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## Genetic and Phenotypic Parameters on Reproductive Traits of Crossbred Cattle in a Selected Farm of Bangladesh

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**Abstract:** The study was conducted in Milk and Cattle Improvement Farm, Bogra, Bangladesh from 1995 to 2003 with a view to estimate genetic and phenotypic parameters of crossbred cattle. The reproductive traits considered in the study were services per conception (SPC), age at first heat (AFH), age at first calving (AFC), gestation length (GL), calving interval (CI), post parturition heat (PPH) and birth weight (BW). Heritability was calculated from parental half-sib relationship. The average mean of SPC, AFH, AFC, GL, PPH, CI and BW were  $2.76 \pm 0.13$ ,  $1223.60 \pm 62.47$ ,  $1751.02 \pm 71.79$ ,  $277.61 \pm 0.58$ ,  $105.80 \pm 6.08$ ,  $554.59 \pm 17.85$  days and  $22.18 \pm 0.23$  kg, respectively. The heritability estimates of SPC, GL, PPH, CI and BW were  $0.08 \pm 0.05$ ,  $0.31 \pm 0.08$ ,  $0.14 \pm 0.06$ ,  $0.38 \pm 0.05$  and  $0.33 \pm 0.09$ , respectively. The repeatability estimates of SPC, GL, PPH and CI were  $0.46 \pm 0.08$ ,  $0.012 \pm 0.6$ ,  $0.35 \pm 0.09$  and  $0.022 \pm 0.04$ , respectively. The effects of genetic groups on various traits were non-significant except PPH ( $p < 0.001$ ). The results of the study revealed that the Local Crossbred cows are late maturing animals with a long inter-calving interval. High services per conception indicate their poor fertility. However, high magnitude of heritability estimates of some traits indicates additive genetic variance is pronounced and good response to selection can be achieved for these traits.

**Key words:** Genetic, phenotypic, parameters, crossbred, cattle

### INTRODUCTION

The cattle of Bangladesh are mostly non-descriptive indigenous zebu (*Bos indicus*) type. They seem to be late maturing animals with poor production and reproductive performances. In spite of their poor production and reproduction potentiality the local variety has some good criteria, viz., resistant to diseases and parasites, efficient to utilize low quality roughages and well-adapted to harsh environmental conditions. The reproductive traits like service per conception, age at first heat, age at first calving, gestation length, calving interval and post parturition heat period are considered as some of the economically important traits. These traits are integral part of the profit-loss equation of a dairy farm. To improve the production and reproduction potentialities of the local cattle, efforts were made to cross breed with different exotic breeds several times in the past. The introduced breeds are Friesian, Jersey, Sahiwal, Haryana, Sindhi, etc. But no fruitful improvement has so far been achieved due to indiscriminate breeding policy.

The rate of genetic gain that could be made by selection is depends on the heritability ( $h^2$ ) of the trait.

Estimation of  $h^2$  and repeatability (R) of the traits are essential genetic parameters required in animal breeding research and in the design and application of practical breeding program<sup>[1]</sup>. The majority of the genetic parameters estimates available in the literature are based upon records obtained from temperate breeds (*Bos taurus*). Genetic parameters are specific to population, i.e., estimates of genetic parameters from one breed may not appropriate when applied to other breeds<sup>[2]</sup>. Keeping this in view, the present study was undertaken to estimate  $h^2$  and R of some reproductive traits of crossbred dairy cattle from the data available at a government dairy farm of Bangladesh.

### MATERIALS AND METHODS

The study was conducted in Milk and Cattle Improvement Farm, Sherpur, Bogra, Bangladesh. Department of Livestock Services, Bangladesh established the farm in 1995 with a view to improve the Local zebu cattle (*Bos indicus*) of Bangladesh. Crossbreeding program has been carried out since the establishment of the farm. The feeding and management

system of the farm is as uniform as possible through out the year. The average body weight of the milking cows was 315 kg. Average 3.6 kg of concentrate feed was provided per cow per day. The concentrate feed contained 18.38% crude protein (CP) and 2359 Kcal ME per kg feed. The ingredients of concentrate feed were wheat bran (*Triticum aestivum*), rice polish (*Oryza sativa*), sesame oil cake (*Sesamum indicum*), grass pea (*Lathyrus sativus*), black gram (*Vigna mungo*), gram (*Cicer arietinum*) and common salt. Rice straw was supplied at 3.5 kg per cow per day. Both concentrate and rice straw were supplied twice daily. Six kg of green grass was allocated daily for each cow. The milking cows were entirely confined into the shed, whether dry cows and heifers were allowed to graze 2 h per day. After 5 months of pregnancy, the cows were allowed 0.5 kg of concentrate feed in addition to the above-mentioned quantity.

**Data:** Records on reproductive performances of crossbred cows kept at the farm were used for the study that covered 1995 to 2003. The genotypes of the cows considered in the study were Local×Friesian (F<sub>1</sub>), Local×Sindhi (F<sub>1</sub>), Sahiwal×Friesian (F<sub>1</sub>) and Local×Friesian (F<sub>2</sub>). The reproductive traits considered in the study were services per conception (SPC), age at first heat (AFH), age at first calving (AFC), gestation length (GL), calving interval (CI), post parturition heat period (PPH) and birth weight (BW).

**Statistical analysis:** Data were analyzed using statistical package “SPSS” for mean, standard error (SE) and analysis of variance (ANOVA). Variance components from ANOVA table were computed according to Becker<sup>[3]</sup>. The statistical model used to estimate the variance components was as follows:

$$Y_{ik} = \mu + \alpha_i + e_{ik}$$

Where:

- $\mu$  = the overall mean
- $\alpha_i$  = the effect of ith sire or ith record of individual
- $e_{ik}$  = the random error and
- $Y_{ik}$  = the individual record of kth individual of the ith sire or kth measurement of the ith individual.

Heritabilities were calculated from parental half-sib relationship according to the following formula<sup>[3]</sup> outlined below:

$$h^2 = 4 \sigma_s^2 / \sigma_s^2 + \sigma_w^2$$

repeatability was calculated by the following formula:

$$R = \sigma_b^2 / \sigma_s^2 + \sigma_w^2$$

Where:

- $\sigma_w^2$  = the within sire component of variance/ within component of variance
- $\sigma_s^2$  = the between sire component of variance
- $\sigma_b^2$  = the between component of variance

Standard error of estimated  $h^2$  and R was also calculated according to the formula outlined by Becker<sup>[3]</sup>.

## RESULTS AND DISCUSSION

**Services per conception (SPC):** Results showed that the lowest SCP (2.00) was found in Local×Friesian (F<sub>2</sub>) and highest value (2.95) was in Local×Friesian (F<sub>1</sub>) where the overall mean was 2.76 (Table 1). These values were higher than those of reported by Islam *et al.*<sup>[4]</sup> (1.30), Bhuiyan and Sultana<sup>[5]</sup> (1.76), Majid *et al.*<sup>[6]</sup> (1.76), Chaudhry *et al.*<sup>[7]</sup> (2.5) in Local cows. These variations may be due to inaccurate insemination techniques, neglected heat detection, using low quality semen for artificial insemination and poor fertility of cows. The effect of genetic groups was found non-significant (Table 1) and similar results were found by Ashraf *et al.*<sup>[8]</sup>, Islam and Bhuiyan<sup>[9]</sup>, Bhuiyan and Sultana<sup>[5]</sup>. The heritability ( $h^2$ ) estimate of the trait was 0.08 for crossbred cattle (Table 3). The  $h^2$  estimate of SPC in crossbred Friesian cows was 0.05<sup>[10]</sup>, which was consistent with present findings. Bhuiyan *et al.*<sup>[11]</sup> reported that the  $h^2$  of Friesian and Local-Friesian crossbred cows were 0.046 and 0.16, respectively, whereas Legates and Warwick<sup>[12]</sup> reported the  $h^2$  of exotic cows was 0-0.05. Repeatability estimate of the trait was 0.46. Pirchner<sup>[13]</sup>, Legates and Warwick<sup>[12]</sup> found comparatively lower R-values of exotic cattle as 0.01-0.05 and 0-0.1, respectively.

**Age at first heat (AFH):** Age at first heat for Local×Friesian (F<sub>1</sub>), Local×Sindhi (F<sub>1</sub>), Sahiwal×Friesian (F<sub>1</sub>) and Local×Friesian (F<sub>2</sub>) were 1161.30, 1441.60, 1421.63 and 893.00 days, respectively where the overall mean was 1223.60 days (Table 1). Nahar *et al.*<sup>[14]</sup> observed that the AFH for Local×Friesian (F<sub>1</sub>) and Local×Sindhi (F<sub>1</sub>) were 919.6 and 1057.6 days, respectively. Rahman *et al.*<sup>[15]</sup> also studied that age at first heat of Local×Sindhi (F<sub>1</sub>), Local×Sahiwal (F<sub>1</sub>), Local×Jersey (F<sub>1</sub>) and Local×Friesian (F<sub>1</sub>) were 35.00±1.90, 19.00±2.30, 32.00±4.60 and 21.00±2.80 months, respectively. Ashraf *et al.*<sup>[8]</sup> found the AFH in Local heifers was (37.87±1.44 months). Where as Jabbar and Ali<sup>[16]</sup> observed that the overall age at first heat of

Table 1: Mean of different reproductive traits according to the genotypes of cow

Traits	Genotypes of cow	N	Mean	Std. Error	F-values
Services per conception	Local×Friesian (F <sub>1</sub> )	108	2.95	0.17	2.08 (NS)
	Local×Sindhi (F <sub>1</sub> )	21	2.81	0.34	
	Sahiwal×Friesian (F <sub>1</sub> )	31	2.26	0.22	
	Local×Friesian (F <sub>2</sub> )	9	2.00	0.41	
	Total	169	2.76	0.13	
Age at first heat (days)	Local×Friesian (F <sub>1</sub> )	27	1161.30	75.47	2.11 (NS)
	Local×Sindhi (F <sub>1</sub> )	5	1441.60	147.39	
	Sahiwal×Friesian (F <sub>1</sub> )	8	1421.63	152.47	
	Local×Friesian (F <sub>2</sub> )	3	893.00	234.16	
	Total	43	1223.60	62.47	
Age at first calving (kg)	Local×Friesian (F <sub>1</sub> )	27	1784.96	91.24	1.89 (NS)
	Local×Sindhi (F <sub>1</sub> )	5	1911.20	136.65	
	Sahiwal×Friesian (F <sub>1</sub> )	8	1755.25	167.55	
	Local×Friesian (F <sub>2</sub> )	3	1167.33	236.68	
	Total	43	1751.02	71.79	
Gestation length (days)	Local×Friesian (F <sub>1</sub> )	108	278.57	0.66	1.74 (NS)
	Local×Sindhi (F <sub>1</sub> )	21	276.29	1.12	
	Sahiwal×Friesian (F <sub>1</sub> )	31	275.97	1.96	
	Local×Friesian (F <sub>2</sub> )	9	274.78	1.42	
	Total	169	277.61	0.58	
Post parturition heat (days)	Local×Friesian (F <sub>1</sub> )	93	104.31 <sup>a</sup>	7.39	6.12 (***)
	Local×Sindhi (F <sub>1</sub> )	17	65.82 <sup>b</sup>	13.32	
	Sahiwal×Friesian (F <sub>1</sub> )	26	148.00 <sup>c</sup>	13.73	
	Local×Friesian (F <sub>2</sub> )	6	59.17 <sup>a</sup>	21.43	
	Total	142	105.80	6.08	
Calving interval (days)	Local×Friesian (F <sub>1</sub> )	81	552.93	22.56	1.18 (NS)
	Local×Sindhi (F <sub>1</sub> )	16	487.38	39.13	
	Sahiwal×Friesian (F <sub>1</sub> )	24	607.71	44.54	
	Local×Friesian (F <sub>2</sub> )	5	541.60	77.03	
	Total	126	554.59	17.85	

\*\*\* P<0.001, NS= Non-significant, Mean with uncommon superscripts for each traits differ significantly

Table 2: Birth weight (kg) of calves according to their genotypes

Calf genotypes	N	Mean	Std. Error	F-Value
Local-Friesian×Friesian	61	22.59	0.44	1.495 (NS)
Local×Friesian (F <sub>2</sub> )	8	21.50	0.50	
Local×Friesian (F <sub>2</sub> )	31	23.23	0.52	
Local-Sindhi×Friesian	16	20.81	0.55	
Sahiwal-Friesian×Local-Friesian	19	21.37	0.65	
Sahiwal×Friesian (F <sub>2</sub> )	7	20.86	1.42	
Total	142	22.18	0.23	

NS = Non-significant

Table 3: Heritability (h<sup>2</sup>) and Repeatability (R) estimates of reproductive traits of crossbred cattle

Traits	Heritability (h <sup>2</sup> )	Repeatability (R)
Services per conception	0.08±0.05	0.46±0.08
Gestation length	0.31±0.08	0.01±0.06
Post parturition heat	0.14±0.06	0.35±0.09
Calving interval	0.38±0.05	0.02±0.04
Birth weight	0.33±0.09	-

Local heifer was 45.00±10.20 months. Effect of genetic groups on this trait was found non-significant (Table 1) which was in agreement with the findings of Chaudhry *et al.*<sup>[7]</sup>.

**Age at first calving:** Age at first calving for Local×Friesian (F<sub>1</sub>), Local×Sindhi (F<sub>1</sub>), Sahiwal×Friesian (F<sub>1</sub>) and Local×Friesian (F<sub>2</sub>) were 1784.96, 1911.20, 1755.25 and 1167.33 days, respectively where the overall mean was 1751.02 days (Table 1). Nahar *et al.*<sup>[14]</sup> observed comparatively lower AFC in Local×Friesian (F<sub>1</sub>) and

Local×Sindhi (F<sub>1</sub>) as 1201.4 and 1450.5 days, respectively. Islam *et al.*<sup>[4]</sup> found the average AFC in Local cows was 47.62 months. Although Husain and Mostafa<sup>[17]</sup> found much lower AFC (35.20±2.48 months) in Local cattle.

**Gestation length (GL):** The gestation length of Local×Friesian (F<sub>1</sub>), Local×Sindhi (F<sub>1</sub>), Sahiwal×Friesian (F<sub>1</sub>) and Local×Friesian (F<sub>2</sub>) cows were 278.57, 276.29, 275.97 and 274.78 days, respectively and total mean was 277.61 days (Table 1). The effect of genetic groups on this trait was found non-significant (Table 1). Similarly Islam and Bhuiyan<sup>[9]</sup> obtained non-significant effect of genetic group. Heritability estimate of the trait was 0.31 (Table 3), which was consistent with the findings of Pirchner<sup>[13]</sup> (0.25-0.45). Estimated R of the trait was 0.012 in crossbred cows. Whereas Pirchner<sup>[13]</sup> and Legates and Warwick<sup>[12]</sup> observed this parameter as 0.15-0.2 and 0.2-0.3, respectively.

**Post parturition heat (PPH):** Post parturition heat period for Local×Friesian (F<sub>1</sub>), Local×Sindhi (F<sub>1</sub>), Sahiwal×Friesian (F<sub>1</sub>) and Local×Friesian (F<sub>2</sub>) cows were 104.31, 65.82, 148.00 and 59.17 days, respectively and overall mean was 105.80 days (Table 1). Ashraf *et al.*<sup>[8]</sup> observed PPH period of 143 days and 97.3 days for Local×Friesian (F<sub>1</sub>) and Local×Sindhi (F<sub>1</sub>), respectively.

Genetic groups had highly significant ( $P < 0.001$ ) effect on this trait (Table 1) in the present study. Significant effect of genetic groups on PPH was also found by Ashraf *et al.*<sup>[8]</sup> and Naharet *al.*<sup>[14]</sup>. However, Islam and Bhuiyan<sup>[9]</sup>, Majid *et al.*<sup>[6]</sup> found non-significant effect of genetic groups on this trait. Heritability and repeatability estimates of the trait were 0.14 and 0.35, respectively (Table 3).

**Calving interval (CI):** Calving interval for Local×Friesian ( $F_1$ ), Local×Sindhi ( $F_1$ ), Sahiwal×Friesian ( $F_1$ ) and Local×Friesian ( $F_2$ ) were 552.93, 487.38, 607.71 and 541.60 days, respectively and total mean was 554.59 days (Table 1). Islam *et al.*<sup>[4]</sup> observed the overall mean CI of 519.10 days in Local cows. Nearly similar results were found by Majid *et al.*<sup>[6]</sup> (484.21 days), Husain and Mostafa<sup>[17]</sup> (436.60±10.81 days), Bhuiyan and Sultana<sup>[5]</sup> (449.78±27.87 days) in Local cows. Nahar *et al.*<sup>[14]</sup> found 485.80±3.90 days of CI in Sindhi×Local cows whereas Hossain and Routledge<sup>[18]</sup> found CI of 536±110 days in Local cows. Heritability and repeatability estimates of the trait were 0.38 and 0.022, respectively (Table 3). The  $h^2$  estimates was almost similar with the findings of Jain *et al.*<sup>[19]</sup> who reported that  $h^2$  value of the crossbred cows was 0.43. Bhuiyan *et al.*<sup>[11]</sup> observed the  $h^2$  estimates in Friesian and Friesian-Local crossbred as 0.15 and 0.25, respectively. They reported that the R estimates were 0.12 and 0.19 for Friesian and Friesian-Local crossbred cows.

**Birth weight (BW):** The birth weight of calves was measured according to their own genotypes. The weight of calves at birth for Local-Friesian×Friesian, Local×Friesian ( $F_2$ ), Local×Friesian ( $F_3$ ), Local-Sindhi×Friesian, Sahiwal-Friesian×Local-Friesian and Sahiwal×Friesian ( $F_2$ ) calves were 22.59, 21.50, 23.23, 20.81, 21.37 and 20.86 kg, respectively and total mean was 22.18 kg (Table 2). The effect of calf genotypes was found non-significant on birth weight of calves. Heritability estimate of the trait was 0.33 (Table 3), which was consistent with the findings of Legates and Warwick<sup>[12]</sup> (0.25-0.35), Wakhungu *et al.*<sup>[20]</sup> (0.40). Bhuiyan *et al.*<sup>[11]</sup> observed much higher  $h^2$  values of Friesian (0.52) and Friesian-Local crossbred (0.64).

The results of the study revealed that among the different genotypes of cow Local×Friesian ( $F_2$ ) showed the better performances for the reproductive traits. However, the Local crossbred cows are late maturing animals with a long inter-calving interval. Higher services per conception indicate their poor fertility. High magnitude of heritability estimates of some traits indicates additive genetic variance is pronounced and good response to selection can be achieved for these traits.

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