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Effects of breed, age, parity, body weight and body condition on productive and reproductive performance of buffalo cows at Rajshahi district of Bangladesh

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Abstract: The present study was to evaluate the reproductive and productive performance (RPP) of Indigenous (n=145) and Nili-Ravi cross-bred (n=55) dairy buffalo in relation to age, parity, body weight and body condition. A total of 200 buffalo cows were randomly selected and interviewed to collect data on reproductive and productive performance of buffalo cows of Rajshahi district by using pre-tested questionnaire during the period from January 2015 to December 2015. The average mean \pm SD value of reproductive and productive performances were as age at puberty (AP), age at first calving (AFC), gestation length (GL), post-partum heat period (PPHP), milk yield per day (MYPD), lactation length (LL), birth weight of calf (BWC) and calving interval (CI) were recorded as 25.05 \pm 4.00 months, 35.26 \pm 4.14 months, 308.28 \pm 12.46 days, 84.00 \pm 25.95 days, 3.59 \pm 0.56 litre, 202.76 \pm 33.54 days, 28.79 \pm 4.23 kilogram and 461.36 \pm 15.41 days, respectively. Nili-Ravi cross-bred buffalo cow had shown better RPP than Indigenous. The genotype of buffalo cows had significant effect ($p<0.05$) on most of the RPP except AP, AFC and CI. Age of buffalo had also significant effect ($p<0.05$) on GL, PPHP and BWC and middle age (4 to < 7yrs) observed good RPP. The best RPP were recorded in 2nd parity than others and also significant effect ($p<0.05$) on GL, MYPD and BWC. Body weight and body condition of buffalo had significant effect ($p<0.05$) on PPHP, BWC and MYPD. The body weight of >350 kg and very good body condition groups were observed better reproductive performance. It could be concluded that the buffalo owners of these areas do not follow any scientific method of buffalo husbandry; they just follow traditional rearing systems. Very recently, a few farmers started farming of the mostly Indigenous buffalo cows for dairy purpose at Rajshahi region of Bangladesh.

Keywords: effects; breed; age; parity; body weight; body condition; Buffalo cows; Rajshahi district

1. Introduction

Buffalo cow rearing is one of the most important occupations. The success of any dairy farm depends upon efficient productive and reproductive performances of a dairy animal. Different genetic and non-genetic factors influence its performance potential (Boro *et al.*, 2020). Productive performance is determined to a great extent by the milk yield at first lactation and the farm, followed by the age at first calving (Ilieva and Peeva, 2007). The importance of livestock production has increased in Bangladesh as witnessed by the growth of the sub-sector over the last few decades in Bangladesh (FAO, 2005). The buffalo hold strategic place in overall livestock economy of Bangladesh and serve three important purposes viz. milk production, meat and draught power (Ghaffar *et al.*, 1991). Cattle and buffalo supplies about 99% of the total milk produced in the country, 50.2% of the total milk consumes and 98% of the draught power requirement of the country. Contribution of cattle to national economy is not static rather varies depending upon population size and location. The domestic buffalo is an important animal in the agricultural economy of many tropical and subtropical countries and being an integral part of farming system (Suhail *et al.*, 2009). Buffalo is contributing 12.1% to the world, 38.0% in

Asia, 66.6% in Pakistan, 55.0% in India, 16.4% in China, 50.8% in Egypt and 65.2% in Nepal's total milk production (FAO, 2007). In addition to the milk buffalo is also used as an important source of beef production in the form of culled adult females, males and unwanted male calves. Buffalo is contributing around 1.3, 2.8, 24.4, 26.9, 0.6, 21.2, and 51.8% of the total meat production in the aforementioned countries (Suhail *et al.*, 2009). Buffalo have significant contribution in GDP through production of meat, milk and skin representing about 27.0%, 23.0% and 28.0%, respectively to the total production from livestock sector (FAO, 2009) in Bangladesh. According to the estimate of Bangladesh Economic Review (2009), the current buffalo population in Bangladesh is about 1.3 million. Of the total buffalo population of the country 42.8%, 39.9% and 11.8% buffaloes are found in the sugarcane belt, coastal areas and marshy land, respectively (Faruque *et al.*, 1990). Buffalo have a number of advantages over cattle viz. utilization of low quality roughages to produce more protein and to gain more body weight, more resistance to common diseases, outstanding draught power, faster body growth and longer life span. A pair of buffalo has more draught capacity than a pair of cattle (Faruque *et al.*, 1990; Rahman, 1991). Generally Indigenous buffalo cows produces more milk than Indigenous cows having more milk fat (10.5%) and total solid (21%). Another notable advantage specially is that they can survive against tidal wave which they are to encounter now and then. Khan *et al.* (2008) investigated the post-conception decline in milk yield and reported that dairy buffalo in parity 3 had the least reduction in milk yield followed by parity 2, 4, 1, 5, and 6, indicating parity 3 as the best phase for milk production in dairy buffaloes. Bashir *et al.* (2007) reported that economic returns from dairy buffaloes depend on lifetime performance. Herd life and productive life were also used to describe lifetime performance. Husbandry and production systems for buffaloes vary depending on the topography and vegetation patterns of the country. Buffaloes are raised under an extensive system in the coastal and hilly areas where large-scale pasture land and enough green forage are available. There are several published reports regarding reproductive and productive parameters and management system of buffalo cows throughout the world (Hadi, 1965; EI-Kirabi, 1995 and Suhail *et al.*, 2009) but there is very limited information of this issue in contest of Bangladesh especially in Rajshahi areas. Few scientific works have been done by Faruque and Amin (1994; 1995) on limited buffaloes in specific region. But limited scientific research had taken place upon the indigenous buffalo of this region. So, the author showed the greatest interest to obtain some basic reproductive characteristics about the buffalo cows at Rajshahi district for its appropriate description. Despite their important role in national economy and their outstanding production potentials, buffaloes are most neglected in Bangladesh. They are often called non descriptive types (Cockril, 1974). Very little is known about the extent of productive and reproductive performances in buffalo cows in Rajshahi district of Bangladesh. Keeping the facts and ideas in mind, the present study was undertaken to meet up the effect of breed, age, parity, body weight and body condition of buffalo cows on reproductive and productive performance of Rajshahi district of Bangladesh.

2. Materials and Methods

2.1. Study areas and population

To conduct the study at the districts of Bangladesh namely Rajshahi was selected. Two hundred (200) buffalo cows were randomly selected to collect data regarding reproductive and productive performance of those buffalo cows with separate questionnaires during the period from January 2015 to December 2015.

2.2. Selection of Animals

Different breeds of buffalo cows from different places upto 6 parities an absolutely for dairy and drought purpose was considered and selected for the present study. A total 200 buffalo cow were selected from greater Rajshahi district (Kakonhat, Nawhata, Kasiadanga, Damkura, Puthiapara, Godagari, Rajabari, Courtstation and Rajshahi city) in Bangladesh.

2.3. Method of data collection

A questionnaire was developed for proper recording the reproductive and productive performance of buffalo cows. The data were collected directly from the buffalo cow owners/farmers/attendant who was responsible for the rearing of buffalo cows. During data collection careful attention was given to attained accurate and reliability of data during the period from January 2015 to December 2015. The data were collected from the randomly selected areas by the researcher every three (3) months interval in year. After collecting the information, data were prepared for analysis.

2.4. Grouping of experimental animals

To achieve the goal, animals were grouped according to the following considering factors:

Genotype or Breed: The buffalo cows were classified broadly in Indigenous and Nili-Ravi cross.

Group I: Indigenous (n=145)

Group II: Nili-Ravi cross (n=55)

Age group: Age of the buffalo cows were measured by examination of teeth and counting number of horn ring and birth record kept by the farmers/register book. After confirmation of age of these buffalo cows then divided in the following groups:

Group I: <4 yrs (n=53)

N Group II: 4 to < 7yrs (n=118)

Group III: > 7yrs (n=29)

Parity: The buffalo cows those did not give any calf considered as heifer (P₀), those gave 1st calf considered as parity 1 (P₁), those gave 2nd calf considered as parity 2 (P₂), those gave 3rd calf considered as parity 3 (P₃) and so on. The buffalo cows were divided in the following groups:

Group I: 1st calving (n=52)

Group II: 2nd calving (n=93)

Group III: >3rd calving (n=55)

Body Weight: The body weight of each buffalo cow was recorded in kg and the body weight was measured by means of a measuring tape applying the formula of Rahman *et al.* (2004).

$$\text{Live body weight} = \frac{L \times G^2}{300} \text{ pounds}$$

Where, L = Length from the point of shoulder to pin bone in inches

G = Chest girth in inches

Then, the body weights were converted from pound to kg, dividing by 2.2

The selected cows were classified according to their body weight such as

Group I: <250 kg (n=63)

Group II: 250 - 350 kg (n=127)

Group III: > 350 kg (n=10)

Body condition: Buffalo cows of different body condition were considered for the study and BCS were determined by Nicholson and Butterworth (1986) with some modified technique. The buffalo cows were divided in the following groups considering body conditions:

Group I: Poor (n=32)

Group II: Medium (n=95)

Group III: Good (n=73)

2.5. Reproductive and productive traits of buffalo cows studied

The following reproductive and productive traits of buffalo cows were studied in this study.

Age at puberty: The age at which a heifer first shows estrus sign and behavior may be defined as age at puberty (Hafez, 1993). It measured in month (m) and total number of observation was 200.

Age at first calving: The actual age of buffalo at the time of its first calving. It is defined as the age when a buffalo heifer first calving a newborn calf. It measured in month (m)

Gestation length: It is defined as the period between fertilization and birth or the period during which an embryo develops. It is calculated in days (d).

Post partum heat period: It is considered as the interval between date of calving and the date of first insemination or first heat show after parturition. It was calculated in days (d).

Calving interval: It is the period between two successive calving i.e. the period between the calving of the first calf to the calving of immediate next calf and was expressed in days.

Average daily milk yield: It refers to the average milk yield of buffalo during the lactation. This was measured in litre/day by using the following formula:

$$\text{Average milk yield (lit./day)} = \text{Lactation yield} / 205 \text{ days}$$

Lactation length: It is the number of days a buffalo remain in milk from the date of calving to the date of dry. It express in days or months:

Birth weight of calf: It is defined as the weight of calf during the period of birth. It is calculate in kilogram (kg).

2.6. Data management and analysis

The data obtained from the questionnaire was entered into the Microsoft Excel 2007 and transferred to SPSS version, 17.0. Data were statistically analyzed to calculate the effect of reproductive and productive traits of buffalo cows. Various standard statistical procedures had been adopted in the study. The standard error of mean for the reproductive traits was calculated with help of a computer package programme (SPSS) version 17.0. Mean of different traits were then tested by using analysis of Variance (ANOVA) by Duncan Multiple Range Test (DMRT). Data were presented as Mean \pm SE. $P < 0.05$ was considered as significant. Simple ANOVA was performed considering the age of buffalo cows and to observe the significant differences among the mean values, Duncan's multiple range test (DMRT) was performed to observer significant differences of reproductive traits in different genotype, age, parity, body weight, body condition of buffalo cows.

3. Results

3.1. The reproductive and productive performance of buffalo cows in Rajshahi district

The average mean \pm SD value of reproductive and productive performance such as age at puberty (m), age at first calving (m), gestation length (d), post partum heat period (d), milk yield per day (d) and lactation length (d) were 25.05 \pm 4.00, 35.26 \pm 4.14, 308.28 \pm 12.46, 84.00 \pm 25.95, 3.59 \pm 0.56 and 202.76 \pm 33.54, respectively (Figure 1).

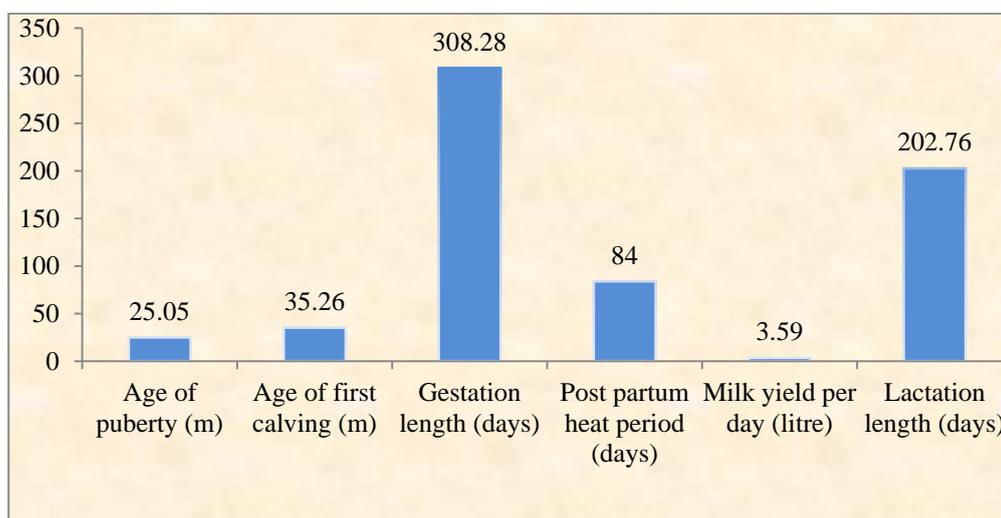


Figure 1. Graphical representation of reproductive and productive values.

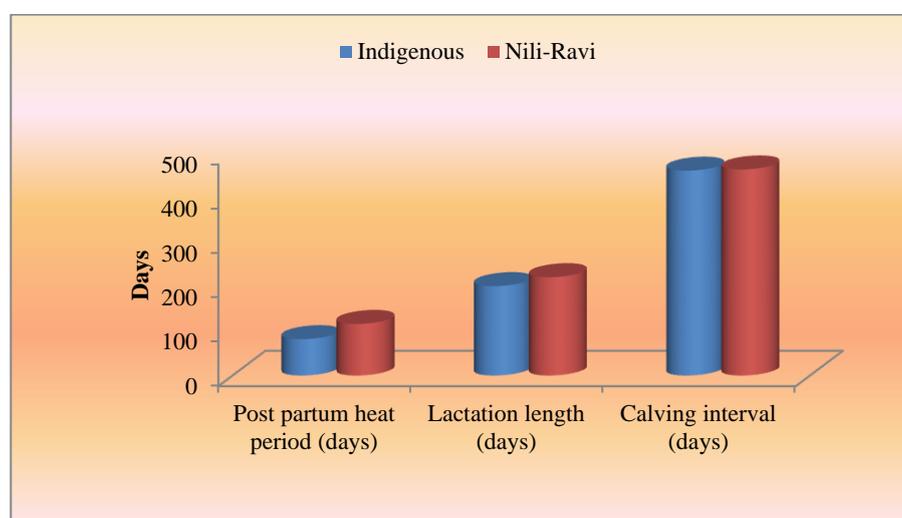
3.2. Effects of genotypes on reproductive and productive performance of buffalo cows

The effects of genotype on reproductive and productive performance of buffalo cows are summarized in Table 1 and Figure 2. The higher value of age at puberty, age at first calving, gestation length and post-partum heat period (25.41 \pm 5.86, 35.83 \pm 5.57, 312.75 \pm 10.74 and 116.25 \pm 14.63) were observed in Indigenous buffalo cows and lower value of (25.02 \pm 3.87, 35.22 \pm 4.04, 307.99 \pm 12.53 and 81.91 \pm 25.15) were observed in Nili-Ravi Cross buffalo cows. The higher value of milk yield per days, lactation length, birth weight of calf and calving interval (3.60 \pm 0.56, 221.67 \pm 33.25, 30.00 \pm 5.22 and 465.83 \pm 17.50) were observed in Nili-Ravi Cross buffalo cows and lower value of (3.37 \pm 0.48, 201.55 \pm 33.28, 28.71 \pm 4.17 and 362.29 \pm 15.36) were observed in Indigenous buffalo cows. There was significant effect ($P < 0.05$) of breeds on gestation length, post partum heat period, milk yield per day, lactation length and birth weight of calf. Other reproductive traits were not significant ($P > 0.05$).

Table 1. Effects of genotype on reproductive and productive performance of buffalo cows.

Reproductive and Productive performances	Genotype		Average Value
	Indigenous	Nili-Ravi Cross	
Age at puberty (m)	25.41±5.86 N=145	25.02±3.87 N=55	25.05±4.00 N=200
Age at first calving (m)	35.83±5.57 N=145	35.22±4.04 N=55	35.26±4.14 N=200
Gestation length (days)	312.75±10.74 ^a N=145	307.99±12.53 ^b N=55	308.28±12.46 N=200
Post partum heat period (days)	116.25±14.63 ^a N=145	81.91±25.15 ^b N=55	84.00±25.95 N=200
Milk yield per day (litre)	3.37±0.48 ^a N=145	3.60±0.56 ^b N=55	3.59±0.56 N=200
Lactation length (days)	201.55±33.28 ^a N=145	221.67±33.25 ^b N=55	202.76±33.54 N=200
Birth weight of calf (kg)	28.71±4.17 ^a N=145	30.00±5.22 ^b N=55	28.79±4.23 N=200
Calving interval (days)	462.29±15.36 N=145	465.83±17.50 N=55	461.36±15.41 N=200

m=months, kg= kilogram, superscripts (a, b) in the same column differs significantly with each other (p<0.05).

**Figure 2. Effect of genotypes of buffalo cows on postpartum heat period, lactation length and calving interval.**

3.3. Effects of age group on reproductive and productive performance of buffalo cows

The effects of age groups on reproductive and productive performance of buffalo cows are presented in Table 2 and Figure 3. The lower value of age at puberty, age at first calving, gestation length, post partum heat period, lactation length, birth weight of calf and calving interval (24.09±2.99, 34.47±3.06, 304.08±8.07, 79.05±21.12, 202.14±36.06, 27.49±2.83 and 459.47±26.29) were observed in <4 yrs of age, milk yield per day (3.43±0.48) was found in >7yrs and higher value of age of puberty, age of first calving, milk yield per day and calving interval (25.56±4.52, 35.77±4.68, 3.63±0.50 and 464.43±37.54) were observed in 4 to < 7yrs and higher value of gestation length, post partum heat period, lactation length and birth weight of calf (307.67±11.22, 94.31±27.34, 205.52±29.22 and 30.79±2.7) were observed in >7yrs. Age group had significant (P<0.05) effect on gestation length, post partum heat period and birth weight of calf and had no significant (P > 0.05) effect on age of puberty, age of first calving, milk yield per day, lactation length and calving interval.

Table 2. Effects of age groups on reproductive and productive performance of buffalo cows.

Reproductive and Productive performances	Age group			Average Value
	<4 yrs	4 to <7yrs	> 7yrs	
Age at puberty (m)	24.09±2.99 N=53	25.56±4.52 N=118	24.68±2.92 N=29	25.05±4.00 N=200
Age at first calving (m)	34.47±3.06 N=53	35.77±4.68 N=118	34.62±3.13 N=29	35.26±4.14 N=200
Gestation length (days)	304.08±8.07 ^b N=53	307.67±11.22 ^b N=118	318.41±17.76 ^a N=29	308.28±12.46 N=200
Post partum heat period (days)	79.05±21.12 ^b N=53	83.60±26.97 ^b N=118	94.31±27.34 ^a N=29	84.00±25.95 N=200
Milk yield per day (litre)	3.61±0.59 N=53	3.63±0.50 N=118	3.43±0.48 N=29	3.59±0.56 N=200
Lactation length (days)	202.14±36.06 N=53	202.64±30.23 N=118	205.52±29.22 N=29	202.76±33.54 N=200
Birth weight of calf (kg)	27.49±2.83 ^b N=53	28.89±4.8 ^b N=118	30.79±2.7 ^a N=29	28.79±4.23 N=200
Calving interval (days)	459.47±26.29 N=53	464.43±37.54 N=118	463.45±33.01 N=29	461.36±20.41 N=200

m=months, kg=kilogram, superscripts (a, b) in the same column differs significantly with each other (p<0.05).

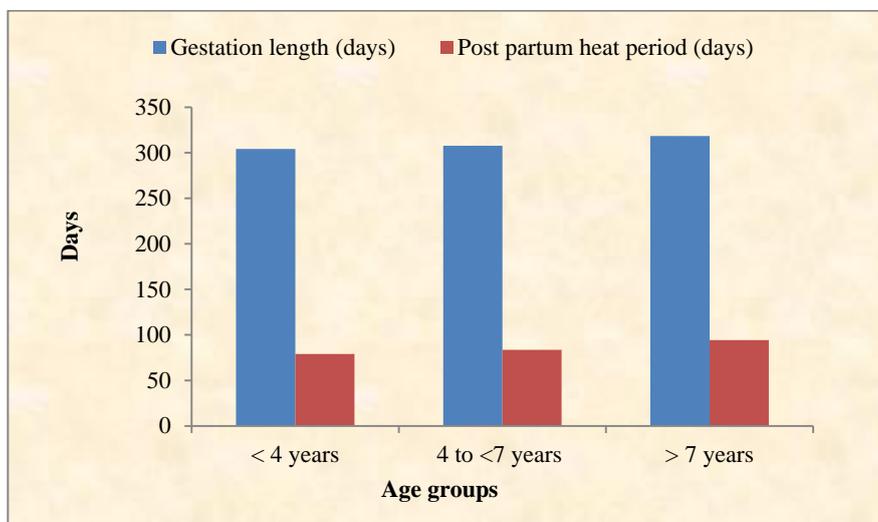


Figure 3. Effects of age groups on gestation length and postpartum heat period in buffalo cows.

3.4. Effects of parity on reproductive and productive performance of buffalo cows

To determine the variation of reproductive and productive parameters of buffalo cows due to parity effects are shown in Table 3 and Figure 4. The lower value of almost reproductive traits of age at puberty, age at first calving, gestation length, post partum heat period, birth weight of calf and calving interval (24.09±3.39, 34.46±3.47, 305.71±8.79, 80.14±24.52, 27.05±2.81 and 360.29±21.38) were found in 1st calving and the higher values of (25.53±4.77, 35.80±4.94, 314.84±16.87, 85.75±25.26, 29.50±4.03 and 364.07±34.57) were found in >3rd calving. The lower values of milk yield per day and lactation length (3.48±0.52 and 200.45±34.90) were found in 3rd calving and the higher values (3.72±0.51 and 207.69±31.31) were found in 1st calving. Parity had significant (P<0.05) effect on gestation length, milk yield per day, birth weight of calf and had no significant (P>0.05) effect on age of puberty, age of first calving, post partum heat period, lactation length and calving interval.

Table 3. Effects of parity on reproductive and productive performance of buffalo cows.

Reproductive and productive performances	Parity			Average Value
	1 st Calving	2 nd Calving	3 rd Calving	
Age at puberty (m)	24.09±3.39 N=52	25.12±2.83 N=93	25.53±4.77 N=5	25.05±4.00 N=200
Age at first calving (m)	34.46±3.47 N=52	35.09±3.00 N=93	35.80±4.94 N=55	35.26±4.14 N=200
Gestation length (days)	305.71±8.79 ^b N=52	305.92±10.05 ^b N=93	314.84±16.87 ^a N=55	308.28±10.92 N=200
Post partum heat period (days)	80.14±24.52 N=52	84.54±28.37 N=93	85.75±25.26 N=55	84.00±25.95 N=200
Milk yield per day (litre)	3.72±0.51 ^a N=52	3.58±0.59 ^{ab} N=93	3.48±0.52 ^b N=55	3.59±0.56 N=200
Lactation length (days)	207.69±31.31 N=52	202.00±33.34 N=93	200.45±34.90 N=55	202.76±33.54 N=200
Birth weight of calf (kg)	27.05±2.81 ^b N=52	29.34±4.74 ^a N=93	29.50±4.03 ^a N=55	28.79±4.23 N=200
Calving interval (days)	460.29±21.38 N=52	460.42±27.89 N=93	464.07±34.57 N=55	461.36±20.41 N=200

m=months, kg=kilogram, superscripts (a, b) in the same column differs significantly with each other (p<0.05).

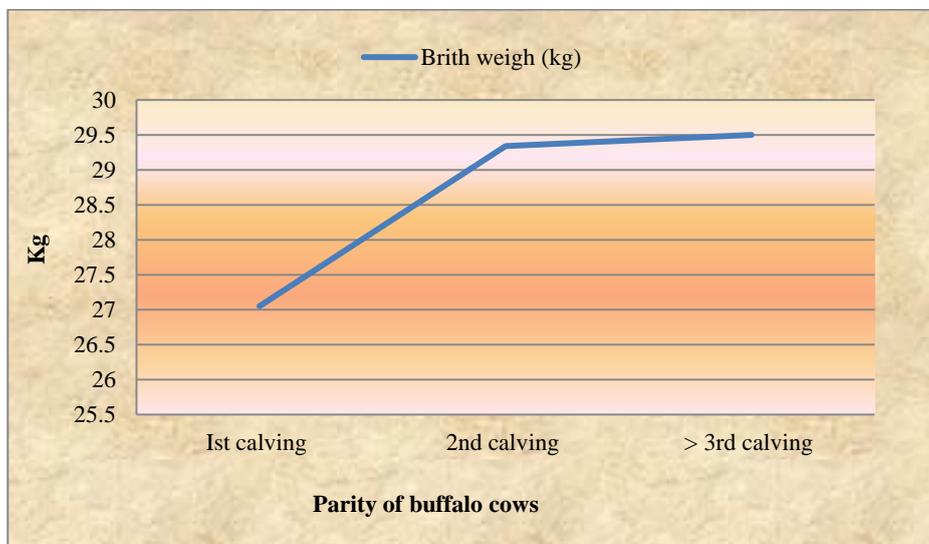


Figure 4. Effects of parity of buffalo cows on birth weight of calf.

3.5. Effects of body weight on reproductive and productive performance of buffalo cows

The effects of body weight on reproductive and productive performances of buffalo cows are furnished in Table 4 and Figure 5. The lower value of the reproductive traits of age at first calving (34.80±3.69), gestation length (305.86±9.35), post partum heat period (81.93±24.26), milk yield per day (3.45±0.43), lactation length (201.93±33.51), birth weight of calf (25.09±2.31) and calving interval (460.54±25.79) were found in <250 kg and the higher value of almost reproductive traits of age at first calving (36.70±6.60), gestation length (311.40±13.20), post partum heat period (105.00±31.62), milk yield per day (3.63±0.45), lactation length (216.00±39.77), birth weight of calf (34.00±2.10) and calving interval (463.50±24.15) were found in > 350 kg body weight of buffalo cows except age at puberty which lower value (24.69±3.38) were found in 250-350 kg of body weight and its higher value (26.40±7.05) were found in <250 kg body weight. Body weight had significant (P<0.05) effect on post partum heat period, birth weight of calf and had no significant (P>0.05) effect on other traits.

Table 4. Effects of body weight on reproductive and productive performance of buffalos cows.

Reproductive and Productive performances	Body weight			Average Value
	<250 kg	250 - 350 kgs	> 350 kg	
Age at puberty (m)	26.40±7.05 N=63	24.69±3.38 N=127	25.55±4.48 N=10	25.05±4.00 N=200
Age at first calving (m)	34.80±3.69 N=63	35.95±4.44 N=127	36.70±6.60 N=10	35.26±4.14 N=200
Gestation length (days)	305.86±9.35 N=63	309.23±13.60 N=127	311.40±13.20 N=10	308.28±12.46 N=200
Post partum heat period (days)	81.93±24.26 ^b N=63	83.34±25.78 ^b N=127	105.00±31.62 ^a N=10	84.00±25.95 N=200
Milk yield per day (litre)	3.45±0.43 N=63	3.58±0.61 N=127	3.63±0.45 N=10	3.59±0.56 N=200
Lactation length (days)	201.93±33.51 N=63	202.33±32.70 N=127	216.00±39.77 N=10	202.76±33.54 N=200
Birth weight of calf (kg)	25.09±2.31 ^c N=63	30.22±3.78 ^b N=127	34.00±2.10 ^a N=10	28.79±4.23 N=200
Calving interval (days)	460.54±25.79 N=63	461.61±18.16 N=127	463.50±24.15 N=10	461.36±20.41 N=200

m=months, kg=kilogram, superscripts (a, b, c) in the same column differs significantly with each other (p<0.05).

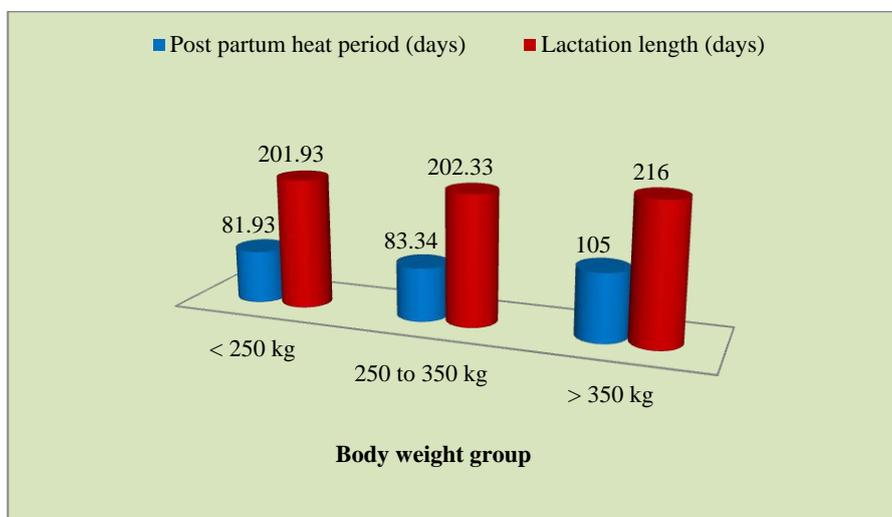


Figure 5. Effects of body weight on postpartum heat period and lactation length in buffalo cows.

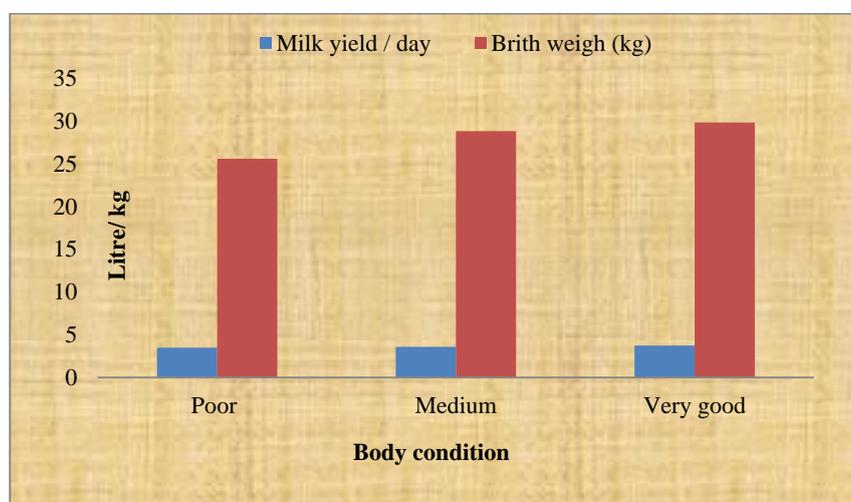
3.6. Effects of body condition on reproductive and productive performance of buffalo cows

The effects of body condition score on reproductive and productive performance of buffalo cows are presented in Table 5 and Figure 6. Effects of good body condition resulted the lower value of reproductive traits of age at puberty (24.71±3.49), age at first calving (34.81±3.64), gestation length (306.79±10.92), post partum heat period (80.78±22.57), calving interval (359.20±29.14) and the higher value of reproductive traits of age at puberty (25.50±4.45), age at first calving (35.76±4.54), gestation length (309.53±11.32), post partum heat period (84.86±27.46), calving interval (363.91±6.18) were found in poor body condition of buffalo cows except milk yield per day, lactation length and birth weight of calf which lower value (3.49±0.50, 197.03±34.23, 25.59±3.32) were found in poor body condition and the higher value (3.73±0.64, 204.00±33.07, 29.83±3.68) were found in good body condition of buffalo cows. Body condition score had significant (P<0.05) effect on milk yield per day, birth weight of calf and had no significant (P>0.05) effects on other reproductive traits.

Table 5. Effects of body condition on reproductive and productive performance of buffalo cows.

Reproductive and Productive performances	Body condition			Average Value
	Poor	Medium	Very good	
Age at puberty (m)	25.50±4.45 N=32	25.00±4.36 N=95	24.71±3.49 N=73	25.05±4.00 N=200
Age at first calving (m)	35.76±4.54 N=32	35.43±4.53 95	34.81±3.64 N=73	35.26±4.14 N=200
Gestation length (days)	309.53±11.32 N=32	308.99±13.87 N=95	306.79±10.92 N=73	308.28±12.46 N=200
Post partum heat period (days)	84.86±27.46 N=32	84.29±25.52 N=95	80.78±22.57 N=73	84.00±25.95 N=200
Milk yield per day (litre)	3.49±0.50 ^b N=32	3.58±0.42 ^{ab} N=95	3.73±0.64 ^a N=73	3.59±0.56 N=200
Lactation length (days)	197.03±34.23 N=32	203.74±33.82 N=95	204.00±33.07 N=73	202.76±33.54 N=200
Birth weight of calf (kg)	25.59±3.32 ^b N=32	28.84±4.59 ^a N=95	29.83±3.68 ^a N=73	28.79±4.23 N=200
Calving interval (days)	463.91±6.18 N=32	463.07±38.56 N=95	459.20±29.14 N=73	461.36±20.41 N=200

m=months, kg=kilogram, superscripts (a, b) in the same column differs significantly with each other (p<0.05).

**Figure 6. Effects of body condition on milk yield per day and birth weight of calf in buffalo cows.**

4. Discussion

4.1. The reproductive performance of buffalo cows in Rajshahi district of Bangladesh

Problems that create from infertility are usually overlooked by the farmers, imbalance and undernourished feed management of dairy and buffalo cows and their calves, unavailability of pasture land, inadequate veterinary services and unawareness of farmers in herd health management are the burning issues, which seriously affects the farm economy in Bangladesh (Shamsuddin *et al.*, 2001). In the present study, we found significant (p<0.05) difference on gestation length and post partum heat period of reproductive traits of Rajshahi district. Cuong (1983) concluded that age of puberty of local Murrah and their crosses buffalo in Vietnam were 36, 30, 34 months. The present study shown that the average age at puberty of buffalo cows were 25.05±4.00 months, which is lower than the other study. The result is quit difference due to breed of buffalo, feed quality, environmental and managerial practices as well as data error.

Shah *et al.* (1987) mentioned that the average age at first calving of rural Nili-Ravi buffalo was 45.84±0.19 months in Punjab. The average age at first calving reported by Bhalaru and Dhillon (1987) was about 42.36 months in Nili-Ravi buffaloes. Gupta *et al.* (1994) and Boro *et al.* (2020) found that age at first calving for Murrah buffaloes were 45.8 months and 43.69±0.46 months, respectively. Singh and Dhillon (1975) reported the average age at first calving of Murrah buffalo in India was 42.88±0.24 months. On the other hand Cuong (1983) mentioned the age at first calving for Local, Murrah and their crosses in Vietnam were 48-54, 36-42 and

42-48 months, respectively. This study shown that the average age at first calving was 35.26 ± 4.14 months, which is very earlier than other authors. Joshi *et al.* (1968) found the average gestation length of Indian buffaloes was 308.1 ± 9.6 days. The gestation period in farm bred and purchased buffaloes in India was found 314.02 ± 1.53 and 308.53 ± 1.83 days by Singh *et al.* (1973). The gestation period of Nili-Ravi was found 308.7 ± 0.4 days in Pakistan by Usmani and Atahar (1997). Khan (1995) mentioned the average gestation period for Nili-Ravi and crossbred buffalo cows were 302.67 ± 1.90 and 300.67 ± 3.55 days, respectively. The present study shown that the average gestation length of buffalo cows was 308.28 ± 12.46 days which is very close to other authors. El-Sheikh and Mohamed (1967) found the post partum service interval of 1st, 2nd and 3rd calving for Egyptian buffalo were 192.95, 152.9 and 317.0 days, respectively. Liu *et al.* (1985) reported the post partum heat period for triple cross-bred, Nili-Ravi, Murrah and Indigenous were 70.0 ± 17.8 , 127.9 ± 107.2 , 94.7 ± 82.7 and 169 days, respectively. Unar *et al.* (1987) mentioned the first post partum estrus of Nili-Ravi buffalo ranged from 56.4 ± 1.9 to 124.2 ± 4.5 days. On the other hand, Pervez *et al.* (1994) found the post partum heat interval averaged 171.79 ± 4.01 days. So the findings of present study were more or less similar to the findings of various authors as mentioned above. Hadi (1965) found that calving interval of Marathwada buffalo was 429.9 ± 7.4 days. El-Sheikh and Mohamed (1967) mentioned first calving interval of Egyptian buffalo was 484.74 ± 2.86 days. Gurnani *et al.* (1976) reported the calving interval for Murrah buffalo averaged 434 ± 6 days. On the other hand Parera *et al.* (1987) found the average calving interval for indigenous buffalo of Srilanka was 329 to 416 days (mean 384.9 ± 62.9). Shah *et al.* (1987) and Bhalaru and Dhillon (1987) showed calving interval for Nili-Ravi buffalo were 15.77 ± 0.09 months (about 474 days) and 497.7 ± 8.7 days, respectively. Boro *et al.* (2020) reported calving interval for Murrah buffalo was 15.5 ± 4.51 months. Khan *et al.* (1990) reported the average length of calving interval for Nili-Ravi buffalo in Pakistan was 552.44 ± 18.4 days. The average calving interval obtained by Patel and Tripathi (1998) for Surti Buffalo in Gujarat was 556 ± 11.9 days. So the findings of present study, the average calving interval of buffalo cows were 461.36 ± 20.41 days which is more or less similar to other author. The results are quit difference due to breed of buffalo, better overall management, environment, high quality feed supply, available of veterinary services and awareness program of farmers etc.

4.2. The productive performance of buffalo cows in Rajshahi district

Productive performance is determined to a great extent by the milk yield at first lactation and the farm, followed by the age at first calving (Ilieva and Peeva, 2007). The success of any dairy farm depends upon efficient productive and reproductive performances of a dairy animal. Different genetic and non-genetic factors influence its performance potential (Boro *et al.*, 2020). Arjava and Basu (1985), Bhalaru and Dhillon (1987), Huang and Runpei (1987), Singh *et al.* (1987), Vhat and Singh (1988) and Khan and Akhtar (1999) observed the average lactation yield for Nili-Ravi buffalo cows were 1847.98 ± 41.47 , 1641.1 ± 32.1 , 1959, 1701.13 ± 51.836 , 1710.2076 ± 843 and 2020.04 ± 44.59 kg, respectively. Boro *et al.* (2020) reported that the milk yield per day and the average lactation yield for Murrah buffalo were 8.87 ± 0.05 kg and 2147.6 ± 87.06 kg, respectively. Das and Patro (1988) reported the average milk yield of Kalahandi buffalo breed in India which ranged from 1-4 litre per day. On the other hand Faruque (1994) found the average milk yield for indigenous buffalo in Mymensingh was 2.12 ± 0.34 litre per day. The present study observed that the average milk yield per day was as 3.59 ± 0.56 litre which is more or less similar to other author. The variation of milk yield may be due to breed, feed and fodder availability and other management practices etc.

Arjava and Basu (1985) founded the average first lactation length for Nili buffalo cows was 308.83 ± 3.46 days. Singh *et al.* (1987) observed the first lactation mean for Nili Ravi buffalo cows was 355.939 days. On the other hand Acharya (1988) showed the average lactation length of river buffalo in India ranged 276-324 days. Tripathy *et al.* (1988) and Boro *et al.* (2020) reported the average lactation length for Murrah buffalo were 307.66 ± 8.28 and 297.8 ± 1.9 days, respectively. The findings of present study, the average lactation length of buffalo cows were 202.76 ± 33.54 days which is lower than the above findings.

Faruque and Amin (1994) mentioned that the average birth weight of indigenous buffalo calf of the coastal areas of Bangladesh was 22.00 ± 3.50 kg. On the other hand Hussien (1990) reported the average birth weight of buffalo calf in Tangail district was 26.74 ± 2.4 kg. Faruque (1994) observed the birth weight of indigenous buffalo calf in Mymensingh district was 24.75 ± 2.12 kg. In the present study the average birth weight of calf was 28.79 ± 4.23 kg which is more or less similar to the findings of above authors. Bangso and Mahadevan (1989) and Boro *et al.* (2020) reported that the birth weight of Murrah calf were as 33.7 ± 0.83 and 34.76 ± 0.54 kg, respectively. Bhat and Singh (1988) mentioned that the birth weight of Murrah and Nili-Ravi breed ranged from 27-41 kg. On the other hand Khan (1995) reported that the average birth weight of Nili-Ravi and cross-bred calves were as 32.76 ± 0.80 and 28.50 ± 0.79 kg, respectively. These findings might be higher than the present study. The higher birth weight of calves might be due to consideration of Nili-Ravi and their cross-bred

progeny. Therefore, training and awareness creation and available of veterinary services should be given to the farmers to increase the reproductive and/or productive performances of the buffalo cows and livelihood of the farmers through improved management practices.

5. Conclusions

The current investigation showed a relatively lower productive and reproductive performance of buffalo cows in Rajshahi district of Bangladesh. It depends on many factors such as managemental practices adopted, age, sires used for breeding, parity, environmental conditions and variations in feed and fodder availability etc. It could be concluded that the owners of buffalo of the Rajshahi areas of Bangladesh do not rear their buffalo in a scientific way rather than following traditional ways. It is therefore, necessary to give emphasis on improvement in the husbandry practices. It is needed to improve the productive and reproductive performance of Indigenous buffalo cows in order to gain more profit from buffalo rearing. Further work is suggested to collect more information regarding this line. Although it is difficult to come on a clear cut conclusion but data collected in this experiment will be helpful for future research and also gives a base line for buffalo development in Bangladesh.

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Conflict of interests

None to declare.

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