PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF INDIGENOUS AND CROSSBRED COWS BRED ARTIFICIALLY IN GOBINDAGANJ UPAZILA OF GAIBANDHA DISTRICT

MST. ASSRAFI SIDDIKA

DEPARTMENT OF ANIMAL NUTRITION, GENETICS AND BREEDING
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

JUNE, 2022

PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF INDIGENOUS AND CROSSBRED COWS BRED ARTIFICIALLY IN GOBINDAGANJ UPAZILA OF GAIBANDHA DISTRICT

BY

MST. ASSRAFI SIDDIKA

REGISTRATION NO.: 20-11100

A Thesis

Submitted to the Department of Animal Nutrition, Genetics and Breeding
Sher-e-Bangla Agricultural University, Dhaka,
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE (MS)

IN

ANIMAL BREEDING AND GENETICS

SEMESTER: JANUARY-JUNE, 2022

Approved by:

Prof. Dr. Lam Yea Asad
Supervisor
Department of Animal Nutrition, Genetics and Breeding
Sher-e-Bangla Agricultural University
Dhaka-1207

Prof. Dr. Md. Mufazzal Hossain
Co-supervisor
Department of Animal Nutrition, Genetics and Breeding
Sher-e-Bangla Agricultural University
Dhaka-1207

Dr. Al-Nur Md. Iftekhar Rahman
Associate Professor and Chairman
Examination Committee
Department of Animal Nutrition, Genetics and Breeding
Sher-e-Bangla Agricultural University
Dhaka-1207

DEPARTMENT OF ANIMAL NUTRITION, GENETICS AND BREEDING
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

*This is to certify that thesis entitled, "**PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF INDIGENOUS AND CROSSBRED COWS BRED ARTIFICIALLY IN GOBINDAGANJ UPAZILA OF GAIBANDHA DISTRICT**" was submitted to the Department of Animal Nutrition, Genetics and Breeding, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS) in ANIMAL BREEDING AND GENETICS,** embodies the result of a piece of bona-fide research work carried out by **MST. ASSRAFI SIDDIKA**, Registration no. **20-11100** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma in any other institution.*

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

Date:
Place: Dhaka, Bangladesh

Prof. Dr. Lam Yea Asad
Supervisor
Department of Animal Nutrition, Genetics and Breeding
Sher-e-Bangla Agricultural University,
Dhaka-1207

ACKNOWLEDGEMENT

All praises are put forward to The Almighty ALLAH Who is the Supreme Planner and has blessed the author to complete this piece of study as required for the degree Master of Science.

The work was done in the Department of Animal Nutrition, Genetics and Breeding, Sher-e-Bangla Agricultural University, Dhaka. I really feel emotional to express my heartfelt gratitude and honor to my Supervisor, Professor, ***Dr. Lam Yea Asad,*** *Department of Animal Nutrition, Genetics and Breeding, sher-eBangla Agricultural University, Dhaka whose consistent eye, inspiration, immense help, constructive criticism, valuable time, guidance and instruction paved the way to walk with this research work. My lifelong salute and respect to her.*

It gives the author great pleasure to express her sincere appreciation to her co-supervisor ***Prof. Dr. Md. Mufazzal Hossain*** *of the Department of Animal Nutrition, Genetics and Breeding at Sher-e-Bangla Agricultural University in Dhaka for his expert guidance, oversight, gracious cooperation, and insightful suggestions during the thesis preparation.*

It is with the utmost gratitude that the author expresses her gratitude to ***Dr. Al-Nur Md. Iftekhar Rahman****, Associate Professor and Chairman, Department of Animal Nutrition, Genetics and Breeding, Sher-e-Bangla Agricultural University, Dhaka, for the exceptional services he provided to the author while she was a student.*

The author additionally extends sincere gratitude to the members of the Department of Animal Nutrition, Genetics and Breeding and employees for their kind assistance and support throughout the research period.

The author expresses her heartfelt thanks to her parents, spouse, brother, sister and other relatives who continuously prayed for her success, and without whose love, affection, inspiration and sacrifice this work would not have been completed.

Finally, everlasting respect to almighty Allah again for his kind grace to finish this research work successfully.

May Almighty bless and protect them all.

The Author

Email: asrafi.siddika14@gmail.com
Phone Number: +8801518371668

PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF INDIGENOUS AND CROSSBRED COWS BRED ARTIFICIALLY IN GOBINDAGANJ UPAZILA OF GAIBANDHA DISTRICT

ABSTRACT

The aim of the study was to evaluate the productive and reproductive performances of crossbred and indigenous cows through artificial insemination. The study was conducted at farmer's level in different areas in Gobindaganj upazila of Gaibandha district from January 2021 to December 2021. Based on the goal of the study, a total of 100 dairy cows were examined across three genotypes. According to their genetic composition selected genotypes were Friesian cross (F×I=45), Sahiwal cross (SL×I=35) and Indigenous (I=20). The three breeds differ significantly in terms of reproductive traits. The results showed that shortest age at puberty (20.77±0.10 month), age at first service (22.65±0.22 month), age at first calving (31.95±0.30 month), gestation period (278.44±0.97 days) and calving interval (404.20±2.31 days) in Friesian cross. On the contrary longest age at puberty, age at first service, age at first calving, gestation period and calving interval were 25.58±0.11 month, 27.08±0.11 month, 37.01±0.34 month, 284.30±1.08 and 453.30±2.91 days found in indigenous cow, respectively. There is no significant effect of service per conception between indigenous and crossbred cows. Where indigenous cows need minimum (1.20±0.09) services per conception though Sahiwal cross required for maximum (1.56±0.13) service per conception. Regarding productive attributes, significant variations between indigenous and crossbred cows were identified. It was observed that highest birth weight, milk yield per day and lactation length were 25.08±0.58 kg, 13.44±.54 liter and 287.72±2.52 days, respectively found in Friesian cross. On the other side lowest birth weight, milk yield per day and lactation length were 13.55±0.98 kg, 2.30±0.12 liter and 229.3±2.52 days, respectively observed in indigenous. It was revealed that the Friesian cross is superior in relation to milk production and lactation length. From the above point of view, it could be concluded that Friesian cross cows might be suitable for profitable dairy farming compared to other breed in this study area. However, further study with greater sample sizes covering more different management systems would be required to describe a better inference in this consideration.

LIST OF CONTENTS

LIST OF CONTENTS (Contd.)

LIST OF CONTENTS (Contd.)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviations		**Full word**
%	:	Percentage
,	:	Comma
.	:	Fulstop
:	:	Colon
;	:	Semi colon
<	:	Less than
>	:	Greater than
±		Plus minus
A.D	:	Anno Domini
AFS	:	Age at first service
AFS	:	Australian Friesian Sahiwal
AI	:	Artificial insemination
ANOVA	:	Analysis of Variance
BAU	:	Bangladesh Agricultural University
BER	:	Bangladesh Economic Review
BW	:	Birth weight
CCBDF	:	Central Cattle Breeding and Dairy Farm
CI	:	Calving interval
CR	:	Conception Rate
D	:	Desi
DLS	:	Department of Livestock Services
DO	:	Days open
et al.	:	And others
F	:	Friesian
GDP	:	Gross Domestic Product
HF	:	Holstein Friesian
HF×L	:	Holstein Friesian × Local
I	:	Indigenous
F×I	:	Friesian × Indigenous
SL×I	:	Sahiwal × Indigenous

LIST OF ABBREVIATIONS AND SYMBOLS (Contd.)

Abbreviations		**Full word**
kg	:	Kilogram
l	:	Liter
L	:	Local
L×F	:	Local × Friesian
L×S	:	Local × Sindhi
L×SL	:	Local × Sahiwal
no.	:	Number
NS	:	Non-significant
NSC	:	Number of service per conception
NSPC	:	Number of service per conception
NST	:	National Science and Technology
SE	:	Standard Error
SL	:	Sahiwal
SL×F	:	Sahiwal × Friesian
SPSS	:	Statistical package for the social sciences
WW	:	Weaning weight
viz	:	Namely

CHAPTER I

INTRODUCTION

Bangladesh is a densely populated and agro-based developing country where the two main challenges are to eradicate the poverty and malnutrition. Most of the rural people of Bangladesh are dependent for their livelihood mainly on cropping and livestock farming. To overcome these challenges, livestock; mainly dairy cattle has been supporting much. The livestock sector is one of the fastest growing segments of the agricultural economy particularly in the developing world (Delgado *et al.*, 2009). Livestock is the prominent sector of agriculture and the contribution of this sector in GDP is 1.90%, growth rate of livestock in GDP is 3.10% and in agricultural GDP is about 16.52% (DLS, 2022). The contribution of livestock to the national economy particularly with regard to foreign currency earnings is through exportation of bones, offals, feather and skin and hides. Livestock resources also play an important role in the sustenance of landless people (DLS, 2008). The total cattle population of Bangladesh is 24.70 million yielding 13.07 million metric ton milk per year but the demand is 15.67 million metric ton (DLS, 2022). That indicates the importance of the requirement for increasing the milk production in Bangladesh.

The reproductive performance of the breeding female is probably the single most important factor that is a prerequisite for sustainable dairy production system and influencing the productivity of dairy cattle (Kiwuwa *et al.*, 1983). The poor reproductive performance of high yielding cows may affect the overall economic performance of the herd especially under high ambient temperature (Jainudeen and Hafez, 2000). Reproductive performance traits like age at first service, age at first calving, number of services per conception, days open and calving interval are the basis for a profitable dairy farming (Mukasa-Mugerewa, 1989). Days open and number of services per conception of the cows have been studied by several investigators due to the economic importance associated with the reproductive efficiency and fertility in dairy cattle. They are important in determining calving interval and influencing milk production (Ali *et al*., 2003; Riecka and Candrak, 2011). Productive traits directly affect the profitability of the farm. These traits depend largely on the genetic potential of the dam and sire. Profitable breeding could be improved by keeping lactation length, dry period and service period between optimal

limits (Alpan, 1994; Cilek and Tekin, 2005). Producing more milk annually is a primary measure of efficiency because maximum production of dairy cows has typically occurred with optimal management conditions (Kellogg *et al.,* 2001). Because of the low milk production of indigenous breeds; exotic breeds are adopted to increase milk production in commercial herds where intensive systems were followed. The revenues of milk production depend on the reproductive efficiency of the herds (Ahmed *et al.,* 2000).

Productive and reproductive traits are crucial factors determining the profitability of dairy production (Lobago *et al.,* 2007). The poor reproductive performance of high yielding cows may affect the overall economic performance of the herd. In order to improve the low productivity of local cattle, selection as well as cross breeding of indigenous breed with high producing exotic cattle has been considered as a practical solution (Tadesse, 2002). It is necessary to evaluate the productive and reproductive performances of indigenous stocks and their crossbred for designing appropriate breeding strategies. In addition, reproductive performance is vital measures for assuring the profitability of many animal production systems. Especially, the economics of dairy enterprise is based on an efficient reproductive performance of dairy animals (Sodakar *et al.,* 1988). In Bangladesh, most of the cattle are of indigenous type along with few crossbreds and some purebreds, such as Red Sindhi, Sahiwal, Hariana, Jersey and Holstein Friesian. During the last century numerous attempts have been carried out in order to improve the milk production potentialities of indigenous cattle through crossbreeding. Locally adapted breeds will continue to be valuable in our countries because these countries cannot afford the inputs that are required to sustain breeds that have been developed in low stress, high input production systems (Al-Amin *et al.,* 2007). Although the milk production potential of the crossbred and pure breeds are higher than that of our indigenous cattle. For this reason there is a controversy about crossbreeding programme, although the number of crossbred cattle is increasing day by day with the spread of artificial insemination (AI). Crossbred is an animal that having best reproduction and productive performance compared to indigenous animal, which mainly due to recombination and heterosis effect. Accordingly, enormous efforts have been made to improve the genetic potential of local cattle through cross breeding with exotic breeds. The native cattle of Bangladesh have low productivity but disease resistance capacity was higher

than that of exotic breeds. To develop the performance of native cattle, up gradation is necessary. 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. Crossbred cows are more productive in good nutrition and proper management. Therefore, programs have been taken to improve the genetic potential as well as productivity of non-descript indigenous cows through crossbreeding since 1970 (Bhuiyan, 2006).

The success of dairy production in general and crossbreeding programmes need to be monitored regularly by assessing the productive performances under the existing management system. For improving the production potential and genetic merit of the nondescript indigenous cows, superior germ plasms have been introduced all over the country through artificial insemination (Sarder *et al.,* 2001). Although the history of research into artificial insemination (AI) is over two centuries old and its commercial application has now already span 75 years in Bangladesh and AI has first been introduced just in 1959 (Shamsuddin *et al.,* 1987; Alam and Ghosh, 1988). However, the achievements through AI in Bangladesh are still unsatisfactory. The success of any AI program may be influenced by many factors (Shamsuddin *et al*., 2001; Paul *et al*., 2011). Breeding of cattle is mostly uncontrolled in Gobindaganj upazila making genetic improvement difficult and appropriate bull selection criteria have not yet been established applied and controlled. AI has proven to be a very effective reproductive technology that selectively increases genetic gain through increased selection pressure on males. AI service has been considered as a significant vehicle to upgrade the existing reproductive performances of cattle breeds by implementing the crossbreeding program in order to increase the cattle production. It has been considered as a promising tool to improve genetic potential of dairy animals and many farmers at field conditions are unaware about the technology with huge regional variations in terms of knowledge level and adoption of this promising technology (Foote, 2002). Capacity of AI technician and insemination technique is also plays a major role for poor fertility indices (Paul *et al*., 2011). In order to increase the production and productivity of cattle AI services are being provided across the country through 15,389 AI sub-centers/points. Over the past decade, AI coverage has increased from 28 percent to 55 percent (BER, 2022). In Bangladesh, AI services have been operated commercially by both government and private organizations

whereas the autonomous organization provides the AI services within their research and extension strategy. All the government cattle breeding activities are performed by the DLS-a base organization working under the Ministry of Fisheries and Livestock. The AI services are mainly delivered by District AI centre (Uddin et *al*., 2014). Therefore; we have designed this study considering the hypothesis of the productive and reproductive performance of indigenous and crossbreed cows through AI may evaluate the most conception rate, milk and meat production performance in the research area.

AI plays an important role to increase the yielding capacity of cows and is the appropriate and cheapest way of genetic improvement and the realization of breeding programs has to be well organized and excited in a very reliable way and AI is fully functional when it is corporates with good animal husbandry such as effective heat detection (Noakes *et al.*, 2001). To meet the increasing demand and ensure adequate amount of protein from animal source and thus, food security at household level the famers need to increase their productivity. The existing low productive local cattle, low production of milk and meat and low investment in the sector are the major challenges towards improvement of livestock sector (Bormann *et al.*, 2006; Ferguson *et al.*, 1996). In addition, lack of appropriate breeds, suitable breeding policy and shortage of feeds and fodders throughout the year are also hindering the productivity (Schilling and England, 1998; Khan, 2008). The government intervention to overcome those problems by importing high yielding temperate breeds could not bring a solution to increase productivity. This instigates to search for alternative options; one of which is to infuse the exotic blood into the best local cows through either upgrading or crossbreeding through AI. Hence, the present investigation was taken up with the following objectives:

- To evaluate the conception rate of indigenous and cross breed cows through artificial insemination in the area.
- To assess the productive performance of indigenous and crossbreed cows following artificial insemination.
- To assess the reproductive performance of indigenous and crossbreed cows following artificial insemination.

CHAPTER II
REVIEW OF LITERATURE

Actual research works have been carried out in different countries of the world related to the productive and reproductive performance of indigenous and crossbred dairy cows bred artificially in several areas. In Bangladesh this kind of works have also been done in different region. However, very little research has been done on the productive and reproductive performance of indigenous and crossbred dairy cows through artificial insemination in Gobindganj upazila of Gaibandha district. But the related findings of research work carried out in Bangladesh as well as abroad are reviewed in this section.

2.1 Definition and History of Artificial Insemination

Artificial insemination (AI) or introduction of semen in the female genital tract by means of instruments is the first generation of reproductive biotechnologies which was feasible in cattle. AI is one of the earliest perfected technologies where new breeds of animals are produced through the introduction of the male sperm from one superior male to the female reproductive tract without mating (Wilmut *et al.*, 1997). It is a process by which sperm are collected from the male, processed, stored and artificially introduced into the female reproductive tract for the purpose of conception (Webb, 2003; Temesgen *et al.*, 2017). Leeuwenhoek first described the spermatozoon in 1677. However the earliest report AI practice dates back to 1322 A.D. with Arabian horse breeders. The First documented successful insemination was in the bitch (Spallanzani, 1784).

The first commercial AI cooperative was established in 1936 by a Dane, Sorenson (Foote, 2002). Before the Second World War, most cows in Europe and North America were fertilized by means of natural service. However, since several cows on different farms were mated by the same bull, the spread of genital diseases with decreased fertility outcomes was a constant threat. Moreover, keeping herd bulls was expensive and represented potential danger for the herd manager (Vishwanath, 2003). Apart from these facts, the limited number of offspring produced per bull after natural mating made it impossible to set up effective progeny testing schemes and resulted in a very poor genetic gain. The introduction of AI in cattle was mainly forced by

sanitary reasons and especially by fertility problems caused by *Campylobacter foetus* subspecies venerealis (vibriosis) and *Trichomonas foetus*. However, also the control and prevention of non-sexually transmitted diseases such as tuberculosis, brucellosis and paratuberculosis at the farms benefited from the introduction of AI (Thibier *et al.,* 2004). Semen is collected from the bull, deep-frozen and stored in a container with Liquid Nitrogen at a temperature of minus 196 degrees Centigrade and made for use. AI has become one of the most important techniques ever devised for the genetic improvement of farm animals. It has been widely used for breeding dairy cattle as the most valuable management practice available to the cattle producer and has made bulls of high genetic merit available to all (Webb, 2003; Bearden *et al.,* 2004).

2.2 Artificial Insemination Service Facilities

Artificial Insemination (AI) technology has also led to one of the most successful smallholder dairy systems in the developing world. However, the use of AI has also failed in many situations in developing countries because of the lack of infrastructure and the costs involved, such as for transportation and liquid nitrogen for storage of semen or because the breeding program has not been designed to be sustainable (Mpofu and Rege, 2002; Philipsson *et al.,* 2005). Improper use of AI for crossbreeding of indigenous cattle with exotics may be disastrous when information is needed to maintain the appropriate level of exotic genes in an environment for long-term strategy(Azage *et al.,* 1995).

2.3 Reproductive Performance of Cow

2.3.1 Artificial Insemination Per Conception

Number of service per conception depends largely on the breeding system used. It is higher under uncontrolled natural breeding than hand-mating and artificial insemination (Gabriel *et al.,* 1983).

Gautam and Khadka, (2022) compared between reproductive and productive performance of crossbred and terai cattle in Bardiya district of Nepal. Total of 262 cows [Jersey cross (n=107), Holstein cross (n=24) and indigenous Terai cattle (n=131)] were considered to determine the production and reproduction parameters. The number of services per conception was Terai cattle 1.3±0.7, compared to Jersey cross 1.7±1.3 and Holstein cross 1.8±0.9, respectively.

Dinka (2012) reported that he overall mean of the number of services per conception in Gondor by was 1.8±0.3 NSC.

Kumar *et al.* (2014) studied that indigenous cows had the significantly higher NSC (2.2±0.2) than that of HF crossbreds (1.5±0.3). The peri-urban zone of study area had significantly higher average NSC (2.0±0.4) than that of urban zone (1.6±0.2). Herd size and season of calving did not influence NSC significantly. The first (2.2±0.4) NSC was significantly larger than fifth (1.8±0.3), second (1.7±0.3), third (1.7±0.3) and fifth (1.6±0.2). The farming system did not have any significant influence on NSC.

Jabbar and Ali (1988) investigated the limitation of cross breeding for improvement of cattle in Bangladesh. He reported that the service per conception of crossbred and local cow were 3.3 and 2.0 respectively in Gaibandha district.

Rahman *et al.* (2017) studied to evaluate the productive and reproductive performances of local and crossbred cows in Manikgonj district of Bangladesh. He observed that the number of services per pregnancy of Local cows was 1.36 and Local × Friesian cow was 1.40 respectively.

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

2.3.2 Age at Puberty

Sultana *et al.* (2001) conducted a comparative study on productive and reproductive performance of different cross-bred and indigenous dairy cows was done under small scale dairy farm condition who found that the ages at puberty of Desi, Friesian×Desi and Sahiwal×Desi cows were 25.2, 21.4 and 24.4 months, respectively.

Khan (1990) carried out the study on the reproductive efficiency of native and crossbred cows. He found that age at puberty of Holstein-Friesian and Sahiwal were 1378±30.45 and 1114±12.23 days.

Azizunnesa *et al.* (2010) studied those productive and reproductive performances of Red Chittagong Cow at rural areas in Chittagong in Bangladesh. She found that

reproductive performances of Red Chittagong cows such as age at puberty were 2.68±1.72 years.

Uddin et *al.* (2008) conducted to compare the productive and reproductive performance of indigenous and crossbred cow likely Friesian, Sahiwal and Sindhi cross. A total of 180 dairy cows were selected randomly from four upazilas of Comilla district. He reported that the Age puberty was shorter in Friesian cross (662.44±2.52 days).

Paul *et al.* (2013) compared the reproductive performance of crossbred and desi cows at farmer's level. This study was conducted among 120 different breed cows at selected areas of Sirajgonj district from March to July 2010. They founded that the crossbred cows had significantly ($p<0.01$) lower pubertal age (20.4 ± 1.2) than Desi (25.9 ± 1.1) months.

Islam *et al.* (2017) investigated to know about existing genotype dairy cattle and their performance at Savar Dairy Farm, Dhaka. The existing genotypes of cattle were Local (L), Sahiwal (SL), Fresian (F), Australian Fresian Sahiwal (AFS), Local×Fresian (L×F), Sahiwal×Fresian (SL×F), Local×Friesian×Friesian (LF1×F), Local×Friesian× Friesian×Friesian (LF2×F). In the research work, the highest age at puberty was (1525.58±28.05) day found in AFS. The lowest age at puberty was found (1055.97±11.5) day in LF2×F cow.

2.3.3 Age at First Service

Age at first service (AFS) is the age at which heifers attain body condition and sexual maturity for accepting service for the first time. As some researchers reported that the average age of heifers at first service was 18.96 month (Tadesse *et al.*, 2014), 722.24 days (Lemma *et al.*, 2010), 18.7±3.7 and 18.7±3.5 months old for cross breed cattle reared by the farmers in Bishoftu and Akaki, respectively reported by Genzebu *et al.* (2016).

Belay *et al.* (2012) investigated to know about the productive and reproductive performance of Zebu×Friesian crossbred dairy cows in Jimma Town, Oromia. He reported that the AFS of crossbred dairy cows were 24.30±8.01 month in Jima Town.

Zewdie (2010) studied to livestock production systems in relation with feed availability in the Highland sand Central Rift Valley of Ethiopia. In the studies he found that the age at first service was 27.5 months for crossbred dairy cows.

Khoda *et al.* (2015) conducted to evaluate productive and reproductive performances of crossbred and desi dairy genotypes and to find out possible scope of seed bull production through farmer participatory approach. In the studies the shorted length of age at first service was found in 75% HF (25.86±2.01 months) followed by 50% HF, 62.5% HF, Desi and 50% SL cows having 26.10±1.55, 26.10±1.55, 32.31±0.73 and 33.17±1.42 month, respectively.

2.3.4 Conception Rate

Conception rate (CR) plays a major role to achieve a successful dairy farm. Pregnancy was diagnosed between 60 and 90 days after insemination by rectal palpation at the farmer's house with the help of artificial insemination (AI) technician.

Shohiduzzaman *et al.* (2012) conducted the study to know effect of artificial insemination on conception rate in cows at Mymensingh district in Bangladesh. They found conception rate Local, Sahiwal cross, Friesian cross respectively 56.3%, 55.6% and 47.3%.

Khatun *et al.* (2014) investigated the post AI conception rate in cattle at rajarhat of Kurigram in Bangladesh. He found AI per conception of Local (52.9%) and Friesian cross (62.3%) cows was relatively higher than that of Sahiwal cross (40%).

Miah *et al.* (2004) presented that the experiment was conducted for a period of 1.5 years at the district Artificial Insemination Centre, Sylhet, Bangladesh. He observed the highest conception rate was in the cows which were indigenous local cows (46.1%) of second parity and inseminated by local × Holstein-Friesian cows (44.4%).

Shamsuddin *et al.* (1997) carried out the studied to investigate the fertility related factors at Artificial Insemination in cattle in Bangladesh. The average conception rate of local nondescript and crossbred cows with Holestein-Friesian and Sahiwal breed were 42.5% and 45.2% to 53.1%, respectively.

Howlader *et al.* (2019) studied to observe the conception rate (CR) of dairy cattle following artificial insemination (AI) in Sirajgonj district of Bangladesh. In this study he reported that the CR of local, L×F is 73.98% and 70.02%, respectively.

Gosh (1995) studied to the Economic traits of cross breed cattle in small dairy enterprises of Gazipur district found different breeds of cows LxHF=50%, LxSL= 44%. The reasons for low conception rate in Friesian cross are environment factor, susceptibility, humidity.

2.3.5 Age at First calving

Paul *et al.* (2013) carried out a study to compare the reproductive performance of crossbred and desi cows at farmer's level. This study was conducted among 120 different breed cows at selected areas of Sirajgonj district from March to July 2010. In this study they found that the average age of first calving between Friesian × Desi and Shahiwal × Desi was 32.6 ± 2.3 and 28.0 ± 0.0 months, respectively.

Asaduzzaman and Miah (2004) investigated to know about comparative performance of crossbred and indigenous dairy cows under smallholder dairy farming condition. They found that the age at first calving of Friesian×Desi and Shahiwal×Desi was 36.3 ± 3.1 and 37.3 ± 3.0 months, respectively.

Sarder *et al*. (2001) conducted to evaluate reproductive and productive performance of indigenous cows. In this experiment, the average age at first calving was higher for indigenous dairy cows (37.6±1.3 months) and lower for the Sahiwal×Desi (28.0±1.0 month), and the average age at first calving between crossbred and desi cows differed significantly ($p<0.01$). It was also observed that the intensive management practices reduced the age at first calving

Rokonuzzaman *et al.* (2009) studied to investigate productive and reproductive performances of crossbreds and indigenous dairy cows under small holder farming system. The age at first calving of crossbred cows was almost similar but significantly ($p<0.01$) lower than that of indigenous cow. In this studies age at first calving was found was 34.12±3.78 months in Friesian cross and was 40.48±4.54 months in Indigenous cow.

Famous *et al.* (2021) studied to evaluate productive and reproductive performance of different crossbred dairy cattle at Kishoreganj, Bangladesh. A total of 162 crossbred dairy cows under 3 genotypes were studied on the basis of productive and reproductive performances. They found that the average age at first calving of L×F, L×SL, L×S crossbred cattle were 33.3, 36.3 and 40.3 months, respectively. The highest age at first calving was 40.3 months found in case of L×S crossbred cattle. The lowest age at first calving was 33.3 months and it was for L×F crossbred cattle.

2.3.6 Gestation Period

The gestation period is the time in which a fetus develops, beginning with fertilization ending at birth. Variation in gestation length within the species may be contributed mainly by maternal and fetal factors.

Nahar *et al*. (1992) studied to know the performance of F1 crossbred cows under rural conditions in and around the BAU campus. She reported that the average gestation period of Sahiwal and Holstein crossbred cows were 279.81 and 279.91 days respectively.

Rahman and Rahman (2006) carried out a study to observe the productive and reproductive performance of native cows under farm condition. He found that 286.2±1.5, 279.0.6±0.6, day's gestation length for Local, LF respectively. Rahman demonstrated the gestation length for Sahiwal×Indigenous and Friesian×Indigenous was 281.1 and 282.7 days, respectively.

Sarder *et al*. (2007) investigated to know about consequence of dam genotypes on productive and reproductive performance of dairy cows under the rural condition in Bangladesh. He observed that gestation lengths of Desi, Friesian×Desi and Sahiwal×Desi cows were 279.7, 278.2 and 278.8 days, respectively.

Paul *et al.* (2013) compared the reproductive performance of crossbred and desi cows at farmer's level. This study was conducted among 120 different breed cows at selected areas of Sirajgonj district from March to July 2010. They reported that The average gestation length of Desi, Shahiwal×Desi, Friesian×Desi and Jersey×Desi were 289.9±1.4, 285.0±0.0, 285.0±4.2 and 282.1±2.4 days, respectively.

Miazi *et al.* (2007) studied to know 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. He observed the average gestation length of Local, Sahiwal×Local, Friesian×Local and Jersey×Local was 289.88±1.44, 285.0±0.0, 285.0±4.18 and 282.08±2.42 days, respectively.

2.3.7 Post-partum Heat Period

The time of postpartum first heat is considered as an important economic reproductive trait for profitable dairy farming. The time of post-partum breeding delays up to 60 to 85 days after parturition, when the uterus under goes recovery and preparation for the next conception.

Rokonuzzaman *et al.* (2009) investigate to know productive and reproductive performance of crossbred and indigenous dairy cows under smallholder farming system. He found shortest time of post-partum heat period 6.5±23.7 in LF cow.

Majid *et al.* (1995) carried out the study to know the reproductive performance of pure breed, F1, F2 and F3 cows related at Savar dairy farm. He found longest average postpartum heat period (223.5±40.14 days) in ¼ Local-Friesian crossbred and the lowest (117.24±7.2 days) in ½ Local – ½ Friesian cows at the Central Cattle Breeding and Dairy Farm, Savar.

Kabirand Kisku (2013) conducted a study on reproductive performance of different crossbred cows of Bangladesh. In this study he found that postpartum heat period (135.5±10.58 days) was observed in L×F crossbred cows. He also founded that the longest postpartum heat period (201.7±17.40 days) was found in LF1×F cows.

Khoda *et al.* (2015) evaluated productive and reproductive performances of crossbred and desi dairy genotypes and to find out possible scope of seed bull production through farmer participatory approach. The available dairy genotypes were Desi (D), 50% Holstein Friesian (HF)-50% D (50% HF), 62.5% HF-37.5% D (62.5% HF), 50% Sahiwal (SL)-50% D (50% SL) and H-SL-D. He reported that the shortest post-partum heat period was found in 75% HF (88.95±6.89 days) cows followed by 50%

HF, 62.5% HF, Desi, H-SL-D, 50% SL cows (93.72±5.66, 94.38±7.87, 108.08±7.16, 120.00±28.72, 134.63±16.27 days, respectively.

Hauque *et al.* (2011) carried out a study to evaluate some productive and reproductive performances of different crossbred and indigenous dairy cows. In this study a sample of crossbred and indigenous dairy cows under small holder farming dairy cows were selected randomly. He reported that post-partum heat period of Holstein Friesian cross, Sahiwal cross, Sindhi cross and Indigenous cows were 89.48±28.656, 105.68±41.09, 127.08±43.47 and 119.42±52.10 days respectively.

2.3.8 Calving Interval

Calving interval refers to the period between two consecutive calving and is a function of a day's open and gestation length. Since gestation length is more or less constant for a given breed, the number of days open becomes the sole variable of calving interval.

Mulugeta and Belayneh (2013) found that crossbreds of unknown exotic blood level have 622.6 days calving intervals in Tatesa from Cattle Breeding Center. Another result was reported by Belay *et al.* (2012) in North Showa zone and Jimma Zone indicated that crossbreds of unknown exotic inheritance have calving interval of 660 and 640.8±3.84 days respectively.

Gabriel *et al.* (1983) stated that calving interval of crossbred born form indigenes cows with Holstein Frisian/HF with different exotic blood level of Ari×HF of 50%, 75% and 87.5% have calving interval of 503, 464 and 525 days respectively and crossbred of Zebu ×HF of 50%, 75% and 87.5% have calving interval of 458, 475 and 525 days respectively.

Million and Tadelle (2003) found that as well as crossbred of Borana×HF of 50%, 75% and 87.5% exotic blood level had calving interval of 440, 471 and 493 days respectively and crossbred of Barca×HF of 50%, 75% and 87.5% had calving interval of 415, 474 and 512 days respectively.

Hauque *et al.* (2011) carried out a study to evaluate some productive and reproductive performances of different cross bred and indigenous dairy cows. In this study a sample of cross bred and indigenous dairy cows under small holder farming dairy

cows were selected randomly. He found that Calving intervals of Holstein Friesian cross, Sahiwal cross, Sindhi cross and Indigenous cows were 391.93±33.87, 398.26±42.74, 422.00±42.03 and 422.69±64.15 days, respectively.

Yifat *et al*. (2012) reported that calving interval was shorter in crossbred than indigenous under properly management of animals was practiced.

2.4 Productive Performance of Cow

2.4.1 Birth weight

Birth weight is a weight when new born calves were directly weighed with a balanced within 24 hours after birth. Management system, sex, parity of dam, season of birth, year of birth etc. had effect on birth weight of calves.

Mekonnen *et al.* (2010) studies on genetics and environmental trends in growth performance of Horro and crosses of Holstein Friesian and Jersey cattle breeds. Phenotypic genetics and environmental trends of birth weight (BW) and weaning weight (WW) were considered on data collected from Horro cattle and their crosses during the year 1980-2008. The overall mean predicted breeding value for birth weight 0.11±0.06 kg.

Lemma *et al.*(2010) reported that the mean birth weight of calves was 22.87 kg (SE=0.17) in Wolaitasodo, South Ethiopia. The mean birth weight for male calves was 23.61 kg and that of female was 22.03 kg. Birth weight of calves increased consistently until parity three and then follows irregular trend.

Hundie *et al.* (2013) carried out a research who found mean birth weight 18.2 ±2.03 kg Horro-Jersey crossbred calves.

Rokonuzzaman *et al.* (2009) conducted a study to know productive and reproductive performance of crossbred and indigenous dairy cows under smallholder farming system. He reported that the birth weight of Local, Local×Friesian, were 17.0±0.4 and 22.5±0.3 kg respectively.

Saha *et al.* (2008) compared between the reproductive and productive performance of different crossbred dairy dews at Government Dairy Farm. He found that the mean value of birth weight of F × L crossbred cows was 24.95 ±5.83 Kg.

Islam *et al.* (2017) investigated to know about existing genotype dairy cattle and their performance at Savar Dairy Farm, Dhaka. The existing genotypes of cattle were Local (L), Sahiwal (SL), Fresian (F), Australian Fresian Sahiwal (AFS), Local×Fresian (L×F), Sahiwal×Fresian (SL×F), Local×Friesian×Friesian (LF1×F), Local×Friesian× Friesian×Friesian (LF2×F). Maximum birth weight was found in case of Fresian (37.5 ± 0.65 kg); minimum in Local (16.7±0.48 kg).

Demeke *et al.* (2003) stated that birth weight was significantly affected by breed of calf and birth year; a crossbred calf (Fogera×Friesian) was 23.5 kg heavier than Fogera calves and calves born in 2002 were heavier than those calves born in 2003. The effect of breed might be because of the heterosis effect.

2.4.2 Daily Milk Yield

Abaye *et al.* (1991) investigated that indigenous breed of cows are generally considered low milk producers. However, they are the major source of milk in Ethiopia that account for 97 % of the total milk production in the country.

Tadesse *et al.* (2014) stated that the average milk yield reported in Dabra Tabor town was 12 litter, 9.75 litter, and 8 litters for the first, second and third stage of lactations, respectively with an overall average of 9.91 liters per day/cows. The milk production was significantly decreased in third than first and second stage of lactation. The milk production was decreased with the advanced of lactation stage.

Saha *et al.* (2008) compared between the reproductive and productive performance of different crossbred dairy dews at Government Dairy Farm. He found that, the daily milk yield mean 12.54±3.50 litters for HF×L crossbred cows.

Uddin *et al.* (2008) conducted to compare the productive and reproductive performance of indigenous and crossbred cow likely Friesian, Sahiwal and Sindhi cross. A total of 180 dairy cows were selected randomly from four upazilas of Comilla district. He was observed that mean milk yield and lactation length of indigenous, Friesian cross, Sahiwal cross and Sindhi cross were 2.35±0.04, 7.36±0.11, 4.78±0.08 and 4.03±0.05 litre/day and 218.22±8.35, 284.69±1.64, 251.77±3.66 and 259.77±4.91 days respectively. It reveals that the Friesian cross is the best performer in relation to milk production and lactation length.

Rahman *et al.* (2017) carried out the study to evaluate the productive and reproductive performance of crossbred and local cows at farmer's level in Manikgonj district. All cows were divided into three groups, according to their genetic composition as Local, Local×Friesian and Local×Friesian×Friesian cows. In this study the lowest average milk production (2.25±0.04 L/day) in local cows. On the contrary highest average milk production (7.45±0.11 L/day) was observed in LFF cows.

Miazi *et al.* (2007) studied to know 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. He founded that the average daily milk production of Local, Sahiwal×Local, Friesian×Local and Jersey×Local dairy cows was 2.26±0.19, 4.9±0.95, 6.0±1.0 and 5.71±0.87 liter respectively.

Lemma *et al.* (2005) reported that the average milk yield of local Arsi cows was 1.0 liter/head/day. For Fogera cattle the overall average estimate lactation yield was 506.78 liters, which is very low due to poor genetic make-up and shortage of feed and poor management conditions (Mulugeta, 2005).

Azage and Alemu (1997) found that milk production per day per head is very low and this is further affected by relatively short lactation length and extended post-partum anestrus resulting in low production efficiencies.

2.4.3 Lactation Length

Lactation length refers to the time of period from when a cow starts to secrete milk after parturition to the time of drying off. A lactation period of 305 days is recommended to take advantage of 60 days dry period.

According to CSA (1996), an average lactation length of cows in private holding ragged from 5-7 months. The mean±SD lactation length of cross breed cows was reported 276.6±35.1 days, 280.7±19.3 days, respectively (Genzebu *et al.*, 2016).

Mulugeta and Belayneh (2013) conducted a study in North Showa zone indicated that local breeds (273.9 days) had shorter lactation length than crossbreds (333.9 days).

Gabriel *et al.* (1983) found that lactation length of crossbred of different indigenous cows with Holstein Frisian with different exotic blood level of Ari×HF of 50%, 75% and 87.5% have lactation length of 334, 408 and 411 days respectively and crossbred of Zebu×HF of 50%, 75% and 87.5% have lactation length of 378, 378 and 411 days respectively.

Million and Tadelle (2003) conducted a study who reported that crossbred of Borana×HF of 50%, 75% and 87.5% have lactation length of 1740, 2044 and 1902 L respectively. As their statements as exotic blood level is increased all reproductive and productive trait performance of crossbred were increased until 75% exotic blood level and then it shows turn down.

Hasan (1995) investigated to know about the distribution pattern and some economic dairy characters of locals and crossbred cows in Mymensingh Sadar. He reported the average lactation period of Holstein, Sahiwal crosses were 272 and 262 days respectively.

Khan (1990) carried out the study on the reproductive efficiency of native and crossbred cows. He reported that lactation length of Desi and Friesian × Desi cross were 221 and 281 days, respectively. He also reported that the average lactation period of Pabna, Sindhi cross and Sahiwal cross were 200, 251 and 282 days, respectively.

Sultana *et al.* (2001) compared between productive and reproductive performance of different crossbred and indigenous dairy cows under small scale dairy farm condition. She found that the lactation length of Desi, Friesian×Desicross and Sahiwal×Desi cows were 221, 287.5 and 254 days, respectively.

CHAPTER III
MATERIALS AND METHODS

The present study was done under the Department of Animal Nutrition, Genetics and Breeding, Sher-e Bangla Agricultural University (SAU), Dhaka-1207, entitled "Productive and reproductive performance of indigenous and crossbreed cows bred artificially in Gobindaganj upazila of Gaibandha district". Materials and methods followed during the course of the study have been mentioned in this chapter under the heads and sub-heads as follows.

3.1 Study area

This study was investigated at different places in Gobindaganj upazila of Gaibandha district. At northern part of Bangladesh Gaibandha district is situated. Gobindaganj upazila of Gaibandha district under Rangpur division experiences a hot, wet and humid tropical climate. It is one of the largest upazila in Bangladesh including 17 unions and 1 municipality. The economy of Gobindaganj upazila is mainly depends upon agriculture and livestock based production. The area was selected for the study purpose due to the following criteria:

i. No study of this type was conducted previously in this area.
ii. A large number of crossbred and indigenous dairy cows were raised in this area.
iii. A lot of farmers in the area adopt government and non-government Artificial Insemination (AI) for their cattle.
iv. The study area was well communicated which would help the research in collection necessary data easily.
v. Co-operation from the respondents were expected to be high, so that the reliable data would be obtained.

Figure 1: Map of the study area in Gobindaganj upazila.

3.2 Study population

The regular breeding cattle including breeds like as cross of Holstein Friesian, cross of Sahiwal and also indigenous breed's population. The ages of the cows were different. Regular cyclic cows were evaluated for this study. Cows were divided into three genetic groups according to their genetic composition, such as Indigenous cows (I; n=20), Friesian cross (F×I; n=45) and Sahiwal cross (SL×I; n=35).

3.3 Animal management and selection

Gobindaganj upazila of Gaibandha district is known as hot, wet and humid tropical climate. Most of the animals were reared under extensive management system in these areas. In this system cows are allowed to feed from naturally available feeds in day time and kept in confinement in night time. Most of farmers kept their cows beside their living room. Only at winter season farmer provide bedding materials such as rice straw, rice husk or dry tree leaves to their animal. Some farmers made house with bamboo sheet for their animals. Sometimes the cows were tethered by rope and allowed to graze. During rainy season they provide some green grass which was

cutting from road side. In village some farmers cultivated Napier, German and Maize for their cow beside their home. The cattle management system is small scale dairy with traditional crop-based farming system. The feeding practice is 'cut and carry system' where indigenous grass is obtained from various places and carried back to the housed animals. Common supplements are rice polish, wheat bran, oilcake and household residue were also used in daily basis but their supply to animals are low, irregular and restricted mostly to milking cows. Farmers take close observation of their cow during pregnancy and calf after birth. The common breeds are indigenous and their crosses with Holstein-Friesian and Sahiwal. The frozen semen was brought from Central Cattle Breeding and Dairy Farm (CCBDF), Savar, Dhaka. The indigenous and crossbreed cows will be selected on the basis of conception through AI. Some farmers are not eager for proper treatment to their cows. When they faced disease, they provide treatment. The biosecurity was not maintained strictly in village. Few farmers provide some vaccination and anthelminthic drug for their cows.

3.4 Artificial insemination in the study area

For about fifty years, the artificial insemination (AI) technique has been used in Bangladesh and every year this program is extended. Using AI, the productive and reproductive performances of our cattle population have improved day by day in the study area. Many government and private organizations provide semen of improved cattle varieties to the farmers. By adapting AI, there would be a considerable reduction in both genital and non-genital disease in the cattle population. So, the farmers are economically benefited by rearing dairy cows through AI in Gobindaganj upazila.

3.5 Preparation of questionnaire

The questionnaire was developed in accordance with objectives of the study.

i) General identification and information of the selected dairy cow owners:

a) Name of the owner b) Name of the village c) Age, Gender, Occupation etc.

ii) Productive and reproductive traits of indigenous and crossbred cows such as:

a) Age at puberty (m) b) Age at first service (m) c) Age at first calving (m) d) Service per conception (no.) e) Gestation period (d) f) Post-partum heat period (d) g) Calving

interval (d) h) Conception rate (%) (d) i) Birth weight of calves (kg) j) Daily milk production (l) k) Lactation length (d)

3.6 Study period and data collection

Data collection for the study was conducted through door to door visit at farmer's house during July 2021 to December 2021. Data were collected through previously prepared interview schedule. The questionnaire include both open and closed question to collect data with view to objectives of this study. Each respondent was given a brief description about the nature and purpose of the study. The questions were asked in a very simple manner with explanation where necessary and the responses were recorded directly on the survey schedule. The farmers under the study areas maintained the dairy cows under traditional management system.

3.7 Parameters of the study

To evaluate the productive and reproductive performance of cows the following parameters were considered for the study.

3.7.1 Productive traits

3.7.1.1 Birth weight of calves (kg)

It is the first weight of young animal, taken just after being born and recorded in the data sheet.

3.7.1.2 Daily milk yield (l)

The amount of milk produces per day per cow throughout the lactation period and recorded in liter per day.

3.7.1.3 Lactation period (d)

It is defined as the period from calving to dry off of the cow which is recorded in the data sheet in days.

3.7.2 Reproductive traits

3.7.2.1 Age at puberty (m)

The period when an animal produced mature fertile ova, which is recorded in the data sheet for analysis in month.

3.7.2.2 Age at first service (m)

It indicates the age at when heifers attain body condition and sexual maturity for accepting service for the first time which is recorded in month.

3.7.2.3 Age at first calving (m)

It indicates the age when a cow give birth a calf for first time which was recorded in month.

3.7.2.4 Service per conception (no.)

The average number of services required for conception in a defined population. It is used as a measurement of reproductive efficiency in cows and recorded in the data sheet.

3.7.2.5 Conception rate (%)

Pregnancy was diagnosed between 60 and 90 days after insemination by rectal palpation at the farmer's house with the help of artificial insemination (AI) technician. The equation used to calculate the Conception rate (%) of cows:

$$\text{Conception rate (\%)} = \frac{\text{Number of cows/heifer pregnant}}{\text{Number of cows/heifer inseminated}} \times 100$$

3.7.2.6 Gestation length (d)

The period of intra-uterine development of embryo and fetus was considered as gestation length. It was calculated as the interval from fertile service to parturition. The duration of gestation was determined in days.

3.7.2.7 Post-partum heat period (d)

Time of post-partum heat 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.

3.7.2.8 Calving interval (d)

The interval between the dates of one calving to the dates of next calving is known as calving interval. The calving intervals were recorded in days.

3.8 Statistical analysis

The collected data was compiled, tabulated and analyzed in accordance with the objectives of the study. The data were subjected to statistical analysis and compute analysis of variance and means of each variance with standard error (SE) according to Steel & Torrie (1980). For meaningful comparison, turkey test and ANOVA were performed with SPSS (26 version).

Figure 2: Some pictorial view during data collection

CHAPTER IV
RESULTS AND DISCUSSION

The study was conducted in different places in Gobindaganj upazila of Gaibandha district of Bangladesh from January 2021 to December 2021 to know the productive and reproductive performance of indigenous and crossbred cows bred artificially at village condition. The works include three breed such as Friesian cross (Friesian×Indigenous), Sahiwal cross (Sahiwal×Indigenous) and Indigenous (I). Experimental data for this study were collected from some village areas such as Darbasta, Mahimaganj, Gumaniganj, Kamdia, Shakhahar of Gobindaganj upazila in Gaibandha district. This chapter represents the results obtained from the present study according to the objectives have been presented and discussed in this chapter.

Table 1: Reproductive performances of indigenous and crossbred dairy cows.

Breed (♂ × ♀) / Reproductive Trait	Friesian cross (F×I) Mean ± SE n=45	Sahiwal cross (SL×I) Mean ± SE n=35	Indigenous (I) Mean ± SE n=20	Level of Significance
Age at puberty (m)	20.77^{c}±0.10	23.91^{b}±0.09	25.58^{a}±0.11	*
Age at first service (m)	22.65^{c}±0.22	24.88^{b}±0.08	27.08^{a}±0.11	*
Age at first calving (m)	31.95^{c}±0.30	34.04^{b}±0.08	37.01^{a}±0.34	*
Service per conception (no.)	1.40±0.10	1.56±0.13	1.20±0.09	NS
Conception rate (%)	56.92^{ab}±1.98	51.26^{b}±2.00	62.72^{a}±1.11	*
Gestation period (d)	278.44^{b}±0.97	280.84^{b}±0.92	284.30^{a}±1.08	*
Post-partum heat period (d)	93.80^{b}±1.06	111.96^{a}±1.09	113.95^{a}±1.84	*
Calving interval (d)	404.20^{c}±2.31	423.88^{b}±2.73	453.30^{a}±2.91	*

In a row, values having the same superscripts under each breed do not differ significantly whereas values with dissimilar superscripts differed significantly.
* = Significant at 5% (P< 0.05) level of significance, NS= Non-significant.
Here, I= Indigenous, F= Friesian and SL= Sahiwal

Table 2: Productive performances of indigenous and crossbred dairy cows.

Breed (♂ × ♀) / Productive Trait	Friesian cross (F×I) Mean ± SE n=45	Sahiwal cross (SL×I) Mean ± SE n=35	Indigenous (I) Mean ± SE n=20	Level of Significance
Birth weight of calves (kg)	25.08^{a}±0.58	21.80^{b}±0.91	13.55^{c}±0.98	*
Daily milk yield (l)	13.44^{a}±0.54	5.86^{b}±0.21	2.30^{c}±0.12	*
Lactation length (D)	287.72^{a}±2.52	255.20^{b}±2.45	229.3^{c}±2.52	*

In a row, values having the same superscripts under each breed do not differ significantly whereas values with dissimilar superscripts differed significantly.
* = Significant at 5% (P< 0.05) level of significance, NS= Non-significant.

4.1 Age at puberty in different breed

Average age at puberty of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) cows were 20.77±0.10, 23.91±0.09, and 25.58±0.11 month, respectively are presented in Figure 1. There is a significant (P< 0.05) effect on age at puberty among the three breeds (Table 1). From the result highest age at puberty was found in Indigenous (25.58±0.11 month) and the lowest value was observed in Friesian cross (20.77±0.10 month). Here F×I cross exhibited the better results from others.

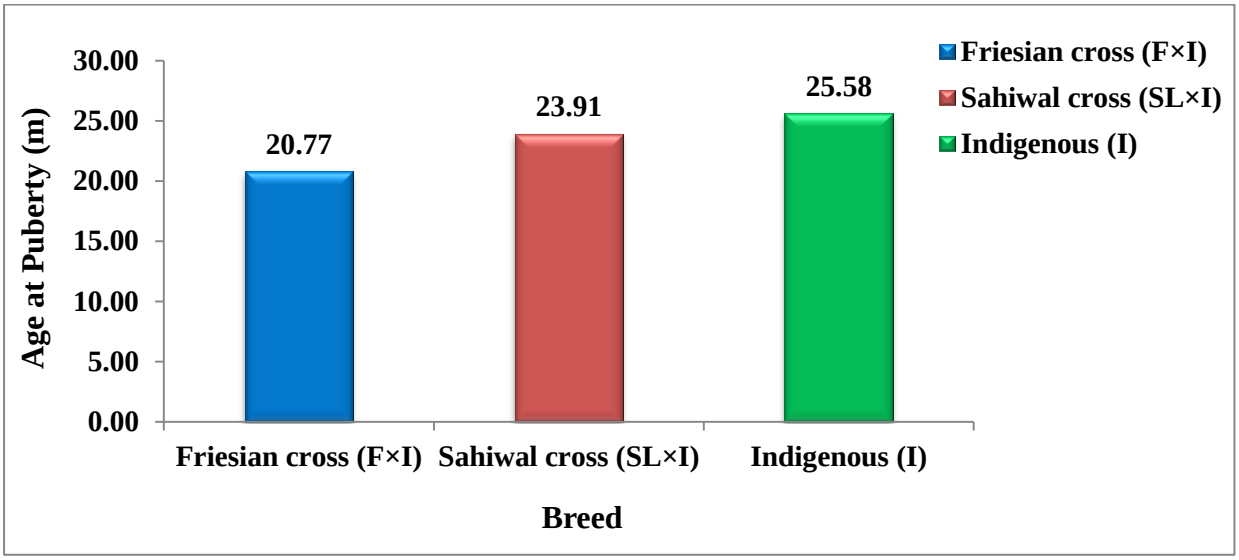

Figure 3: Age at puberty (m) in different breed of dairy cows

These findings were agreed with Uddin *et al.* (2008) who found that, age at puberty of Indigenous and Friesian cross cows were 24.17±7.74 and 22.08±2.52 month, respectively. Kabir and Islam (2009) also found the differences between crossbred

and indigenous cows which were significant (P<0.01). The age at puberty of Indigenous and Holstein×Indigenous were 26.62±1.58 and 21.16±3.40 month, respectively and these results are closely similar with my study. Sultana *et al.* (2001) who revealed that the ages at puberty of Desi, Friesian×Desi cross cows were 25.20 and 21.40 month, respectively and these results are also similar the present study. Other findings reported those ages at puberty of Local, Friesian×Local cross cows were 25.92±1.08 and 20.6±2.10 month, respectively (Miazi *et al.,* 2007). In the present study F×I cross reached puberty earlier than other genetic groups of like Indigenous and SL×I. This might be due to higher nutritional status the animals that are reared in abundance of green grass good management system those progenies get early puberty which is one of the main demands of dairy farmer from his herd. Environment proper care also plays a vital role in getting puberty earlier. Finally, genetic makeup is the main factor influencing the trait.

4.2 Age at first service in different breed

Age at first service indicate the beginning of the heifer's reproduction and production, also influences both productive and reproductive life of the female through its effect on her life time calf yield. From the present study average age at first service (month) of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) cows were found 22.65 ±0.22, 24.88±0.08 and 27.08±0.11 month, respectively are showed in Figure 4. There was a significant difference (P<0.05) between indigenous and crossbred cows on this trait (Table 1). Maximum value of age at first service was 27.08±0.11 month found in indigenous cows, on contrary minimum value 22.65 ±0.22 month was recorded from F×I cross. Age at first service is the age at which heifers attain body condition and sexual maturity for accepting service for the first time. So findings say that F×I cross are superior as they gaining early maturity than other breeds. Famous *et al.* (2021) found that the mean value of age at first service of F×I crossbred cows was 24.20±1.10 month which are almost similar to present study. Average age at first service for the Local and Local×Friesian were 29.48±0.51 and 24.64±0.33 month found by Islam *et al.* (2016) which are more or less similar with the study. Beside this Sarder and Hossain (2001) stated that age at first service was 30.30±0.7 month for the indigenous cows which are higher from present study.

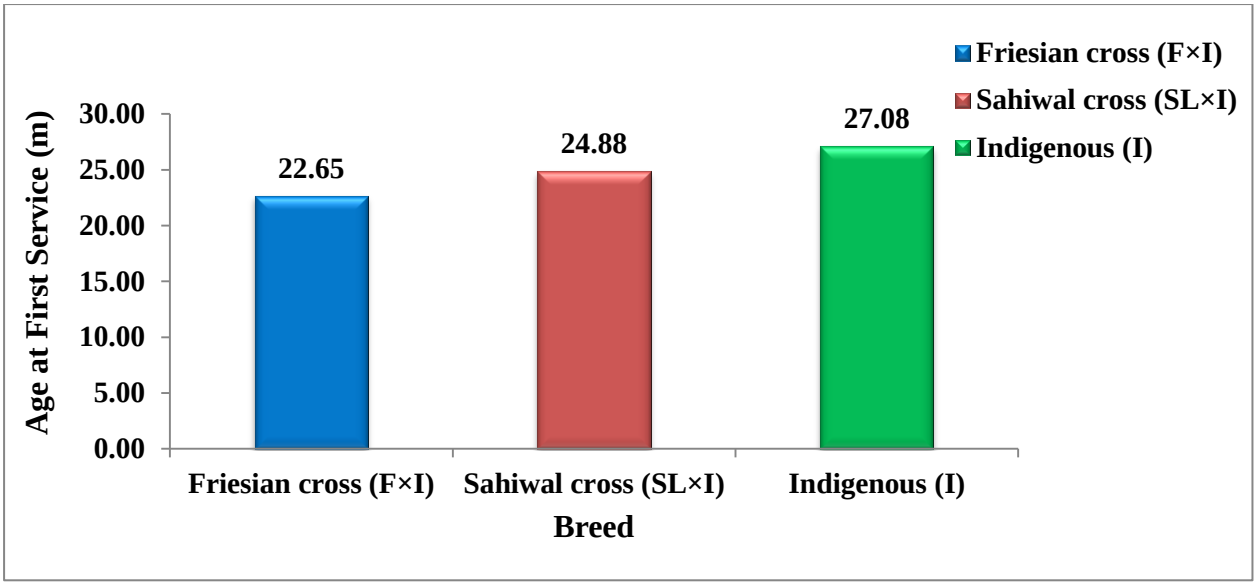

Figure 4: Age at first service (m) in different breed of dairy cows

There is a difference between age at first heat and age at first service that indicates farmers' are intentionally escaping to serve at first at least for two or three estrous. Age at first service is influenced by genotype, feeding practice, nutrition and other environmental factors (Zewdie, 2010).

4.3 Age at first calving in different breed

The beginning of productive life of heifer is called age at first calving. Average age at first calving of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) cows were found 31.95±0.30, 34.04±0.08, and 37.01±0.34 month, respectively are presented in Figure 5. There was a significant difference ($P< 0.05$) age at first calving among the three breeds (Table 1). The results revealed that highest age at first calving was found in Indigenous (37.01±0.34 month) and the lowest value (31.95±0.30 month) was observed in Friesian cross. It determines that early calving date is the beginning of the cow's productive life and influences her life time productivity. That's why the obtained results showed that Holstein cross is relatively better performer than other breeds. Paul *et al.* (2013) stated that the average age at first calving of Desi and Friesian×Desi were 37.36 ± 1.1 and 32.6±2.3 month, respectively and similar findings also found by Omar *et al.* (2007). This consequence is more or less similar in this conducted study.

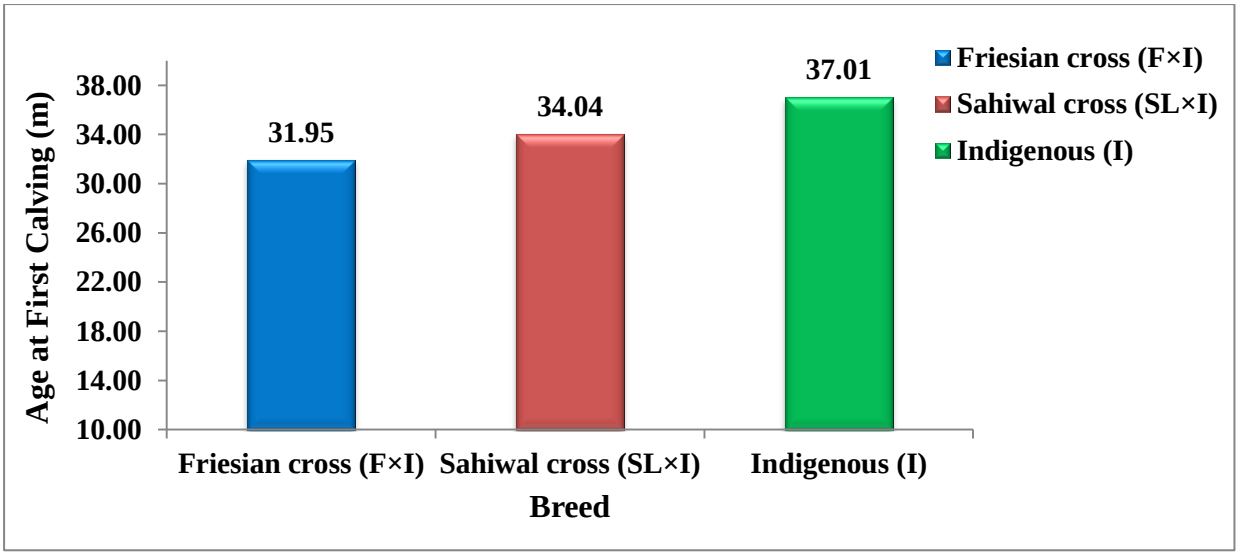

Figure 5: Age at first calving (m) in different breed of dairy cows

Another research describe that the mean value of age at first calving of indigenous cow was 36.85±2.87 month (Ali *et al.*, 2000) which are almost similar to present study. Findings from Islam *et al.* (2009) on age of first calving were 40.51±4.5 and 34.10±3.8 month in L and L×F, which is differ from the study might be due to management and environmental factors. Age at first calving is an important economic trait of cattle having bearing on life time production, generation interval and genetic gain. Early age at first calving may increase profit, reduce generation interval and help in enhancing genetic gain per unit time.

4.4 Service per conception in different breed

In this study the average number of service is required per conception were 1.40±0.10, 1.56 ± 0.13 and 1.20±0.9 for Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) cows, respectively displayed in Figure 6. In case of service per conception no significant difference ($p<0.05$) was found between Indigenous and crossbred cows (Table 1). Indigenous cows were required minimum (1.20±0.09) number of insemination per conception whereas Sahiwal cross needed to maximum (1.56±0.13) number of insemination per conception. Service per conception means the number of services or insemination required per conception. About this reproductive characteristics every test breeds were showed more or less similar performance. Number of AI per conception required for L×F and L cows was 1.40±0.09 and 1.36±0.08, respectively (Rahman *et al.*, 2017) and these result are closely agree with this study. Miazi *et al.* (2007) found that the AI per conception of

Local, Friesian×Local cross cows were 1.32±0.13, 1.60±0.24 respectively and these findings also nearly similar to present study. The variation of service per conception might be influenced by breed, body weight, nutrition, semen quality, time of insemination, skill of the AI worker and poor fertility of cows. It could be due to difference in service number for lack in quality and quantity of the semen used during artificial insemination, lack of proper heat detection and time of insemination of the cows as well as lower husbandry practices.

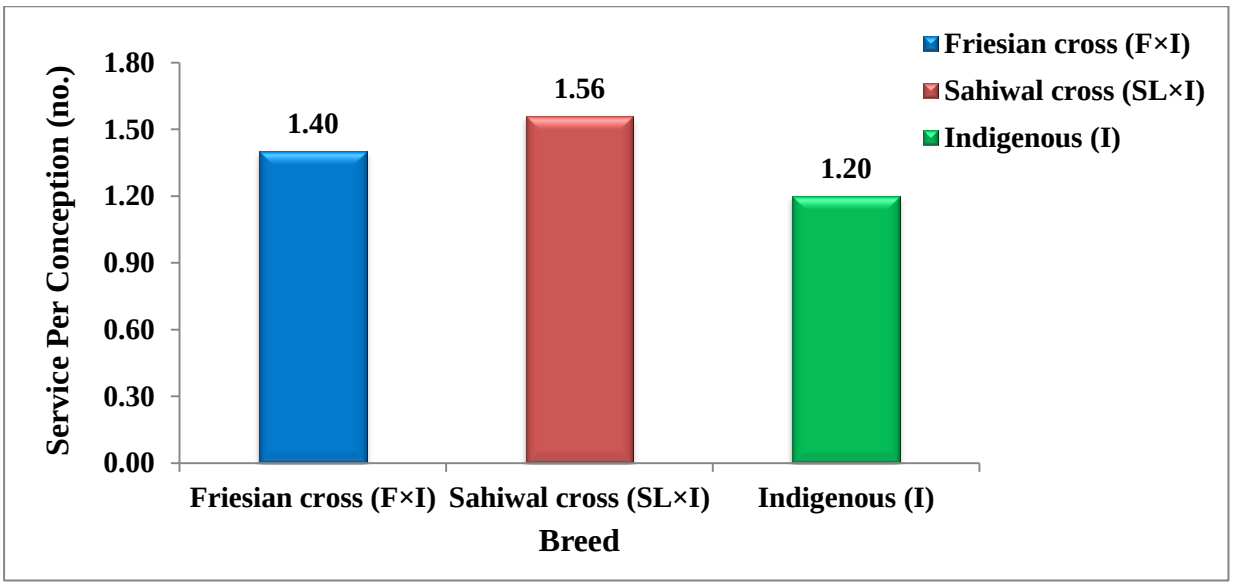

Figure 6: Service per conception (no.) in different breed of dairy cows

4.5 Conception rate in different breed

Conception rate is the most prominent indicator of the reproductive performance of a dairy cow. Findings from this present study the average percentage of conception rate of Friesian cross (F×I), Sahiwal cross (SL×I) and indigenous (I) cows were observed 56.92±1.98, 51.26±2.00 and 62.72±1.11, respectively showed in Figure 7. A significant difference ($p<0.05$) was found on conception rate among the three test breeds (Table 1). The highest conception rate was found in Indigenous (I) cows (62.72%), whereas lowest value was observed in case of Sahiwal cross cows (51.26%). Khan *et al.* (2015) found the conception rate of Local, Friesian and Sahiwal were 63.8, 57.1 and 52.6%, respectively and these results are more or less similar with this study. Khatun *et al.* (2014) observed that the AI per conception of Local (52.9%) and Friesian cross (62.3%) and Sahiwal cross (40%) that was lower than from the present findings.

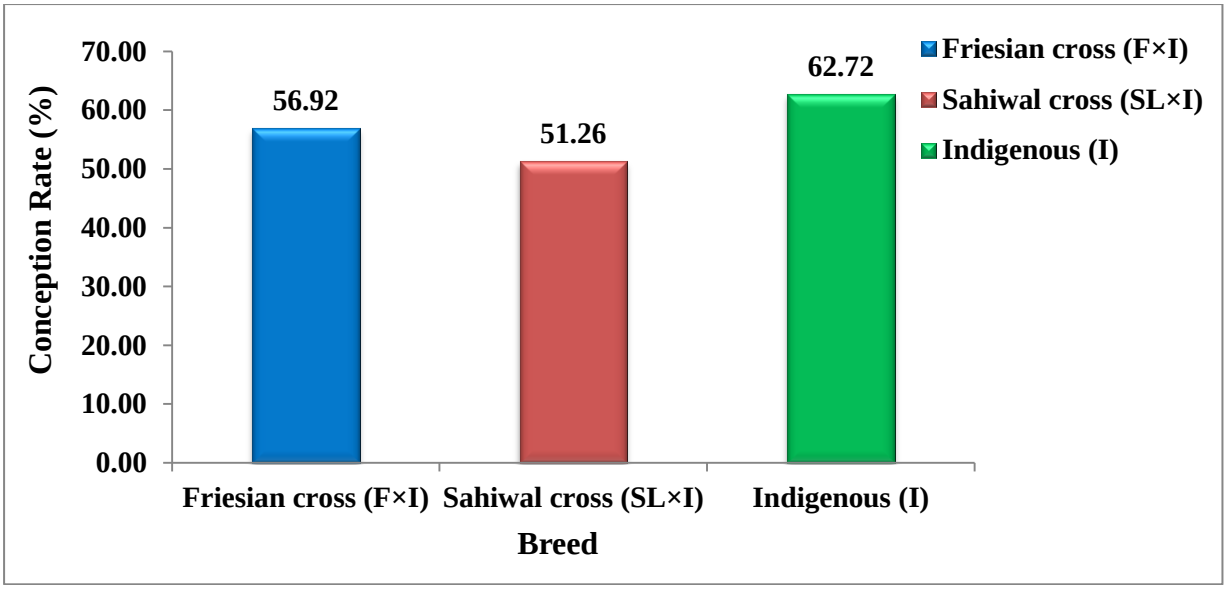

Figure 7: Conception rate (%) in different breed of dairy cows

Howlader *et al.* (2019) observed the conception rate of dairy cattle following artificial insemination and he reported that the conception rate of Local, Local×Friesian were 73.98%, 70.02%, respectively that was higher than from this study. Any of these factors viz age of cow, skill of technician, age of semen, interval from calving to insemination and the breeding value of the sire might affect the conception rate (Visser *et al*., 1988).

4.6 Gestation period in different breed

Average gestation period of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) cows were found 278.44±.97, 280.84±.92, and 284.30±1.08 days, respectively are given in Figure 8. There also a significant difference ($P< 0.05$) on gestation period among the three breeds (Table 1). From the result longest gestation period was found in Indigenous (284.30±1.08 days) and the shortest period was observed in Friesian cross (278.44±.97 days). Above outcomes indicate that period of gestation of all breed are closely similar but statistically dissimilar. Gestation period is more or less constant for every genotype which varying slightly due to breed, calf sex, litter size, dam age and month of calving and little can be done to significantly manipulate the gestation length (Fikirie *et al.*, 2007). Rahman *et al.* (2016) who found that the gestation period of Local and Local x Friesian were 286±2.0 and 279±4.0 days, respectively and these results are fall in with the present study. Another study reported that the gestation period of Indigenous and Holstein cross were 281±2.31 and

279±3.85 days, respectively (Islam *et al.*, 2014) and these result is closely parallel to this study. Variation in gestation length within the species might be contributed by maternal and fetal factors. The maternal factors include age of the dam, nutritional status and body condition of the dam. Fetal factors include the sex of the fetus, twinning and hormonal functions of the fetus besides environment such as season, feeding and management also contribute to some extent (Hafez, 1993).

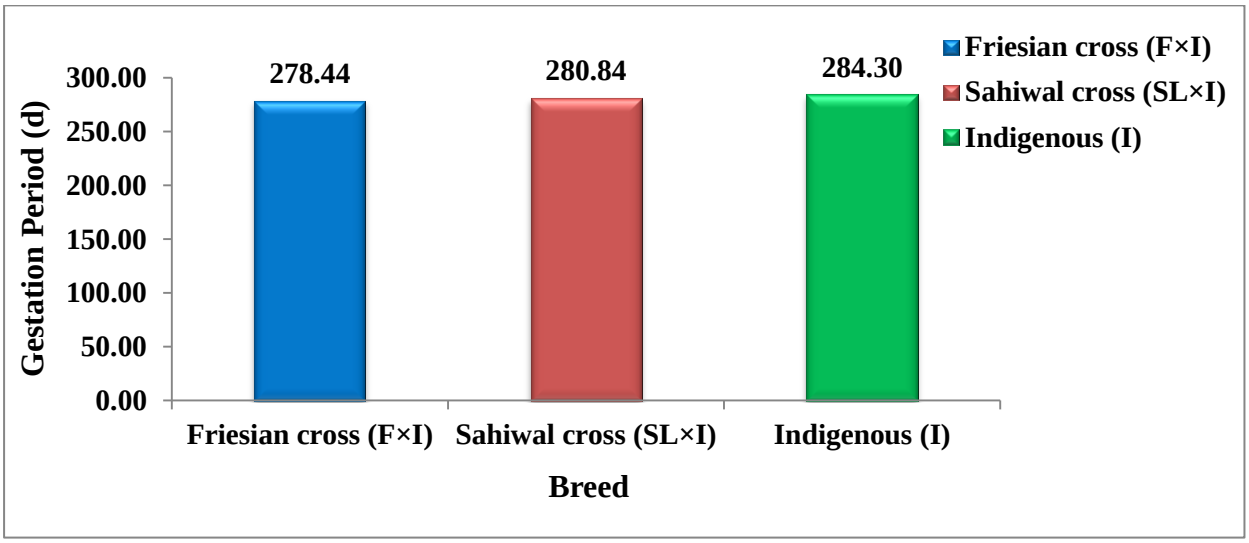

Figure 8: Gestation period (d) in different breed of dairy cows

4.7 Post-partum heat period in different breed

Figure 9 represents the post-partum heat period of three test genotype. It is a very important period after calving to next heat that determine the conception of cow. Average post-partum heat period of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) cows were found 93.80±1.06, 111.96±1.09 and 113.95±1.84 days, respectively. There is a significant variance ($p<0.05$) of post-partum heat period among the studied breed (Table 1). The results indicated that longest post-partum heat period was found in Indigenous (113.95±1.84 days) and the shortest period of post-partum heat was observed in Friesian cross (93.80±1.06 days). This result supported to the findings of Paul *et al.* (2013), who found that the average post-partum heat period of Desi, Friesian × Desi was 102 ± 8.7, 90.0 ± 13.42 days, respectively. Hauque *et al.* (2011) reported that the average post-partum heat periods of Friesian cross, Indigenous cows were 89.48±28.65 and 119.42±52.10 days respectively and both values were found significantly different. These findings are closely similar with the current study. Belay *et al.* (2012) found 125 days of post-partum heat period for Friesian × zebu cattle which is disagree with the output of this study. The length of

post-partum heat period might be influenced by nutrition, body condition, age, genetics, daily milk yields and presence of the calf. Physiologic and metabolic factors such as breed, nutritional status, lactation length, suckling frequency etc. are responsible for variation in post-partum heat period.

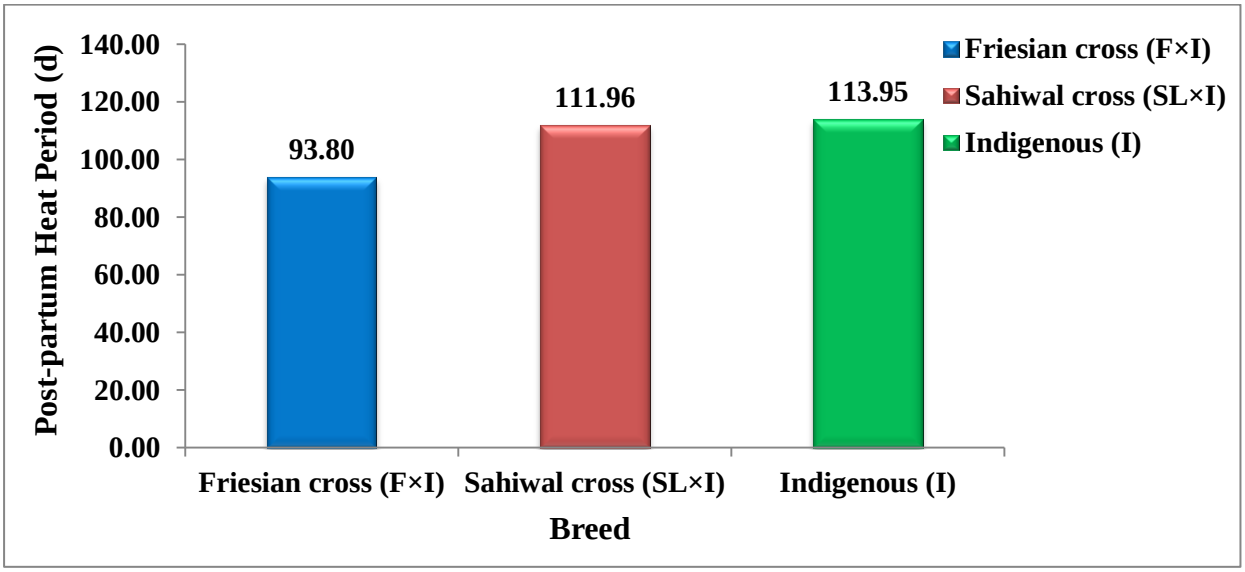

Figure 9: Post-partum heat period (d) in different breed of dairy cows

4.8 Calving interval in different breed

Calving interval is the most important indicator of the reproductive performance of a dairy cow. Findings from this study the average duration of calving interval of Friesian cross (F×I), Sahiwal cross (SL×I) and indigenous (I) cows were 404.20±2.31, 423.88±2.73 and 453.30±2.91 days, respectively showed in Figure 10. A significant difference ($p<0.05$) was found in calving interval among three breeds (Table 1). The lowest calving interval was found in F×I cows (404.20±2.31 days) but the highest calving interval was observed in indigenous cows (453.30±1.84 days). So findings says that F×I cows are superior as their shortest duration of calving interval than other breeds. Uddin *et al.* (2008) stated that, the calving interval of Indigenous, Friesian cross cows were found 472.55±69.17, 413.77±53.87 days, respectively. These result almost similar with this study. Calving interval of Desi cows were observed 415.00±5.00 days (Al-amin and Nahar, 2007), and 418.78±36.74 days (Islam *et al.*, 2002) which is more or less similar to present study. Famous *et al.* (2021) found that the mean value of calving interval of F×I crossbred cows was 410±10 days which are almost similar to present study. Calving interval reported to 50% HF-50% D cross cow was 411.0±0.40 days (Khoda *et al.*, 2015). These findings fall in with present

study. A part from heredity one of causes of long calving interval in Indigenous cows is that they were poorly fed and managed by low input farmers in contrast to that of F×I cow (Mulugeta and Belayeneh, 2013).

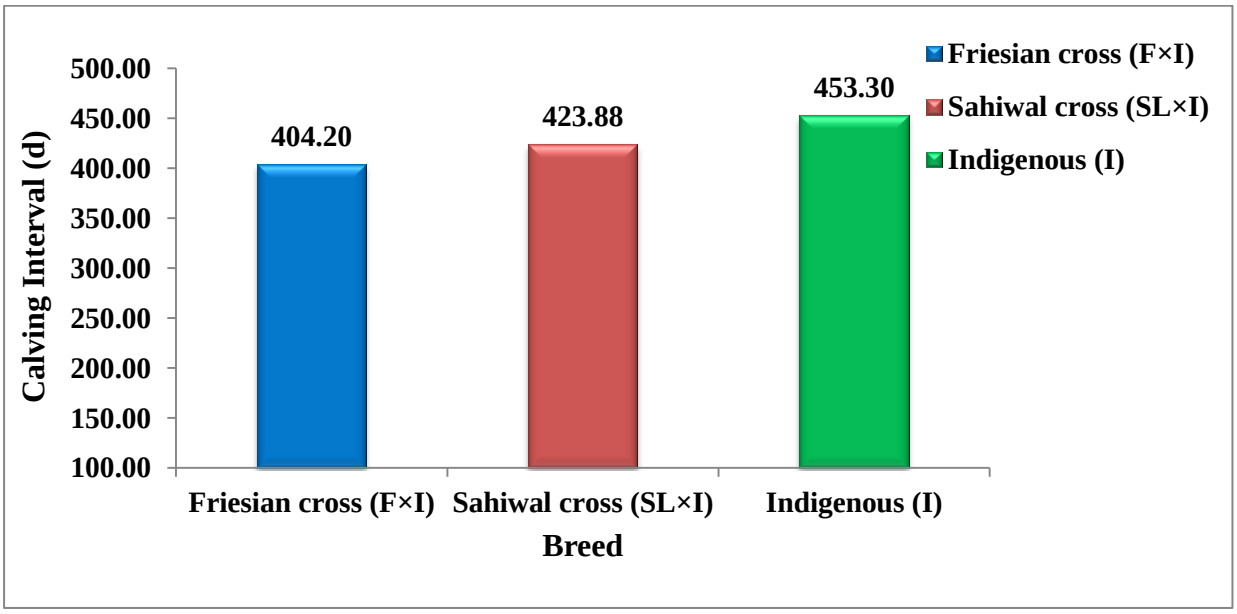

Figure 10: Calving interval (d) in different breed of dairy cows

4.9 Birth weight of calves in different breed

In this study the average birth weight of calves of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) dairy cows were found 25.08±0.58, 21.80±0.91 and 13.55±0.98 kg, respectively are presented in Figure 11. Among three breeds there is a significant difference ($P<0.05$) on birth weight of calves (Table 2). The results stated that highest birth weight of calves (25.08±0.58 kg) was observed for Friesian cross calves, whereas lowest birth weight of calves (13.55±0.98 kg) was found in Indigenous (I). Crossbred of F×I found superior as their maximum birth weight of calves than other breeds. Results of the present study has close agreement with the work of Kabir and Islam (2009) who found that the average birth weight of calves of Friesian cross was 24.1±1.73 kg and the birth weight of indigenous was 14.30±0.06 kg found by Rahman *et al.* (2017) which is slightly closer this study. Mean value of birth weight of F×L crossbred cows was 24.95±5.83 kg recorded by Saha *et al.* (2008). Birth weight of calves of Local, Local x Friesian were found 17.0±0.4 and 22.5±0.3 kg, respectively (Islam *et al.*, 2009) which is slightly differ with the results of this study. Birth weight of calves variation occurred due to the breed factor,

management factor, maintenance, hereditary factor, feeding practice and physiological status followed in this selected areas of present study.

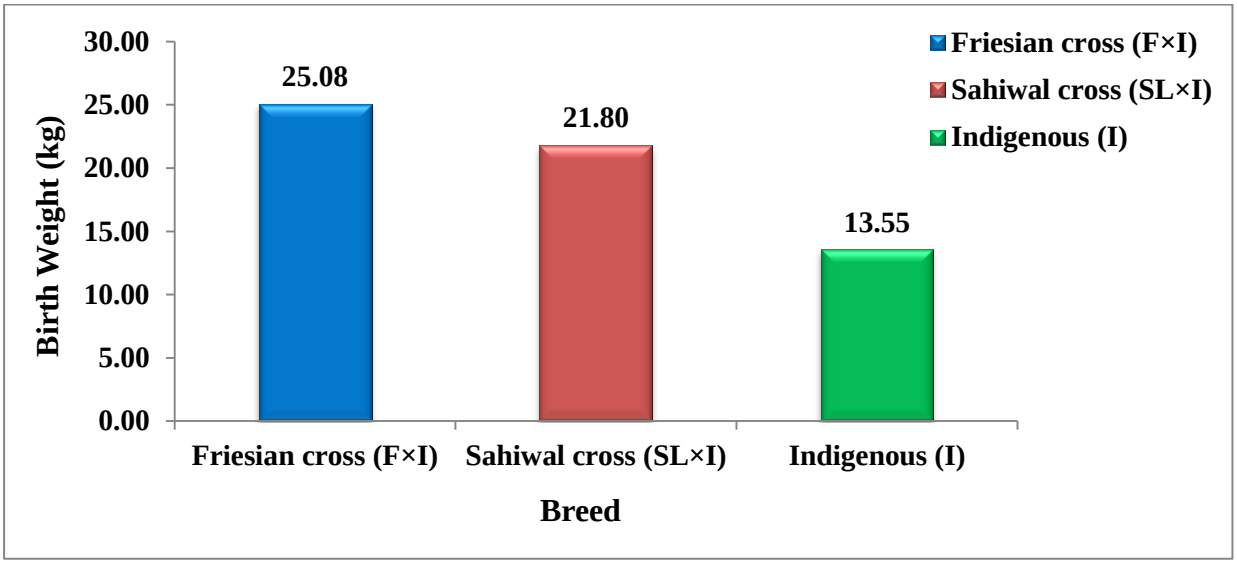

Figure 11: Birth weight of calves (kg) in different breed of dairy cows

4.10 Daily milk yield in different breed

Figure 12 represents the daily milk yield of three test genotype. The most important economical characters of a lactating cow is milk yield which is a combination of milk yield and lactation length. Average daily milk yield of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) dairy cows were recorded 13.44±0.54, 5.86±0.21 and 2.3±0.12 liter, respectively. Significant difference ($p<0.05$) were found on daily milk yield between two crossbred Friesian cross, Sahiwal cross and indigenous cows (Table 2). In this study highest milk yield per day (13.44±0.54 liter) was recorded in Friesian crossbred followed by lowest yield value (2.3±0.12 liter) was found in indigenous cows. From the above result it is clear that the F×I cross cows are more superior in milk production purpose than other breed. Famous *et al.* (2021) found that the average milk yield per day or F×I, I×SL crossbred cattle were 13.9±0.73, 6.3±1.01 liter, respectively and these results are closely similar with the present study. Nearly similar results were found for indigenous cows 2.10±0.41 liter (Kabir and Islam, 2009), 2.38±0.73 liter (Rokonuzzaman *et al.*, 2009), 2.26±0.19 liter (Faruk *et al.*, 2007), respectively. Alam *et al.* (2008) reported that indigenous cows are produced 1.63±0.72 liter of milk per day respectively; which are below from the present study. Another findings (2.63±0.38 liter) is that recorded from indigenous cows (Sultana *et al.*, 2001), which are above to the present study.

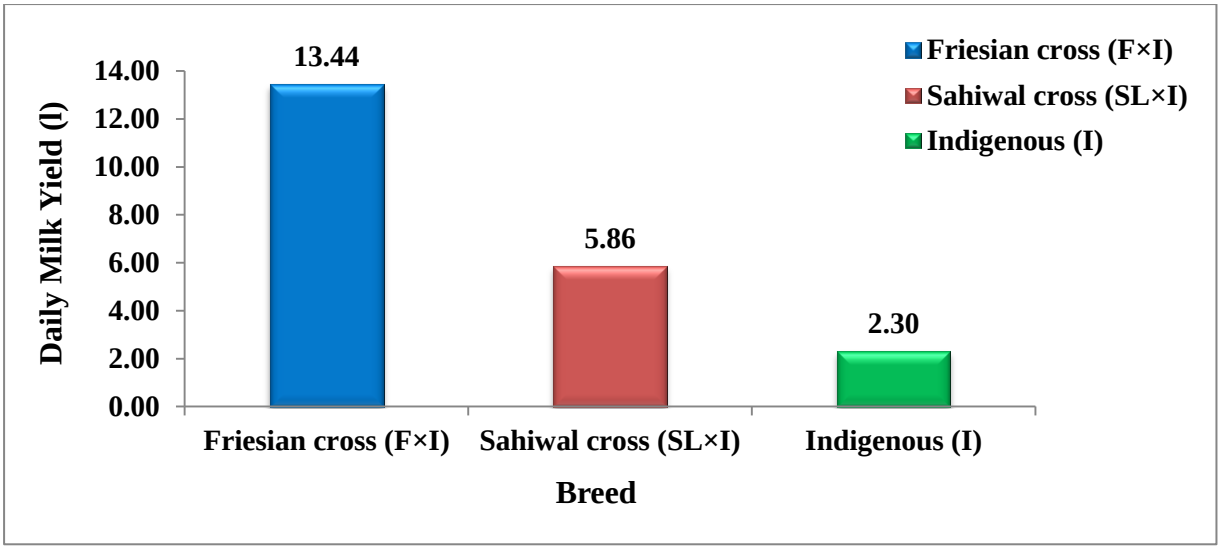

Figure 12: Daily milk yield (l) in different breed of dairy cows

The daily milk yield variation possibly occurred due to following factors viz genetic, biological phenomenon, hormonal influences, feeding system, quality and quantity of feed, irresponsible care taker and severe intensive sun light and overall management. Milk yield is highly heritable, as cows produce more milk either by using ingested food or by mobilizing body fat (Schei *et. al.*, 2005).

4.11 Lactation length in different breed

Lactation length is an important production trait as it influences the total milk yield by a cow. Average lactation length of Friesian cross (F×I), Sahiwal cross (SL×I) and Indigenous (I) cows were observed 287.72±2.52, 255.2±2.45, and 229.3±2.52 days, respectively are showed in Figure 13. A significant difference ($p<0.05$) was found in lactation length among Friesian cross (F×I), Sahiwal cross (I×SL) and indigenous (I) cows presented in Table 2. In this results higher lactation length (287.72±2.52 days) was recoded in Friesian cross cow, on contrary lower length (229.3±2.52 days) of lactation length was found in Indigenous cow. In the majority of improved dairy farms, a lactation length of 305 days usually accepted as a benchmark. This standard allows for calving every 12 months with a 60 day dry period. It could be stated that the F×I cross cows are better performer in case of long time milk production than other breed. Paul *et al.* (2013) found that the average lactation length of Friesian×Desi, Sahiwal×Desi and Desi were 270.0±0.0, 234.0±24.2 and 235.4±7.0 days respectively and these results are lower from the present study.

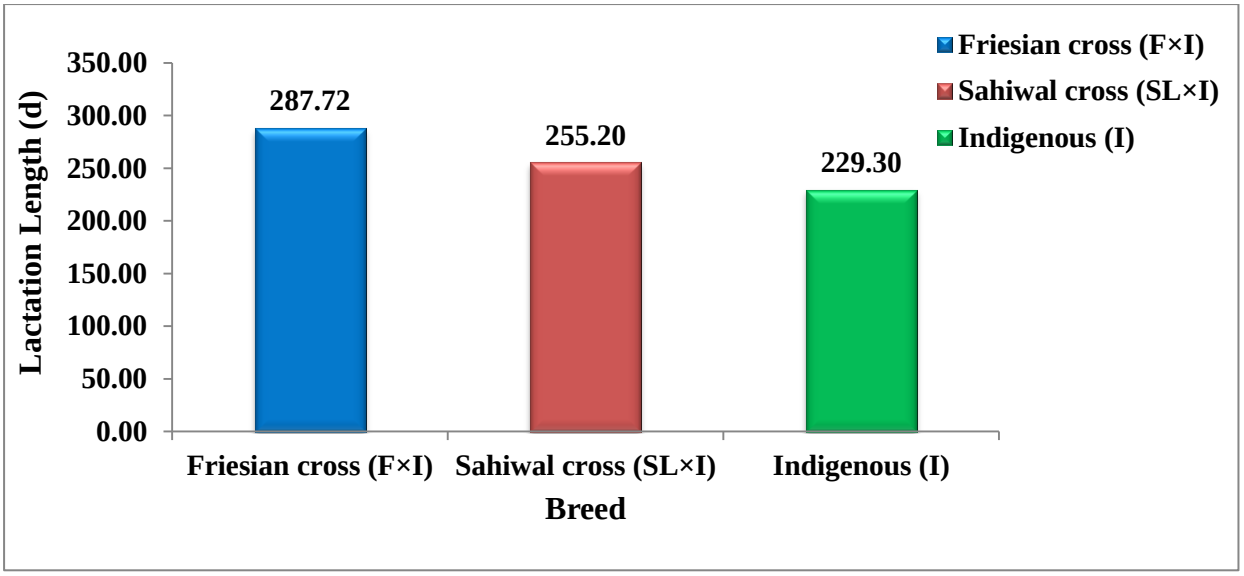

Figure 13: Lactation length (d) in different breed of dairy cows

Another finding revealed that average lactation length of Friesian cross, Sahiwal cross and indigenous cows were 284.69±1.64, 251.77±3.66, 251.77±3.66 and 218.22±8.35 days respectively (Uddin *et al.,* 2008), these results have closely similar with the present study. Kabir and Islam (2009), Rokonuzzaman *et al.* (2009), Alam *et al.* (2008), found that lactation length of indigenous cows 170.0±22.36, 227.8±32.50, and 217.9±17.65 days respectively; which values are similarly close to the present study. Variations of lactation length in different crossbred might be influenced by disease occurrence, managemental system, feeding, housing and nutritional supplement of cows.

CHAPTER V

SUMMARY AND CONCLUSION

This study was conducted at different places in Gobindaganj upazila of Gaibandha district from January 2021 to December 2021. The objective of this study was to evaluate the productive and reproductive performance of indigenous and crossbreed cows through artificial insemination in the area. A study was conducted at farmer's level in different areas of selected location. Total of 100 dairy cows were examined across three genotypes which are Friesian cross (F×I=45), Sahiwal cross (SL×I=35) and Indigenous (I=20). Data were collected on the basis of different productive and reproductive traits viz, Age at puberty, Age at first service, Age at first calving, Service per conception, Conception rate, Gestation period, Post-partum heat period, Calving interval, Birth weight of calves, Daily milk production and Lactation length.

There was a significant ($P< 0.05$) effect on age at puberty among the three breeds. From the result lowest value of age at puberty was observed in Friesian cross (20.77±0.10 month). There also a significant difference ($P<0.05$) between indigenous and crossbred cows on age at first service. In cage of at age first service minimum value 22.65±0.22 was recorded from Friesian cross cow. A significant difference ($p<0.05$) was found on age at first calving among the three selected breeds. The lowest age at first calving was found in Friesian cross (31.95±0.30 month). In case of service per conception no significant difference ($p<0.05$) was found between Indigenous and crossbred cows. Lowest number of service per conception was required for indigenous (I) cows. A significant difference ($p<0.05$) was found on conception rate among the three test breeds. Highest conception rate was found in Indigenous (I) cows (62.72%). There also a significant difference ($P< 0.05$) on gestation period among the three breeds. But period of gestation for all breed are closely similar but statistically dissimilar. From the result the shortest period was observed in Friesian cross (278.44±.97 days). There was a significant variance ($p<0.05$) of post-partum heat period among the studied breed. The results indicated the shortest period of post-partum heat was observed in Friesian cross (93.80±1.06 days). A significant difference ($p<0.05$) was found in calving interval among test breeds. Findings from this study the lowest calving interval was found in Friesian cows (404.20±2.31 days). Among three breeds there was a significant difference

(P<0.05) on birth weight of calves. The results stated that highest birth weight of calves (25.08±0.58 kg) was observed in Friesian cross calves. In this current study significant difference (p<0.05) were found on daily milk yield between two crossbred Friesian cross, Sahiwal cross and indigenous cows. The highest milk yield per day (13.44±0.54 liter) was recorded in Friesian crossbred. The lactation length was recorded in different breeds under the study. A significant difference (p<0.05) was found in lactation length among Friesian cross, Sahiwal cross and indigenous (I) cows. In this results higher lactation length (287.72±2.52 days) was recorded in Friesian cross cow.

The crossbred cattle performed better than that of native cattle in terms of adaptability and production. So, it is necessary to improve native cattle by selective breeding through AI to increase the productive and reproductive performance. Results of this study showed productive and reproductive performances viz, the shortest gestation length and calving interval, lowest age at first service, the longest lactation period and the highest amount of milk yield were better in Friesian cross (F×I) cows. However, the production potentials not only attributed with the genetic makeup of a cow, but also have an interaction with environment or variation of management. Considering the above findings it is concluded that Friesian crossbred (F×I) cows seemed to be more suitable for sustainable and profitable dairy farming under village context in the study area.

Recommendation

Friesian cross (F×I) cows could be profitable for dairy farming under rural condition of Gobindaganj upazila. Providing proper management and care we can get better output of the productive traits of Friesian cross in village condition. The existing AI services should be extended to solve the breeding problem and the facilities of AI centre and sub centre should be improved. Training and awareness creation should be given to the farmers to increase the production of indigenous and crossbred dairy cattle.

REFERENCES

Abaye, T., Tefera, G.M., Alemu, G.W., Beruk, Y. and Philip, C. (1991). Status of dairying in Ethiopia and strategies for future development. pp 91-104. In the proceeding of the 3rd Annual Livestock improvement Conference, 24-26 May 1989, IAR (Institute of Agricultural Research), Addis Ababa, Ethiopia.

Ahmed, A.M., El-Saied, U.S., El-Asheeri, K.A., El-Wardani, M.A. and Barkawi, A.H. (2000). Effect of heat detection in buffaloes on length of service period and herd profitability. *Egypt. J. Anim. Prod.* 37: 67-76.

Alam, M.G.S and Gosh, A. (1988). Reproductive Performance in Cows: its Relation to Pairity and Season. *Bangladesh Vet. Journal*. 22: 51-56.

Al-Amin, M., Nahar, A., Bhuiyan, A.K.F.H. and Faruque, M.O. (2007). On farm characterization and present status of North Bengal Grey (NBG) cattle in Bangladesh. AGRI. 40: 55-64.

Alam, M.M., Sarder, M.J.U., Ferdousi, Z. and Rahman, M.M. (2008). Productive and reproductive performance of dairy cattle in Char areas of Bangladesh. *The Bangladesh Vet.* 25(2): 68-74.

Al-Amin, M. and Nahar, A. (2007). Productive and Reproductive Performance of Non-descript (Local) and Crossbred Dairy Cows in Costal Area of Bangladesh. *Asian Journal of Animal and Veterinary Advances.* 2(1): 46- 49.

Ali, A.K., Al-Seaf, A.M., Alshaikh, M.A., Alkiadess, M.S. and Al-Haidary, A. (2003). Effect of non-genetic factors on lactation cure of Holstein Friesian cows in Saudi Arabia. *J. King Saud Univ.* 15: 115-124.

Ali, M.H., Miah, A.G., Ali, M.L.U., Salma, Khan, M.A.S. and Islam, M.N. (2000). A Comparative Study on the Performance of Crossbred and Indigenous (Zebu) Cows under the Small Holder Dairy Farming Condition in Gaibandha District. *Pak. J. Biol. Sci.* 3(6): 1080-1082.

Alpan, O. (1994). Breeding and feeding of cattle. Ph.D. thesis, Selcuk University, the Institute for Health Sciences, Ankara, Konya, Turkey, pp. 5-57.

Asaduzzaman, M and Miah, G. (2004). A comparative performance of crossbred and indigenous dairy cows under smallholder dairy farming condition. *J. Agri. and Rural Development.* 7: 12-18.

Azage, T. and Alemu, G. W. (1997). Prospect for per-urban dairy development in Ethiopia. pp 28-39. Fifth national conference of Ethiopian Society of Animal Production, Addis Ababa, Ethiopia, 15-17 may. Research Report No. 11.

Azage, T., Lahlou-Kassi, A. and Mukassa-Mugrwa, E. (1995). Biotechnology in animal production. Development Opportunities in Livestock Agriculture. Proceedings of the Second Annual Conference of the Ethiopian Society of Animal Production, 26-27 May, Addis Ababa, Ethiopia. pp. 49-80.

Azizunnesa, S., Hasanuzzaman, M., Miazi, O.F., Aktaruzzaman, M. and Faruk, M.O. (2010). Study on the Productive and Reproductive Performances of Red Chittagong Cow at rural areas in Chittagong. *Univ. J. Zool. Rajs. Univ.* 28: 27-31.

Bearden, H.J., Fuquary, J.W. and Willard, S.T. (2004). Applied Animal Reproduction. 6th ed. Mississippi State University. Pearson, Prentice Hall. Upper Saddle River, New Jersey 07458. Pp. 155-233.

Belay, D., Yisehak K. and Janssens, G.P.J. (2012). Productive and Reproductive Performance of Zebu X Holstein-Friesian Crossbred Dairy Cows in Jimma Town, Oromia. *Ethiopia Global Veterinaria.* 8(1): 67-72.

BER. (2022). Bangladesh Economic Review, Chapter 7. Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

Bhuiyan, A.K.F.H. (2006). Proven bull production for dairy cattle development in Bangladesh. Seminar Paper, BIAM Foundation.

Bormann, J.M., Totir, L.R., Kachman, S.D., Fernando, R.L. and Wilson, D.E. (2006). Pregnancy rate and first-service conception rate in Angus heifers. *J. Anim. Sci.* 84: 2022-2025.

Cilek, S. and Tekin, M.E. (2005). The environmental factors effecting milk yield and fertility traits of Simmental cattle rose at Kazova State Farm and phenotypic correlations between these traits. *Turk. J. Vet. Anim. Sci.* 29: 987-993.

CSA (Central Statistical Authority). (1996). Livestock resource and production statistics in Ethiopia. In: CSA 2012/13. Agricultural sample survey. Report on livestock and livestock characteristics. The Federal Democratic republic of Ethiopia, Central Statistical Agency (CSA). Private Peasant Holdings. Statistical Bulletin 570, Addis Ababa, Ethiopia, April, 2013.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois, C. (2009). Livestock to 2020: The next food revolution. Publ. IFPRI, Washington, USA.

Demeke, S., Neser, F.W.C. and Schoeman, S.J. (2003). Early growth performance of Bos Taurus x Bosindicus cattle crosses in Ethiopia: Evaluation of different crossbreeding models. *J. Anim. Breed. Genet.* 120: 39-50.

Dinka, H. (2012). Reproductive performance of crossbred dairy cows under small holder condition in Ethiopia. *Int. J. Livest. Prod.* 3 (3): 25-28.

DLS. (2008). Annual Report, Department of Livestock Services, Ministry of Fisheries and Livestock, Government of the People's Republic of Bangladesh.

DLS. (2022). Annual Report, Department of Livestock Services, Ministry of Fisheries and Livestock, Government of the People's Republic of Bangladesh.

Famous, M., Aditya, A.C., Ahmed, S. and Sutradhar, S. (2021). Productive and reproductive performance of different crossbred dairy cattle at Kishoreganj, Bangladesh. *Res. Vet. Sci.* 7(1): 69-76.

Faruk, O.M., Emran, M.H. and Hassan, M.M. (2007). Productive and reproductive performance of crossbred and indigenous dairy cows under rural conditions in Comilla, Bangladesh. *Univ. J. Zoo. Raj*. 26: 67-70.

Ferguson, J.D., Blanchard, D.T., Galligan, D.C., Hoshall, T. and Chalupa, W. (1996). Infertility in dairy cattle fed a high percentage of protein degradable in the rumen. *J. Am. Vet. Med. Assoc.* 192: 659- 662.

Fikirie, L., Merga, B.H. and Kindahl, H. (2007). Longitudinal observation on reproductive and lactation performances of smallholder crossbred dairy cattle in Fitche, Oromia region, central Ethiopia. *Trop. Anim. Health Prod.* 39: 395-403.

Foote, R. H. (2002). The history of artificial insemination: Selected notes and notables. *J. Anim. Sci.* 80: 1-10.

Gabriel, H.K., John, C.M., Trail, M.Y., Kurtu, G.W., Frank, M.A. and Jeffrey. D. (1983). Crossbred dairy cattle productivity in Arsi Region, Ethiopia. ILCA Research Report No. 11.

Gautam, G. and Khadka, U. (2022). Reproductive and Productive Performance of Crossbred and Terai Cattle in Bardiya District of Nepal. *J. Nep. Agric. Res. Counc.* 8: 64-71 .

Genzebu, D., Tamir, B. and Berhane, G. (2016). Study of Reproductive and Production Performance of Cross Breed Dairy Cattle under Smallholders Management System in Bishoftu and Akaki Towns. *Int. J. Adv. Res. Biol. Sci.* 3(2): 151-157.

Ghosh, D.K. (1995). Economic traits of cross breed cattle in small dairy enterprises of Gazipur district. Msc Thesis, Department of Physiology, Bangladesh Agricultural University, Mymensingh.

Hafez, E.S.E. (1993). Reproduction in Farm Animals, 6th edition, Lea & Febiger, Philadelphia. pp. 165-166.

Hasan, M.M. (1995). Distribution pattern and some economic dairy characters of locals and crossbred cows in Mymensingh Sadar, M.S. Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Hauque, M., Jahan, M., Rahman, M.M., Islam, J. and Ahmad, N. (2011). A Comparative Study on Some Productive and Reproductive Performances of Different Cross Bred and Indigenous Dairy Cows in Satkhira District. *Bangladesh Vet. J.* 45(1-4): 1-10.

Howlader, M.M.R., Rahman, M.M., Hossain, M.G. and Hai, M.A. (2019). Factors Affecting Conception Rate of Dairy Cows Following Artificial Insemination in Selected Area at Sirajgonj District of Bangladesh. *Biomed. J. Sci. & Tech. Res.* 13(2). BJSTR. MS.ID.002386.

Hundie, D., Beyene, F. and Duguma, G. (2013). Early Growth and Reproductive Performances of Horro Cattle and their F1 Jersey Crosses in and around Horro-Guduru Livestock Production and Research Center, Ethiopia. *Bako Agricultural Research Center*. 2(3): 134-141.

Islam, A., Ahmed, A., Hasan, B.M.T., Islam, M., Shuvo, S., Islam, M.A., Rahman , M.R., Hossain, M.M. and Islam, K.M. (2017). Productive and Reproductive performance of different breed and crossbreds dairy cattle at Central Cattle Breeding and Dairy Farm, Savar, Dhaka, Bangladesh. *Int. J. Nat. Sci.* 6(3): 148-153.

Islam, S., Sultana, S., Rokonuzzaman, M. and Hassan, M.R. (2009). Productive and reproductive performance of crossbred and indigenous dairy cows under smallholder farming system. *J. Bang. Agri. Univ.* 7: 69–72.

Islam, M.A., Sarder, M.J.U., Jahan, S.S. and Islam, M.H. (2016). Evaluate the Productive and Reproductive Performance Considering Genotypes of Dairy Cows. *Int. J. Food Sci. Nutr.* 5(6): 10-15.

Islam, M.T., Shoshe, N.Z., Islam, M.T., Howlader, M.M.R. and Islam, M.S. (2014). Evaluation of productive and reproductive performances of indigenous and crossbred dairy cows at sylhet district in Bangladesh. *J. Sylhet Agril. Univ.* 1(2): 155-159.

Islam, M.N., Islam, M.N., Rahman, M.M. and Faruque, S. (2002). Reproductive performance of different crossbred and indigenous dairy cattle under small holder farming condition in Bangladesh. *Online J. of Biological Sci.* 2(4): 205-207.

Jabbar, M. A. and Ali, I.Z. (1988). The limitation of cross breeding for improvement of cattle in Bangladesh. *Oxford Agrarian Studies.* 17: 29-56.

Jainudeen, M.R. and Hafez, E.S.E. (2000). Reproductive failure in females. Reproduction in farm animals, 7th edition reproductive failure. pp 294-322.

Kabir, F. and Kisku, J.J. (2013). Reproductive performance of different crossbred cows of Bangladesh. *Afr. J. of Agric. Res.* 8(9): 723-726.

Kabir, F. and Islam, M.R. (2009). Comparative study on productive and reproductive performance of local and different crossbred dairy cows at Daulatpur, Khulna in Bangladesh. *Bangladesh Res. Publ. J.* 3(2): 909-914.

Kellogg, D.W., Pennington, J.A., Johnson, Z.B. and Panivivat, R. (2001). Survey of management practices used for the highest producing DHI herds in the United States. *J. Dairy Sci.* 84: 120-127.

Khan, A.A. (1990). A comparative study on the reproductive efficiency of native and crossbred cows. M.S. Thesis, Department of Dairy Science. Bangladesh Agricultural University, Mymensingh.

Khan, M.R.K. (2008). Post Artificial Insemination conception rate at Bangladesh Agricultural University Veterinary Clinic. M.S. Thesis, Department of Surgery And Obstetrics. Bangladesh Agricultural University, Mymensingh.

Khan, M.R.K., Uddin, J. and Gofur, M.R. (2015). Effect of age, parity and breed on conception rate and number of service per conception in artificially inseminated cows. *Bangladesh livestock J.* 1: 1-4

Khatun, M.A., Bari1, F.Y., Shah Alam, M., Ali, M.R. and Sarkar, P.K. (2014). Post ai conception rate in cattle at rajarhat of Kurigram in Bangladesh, *Wayamba J. Anim. Sci.* ISSN: 2012-578X; 845-854.

Khoda, M.S., Sarker, N.R., Bhuiyan, A.K.F.H. and Bhuiyan M.S.A. (2015). Evaluation of productive and reproductive performances of crossbred and Deshi dairy genotypes in Bangladesh. *Intl. J. of Nat. and Soc. Sci.* 2(4): 06-13.

Kiwuwa, G.H., Trail, J.C., Kurtu, M.Y., Worku, G.M., Anderson, F.M. and Durkin, J. (1983). Crossbred dairy cattle productivity in Arsi Region, Ethiopia.

International Livestock center for Africa (ILCA). Research report No. 11: 1-29.

Kumar, N., Eshetie, A., Gebrekidan, B. and Gurmu, E.B. (2014). Reproductive performance of indigenous and HF crossbred dairy cows in Gondar, Ethiopia. *IOSR J. Agric. Vet. Sci.* 7(1): 56-61.

Lemma, F, Fekadu, B. and Hegde, P.B. (2005). Rural smallholder milk and dairy products reproductive performance in dairy cows. *J. of Dairy Sci.* 76: 3257-3268.

Lemma, H., Belihu, K. and Sheferaw, D. (2010). Study on the reproductive performance of Jersey cows at WolaitaSodo dairy farm, Southern Ethiopia. *Ethiop. Vet. J.* 14(1): 53-70.

Lobago, F., Bekana, M., Gustafsson, H. and Kindahl, H. (2007). Longitudinal observation on reproductive and lactation performances of smallholder crossbred dairy cattle in Fitche, Oromia region, central Ethiopia. *Trop. Anim. Health Prod.* 39: 395-403.

Majid, M., Nahar, T.N., Talukder, A.I. and Rahman, M.A. (1995). Reproductive performance of pure breed, F1, F2 and F3 cows related at Savar Dairy Farm. *Bangladesh J. Livs. Res.* 2: 53-62.

Mekonnen, T., Bekana, M. and Abayneh, T. (2010). Reproductive performance and efficiency of artificial insemination smallholder dairy cows/heifers in and around Arsi-Negelle, Ethiopia. *Livestock Research for Rural Development*. 22: 3-7.

Miah, A.G., Salma, U. and Hossain, M.M. (2004). The production and characterization of monoclonal antibodies specific for cattle proinsulin using a sensitive microdot assay procedure. *Endocrinology,* 113: 2135-2144.

Miazi, O.F., Hossain, M.E. and Hassan, M.M. (2007). Productive and reproductive performance of crossbred and indigenous Dairy cows under rural conditions in Comilla. Bangladesh. *Univ. j. zool. Rajshahi Univ.* 26: 67-70.

Million, T. and Tadelle, D. (2003). Milk production performance of Zebu, Holstein Friesian and their crosses in Ethiopia. *Livestock research for rural development.* 15: 1-9

Mpofu, N. And Rege, J. (2002). Monitoring of sahiwal and Friesian cattle genetic improvement programs in kenya. in: Ojango J M, Malmfors B, Okeyo a (eds.) animal genetics training resource, version 2, 2006. Nairobi, Kenya: international livestock research institute; Uppsala, Sweden: Swedish university of agricultural sciences, pp. 35-44.

Mukasa-Mugerwa, E. (1989). A review of reproductive performance of the Female Bos-indicus (zebu) cattle. International Livestock Centre for Africa (ILCA). Monograph no. 6p. 134.

Mulugeta, A. (2005). Characterization of dairy production systems of Yerer watershed Adalibebworeda, Oromia region, Ethiopia. MSc Thesis. Dra Dawa, Ethiopia.

Mulugeta, A. and Belayeneh, A. (2013). Reproductive and lactation performances of dairy cows in Chacha Town and nearby selected kebeles, North Shoa Zone, Amhara Region, Ethiopia. *World J. of Agric. Sci.* 1(1): 8-17.

Nahar, T.N., Islam, M. and Hasanath, M.A. (1992). A comparative study on the performance of F1 crossbred cows under rural conditions in and around the BAU campus. *Asian-Australasian J. Anim. Sci.* 5(3): 435-438.

Noakes, D.E., Parkinson, T.J. and England, G.C.W. (2001). Veterinary reproduction and obstetrics (8th edition).

Omar, F.M., Hossain, M.E. and Hassan, M.M. (2007). Productive and reproductive performance of crossbred and indigenous dairy cows under rural conditions in Comilla, Bangladesh. *Univ. J. Zoo. Raj.* 26: 67-70.

Paul, A.K., Alam, M.G.S. and Shamsuddin, M. (2011). Factors that limit first service pregnancy rate in cows at char management of Bangladesh. *Livestock Res. Rural Dev.* 23(3): Article 57.

Paul, A.K., Maruf, A.A., Jha, P.K. and Alam, G.S. (2013). Reproductive Performance of Crossbred and Indigenous (Desi) Dairy Cows under Rural Context at Sirajgonj District of Bangladesh. *J. Emb. Trans.* 28(4): 319-324.

Philipsson, J., Eriksson, J.A. and Stalhammar, H. (2005). Know-how transfer in animal breeding the power of integrated cow databases for farmer's selection of bulls to improve functional traits in dairy cows. In: knowledge transfer in cattle husbandry. EAAP publication 117.

Rahman, M. and Rahman, M.M. (2006). Productive and reproductive performance of native cows under farm condition. *Asian J. Anim. Vet. Adv.* 1: 13-17.

Rahman, M.H., Ali, M.Y., Juyena, N.S. and Bari, F.Y. (2017). Evaluation of productive and reproductive performances of local and crossbred cows in Manikgonj district of Bangladesh. *Asian J. Med. Biol. Res.* 3(3): 330-334.

Rahman, M. M., Gofur, M. R., Rahman, M.S., Bari, F.Y. and Juyena, N.S. (2016). Effect of Genotype on Reproductive and Productive Performances of Dairy Cows under Rural Context in Bangladesh. *International J. Livest. Res.* 6(6): 9-24.

Riecka, Z. and Candrak, J. (2011). Analysis of relationship between production and reproduction traits of Holstein cattle population in the Slovak Republic. *Anim. Sci. Biotechnol.* 44: 332-336.

Rokonuzzaman, M., Hass, M.R., Islam, S. and Sultana, S. (2009). Productive and reproductive performance of crossbred and indigenous dairy cows under smallholder farming system. *J. Bangladesh Agril. Univ.* 7(1): 69-72.

Saha, A.K., Adhikary, G.N. and Hague, M.N. (2008). The reproductive and productive performance of different crossbred dairy dews at Government Dairy Farm, Sylhet. *Int. J. Nat. Sci.* 6(3): 148-153.

Sarder, M.J.U., Joarder, O.I. and Ali, M.S. (2001). Semen production in relation to the age and season of Friesian cross and Sahiwal bulls for artificial insemination. *J. Biosci.* 9: 39-46.

Sarder, M.J.U. and Hossain, M.A. (2001). Reproductive and productive performance of indigenous cows. *J. Bangladesh Vet.* 18(2): 123-129.

Sarder, M.J.U., Rahman, M.M., Ahmed, S., Sultana, M.R., Alam, M. and Rashid, M.M. (2007). Consequence of dam genotypes on productive and Reproductive performance of dairy cows under the rural condition in Bangladesh. *Pak. J. Biol. Sci.* 10: 3341-3349.

Schei, I., Volden, H. and Baevre, L. (2005). Effects of energy balance and metabolizable protein level on tissue mobilization and milk performance of dairy cows in early lactation. *Livest. Prod. Sci*. 95: 35-47

Schilling, P.E. and England, N.C. (1998). Some factors affecting reproduction in beef cattle. *J. Anim. Sci.* 27: 1363-1367.

Shamsuddin, M., Ahmed, J.U. and Alam, M.G.S. (1987). Effect of age of semen on conception rate in cattle under farm condition. *Bangladesh Vet. Journal*. 21: 51-58.

Shamsuddin, M., Bhuiyan, M.M.U., Chanda, P.K., Alam, M.G.S. and Abedin, J. (1997). Fertility related factors at Artificial Insemination in catle in Bangladesh. Proc. BSVER Symposium on Reproductive Health Management in Ruminants BAU, Mymensingh, Publication. 9: 21-33.

Shamsuddin. M., Bhuiyan, M.M.U., Sikder, T.K., Sugulle, A.H., Alam, M.G.S. and Galloway, D. (2001). Constraints limiting the efficiency of artificial insemination of cattle in Bangladesh. Proceedings of Final Research Co-ordination Meeting on Radioimmunoassay and Related.

Shohiduzzaman, M., Hossain, M.M., Alam, J. and Islam, M.T. (2012). Effect of artificial insemination on pregnancy rate in cows at Mymensingh district in Bangladesh. *J. Sher-e-Bangla Agric. Univ.* 6(2): 1-6.

Sodakar, S. B., Singh, B.N. and Khan, F.H. (1988). Studies on breeding efficiency in Friesian x Sahiwal crossbred. *Ind. J. Dairy Sci.* 41: 185-187.

Spallanzani, L. (1784). Dissertations relative to the natural history of animals and vegetables. *J. Murray, London*. 2: 195-199.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and Procedures of Statistics. McGraw-Hill Book Company Inc., New York, USA.

Sultana, N., Rahid, M.M. and Hossain, S.M.J. (2001). A comparative study on productive and reproductive performance of different cross-bred and indigenous dairy cows under small scale dairy farm condition. *Pak. J. Biol. Sci.* 4: 1036-1037.

Tadesse, B. (2002). Reproductive performances of zebu (Fogera) breed in the central highlands of Ethiopia. DVM thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

Tadesse, S., Fesaha, G., Abebe, A., Hailu, B. and Dejen, W. (2014). Assessment of Productive and Reproductive Performances of Cross Breed Dairy cows in Debre Tabor town. *J. Bio. Agric. and Health.* 4(23): 112-114

Temesgen, T., Tibebu, M. and Usman, L. (2017). Review on Status and Constraints of Artificial Insemination in Dairy Cattle in Developing Countries: The Case of Ethiopia. *J. Bio. Agric. and Health.* 7(5): 79-87.

Thibier, M., Humbolt, P. and Guerin, B. (2004). Role of reproductive biotechnologies: global perspective, current methods and success rates. In G. Simm, B. Villanueva, K.D. Sinclair & S. Townsend (Eds), Farm Animal Genetic Resources. British Society for Animal Science, Publication 30, Nottingham University Press, Nottingham, United Kingdom, pp 171-189.

Uddin, M.K., Wadud, A., Begum, D., Siddiki, M.S.R. and Rashid, M.H. (2008). Productive and Reproductive Performance of Indigenous and Crossbred Cattle in Comilla District. *Bang. J. Anim. Sci.* 37(1): 39-43.

Uddin, M.M., Sultana, M.N., Huylenbroek, G.V. and Peters, K.J. (2014). Artificial insemination services under different institutional framework in Bangladesh. *Bang. J. Anim. Sci.* 43(3): 166-174.

Vishwanath, R. (2003). Artificial insemination: the state of the art. *Theriogenology*. 59: 571–584.

Visser, A. Shannon, P. and Wickhan, BW. (1988). Factor affecting conception rate in cattle. *New Zealand Soc. Anim. Reprod.* 48: 61-63.

Webb, D.W. (2003). Artificial Insemination in Cattle. University of Florida, Gainesville. IFAS Extension, DS. 58: 1-4.

Wilmut, I., Schnieke, A.E., McWhir, J., Kind, A.J. and Campbell, K.H.S. (1997). Viable offspring derived from fetal and adult mammalian cells. *Nature*. 385: 810–813. doi:10.1038/385810A0.

Yifat, D., Bahilibi, W. and Desie, S. (2012). Reproductive performance of Boran cows at Tatesa cattle breeding center. *Advances in Biol. Res.* 6(3): 101-105.

Zewdie, W. (2010). Livestock Production Systems in Relation with Feed Availability in the Highlands and Central Rift Valley, M.Sc. thesis submitted to the School of Animal and Range Sciences, School of Graduate Studies, Haramaya University, Ethiopia.

APPENDICES

Appendix 1: Questionnaire on productive and reproductive performance of indigenous and crossbred cows bred artificially in Gobindaganj upazila of Gaibandha district.

Serial no. of questionnaire				
Name of the owner				
Name of the village				
Age				
Gender				
Level of education				
Occupation				
Type of breed use	1. Indigenous 2. Friesian cross 3. Sahiwal cross			
Breed / Parameters	**Indigenous (I)**	**Friesian Cross (F×I)**	**Sahiwal Cross (SL×I)**	**Remarks**
Age at puberty (m)				
Age at first service (m)				
Age at first calving (m)				
Service per conception (no.)				
Gestation period (d)				
Birth weight of calves (kg)				
Daily milk yield (l)				
Lactation length (d)				
Calving interval (d)				
Post-partum heat period (d)				

Appendix 2: Analysis of variance of age at puberty (m) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	272.213	2	136.107	657.773	.0001
Within Groups	13.864	67	.207		
Total	286.077	69			

Appendix 3: Analysis of variance of age at first service (m) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	219.110	2	109.555	210.097	.0001
Within Groups	34.937	67	.521		
Total	254.047	69			

Appendix 4: Analysis of variance of age at first calving (m) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	284.040	2	142.020	96.377	.0001
Within Groups	98.730	67	1.474		
Total	382.771	69			

Appendix 5: Analysis of variance of service per conception (no.) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.440	2	.720	2.492	.090
Within Groups	19.360	67	.289		
Total	20.800	69			

Appendix 6: Analysis of variance of conception rate (%) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	656.808	2	328.404	10.780	.001
Within Groups	822.522	67	30.464		
Total	1479.329	69			

Appendix 7: Analysis of variance of gestation period (d) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	382.223	2	191.111	8.493	.001
Within Groups	1507.720	67	22.503		
Total	1889.943	69			

Appendix 8: Analysis of variance of post-partum heat period (d) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5872.961	2	2936.481	74.078	.0001
Within Groups	2655.910	67	39.640		
Total	8528.871	69			

Appendix 9: Analysis of variance of calving interval (d) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	26860.531	2	13430.266	82.973	.0001
Within Groups	10844.840	67	161.863		
Total	37705.371	69			

Appendix 10: Analysis of variance of birth weight of calves (kg) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1828.653	2	914.326	57.995	.0001
Within Groups	1056.290	67	15.766		
Total	2884.943	69			

Appendix 11: Analysis of variance of daily milk yield (l) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1489.955	2	744.978	247.562	.0001
Within Groups	201.620	67	3.009		
Total	1691.575	69			

Appendix 12: Analysis of variance of lactation length (d) in different breed of dairy cows

ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	38611.746	2	19305.873	132.296	.0001
Within Groups	9777.240	67	145.929		
Total	48388.986	69			

Appendix 13: Summary of questionnaires

SL. No.	Farmer Name	Name of Location	Mobile No.
1.	Nippon Mia	Bosadao	01989-774015
2.	Shajahan	Bamonhazra	01717-798540
3.	Mahmuda	Munsipara	01950-503746
4.	Sheuli	Bamonhazra	01734-627979
5.	Rekha	Shrepotipur	01797-777963
6.	Oyadud	Munsipara	01734-562556
7.	Jamila	Shrepotipur	01774-112101
8.	Sadekur	Bamonhazra	01934-150450
9.	Sohag	Mohimagonj	01748-595657
10.	Aminul	Munsipara	01928-429528
11.	Juwel	Bamonhazra	01784-927925
12.	Jabeda	Bamonhazra	01754-776126
13.	Shantona	Mohimagonj	01929-005621
14.	Najma	Mohimagonj	01726-234474
15.	Rabeya	Bamonhazra	01935-238852
16.	Mishu	Bamonhazra	01992-455817
17.	Enamul	Mohimagonj	01913-575938
18.	Momota	Mohimagonj	01835-029594
19.	Safiul	Hirok para	01749-961969
20.	Rojina	Shrepotipur	01822-807492
21.	Khadija	Shrepotipur	01744-400398
22.	Shahin	Hirok para	01754-159990
23.	Shahana	Hirok para	01718-892629
24.	Rashed	Mohimagonj	01678-591319
25.	Sanjida	Mohimagonj	01538-350673
26.	Eva	Bamonhazra	01307-395681
27.	Soikot	Hirok para	01406-618534
28.	Raihan	Satanaboluya	01744-380224
29.	Noyon	Satanaboluya	01877-474958
30.	Jafor	Satanaboluya	01774-379376
31.	Panna	Satanaboluya	01773-900891
32.	Ijuddin	Satanaboluya	01993-169914
33.	Bipul	Mariya	01785-415674
34.	Kalam	Darbasto	01810-911702
35.	Aowyal	Darbasto	01738-535132

SL. No.	Farmer Name	Name of Location	Mobile No.
36.	Halim	Satanaboluya	01701-903556
37.	Selim	Satanaboluya	01745-546554
38.	Soyaib	Darbasto	01782-209121
39.	Dalu	Darbasto	01889-450976
40.	Rakib	Bashidappur	01739-889920
41.	Nishi	Hirok para	01773-509914
42.	Afsana	Hirok para	01721-213733
43.	Sumon	Horirampur	01791-819697
44.	Joynal	Kalitola	01877-338025
45.	Thandu	Darbasto	01832-633859
46.	Akher	Pantapara	01826-065395
47.	Akhi	Akotapara	01780-892667
48.	Anik	Nakaihat	01738-427428
49.	Assaduzaman	Shapmara	01571-756130
50.	Samsunahar	Horirampur	01861-893393
51.	Bipul	Jamalpur	01715-567273
52.	Bilkis	Noldanga	01757-445764
53.	Dulal	Pantapara	01744-855510
54.	Laki	Shapmara	01307-395681
55.	Juwel	Kuntol	01722-862909
56.	Kanon	Bamonhazra	01740-386025
57.	Lota	Mohimagonj	01926-187964
58.	Nargish	Noldanga	01749-566298
59.	Sabiha	Akotapara	01741-208783
60.	Saffin	Noldanga	01717-469269
61.	Shopna	Bashidebpur	01703-085734
62.	Lutfor Rahman	Katabari	01624223997
63.	Anisur Rahman	Katabari	01766231022
64.	Laboni Begum	Katabari	01771216978
65.	Hafizur Rahman	Katabari	01750605539
66.	Farid	Katabari	01792654421
67.	Motahar Mahmud	Katabari	01716215772
68.	Atikur Rahman	Katabari	01710791943
69.	Munsur Ali	Katabari	01740805163
70.	Monoar Hossain	Katabari	01724765012

SL. No.	Farmer Name	Name of Location	Mobile No.
71.	Abdul Momin	Gobindaganj Municipality	01721213610
72.	Lazu Sorkar	Gobindaganj Municipality	01730935380
73.	Bulbul	Gobindaganj Municipality	01716370125
74.	Arup kumar	Gobindaganj Municipality	01712653965
75.	Anwara Begum	Gobindaganj Municipality	01765018014
76.	Saidur	Gobindaganj Municipality	01767111654
77.	Lipi Begum	Gobindaganj Municipality	01321317394
78.	Bulu Miah	Gobindaganj Municipality	01742068651
79.	Deepak Kumar	Gobindaganj Municipality	01310183037
80.	Sharmin Akter	Gobindaganj Municipality	01712387652
81.	Fatema Begum	Gobindaganj Municipality	01744699054
82.	Nur Alom	Dorbosto	01792791446
83.	Rupali Begum	Dorbosto	01774332725
84.	Sadeka Begum	Dorbosto	01821248216
85.	Sonju Mia	Dorbosto	01773650223
86.	Mahabur Rahman	Dorbosto	01746326428
87.	Monoara Begum	Dorbosto	01766180402
88.	Saleha Begum	Rakhal Buruj	01785618190
89.	Ferdousi Akter	Rakhal Buruj	01773903711
90.	Dolena Begum	Rakhal Buruj	01305131353
91.	Shammi	Rakhal Buruj	01784956161
92.	Sheuli Begum	Rakhal Buruj	01740367971
93.	Jerin	Rakhal Buruj	01734379907
94.	Momena	Rakhal Buruj	01797981457
95.	Lipi Begum	Rakhal Buruj	01742169300
96.	Nahid Akter	Rakhal Buruj	01764090494
97.	Momtaj Begum	Rakhal Buruj	01733138247
98.	Abdul Matin	Rakhal Buruj	01732084294
99.	Md. Bhola	Razahar	01749597435
100.	Jamal Fakir	Razahar	01740811019