Journal of Tropical Resources and Sustainable Science *ISSN: 2289-3946*
Volume 1 Number 1, January 2013:71-86 *Universiti Malaysia Kelantan Publisher*

REPRODUCTIVE POTENTIAL OF RED CHITTAGONG CATTLE IN BANGLADESH

[1]M.R. AMIN, [2]M.A. HABIB AND [2]A.K.F.H. BHUIYAN

[1]*Faculty of Agro Based Industry, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan, Malaysia*
[2]*Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh 2202*

Corresponding author: ruhulaminbau1961@gmail.com

Abstract: The study was carried out to investigate the phenotypic and genetic potential of reproductive traits of Red Chittagong Cattle (RCC) of Bangladesh. For that purpose accumulated data on a total of 101 animals from four different herds covering a period from 2005 to 2011 were used for analyses. The overall mean (±SE) values of age at first heat (AFH), age at first conception (AFC), age at first calving (AC), calving rate per productive year (CR), interval to post partum heat (IPPH), days open (DO), calving interval (CI) and generation interval (GI) were 35.9±1.1 month, 42.1±1.3 month, 50.6±1.1 month, 0.87±0.01 month, 149.4±9.5 days, 178.6±11.0 days, 454.9±10.4 days and 4.2±0.1 year, respectively. The factors having significant effects on reproductive traits were herd on DO and CI and calving year on DO. Calving parity and calving season had no significant effect on those traits. The heritability estimates of IPPH, DO and CI were very low (0, 0.06 and 0.09) and that of corresponding repeatability estimates were also low (0.06, 0.08 and 0.09, respectively). The heritability estimates for other traits were moderate (0.39 to 0.50). The results indicated that though reproductive potential of RCC for most of the traits are below than expected, that may be due to their lower inherent capability of indigenous Zebu compared to *Taurus*, but there is still opportunity of considerable improvement of these traits studied as indicated by their phenotypic variations among population.

KEYWORDS: *Red Chittagong Cattle; reproductive potential; non-genetic effect; genetic parameters.*

Introduction

Reproduction in any species is required for the propagation of generations. Reproduction of livestock is the beginning the next attempts for economic yields like meat, milk etc (Bakir and Cilek, 2009). Low fertility is of economic importance for dairy enterprises, because it results in higher levels of involuntary replacement and reduced annual milk production (Goshu *et al*., 2007). Reports indicated that calving interval of 12 to 13.5 months; number of services per conception of 1.3 to 1.5 and days open of 85 days are considered as standard values (McDowell, 1985; Radostits, 2001).

Accurate evaluation of the reproductive efficiency of indigenous stocks and their crossbred in different production systems is essential for the development of appropriate breeding strategies (Negussie *et al.,* 1998). Low reproductive efficiency hinders genetic improvement efforts and causes direct economic loss (Mukasa-Mugerwa *et al.*, 1991). Reproductive efficiency of dairy cows is influenced by different factors including genetic, season, age, production system, nutrition, management, environment and disease (Alberro, 1983; Agyemang and Nkhonjera, 1990; Mukasa-Mugerwa *et al.*, 1991; Bekele *et al.*, 1991; Negussie *et al.*, 1998; Shiferaw *et al.*, 2003). In general, low fertility rates of cattle in the tropics compared to temperate regions are probably related to environmental differences including inadequate nutrition, prevalence of diseases and parasites as well as the interaction between genotype and environment (Mukasa-Mugerwa, 1989).

The Red Chittagong Cattle of Bangladesh (Figure 1) is a promising type of cattle genotype having some potential reproductive capability. Though, genetic control on most of the reproductive traits is lower, non-genetic or environmental factors play a vital role for expressing the reproductive efficiency of cattle. The reproductive potentiality of RCC for some traits is comparable with *Taurus* and some other local Non-descript indigenous cattle available in Indo-Pak subcontinent like North Bengal Grey cattle and Munshiganj type cattle in Bangladesh. Although, local indigenous cattle for their reproductive potential have been studied, but very limited work have so far been done on this type of cattle. So, this study was conducted to investigate the genetic and non-genetic control of reproductive parameters of RCC in Bangladesh.

Figure 1: Red Chittagong Cattle

Materials and methods

Study sites with geographical location and climate

The study was conducted from four different sites/herds located at Anwara ($22^0$10' to $22^0$14' N and $91^0$52' to $91^0$56' E) and Chandanaish ($22^0$12' to $22^0$14' N and $92^0$0' to $92^0$06' E) Upazila in Chittagong district and Bangladesh Agricultural University (BAU) nucleus herd ($24^0$30' to $25^0$10' N and $90^0$15' to $91^0$15' E) and Char Jailkhan community herd ($24^0$77' to $24^0$78' N and $90^0$39' to $90^0$41' E) in Mymensingh district having a pronounced tropical monsoon-type climate has warm temperatures throughout the year, with a hot and rainy summer and a dry winter with relatively little variation from month to month. January tends to be the coolest month with temperatures averaging near 26^0C (78^0F) and April/May the warmest with temperatures from 33 to 36^0C (91 to 96^0F). The climate is one of the wettest in the world. Most places receive more than 1,525 mm of rain a year, and areas near the hills receive 5,080 mm. Most rains occur during the monsoon (June-September) and little in winter (November- February) (Anonymous, 2012).

Management of animals in the herds

The feeding and management of RCC by smallholders was semi-intensive. The animals were grazed most of the time in a day (6-8 hrs/day). So, land side grasses are the basal diet of the animals. Rice straws were the second main basal diets of the animals specially during cropping seasons. Most of the farmers provided rice bran and common salt to their animals fed with drinking water daily. Housing system provided to the animals were traditional in a shabby house made of bamboo with thatched roofs. The feeding and management of RCC at BAU Nucleus herd was intensive. The animals were housed in a paddock with a faced out open house system. The animals of the Nucleus Herd were stall fed throughout the year. The animals were provided concentrate, green grass and straw where straw was the basal diet supplemented with urea and/molasses. The animals were allowed to graze due to lack of facility. Sometimes, the animals were given a mixture of molasses and straw only twice a day *ad libitum* throughout the year. Green forages like German grass, Sorghum grass, and Maize fodder were provided with limited amount due to scarcity of their availability round the year. Concentrate mixture was supplied once a day in the morning at the rate of 600g/lactating cow, 500g/pregnant cow and 250g/dry cow and heifer. The pregnant cows were transferred to a separate house a few days prior to calving and returned to cow barn few days after calving. The calves were allowed to suckle their dam for few hours after milking and again few hours before evening and it continued up to 3-4 months. Afterwards, calves were allowed to suckle once a day after milking until weaning. In the herds of Chittagong district of Bangladesh, farmers seldom vaccinated and dewormed their animals. In the BAU nucleus and community herd in Mymensingh, the animals were dewormed and vaccinated (against FMD and Anthrax disease) at regular interval for close monitoring.

Animals and data preparation

The data consisted of records of 101 animals included from two generations raised in the above mentioned herds collected from 2005 to 2011. The number of data set used for analyses of various traits is given in Table 1.

Table 1: Number of observations of reproductive traits in different herds.

Traits	Number of observations (N)				
	Site-1	Site-2	Site-3	Site-4	Total
Age at first heat (AFH)	-	-	*Mixed		39
Age at first conception (AFC)	-	-	*Mixed		40
Age at first calving (AC)	-	-	*Mixed		39
Calving rate per productive year (CR)	-	-	*Mixed		41
Interval to *post-partum* heat (IPPH)	14	15	97	37	163
Days open (DO)	5	10	83	42	140
Calving interval (CI)	5	10	59	65	139
Generation interval (GI)	-	-	*Mixed		41

*Records of animals reared in combination of herds in site-3 and site-4.

After collecting the necessary data for analyses, preliminary editing was performed to exclude abnormal or biased data. Then all data were plotted in a normal distribution curve and those fell beyond the normal curve were eliminated. About 2 to 10% records were rejected as they fell outside the range of normal distribution fitted for statistical models. In this way final composition of data set is shown in Table 2.

Table 2: Generation of reproductive traits data for analysis.

Traits[1]	Total records	Accepted range	Records removed		Records used
			No.	%	
AFH (months)	39	23.5-47	3	7.7	36
AFC (months)	40	26-60	3	7.5	37
AC (months)	39	36-65	4	10.3	35
CR (no)	41	0.7-1.02	1	2.44	40
IPPH (days)	163	20-400	7	4.3	156
DO (days)	140	20-425	6	4.3	134
CI (days)	139	300-700	7	5.0	132
GI (years)	41	3-5	4	9.8	37

[1]Traits described in Table 1.

Traits analyzed

Traits considered in the analyses included: age at first heat (AFH) estimated months between date of birth and date of showing first heat, age at first conception (AFC) estimated months between date of birth and date of first conception, age at first calving (AC) estimated months between date of birth and date of first calving, calving rate per productive year (CR) estimated from total number of newborns gave birth by a dam (considered a minimum of 3 animals) divided by years between first conception and last calving, interval to *post-partum* heat (IPPH) estimated days between date of calving and date of next showing heat, days open (DO) estimated days between date of calving and date of subsequent conception, calving interval (CI) estimated days between consecutive calvings and generation interval (GI), and estimated years between date of birth and date of first mothering.

Data analyses and statistical model

Animals were arranged in contemporary groups of calving parity, herd, year and season. The general linear model (GLM) procedure of SPSS 11.5 was used to test the main fixed effects as well as interactions effects. The following generalized linear model was used for least squares analysis:

$$Y_{ijkl} = \mu + par_i + hrd_j + yr_k + sea_l + (hrd\text{-}yr\text{-}sea)_{jkl} + e_{ijklm}$$

Where, Y_{ijkl} = Dependent variables (IPPH, DO, CI)

μ = Overall population mean for any of the said trait;

par_I is the fixed effect of calving parity (1-7+),

hrd_j is the fixed effect of herd (4 herds),

yr_k is the fixed effect of calving year (7 years),

sea_l is the fixed effect of calving season (3 seasons),

$hrd\text{-}yr\text{-}sea_{jkl}$ is the interaction effect of herd, year and season

e_{ijklm} is the random residual error

Heritability was estimated using REML procedure by VCE 4.2.5 software (Groeneveld, 1998) with single trait animal model. Random effect considered in the model was animal's additive genetic effect. In the animal model calving parity, herd, season and year of calving were included as fixed effects. Each year was divided into three seasons: March-June (summer), July-October (rainy) and November-February (winter). All relationships among individuals were considered in the animal model. The general form of animal model was as follows:

$$Y = Xb + Za + Wc + e \quad \text{(Groeneveld, 1998)}$$

Where,

Y = Vector of observations
X, Z, and W = Known incidence matrices associated with levels of b, a and c with Y.
b = Unknown vector of fixed effects (i.e. sex, herd, year, season, parity, age)
a = Unknown vector of breeding values
c = Unknown vector of permanent environmental effects
e = Vector of residual effects

The animals selected for repeatability estimation of reproductive traits were those with number of repeated records more than single. Repeatability was estimated by intra-class correlations as described by Lush (1945) from analysis of variance with the following formula given below.

Repeatability (r) = $\sigma^2_B/(\sigma^2_B + \sigma^2_w)$, where σ^2_B is the variance between animals and σ^2_w is the variance within animals. The standard error of repeatability was estimated by using the formula of Swiger *et al.* (1964).

Results and discussion

Estimation of phenotypic parameters

Table 3 presents the phenotypic mean (±SE), range (minimum and maximum) and phenotypic coefficient of variation of reproductive traits of RCC.

Table 3: Phenotypic mean, standard error (SE), minimum (Min.), maximum (Max.) and coefficient of variation (CV %) for reproductive traits of RCC

Trait[1]	Number of records	Mean	SE	Range		CV (%)
				Min.	Max.	
AFH (months)	036	35.9	1.1	23.5	46.8	17.7
AFC (months)	037	42.1	1.3	26.4	60.2	19.1
AC (months)	035	50.6	1.1	36.7	64.5	13.4
CR (no)	040	0.87	0.01	0.7	1.02	10.6
IPPH (days)	156	149.4	9.5	21	391	54.6
DO (days)	134	178.6	11.0	23	412	50.1
CI (days)	132	454.9	10.4	303	679	19.1
GI (years)	037	4.2	0.1	3.1	5.2	12.9

[1]Traits described in Table 1.

Age at first heat (AFH)

The age at first heat of RCC heifers in this study averages 35.9±1.1 months (Table 3) which is somewhat lower (37.5±0.9 months) than the recent study of Habib (2011). Bag *et al.* (2010), Azizunnesa *et al.* (2010) and Hossain *et al.* (2006) on their field survey observations reported slightly lower age at puberty (32.4±3.6, 32.2±20.7 and 32.4±3.9 months, respectively) for RCC in their home tract. Some other authors reported values ranging from 32.5 to 42.5 months for Non-descript Deshi/indigenous cows (Majid *et al.*, 1995; Ali *et al.*, 2006), 39.2±4.3 and 35.1±9.2 months for Pabna and Sahiwal×Pabna cross cows (Hoque *et al.*, 1999). Their reports are in line with this study. But in case of Friesian×Pabna crosses the value was 25.5±5.6 months reported by Hoque *et al*. (1999) which was much shorter age than this study. Singh *et al.* (2002) reported 35.6±0.5 months for Deoni cattle in India which coincides by RCC. The variation within and between breeds might be happened due to differences in nutritional level, body condition score (BCS), management, environment and genotypes. It is also evident that temperate breeds come into maturity at an earlier age than the breeds of tropical environment. Different factors advance or delay puberty. Environmental factors, especially nutrition, determine pre-puberal growth rates, reproductive organ development, and onset of puberty and subsequent fertility. Substantial evidences exist to prove that dietary supplementation of heifers during their growth reduces the interval from birth to first service and birth to first calving. Optimum nutrition accelerates growth of heifers and reproductive phenomena are associated with body weight in a particular breed rather than age (Kayongo-Male *et al.*, 1982; Azage, 1989).

Age at first conception (AFC)

The average age at first conception of RCC in this study is estimated at 42.1±1.3 months (Table 3). On the other hand the cows showed first heat about 6 months earlier which was estimated at 35.9 months. For a fertile herd interval between first heat and first conception should be as minimum as possible. In this case heifers might require more number of services than cows in first conception which lengthened the age at first conception. Although, literatures on this estimate are rare, but may be interpreted with literatures on age at first calving by deducting the mean days of 285 for gestation. In this way, the result of 49.7 months for age at first calving of RCC by the study of Habib (2011) stands 40.2 months for age at first conception which is about 2 months earlier than this study. Other studies (Hossain *et al.*, 2006 and Bag *et al.*, 2010) stand 33.5 and 34 months, respectively based on their reported age at first calving of RCC. Their estimates are lower than the estimate of this study. The probable variations among studies for the same genotype may be due to difference in sample size, management system, nutritional status, endocrine factors and other unknown reasons.

Age at first calving (AC)

The average age at first calving of RCC was 50.6±1.1 months (Table 3) which is in agreement with the report (49.7±1.1 months) by Habib (2011). In contrary, earlier age at first calving (43.1±4.6 SD and 43.5±0.5 months) was observed in reports of field survey with RCC in their home tract in Chittagong region of Bangladesh conducted by Bag *et al.* (2010) and Hossain *et al.* (2006). However, age at first calving ranging from 45.7±0.5 to 54.0 months as reported by Singh *et al*. (2002) for Deoni cattle, Gaur *et al.* (2002) for Ongole also known as "*Nellore*" and Mwacharo and Rege (2002) for Kenyan small native indigenous cattle named South East African Shorthorn Zebu cattle (SEAZ) are in line with this study. The variation of age at first calving among different authors for the same breed might be due feeding management and health status of animals. This supports the concept that appropriate feeding management in early life should lower the age at first calving (Mahadevan, 1953). Previous works indicated that feeding management and health status determines pre-pubertal growth rates and reproductive development (Negussie *et al.,* 1998 and Masama *et al.,* 2003). The better-managed and well-fed heifers grew faster, served earlier and resulted in first calving at earlier age at first calving (Negussie *et al.,* 1998 and Masama *et al.,* 2003).

Calving rate per productive year (CR)

The calving rate per productive or breeding year of RCC estimated in this study averaged at 0.87±0.01 calves per year (Table 3). Although zebu cattle tend to reach sexual maturity rather late, their productive life and that of their crosses tends to be longer than that of taurine cattle (Fowler, 1969). The useful life of zebu cattle in the tropics varies from 4.5 to 8.5 years, during which cows produced 3 to 5.4 calves (Alim, 1960, 1962; Aroeria *et al.*, 1977; Pires *et* *al.*, 1977; Saeed *et al.*, 1987; Mukasa-Mugerwa *et al.*, 1989). Their reports give an estimation of 0.64 to 0.67 calves per productive year which are much below than RCC in this study.

Table 4: Reproductive traits (IPPH, DO and CI) as affected by parity, herd, season and year

Effect	Least squares means ±SE		
	IPPH (days)	DO (days)	CI (months)
Parity	NS	NS	NS
1	184.18±18.14 (31)	215.92±18.40 (29)	-
2	154.85±20.97 (21)	173.42±24.17 (17)	476.01±19.20 (27)
3	156.10±18.31 (31)	202.72±20.75 (24)	447.25±23.97 (17)
4	126.07±18.31 (31)	176.82±19.68 (28)	468.19±19.89 (25)
5	150.34±22.06 (20)	165.80±23.93 (18)	461.26±20.03 (26)
6	108.37±26.06 (13)	180.04±27.06 (13)	438.02±23.82 (19)
7+	166.24±40.30 (09)	135.19±45.42 (05)	438.40±23.26 (18)
Herd	NS	*	*
Site-1	161.30±30.90 (10)	121.70^{a}±44.50 (05)	409.13^{a}±40.39 (05)
Site-2	139.08±25.24 (15)	116.50^{a}±31.33 (10)	390.81^{a}±31.10 (10)
Site-3	145.68±11.44 (94)	178.06^{ab}±13.09 (78)	457.28^{ab}±15.42 (58)
Site-4	154.64±18.23 (37)	231.71^{b}±19.25 (41)	491.77^{b}±15.64 (59)
Season	NS	NS	NS
Summer	143.90±16.31 (55)	172.02±18.84 (44)	443.87±17.51 (42)
Rainy	148.16±18.89 (41)	194.02±18.78 (34)	488.70±20.89 (34)
Winter	156.07±13.77 (60)	172.66±17.93 (56)	437.67±16.90 (56)
Year	NS	*	NS
2005	112.36±20.31 (26)	-	414.28±19.62 (24)
2006	156.42±21.05 (20)	124.44^{a}±20.47 (26)	433.95±21.74 (23)
2007	171.63±20.26 (39)	170.76^{ab}±22.93 (30)	450.69±20.75 (28)
2008	141.89±20.34 (35)	174.50^{ab}±23.07 (30)	480.89±25.51 (28)
2009	130.73±31.70 (16)	177.48^{b}±21.42 (25)	513.95±26.04 (26)
2010	182.84±21.36 (16)	242.53^{b}±26.57 (23)	424.85±52.07 (03)
2011	119.97±43.45 (04)	-	-

[1]IPPH-interval to *post-partum* heat; DO-days open; CI-calving interval; *-significant at p<0.05; NS-non significant (p>0.05); Least square means without a common superscript differed significantly (p<0.05); Figures in the brackets indicate the number of observations.

Interval to post- partum heat (IPPH)

The average interval to *post- partum* heat of RCC is 149.4±9.5 days (Table 3) which is higher than earlier report (131.4±6.7 days) of Habib (2011) in the same herds. On the field surveys of RCC in their home tract in Chittagong region of Bangladesh, Hossain *et al.* (2006) Azizunnesa *et al.* (2010) and Bag *et al.* (2010) reported lower estimates (44.47±3.47, 92.46±30.27SD and 43.1±5.4 days, respectively) in their studies. But Roy (1999) and Rahman *et al.* (2001) estimated *post-partum* estrous period of 141.3±88.4 days for Non-descript Deshi and 160.7±80.3 days for Pabna cows, respectively which are almost same with that of present study. The variation of interval to *post-partum* heat among workers within same genotype may be due to sample size or production system. However, the effect of low level of nutrition on extended *post-partum* period due to weight loss was noted by Gebregziabher *et al.* (2005). They also added that heavier cows at calving and cows that gained weight during the first three months *post-partum* were in a positive energy balance, which enabled them to return to normal estrous cycles. Negative energy balance delays the resumption of ovarian activity (Butler and Smith, 1989). Apart from nutritional effect, poor estrus detection by herdsman and poor estrus expression could be the other factors for long interval to *post-partum* heat.

Days open (DO)

The overall days open (178.6±11.0 days) obtained for RCC in this study is higher than 141.2±8.4 days for RCC in the same herds estimated previously (Habib, 2011). Some other authors noticed 135±86 (mean±SD) days for Deshi cattle in India (Moulick *et al.*, 1972) and 159±1.6 days for Sahiwal cows in Pakistan (Zafar *et al.*, 2008), which were rather comparatively similar with the reports of 170.0±7.0 days for Deoni cattle (Sing *et al.*, 2002) and 177±5.4 days for Friesian cattle (Goshu *et al.*, 2007), however others (Rahman *et al.*, 2001 and Gaur *et al.*, 2002) reported comparatively higher values (188.1±106.7 to 309.0±182.9 days) for Bangladeshi Local, Friesian, Sahiwal, Ongole and different graded cattle.The variations of days open among different researchers might be due to different breed, herd, sample size, efficiency of inseminator, proper heat detection, management and nutrition. Several scholars suggested that differences in management might have accounted for the observed differences on days open (Masama *et al.*, 2003; Shiferaw *et al*., 2003; Lyimo *et al*., 2004).

Calving interval (CI)

The calving interval of RCC in this study averages 454.9±10.4 days (about 15 months) (Table 3), which is higher than 422.8±9.7 days reported by Habib (2011) in the same herds estimated previously. The result of this study closely agrees within the range reported by the studies of Bag *et al.* (2010), Azizunnesa *et al.* (2010) and Hossain *et al.* (2006) for RCC (14.0 to 14.84 months, i.e 420 to 445 days), Sultana and Bhuiyan (1997) and Rahman *et al.* (2001) for Non-descript Deshi, Singh *et al*. (2002) for Indian Deoni cows and Moulick *et al.* (1972) for Indian Deshi cattle (419 to 466 days). Comparatively shorter calving interval (347 to 411 days) were found by Hoque *et al*. (1999) for Friesian×Pabna crosses, Habib *et al.* (2003) for RCC, and Munim *et al*. (2006) for indigenous, RCC and Jersey×indigenous crosses. But comparatively longer calving interval (484 to 536 days) were found by the studies of Majid *et al*. (1995) and Hossain and Routledge (1982) for Pabna cows in Bangladesh and Gaur *et al*. (2002) for Ongole cattle in India. Taneja and Bhat (1986) reported the calving interval of Indian Non-descript cattle was 18.7±1.0 months (i.e 561 days) which was higher than that of RCC. The calving interval varied among previous studies which may be due to different genotype, herd, sample size, feeding, general and reproductive management, disease condition, number of services per conception, *post-partum* interval period and days open. However, the calving interval in the present study exceeded the desirable interval of 365 days.

Generation interval (GI)

The average generation interval of RCC found in this study is 4.2±0.1 years (Table 3). Lasley (1978) reported generation interval of cattle (beef and dairy) from 4.5 to 6.0 years for females. Willis (1998) reported generation interval of 5 to 7 years for dairy cattle and 4 to 5 years for beef cattle. The present finding is in agreement with their reports. Lasley (1978) also stated that generation interval of cattle conceivably would be as short as 2.5 to 3.0 years. Early puberty will set lower limit of generation interval associated with type of cattle (Zebu or Taurus), nutrition, management and environment. There appear to have no more literatures on this trait for indigenous cattle of Bangladesh to compare.

Effects of fixed/non-genetic factors

Table 5 shows the results of the analysis of variance for traits analyzed in this study.

Table 5: Analysis of variance for weight and growth traits

Traits[1]	*F* value and significance[2]					R^2
	Parity	Herd	Season	Year	HYS	
AFH (months)	-	-	-	-	-	-
AFS (months)	-	-	-	-	-	-
AFC (months)	-	-	-	-	-	-
CR (no)	-	-	-	-	-	-
IPPH (days)	1.548	0.310	0.170	1.635	1.463	0.31
DO (days)	0.923	3.553*	0.370	3.266*	1.238	0.33
CI (months)	0.536	2.970*	1.288	1.837	1.081	0.30
GI (years)	-	-	-	-	-	-

[1]Traits described in Table 1; *-significant at p<0.05; - effect not included in the model; R^2-coefficient of determination

Parity

Table 4 and 5 indicate that calving parity has no significant effect (p>0.05) on reproductive traits (interval to post partum heat, days open and calving interval). The result from this study is in consonance from the results of El-Keraby and Aboul-Ela (1982), Habib *et al.* (2003), and Cilek and Tekin (2005) who stated that parity did not affect any of those traits. But the results are in contrary to that documented by Hammoud *et al.* (2010), Tadesse *et al.* (2010) and Mureda and Zeleke (2007), as they reported significant effect of calving parity on those traits.

Herd

The variation of interval to post partum heat among herds is not significant (p>0.05) for RCC (Table 4 and 5). This do not coincide by the study of Tadesse *et al.* (2010) and Mureda and Zeleke (2007) who found significant (p<0.001; p<0.05) influence on this trait among different herds. But, herd is a significant (p<0.05) source of variation for days open in this study which is in aggrement with the studies of Tadesse *et al.* (2010) and Mureda and Zeleke (2007), while dissimilar to that observed by Habib (2011) and Salah and Mogawer (1990). Herd also has significant (p<0.05) effect on calving interval for RCC (Table 5). The result is in line with that reported by Tadesse *et al.* (2010) and Mureda and Zeleke (2007). On contrary, Habib (2011) and Parra-Bracamonte *et al.* (2005) found no significant effect of the trait for different herds. The significant variations of the latter two traits due to herds could be attributed to the existing differences in nutrition, reproductive managements and environment or climate in different herds.

Calving season

Calving season has no significant effect (p>0.05) on reproductive traits (interval to *post-partum* heat, days open and calving interval). The results come into agreement with the earlier reports of Habib (2011), Tadesse *et al.,* (2010) and Cilek and Tekin (2005), but not postulated with others (El-Keraby and Aboul-Ela, 1982 and Hammoud *et al*., 2010;) Some authors suggested that seasonal variation in reproductive activities could be due to photoperiod (Thibault *et al*., 1966) or to seasonal differences in nutrition and/or housing (De Kruik, 1975) but the reason has not yet been resolved. But the seasonal influence on reproductive performance not existed in RCC, could be due to their inherent adaptability in to the harsh environments.

Calving year

There are no significant variations of interval to post partum heat and calving interval among different calving years of RCC in this study (Table 4 and 5). Similar effect was also reported by the earlier study of Habib (2011) in the same herds of RCC for those two traits. In contrast, Hammoud *et al*. (2010), Tadesse *et al.* (2010) and Cilek and Tekin (2005) reported significant variations for those traits due to different calving year. But, significant effect of calving year is seen for days open (Table 4 and 5) in this study. Hammoud *et al*. (2010), Tadesse *et al.* (2010) and Cilek and Tekin (2005) in their studies found significant effect of year of calving on days open. They explained the possible reasons for significant variation due to change of management practices and nutritional level over the years studied. So, the result of this effect for the trait is concomitant by their studies, while contradicted with others (Habib, 2011; Bakir and Cilek, 2009). Year effect on reproduction in the tropics has been reported to be indirect due to dynamic climatic changes which are frequently associated with disease pattern and changes in management by farmers (Mulangila, 1997).

Heritability

The variance components and heritability estimates along with corresponding standard errors of different reproductive traits of RCC are illustrated in Table 6. Table 6 shows that the heritability estimates of interval to postpartum heat, days open and calving interval are very low ranging from 0 to 0.09, while in case of age at first heat, age at first conception, age at first calving, calving rate per productive year and generation interval are medium to high ranging from 0.39 to 0.50.

Table 6: Variance components and heritability (±SE) estimates of reproductive traits

Traits	Variance components				h^2±SE
	Additive genetic (σ^2_A)	Environmental (σ^2_{PE})	Residual (σ^2_E)	Phenotypic (σ^2_P)	
AFH	16.088	0.00	16.088	32.176	0.50±0.14
AFC	36.941	0.00	36.941	72.882	0.50±0.14
AC	24.063	8.277	24.063	56.403	0.43±0.19
CR	0.005	0.00	0.005	00.010	0.50±0.09
IPPH	0.00	291.402	7001.707	7293.109	0
DO	522.194	1916.605	6893.572	9332.371	0.06±0.06
CI	959.643	3323.973	5934.00	10217.616	0.09±0.05
GI	0.106	0.059	0.106	00.271	0.39±0.14

The heritability estimates of reproductive traits of cow are reported to be low (Davenport *et al*., 1965; Dearborn *et al*., 1973) indicating the major part of variations for reproductive traits are due to non-genetic (environment) factors and rapid response could be expected only by improving environmental conditions such as feeding regime and management system (Ulutas and Sezer, 2009). Phillips (2006) reported that reproductive traits usually have a heritability of <0.10. Our reports match for some traits by their reports. The recent study of this author (Habib, 2011) in the same herds found the heritability estimates of interval to postpartum heat, days open and calving interval as 0.06±0.08, 0.04±0.09 and 0.03±0.04, respectively which are closely in the line of this study. The results are also in agreement with Lasley (1978) and Ageeb and Hayes (2000) for interval to post partum heat (0.06-0.08 and 0), Warwick and Legates (1979) and Willis (1998) for days open (0 to 0.09), Willis (1998), Warwick and Legates (1979) and Lasley (1978) for calving interval (0-0.15). The heritability estimates of age at first heat and age at first calving are very closer agreement by the earlier work of (Habib, 2011) reported as 0.49±0.07 and 0.50±0.09. In another literatures reviewed by Puri and Malik (1963) and Demeke *et al.* (2004) reported age at maturity and age at first calving to be 0.44±0.5 and 0.44±0.05, respectively which come in to agreement with our findings. Bastidas and Verde (1981) and Baliero *et al.* (1981) reported heritability of age at first conception of Zebu and Guzerat cattle as 0.14±0.19 and 0.2, respectively which are lower compare to our estimate. Unfortunately, we are unable to compare the heritability estimates of calving rate per productive year and generation interval due to unavailability of relevant literatures. From the heritability study of the reproductive traits, it is clear that genetic improvement for some traits is possible by selecting animals on performance evaluation, but not possible for some other traits due to environmental effects are greater than their genetic background.

Repeatability

The variance components and repeatability along with corresponding standard errors of different repeatable reproductive traits are presented in Table 7. Table 7 shows that the repeatability estimates of reproductive traits are very low ranging from 0.06 to 0.09 as because of their low level of corresponding heritability values.

Table 7: The variance analyses and repeatability (±SE) of reproductive traits

Traits	Variance components		r ± SE
	Variance between cows (σ^2_B)	Variance within cows (σ^2_w)	
IPPH (days)	548.034	9004.208	0.06±0.08
DO (days)	637.800	6948.113	0.08±0.09
CI (months)	767.223	6919.272	0.09±0.09

Habib (2011) in his recent study in the same herds found repeatability estimates of 0.04±0.11, 0.09±0.13 and 0.01±0.13, respectively for the traits of interval to postpartum heat, days open and calving interval which are concomitant with this findings. The results also agree with other reports reviewed by Lasley (1978) for interval to postpartum heat (0.02 to 0.15), Demeke *et al.* (2004) for days open (0.14±0.02), Singh and Desai (1962b) for calving interval (0.10) for different breeds in different places. As can be seen as very minor genetic control on the reproductive traits, there might be a little chance of prediction for reproductive traits in their future performance. Thus, attention should be paid on the environmental factors directly associated with reproductive performances.

Conclusion

It may, therefore, be concluded that the reproductive potentiality of RCC found in this study is comparable with other indigenous cattle available in Bangladesh and even in other countries on the basis of literatures. However, the improvement of reproductive performance that is below than expected due to their inherent fact may overcome some extent providing favorable environment like feeding, general and reproductive management, disease control rather than genetic improvement due to low heritability.

Acknowledgement

The authors would like to acknowledge USDA for funding the RCC project from which data were collected to prepare this work.

References

Ageeb, A.G. and J.F. Hayes. 2000. Reproductive Responses of Holstein-Friesian Cattle to the Climatic Conditions of Central Sudan. Trop. Anim. Hlth. Prod., 32(4): 233-243.

Agyemang, K., and Nkhonjera, L. P. 1990. Productivity of Crossbred Cattle on Smallholder Farms in Southern Malawi. Tropical Animal Health and Production 22: 9-16

Alberro, M. 1983. Comparative Performance of F_1 Friesian×Zebu Heifers in Ethiopia. Anim. Prod., 37: 247-252.

Anonymous 2012. http://www.discoverybangladesh.com/meetbangladesh/climate.html

Ali, M.H., M.N. Islam, M.A.S. Khan and M.N. Islam. 2006. Reproductive Performance of Different Crossbred and Indigenous Dairy Cows at Takerhat Milk Shed Area, under the Bangladesh Milk Producers' Co-operative Union Limited (Milk Vita). J. Bangladesh Soc. Agric. Sci. Tech., 3(3&4): 91-94.

Alim, K. A. 1960. Reproductive rates and milk yield of Kenana cattle in Sudan. *Journal of Agricultural Science* 55: 183-188.

Alim, K. A. 1962. Environmental and genetic factors affecting milk production of Butana cattle in the Sudan. *Journal of Dairy Science* 45: 242-247.

Aroeria, J. A. D., da Silva, H. M., Fontes, L. R. and Sampaio, I. B. M. 1977. Age at first calving, length of reproductive life and life expectancy in Zebu cows.*Arquivos da Escola de Veterinaria, Universidade Federal de Minas Gerais* 29: 301-309 (*Animal Breeding Abstracts* 46: 32-72).

Azage, T. 1989. Reproductive Development and Function in Zebu and Crossbred Cattle in Ethiopia. Ph.D. Thesis, James Cook University, Australia.

Azizunnesa, B.C. Sutradhar, M. Hasanuzzaman, O.F. Miazi, M. Aktaruzzaman and M.O. Faruk. 2010. Study on the Productive and Reproductive Performances of Red Chittagong Cows at Rural Areas in Chittagong. Univ. J. Zoo., Rajshahi University, 28: 27-31.

Bag, M.A.S., M.A. Mannan, M.S.R. Khan, M.M. Parvez and S.M. Ullah. 2010. Morphometric Characterization and Present Status of Red Chittagong Cattle (RCC) in Chittagong District in Bangladesh. Int. J. BioRes., 1(2): 11-14.

Bakir, G. and S. Cilek. 2009. A Research on Reproductive Traits of Holstein Cattle Reared at Tahirova State Farm in Balikesir Province in Turkey. J. Anim. Vet. Adv., 8(11): 2383-2387.

Baliero, E., de Silva, S., Carnerio, G. G. and Salvo, A. E. W. 1981. Reproductive efficiency in a herd of Guzerat dairy cows. I. Age at first conception. *Arquivos da Escola de Veterinaria, Universidade Federal de Minas Gerais* 33: 483-488 (*Animal Breeding Abstracts* 50: 5491).

Bastidas, M. P. S. and Verde, S. O. G. 1981. Factors affecting conception rate and age at first calving in Bos indicus heifers. *Memoria, Asociacion Latinoamericana de Produccion Animal* 16: 123 (*Animal Breeding Abstracts* 52: 6441).

Bekele, T., O.B. Kasali and T. Alemu. 1991. Reproductive Problems in Crossbred Cattle in Central Ethiopia. Anim. Repro. Sci., 26: 41-49.

Britt, J.H., R.G. Schott, J.D. Armstrong and M.D. Whitacre. 1986. Determinants of Estrous Behavior in Lactating Holstein Cows. J. Dairy Sci., 69: 2195-2202.

Butler, W.R. and R.D. Smith. 1989. Interrelationship between Energy Balance and Postpartum Reproductive Function in Dairy Cattle. J. Dairy Sci., 72: 767-783.

Cilek, S. and M.E. Tekin. 2005. The Environmental Factors Effecting Milk Yield and Fertility Traits of Simmental Cattle Raised at Kazova State Farm and Phenotypic Correlations between these Traits. Turkey J. Vet. Anim. Sci., 29: 987-993.

De Kruik, A. 1975. An Investigation of the Parameters which Determine the Fertility of a Cattle Population and of Some Factors which Influence these Parameters. Vet. Med. Mag., 100, p. 1089.

Demeke, S., F.W.C. Neser and S.J. Schoeman. 2004. Estimates of Genetic Parameters for Boran, Friesian and Crosses of Friesian and Jersey with the Boran Cattle in the Tropical Highlands of Ethiopia: Reproduction Traits. J. Anim. Breed. Genet., 121(1): 57–65.

El-Keraby, F. and M.B. Aboul-Ela. 1982. A Study of Some Non-genetic Factors Affecting Postpartum Reproductive Performance in Friesian Cows. Trop. Anim. Prod., 7: 307-314.

Fowler, S. H. 1969. *Beef production in the south*. Interstate Printers and Publishers, Danville, Illinois, USA. pp. 212-213, 219-220.

Gaur, G.K., S.N. Kaushik and R.C. Garg. 2002. Ongole Cattle Status in India. Anim. Gen. Res. Info., 32: 27-34.

Gebregziabher G., A. Tegegne, M.L. Diedhion and B.P. Hegde. 2005. Days to First Service, Conception Rate and Service Period of Indigenous and Crossbred Cows in relation to Postpartum Body Weight Change at Bako, Ethiopia. Ethiopian J. Anim. Prod., 5(1): 83-90.

Goshu, G., K. Belihu and A. Berihum. 2007. Effect of Parity, Season and Year on Reproductive Performance and Herd Life of Friesian Cows at Stella Private Dairy Farm, Ethiopia. Livest. Res. Rural. Devlop., 19(7), Art. 98 (http://www.lrrd.org/lrrd19/7/gosh19098.htm).

Groeneveld, E. 1998. VCE4.2.5 User's Guide and Reference Manual Version 1.1. Institute of Animal Husbandry and Animal Behaviour, Mariensee, Federal Agricultural Research Center, Germany.

Habib, M.A. 2011. Analysis of Red Chittagong Cattle Genotype in Nucleus Breeding Herd. Ph.D. Dissertation, Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh, p. 158.

Habib, M.A., A.K.F.H. Bhuiyan, M.S.A. Bhuiyan and A.A. Khan. 2003. Performance of Red Chittagong Cattle in Bangladesh Agricultural University Dairy Farm. Bangladesh J. Anim. Sci., 32 (1-2): 101-108.

Hammoud, H.M., S.Z. El-Zarkouny and E.Z.M. Oudah. 2010. Effect of Sire, Age at First Calving, Season and Year of Calving and Parity on Reproductive Performance of Friesian Cows under Semiarid Conditions in Egypt. Arch. Zoot., 13(1): 60-82.

Hoque, M.A., M.R. Amin and M.S. Hussen. 1999. Dairy Potential of Pabna Cows and Crossbreds with Sahiwal and Friesian and Within-and Between-Breed Sire Effects. Asian-Aust. J. Anim. Sci., 12(2): 161-164.

Hossain, M.A. and S.F. Routledge. 1982. Performance of Crossbred and Local Cattle under Village Condition in Pabna District of Bangladesh. Proc. of "Maximum Livestock Production from Minimum Land". Seminar Paper held at Bangladesh Agricultural University, Mymensingh, Bangladesh, pp. 161-167.

Hossain, M.M., A.K.F.H. Bhuiyan, M.O. Faruque and G.K. Dev. 2006. Characterization and Distribution Pattern of Red Chittagong Cattle of Bangladesh. Progress. Agric., 17 (1): 103-110.

Kayongo-Male, H., C.N. Karue and E.R. Mutiga. 1982. The Effect of Preconception Supplementation on the Productivity of Dairy Heifers Grazed on Medium Quality Pasture under East African Conditions. Bull. Anim. Hlth. Prod. Africa, 30: 65-72.

Lasley, J.F. 1978. Genetics of Livestock Improvement. 3rd edition, Prentice-Hall, Inc., Eaglewood Cliffs, New Jersey, USA. pp. 1-492.

Lush, J.L. 1945. Animal Breeding Plans. 3rd ed. Iowa State College Press, Ames.

Lyimo, C., R. Nukya, L. Schoolman and F.J. Van Ferdenbutg. 2004. Post-partum Reproductive Performance of Crossbred Dairy Cattle on Smallholder Farms in Sub Humid Coastal Tanzania. Trop. Anim. Hlth. Prod., 36: 269-279.

Mahadevan, P. 1953. Dairy Cattle Breeding in East Africa. E. African Agric. For. J., 30:320.

Majid, M.A., T.N. Nahar, A.I. Talukdar and M.A. Rahman. 1995. Factors Affecting the Reproductive Efficiency of Crossbred Cows. Bangladesh J. Livest. Res., 2(1): 18-22.

Masama, E., K.T. Kusina, S. Sibanda and C. Majoni. 2003. Reproduction and Lactation Performance of Cattle in a Smallholder Dairy System in Zimbabwe. Trop. Anim. Hlth. Prod., 35: 117-129.

McDowell R.E. 1985. Crossbreeding in Tropical Areas with Emphasis on Milk, Health and Fitness. J. Dairy Sci., 68: 2418-2435.

Moulick, S.K., R.E. McDowell, L.D. Van Vleck and H.Guha. 1972. Potential of Deshi Cattle of India for Dairy Production. J. Dairy Sci., 55(8): 1148-1155.

Msanga, Y.N., M.J. Bryant and A.M. Katule. 1999. Effect of Environmental Factors and Proportions of Holstein Blood on Days to First Insemination and Calving Interval of Crossbred Dairy Cattle on Smallholder Farmers in Northeast Tanzania. In: Proc. Tanzania Soc. Anim. Prod., 26: 161-175.

Mukasa-Mugerwa E, Ephraim Bekele and Taddese Tessema. 1989. Type and productivity of indigenous cattle in Central Ethiopia. *Tropical Animal Health and Production*

Mukasa-Mugerwa, E. 1989**.** A Review of Reproductive Performance of Female *Bos indicus* (Zebu) Cattle. ILCA, Monograph No. 6. International Livestock Center for Africa, Addis Ababa, Ethiopia (http://www.ilri.org/InfoServ/Webpub/Fulldocs/X5442e/X5442e00.htm).

Mukasa-Mugerwa, E., A. Tegegne, T. Mesfin and Y. Teklu. 1991. Reproductive Efficiency of *Bos indicus* (Zebu) Cows under AI Management in Ethiopia. Anim. Repro. Sci., 24: 63-72.

Mulangila, R.C.T. 1997. A Study of Dairy Cattle Productivity in Tanga Region, M.Sc. Thesis. Sokoine University of Agriculture, Morogoro, Tanzania, pp.32.

Munim, T., S.S. Husain, M.A. Hoque and M.A.M.Y. Khandoker. 2006. Estimation of Heritability for Productive and Reproductive Traits in Different Genetic Groups of Cows. Progress. Agric., 17 (1): 111-119.

Mureda, E. and Z.M. Zeleke. 2007. Reproductive Performance of Crossbred Dairy Cows in Eastern Lowlands of Ethiopia. Livest. Res. Rural. Develop., 19(11). http://www.lrrd.org/ lrrd19/11/mure19161.htm

Mwacharo, J.M. and J.E.O. Rege. 2002. On-farm Characterization of the Indigenous Small East African Shorthorn Zebu Cattle (SEAZ) in the Southeast Rangelands of Kenya. Anim. Gen. Res. Info., 32: 73-86.

Negussie, E., E. Brannang, K. Banjaw and O.U. Rottmann. 1998. Reproductive Performance of Dairy Cattle at Assella Livestock Farm. Arsi. Ethiopia. I: Indigenous Cows Versus their F_1 Crosses. J. Anim. Breed. Gen., 115: 267-280.

Parra-Bracamonte, G.M., J.G. Magana, R. Delgado, M.M. Osorio-Arce and J.C. Segura-Correa. 2005. Genetic and Non-genetic Effects on Productive and Reproductive Traits of Cows in Dual-purpose Herds in Southeastern Mexico. Genet. Mol. Res., 4(3): 482-490.

Phillips, C.J.C. 2006. Principles of Cattle Production. CSIRO Publishing, PO Box 1139, Collingwood, Victoria 3066, Australia, pp. 122-141

Pires, R. M. L., Pres, F. L. and Naufel, F. 1977. Aspects of reproductive performance in a herd of Guzerat cattle. *Boletin de Industria Animal* 34: 237-242.

Puri, T.R. and C.L. Malik. 1963. Statistical Studies on Economics of Calf-rearing. Indian J. Dairy Sci., 16: 252-260.

Radostits, O.M. 2001. Herd Health: Food Animal Production Medicine. Third Edition. Philadelphia. USA, pp. 255-289.

Rahman, M.M., M.A.S. Khan, M.N. Islam, M.N. Haque and M.S.K. Sarker. 2001. Genetic Differences in the Performance of Local, Pure and Crossbred Cows. Bang. J. Anim. Sci., 30(1-2): 155-164.

Roy, B.K. 1999. A Comparative Study on the Productive and Reproductive Performances of Different Genetic Groups of Dairy Cows in Military Farm Savar, Dhaka and Ishwardi, Pabna. MS Thesis. Department of Dairy Science. Bangladesh Agricultural University, Mymensingh. pp. 1-112.

Saeed, A. M., Ward, P. N. Light, D., Durkin, J. W. and Wilson, R. T. 1987. *Characterisation of Kenana cattle at Um Banein, Sudan.* ILCA Research Report 16. ILCA, Addis Ababa, Ethiopia. 46 pp.

Salah, M.S. and H.M. Mogawer. 1990. Reproductive Performance of Friesian Cows in Saudi Arabia1. Calving Interval, Gestation Length and Days open. J. King Saud Univ. Agric. Sci., 2(1): 13-20.

Shiferaw, Y., B.A. Tenhagn, M. Bekana and T. Kassa. 2003. Reproductive Performance of Crossbred Dairy Cows in Different Production Systems in the Central Highlands of Ethiopia. Trop. Anim. Hlth. Prod., 25: 551-561.

Singh, G., G.K. Gaur, A.E. Nivsarkar, G.R. Patil and K.R. Mitkari. 2002. Deoni Cattle Breed of India. A study on Population Dynamics and Morphometric Characteristics. Anim. Gen. Res. Info., 32: 35-43.

Singh, S.B. and R.N. Desai. 1962b. Inheritance of Some Economic Characters in Hariana Cattle. 6. Calving Interval. Indian J. Dairy Sci., 15: 9-14.

SPSS, Windows for version-11.5. Release on 27.10.1999 (Microsoft Corp. 1998). Trends SPSS Inc., Michigan Avenue, Chicago, IL. 19-182.

Sultana, R. and A.K.F.H. Bhuiyan. 1997. Quantitative Analysis of the Reproductive Potentialities of Different Genotypes of Cattle in Bangladesh. Bangladesh J. Agric. Sci., 24(2): 55-58.

Swiger, L.A., W.R. Harvey, D.O. Everson and K.E. Gregory. 1964. The Variance of Intraclass Correlation Involving Groups with one Observation. Biomet., 20: 818-826.

Tadesse, M., J. Thiengtham, A. Pinyopummin and S. Prasanpanich. 2010. Productive and Reproductive Performance of Holstein Friesian Dairy Cows in Ethiopia. Livest. Res. Rural. Develop., 22(2) (http://www.lrrd.org/lrrd22/2/tade22034.htm).

Taneja, V.K. and P.N. Bhat. 1986. Milk and Beef Production in Tropical Environments. In 3rd World Congress on Genetics Applied to Livestock Production, Lincoln, Nebraska, July 1986. IX: 73-91.

Thibault, C., M. Courot, L. Martinet, P. Mauleon, F. Du Mesnil Du Buisson, R. Ortavant, J. Pelletier and J.P. Signoret. 1966. Regulation of Breeding Season and Oestrus Cycle by Light and External Stimuli in Some Mammals. J. Anim. Sci., 25(suppl.): 119-139.

Ulutas, Z. and M. Sezer. 2009. Genetic Study of Milk Production and Reproduction Traits of Local Born Simmental Cattle in Turkey. J. Agric. Fac., 26(1): 53-59.

Warwick, E.J. and J.E. Legates, 1979. Breeding and Improvement of Farm Animals. 7th ed. Tata McGraw-Hill Publishing Company Ltd. New Delhi. pp. 1-624.

Willis, M.B. 1998. Dalton's Introduction to Practical Animal Breeding. 4th ed. Blackwell Sc. London, 166 p.

Zafar, A.H., M. Ahmad and S.U. Rehman. 2008. Study of Some Performance Traits in Sahiwal Cows During Different Periods. Pakistan Vet. J., 28(2): 84-88.