# Productive and Reproductive Potentialities of Different Genetic Groups of Crossbred Cows Reared under Different Farming Conditions

**Research Article**

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## ABSTRACT

A cross-sectional comparative study was carried out to investigate the productive and reproductive performances of different genetic groups of crossbred cows at three different farming conditions in Bangladesh. Crossbred cows (n=90) those already completed third lactations, were selected randomly from three different dairy farms (e.g. Jarip, Mullah and Nahar) located in Chittagong, Bangladesh. The numbers of animals of each of the genetic groups were 30 for 50% Holstein Friesian (HF) × 50% Sahiwal (SL) cross, 30 for 62.5% HF × 37.5% SL cross and 30 for 75% HF × 25% SL cross. Different productive and reproductive traits of crossbred cows such as age at first heat, calving interval, gestation length, service per conception, days open, lactation length and milk yield, etc., were measured in this study. Results demonstrated that gestation length of 50% HF × 50% SL, lactation length of 62.5% HF × 37.5% SL, gestation and lactation length of 75% HF × 25% SL crossbred cows between the farms were significantly influenced (P<0.05). Other parameters of crossbred cows such as age at first heat, age at first calving, service per conception, average daily milk yield, days open and calving interval of different genotypes were not influenced (P>0.05) by different farms. The highest (282.00±0.00 days) and lowest (276.43±0.92 days) gestation length were found in crossbred cows of the Jarip and Nahar dairy farm, respectively. The highest (297.50±3.50 days) and lowest (282.00±0.00 days) gestation length were found in crossbred cows of Mullah and the Jarip dairy farm, respectively. The overall productive and reproductive performance of different crossbred cows of the Nahar and Mulla dairy farm were superior to that of the Jarip dairy farm.

**KEY WORDS** crossbred, genetic groups, productive and reproductive performance.

## INTRODUCTION

Bangladesh is an agro-based developing country, where the majority of the rural people are reliant on their livelihood mostly on livestock and cropping farming. Livestock sub-sector is playing a vital role in the traditional subsistence farming, contributing about 2.9% of the gross domestic product (GDP), providing engagement 20% of the total population and earning13% of the total foreign currency (Bangladesh Bureau of Statistics, 2012). Sustainable dairy farming is not possible with indigenous cattle owing to their less productive performance. For this purpose, the concept of intensive dairy farming with high yielding crossbred cows comes to a mainstream in Bangladesh. A

large number of the farmers are facing several types of difficulties by rearing crossbred cattle (Haque *et al.* 2011) and other animals (Seidavi, 2010a; Seidavi 2010b; Neshagaran Hemmatabadi *et al.* 2016) due to lack of management knowledge. The country has 4.16 million dairy cows, among them, 47.0% are crossbreds (Huque, 2014). The estimated per capita annual intake of liquid milk is 21.4 liters (23.6% of the requirement) considering the total liquid milk production of 3.46 million tons in 2012 (Bangladesh Economic Review, 2013). According to Huque (2014), the predicted total milk production and its per capita consumption will be 4.91 million tons and 27.5 kg, respectively in 2021. The annual per capita availability of milk will persist below than that of the average (55.0 kg/head in 2015 or 67 kg in 2030) of the developing country (Steinfeld *et al.* 2006). In Bangladesh, daily average milk consumption is 40 mL/head against required daily allowance of FAO recommendation 250 mL/head with a deficiency of 210 mL/head (Kumar and Singh, 2010). To increase the number of crossbred animals in Bangladesh, Central Cattle Breeding and Dairy Farm (CCBDF) was established, and it has been increasing day by day with a spread of artificial insemination (AI). A good number of small, medium and large sized dairy farms has been developed mostly in urban and semi-urban milk pocket areas like Pabna, Sirajgonj, Manikgonj, Munshigonj, Faridpur, Madaripur, Kishoregonj, Rangpur, Kustia and Chittagong districts in Bangladesh (Rokonuzzaman *et al.* 2009).

The economic condition of a dairy farm depends on to a greater extent on the productive and reproductive performance of the animal. The productive performance is considered as average milk yield per lactation per cow, average lactation length of different genotypes. The reproductive performance is considered as age at first heat, age at first calving, service per conception, gestation length, calving interval, days open. Prolonged days open and low conception rate is the major constraints limiting the dairy farming in Bangladesh (Rokonuzzaman *et al.* 2009; Alam and Ghosh, 1994; Shamsuddin *et al.* 2001).

Appropriate periodical evaluation of factors affecting reproductive performance of animals is very important for future planning and management (Mengistu *et al.* 2016). We know that the productive and reproductive performance of the cows mostly depends on genetic merits of cows. Researchers have shown that the productive and reproductive performances of the cows along with the variation of genotype. But the productive and reproductive performances of the cows are also controlled by feeding, hygienic condition, biosecurity and other management practices in different farms. There has no so much research work in Bangladesh regarding the productive or reproductive performances of the dairy cow. Sufficient information about the relationship between genetic merit and management in different farming condition might help the farmers to solve the critical problems of dairy farming and thus to enhance milk production. Hence the present study was undertaken to ascertain the productive and reproductive performances of the different genotypic crossbred cows at the various farming condition.

## MATERIALS AND METHODS

The study was conducted on three different dairy farms, namely Jarip, Mullah and Nahar dairy farms, to investigate the productive (daily milk yield, lactation length) and reproductive performances (eg. age at first heat, age at first calving, service per conception, gestation length, days open and calving interval, etc.) of dairy cows reared in Chittagong areas of Bangladesh. A number of crossbred cows (n=90) comprising of 3 different genotypic groups such as 50% Holstein Friesian (HF) × 50% Sahiwal (SL), 62.5% HF × 37.5% SL and 75% HF × 25% SL, were selected randomly from those dairy farms, which were already completed 3rd lactation. The dairy farms, genotype and number of cows were shown in Table 1.

### Management practices of farm

The Jarip dairy farm was situated in Hathajari, Chittagong, Bangladesh. It was not such an organized farm as Nahar and Mulla dairy farms. Concentrate feeding (metabolizable energy (ME)=1894.19 kcal/kg, crude protein (CP)=17.86%) was more or less similar to other farms but green grasses were not available. In comparison to other farms, biosecurity of this farm was poor and drying off was not maintained for some cows, those produced milk up to calving. All record books were also available on this farm.

The Mullah dairy farm was an organized dairy farm situated in Patenga, Chittagong. Cows were reared in half tin shed building. Face out and face in the stanchion barn housing system was practiced in this farm. They had available fodder land and also provided green grass to the cows, but less than the Nahar dairy farm. Concentrate feed (ME=1874.13 kcal/kg, CP=18.86%) was also provided to the cows. Biosecurity was not satisfactory, but the overall management system was better than the Jarip dairy farm. The hygienic condition was better, that's why animals were less affected by diseases specially mastitis. Drying off was not maintained for some cows those produced milk up to calving. All record books were available on this farm.

The Nahar dairy farm was an organized dairy farm situated in Mirsarai, Chittagong. Cows were reared in the tin shed building. Face out and face in stanchion barn housing system was practiced in this farm. They had available fodder land and provided an adequate amount of green grass for cows.

**Table 1** Dairy farms, location, genotypic group and number of selected cows

| Name of dairy farms | Farm location | Genetic group* | No. of cows |
|---|---|---|---|
| Jarip | Hathajari, Chittagong | 50% HF × 50% SL | 10 |
| | | 62.5% HF × 37.5% SL | 10 |
| | | 75% HF × 25% SL | 10 |
| Mullah | Patenga, Chittagong | 50% HF × 50% SL | 10 |
| | | 62.5% HF × 37.5% SL | 10 |
| | | 75% HF × 25% SL | 10 |
| Nahar | Mirsarai, Chittagong | 50% HF × 50% SL | 10 |
| | | 62.5% HF × 37.5% SL | 10 |
| | | 75% HF × 25% SL | 10 |

* 50% HF × 50% SL: crossbred cow that is comprised of 50% Holstein Friesian (HF) and 50% Sahiwal (SL) blood, similarly; 62.5% HF × 37.5% SL: crossbred cow that consists of 62.5% HF × 37.5% SL blood and 75% HF × 25% SL: crossbred cows that have 75% HF × 25% blood.

Concentrate feed (ME=1871.9 kcal/kg, CP=19.56%) was also provided to the cows. Biosecurity was strictly maintained, and the overall management system was better than the others farm. The hygienic condition was better, that's why animals were less affected by diseases specially mastitis. Drying off was strictly maintained in case of some cows those produced milk up to calving. All record books were available on this farm.

**Methods of data collection**

A questionnaire was prepared to collect the information or data from the farms. The data was composed by the name of the farm, animal identification number (ID), genotype, age at first heat, age at first calving, service per conception, gestation length, average daily milk yield, days open, calving interval and average lactation length. The data were collected from the record book of the respective farms. Confusions were met through discussion with the farm managers, owners and the attendants of the respective farms. Genotype: genotype that means blood percentage was determined by using an AI record book that denotes the percentage of foreign blood which was used in the cow.

Age at first heat: it was determined by determining the first estrus date that was included in the data record book and was expressed in months.

Service per conception: service per conception was estimated by the average number of services for conception.

Age at first calving: it was determined by calculating intervals from the date of birth to date of the first calving, and was expressed in months.

Gestation length: it was determined by calculating intervals from the date of the successful AI to the date of calving and was expressed in days.

Average daily milk yield per cow: it was determined by calculating the total milk yield per lactation and divided by the total lactation length and was expressed in liters.

Days open: it was determined by calculating intervals from the date of calving and date of the first estrus after calving and expressed in days.

Calving interval: the calving intervals were recorded on the basis of the interval between the dates of one calving to the date of next calving and expressed in months.

Average lactation length: lactation length was calculated from the date of let-down of milk after calving to the date of the end of milking of a cow in days.

**Statistical analysis**

The collected data were analyzed using SPSS 16.0 software. Completely randomized design (CRD) was used for data analyzing. Least significant difference (LSD) test was performed to estimate the significance of means.

## RESULTS AND DISCUSSION

The results of age at first heat (AFH), age at first calving (AFC), service per conception (SPC), gestation length (GL), average daily milk yield (MY), days open (DO), calving interval (CI) and average lactation length (LL) of dairy cows considering the farming condition are shown in Tables 2, 3 and 4, respectively.

Except for the GL, the remaining other mean productive and reproductive traits (AFH, AFC, SPC, MY, DO, CI and LL) of (50% HF×50% SL) crossbred cows measured here in this study between farms were unaffected (P>0.05) as shown in Table 2.

The highest MY (15.18±0.78 L/d), DO (97.96±5.73 days), CI (14.26±0.46 months) and LL (298.11±4.40 d) were found in the Mulla dairy farm and lowest MY (14.37±0.48 L/d), DO (93.33±7.10 days), LL (288.75±6.15 days), AFH (21.25±1.48 months) were found in the Jarip dairy farm. Only the longer (P<0.05) GL (280.00±0.56) was observed in the Jarip dairy farm than those of other dairy farms. It is found that the mean gestation length in the Jarip, Mulla and Nahar dairy farms are 280.00 ± 0.56, 278.89 ± 0.65, 277.20 ± 0.66 days, respectively.

The lowest gestation length is found in the Nahar dairy farm and highest gestation length observed in the Jarip dairy farm.

**Table 2** Comparison of productive and reproductive performances of crossbred cows (50% HF×50% SL) among different farms

| Traits | Dairy farms | | | Level of significance |
|---|---|---|---|---|
| | Jarip | Mullah | Nahar | |
| AFH (months) | 21.25±1.48 | 21.44±1.43 | 23.40±1.72 | NS |
| AFC (months) | 34.63±1.25 | 33.89±1.04 | 33.60±1.60 | NS |
| SPC (no.) | 2.37±0.10 | 2.04±0.33 | 2.40±0.30 | NS |
| GL (days) | 280.00±0.56[a] | 278.89±0.65[b] | 277.20±0.66[b] | * |
| MY (litres) | 14.37±0.48 | 15.18±0.78 | 14.39±0.16 | NS |
| DO (days) | 93.33±7.10 | 97.96±5.73 | 95.46±7.07 | NS |
| CI (months) | 14.16±0.39 | 14.26±0.46 | 13.33±0.18 | NS |
| LL (days) | 288.75±6.15 | 298.11±4.40 | 291.20±3.48 | NS |

AFH: age at first heat; MY: milk yield; AFC: age at first calving; DO: days open; SPC: service per conception; CI: calving interval; GL: gestation length and LL: lactation length.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
* (P<0.05).
NS: non significant.

**Table 3** Comparison of productive and reproductive performance of crossbred cows (62.5% HF×37.5% SL) among different farms

| Traits | Dairy farms | | | Level of significance |
|---|---|---|---|---|
| | Jarip | Mullah | Nahar | |
| AFH (months) | 20.60±1.04 | 21.67±0.92 | 23.00±1.08 | NS |
| AFC (months) | 30.10±1.01 | 32.00±1.19 | 33.63±1.16 | NS |
| SPC (no.) | 2.15±0.05 | 2.34±0.12 | 1.95±0.15 | NS |
| GL (days) | 280.30±1.06 | 279.44±1.18 | 277.50±0.42 | NS |
| MY (litres) | 17.03±0.54 | 17.26±0.86 | 16.12±1.11 | NS |
| DO (days) | 98.30±8.32 | 97.36±8.12 | 96.91±7.04 | NS |
| CI (months) | 13.73±0.27 | 14.22±0.27 | 13.24±0.21 | NS |
| LL (days) | 282.10±1.35[a] | 292.89±2.95[b] | 290.50±2.41[b] | ** |

AFH: age at first heat; MY: milk yield; AFC: age at first calving; DO: days open; SPC: service per conception; CI: calving interval; GL: gestation length and LL: lactation length.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
** (P<0.01).
NS: non significant.

**Table 4** Comparison of productive and reproductive performance of crossbred cows (75% HF×25% SL) among different farms

| Traits | Dairy farms | | | Level of significance |
|---|---|---|---|---|
| | Jarip | Mullah | Nahar | |
| AFH (months) | 19.00±0.00 | 17.00±2.00 | 19.43±0.61 | NS |
| AFC (months) | 29.50±0.50 | 26.50±2.50 | 30.29±0.60 | NS |
| SPC (no.) | 2.00±0.00 | 2.30±0.00 | 2.15±0.16 | NS |
| GL (days) | 282.00±0.00[a] | 281.50±0.50[a] | 276.43±0.92[b] | ** |
| MY (litres) | 15.67±0.00 | 19.83±0.83 | 19.81±0.94 | NS |
| DO (days) | 132.00±2.00 | 102.00±16.00 | 112.57±10.19 | NS |
| CI (months) | 14.33±0.00 | 13.66±0.33 | 13.47±0.27 | NS |
| LL (days) | 282.00±4.00[a] | 297.50±3.50[b] | 291.29±1.12[c] | ** |

AFH: age at first heat; MY: milk yield; AFC: age at first calving; DO: days open; SPC: service per conception; CI: calving interval; GL: gestation length and LL: lactation length.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
** (P<0.01).
NS: non significant.

The comparative productive and reproductive performances results of crossbred cows (62.5% HF×37.5% SL) among different farms indicate that all the parameters are similar (P>0.05) except for LL only (Table 3). The Mullah dairy farm had the highest (P<0.01) lactation length (LL) compared to other farms. The LL in the Jarip, Mulla and Nahar dairy farms are 282.10 ± 1.35, 292.89 ± 2.95, 290.50 ± 2.41 days, respectively (Table 3). The highest AFH (23.00±1.08 months), AFC (33.63±1.164 months) were found in the Nahar dairy farm and lowest AFH (20.60±1.04 months), AFC (30.10±1.01 months) were found in the Jarip dairy farm.

On the contrary, the highest GL (280.30 ±1.06 days), DO (98.30±8.32 days) were found in the Jarip dairy farm and lowest GL (277.50 ±0.42 days), DO (96.91±7.04 days) were found in the Nahar dairy farm.

Table 4 denotes that all the parameters of crossbred cows (75% HF×25% SL) are similar (P>0.05) between treatment except for GL and LL only. The highest lactation length (LL-297.50±3.50) was found in the Mulla dairy farm while the Jarip dairy farm being the lowest LL. Jarip farm had higher (P<0.01) GL than others (Table 4). The lowest gestation length was found in the Nahar dairy farm and highest gestation length is found in the Jarip dairy farm.

The highest AFH (19.43±0.61 months), AFC (30.29±0.60 months) were found in the Nahar dairy farm and lowest AFH (17.00±2.00 months), AFC (26.50±2.50 months) found in the Mulla dairy farm. The highest SPC (2.30±0.00) and MY (19.83±0.83 L/day) were found in the Mulla dairy farm and the lowest SPC (2.00±0.00) and MY (15.67±0.00 L/day) were found in the Jarip dairy farm. The highest CI (14.33±0.00 days), DO (132.00±2.00 days) were observed in the Jarip dairy farm and lowest CI (13.47±0.27 days), DO (102.00±16.00 days) in the Nahar and Mulla dairy farm, respectively.

The farm economy of dairy farming is dependent solely on the productive and reproductive performances of individual cows reared on each farm. Genetic and environmental factors are mainly responsible for a successful dairying and profitable production. The age at first heat of heifers differed significantly (P<0.05) among genetic groups coincide with findings of Hossen *et al.* (2012). An experiment was conducted by Sultana (1995) on the performance of exotic cattle breeds and their crosses in Bangladesh and observed that genetic and non-genetic factors had no significant effect on service per conception. Many other factors like as the quality and quantity of semen used in artificial insemination, improper detection of heat, failure to inseminate at appropriate time and skill of the inseminator have influenced the variation in service per conception. The other related factors (the age of bulls and cows, season of the year, age of semen, diseases, semen handling techniques and other environmental factors) may be influenced the level of fertility. In this study, the gestation period was not significantly affected (P>0.05) by genetic groups which are in agreement with Majid *et al.* (1995). Similar results were also obtained by Sultana (1995) and Rahman *et al.* (2009), who found a wide range of gestation period of 270-285 days and no significant differences were observed in gestation length among different breeds and crossbreds. The gestation period of different crosses might be varied from 280 days (Nahar *et al.* 1992). The genetic group had no significant (P>0.05) effect on calving interval. Results of the present study for calving interval were inconsistent with the findings of Uddin (2001). The results of this study for lactation length of the different genetic group of cows agreed with the findings of Sultana (1995), who also observed almost similar lactation length for different genotypes.

Although we know that productive and reproductive performances of cows indelibly depend on their genetic merits, the contribution of environmental factors is undeniable. The joint effect of hereditary (breed) and environmental factors (e.g nutrition, management, disease incidences, temperature, humidity, rainfall and so forth) can contribute to only full growth potential and optimum production.

However, it is obvious from our current study that the gestation length of 50% HF × 50% SL and 75% HF × 25% SL crossbred cows among the different Jarip, Mulla and Nahar dairy farms were significantly influenced by treatment.

The lowest gestation length (277.20±0.66 days) found in the Nahar dairy farm whilst the highest gestation length (280.00±0.56 days) noticed in the Jarip dairy farm. The lowest gestation length in the Nahar dairy farm could be due to good management and environment because the overall management system (specially feeding, hygiene and strong biosecurity) of the Nahar dairy farm was better than the Mulla and Jarip dairy farm. Gestation length of crossbred dairy cows under farm and urban conditions were studied by Hasan (1995) and Kabirand Islam (2009) and reported that breed had no significant effect on gestation length which coincides with the present study. This variation may be attributed to the maternal – i.e., age, nutritional status and body conditions of the dam and the fetal factors-i.e., sex of the fetus, twinning and hormonal functions of the fetus (Islam *et al.* 2006).

Our result further revealed that the lactation length of 62.5% HF × 37.5% SL and 75% HF × 25% SL crossbred cows amongst the different Jarip, Mulla and Nahar dairy farms were also affected. The variation of LL of crossbred cows between farms might be due to factors of the different hygienic management among the farms. The hygienic condition of Mulla and Nahar dairy farms were better than the Jarip dairy farm. Our result is not consistent with the report of previous investigators (Bhuiyan and Sultana, 1994; Hasan, 1995; Uddin *et al.* 2008; Rokonuzzaman *et al.* 2009).

They showed that lactation length varies due to genetic difference. Kumar and Abadi (2014) mentioned that the variation of all productive and reproductive traits due to location of herd and farming system were statistically non-significant in their experiment which is more coincide with our findings.

## CONCLUSION

An overview of the results obtained in this study revealed that lactation length and gestation length amongst other performance traits of crossbred cows were altered due to rearing in different farming condition. The study showed that though same genotypic crossbred cows present in different farms, they vary in gestation length and lactation length. Therefore, it may be concluded that productive and reproductive performances of same breed individual could vary greatly due to various factors such as farming condition, feeding management and environment rather than genetic merits only.

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