REPRODUCTIVE PERFORMANCES AND DISEASES OF DIFFERENT CROSS BRED COWS AT CENTRAL CATTLE BREEDING AND DAIRY FARM OF BANGLADESH

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*This is to certify that the thesis entitled "**REPRODUCTIVE PERFORMANCES AND DISEASES OF DIFFERENT CROSS BRED COWS AT CENTRAL CATTLE BREEDING AND DAIRY FARM OF BANGLADESH**" submitted to the Faculty of Animal Science & Veterinary Medicine, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF ANIMAL SCIENCE**, embodies the result of a piece of bona fide research work carried out by **SHAHIDUL ISLAM**, Registration No. **13-05346** under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Date: June, 2020
Place: Dhaka, Bangladesh

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Dedicated To
My Beloved Parents

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The Author

ABSTRACT

This study was conducted on reproductive performances and diseases status of different cross bred cows of dairy cattle at Cental Cattle Breeding and Dairy Farm Savar, Dhaka to know about existing reproductive performances and diseases occurrence. In this farm, the existing genotypes of cattle were Local (L), Sahiwal (SL), Friesian (F), Australian Friesian Sahiwal (AFS), Local×Friesian (L×F), Sahiwal×Friesian (SL×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The highest age at puberty was (1392.47±15.49) days found in Friesian. The lowest age at puberty was found (1052.14±9.53) days in F75% cow. The highest gestation length was (285.86 ± 3.92) days and it was for Local milch cow and lowest gestation length was (278.21 ±3.90) days and it was for F75% cow. Maximum number of service per conception was found in case of Friesian (3.412 ± 0.59) and minimum in local (1.49±0.24). Maximum birth weight was found in case of Friesian (37.35 ± 1.15) kg; minimum in Local (16.51±0.96) kg. Highest milk yield was found in case of Friesian (14± 6.64) L/day and lowest in Local (2.1 ± 0.56) L/day. The highest lactation length was observed in Holstein Friesian milch cow (412.13 ± 6.13 days) & lowest was found in Local (196.15±10.17 days). The highest calving interval was found in Holstein-Friesian x Sahiwal (607.04 ± 8.72) days and lowest in Local (479.78±6.24) days. The highest Postpartum heat period was found in case of LF (298.75 ± 5.80) days and lowest in case of Local (102.41±5.75) days milch cow. The maximum average sperm concentration of frozen semen was obtained from SL and the mean value was 1786.2 million/ml. The minimum average sperm concentration of frozen semen was obtained from F62.5% and the mean value was 1246.2 million/ml. The maximum average pH of frozen semen was obtained from F75% and the mean value was 6.3. The maximum average motility of frozen semen was obtained from SL and the mean value was 66.8%. However, the minimum average motility of frozen semen was obtained from L and the mean value was 65%. Nine major reproduction related diseases and disorders were diagnosed among (n=150) registered sick cows. The highest proportion of cows was diagnosed as retained placenta (24.67%; n=37). Reproductive performances of Holstein Friesian were superior to other dairy crossbreds. Friesian75% breed ranked second and performances of other genotypes were nearly similar. The highest occurrence of retained placenta and anoestrus is very alarming which needs further research to decrease the occurrence of such disorders of cows in population.

Keywords: Breed, Cross Bred, Production, Reproduction, Diseases, Semen, Frozen Semen, Frozen Semen Quality, Frozen Semen Evaluation.

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LIST OF ABBREVIATIONS AND SYMBOLS

L=Local

HF= Holstein Friesian

F=Friesian

SL=Sahiwal

L× F=Local × Friesian

F× SL= Friesian × Sahiwal

F 62.5%= Local × Friesian × Friesian

F75%=Local ×Friesian ×Friesian × Friesian

et al. = And his associates

Kg =Kilogram

SD = Standard Deviation

AAP= Age at Puberty

PPH=Postpartum Heat Period

N/n=Number

D= Day

CHAPTER I

INTRODUCTION

Livestock plays an important role in the development of the traditional economy of Bangladesh. The landless and marginal farmers largely depend on livestock for their survival. On the other hand, Cattle are our main sources of milk, meat and leather. Generally crossbred cows yield from 600 to 800 liters per lactation of 210 to 240 days (Islam, M. A. 1992). At present Bangladesh have 43 million cattle, out of which 16 million are dairy cattle of local and crossbreed (DLS, 2020). Rapid improvement in dairy productivity for food security and livelihood leading to poverty reduction is needed in Bangladesh. Climatic stresses in the form of high ambient temperature, high humidity and erratic or inadequate rainfall affect the productivity of dairy cattle in the tropics. Reproductive efficiency is a major factor in the profitability of a dairy enterprise through its effect. Various diseases and disorders play an important role in developing healthy productive livestock in Bangladesh. It has been reported that reproductive disorders is responsible for remarkable economic loss to the dairy farmers in Bangladesh (Mia and Haque, 1967). In European and American dairy herds, about a third of all cows are culled because of reproductive disturbances (Faruq, 2001).

The occurrence of different reproductive disorders in cows has been reported in Bangladesh by several authors (Shamsuddin *et al*., 1988; Das *et al*., 1995; Shamsuddin *et al*., 1995). The occurrence of various reproductive disorders is increased in Bangladesh due to introduction of intensive crossbreeding programme through artificial insemination (Faruq, 2001). Nevertheless, the diseases and disorders of livestock are treated by the specialized veterinarians related broadly to medicine, surgery and reproduction. Although the usual prevalence of diseases or disorders related to medicine is higher than that of

surgery and reproduction related counterparts, the reproduction-related diseases or disorders cause most economic loss to farmers. The economic dairy farming greatly depends on the yearly calf production from each healthy dam with normal reproductive physiology. Unlike many diseases related to medicine, occurrence of most of the reproduction related problems cannot be controlled or prevented by vaccination. Further, the skill of field veterinarians is not without question to diagnose and treat reproduction related diseases or disorders in Bangladesh. Therefore, it is important to know the occurrence of reproductive related diseases or disorders for making future research plan for reducing occurrence of such diseases or disorders by proper diagnosis and treatment. So far, the investigation on prevalence of different reproductive disorders has been conducted on crossbred cows in an organized dairy farm (Shamsuddin *et al*., 1988). However, according to my knowledge, still there is no comprehensive study to determine the clinical occurrence of reproduction related diseases or disorders in rural areas of Bangladesh. The present investigation was undertaken to determine the clinical trend of reproductive diseases and disorders of cattle at Central cattle breeding and dairy farm Savar, Dhaka. The native cattle of Bangladesh have low productivity but disease resistance capacity was higher than that of exotic breeds. Livestock development depends mainly on genetic potential of the animal.

Native ruminant animals are non-descriptive and their genetic potential has not yet been recognized. Conservation and improvement of native animal germplasm are essential for profitable livestock farming to meet the increasing demand of milk and meat. Optimum nutrition, disease control and management practices permit better expression of genetic potential. Reproductive efficiency is a major factor in the profitability of a dairy enterprise through its effect on the annual milk production of the herd and the cost of herd depreciation. In this study an attempt was made to evaluate the reproductive performances and diseases of different crossbred cows and to find out the suitable crossbred animals. This study was therefore, under taken at Central cattle Breeding and Dairy Farm

Savar, Dhaka. Bangladesh has established Central Cattle Breeding and Dairy Farm (CCBDF) at Savar, Dhaka. This farm is located about 30 km northwest of the capital city of Dhaka. The farm was established in 1973 on 1300 acres of land with assistance of German Agency for Technical Cooperation. This is the largest farm in Bangladesh which is established with the major following objectives:

- ✓ To produce bred heifers and bulls for distribution to farmers.
- ✓ To collect semen from the proven bulls that are produced and reared in order to support national artificial insemination program.
- ✓ To supply milk to Dhaka city.

Objective

- ❖ Knowing the breeding performances of crossbred cows at Central Cattle and Dairy Farm at Savar in Dhaka.
- ❖ Detection of incidence of major reproductive diseases of dairy crossbred cows at Central Cattle Breeding and Dairy Farm at Savar in Dhaka.

Special Objective

- ➢ To compare the productive performances of crossbred cows.
- ➢ To explore the production and reproduction profile of cows.
- ➢ To know the vaccination schedule of cows.
- ➢ To compare frozen semen quality of different cross bred bull.

CHAPTER II

REVIEW OF LITERATURE

2. Reproductive Performances of Dairy Cattle

2.1 Age at Puberty

Uddin *et al*. (2008) was reported that a total of 180 dairy cows were randomly selected from four sub-districts of Cumilla district. It was observed that mean Age at puberty of indigenous, Friesian cross, Sahiwal cross and Sindhi cross were 725.11±7.74, 662.44±2.52, 712.55±2.24 and 735.88±1.77 Days respectively. Age at puberty was shorter in Friesian cross (662.44±2.52) days.

Islam *et al.* (2017) was conducted a study on 244 crossbred cows of CCBS Savar, Dhaka to evaluate the effect of different genetic groups on their lifetime performance of various reproductive traits using twenty years data. Data were accumulated from a prescribed data sheet maintained by Central Cattle Breeding Station, Dhaka. Genetic groups for this experiment were (L×F), (L×J), (LH x F), (LF x LF) and (LJ x LJ). It reveals that age at puberty (days) followed the order (1011.78 ± 102.47) > (967.89 ± 104.39) > (953.61 ± 101.36) > (878.09 ± 97.66) > (794.27 ± 99.01) for genetic group LF x LF and LJ x LJ, LH x F, L x J, L x F, respectively. It was found that earliest age at puberty were in L x F (749.27±99.01) days.

Faruk *et al.* (2007) was conducted a comparative account of the productive and reproductive performance of crossbred and indigenous dairy cows at some selected areas of Cumilla district. The survey was conducted on 50 dairy cows for a period of four months from June to September, 2004. Out of 50 cows 25 were crossbred and 25 were indigenous. The age at puberty of Local, Sahiwal x

Local and Holstein x Local and Jersey x Local were 25.92 ±1.08, 18.0 ±00, 21.6 ±2.40 and 20.44 ±1.60 months respectively.

Ali *et al.* (1998) reported age at puberty in indigenous cattle of Bangladesh to be 42.40 months. It appears that AAP was significantly ($P<0.05$) lower in ½ Local x ½ Friesian and ½ Friesian x ½ Sindhi heifers compared to other breeds, types and crosses.

Hoque *et al.* (1999) investigated AAP in different dairy type cattle of Bhaghabarighat Milk Pocket area of Bangladesh Milk Producers Cooperative Union Ltd. (Milk Vita) and visualized that Friesian crosses exhibit AAP earlier (765) days in comparison to Pabna (1176) days and Pabna x Sahiwal (1050) days.

Qureshi *et al.* (2002) reported that age of sexual maturity ranged from 420 to 1110 day with a mean of 745.3±51.0 days.

Rahman *et al.* (2006) reported that late sexual maturity was observed in local cow (1125.8±6.8) days and early in LF (916.9±1.2) days.

Sultana *et al.* (2001) who found that the ages at puberty of Desi, Friesian × Desi cross and Sahiwal × Desi cross cows were 25.2, 21.4 and 24.4 months, respectively. The highest age at puberty was (1525.58±28.05) days found in AFS. The lowest age at puberty was (1055.97±11.5) day in LF_2×F milch cow.

Saha *et al.* (2008) found that, the mean value of age at puberty was 1138.5± 110.60 days for HF × L crossbred. The age at puberty is different in dairy cows might be due to environmental, feeding and manage mental effects.

Khan *et al.* (2001) found that age at puberty of Holstein-Friesian and Sahiwal were 1378±30.45 and 1114±12.23 days.

2.2 Gestation Length

Uddin *et al*. (2008) was reorted that a total of 180 dairy cows were randomly selected from four sub-districts of Cumilla district.

Gestation length was shorter in case of Sahiwal cross (277.64±1.99 days) and it varies within Friesian and Sindhi cross in a short range (278.77±1.38 to 279.31±1.00) days.

Kabir and Kisku (2013) was conducted a respectively study at Central Cattle Breeding and Dairy Farm in Savar, Dhaka to evaluate the reproductive performance of different crossbred cows in terms of gestation length, service per conception, postpartum heat period and calving interval. The genotypes Australian Friesian Sahiwal (AFS), Sahiwal × Friesian (SL×F), Local × Friesian (L×F), Local × Friesian × Friesian (LF_1×F) and Local × Friesian × Friesian × Friesian (LF_2×F) were considered. Gestation length of different genetic groups were found to be 274.5±6.83, 281.0±3.26, 277.0±5.21 279.3±4.54 and 277.2±3.93 days under the genotypes AFS, SL×F, L×F, LF_1×F, LF_2×F, respectively. The mean gestation length was highest in SL×F (281.0±3.26) days and lowest in AFS (274.5±6.83) days.

Faruk *et al.* (2007) was conducted a comparative account of the productive and reproductive performance of crossbred and indigenous dairy cows at some selected areas of Cumilla district. The survey was conducted on 50 dairy cows for a period of four months from June to September, 2004. Out of 50 cows 25 were crossbred and 25 were indigenous. Results showed that the average gestation length of Local, Sahiwal x Local, Friesian x Local and Jersey x Local were 289.88±1.44, 285.0±0.0, 285.0±4.18, and 282.08±2.42 days respectively.

Rahman *et al.* (2013) reported that 286.2±1.5, 279.0.6±0.6, 277.8±0.4 days gestation length for Local, LF and LF_1×F respectively.

Sarder *et al.* (2007) who found that gestation lengths of Desi, Friesian x Desi and Sahiwal x Desi cows were 279.7, 278.2 and 278.8 days respectively.

Maarrof *et al.* (1987) who analyzed the data of 85 Jenubi cattle in dairy farms of central Iraq, where average gestation length was (283±1.5) days.

Rukonojjaman *et al.* (2009) found that the average gestation length of Holstein-Friesian, Sahiwal, were 275±3.95, 276±4.26 days respectively.

Majid *et al.* (1995) observed that the gestation length for Hosltein-Friesian x Sahiwal and Holstein-Friesian x Local were 282 & 284 days respectively.

2.3 Service per Conception

Mondal *et al.* (2005) was conducted a study at Bangladesh Agricultural University Dairy Farm for a period of six months. A total of 164 dairy cows belongs to different breeds, such as Jersey cross, Sahiwal cross, Sindhi cross, Holstein cross and Red Chittagong cows were selected and their information regarding milk production and other reproductive parameters were collected from farm records for a period of last five years (1993-1997). The number of animals of each of the genotypic classes were 48 for Jersey cross, 46 for Sahiwal cross, 35 for Sindhi cross, 20 for Holstein cross and 15 for Red-Chittagong. It was observed that service per conception were 1.63±0.61, 1.63±0.64, 1.60±0.65, 1.60±0.59 and 1.67±0.62 for jersey cross, Sahiwal cross, Sindhi cross and Red Chittagong cows, respectively. Statistical analysis showed that there was no significant difference within the service per conception of different genotypes.

Jabbar and Ali (1988) studied the reproductive performance of native and crossbred cows in Bangladesh and the average value of service per concept was 1.66 ± 0.57. The observed value of crossbred, local (milk) and local (draft) is 1.61 ± 0.52 and 1.26 ± 0.59 respectively.

Uddin *et al.* (2008) was conducted a study of 180 dairy cows were randomly selected from four sub-districts of Cumilla district. It was observed that the average number of service per conception of indigenous, Friesian cross, Sahiwal cross and Sindhi cross were 1.81±0.048, 2.44±0.053, 2.13±0.037, 2.00±03043.

About the reproductive performances it shows that indigenous cows need minimum (1.81±0.048) and maximum for Friesian cross (2.44±0.053) services per conception.

Islam *et al.* (2017) was conducted a study on 244 crossbred cows of CCBS Savar, Dhaka to evaluate the effect of different genetic groups on their lifetime performance of various reproductive traits using twenty years data. Data were accumulated from a prescribed data sheet maintained by Central Cattle Breeding Station, Dhaka. Genetic groups for this experiment were (L×F), (L×J), (LH x F), (LF x LF) and (LJ x LJ). Number of services required for conception in descending order were 1.83±0.21, 1.80±0.21, 1.74±0.19, 1.72±0.17 and 1.60±0.19 in genetic group (LJ x LJ), (L x J), (LF x LF), (LH x F) and (L x F) respectively. Service per conception was lower in L x F 1.60±0.19.

Faruk *et al.* (2007) was conducted a comparative account of the productive and reproductive performance of crossbred and indigenous dairy cows at some selected areas of Cumilla district. The survey was conducted on 50 dairy cows for a period of four months from June to September, 2004. Out of 50 cows 25 were crossbred and 25 were indigenous. Service per conception for Local, Sahiwal x Local, Friesian x Local and Jersey x Local is 1.32±0.13, 1.50±0.50, 1.60±0.24 and 1.25±0.13 respectively. Service per conception for local and crossbred were 1.32±0.13 and 1.37± 0.11 respectively. Statistical analysis showed that there were no significant differences (P>0.05) in the service per conception of different genetic groups of cows.

Islam and Bhuiyan (1997) found that service per conception were 1.23±0.17 in JR, 1.46±0.19 in JR×SN, 1.45±0.12 in SL×PMC and 1.23±0.10 in ¼ PMC × ¾ SL cows at Baghabarighat milk shed area.

Hossen *et al.* (2012) observed the lowest service per conception (1.22) in PMC cows.

Rahman *et al.* (2006) who found that the number of services per pregnancy of Desi cows was 1.5.

Sarder *et al.* (2007) stated that the number of services per pregnancy in Friesian × Desi and Sahiwal × Desi cows was 1.6.

Saha *et al.* (2008) found that the mean values of service per conception was 1.4± 0.25 for Holstein-Friesian x Local.

2.4 Birth Weight of Calves

Islam *et al.* (2017) was conducted a study on 80 cows of different genotype of dairy cattle at Savar Dairy Farm, Dhaka to know about existing genotype and their performance. In this farm, the existing genotypes of cattle were Local (L), Sahiwal (SL), Friesian (F), Australian Friesian Sahiwal (AFS), Local×Friesian (L×F), Sahiwal×Friesian (SL×F), Local × Friesian × Friesian (LF_1×F), Local × Friesian × Friesian × Friesian (LF_2×F). In this study, the average birth weight of L, F, AFS, SL, F×SL, L×F, LF_1×F and LF_2×F were 16.7±0.48, 37.5± 0.65, 30.02±1.08, 19.45± 0.42, 21.25 ± 2.89, 22.57 ± 0.30, 23.88±0.5, 25.05 ±.48 kg respectively. Maximum birth weight found in case of Holstein Friesian 37.5 ± 0.65 kg and minimum was found in case of Local (16.7± 0.48) kg.

Mondal *et al.* (2005) was conducted a study at Bangladesh Agricultural University Dairy Farm for a period of six months. A total of 164 dairy cows belongs to different breeds, such as Jersey cross, Sahiwal cross, Sindhi cross, Holstein cross and Red Chittagong cows were selected and their information

regarding milk production and other reproductive parameters were collected from farm records for a period of last five years (1993-1997). The number of animals of each of the genotypic classes were 48 for Jersey cross, 46 for Sahiwal cross, 35 for Sindhi cross, 20 for Holstein cross and 15 for Red-Chittagong.

It was found that average birth weight of calves of Jersey cross was 14.2±1.73 kg, for Sahiwal cross was 13.5±0.89 kg, for Sindhi cross was 13.6±0.99 kg, for Holstein cross was 15.2±0.87 kg and for Red-Chittagong was 13.5±1.02 kg. Statistical analysis showed that there was significant difference ($P< 0.01$) within the birth weight of calves of different dairy cows. Among the different types of cows highest birth of was recorded in case of Holstein cross and lowest was recorded in case of Sahiwal cross.

Khan (1990) found that average birth weight of calves for Jersey, Sahiwal, Sindhi crossbred and Red Chittagong calves were 17.1±0.17, 17.8±0.18, 17.9±0.17 and 17.4+0.20 kg respectively.

Rokonuzzaman *et al.* (2009) reported that the birth weight of Local, Local×Friesian, were 17.0±0.4 and 22.5±0.1 kg respectively.

Saha *et al.* (2008) found that the mean value of birth weight of F × L crossbred cows was 24.95 ±5.83 Kg. study found that the mean value of birth weight of F×L was 22.57 ± 0.30 Kg. The mean birth weight of F x SL cows was 21.25 ± 2.89 kg.

2.5 Milk Yield

Bhuyan and Sultana (1994) analyzed locally the production performance of 1315 cows of various exotic breeds and their crosses locally between 1715 (1973 to 1989) using data collected from livestock breeding and central cattle breeding and dairy farming in Savar, Dhaka. They found a very significant effect on the

genetic group, calf year and average daily milk yield of lactation. The highest milk yield is in Holstein Friesian and the lowest in native cows.

Islam *et al.* (2017) was conducted a study on 80 cows of different genotype of dairy cattle at Savar Dairy Farm, Dhaka to know about existing genotype and their performance.

In this farm, the existing genotypes of cattle were Local (L), Sahiwal (SL), Friesian (F), Australian Friesian Sahiwal (AFS), Local×Friesian (L×F), Sahiwal×Friesian (SL×F), Local × Friesian × Friesian (LF_1×F), Local × Friesian × Friesian × Friesian (LF_2×F). In this study the average milk yield/day of L, F, AFS, SL, F×SL, L×F, LF_1×F and LF_2×F were 1.42±.56, 11.57 ±0.32, 4.68±.02, 2.24 ± 0.06, 3.55 ± 0.08, 3.36 ± 0.03, 4.1±0.4, and 4.5±0.8 Litres respectively. Highest milk yield found in Holstein Friesian 11.57 ± 0.32 Litres.

Sarkar (1995) demonstrated milk production from crossbred and local dairy cows at 6.74 and 1.63 Litres respectively.

Uddin *et al.* (2008) was conducted a study of 180 dairy cows were randomly selected from four sub-districts of Cumilla district. It was observed that mean milk yield of indigenous, Friesian cross, Sahiwal cross and Sindhi cross were 2.35±0.04, 7.36±0.11, and 4.78±0.08 Litres respectively.

Faruk *et al.* (2007) was conducted a comparative account of the productive and reproductive performance of crossbred and indigenous dairy cows at some selected areas of Comilla district. The survey was conducted on 50 dairy cows for a period of four months from June to September, 2004. Out of 50 cows 25 were crossbred and 25 were indigenous. Results showed that the average daily milk production of Local, Sahiwal x Local, Friesian x Local and Jersey x Local dairy cows were 2.26±0.19, 4.9±0.95, 6.0±1.0 and 5.71±0.87 litres respectively. It was observed that crossbreeding had a significant effect ($P < 0.01$). Among different cows, highest milk production was recorded in case of Friesian x Local

cross (6.0 ±1.0) litres and lowest milk yield was recorded (2.26±0.19) litres in Local cows.

Rahman *et al.* (2013) reported that daily milk yield mean (14.38±0.2) Litres for Local, (17.63±0.2) Litres for L×F and (19.5±0.3) Litres for LF_1×F.

Nahar *et al.* (1992) reported that the average daily milk yield of Holstein x indigenous, Sahiwal x indigenous, Sindhi x Indigenous, and Jersey x Indigenous crossbreds were 5.5±0.1, 2.9±0.1, 3.0±0.1, 3.8±0.1 Litres respectively.

2.6 Lactation Length

Islam *et al.* (2017) was conducted a study on 80 cows of different genotype of dairy cattle at Savar Dairy Farm, Dhaka to know about existing genotype and their performance. In this farm, the existing genotypes of cattle were Local (L), Sahiwal (SL), Friesian (F), Australian Friesian Sahiwal (AFS), Local×Friesian (L×F), Sahiwal×Friesian (SL×F), Local × Friesian × Friesian (LF_1×F), Local × Friesian × Friesian × Friesian (LF_2×F). In this study, the Average lactation length of L, F, AFS, SL, F×SL, L×F, LF_1×F and LF_2×F were 197.5±5.3, 513.8 ± 28.1, 499.5±20.7, 231 ± 10.58, 337 ± 15.7, 324.5 ± 3.3, 338.4±6.2, 340.5±7.8 days respectively.

Rahman *et al.* (2006) was conducted data in five parities of native cows from 2001 -2004 of Central Cattle Breeding Station (CCBS) and Dairy Farm, Savar, Dhaka were evaluate per day milk production, Lactation length, birth weight of calves, postpartum heat period, period of calving to conception, gestation length, calving interval and number of service per conception.

Rahman *et al.* (2013) reported that 197.5±5.3, 232.1±2.4, 266.7±2.7 days Lactation length for L, LF and LF_1×F.

Uddin *et al.* (2008) conducted a study of 180 dairy cows were randomly selected from four sub-districts of Cumilla district. It was observed that mean lactation

length of indigenous, Friesian cross, Sahiwal cross and Sindhi cross were 218.22±8.35, 284.69±1.64, 251.77±3.66 and 259.77±4.91 days respectively. It revealed that the Friesian cross was the best.

Rokonuzzaman *et al.* (2009) was undertaken a study to investigate productive and reproductive performances of crossbreds and Indigenous dairy cows. A total of 400 dairy cows each are equal number of Friesian x Indigenous (FI), Sahiwal x Indigenous (SaI), Sindhi x Indigenous (SiI) and Indigenous (I) were selected from eight thanas in Jashore district. Lactation period of Friesian x Indigenous (FI), Sahiwal x Indigenous (SaI), Sindhi x Indigenous (SiI) and Indigenous (I) dairy cows were 262.0±24.15, 250.4 ±28.06, 258.8 ±34.03, and 227.8±32.50 days respectively.

Hasan (1995) who reported the average lactation period of Jersey, Holstein, Sahiwal and Sindhi crosses were 286, 272, 262 and 255 days respectively.

Khan (1990) reported that the average lactation period of Pabna, Sindhi cross and Sahiwal cross were 200, 251 and 282 days respectively.

Khan *et al.* (2001) who found that lactation length of Desi and Friesian × Desi cross were 221 and 281 days respectively.

Sultana *et al.* (2001) found that the lactation length of Desi, Friesian × Desi cross and Sahiwal × Desi cows were 221, 287.5 and 254 days respectively.

Miazi *et al.* (2007) found that the average lactation length of Holstein-Friesian x Sahiwal and Hostein- Friesian x Local were 270±15 and 234.0±24.0 days respectively.

Hasan (1995) found that average lactation lengths of HF x SL, HF x L were 256.3±24.37 and 263.0±30.68 days respectively.

2.7 Postpartum Heat Period

Islam *et al.* (2017) was conducted a study on 244 crossbred cows of CCBS Savar, Dhaka to evaluate the effect of different genetic groups on their lifetime performance of various reproductive traits using twenty years data.

Data were accumulated from a prescribed data sheet maintained by Central Cattle Breeding Station, Dhaka. Genetic groups for this experiment were (L×F), (L×J), (LH x F), (LF x LF) and (LJ x LJ). The observed post-partum heat periods in LxF, LxJ, LHxF, LFxLF and LJxLJ crossbred genetic groups were 145.75±94.44, 75.05±129.90, 176.22±110.50, 196.52±126.91 and 231.76±138.87 days respectively. Postpartum heat period was lower in (145.75±94.44) days respectively.

Nahar *et al.* (1992) reported post-partum heat period of four genetic groups as crossbred of Sindhi, Sahiwal, Jersey and Holstein Friesian with Local as 165.7±6.9, 145.6±8.8, 120.4±7.2 and 123.1±4.3 days.

Islam *et al.* (1997) found postpartum heat period in Local and crossbred cattle in Natore district to be 116 and 149 days respectively.

Majid *et al.* (1995) found insignificantly (P>0.05) shorter (117 days) PPH in ½Sahiwalx ½Friesian and longest (224 days) in ¾ Local x ¾Friesian in Savar Dairy and Cattle Improvement Farm.

Rahman *et al.* (2013) reported that 103.2±6.8, 117.9±0.8, 113.0±0.4 days PPHP for L, L×F, LF_1×F respectively.

Rokonuzzaman (2009) *et al.* who found shortest time of PPHP 86.5±23.7 days in LF cow.

Majid *et al.* (1995) who found longest average postpartum heat period (223.5±40.14 days) in ¼ Local-Friesian crossbreed and the lowest (117.24±7.2

days) in ½ Local – ½ Friesian cows at the Central Cattle Breeding and Dairy Farm, Savar, Dhaka.

2.8 Calving Interval

Uddin *et al.* (2008) was conducted a study of 180 dairy cows were randomly selected from four sub-districts of Cumilla district. The mean calving interval of various genetic groups of indigenous, Friesian cross, Sahiwal cross and Sindhi cross were 472.55±169.17, 413.77±53.87, 454.00±87.17, and 459.33±87.68 days respectively. Among the different genetic group of cows the highest calving interval was found in Indigenous cows (472.55±169.27) days but shortest record in Friesian cross (413.77±53.87) days.

Islam *et al.* (2017) was conducted a study on 244 crossbred cows of CCBS Savar, Dhaka to evaluate the effect of different genetic groups on their lifetime performance of various reproductive traits using twenty years data. Data were accumulated from a prescribed data sheet maintained by Central Cattle Breeding Station, Dhaka. The highest calving interval (462±152.73) days was observed in genetic group (LF x LF) and other genetic groups follow in the order of (461 days), (441 days), (432 days) and (411 days) for genetic groups (LJ x LJ), (LH x F), (L x F) and (L x J) respectively.

Asaduzzaman and Miah (2004) who observed that the calving interval of indigenous, Sahiwal x Local and Holstein x Local were 422.4±49.53, 417.0±34.38 and 393.8±33.64 days respectively.

Mondal (1998) who found that the mean calving interval of Jersey cross, Sahiwal cross and Holstein Friesian cross cows were 501.4±86.41, 444.9±94.93 and 414.21±45.14 days respectively at Bangladesh Agricultural University (BAU) Dairy Farm.

Calving interval was highest for Local cows (15.4±075) months and lowest for Jersey x Local (14.08±0.62) months. It was also observed that three was no significant difference (P>0.05) between the calving interval of different crossbred and indigenous dairy cows.

Rahman *et al.* (2013) reported 481.3±0.8, 462.1±2.6, 435.6±2.4 days calving interval for L, LF and LF_1×F respectively.

Ghose *et al.* (1997) who recorded calving interval of 489.52 days for Pabna, 524.00 days for Dhaka, 430.86 days for Red Chittagong, 491.16 days for Sahiwal, 490.00 for Sindhi, 571.00 days for Sindhi×Pabna, 457.00 days for Sindhi × Local and 485.25 days for Sahiwal×Local cows.

Hossen *et al.* (2012) found the shortest calving interval (414.90) days in PMC cows.

Uddin *et al.* (2004) who found that calving intervals of Desi and Friesian x Desi cows were 484.1 and 489.2 days respectively.

Sultana *et al.* (2001) found that the calving interval of Sahiwal × Desi cows was 453.7 days.

Saha *et al.* (2008) found that the calving interval of HF x SL and HF x L were 450.12±48.16 days and 395.28±36.51 days respectively.

2.9 Frozen Semen Quality

Hossain *et al.* (2012) was conducted a study on 97 breeding bulls at the central cattle breeding and dairy farm, Savar, Dhaka to find out the physical and chemical properties of different bull semen. Out of 97 bulls, 9 were Local (L), 9 were Friesian (F), 13 were Sahiwal (SL), 12 were Local×Friesian (L×F), 10 were Sahiwal×Friesian (SL×F), 26 were Local×Friesian×Friesian (LF_1×F), 18 were Local×Friesian×Friesian×Friesian (LF_2×F) bulls. In this study, the average

Sperm conc. of frozen semen of L, F, SL, SL×F, L×F, LF_1×F and LF_2 ×F were 1572.1, 1287.5, 1765.5, 1403.2, 1453.8, 1222.3, and 1336.1 mill./ml respectively. The average pH of L, F, SL, F×SL, L×F, LF_1×F and LF_2×F were 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, and 6.2 respectively.

The mean Motility of L, F, SL, F×SL, L×F, LF_1×F and LF_2×F were 62.2%, 62.3%, 63.6%, 62.9%, 62.6%, 62.6%, and 63.6% respectively.

Reveco *et al*. (2016) was conducted a study to show a freezability analysis of semen stored for 1, 10, 25, 40, 45 years. They stated that the average sperm motility was 60%, pH was 6.

2.10 Incidence of Reproductive Diseases

Khair *et al.* (2013) was conducted a study over a period of twelve months from March 2012 to February 2013. The incidence rate, cumulative incidence and seasonal incidence of reproductive (RD) and production (PD) disorders were measured. The overall incidence rate and cumulative incidence of RDs and PDs were 33/tcm (10000 cattle-months at risk) and 3.9% respectively. The incidence rate and cumulative incidence of repeat breeder were highest as 11/tcm and 1.29% respectively followed by anoestrus (7/tcm and 0.81%), metritis (3/tcm and 0.34%), retained placenta (2/tcm and 0.27%) and abortion (2/tcm and 0.20%). The incidence rate and cumulative incidence of clinical mastitis were 8/tcm and 1.0% respectively. The proportionate incidence was highest for repeat breeder (32.76%) followed by mastitis (25.86%) and anoestrus (20.69%).

Maruf *et al.* (2012) was to find out the prevalence of reproductive disorders in dairy cows in Potiya Upazila of Chattagram district of Bangladesh. The data on the prevalence of reproductive disorders on 1658 dairy cows from 202 dairy farm owners were collected by using questionnaires. Thirteen major reproductive disorders were diagnosed. Overall prevalence of reproductive disorders were 23%, among of the disorders, occurrence of anoestrus was 5.1%, retained

placenta 4.6%, metritis 4.4%, repeat breeder 3.7%, poor heat detection 1.6%, ovarian cyst 0.4%, dystocia 1.0% and pyometra was 0.2%.

Hemayatul *et al.* (2012) stated that reproductive disorder among farm animals is the great economic problems.

To determine the reproductive problems of dairy cattle at Bogra district in Bangladesh were grouped on the basis of genotype, age and parity. A total 1500 data were collected by using individual questionnaire model, compiled SPSS package to obtain result and student t-test for interpretation. Genotype had significant ($P< 0.05$) effect on abortion, retained placenta, metritis, pyometra, mastitis, repeat breeding, anoestrus. The genotype L×F was showed 0.9%, 0.8%, 6.3%, 1.1%,1.5%, 0.8%, 1.2%, 1.2%, 0.7%, 5.9, 10.6% and 12.9% highest prevalence on abortion, stillbirth, retained fetal membrane, metritis, pyometra, vaginal prolapse, uterine prolapse, dystocia, milk fever, mastitis, repeat breeding and anestrus, respectively.

Rahman *et al.* (2013) was undertaken a investigation to determine the clinical trend of reproductive diseases and disorders of cows at Saturia Government Veterinary Hospital, Manikgonj. Eight major reproduction related diseases and disorders were diagnosed among 5.51%, n=358 registered sick cows. The highest proportion of cows was diagnosed as anoestrus (22.35%; n=80) followed by retained placenta (20.39%; n=73), repeat breeding (19.27%; n=69), dystocia (13.69%; n=49), utero-vaginal prolapse (13.40%; n=48), pyometra (8.66%; n=31), abortion (1.95%; n=7) and ovarian cysts (0.28%; n=1).

CHAPTER III

MATERIALS AND METHOD

3.1 Study Site

The study was conducted at the Central Cattle Breeding and Dairy Farm at Savar, Dhaka, Bangladesh. The CCBDF was established in 1973 on 1300 acres of land with the assistance of the German Agency for Technical Cooperation at Savar Upazila in the Dhaka district of Bangladesh. This farm is located between 23^0 46' and 23^0 58' North latitude and 90^0 12' and 90^0 20' East longitude and about 30 km northwest of the capital city of Dhaka.

3.2 Study Animals and Duration

The study was conducted from January, 2019 to December, 2019 CCBDF at Savar Dhaka, to know the performances of Dairy Cattle.
The study was conducted among the following genetic groups of cattle.

- Local (L)
- Friesian (F)
- Sahiwal (SL)
- Local ×Friesian (L×F) [50% L×50% F]
- Sahiwal×Friesian (SL×F) [50% SL× 50% F]
- Friesian (F) 62.5% [LF_1 ×F]
- Friesian (F) 75% [LF_2 × F]

3.3 Data Collection

The data was collected from record books of Byre section.

3.4 Feeding and Management

Feeding and management system in the farm was uniform throughout the year. Stall-feeding was practiced regularly. Concentrate feeds were included wheat bran, Maize, Soyabean meal, Di- Calcium Phosphate, Limestone, Vitamin and salt (Table 1).

Table 1. Concentrate Feeding chart of Dairy Cows in CCBDF

Feed	Percentage of Feed	Percentage of crude protein	Energy Kcl/kg
Wheat Bran	53.5	17.6	4520
Maize	20	8.8	4450
Soyabean Meal	20	44-48%	3619
Di- Calcium Phosphate	2	0	0
Limestone	3.4	0	0
Vitamin	0.1	0	0
Salt	1	0	0
Total	100		

Green grasses were supplied daily. Different types of green grasses that is Napier, Para, Maize, German grass were cultivated in the field near the farm (Figure 1).

Figure 1. Chopping Green Grass for Dairy Cow in CCBDF

The grass after collection were ensiled in the pits and fed to cows both as fresh and ensiled. (Figure 2).

Figure 2. Feeding Chopping Grass

3.5 Traits Studied

The following characteristics were used to measure reproductive performance of different crossbred animals that are Age at puberty, Gestation length, Service per conception, Birth weight of calves, Milk yield per day, Lactation length, Postpartum heat period and Calving interval.

3.5.1 Age at Puberty

The length of time between the date of birth and the date of showing first heat in life of an individual is termed as age at puberty.

3.5.2 Gestation Length

The gestation length is the period between the date of fertile service and the date of calving. This period is almost invariable within individual in a breed or type. Rectal palpation technique was used for diagnosis of pregnancy. The period of intra-uterine development of embryo and fetus was considered as gestation length.

Gestation length was measured from the date of successful insemination and date of calving. The duration of gestation was determined in days. The difference in gestation length was associated with twinning, sex of calf and parity of cow.

3.5.3 Service per Conception

This is defined as the average number of services or insemination required per conception and is a simple method of assessing fertility (Payne, 1970). Experimental animals were serviced by using artificial insemination (A.I.) technique. Service per conception is estimated by the average number of services for conception.

$$\text{Service Per Conception} = \frac{\text{Total Number of Cow Conceived}}{\text{Total Number of Service}}$$

3.5.4 Birth Weight of Calves

The birth weight of a newborn calf is termed as its body weight of calf. Birth weight was measured in kilogram (kg) by a platform digital balance within 24hours a birth.

3.5.5 Milk Yield per Day

Daily milk production was recorded. It was measured in litre (Table 2).

Table 2. Daily Milk Production Record in CCBDF

Breed	Daily Milk Production (Litre)	
	Highest	Lowest
Friesian	26	2
Sahiwal	9	1
Cross Bred	15	2
Local	2.9	1.3

3.5.6 Lactation Length

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

3.5.7 Postpartum Heat Period

Postpartum heat period was calculated as the interval between parturition to next heat that was observed after a certain period of parturition. The period was considered in days.

3.5.8 Calving Interval

The calving interval refers to the time elapses between two successive calving. This trait is very much important to the breeders because the lowest the calving

interval the highest the lifetime calf production. The calving intervals were recorded on the basis of interval between the dates of one calving to the date of next calving. The calving intervals were recorded in days.

3.5.9 Frozen Semen Examination

During frozen semen examination a straw of the frozen semen is examined through a high-powered microscope and a computer.

Figure 3. Semen Examination through high powered Microscope

When testing the frozen semen motility of a bull, the percentage of live sperm that are “progressively forward motile” (PFM). In other words how the sperm “swim” and the speed with which they move forward. A healthy sperm should swim forward two times its body length per second (Figure 4).

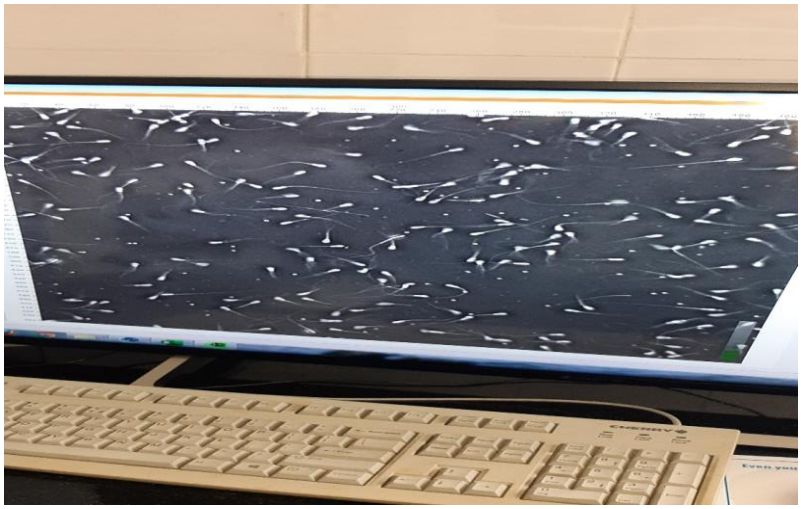

Figure 4. Semen Motility observed by connecting a Computer with microscope

P^H of semen was determined by indicator paper strips. Sperm concentration was determined by direct cell count machine (Figure 5).

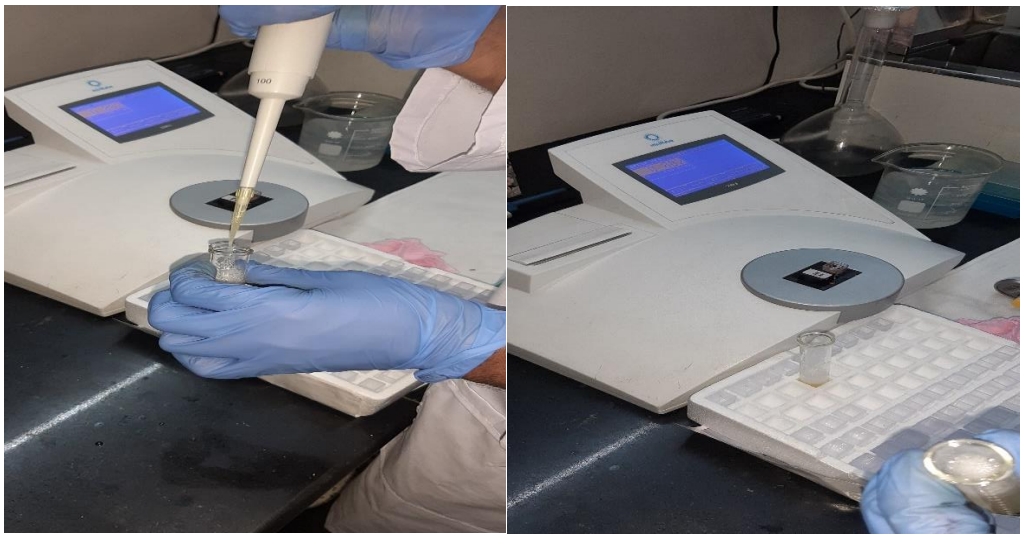

Figure 5. Determination of Sperm Concentration

3.6 Study Approaches

The number of cattle affected by reproductive diseases during the period from Jun 2019 to December 2019 was recorded from the register book. The diseases or disorders of reproduction related of cattle were calculated on the basis of

record book of veterinary Section of Central Cattle Breeding Dairy Farm with the help of Record Keeper.

3.7 Reproductive Diseases and Disorders

The diagnosis of diseases or disorders were performed on the basis of history, clinical signs and clinical examination of animals by the working Government Veterinary Surgeon in CCBDF, Dhaka. The Diseases and Disorders of dairy Cows are:

3.7.1 Retained Placenta (RP)

A cow was considered to have RP when the foetal membranes were visible at the vulva or were identified in the uterus or vagina by vaginal examination more than 24 h after calving.

3.7.2 Anoestrus

Lack of expression of the oestrus at an expected time is called anoestrus. Clinically if a heifer was 18 or more months old or a cow passed 40 days post-partum but did not show oestrus the condition is referred as anoestrus.

3.7.3 Repeat Breeders (RBs)

Cows failing to conceive after a defined number of inseminations (generally three or more) with fertile semen, have been classified as repeat breeders (Zemjanis, 1980; Gunther, 1981; Levine, 1999).

3.7.4 Dystocia

An abnormal and difficult birth in which the first or specially the second stage of parturition was markedly prolonged and subsequently found impossible for the dam to deliver without artificial aid.

3.7.5 Mastitis

The term Mastitis refers to inflammation of the mammary gland regardless of the cause. It is characterized by physical, chemical and usually bacteriological changes in the milk and by pathological changes in the gland (Radostits *et al.*; 2006). Diagnosis of mastitis was based on history, physical abnormalities of udder and gross abnormalities in the milk like discoloration and presence of clots/flakes. Palpation of udder revealed enlarged and painful with the presence of clots/ flakes in the milk confirmed the diagnosis of mastitis.

3.7.6 Abortion

Abortion is a condition in which the foetus was delivered live or dead before reaching the stage of viability and in which the delivered foetus was generally visible by naked eyes.

3.7.7 Utero-vaginal prolapse

A uterine prolapse could occur directly after the cow calves. The vaginal prolapse is more common and looks like a pink mass of tissue about the size of a large grapefruit or volleyball. Prolapse of the uterus is a larger, longer mass, more deep red and covered with the "buttons" on which the placenta attached.

3.7.8 Metritis

Metritis is the inflammation of the uterus generally caused by infectious agents. Usually cows have red to brown discharge during the first two weeks after calving. If discharge persists beyond two weeks or if the discharge is fetid odor is an evidence of metritis.

3.7.9 Ovarian Cyst

Ovarian Cyst disease in cows is usually seen in the first two months post calving. Ovarian cysts are characterised as structures greater than 2.5 cm (approximately 1 inch) in diameter remaining on an ovary for more than 10 days.

3.8 Vaccination Programme

Table 3. Vaccination Programme of Cows in CCBDF

Diseases	Dose		Date of 1st Dose	Date of next Dose
	Adult cows	Calves		
Anthrax	1 ml	0.5 ml	14-08-19	14-08-20
Black Quarter	5 ml	-	29-08-19	29-02-20
Food and Mouth Disease (FMD)	6 ml	3ml	12-12-19	12-04-20
Hemorrhagic Septicemia	2 ml	-	5-02-19	5-02-20
Deworming	According to Weight		4-10-19	4-1-20

3.9 Data Analysis

The data were checked manually for obvious inconsistencies, recording errors or missing Data. Data with suspicious values were excluded. Data were entered in Microsoft Excel 2013 for descriptive study. The mean difference was significant at 0.05 level.

CHAPTER IV

RESULTS & DISCUSSION

4.1.1 Age at Puberty

In this study the average age at puberty of Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 1119.61 ± 11.17, 1392.47 ± 15.49, 1136.32 ± 10.00, 1090.47 ± 10.01, 1085.23± 10.44, 1070.73 ± 8.63 and 1052.14± 9.53 days respectively (Shown in Table 4). Qureshi *et al.* (2002) reported that age of sexual maturity ranged from 420 to 1110 days with a mean of 745.3±51.0 days. Islam *et al.* (2017) stated that the highest age at puberty was (1525.58±28.05 days) in AFS and the lowest age at puberty was (1055.97±11.5 days) in LF_2×F cow. Rahman *et al.* (2006) reported that late sexual maturity was observed in local cow (1125.8±6.8 days) and early in LF (916.9±1.2 days). Sultana *et al.* (2001) who found that the ages at puberty of Desi, Friesian×Desi cross and Sahiwal×Desi cross cows were 25.2, 21.4 and 24.4 months respectively. The highest age at puberty was (1525.58±28.05days) in AFS. The lowest age at puberty was (1055.97±11.5 days) in LF_2×F milch cow. Saha *et al.* (2008) found that the mean value of age at puberty was (1138.5± 110.60 days) for HF × L crossbred. On the other hand, Khan *et al.* (1990) found that age at puberty of Holstein-Friesian and Sahiwal were 1378±30.45 and 1114±12.23 days that was similar with our findings.

Table 4. Average age at puberty (Mean ±SD) of different cattle genotypes at CCBDF.

Trait	Cattle genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average age at Puberty(days)	1119.61 ± 11.17	1392.47 ± 15.49	1136.32 ± 10.00	1090.47 ± 10.01	1085.23 ± 10.44	1070.73 ± 8.63	1052.14 ± 9.53

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

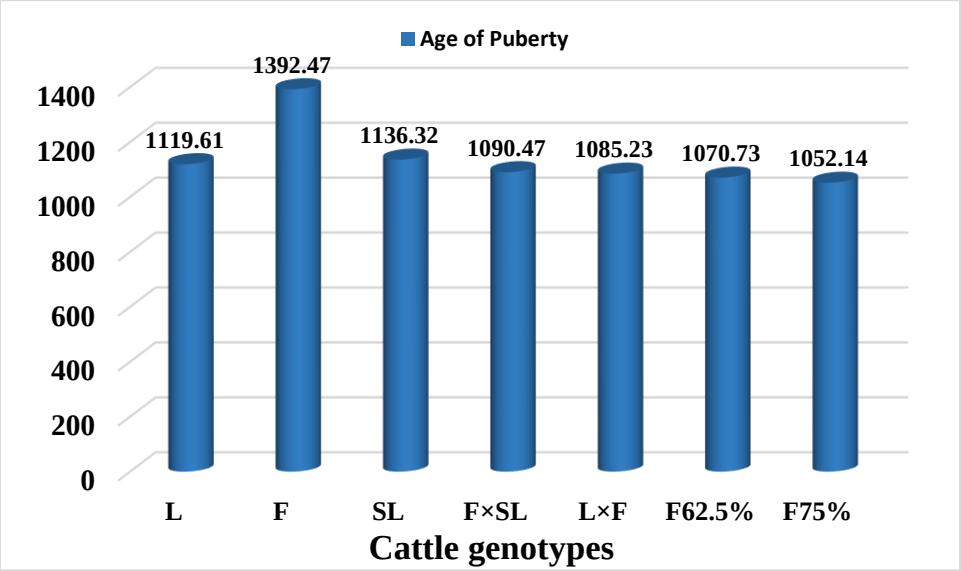

Figure 6. Age of Puberty of Different Dairy Cattle

4.1.2 Gestation Length

In our study the average gestation length Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 285.86 ±3.92, 283.05±4.28, 285.71± 5.04, 280.26± 3.95, 278.74± 3.87, 279.03± 4.55 and 278.21 ±3.90 days respectively (Shown in Table 5). Islam *et al.* (2017) found that the highest gestation length was 286.9 ± 1.23 days and it was for Sahiwal milch cow and gestation length was (277.2 ±3.93) days and it was for LF_2×F cow in Savar dairy farm Dhaka. Rahman *et al.* (2013) reported that 286.2±1.5, 279.0.6±0.6, 277.8±0.4 days gestation length for Local, LF and LF_1×F respectively. Kabir and Kisku (2013) found the gestation length of 277.5±5.2 and 279.3±4.5 days in genotypes L×F, LF_1×F respectively. Rahman *et al.* (2006) demonstrated the gestation length for Sahiwal x Indigenous and Friesian x Indigenous were 281.1 and 282.7 days respectively. Sarder *et al.* (2007) who found that gestation lengths of Desi, Friesian x Desi and Sahiwal x Desi cows were 279.7, 278.2 and 278.8 days respectively. The gestation length of present findings are more or less similar with the findings of Maarrof *et al.* (1987) who analyzed the data of 85 Jenubi cattle in dairy farms of central Iraq, where average gestation length was 283±1.5 days. Variation in gestation length within the species may be contributed mainly by maternal and fetal factors. The maternal factors include age of the dam, nutritional status and body condition of the dam (Maarrof *et al.*, 1987). Fetal factors include the sex of the fetus, twinning and hormonal functions of the fetus. Environment such as season, feeding, and management also contribute to some extent (Hafez ESE. 1993). Rukonojjaman *et al.* (2009) found that the average gestation length of Holstein-Friesian, Sahiwal, were 275±3.95, 276±4.26 days respectively and the findings are almost dissimilar to our findings. In another study, Majid *et al.* (1995) observed that the gestation length for Hosltein-Friesian x Sahiwal and Holstein-Friesian x Local were 282 & 284 days respectively. It was also dissimilar with our findings.

Table 5 Gestation Length (Mean ±SD) of different cattle genotypes at CCBDF.

Trait	Cattle genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average gestation length (Days)	285.86 ± 3.92	283.05 ± 4.28	285.71 ±5.04	280.26 ± 3.95	278.74 ± 3.87	279.03 ±4.55	278.21 ±3.90

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

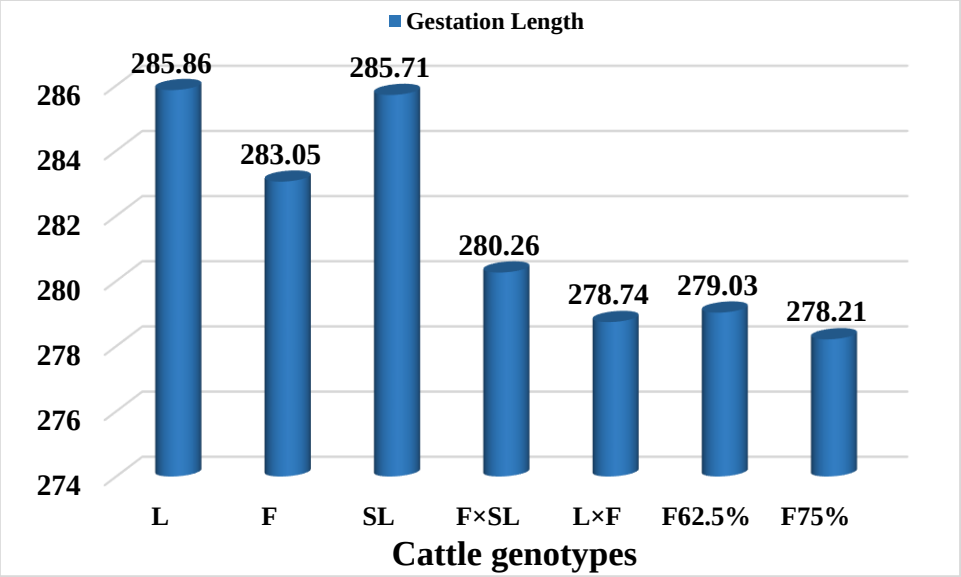

Figure 7. Gestation Length of Different Dairy Cattle

4.1.3 Service per Conception

In this study, service per conception means the number of services or insemination required per conception. In this study the average number of service per conception Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 1.494± 0.24, 3.412± 0.59, 3.314± 0.49, 1.794 ±0.23, 2.643± 0.37, 1.738 ±0.39, and 1.621± 0.30 for L, F, SL, F×SL, L×F, F62.5% and F75% respectively (Shown in Table 6). Kabir and Kisku (2013) found that the highest performance in AFS (1.40±0.69) and lowest performance in SL×F (1.80±0.63) cows were recorded in terms of services required per conception in Savar dairy farm, Dhaka. Ali (1998) reported that the service per conception of crossbred and local cow were 3.3 and 2.0 respectively in gaibandha district. Rahman *et al.* (2013) reported 1.302 ± 0.2, 1.4 ± 0.2, 1.2 ± 0.1 for L, L×F and LF_1×F respectively. Islam and Bhuiyan (1997) found that service per conception was 1.23±0.17 in JR, 1.46±0.19 in JR×SN, 1.45±0.12 in SL×PMC and 1.23±0.10 in ¼ PMC × ¾ SL cows at Baghabarighat milk shed area. Hossen *et al.* (1012) observed the lowest service per conception (1.22) in PMC cows. Rahman *et al.* (2006) who found that the number of services per pregnancy of Desi cows was 1.5. Sarder *et al.* (2007) stated that the number of services per pregnancy in Friesian × Desi and Sahiwal × Desi cows was 1.6. Saha *et al.* (2008) found that the mean values of service per conception was 1.4± 0.25 for Holstein-Friesian x Local. The mean value of service per conception 1.69 ± 0.18 for Holstein-Friesian x Sahiwal according to Saha *et al* (2008).

Table 6. Service per Conception (Mean ±SD) of different cattle genotypes at CCBDF.

Trait	Cattle genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average service per conception	1.49 ± 0.24	3.41 ± 0.59	3.31 ± 0.49	1.79 ± 0.23	2.64 ±0.37	1.73 ± 0.39	1.62 ± 0.30

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

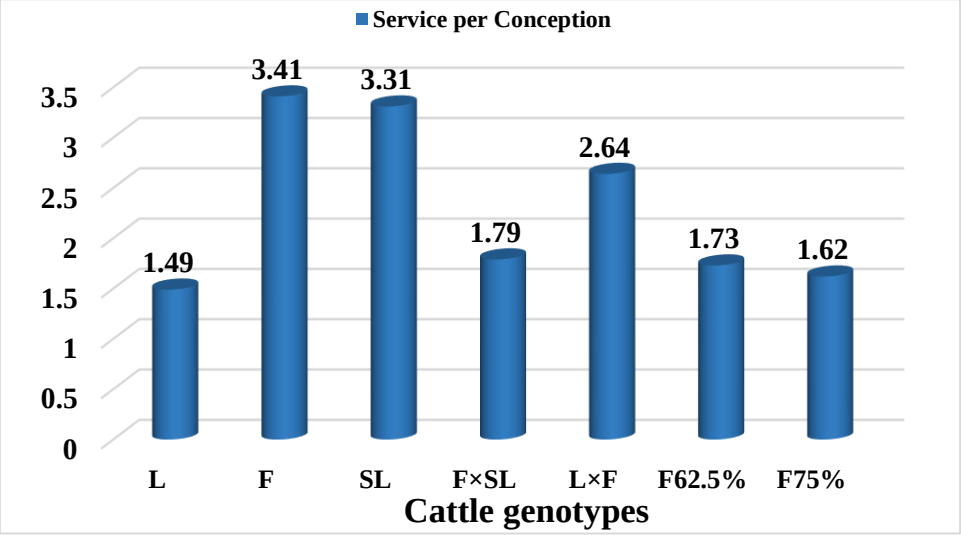

Figure 8. Service per Conception of Different Dairy Cow

4.1.4 Birth Weight of Calves

In this study, the average birth weight Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F),

Friesian 75% (LF_2 ×F) were 16.51 ± 0.96, 37.35 ± 1.15, 19.73±1.13, 21.86 ±1.70, 22.59 ± 1.01, 23.79 ± 0.98 and 25.40± 1.08 kg respectively (Shown in Table 7). Islam *et al.* (2017) stated that maximum birth weight found in case of Holstein Friesian (37.5 ±0.65) kg and minimum was found in case of Local (16.7± 0.48) kg in Savar dairy farm. Rokonuzzaman *et al.* (2009) reported that the birth weight of Local, Local× Friesian, were 17.0±0.4 and 22.5±0.1 kg respectively. Saha *et al.* (2008) found that the mean value of birth weight of F × L crossbred cows was (24.95 ±5.83) Kg. It was dissimilar with our study because the study found that the mean value of birth weight of F×L was 22.57± 0.30Kg. The mean birth weight of F x SL cows was 21.25± 2.89 kg. It was also similar with our study. From the above data we can stated that the birth weight of different cross breed is lower than study of Saha *et al.* (2008) due to the breed factor, managemental maintenance, hereditary factor, feeding practice and physiological status were also responsible for the birth weight.

Table 7. Birth weight of Calves (Mean ±SD) of different Cattle genotypes at

Trait	Calves genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average birth weight of Calves (kg)	16.51 ± 0.96	37.35 ± 1.15	19.73 ± 1.13	21.86 ± 1.70	22.59 ± 1.01	23.79 ± 0.98	25.40 ± 1.08

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

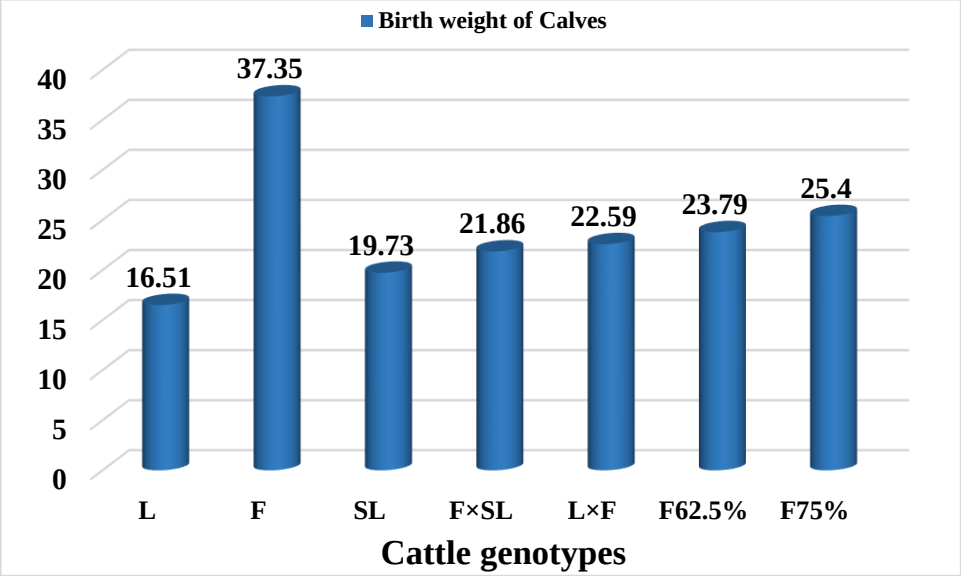

Figure 9. Birth Weight of Different Calves

4.1.5 Milk Yield per Day

Milk yield is the most economic traits of a lactating cow. In this study the average milk yield/day of Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 2.1 ±0.56, 14± 6.64, 4.55± 2.72, 6.77± 1.91, 6.19 ± 2.14, 7.87±2.26 and 8.11 ±2.76 Litre/day respectively (Shown in Table 8). Islam *et al.* (2017) stated that highest milk yield was found in case of Friesian (11.57 ±0.32) L/day and lowest in Local (1.42±.56) L/day. Rahman *et al.* (2013) reported that daily milk yield mean 14.38±0.2 for Local, 17.63±0.2 for L×F and 19.5±0.3 for LF_1×F. Nahar *et al.* (1992) reported that the average daily milk yield of Holstein x Indigenous, Sahiwal x Indigenous, Sindhi x Indigenous, and Jersey x Indigenous crossbreds were 5.5±0.1, 2.9±0.1, 3.0±0.1, 3.8±0.1 kg, respectively. Saha *et al.* (2008) found that, the daily milk yield mean 12.54±3.50 litters for HF x L crossbred cows. Milk yield is highly heritable, as cows produce more milk either

by using ingested food or by mobilizing body fat (Schei *et al.*, 2005). Management and nutrition are important for milk production and fertility (Windig *et al.*, 2006), (Windig *et al.*, 2005).

Table 8. Milk yield performanced (Mean ±SD) of different cattle genotypes at CCBDF.

Trait	Cattle genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average daily Milk yield (Litre)	2.1 ± 0.56	14 ± 6.64	4.55 ± 2.72	6.77 ± 1.91	6.19 ± 2.14	7.87 ± 2.26	8.11 ± 2.76

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

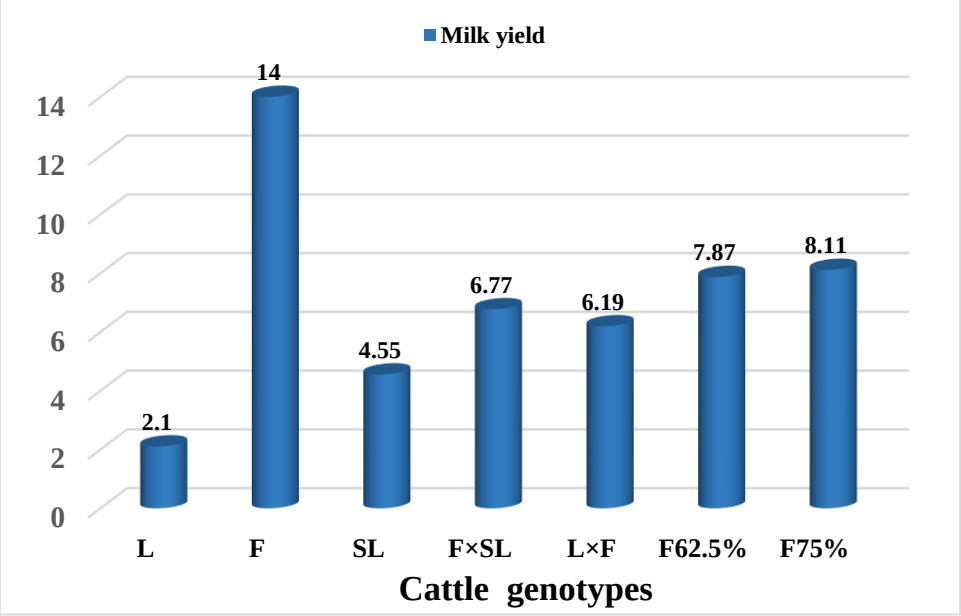

Figure 10. Milk yield of Different Cows

4.1.6 Lactation Length

In this study, the Average lactation length of Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 196.15± 10.17, 412.13 ±6.13, 230.48 ±6.37, 336.82 ±9.01, 324.88±5.04, 338.9 ±8.02 and 341.51± 5.31days respectively (Shown in Table 9). Islam *et al.* stated that the highest lactation length was observed in Holstein Friesian milch cow (513.8 ± 28.1) days & lowest was found in Local (197.5±5.3) days in Savar dairy farm. Rahman *et al.* reported that 196.15 10.17, 512.13 6.13, 230.48 days Lactation length for L, LF and LF_1×F. Hossen *et al.* have stated that season of calving had a significant effect and sire, parity and year of calving had a nonsignificant effect on lactation length. Hasan who reported the average lactation period of Jersey, Holstein, Sahiwal and Sindhi crosses were 286, 272, 262 and 255 days, respectively. Khan reported that the average lactation period of Pabna, Sindhi cross and Sahiwal cross were 200, 251 and 282 days respectively. Khan *et al.* (1990) who found that lactation length of Desi and Friesian × Desi cross were 221 and 281 days respectively. Sultana *et al.* (2001) found that the lactation length of Desi, Friesian × Desi cross and Sahiwal × Desi cows were 221, 287.5 and 254 days respectively. Miazi *et al.* (2007) found that the average lactation length of Holstein-Friesian x Sahiwal and Hostein- Friesian x Local were 270±15 and 234.0±24.0 days respectively & these results have difference with the present study. Hasan (1995) found that average lactation lengths of HF x SL, HF x L were 256.3±24.37 and 263.0±30.68 days respectively.

Table 9. Lactation Length (Mean ±SD) of different cattle genotypes at CCBDF.

Trait	Cattle genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average lactation length (day)	196.15 ± 10.17	412.13 ± 6.13	230.48 ± 6.37	336.82 ± 9.01	324.88 ± 5.04	338.9 ± 8.02	341.51 ± 5.31

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

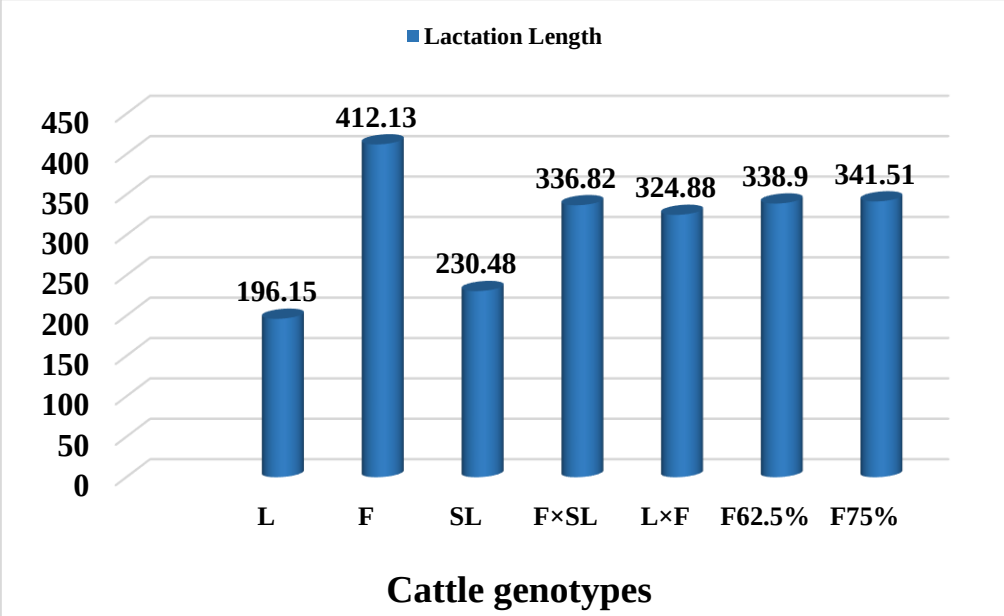

Figure 11. Lactation Length of Different Cows

4.1.7 Postpartum Heat Period

In this study, it was found that the Postpartum heat period (PPHP) of Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 102.41± 5.75, 145.74 ±7.51, 210.51 ±6.72, 221.52 ±6.78, 298.75 ±5.80, 198.95 ± 5.45 and 179.69 ±5.48 days respectively (Shown in Table 10). Kabir and Kisku (2013) observed that the highest average postpartumm heat period was obtained in LF_1×F (201.7±17.40) days and lowest in L×F (135.5±10.58) days crossbred cows in Savar dairy farm, Dhaka. Rahman *et al.* (2013) reported that 103.2±6.8, 117.9±0.8, 113.0±0.4 days PPHP for L, L×F, LF_1×F respectively. Rokonuzzaman *et al.* (2009) who found shortest time of PPHP (86.5±23.7) days in LF cow. Majid *et al.* (1995) who found longest average postpartum heat period (223.5±40.14) days in ¼ Local-Friesian crossbreed and the lowest (117.24±7.2) days in ½ Local – ½ Friesian cows at the Central Cattle Breeding and Dairy Farm, Savar, Dhaka. Postpartum heat period is an important economic reproductive trait in a dairy herd. Hafez (1993) suggested that the postpartum breeding delayed up to 60 to 70 days after parturition, when the uterus under goes recovery and preparation for the next conception. Chowdhury *et al.* (1994) was found the postpartum heat period 154.8 days in FN×SL crossbred cows. Hossen *et al.* (1012) observed that the shortest postpartum heat period 133.23 days was in PMC cows. Saha *et al.* (2008) found that the mean values of postpartum heat period were 122±35.5 days for HF x SL and (110±29.6) days for HF x L crossbred cows. The postpartum heat period of Holstein Friesian was 121 days. On the other hand, Nahar and Mustafa (1987) found that the average PPHP of Holstein Friesian and Sahiwal were 150± 24.4 and 216±2.78 days that was similar with our findings.

Table10. Postpartum Heat Period (Mean ±SD) of different cattle genotypes at CCBDF.

Trait	Cattle genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average postpartum heat period (Day)	102.41 ± 5.76	145.74 ± 7.51	210.51 ± 6.72	221.52 ± 6.78	298.75 ± 5.80	198.95 ± 5.45	179.69 ± 5.481

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

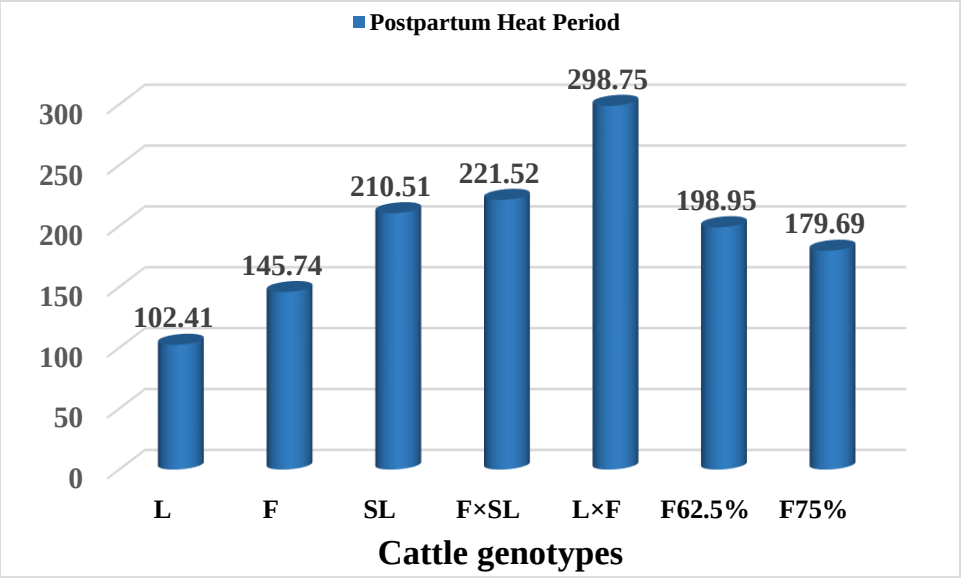

Figure12. Postpartum Heat Period of Different of Cows

4.1.8 Calving Interval

It is defined as the interval between two successful calving of the same cows. In this study, average Calving interval of Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 479.78±6.24, 578.71±8.44, 582.27±7.66, 607.04±8.72, 516.25±9.07, 529.76±10.98 and 507.27±7.32 days respectively (Shown in Table 11). Kabir and Kisku (2013) found that the highest value of calving interval was observed in SL×F (542.0±9.87) days cows and the lowest value was in L×F (436.07±9.87) days cows at Savar dairy farm, Dhaka. Rahman *et al.* (2013) reported 481.3±0.8, 462.1±2.6, 435.6±2.4 days calving interval for L, L×F and LF_1×F respectively. Ghose *et al.* (1997) who recorded calving interval of 489.52 days for Pabna, 524.00 days for Dhaka, 430.86 days for Red Chittagong, 491.16 days for Sahiwal, 490.00 for Sindhi, 571.00 days for Sindhi×Pabna, 457.00 days for Sindhi × Local and 485.25 days for Sahiwal×Local cows. Hossen *et al.* (2012) found the shortest calving interval (414.90 days) in PMC cows. Uddin *et al.* (2004) who found that calving intervals of Desi and Friesian x Desi cows were 484.1 and 489.2 days respectively. Sultana *et al.* (2001) found that the calving interval of Sahiwal × Desi cows was 453.7 days. Saha *et al.* found that, the calving interval of HF x SL and HF x L were 450.12±48.16 days and 395.28±36.51 days respectively.

Table11. Calving Interval (Mean ±SD) of different cattle genotypes at CCBDF.

Trait	Cattle genotypes						
	L	F	SL	F×SL	L×F	F62.5%	F75%
Average calving interval (Day)	479.78 ±6.24	578.71 ±8.44	582.27 ±7.66	607.04 ±8.72	516.25 ±9.07	529.76 ±10.98	507.27 ±7.33

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

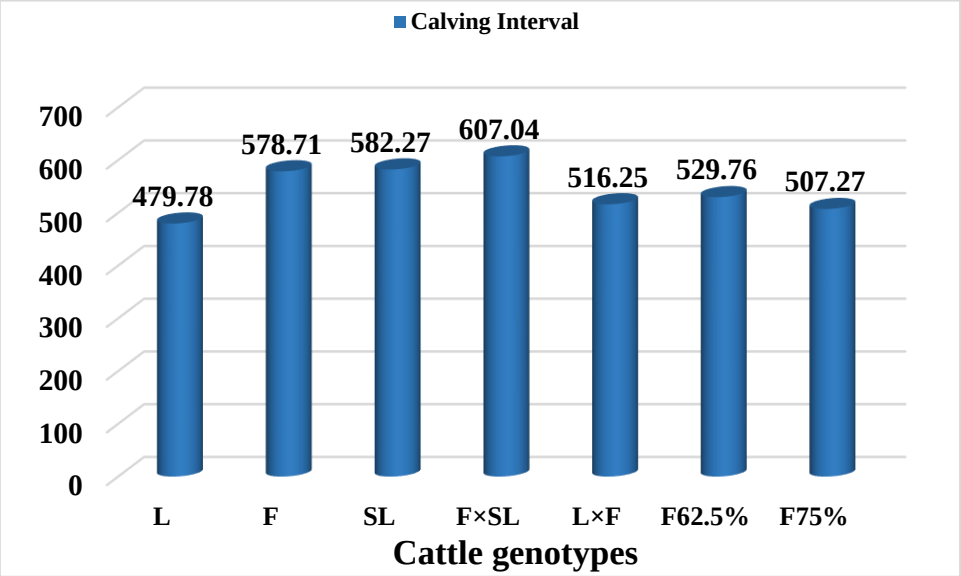

Figure13. Calving Interval of Different Cows

4.1.9 Evaluation of Frozen Semen

In this study, average concentrations of sperm of frozen semen of Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F) were 1649.4±96.14,

1250.6±95.52, 1786.2±61.3, 1423.4±84.7, 1472.4±64.9, 1256.2±74.0 and 1346.6±79.92 million/ml respectively. Average pH of frozen semen of L, F, SL, F×SL, L×F, F62.5% and F75% were 6.22± 0.19, 6.26± 0.24, 6.28 ± 0.27, 6.24± 0.23, 6.26± 0.20, 6.28±0.19 and 6.3± 0.27 respectively. Average sperm Motility sperm of frozen semen of L, F, SL, F×SL, L×F, F62.5% and F75% were 65, 65.4, 66.8, 66.2, 66, 66 and 66.8 percent respectively (Shown in Table12). Hossain *et al.* (2012) found that the maximum average sperm concentration of frozen semen was obtained from SL and the mean value was 1765.5 million/ml. The minimum average sperm concentration of frozen semen was obtained from LF_1×F and the mean value was 1222.3 million/ml. The maximum average pH of frozen semen was obtained from LF_2×F and the mean value was 6.2. The maximum average motility of frozen semen was obtained from SL and the mean value was 63.6%. However, the minimum average motility of frozen semen was obtained from L and the mean value was 62.2% in Savar dairy farm. This study is similar to our study.

Table12. Frozen Semen Quality of Different Bull at CCBDF

Parameter	L	F	SL	F×SL	L×F	F62.5%	F75%
Sperm conc. (mill./ml)	1649.4 ± 96.14	1250.6 ±95.52	1786.2 ±61.3	1423.4 ±84.7	1472.4 ± 64.9	1246.2 ± 69.88	1346.6 ± 79.92
pH	6.22 ± 0.19	6.26 ± 0.24	6.28 ± 0.27	6.24 ± 0.23	6.26 ± 0.20	6.28 ±0.19	6.3 ± 0.27
Motility (%)	65	65.4	66.8	66.2	66	66	66.8

[Local (L), Sahiwal (SL), Friesian (F), Sahiwal×Friesian (SL×F), Local×Friesian (L×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The mean difference was significant at 0.05 level].

4.1.10 Reproductive Diseases

In the present investigation, nine major reproduction related diseases and disorders were diagnosed among (n=150) registered sick cows. The present investigation demonstrated that the highest proportion of cows was diagnosed as followed by retained placenta (24.67%) anoestrus (22%), repeat breeders (15.33%), dystocia (10.67%), mastitis (8%), abortion (7.33%), utero-vaginal prolapse (6%), metritis (4.67%), and ovarian cysts (1.33%) (Shown in Table 13). Contrasting to the present study, the highest occurrence of endometritis (26.2%) was reported at Tangail milk shed area by Das *et al.*, (1995). Moreover, the highest occurrence of retained placenta in Savar Dairy farm (42.6%) by Shamsuddin *et al.* (1988) and in mini dairy farms at Natore district (4.5%) by Shamsuddin *et al.* (1995) was reported among the cows with reproduction related problems. Moreover, the occurrence of pyometra was 4.5% (similar to occurrence of retained placenta) in mini dairy farms at Natore district (Shamsuddin *et al.*, 1995). Further, utero-vaginal prolapse was reported to be occurred in the lowest proportion of cows by Shamsuddin *et al.* (1995). The variation in occurrence of various reproductive problems among investigations may be due to variations in management of cows, breed used and nature of studies. According to our study retained placenta, and anoestrus, repeat breeders, Dystocia, mastitis are the important reproductive and production diseases. Knowledge in terms of risk factors and their mitigation already available about these diseases should be extended to farmers to control them. Low incidence of these diseases indicate that the rate of progression of these diseases is slow in cattle population. Nevertheless, the present study emphasized the requirement of performing detailed research on retained placenta and anoestrus of cows in Bangladesh. The lack of awareness of farmers about reproduction related diseases or disorders of cattle which needs to overcome for profitable dairying in Bangladesh.

Table 103. Percentage of Different Reproductive Diseases Occurrence

Diseases/Disorders	**No. of cows diagnosed n(150)**	**Percentage of occurrence**
Retained placenta	37	24.67
Anoestrus	33	22
Repeat breeders	23	15.33
Dystocia	16	10.67
Mastitis	12	8
Abortion	11	7.33
Utero-vaginal prolapse	9	6
Metritis	7	4.67
Ovarian cyst	2	1.33

CHAPTER V

SUMMARY & CONCLUSION

In this study the considered genotypes were Local (L), Sahiwal (SL), Friesian (F), Local×Friesian (L×F), Sahiwal×Friesian (SL×F), Friesian 62.5% (LF_1 ×F), Friesian 75% (LF_2 ×F). The highest age at puberty was (1392.47±15.49) days found in Friesian. The lowest age at puberty was found (1052.14±9.53) days in F75% cow. The highest gestation length was (285.86 ± 3.92) days and it was for Local milch cow and lowest gestation length was (278.21 ±3.90) days and it was for F75% cow. Maximum number of service per conception was found in case of Friesian (3.412 ± 0.59) and minimum in local (1.49±0.24). Maximum birth weight was found in case of Friesian (37.35 ± 1.15) kg; minimum in Local (16.51±0.96) kg. Highest milk yield was found in case of Friesian (14± 6.64) L/day and lowest in Local (2.1 ± 0.56) L/day. The highest lactation length was observed in Holstein Friesian milch cow (412.13 ± 6.13 days) & lowest was found in Local (196.15±10.17 days). The highest calving interval was found in Holstein-Friesian x Sahiwal (607.04 ± 8.72) days and lowest in Local (479.78±6.24) days. The highest Postpartum heat period was found in case of LF (298.75 ± 5.80) days and lowest in case of Local (102.41±5.75) days milch cow. The maximum average sperm concentration of frozen semen was obtained from SL and the mean value was 1786.2 million/ml. The minimum average sperm concentration of frozen semen was obtained from F62.5% and the mean value was 1246.2 million/ml. The maximum average pH of frozen semen was obtained from F75% and the mean value was 6.3. The maximum average motility of frozen semen was obtained from SL and the mean value was 66.8%. However, the minimum average motility of frozen semen was obtained from L and the mean value was 65%. Nine major reproduction related diseases and disorders were diagnosed among (n=150) registered sick cows. The highest proportion of cows was diagnosed as retained placenta (24.67%; n=37). Reproductive

performances of Holstein Friesian were superior to other dairy crossbreds. Friesian75% breed ranked second and performances of other genotypes were nearly similar. The highest occurrence of retained placenta and anoestrus is very alarming which needs further research to decrease the occurrence of such disorders of cows in population..

Considering the above perspective it is concluded that L×F crossbred cows are most suitable for Considering the above perspective it is concluded that Local×Friesian crossbred cows will most suitable for Bangladesh and the cattle are the most suffering animals among the livestock species and among reproduction related diseases or disorders, the highest proportion of cows suffers from Retained placenta and the lowest proportion suffers from ovarian cysts.

CHAPTER VI

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APPENDIX 1

Data collected during research work

Local / No of cows	Traits							
	Age of puberty (D)	Gestation length (D)	Service per conception (N)	Birth weight of calves (Kg)	Milk yield /day (Littre)	Lactation length (D)	Postpartum Heat period(D)	Calving Interval (D)
I	1125.8	291.4	1.9	16.7	2.9	197.5	103.2	481.3
II	1100.9	279.2	1.8	18	1.3	180	92.7	478.2
III	1130.7	289.2	1.2	14.9	1.47	200.8	95.4	489.9
IV	1135.3	280.9	1.46	15.5	2.73	210.4	107.5	470.4
V	1120.5	283.6	1.57	15.8	2.23	185.7	110.6	483.5
VI	1123.7	285.7	1.25	16.9	1.97	187.5	108.9	470.7
VII	1110.6	290	1.4	16.5	2.5	190.4	104.1	479.8
VIII	1115.3	287.8	1.71	17.4	1.7	205.6	100.4	486.1
IX	1105.9	286.3	1.35	16	1.64	207.9	98.9	475.9
X	1127.4	284.5	1.3	17.4	2.56	195.7	102.4	482

APPENDIX 2

Data collected during research work

Friesian / No of cows	Traits							
	Age of puberty (D)	Gestation length (D)	Service per conception (N)	Birth weight of calves (Kg)	Milk yield /day (Littre)	Lactation length (D)	Postpartum Heat period(D)	Calving Interval (D)
I	1401.5	289	4	37.5	26	413.8	157.3	581.6
II	1380.7	276.4	2.95	35.7	2	420.7	148.6	590.1
III	1375.9	288.1	3.32	39.2	17.9	408.6	137.4	564.3
IV	1370.2	279.8	2.9	36.8	10.1	400	140.9	571.9
V	1390.4	287.3	3.67	37	15.6	412.5	142.7	579.4
VI	1395.3	280.7	3.78	37.9	12.4	410.5	152.1	584.7
VII	1410.1	285.6	4.3	38.3	20	417.3	150.5	587.8
VIII	1415.3	278.9	3.8	38.6	8	415.8	145.8	567.5
IX	1405.4	283.2	3	36.5	14.8	405.7	149.9	581.1
X	1379.9	281.5	2.4	36	13.2	416.4	132.2	578.7

APPENDIX 3

Data collected during research work

Sahiwal / No of cows	Traits							
	Age of puberty (D)	Gestation length (D)	Service per conception (N)	Birth weight of calves (Kg)	Milk yield /day (Littre)	Lactation length (D)	Postpartum Heat period(D)	Calving Interval (D)
I	1138.4	292.9	4	19.45	9	231.7	220.1	582.2
II	1148.2	278.9	2.4	21	1	221.5	200.4	570.8
III	1120.6	290.2	3.3	17.9	3	240.5	205.2	593.2
IV	1125.7	285.7	2.89	18.9	4	224.8	210.3	575.4
V	1135.8	280.9	2.95	19.5	5.1	228.9	213.7	589.3
VI	1140.5	283.3	3	20.8	2.8	235.6	207.8	584.1
VII	1145.1	288.1	3.45	20.6	7	230.4	216.1	580.9

APPENDIX 4

Data collected during research work

L × F / No of cows	Traits							
	Age of puberty (D)	Gestation length (D)	Service Per conception (N)	Birth weight of calves (Kg)	Milk yield /day (Littre)	Lactation length (D)	Postpartum Heat period(D)	Calving Interval (D)
I	1086.7	285.2	3.1	22.57	9	324.5	290.8	516.2
II	1088.3	273.4	1.95	23.8	3	332.1	307.7	500
III	1100.5	278.3	2.43	20.9	6.7	316.9	292.9	528.4
IV	1068.4	280.1	2.7	21.5	5	320.8	300.6	504.9
V	1083.6	283.6	2.81	21.9	8	323.7	295.3	520.1
VI	1089.7	276.9	3.15	22.7	7	329.5	303.8	525.3
VII	1070.2	275.8	2.25	23.4	5.7	330.2	305.1	509.5
VIII	1098.1	277.9	2.91	22	9.1	318.5	297.4	515.8
IX	1079.3	281.7	2.61	23.2	4.9	327	301.2	523.4
X	1087.5	274.5	2.52	24	3.5	325.6	292.7	518.9

APPENDIX 5

Data collected during research work

F × SL / No of cows	Traits							
	Age of puberty (D)	Gestation length (D)	Service per conception (N)	Birth weight of calves (Kg)	Milk yield /day (Littre)	Lactation length (D)	Postpartum Heat period(D)	Calving Interval (D)
I	1092.3	285.7	2.2	21.5	10	337.2	230.8	607.6
II	1110.6	272.8	1.68	18.7	4	323.9	210.9	615.8
III	1075.7	283.6	1.56	24.1	6.7	350.1	215.6	600.9
IV	1083.3	275.9	1.47	22.5	5	325.6	220.3	590.7
V	1086.8	279.3	2	21.9	8	337.8	223.3	617.5
VI	1095.2	283.4	1.95	23.3	7	348.2	225.1	608.6
VII	1093.1	280.5	1.92	20.8	5.7	342.7	218.9	596.8
VIII	1089.5	282.8	1.74	23.6	9.1	335.4	227.2	610.3
IX	1098.5	277.5	1.57	19.8	4.9	339.8	213.7	606.5
X	1079.7	281.1	1.85	22.4	7.3	327.5	229.4	615.7

APPENDIX 6

Data collected during research work

F62.5 % / No of cows	Traits							
	Age of puberty (D)	Gestation length (D)	Service per conception (N)	Birth weight of calves (Kg)	Milk yield /day (Littre)	Lactation length (D)	Postpartum Heat period(D)	Calving Interval (D)
I	1070.8	284.9	2.5	23.88	9	338.4	207.1	530.7
II	1075.1	272.4	1.4	25	4	350.1	190.4	510.4
III	1065.7	283.4	1	22.1	6.5	327.3	201.7	517.5
IV	1060.5	274.8	1.78	22.7	8.1	329.5	203.2	544.6
V	1077.6	280.3	1.96	22.9	6.9	340.7	193.8	520.9
VI	1080.4	279.6	2	23.5	7.2	345.8	205.5	542.1
VII	1072.3	275.9	1.57	23.9	5.8	335.9	197.9	537.7
VIII	1063.9	281.1	1.6	24.5	10	348.2	199.8	535.8
IX	1083.4	284.2	1.85	24.7	9.4	330.5	195.6	527
X	1057.6	273.7	1.72	24.78	11.8	342.6	194.5	530.9

APPENDIX 7

Data collected during research work

F75.5% / No of cows	Traits							
	Age of puberty (D)	Gestation length (D)	Service per conception (N)	Birth weight of calves (Kg)	Milk yield /day (Littre)	Lactation length (D)	Postpartum Heat period(D)	Calving Interval (D)
I	1055.9	282.8	2	25.5	13	340.5	187.9	508.6
II	1037.4	270.6	1	26.8	5	332.7	170.1	495.9
III	1068.1	279.4	1.39	24	6.1	351.2	181.1	517.1
IV	1041.7	281.2	1.78	23.78	4.9	335.8	175.7	515.3
V	1051.3	273.7	1.33	24.5	7.5	347	177.3	500.7
VI	1063.5	275.6	1.57	24.9	9.3	344.1	185.4	505.8
VII	1047.8	277.5	1.82	25.6	8.8	342.9	179.7	510.6
VIII	1054.6	280.3	1.92	26.3	10	338.6	173.9	497.6
IX	1044.9	278.9	1.6	26.8	11	341.9	183.5	507.4
X	1056.2	282.1	1.8	25.9	5.5	340.4	182.3	513.7

APPENDIX 7

Data collected during research work

Parameter	Local				
	I	II	III	IV	V
Sperm conc. (mill./ml)	1758	1527	1700	1572	1690
pH	6	6.3	6.2	6.5	6.1
Motility (%)	60	70	65	60	70

APPENDIX 8

Data collected during research work

Parameter	Friesian				
	I	II	III	IV	V
Sperm conc. (mill./ml)	1368	1189	1272	1300	1124
pH	6.1	6.4	6.6	6.2	6
Motility (%)	60	70	67	60	70

APPENDIX 9

Data Collected during Research work

Parameter	Sahiwal				
	I	II	III	IV	V
Sperm conc. (mill./ml)	1882	1764	1732	1810	1743
pH	6.1	6.4	6.7	6.2	6
Motility (%)	62	70	65	70	67

APPENDIX 10

Data collected during research work

Parameter	Friesian × Sahiwal				
	I	II	III	IV	V
Sperm conc. (mill./ml)	1403	1546	1379	1464	1325
pH	6.1	6.3	6.6	6.2	6
Motility (%)	60	70	68	63	70

APPENDIX 11

Data collected during research work

Parameter	Local × Friesian				
	I	II	III	IV	V
Sperm conc. (mill./ml)	1453	1546	1379	1464	1520
pH	6.5	6.4	6.3	6.1	6
Motility (%)	63	70	67	60	70

APPENDIX 12

Data collected during research work

Parameter	Friesian62.5%				
	I	II	III	IV	V
Sperm conc. (mill./ml)	1222	1335	1146	1278	1250
pH	6	6.4	6.5	6.2	6.3
Motility (%)	62	70	68	60	70

APPENDIX 13

Data collected during research work

Parameter	Friesian75%				
	I	II	III	IV	V
Sperm conc. (mill./ml)	1336	1245	1439	1300	1413
pH	6.1	6.4	6.7	6.3	6
Motility (%)	65	70	69	60	70

APPENDIX 14

Data collected during research work

No. of cows diagnosed	Diseases/Disorders
1	Anoestrus
2	Repeat breeding
3	Retained placenta
4	Repeat breeding
5	Anoestrus
6	Dystocia
7	Retained placenta
8	Dystocia
9	Repeat breeding
10	Retained placenta
11	Utero-vaginal prolapse
12	Repeat breeding
13	Retained placenta
14	Metritis
15	Repeat breeding
16	Mastitis
17	Abortion
18	Retained placenta
19	Metritis
20	Repeat breeding
21	Retained placenta
22	Utero-vaginal prolapse
23	Repeat breeding
24	Mastitis
25	Dystocia
26	Repeat breeding
27	Retained placenta
28	Dystocia
29	Mastitis
30	Repeat breeding
31	Anoestrus
32	Metritis
33	Retained placenta
34	Abortion
35	Ovarian cyst
36	Retained placenta
37	Repeat breeding
38	Mastitis
39	Metritis
40	Retained placenta

APPENDIX 15

Data collected during research work

No. of cows diagnosed	Diseases/Disorders
41	Anoestrus
42	Utero-vaginal prolapse
43	Retained placenta
44	Abortion
45	Dystocia
46	Mastitis
47	Repeat breeding
48	Anoestrus
49	Retained placenta
50	Dystocia
51	Anoestrus
52	Abortion
53	Retained placenta
54	Anoestrus
55	Metritis
56	Retained placenta
57	Anoestrus
58	Repeat breeding
59	Mastitis
60	Dystocia
61	Repeat breeding
62	Mastitis
63	Abortion
64	Abortion
65	Retained placenta
66	Abortion
67	Retained placenta
68	Anoestrus
69	Dystocia
70	Retained placenta
71	Utero-vaginal prolapse
72	Retained placenta
73	Metritis
74	Abortion
75	Abortion
76	Retained placenta
77	Dystocia
78	Retained placenta
79	Repeat breeding
80	Anoestrus

APPENDIX 16

Data collected during research work

No. of cows diagnosed	Diseases/Disorders
81	Mastitis
82	Repeat breeding
83	Anoestrus
84	Mastitis
85	Dystocia
86	Retained placenta
87	Metritis
88	Anoestrus
89	Dystocia
90	Retained placenta
91	Anoestrus
92	Repeat breeding
93	Mastitis
94	Anoestrus
95	Utero-vaginal prolapse
96	Retained placenta
97	Anoestrus
98	Abortion
99	Retained placenta
100	Anoestrus
101	Dystocia
102	Retained placenta
103	Mastitis
104	Abortion
105	Retained placenta
106	Anoestrus
107	Repeat breeding
108	Mastitis
109	Utero-vaginal prolapse
110	Retained placenta
111	Retained placenta
112	Utero-vaginal prolapse
113	Anoestrus
114	Abortion
115	Anoestrus
116	Ovarian cyst
117	Retained placenta
118	Dystocia
119	Anoestrus
120	Repeat breeding

APPENDIX 17

Data collected during research work

No. of cows diagnosed	Diseases/Disorders
121	Anoestrus
122	Utero-vaginal prolapse
123	Retained placenta
124	Anoestrus
125	Anoestrus
126	Repeat breeding
127	Retained placenta
128	Anoestrus
129	Dystocia
130	Anoestrus
131	Utero-vaginal prolapse
132	Retained placenta
133	Anoestrus
134	Dystocia
135	Retained placenta
136	Repeat breeding
137	Anoestrus
138	Dystocia
139	Retained placenta
140	Anoestrus
141	Retained placenta
142	Anoestrus
143	Repeat breeding
144	Anoestrus
145	Repeat breeding
146	Retained placenta
147	Anoestrus
148	Retained placenta
149	Anoestrus
150	Repeat breeding