IJAS Iranian Journal of Applied Animal Science

Performance Traits of Buffalo under Extensive and Semi-Intensive Bathan System

Research Article

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Received on: 6 Apr 2016
Revised on: 26 Jun 2016
Accepted on: 15 Jul 2016
Online Published on: Dec 2016

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Online version is available on: www.ijas.ir

ABSTRACT

This study was conducted to investigate the scenario of buffalo production and reproduction under different farming systems at Subarno Char, in the coastal area of Bangladesh. A total of 14 farms were randomly selected and studied for various traits live weight (LW); daily milk yield (DMY); lactation length (LL); lactation production (LP); calving interval (CI); gestation length (GL); post partum heat period (PPH); age at first calving (AFC) and service per conception (SPC) of buffaloes through pre designed questionnaire, direct observation and available records. The LW (372.31±14.64 kg) and DMY (1.99±0.16 liter/day/cow) were found to be highest under semi-intensive bathan farming systems than other systems, however, the LL (275.25±2.857 days) and LP (628.80±34.49 liter) were found higher under extensive bathan farming system irrespective of breeds. On the other hand, LW (390.54±14.06 kg), DMY (2.82±0.13 liter/day/cow), LL (284.96±3.31 days) and LP (899.75±52.83 liter) were higher in River type buffaloes than other types. The GL (305.37±0.72 days), CI (640.34±51.31 days), AFC (54.72±1.57 months) and SPC (1.62±0.21) were found lowest under semi-intensive bathan farming system, but PPHP (134.04±5.30 days) was found lowest under the extensive bathan farming system. The GL (301.74±0.63 days), PPHP (123.21±7.50 days), AFC (47.00±1.35 months) and SPC (1.40±0.16) were found lowest in River type buffaloes, but CI (660.31±43.82) was lowest in crossbred buffalo cows. The birth weight was highest (28.28±0.48 kg) under semi-intensive bathan farming system. Productive and reproductive performances of buffaloes under the study area found were moderate. The profitability of buffalo rearing under extensive farming system was higher than other. The findings of this study may assist farmers and policy makers in making decisions for future buffalo farming and undertaking the genetic improvement program to increase the milk production in Bangladesh.

KEY WORDS breeding, buffaloes, farming systems, management, performance traits.

INTRODUCTION

Buffalo population in Bangladesh is about 1.47 million (FAO, 2013), which is 0.7% of total population of the world (FAO, 2010). Buffaloes are the important species in the tropical and subtropical countries of the world including Bangladesh for their uses in agricultural sector. The farmers are keeping buffaloes for milk and traction their cultivable land. Buffaloes are the second largest ruminants, reared extensively in this country and a vital part of the national economy. Buffalo not only contributes significantly to the national gross domestic product (GDP) of Bangladesh but also the provision of employment and food to the rapidly growing population of the country. Buffaloes are raised under an extensive system in the coastal and hilly areas where large-scale pasture land and enough green forages/grasses are available. In addition, buffaloes are raised under a semi-intensive system on plain land and marshy land where there is limited pasture land. Both the River and Swamp type and their crossbred buffaloes are available in Bangladesh. These buffalo are found in the Bramhaputra-Jamuna flood plain of central Bangladesh, the Ganges-Meghna flood plain of southern Bangladesh and in institutional herds (Faruque, 2000). The Subarno Char is in the coastal area of the Bay of Bengal which represents an extensive flat, coastal and delta land, situated on the tidal flood plain of the Meghna river delta, characterized by flat land and low relief.

The area is affected by diurnal tidal cycles and the tidal fluctuations vary depending on seasons, being pronounced during the monsoon season. However, there are very little information available for current buffalo production (breeding, feeding), management and economics in this area. Furthermore, the decision is required for profitable farms these are (i) the number of buffaloes to be run by a farmer; (ii) which breeds/genotype (s) are suitable; (iii) what type and level of supplementary feed is required throughout the year; (iv) the area to be cultivated for fodder; (v) the amount of feed to be conserve to meeting the shortage of feed. For running a profitable farm it is very important to identify the differences in production and efficiency to use the input (Kirk *et al*. 1988; Khan, 2009) this will assist the policy makers, researchers and farmers to making decision for profitable buffalo farming. Although the buffaloes are available their present scenarios are unidentified. Therefore, the current study was aim to find out solution of the above questions, evaluate the present situation of buffalo production, reproduction, economics and provide suggestion for improve the buffalo production.

MATERIALS AND METHODS

Study area and study period

The study was conducted in the coastal area (Subarno Char) from October, 2013 to November, 2014 in the Noahkhali District, which is located in the western part of Bangladesh at the bank of "the Bay of Bengal" and in the Department of Genetics and Animal Breeding at Chittagong Veterinary and Animal Sciences University (CVASU). Total number of buffaloes is shown in Table 1.

Identification of type

Different types of buffalos were seen in this area. The phenotypic and morphological features of the available buffaloes were recorded according to the criterion described by Faruque *et al*. (2004); Faruque and Hossain (2010). As per the phenotypic and morphological features; the available buffaloes in the study area were categorized and identified their breed/type.

Data collection

A pre designed questionnaire was used for collecting the information on buffalo production, reproduction and their management. Data was collected on various production parameters (live weight, milk yield, lactation length and lactation production) and reproduction parameters (calving interval (CI); gestation length (GL); postpartum heat period (PHP); age at first calving (AFC) and service per conception (SPC). A total of 14 households (of those farmers who have at least 10 buffalo) were surveyed directly.

Table 1 The number of various genotypes in different system

Type	Semi intensive farming system	Extensive farming system
River type	152	68
Crossbred type	181	203
Swamp type	127	411
Total	460	682

Calculation of live weight (LWT)

Body length (L) was taken from the point of shoulder to the pin bone and heart girth (G), were measured in inch using a measuring tape and the live weight of each buffalo was estimated according to the simple fairly accurately method of (Carroll and Huntington, 1988; Hossain and Akhter, 1999; Milner and Hewitt, 1969) by using the following formula:

$$LWT\ (kg)= (L\times G^2) / (300\times 2.25)$$

Fitting the linear regression

In the linear regression equation:

$$Y= a + bx$$

Where:
Y: value of the traits.
x: lactation number.
a and b: parameters that define the shape of the curve.

The different traits (daily milk yield, lactation production, lactation length, post partum heat period and gestation length and live weight) was set as dependent and time (lactation number) was set as independent variable. The model was analyzed by microsoft excel-2007 to obtain the model parameters (a and b). Along with the fit statistic co-efficient of determination (R^2) was also obtained. Estimated values of various traits were calculated according to Van Arendok (1985) for comparing the studied values by using age adjustment factor as lactation adjustment factor.

Profitability estimation

For estimating the profitability of buffaloes under two different production systems a deterministic linear programming model, context using Microsoft Excel was used according to Khan *et al.* (2010) and Khan *et al.* (2014). The profitability analyses were done based on average values of marketable products (milk and meat) and the expenses incurred in buffalo production (feed costs, health, reproduction and fixed costs). The profit was derived as the difference between income (I) and costs (C). The input parameters of buffaloes are presented in Table 5. Total metabolizable energy (ME) requirement per buffalo cow per year was the sum of ME requirement for maintenance, growth, pregnancy and production and was calculated according to AFRC (1993). The milk production per lactation was considered as milk production per calving interval and the milk yield (kg/year). The dry matter (DM) requirements were calculated by the content of ME per kg DM. It was considered that buffalo cows were consuming roughage from grazing and paddy straw and 2 to 3 kg concentrate mix (brans, oil cakes and grains) per day per buffaloes under semi-intensive and 1 to 2 kg for buffaloes under extensive system, to fulfill their energy requirements. The feed cost (roughage and concentrate mix) for buffaloes under different production systems were calculated at 0.10-0.12 US$ per kg DM. The profit was derived from the differences of the sale of milk and beef, and the cost of feed and fixed costs (operational cost).

Statistical analysis

The collected data was corrected and analyzed by using the statistical package SAS (SAS, 2008) and the following statistical model was used to obtained the least square means for each parameters.

$$Y_{ijk} = \mu + F_i + B_j + e_{ijk}$$

Where:

Y_{ijk}: traits' value.

μ: overall mean.

F_i: effects of farms.

B_j: effect of breed.

e_{ij} is the residual effect, distributed as N $(0, \sigma^2)$.

The mean differences were compared using least significant difference (LSD) (Steel *et al.* 1997) at 5% level of significance.

RESULTS AND DISCUSSION

Productive performance of buffalo cows

The means with standard error values of different productive traits are shown in Table 2. All the productive parameters: LW, DMY were found significantly higher in River type than Swamp type buffalo (Table 2), however, crossbred showed intermediate performance. In comparison to the production system, the LW (372.31±14.64 kg) and DMY (1.99±0.16 liter/day/cow) was found to be highest under semi-intensive bathan farming system than the extensive bathan farming system irrespective to the breed. On the other hand, the LL (275.25±2.857 days) and LP (628.80±34.49 liter) of different breeds were found higher under extensive bathan farming system than the intensive bathan farming system in coastal areas (Table 2).

In comparison to breed, the LW (390.54±14.06 kg), DMY (2.82±0.13 liter/day/cow), LL (284.96±3.31 days) and LP (899.75±52.83 liter) were greatest in the case of River type buffalo cows and lowest in Swamp type, while crossbreed type shown intermediate performance irrespective to farming system. The DMY was significantly different ($P<0.05$) among the season within the breed, within the breed between season, between breed within a season (Table 2).

Reproductive performance of buffalo cows

Reproductive performance found better in river types than any other types. The mean ± standard error values of different reproductive traits are shown in Table 3. All reproductive traits (GL, CI, PHP, AFC and SPC) were highest in Swamp type buffalo cows and lowest in River type buffalo cows and. In comparison to breed type, GL (301.74±0.63 days), PHP (123.21±7.50 days), AFC (47.00±1.35 months) and SPC (1.40±0.16) were found to be lowest in River type buffalo cows than other type buffalo cows, but surprisingly CI (660.31±43.82) was found lowest in crossbred type cow irrespective of farming system (Table 3).

Comparing farming system, GL (305.37±0.72 days), CI (640.34±51.31 days), AFC (54.72±1.57 months) and SPC (1.62±0.21) were found to be lowest under semi-intensive bathan farming system than the extensive bathan farming system, where the values were 306.44 ± 0.58 days, 696.95 ± 35.12 days, 56.02 ± 1.90 months and 1.73 ± 0.11, respectively, whereas PHP (134.04±5.30 days) was found lowest under the extensive bathan farming system than semi-intensive bathan farming system (142.54±7.28 days) irrespective of breed.

Live weight and birth weight of male and female buffaloes

The mean with standard error values of LW and birth weight are shown in Table 4. Average LW of a male buffalo (395.39±12.45 kg) was significantly higher than for a female buffalo irrespective of the breed type (Table 4). There was no significant dissimilarity found between LW of semi-intensive bathan farming system (360.36±11.48 kg) and extensive bathan farming system (365.34±13.33 kg) irrespective of sex.

Table 2 Mean ± standard error of various productive traits in buffalo cows

Types	Semi-intensive Bathan farming system				Extensive Bathan farming system			
	LWT (kg)	DMY (lit/day)	LL (days)	LP (liter)	LWT (kg)	DMY (liter/day)	LL (days)	LP (liter)
River type	427.06[by] ±15.49	3.14[by] ±0.23	283.34[b] ±4.26	890.56[bx] ±47.89	354.01[y] ±12.62	2.50[bx] ±0.12	286.56[b] ±2.35	908.93[by] ±57.77
Crossbred type	343.95[a] ±13.16	1.60[ab] ±0.14	274.58[aby] ±2.19	488.31[abx] ±45.78	340.43[b] ±12.14	1.85[ab] ±0.12	263.93[abx] ±4.75	636.68[aby] ±25.47
Swamp type	345.93[ay] ±15.25	1.25[a] ±0.11	247.54[a] ±2.62	314.70[a] ±22.86	305.50[ax] ±8.65	1.15[a] ±0.09	243.33[a] ±1.48	340.80[a] ±20.23

LWT: live weight; DMY: daily milk yield; LL: lactation length and LP: lactation production.
[a, b]: the means within the same row (within season within breed) with different letter, are significantly different ($P<0.05$).
[x, y]: the means within the same column (between farming system) with different letter, are significantly different ($P<0.05$).

Table 3 Mean ± standard error of various reproductive traits in buffalo cows

Types	Semi-intensive farming system					Extensive farming system				
	GL (days)	CI (days)	PPH (days)	AFC (months)	SPC	GL (days)	CI (day)	PPH (day)	AFC (months)	SPC
River type	301.05[ax] ±0.57	580.86[x] ±37.02	129.75[a] ±9.16	46.00[a] ±1.05	1.43 ±0.20	302.42[ay] ±0.68	762.50[y] ±50.62	116.67 ±5.84	48.00 ±1.65	1.36 ±0.12
Crossbred	305.33[bax] ±0.83	673.75 ±57.24	145.25[a] ±4.39	58.05[b] ±1.35	1.67 ±0.20	307.67[by] ±0.45	647.36 ±30.40	139.50 ±5.83	60.00 ±1.68	1.88 ±0.13
Swamp type	309.54[b] ±0.90	666.41 ±59.68	152.63[b] ±8.29	60.12[b] ±2.32	1.75 ±0.22	309.23[ba] ±0.60	681.00 ±24.35	145.95 ±4.22	60.06 ±2.45	1.94 ±0.09

GL: gestation length; CI: calving interval; PPH: postpartum heat; AFC: age at first calving and SPC: service per conception.
[a, b]: the means within the same row (among season within breed within farming system) with different letter, are significantly different ($P<0.05$).
[x, y]: the means within the same column (between system within season within breed) with different letter, are significantly different ($P<0.05$).

Table 4 Live weight and birth weight of adult male and female buffaloes

Types	Male buffalo LW (kg)			Female buffalo LW (kg)		
	Semi-intensive	Extensive	Birth W (kg)	Semi-intensive	Extensive	Birth W (kg)
River type	457.80[bd] ±10.84	442.82[b] ±21.72		427.06[bcy] ±15.49	354.01[bx] ±12.62	
Crossbred	362.50[ax] ±8.86	396.68[abdy] ±11.37	28.28[y]±0.48	343.95[a] ±13.16	340.43[c] ±12.14	26.82[x]±0.70
Swamp type	359.92[ad] ±8.64	352.62[a] ±10.46		325.72[ac] ±11.95	305.50[a] ±8.65	
Average	**393.41[d] ±9.45**	**397.37[d] ±15.52**		**327.31[c] ±13.53**	**333.31[c] ±11.14**	

LW: live weight and W: weight.
[a, b]: the means within the same row (between breed within system and within sex) with different letter, are significantly different ($P<0.05$).
[c, d]: the means within the same column (between sex within system) with different letter, are significantly different ($P<0.05$).
[x, y]: the means within the same column (between system within breed and within sex) with different letter, are significantly different ($P<0.05$).

Buffalo of extensive bathan farming system attained more LW than semi-intensive bathan farming. Among the breed types, average LW of River type male buffalo (457.80±10.84) considerably differed from crossbreds and Swamp types. Among the breeds, between farming system and between sex River type males attained a maximum weight in the studied area. In case of birth weight, a significant difference ($P<0.05$) was observed between male and female calves.

Performance of various traits after fitting regression equation

The values of the linear regression equation of DMY, LL, LP, GL, PPH and LW of buffalo cows are shown in Table 5.

The curve shape of DMY, LL, LP, GL, PPH and LW of buffalo cows after fitting linear regression have shown in Figure 1.

Profitability of buffaloes under different production systems

Table 6 shows the costs, revenues and profit of buffalo cows under two different production system on a per cow per year basis. Table 6 indicated that the average net income of buffalo cow under semi-intensive system (US$ 100) was higher than extensive production system (US$ 40).

Total revenue was dominated by the sale of milk and beef as buffaloes were reared in these areas for milk and beef.

Table 5 Estimated model parameters (a and b) and fit statistics (R^2) of different traits of buffalo cows irrespective to breeds

Traits	a (intercept)	b (slope)	R^2 (coefficient of determination)	Original value	Estimated value in different lactation							
					1	2	3	4	5	6	7	8
DMY	0.91	0.37	0.96	1.92	1.19	1.62	2.02	2.32	2.590	2.820	3.00	3.13
LL	241.80	6.79	0.97	266.55	248.59	255.38	262.17	268.96	275.75	282.54	289.33	296.12
LP	240.00	109.60	0.97	596.67	325.13	450.01	568.80	657.66	740.72	807.84	866.19	903.96
GL	310.00	-1.18	0.80	305.87	308.82	307.64	306.46	305.28	304.10	302.92	301.74	300.56
PPH	147.00	-4.07	0.53	138.29	142.93	138.86	134.79	130.72	126.65	122.58	118.51	114.44
LW	302.30	14.66	0.48	362.85	293.88	325.24	346.28	350.11	353.06	351.23	347.44	351.54

DMY: daily milk yield; LL: lactation length; LP: lactation production; GL: gestation length; PPH: postpartum heat and LW: live weight.

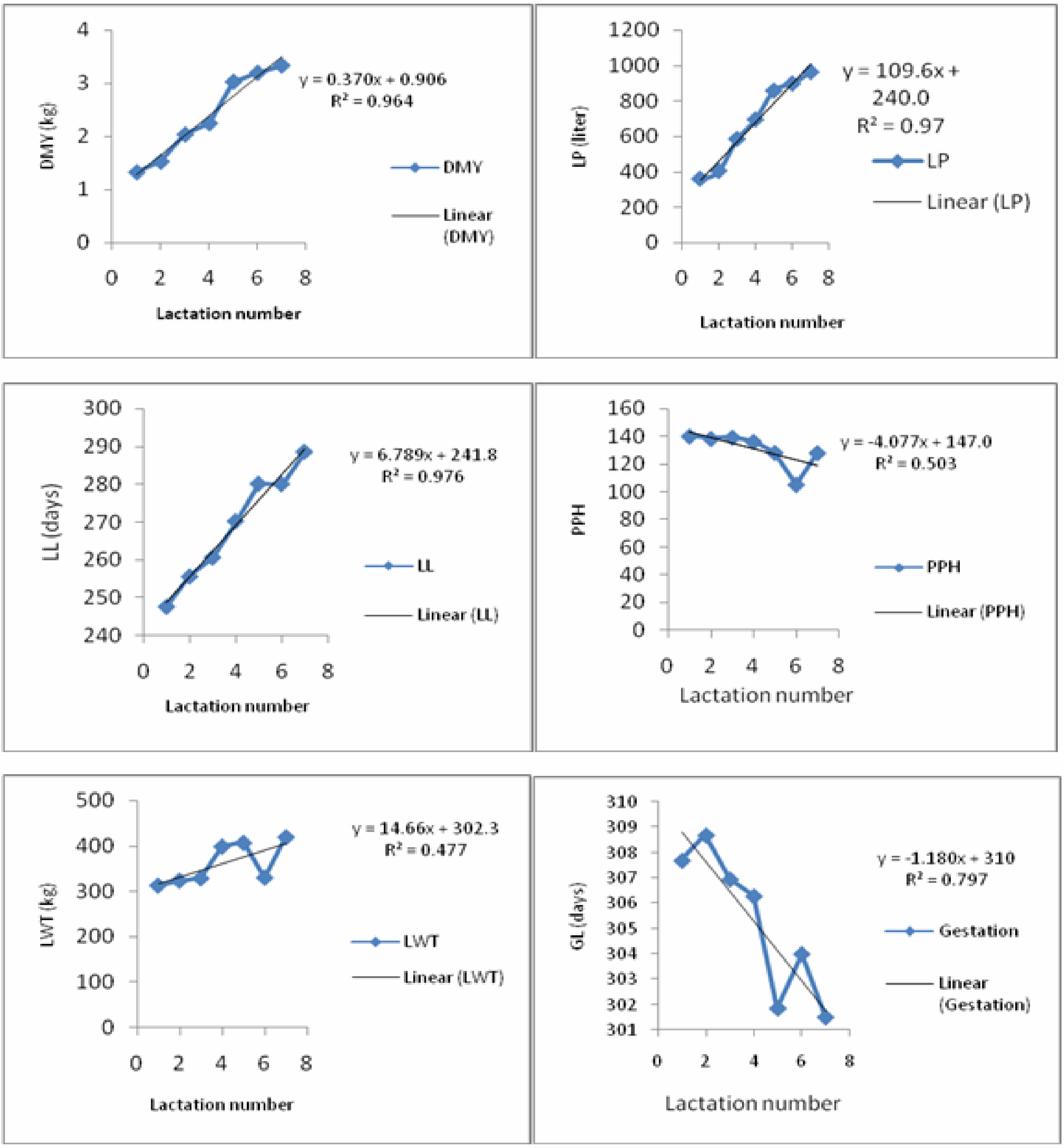

Figure 1 Curves of the different traits obtained from linear regression

Feed costs accounted about 85% of the total costs. Health costs, reproduction costs, labour costs, marketing costs and all other operational and management costs were assumed to be fixed costs. Buffaloes under both systems had similar DM requirements for maintenance, growth of replacements and lactation. However, the buffaloes had the highest milk and beef revenue and that generated highest profit in extensive system than other.

Productive performance of buffalo cows

Considering production system, semi-intensive farming system was superior farming system and river type found better performer buffalo than other type. The live weight of buffaloes irrespective of sex under semi-intensive farming systems were found to be significantly higher ($P<0.05$) than for extensive farming system. This higher value under semi-intensive bathan farming systems might be due to availability of heavier River type of buffalos and their crosses. In addition, this could happen due to good management factors of buffaloes. The farmer's farm buffaloes around their house and were offered the surrounding green grasses and kitchen wastes. In comparison of breed types, River type buffalo cows showed highest LW than other types. Significant variation of LW among breeds was observed due to genetics and environmental factors. Similar factors were found by another researcher (Shankar and Mandal, 2010). The findings of this current investigation were also supported by the findings of Tariq *et al*. (2013), who indicated average LW was 359 ± 160.9 kg in Pakistani buffalos and Ranawana (1989) reported that adult female buffaloes LW ranged from 250 to 350 kg, whereas the weight of Swamp buffalo cows ranged from 350 to 450 kg (Chantalakhana and Bunyavejchewin, 1989). The male buffaloes showed significantly more ($P<0.05$) LW than female buffaloes. Usually male buffaloes are heavier than females reported by Chantalakhana and Bunyavejchewin (1989). In most of the cases, LW of buffalo significantly varied between production systems, availability of green grasses and breeds. Variation of LW might be found due to genetic constituent of the buffaloes and other management factors (Shankar and Mandal, 2010).

The average DMY of buffalo cows under semi-intensive farming system found significantly higher ($P<0.05$) than extensive farming system. This higher average of DMY under semi-intensive bathan farming systems might be due to genetic factor (increased number of high yielding River type genotype and their crosses). A further possible cause might be good management factors (e.g. amount and quality of feed and the skill of farmer detect heat and illnesses) and factors which are beyond the farmer's control such as climatic factors: temperature and humidity, which influences milk production that leads lactation yield.

In comparison to breed types, River type of buffalo cows showed higher average DMY than other two types. Significant variation of average DMY among breeds was found as a result of genetics of cows and environmental factors. The findings of present study were not in accordance with the findings of Islam *et al*. (2004); Siddiquee *et al*. (2010); Karim *et al*. (2013). They reported higher value in their investigation than the present study. Lower milk yield could be attributable to improper and inadequate nutrients availability in the investigated area (Tiwari *et al*. 2007; Sarwar *et al*. 2009; Wynn *et al*. 2009; Pasha and Khan, 2010). Inadequate supply of quality fodder had been identified as one of the reasons for poor performances of buffalo (Sarwar *et al*. 2009) and the supplied fodder contains high fibrous materials resulting in poor growth, production and reproduction (Pasha, 2013).

The average LL of buffalo cows under extensive farming system was found higher than semi-intensive farming system. Comparing breed types, River types of buffalo cows showed highest average LL. Significant variation of average DMY among breeds found and this might be due to genetics and superior productive ability of River type buffalo. The findings of the present study were in line with the findings of Bingzhung *et al*. (2003); Khattab and Kawthar (2007); Siddiquee *et al*. (2010) and Karim *et al*. (2013), but lower than the value reported by Hussen (1990); Islam *et al*. (2004); Khan *et al*. (2007a) and Pasha and Hayat (2012). Lower LL might be due to late starting of milking after parturition and early drying off buffalo cows.

The average LP under extensive farming system was found higher than semi-intensive farming system. Considering breed types, River types of buffalo cows showed highest average LP. Significant variation of average DMY among breeds was found as a reason of genetic constituent of river type buffaloes in semi-intensive farming system. The findings of the present study were in agreement with the findings of Siddiquee *et al*. (2010); Karim *et al*. (2013) but lower than that of Hussen (1990); Islam *et al*. (2004); Khattab and Kawthar (2007). Lower average LP could be due to poor productive ability, shorter LL, poor nutritional management and lack of provision of housing facility.

The average birth weight differed significantly between farming system in this investigation and that might be due to availability of heavier River type of genotypes and their crosses under semi-intensive farming system. Usually, birth weight of River type buffalo found higher than those of Swamp types buffalo. The findings of this study were higher than the findings of Siddiquee *et al*. (2010); Karim *et al*. (2013) but lower than result of (Islam *et al*. 2004). This variation might be owing to genotypic difference of available buffalo's type and improper supply of nutrient rich feeds and fodders during pregnancy period.

Table 6 Profitability of buffaloes under two different production systems (per buffalo cow/year, US$ (1US$=BD Tk 78)

Variables	Semi-intensive Bathan farming system	Extensive Bathan farming system
Birth weight, kg	27.52	26.12
Mature live weight, kg	327.31	333.31
Gestation period, day	305	306
Lactation length (day)	269	264
Milk production/Cl (kg)	564.52	628.80
Calving interval (CI), day	640	697
Milk yield, kg/year	322	329.28
Calving rate, %	70	75
Survivability, %	80	82
Feed price per kg DM, US$	0.12	0.10
Beef price per kg live weight, US$	1.41	1.41
Price per kg milk, US$	0.58	0.58
DM requirement per cow per year, kg	1920	1920
Replacement heifer, kg	756	757
Total, kg	2676	2677
Price, US$	321.12	267.70
Non- feed costs per cow per year, milking cow, US$	36.92	36.92
Replacement heifer, US$	12.05	12.05
Total non-feed costs, US$	6.41	6.41
Total expenditure, US$	55.38	55.38
Revenue per cow per year, milk revenue, US$	195.70	200.15
Beef revenue, US$	208.38	210.74
Manure income, US$	12.82	12.82
Grand total, US$	416.90	423.71
Net income, US$	40.40	100.63

Improper and inadequate nutrients availability causes poor growth and poor reproductive performance in buffalo (Qureshi *et al.* 2002; Tiwari *et al.* 2007; Wynn *et al.* 2009; Pasha and Khan, 2010).

Reproductive performance of buffalo cows

Average GL was found to be lowest in River type buffalo cows than other types of buffalo cows. This might be due to having comparatively better reproductive efficiency of River type's buffalo. In association of farming system, GL under semi-intensive bathan farming system was lower than the extensive bathan farming system, that is due to impact of farming system and breed types of the farm. The results of this investigation were in sequence with the findings of Islam *et al.* (2004); Wangdi *et al.* (2014) but lower than the findings of Karim *et al.* (2013). The average CI was found lowest in crossbred type of buffalo cows irrespective of farming system. This might be due to benefit of vigor, production and reproductive efficiency. Comparing farming system, CI was lowest under semi-intensive bathan farming system than the extensive bathan farming system as a result of impact of farming system and types of buffalo in the farm. The average of CI in the present investigation showed higher value than the findings of Khan *et al.* (2007b); Pasha and Hayat (2012); Karim *et al.* (2013); Wangdi *et al.* (2014) in Bangladesh. This higher value might be due to poor management and poor reproductive performance (silent heat and seasonal breeder) of buffalo cows.

In comparison to type, the average postpartum heat period was lowest in River type buffalo cows compared with other type buffalo cows. Postpartum heat period was lower in the semi-intensive bathan farming system than the extensive bathan farming system irrespective to breed. The outcome of this study was similar to the outcome of Karim *et al.* (2013). Poor reproductive performance occurred due to poor nutrition quality of supplied feeds and fodders (Qureshi *et al.* 2002; Sahoo *et al.* 2004; Tiwari *et al.* 2007; Sarwar *et al.* 2009). Comparing type, the average AFC was lowest in River type buffalo cows than other types. These results might be due to genetics of the River type buffalo as they attained puberty about six months earlier than Swamp type. Between farming system, average age of first calving was found lowest under semi-intensive bathan farming system than the extensive bathan farming system, irrespective of breed type. This might be due to management factors and breed constituent of the farming system. The findings of this investigation was in line with the findings of Bhatti *et al.* (2007) and Karim *et al.* (2013). The average SPC was found lowest in River type buffalo cows than other type buffalo cows in comparison to type, whereas found lowest under semi-intensive bathan farming system than the extensive bathan farming system. The findings of the present investigation was lower than the findings of Wangdi *et al.* (2014) in Bhutan, but higher than the investigation of Islam *et al.* (2004), which is due to breeding methods. Natural breeding is the only method found in the studied area.

Performance of various traits after fitting regression equation

After fitting the regression equation with the various traits (DMY, LL, LP, GL and PPH) it was noticed that the R^2 values of DMY, LL and LP were higher than the GL, PPH and LWT. Highest values of R^2, (coefficient of determination) showed that linear regression of LP fitted more accurately than other traits. Positive values of slope (b) in case of DMY, LL, LP and LW indicates positive correlation with lactation number, where as GL and PPH shows negative values which indicate negative correlation. The higher R^2 values of the traits indicated they more closely fitted with the regression line for the increases of lactation numbers the values were also increased. If a model achieves R-squared above 90%, it indicates close agreement (Karmaker and Ray, 2011). In case of polynomial model Khan *et al.* (2014) considered R^2 values above 0.80 as superior.

Profitability of buffaloes under different production systems

In the study income was derived from the sale of milk, beef and manure and costs included only for feed and fixed costs. The milk payment for the farmers was based on milk volume only, which was used to calculate the profit. The net profit of buffalo cows was higher in semi-intensive production system than extensive system on per buffalo cow per year. The differences of profitability were attributed due to the differences of the prices of feed, milk, meat and the differences of breeds. Similar factors are responsible for the differences profitability was reported by Khan (2009).

The differences of feed DM consumed was found to be variable between types. The body weight of the buffalo cow is important as it affects the profitability and thereby affect on feed requirements for maintenance as well as the value of the carcass. Similar findings were observed by Lopez-Villalobos *et al.* (2000) and Khan (2009). In the present study, feed costs accounted for 85% of the total costs while the remaining percentage was accounted for other operational costs. Similar amount of feed costs out of the total costs for dairy farm operation were reported by Ozawa *et al.* (2005) in Japanese study. Under the rural condition of Bangladesh the farmers are mainly feeding their buffalo cow's straw and concentrate (brans and rice polish) and green grasses when available. The DM intakes and price per kg DM have also influenced the profitability which was also reported previously by Khan (2009) and Rahman *et al.* (2003).

CONCLUSION

The study revealed that most of the buffaloes under the investigated area were swamp types, irrespective to age, sex and farming system. The results showed that river type buffalo's performance and semi-intensive farming system was superior to other breeds and farming system. The live weight and daily milk yield of buffaloes was highest under semi-intensive bathan farming system and lactation length and lactation production found to be highest under extensive bathan farming system. Comparison to breeds, live weight, daily milk yield, lactation length and lactation production was found maximum for river type buffalo cows. The gestation length, calving interval, age of first calving and service per conception found lowest under semi-intensive bathan farming system except postpartum heat, which found lowest under the extensive bathan farming system. It can be concluded that this study indicates some important indication (e.g. best genotype and best farming system) which can be used by the farmers, researcher and policy makers for future improvement of buffalo in this particular area as well as in Bangladesh.

ACKNOWLEDGEMENT

I am immensely pleased to place on record my profound gratitude and heartfelt thanks to my research supervisor and teachers of the Department of Genetics and Animal Breeding, CVASU, for their encouragement and cooperation at every stage of this study from its inception to completion. I am grateful authority of CVASU for providing economical and technical support during research. Last but not the least, i would like to thank my family members and friends and farmers in the studied area for their active support.

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