly as it was not available all the time and 100% of them thought that buffalo meat was not good for health. They bought 3.5kg buffalo meat in a month.

DISCUSSION

This paper aims to discuss the present situation and future prospects of buffalo production at Bhola district in Bangladesh. Buffalo could be a major source of milk and meat to reduce the milk and meat demand gap in Bangladesh. The analysis provided an overview status and with the importance of value chains in the current problems facing this industry.

Socio-Economic Status of farmers

We found that 8.56%, 46.47%, 45.07% were Ultra-poor, Poor, Non-poor respectively (Figure 1). Amin *et al.* (2015) reported that 68% of farmers of Subornochar Upazilla in Noakhali district of Bangladesh were of medium-income categories, but in Bhola district, middle income percentage is lower because of communication facilities. We observed that number of older farmers was higher (52.5%) in experimental areas and 96.4% were male farmers. Each farmer had 5.28 members in his family. Siddiki *et al.* (2016) reported that the average age of the buffalo farmers in the study area was 31.1 years. The majority of the buffalo farmers were below 30 years of age followed by 31-40 years and few numbers of the farmers were above 50 years at Lalpur Upazilla of Natore district in Bangladesh. Islam *et al.* (2016) reported that average family size was 6.17,

which are almost similar with our study.

In this study, it was observed that, 44.43% and 31.48% were under primary education level, and primary level, respectively, which indicated that farmers were not educated in Bhola district. Rahim *et al.* (2018) also reported education level of farmers' which was no schooling (20%), primary (50%), secondary (20%), higher secondary (7%) and graduation (3%), respectively at Suborna char upazilla in Bangladesh, which is more or less similar with this study. However, the level of education is generally considered as an index of social advancement of a community or a nation as a whole. Education has its own merit and contributes to economic, social, environmental and ethical development. It plays a pivotal and significant role in the adoption of new and innovative technology and agricultural modernization, especially in rearing buffalo.

Production and reproduction characteristics of buffaloes and their management system practiced in study areas

We found that buffalo produced high amount of milk during early lactation in this study. Harun-Or-Rashid *et al.* (2017) reported that milk production per day 1.53 ± 0.51 kg, which is similar to this study and averages lactation periods was 230.56 ± 34.78 days, which is higher than our study. Uddin *et al.* (2016) reported total milk production in a lactation period was 435liter, which is higher than this study.

In this study, almost all respondents viewed that average age at first heat that was the puberty of buffaloes was almost similar (3.1 years). Siddiki *et al.* (2016) reported that number of services per conception, post-partum heat period, age of first heat, age at first pregnancy and inter calving period of buffaloes in the selected area were 3.42 times, 5.31 months, 3.46 months, 3.82 months and 13.5 months, respectively at Lalpur upazilla of Natore district in Bangladesh. We found some deviation in case of the number of services per conception and calving interval from the report of Siddiki *et al.* (2016).

Management Practice of Buffalo in Bhola District

All of the farmers practice natural insemination technique, where 63.1% farmers used their own bull for breeding. Data collected on farm management system showed that 58.57% farmers performed de-worming irregularly, no farmer used record keeping system in

the farm. No one use estrus synchronization program (0.00%). Rahim *et al.* (2018) showed that 100% farmer use natural insemination among them 80% farmer have their own breeding bull in plain land of Subornachar upazilla in Bangladesh which is similar with this study. No farmer use Urea molasses Straw, fattening program and regular vaccination. In case of deworming program regular, irregular and once in a year deworming percentage are 00.00%, 58.57%, 42.43%, respectively. Sarker *et al.* (2013) reported that 88% of farmers practiced deworming and vaccination, which was higher than this study. Rahim *et al.* (2018) shows that about 40% of farmers vaccinated their buffalo and 60% of farmers did not vaccinate their buffalo regularly. He also reported that no farmers used hormones, antibiotic and growth promoter for higher meat production, which similar to this study. No farmer use record keeping system on the farm. About 7.71% of farmers have training for buffalo rearing, all of them receive training from Government Institute and 92.29% of farmers do not have training for buffalo rearing. Hossain *et al.* (2016) showed that 3% of farmers kept their livestock record, which is in agreement with this study.

Cost-benefit analysis of Buffalo Farming

We observed farm economy i.e. cost, income and profit from buffalo farming in study areas. 95.18% farmers used own capital and 4.82% received credit for buffalo rearing. These results are similar to the findings of Islam *et al.* (2016), where they reported that 86.7% used their own capital for buffalo production. Siddiki *et al.* (2016) also reported that farmers received bank loan/NGO and own capital were 68 and 32%, respectively.

Average buffalo production cost was BDT 162445.3 ± 6137.49, income was BDT 233493.5 ± 8853.42 Total rearing cost of buffalo per year was BDT 162445.3 ± 6137.49. Farmers generally do not use AI and bred their buffaloes with their own and/or neighboring buffalo bull. For this reason, the breeding cost was low. On the other hand, they did not purchase any feed for buffalo except for the scarcity period; that time they purchase straw and concentrate feed. The major cost of healthcare was medicinal. Amin *et al.* (2015) and Sarker *et al.* (2013) reported that the total rearing cost of one buffalo per year was BDT. 6850.00 and BDT 5070.00, respectively in Bagerhut and Noakhali districts in Bangladesh. The rearing cost was found higher in Lalpur than that from above mentioned district. In this study, it was observed that net profit was

BDT 71048.13 ± 11693.89. Kalash *et al.* (2009) and Amin *et al.* (2015) reported that the net annual income of buffalo rearing was BDT 13932.0, Rs. 30784.00 in Bangladesh and India, respectively. In this study, the net profit from buffalo production per year was BDT 73998.39 indicated that rearing buffaloes in the selected area were profitable.

Interviewing of person involved in buffalo Value Chains

Livestock Service provider (LSP): We observed that there is no trained LSP, also known as quack. But some local quack treated the buffalo. Each quack treated a total of 135 buffaloes per month and earned BDT 13550.0 per month. LSP are involved in the supply of animals for fattening, provision of animal health services, feed and provision of credit services in Bangladesh (Sarma *et al.*, 2017). So, LSP are the vital factors after farmers to keep the buffaloes, its meat and milk products healthy and help in the increment of production.

Dairyman (Goala): We observed that Butcher, dairyman, and bepari mainly bought buffaloes directly from buffalo farmers as there was no available local market excess. Butcher, dairyman, and Bepari earned net BDT 1000.0, 37500.0 and 26333.0, respectively. There is a believe that buffalo meat is not good for health that the reason consumer refuse to take buffalo. We need to raise awareness about the benefit of buffalo meat, milk and milk product. Sarma *et al.* (2017) have mentioned that, these market agents serve as mediators between buyers and sellers in the livestock market. They are usually expected to link buyers with sellers and facilitate the terms of exchange. Considering all the studied parameters, it can be concluded that buffalo rearing was a profitable practice in the selected areas leading the socio-economic status of buffalo farmers.

Producer: According to the information of dairy product producers, 40% producer bought milk directly from farmers and 60% bought from goala. Then, they sold the 46.7% product to local market and 53.3% to Dhaka's market. 60% had no enough knowledge and skill about the hygienic way of production. Producer earns monthly BDT 51090.0 by selling products. Sarma *et al.* (2017) have stated that the smallholder producers in are the major suppliers of buffalo for domestic consumption and meat processing. Particularly the smallholder cattle farmer supplys fattened buffalo to the terminal markets all year-round.Considering the above parameters, producers are the essential part of value chain

because they always supply alternative products to the markets and consumers on the basis of market demand.

Bepari (Dealer): According to the information of dealer, 40% buffalo was sold to butcher and rest 60% buffalo was sold to wholesaler, which contains per month 13.75 in number and profit gain BDT 28340.00. Usually, market agents usually operate in the primary beef markets, buy up to 5-8 animals on a given marketing day using their own capital or big traders' money and they have trade ties with affiliated large traders. Considering the mentioned fact it is evident that dealer plays an important role in value chain by selling and supplying of buffalo meat and milk products.

Butcher (Kosai): Based on the information of butcher, we observed that 50% butcher bought directly from producer and rest 50% bought from dealer. Local customers are the main consumer. They sold monthly 10.5 buffaloes and earned BDT 22500.0 profit. A total of 80% butchers were found to slaughter old aged buffalo and 20% slaughtered young aged buffalo.

According to the operators of butcher stands in supermarkets, minced beef is the best seller among beef products indicating that there many consumers, irrespective of income levels, prefer to purchase minced beef in supermarkets rather than roadside butcheries. The prices are typically significantly higher in comparison to those in road side butcheries (Sarma *et al.*, 2017). This is an indication that consumers are willing to pay more for meat that has been processed in a hygienic manner. Hasanullah (2013) observed that the Metropolitan kosais added the highest value (BDT 6500.00) per 100 kg bull followed by Dealers (BDT 4350.00), local kosai (BDT 3850.00), farmers (BDT 3500.00), foreyas (BDT 1500.00) and brokers (BDT 1350.00). On the basis of above statement it is obvious that, buffalo rearing is the profitable business to the butchers than other animals.

Consumer: It was found that 80% consumers bought liquid milk directly from farmers and 20% bought from goala at a rate of BDT 65.0 per liter only. Most of the producers sell their products like curd, sweets etc. to local market and customers are satisfied about that product. Most of the consumers don't take buffalo meat regularly because it's not available to everywhere. Consumer seems that buffalo meat is not good for health and every consumer purchases 1.75 kilogram beef per month. Sarma *et al.* (2017) have mentioned lack of fresh, hygienic and halal beef, lack of quality and high price as the main causes leading not to consume buffalo meat. Moreover, consumers are also highly interested to consume buffalo meat and milk products if it maintains proper hygiene.

This study shows that there is a vast demand for buffalo's milk and meat and a great employment opportunity in buffalo farming of Bangladesh. This study also suggests that buffalo improvement program through scientific way such as, use of quality breed, improved management system and technical knowledge along with buffalo value chain in different farming systems, will increase the production of buffalo in Bangladesh.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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