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Clinical Trends of Reproductive Disorders of Cows in Rajshahi District of Bangladesh

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CLINICAL TRENDS OF REPRODUCTIVE DISORDERS OF COWS IN RAJSHAHI DISTRICT OF BANGLADESH

PhD Thesis

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CLINICALTRENDS OF REPRODUCTIVE DISORDERS OF COWS IN RAJSHAHI DISTRICT OF BANGLADESH

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Rajshahi-6205, Bangladesh

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Dedicated

TO

MY

Husband (Md. AbulHasnat)

Daughter (Ridi) & Son (Radib)

DECLARATION

I, hereby declare that the thesis entitled **"Clinical trends of reproductive disorders of cows in Rajshahi district of Bangladesh"** is the results of my own and original investigation to the Department of Animal Husbandry and Veterinary Science, Faculty of Agriculture, University of Rajshahi, Rajshahi-6205, Bangladesh under the guidance and Supervision of **Professor Dr. Md. Jalal Uddin Sarder,** Department of Animal Husbandry and Veterinary Science, Faculty of Agriculture, University of Rajshahi, Rajshahi-6205, Bangladesh. The thesis contains no materials which has been accepted for the award of any other degree or diploma elsewhere, and to the best of my knowledge, the thesis contains no material previously published or written by another person, except where due reference is made in the text.

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CERTIFICATE

This is to certify that the PhD dissertation entitled **“Clinical trends of reproductive disorders of cows in Rajshahi district of Bangladesh”** submitted to the University of Rajshahi, Faculty of Agriculture, for the award of the degree of Doctor of Philosophy (PhD) in the Department of Animal Husbandry and Veterinary Science, is the original research work of **Rashida Khaton**, a bona-fide PhD research fellow, carried out under my supervision. The dissertation has not been submitted to this University or to some other University so far and is submitted for the first time. It is further certified that this dissertation is suitable for submission for the degree of Doctor of Philosophy (PhD) in the Department of Animal Husbandry and Veterinary Science, University of Rajshahi and the candidate has fulfilled all the statutory requirements for the completion of the PhD programme.

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ABSTRACT

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The aim of the present study was to evaluate the "Clinical trends of reproductive disorders of cows in Rajshahi district of Bangladesh." The whole study was divided into three experiments to achieve the goal very successfully.

Experiment I: Study on reproductive trends of dairy cows in Rajshahi district

The present study was carried out from 6 upazilas and 4 metro thanas at Rajshahi district to evaluate the Clinical trends (reproductive performance and disorders) of dairy cows. A total of 500 cows selected and data were collected directly from the dairy farms owner by using questionnaires and diagnosis of reproductive disorders (RD) was made on the basis of history, clinical signs and response to treatment from July 2013 to June 2014. The average reproductive performance (RP) were recorded as age at puberty (AP) 26.42±0.22 m, age at first calving (AFC) 35.48±0.22 m, post-partum heat period **(**PPHP**)** 121.85±3.48 days, service per conception (S/C) 1.93±0.04, days open (DO) 136.80±3.57 days and calving interval (CI) 401.04±3.94 days. The better RP was found at Boalia and Rajpara thana but poor performance at Godagari upazila. Genotype had significant effect ($P<0.05$) on all the reproductive traits (RT) except on S/C. Local (L) × Holstein Friesian (HF) genotype showed earlier AP and AFC than L× Sahiwal (SL) and L. Age group had significant ($P<0.05$) effect on AP, AFC and other parameters were not significant ($P>0.05$). Middle age groups of cows had shown better RP than others groups. Parities of cows had significant effect ($P<0.05$) on PPHP, S/C, DO except on AP, AFC and CI. Third parity had better RP than others. The best RP was found in >300 kg BW groups. Body condition score had significant effect ($P<0.05$) on all RP. Good body condition score (BCS) had excellent RP. Secondary educational status of farmers had obtained better RP. Farming experience, rearing system and geographical location of farm had no significant effect ($P>0.05$) on RP. Farm size had significant effect ($P<0.05$) on all RT except on S/C and DO. The best RP was found in small size farm, concrete type of floor, good ventilation system, good quality of feed, preventive measure by veterinarian and AI breeding method. The overall prevalence of productive and RD was 78.6%. It was recorded, among the reproductive and productive diseases, abortion 13.4%, retained placenta 10.2%, dystocia 5.4%, vaginal prolapse 2.4%, uterine prolapse 1.4%, metritis 1.6%, pyometra 1.8%, still birth 0.8%, anoestrus 24.6%, repeat breeding 11.4%, mastitis 4.4% and milk fever 1.2%. The highest occurrence of RD was recorded in Tanore upazila (9.2%) and the lowest in Poba upazila (6.2%). Between the upazila and metro thanas the minimum occurrence of RD were recorded in metro thanas (31%) than upazilas (47.6%). The cross-bred cows were found more susceptible to RD (60.6%) than Local (18%). Maximum RD were observed in L×HF (37.2%) than L (18%). The highest prevalence of RD was observed in >9 years age groups of cows. The highest RD were observed in 2nd parity of cows. 200 to <300 kg body weight had shown the highest RDs than others. Good body condition score (BCS) had the lowest chance of RD than others. Secondary educational status of farmers had the lowest occurrence (16.4%) of RD than other group. The lowest (15.2%) RD was observed in vast farming experience (>5 yrs). The lowest prevalence of RD was found in grazing on pasture land (12.6%) and higher RD in intensive rearing system (39.8%). The small size farm was found minimum chance (20.6%) to RDs than others groups. The minimum no. of cows suffering from RDs in semi-urban (23%) than others. Less change of RDs in cows by natural service (19%) than artificial insemination (59.6%).

Experiment-II: Study on biometrical measurement of reproductive organs in cows at study area

A biometrical study of female reproductive organs of 100 dairy cows of different genotypes (Local, Local × Holstein Friesian, Local × Jersey and Local × Sahiwal), age (<3, 3 to ≤5, >5 years) and body weight (<200, 200 to <300, >300 kg) groups and different parities were conducted to measure reproductive organs. Reproductive organs (RO) of cows were collected immediately after slaughter from different slaughter houses in Rajshahi City Corporation (RCC) area. The mean length of vulva, vagina, cervix and body of uterus were recorded as 8.85±0.14 cm, 22.59±0.34 cm, 5.02±0.11 cm and 3.12±0.72 cm, respectively and corresponding values for the width were 4.83±0.13 cm, 5.44±0.16 cm, 4.56±0.12 cm and 2.51±0.59 cm, respectively. The mean length of right uterine horn and oviduct were 25.34±0.72 cm and 21.05±0.39 cm and that of left one were 25.79±0.73 cm and 21.00±0.38 cm, respectively. Local × Holstein Friesian had significantly higher values (P<0.05) on the most of parameters (Length, width, thickness and weight) of genitalia measured, followed by the Local × Jersey, Local × Sahiwal and Local. L×HF had recorded the longest uterine horn (29.20 ± 1.65 cm for right and 29.87 ± 1.75 cm for left), uterine body (3.42±0.20 cm length and 2.83±1.40 cm width), cervix (5.64±0.24 cm length and 4.89±0.23 cm width) and vagina (24.66±0.64 cm length and 6.08±0.36 cm width) than other genotype. Age group >5 years and BW groups >300 kg and 3rd parity had significantly (P<0.05) higher values on most of the parameters measured than other age groups, BW groups and parities, respectively. All biometrical measurements of RO were increased with the advancement of age and body weight indicated the effect of age and body weight of cows. The right ovary was wider in diameter, larger in length and heavier in weight than left one in all genotypes, age and body weight groups. This confirms the fact of right ovary being more active than the left one. In conclusion, the biometry of reproductive organs in L × HF and L × J and age group (3 to ≤ 5 and >5 years) and body weight group (200 to <300 and >300 kg) of dairy cows are suggestive for selection to get maximum benefits from crossbreeding in respect of productive and RP for livestock improvement and also for genetic improvement.

Experiment-III: Study on the gross and histopathological changes of the affected organs

A study was conducted to determine the pathological diseases (PD) in the reproductive system of cows. A total of 115 female genital organs were randomly collected during the period from March, 2014 to June, 2015 from eight (8) slaughter houses of Rajshahi district. All samples were collected from the cows irrespective of ages. Among these samples, 73% samples showed gross and histopathological changes. The result showed that pathological conditions recorded grossly in the reproductive system were granular vulvo-vaginitis (9.57%), swollen and edematous cervix (10.43%), endometritis (19.14%), pyometra (5.21%), mucometra (2.61%), parasitic cyst within the uterus (0.87%), follicular cyst (9.57%), luteal cyst (2.61%), multicystic ovary (1.73%), mesovarian cyst (0.87%), sub-active ovary (3.48%) and hemorrhage in ovary (6.96%). The representative samples were preserved in 10% buffered neutral formalin for histopathological examination. The relative incidences of various histopathological disorders were endometritis (30.36%), cervicitis (21.42%), vaginitis (23.21%), follicular cyst (17.87%) and multicystic ovary (7.14%). It is concluded that more than one disorder were existed in all sample. These disorders in the female genital organ of cows would enable us to design future research and hygienic care at breeding and parturition should be into consideration and also support to manage the different fertility related problems in cows.

Finally, it was concluded that monitoring of the reproductive health status of cows is helpful for making decision about treatment or culling of non-productive cows from the herd and also selection of good quality of dairy cows for increase calf and milk production which will be helpful to overcome losses due to reproductive disorders.

LIST OF ABBREVIATIONS AND SYMBOLS

α	=	Alpha
β	=	beta
χ^2	=	Chi-Square
<	=	Is less than
>	=	Is greater than
%	=	Percentage
&	=	and
*	=	Significant sign
=	=	Equal to
±	=	Plus minus
±SE	=	Plus minus Standard Error
×	=	Cross
^{o}	=	Degree
^{o}C	=	Celsius
µm	=	Micrometer
AFC	=	Age at first calving
AI	=	Artificial insemination
ANOVA	=	Analysis of variance
AP	=	Age at puberty
BAU	=	Bangladesh Agricultural University
BBS	=	Bangladesh Bureau of Statistics
BCS	=	Body condition score
BW	=	Body weight
CI	=	Calving interval
CL	=	Corpus luteum
cm	=	Centimeter
CT	=	Clinical trends
CV	=	Calculated value
d	=	Day (s)
DF	=	Degree of freedom
DLS	=	Department of Livestock Services
DMRT	=	Duncan’s Multiple Range Test
DO	=	Days open
DPX	=	Dextrin Plasticized Xylene
Edn.	=	Edition
et al.	=	and his associates
F value	=	Factorial value
FAO	=	Food and Agricultural Organization
FSH	=	Follicular Stimulating Hormone
G	=	Chest girth

GDP	=	Gross Domestic Product
g	=	Gram
GnRH	=	Gonadotrophin releasing hormone
GRP	=	Gross reproductive pathologies
H & E	=	Hematoxyline and Eosin
HF	=	Holstein Friesian
J	=	Jersey
Kg	=	Kilogram
L	=	Local
L	=	Length
lb	=	Pound
LH	=	Lutenizing hormone
m	=	Month (s)
n	=	Number of observation
No.	=	Number
NS	=	Natural service
NS	=	Non-significant
OD	=	Obstetrical disorders
P	=	Probability
PD	=	Pathological disorders
PGF2α	=	Prostaglandin $F_{2\alpha}$
PPHP	=	Post-partum heat period
PVD	=	Purulent vaginal discharge
RD	=	Reproductive disorders
RFM	=	Retention of fetal membrane
RO	=	Reproductive organs
RP	=	Reproductive performance
RT	=	Reproductive tract
S/C	=	Service per conception
SE	=	Standard Error of Mean
SL	=	Sahiwal
SPSS	=	Statistical Package for the Social Science
TAI	=	Timed artificial insemination
TV	=	Tabulated value
USA	=	United States of America
UTJ	=	Utero-tubal junction
yrs	=	Years

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Chapter 1

INTRODUCTION

1.1 Scenario of livestock in Bangladesh

Bangladesh is one of the densely populated and the fourth largest agricultural country in the world (Habib, 2001). The economy of Bangladesh largely depends on agriculture. Livestock being one of the four major components (crops, livestock, fisheries and forestry) of agriculture and plays a vital role in national economy. In twenty first century the livestock sub-sector plays an important role in meeting the challenges of alleviate poverty of Bangladesh (Islam, 1998). At present about 6.5% of national GDP is covered by the livestock sector and its annual rate of productivity is 9% (Banglapedia, 2013). This sub-sector supplies more than 42.54% of the animal protein in the form of milk, meat and eggs (BBS, 1998). Livestock contributes to the national economy in the form of essential draft power for agricultural operation, manure, fuel, rural transportation and industrial products. Livestock in Bangladesh is providing 72% of the power for cultivation and 50% of the power for rural transportation (Kumaruddin, 2001). Livestock is generating employment opportunities and full time covering source for about 20% and part time for about 50% of the population. Livestock also produces 80 million metric tons of dung per year, which equal to about 20% of the conventional fuel. The rest is used as manure, which again equal to about 10% of the chemical fertilizer consumed in the country. The country also earns about 13% of foreign exchange through hide and skins export (Alam, 1991; Alam, 1993).

Cattle of Bangladesh is integrated part of agricultural operation and it ranks eleventh in cattle population in the world and in the Asian countries its position is fourth, but it yields only 21% of the world milk production and 34% of the beef production (Rahman, 1992; Alam *et al*., 1994). Among the Asian countries, the condition of livestock in Bangladesh is probably the worst. Livestock population in Bangladesh is mainly made in of cattle, buffalo, goat and sheep, with respective population 24.5 million, 1.39 million, 24.15 million and 3.07 million (BER, 2011). Cattle and buffalo are two species of Bovidae family which supply 99% of the total milk consumed in the country. The annual growth rate of cattle and buffalo were 0.25 and 1.14%, respectively over at the period of 1960-89 (Alam, 1995).

From the statistics given above, it is clear that number of livestock in Bangladesh is not very low in proportion to 16 crore of it's human population, but the major problem lying in the per animal output. Most of the cattle are reared in household basis not in commercial farming system (FAO, 2013). A local cow produces only about 221 litres milk per year against 4920 litres in Denmark and 5,377 litres in USA. Average meat production is about 50 kilogram per cattle compared to about 200 kilogram per cattle in developed countries. Results in Bangladesh, 9.42 million tons milk deficiencies and 5.78 million tons meat deficiencies in year 1999 (Banglapedia, 2013). This low productivity of the native cows is mainly due to poor genetic potentials. Reproductive problem of cows is one of the major problems in livestock sector, result loss of production and not get one calf per year, which is key to success in dairy farming. So, attempt was made to reduce this deficit by establishing dairy farm at privately as well as improving high quality breeds or genotype of the dairy cattle with proper reproductive management. As cattle hold the top position in livestock sector in Bangladesh, emphasis should be given on cattle development programme.

1.2 History of cattle development in Bangladesh

In Asia, all domestic cattle originated from *Bos taurus* as hump-less cattle and *Bos indicus* as hump cattle, from the wild cattle of South East Asia. Hump less Longhorn cattle were first found in South Turkey. They were focus in Mesopotamia about 5000 BC and later in the Indus Valley (Pakistan). The small hump-less short horn cattle, originated some 2000 year later than the Longhorn, are ancestors of the present dairy short-horn cattle found throughout the Middle East and the North African-countries. The Zebu probably originated in Western Asia (Udo, 1994). Mason and Buvanendran (1982) have suggested that the hump and pendulous dewlap, two of the distinguishing features of Zebu cattle, were originally selected by man to emphasize the appearance of size and strength in his bull and thus render them more suitable for religious and social ritual (Mason and Buvanendran, 1982). Zebu is believed to have been brought to India between 2200 and 1500 BC. From India they spread into South East Asia and Western Asia inter bred (Udo, 1994).

The cattle in Bangladesh are mostly non-descript indigenous types, believed to be originating from Indian cattle belonging to the genus *Bos indicus*. Sultana (1995) reported that only about 0.25 million cattle are pure breed and their crosses and rest are indigenous low producing Zebu type. In the hilly areas of Bangladesh the cattle species Gayal (*Bos frontalis*) and their crosses with local cattle are also available.

1.3 Cattle characteristics in Bangladesh

The indigenous cattle in Bangladesh come from primitive breeds. The characteristics are stunned growth, small size, late sexual maturity and poor production even under the good dietary and management condition. But they often exhibit remarkable heat tolerance, the ability to maintain body condition on poor quality feed stuff and to a good degree of resistance to local diseases. On the other hand, exotic breeds from Temperate zone are thought more productive in favorable environmental conditions but cannot adjust to our hot and humid condition (Taneja and Bhat, 1986). According to Taneja and Bhat (1986) the performance of temperate genotypes in tropical environment is 30-40% lower than that of the countries of their origin. Livestock performance depends mainly on genetic potential of the animal. Again optimum nutrition, age, parity, disease control and management practices permit full expression of this genetic potential. Climatic stress in the form of high temperature, high humidity and erratic or inadequate rainfall affect the productivity of dairy cattle in tropical countries (Matin, 1993).

1.4 Cattle rearing practices and its importance

Since the 1960s, the people of Bangladesh have been rearing three categories of cattle viz. pure breed, cross-bred, and local. The pure breed and the cross-bred cattle have high nutritional requirement, less adaptability, require proper intensive management and are susceptible to parasitic infestation, diseases, reproductive problems and disorders compared to the local variety. The cross-bred cows suffer more from reproductive problems than local cows (Faruq, 2001). On the other hand, the local variety is less prone to diseases and is heat tolerant and efficient to utilize low quality roughages, and well-adapted to harsh environmental conditions. In Bangladesh, the best local cattle are available in some selected areas viz. Pabna, Sirajganj, Chittagong, and Munshiganj areas (Banglapedia).

Cattle are almost evenly distributed with a little higher concentration in northern part of the country. Rajshahi is division and main center of northern part of the country. Here cattle have multipurpose functions; it is used for traction of lands and cartage and produces milk and meat. Cow dung is used as manure of soil additive, utilization of forages that cannot be digested by humans, hence there is a significant conservation benefit of grass and forage production on fragile soils and as fuel, and a substrate for methane production. Cattle hides and skin are used for clothing, bags, shoes etc. Different functions of cattle were as relating to crop production such as tillage (ploughing, ridging, weeding), provision of manure, transport (of inputs and produce; also wood, water etc). Consumption as milk for domestic consumption (and local sale), meat, hides, horns and other by-products. Household finance such as investment of crop income (capital growth through herd growth), savings (capital storage: for school fees, bride wealth) and Social as a ritual purposes (e.g. installation of ancestral spirits, ritual slaughter), social status and pleasure in ownership (Barrett, 1991). Some farmers use their cattle as oxen for traction power in farm tasks such as ploughing. In humid areas, water buffalo serve the same purpose (Ker, 1995). The trend is toward high-production, intensive systems (Gillespie, 1997).

Asian civilization is primarily based on agriculture mostly growing rice, wheat, coarse grains, sugar cane and pulses as principal crops and 30-50% of bovine are used for draft operations (Parikh, 1988). Approximately 20% of the value of an animal is in the draft power it supplies (Hoffmann, 1999). Cow-dung is an excellent source of fertilizer for growing crops and is used all over the world. Approximately 40% of the value of an animal could be in the manure it produces (Hoffmann, 1999). Cow-dung is extensively used as fuel for cooking in India, Pakistan, and Bangladesh and in almost all countries. In Bangladesh, 22.7% and 0.7% of people surveyed use dung energy for household and commercial purposes, respectively (Ali, 2002). Castrated adult males are the main draught animal, some farmers also use steers, bulls, heifers and cows (FSRU, 1985; Scoones, 1990; Munn and Zonneveld, 1990). Cows may be used for draught even when lactating.

1.5 Cattle breeding programme and problems in Bangladesh

For grading up of indigenous stock, the technique of Artificial insemination (AI) will surely play a vital role. AI is the best successful biotechnology for the improvement of cattle. To improve the cattle breed, AI method is used popularly around the world. The better characteristics are transmitted into the offspring if the cows are artificially inseminated with high yielding verities of bull semen. The AI technique was introduced in Bangladesh in 1958 in limited area and now continuing throughout the country. Currently a programme of artificial insemination has been operating through 24 AI centres, 416 sub-centres and 3200 points covering all the 64 districts of the country. So, our dairy cows are increasing their productively (milk) day by day. During recent years thousands of organized private sector livestock farms with improved breeds have been established for commercial purposes. According to DLS, (1998) statistics, at present there are 29,649 cross-bred dairy farms in the country and this number increasing day by day. As a result, the foreign expenditure has decreased up to 125 crore taka for importing the powder milk and milk products per year in our country. However, it was 1300 crore taka a few years age. Although AI activities have passed for a long time but their success are not up to the mark still now. One of the major problem is poor management of the dairy farms, resulting cross-bred cows which is more susceptible to infections and reproductive diseases and disorders, suffer frequently and make economic losses of the farmer. Most of cattle farmers of our country are illiterate or less educated and are not adopted with proper management of cross breed and pure breed cows. Result we got frequent complaint from the cattle farmers about history infectious diseases, several reproductive diseases and disorders including anoestrus, repeat breeding, pyometra, metritis, retain placenta, prolapse of uterus and similar problems. Production disorder like milk fever and mastitis are also very common of high yielding cows.

There are variety of problems in livestock sector of Bangladesh such as insufficient pasture land, lack of technical expert, insufficient supply of vaccine, lack of epidemiologic study, and shortage of government employee in the field level, lack of education and knowledge of the farmer, lack of proper management and various diseases of different systems of animals (Islam *et al.,* 2015). Infectious diseases cause a great harm in livestock. It has been estimated that about 10% animals die annually due to diseases (Ali *et al.,* 2011). Disease also causes nutritional deficiency and disturbances in fertility. Understanding on the incidence, prevalence, distribution and determinants or risk factors of diseases and constraints of productive and reproductive performances of dairy cows in a region is important for endeavor economical management program and to ensure the profitable and sustainable dairy farming in Bangladesh.

Infectious diseases, reproductive diseases and disorders frequently cause production losses of high yielding cows. Few farmers take support from professional Veterinarian and most of farmers consult with traditional healers, quacks and drug dealers. Some cows get well and most of the cows faces production loss, infertility repeat breeding, permanent loss of reproductive ability and similar other problems. Cows heals may continue for production with gross and microscopic changes in reproductive organs. Cows which not heals properly are sold in slaughter house. Finally farmers face economic losses and they looses their interest on cattle farming. But if know the clinical trends reproductive disorders and treat it properly then we can get one calf per year, more production and it will make farming more profitable.

Most of the studies were done clinically, where overlapping of problems and the problems showing limited clinical signs may overlooked. Again many diseases or disorders not come for clinical treatment; it is treated by traditional healers of recovered due to natural immunity. Results it remains unreported in clinical study. For prove identification of reproductive problems and its clinical trends we need to survey at the farms and conduct a slaughter house based study from where we can get real sample and identify its disorders and clinical trends. By this study we can also find out the biometrical measurement of reproductive tract of cows and gross and microscopic changes of the affected organs to find out the major problems and taking an effective measure of reproductive problems.

In our country very little comprehensive work has been done regarding the **"Clinical trends of reproductive disorders of cows in Rajshahi district of Bangladesh"** Therefore, from all points of view the main objectives of the present study were as follows:

Objectives:

i. To study the clinical trends (reproductive performance and disorders) of cows in relation to genotype, age, parity, body weight, body condition score, socio-economic status of farmers and management factors.
ii. To evaluate the biometrical study of reproductive organs in cows at study area.
iii. To study the gross and histopathological changes of the affected reproductive organs.

The whole research project was splitted in three (3) experiments for effective and successful completion. The introductions with specific objectives of each experiment have been given as separate heads.

Experiment I: Study on reproductive trends of dairy cows in Rajshahi district

Bangladesh is an agro-based country. It consists of low, flat, and fertile land except the hilly regions in northeast and southeast. The mean annual temperature is about 26^0C with an extreme range between about 4^0C and 43^0C. The average annual rainfall varies from 1429 to 4338 mm (BBS, 2002). Livestock, an integral part of agriculture, plays an important role to keep the rural economy of Bangladesh viable. About 80% of Bangladesh is directly or indirectly involved in agriculture and livestock farming. The contribution of livestock in gross domestic product (GDP) is about 2.51 % in Bangladesh (BBS, 2012). The urban and rural society of Bangladesh has long been enjoying the contribution of livestock for meeting the demand of nutrition and livelihood as an agricultural dependent country. Livestock production is an important sector of the Bangladesh agricultural economy. The growth rate in gross domestic product (GDP) in 2003 for livestock was the highest of any sub sector at 4.5%, compared to 3.2% for crops and 2.3% for the fisheries sub-sector (FAO, 2005). The importance of livestock production has increased in Bangladesh as witnessed by the growth of the sub-sector over the last few decades and the contribution to employment in the country (FAO, 2005). Among the livestock, cattle are most available and versatile component providing a significant contribution to gross domestic, export products and raw materials for industries in relation to existing integrated agricultural farming system in Bangladesh. So, Livestock of Bangladesh is back bone of rural economy. The main goal of dairy farmers is one calf/cow per year. Total cattle population of this country is about 24.5 million, which is about 1.79% of the world and 5.47% of Asia cattle population (FAO, 2004). Livestock is the most prospective sub-sector in Bangladesh contributing poverty alleviation. It plays an important role to promote human health and wealth by supplying animal protein in the form of milk and meat. Currently, 24.5 million cattle, 1.39 million buffalo, 24.15 million goat and 3.07 million sheep (BER, 2013) plays an important role in the rural economy. Although cattle population in Rajshahi district is approximately 5.35 lakh (personal contact with DLS, Rajshahi; 2015).

Many countries have experienced very vast development in dairy sector in or around the largest urban centers, responding immediately to the market demand and profiting from the lack of links between the rural producer and the urban consumer. Urban and peri-urban/rural dairy production systems are emerging as an important component of the milk production system. This system is contributing immensely towards filling in the large demand-supply gap for milk and milk products in urban centers, where consumption of milk and milk products is remarkably high (Azage and Alemu, 1998). The urban and peri-urban/rural dairy production system has tremendous potential for development and could play a significant role in minimizing the acute shortage of dairy products in urban centers of any country (Mureda and Zeleke, 2008).

Reproduction, health and production i.e. calf and milk production are the principal factors affecting the profitability of a dairy herd. In recent years, the dairy industry agenda in many countries has been dominated by health-related problems (Vacek *et al.,* 2007). One prerequisite for effective health management is the accurate knowledge of factors that affect the health status of a cow, such as age, parity, body weight or health history, and of the relationship between health problems and other economically important traits, such as calf, milk production, reproduction, and length of productive life. The parameters required for health management are population-and time-specific and need to be estimated periodically (Emanuelson and Oltenacu, 1998).

The lifetime productivity of cows largely depends on their individual reproductive performance such as age at puberty, age at first calving and calving interval (Ensminger, 1969). Reproductive performance is the trait of outstanding importance in beef cattle enterprises, where if there is no calf, then there is no economic return. The best cows are clearly those that have their first calf at an early age, have minimum calving intervals, and live a long time. Thus, the most important measures of reproductive performance of cows are age at first calving, length of calving interval, and length of cow productive life. In most countries, the primary objective of a reproductive control program in a dairy herd is to have each cow calve and produce a live calf in every 12 months (Rahman *et al*., 1995). The current level of reproductive performance in dairy herds is well below the optimum in most countries (Morton, 2003). Reproductive inefficiency in turn, however, affects dairy herd profitability by decreasing milk yield, the number of replacement heifers produced and by increasing culling rate. Healthy pregnant cows are seldom culled from a dairy management control of reproduction and profitability in dairy herd (Grohn and Rajwala, 2000; Santos, 2007).

The fertility of dairy cows has declined worldwide and this change is surprising given the importance of good fertility to the dairy industry. The decline in fertility can be explained by management change within the dairy industry and also negative genetic co-relation between milk production and reproduction (Lucy, 2007). Like in many other countries, poor reproductive efficiency has been considered to be the major limiting factors in medium and large scale market oriented dairying in Bangladesh.

The cows of Bangladesh are now serving as the main suppliers of milk and milk by-products to the population. Milk production in Bangladesh increased from 1.29 million metric tons in 1987-88 to 1.74 million metric tons in 2001 (Asaduzzaman, 2000). Despite the huge number of cattle and their economic importance, the productivity is low due to various constraints such as disease, feed, poor management and poor reproductive performance of indigenous zebu breeds (ILCA, 1988). Hence, income derived from livestock sector could not impart a significant role in the economic development of the country (Mukasa-Mugerwa, 1989). Abortion in cattle is an important fertility problem causing a serious economic setback due to direct losses of concepts and consequent impairment of fertility. Moreover, the incidence of retained fetal membrane after birth is often high in *Brucella* infected herds (Mukasa-Mugerwa, 1989). These constraints result in poor reproductive performances of dairy cattle in Bangladesh.

Reproductive and production disorders (PD) of cross-bred dairy cattle significantly reduce their productivity which is of great concern of dairy producers worldwide because most reproductive disorders (RD) adversely affect the future fertility. There is a strong interrelationship among productive & reproductive performances and clinical disease/health disorders in dairy cattle (Erb, 1987). Ten to 30% of lactations may be affected by infertility and RD (Erb and Martin, 1980), and 3-6% of the herd is culled annually in developed countries for these reasons. Clinical reproductive problems that have direct impact on reproductive performance of dairy cows are abortion, dystocia, retained placenta (retention of fetal membrane), metritis, prolapse (uterine and/or vagina), anoestrus and repeat breeding etc. causes enormous economic losses of the livestock population including dairy cows all over the world due to slower uterine involution, reduced reproductive rate, prolonged inter-conception and calving interval, negative effect on fertility, increased cost of medication, reduced calf crop and early depreciation of potentially used cows (Lobago *et al.,* 2006).

Reproductive disorders among farm animal is the great economic problems. It is particularly widespread among dairy cattle, but is of lesser significance in the beef breeds (Arthur *et al.,* 1989). Poor reproductive performance is a crucial production imitating issue. It has been reportable that reproductive disorders are accountable exceptional economic losses to the dairy farmers in Bangladesh (Talukder *et al.,* 2005). In European and American dairy herds, about a third of all cows are culled because of reproductive disturbances (Faruq, 2001). The occurrence of various reproductive disorders is increased in Bangladesh due to introduction of intensive cross breeding programme through artificial insemination (Faruq, 2001).

Reproductive diseases leading to prolonged intervals between calving and low conception rate reported earlier in Bangladesh (Shamsuddin *et al.,* 1988; Alam and Ghosh, 1994). The reproductive disorders are the major causes of reproductive infertility in cows that affect the total annual calf crop, resulting in great economic loss in Bangladesh. Economy of dairy farming largely depends on pregnancy rate after insemination. The twelve-month calving interval is advantageous for maximal milk yield per cow per year with good economic return (Opsomer *et al.,* 1996). It is accepted that bovine genital infections, either specific or non-specific in nature (Sirohi *et al.,* 1989) can delay the fertility status or productive performance such as post-partum heat period, days open and calving interval etc.

Nevertheless, the diseases and disorders of livestock are treated by the specialized Veterinarians related broadly to medicine, surgery and reproduction. Although the usual prevalence of diseases or disorders related to medicine is higher than that of surgery and reproduction related counterparts, the reproduction-related diseases or disorders cause most economic loss to farmers (Rahman *et al.,* 2013). Therefore, it is important to know the occurrence of reproductive related diseases or disorders for making future research plan for reducing occurrence of such diseases or disorders by proper diagnosis and treatment.

The differences in management (production) systems and environmental conditions under which cattle are maintained could greatly affect the occurrence of reproductive health problems. Dewan (1987) only surveyed the prevalence of different disease affecting the different systems of cross-bred cattle. Shamsuddin *et al.* (1988) studied the reproductive disorders of cross-bred cows with special reference to incidence of afterbirth in Savar Dairy Farm. The relative percentages of retained placenta, metritis, pyometra, endometritis, cervicitis, persistent corpora lutea, cystic ovaries and non functional ovaries were 42.26%, 10.38%, 8.15%, 27.39%, 1.52%, 1.17%, 3.13%, and 5.95%, respectively.

Zadeh (2013) focused a review on the potential effects of dystocia, stillbirth, abortion, retained placenta and metritis on the productive and reproductive performances in dairy cattle. Reproductive problems occur frequently in lactating dairy cows and can dramatically affect the subsequent productivity of a dairy herd. To ensure food security of our people we need to improve our livestock production first. Low birth rates and reproductive problems are main problems for growth of this sector. Even an apparently healthy animal may not necessarily be in a state of good reproductive health. Therefore, it is recommended that awareness creation to farm owners, attendants and improved management such as, proper feeding, accurate heat detection, considering the size of sire and dam while using AI, and health management should be improved to minimize the occurrence of these problems and associated economic losses in the dairy farms of the area.

In Bangladesh, around the year a large number of animals remain barren or unproductive having exposed many times for natural mating or artificial insemination and become a burden for the farmers. Researches to understand reproductive physiology and the disorders that limit the reproductive efficiencies are important for improving the production system and profitability of dairy farms. The cattle of Bangladesh mostly belong to small holder producers and are maintained on crop residues with limited supply of concentrates (Paul *et al.*, 2011). Reproductive disorders of dairy cows significantly reduce their productivity which is of great concern of dairy producers worldwide because most reproductive disorders adversely affect the future fertility. It has a negative effect on efficient milk production since pregnancy and parturition are prerequisite for the initiation and maintenance of lactation. Arthur *et al*. (1998) identified sub-fertility as the most important limiting factor in maintaining a good productivity in a dairy farm. Ultimately the reduce number of calf and less amount of milk production resulting farmer's become economically looser. For this reason, many farmer's closing their farms. Regular and successful reproduction is the key to profitable cattle production. When sufficient information about reproductive status of cow will be available then these disorders could be minimized.

The occurrence of different reproductive disorders in cows has been reported in Bangladesh by several authors (Shamsuddin *et al.*, 1988; Das *et al.*, 1995). However, except in metro thanas and upazilas near to Rajshahi city, very little work has been done to identify the clinical trends of reproductive disorders of dairy cows in Rajshahi district, especially situated in lowland and hilly areas. Therefore, the present study was undertaken and designed with the objectives of identification of reproductive problems and analysis its clinical trends (reproductive performance and disorders) of cows available in different Metro thanas and Upazillas of Rajshahi district of Bangladesh, which will certainly help to take different initiatives as preventive measures to control the incidence of clinical disorders of dairy cows and to improve productive and reproductive performance. There is a rationale to study the magnitude of major reproductive disorders in indigenous and cross-bred cattle which limit the reproductive performances in dairy farm in Bangladesh. The present study was undertaken with following objectives:

Objectives:

- To study the fertility status or reproductive performance such as age at puberty, age at first calving, post-partum heat period, service per conception, days open and calving interval of dairy cows in Rajshahi district.

- To evaluate the effect of breed, age, parity, body weight and body condition score on reproductive performance as well as management effects (farm size, housing system, feed quality, floor type, ventilation system and treatment pattern etc.).

- To know the effect of socio-economic status of farmers on reproductive performance (educational status and farming experience etc.).

- To explore the prevalence of reproductive diseases and disorders in cows in relation to genotype, age and farm size etc.

- To identify the impact of health, body weight, body condition and overall management on developing reproductive disorders.

Experiment-II: Study on biometrical measurement of reproductive organs in cows at study area

The cattle are important source of milk and meat in the whole world. Cattle occupy the first position of livestock population. It plays an important role not only in the rural economy but also in the national economy in Bangladesh. The current population of cattle 24.5 million (Ministry of Finance, 2013) and cannot met the demand against 16 crore people of Bangladesh. Regular and successful reproduction is the key to profitable cattle production. High reproductive efficiency is an important facet for achieving maximum return from the animal. But the production is hampered due to various reproductive diseases. Research on reproductive system of cow has got paramount importance from the stand point of national development. Any structural and functional abnormalities in reproductive system may interrupt animal reproduction (Shamsuddin *et al.,* 1988). The reproductive disorders of cattle can lead to economic losses in term of reduce fertility, longer inter calving interval and increased expense on medication in farms (Samad *et al.*, 1987). Ultimately its effects fall on the economic tract of this species.

The characterization of genotypes of livestock is the first approach to a sustainable use of its animal genetic resource (Tolenkhomba *et al.*, 2012). The dairy cattle improvement programme in Bangladesh aims to improve local cattle for milk production by incorporation of both tropical breeds (Sahiwal) and temperate breeds (Holstein- Friesian and Jersey). Body weight is an important economic trait in the selection of animals. It is often the most common and informative measure of animal performance (Adeyinka and Mohammad, 2006). It has been found very effective in assessing the reproductive efficiency and performance in cattle (Bongso *et al.,* 1984) and provide readily obtainable and informative measure for selection, feeding and health care (Thiruvenkanden, 2005).

The productive and reproductive performances of different cross-bred cows have been studied by several researchers and they showed that the Holstein-Friesian cross-bred performed comparatively better than others (Khan *et al.,* 2005).

Crossbreeding has been in practice for several years as a tool to improve production performance of our native cattle breeds. Holstein Friesian and Jersey are the two breeds of choice for crossbreeding (Lakshmi *et al*., 2009).

The reproductive performance depends upon the normal structure and functions of genital organs of an animal (Siddiqui *et al*., 2005). The knowledge of biometrical status of female genital tract is essential to perform artificial insemination, pregnancy diagnosis and dealing with the infertility problems (Memon, 1996). However, in a bid to increase and improve cattle production in Bangladesh, study on the effect of genotype/breed, age and body weight on reproductive organ of cow is essential for a maximum and rational utilization of the cattle breeding (Ibrahim *et al*., 2012). Furthermore, there is limited study that compared reproductive organ on morphometric characteristic of any genotypes, age and body weight groups of cows. Little is known on the anatomy and physiology of the female genitalia of tropical breeds of cattle (Kumar *et al*., 2004); compared to the exotic breeds (*Bos taurus*) been described by various authors (Getty, 1975; Napolcan and Quayam, 1997; Amle *et al.*, 1992; Newham, 2001).

Reliable information on the reproductive parameters of cattle of different genotypes, age and body weight groups and parities owned by farmers and nomadic farmers in Bangladesh is scanty in the literature. Superior dairy cows selection seems to be very important and alternative approach to boast up the production potential. Therefore, during selection of dairy cows for breeding/production special attention should be given on genotype, age, body weight, soundness of the sexual organ. Hence, the need for this study to provide a baseline data for teaching and further research on the anatomy and physiology of the reproductive system and for enhancing the reproductive capacity within the genotypes, age and body weight groups.

To date, no works have been recorded in Bangladesh the survey along with to the information about biometry of the reproductive tract in different genotypes, different groups of age and body weight and parity of dairy cows. Reproductive inefficiency is the most costly problems facing the livestock industry today. Therefore, the present study was undertaken the effect of genotypes and to ascertain the influence of age, body weight and parity on growth of reproductive organs in dairy cows and design to determine and compare the ovarian and tubular parts in morphometry of different genotypes, age and body weight groups and parities of dairy cows as well as to establish baseline data on the normal dimensions of different segments of the reproductive tract of cows in Bangladesh. The objectives are as follows:

Objectives:

- To examine the biometrical study of reproductive organs in cows at study area.
- To evaluate the effect of genotype, age, body weight and parity on biometrical study of reproductive organs in dairy cows.

Experiment-III: Study on the gross and histopathological changes of the affected organs

Most Asian countries are agrarian with 60-80% of the population related to farm operations. Livestock has been an integral component of traditional agriculture and cattle is playing one of the crucial role in agricultural operations in terms of the important source of milk, meat and hides, draft power, future herd expansion and contributes 2.67% of the total GDP of Bangladesh (BBS, 2010). It plays an important role in the rural economic and export trades of Bangladesh. Reproductive efficiency is an important facet for achieving maximum return from the animal. But the production is hampered due to various reproductive diseases.

The extent to which reproductive wastage reduces production efficiency is not well documented, for example there is currently no information available regarding the proportion of cows having reproductive problems at the time of slaughter or the percentage of culling rate due to genital disorders. Generally female animals are culled and sent to slaughter houses either because they are uneconomic to maintain or else because they have disease problem. Hence, local slaughter houses could serve as a good source for studying pathological condition of the reproductive organs of the cow. This study could be of value to understand the causes of sub-fertility, infertility or even sterility to some extent (Dobson & Kamanpatana, 1986; Thrusfiled, 1995). In cattle, the infectious diseases in reproductive organs as pyometra, metritis and endometritis etc. in long standing cases cause infertility (Roy, 2001).

There is no alternate of fertility, however reproductive disorders causes various problems ultimately leading to substantial economic losses through failure to produce or delay in producing the animal life calf, that lead to increased calving intervals and culling of useful breeding animal. It has also a negative effect on efficient milk production since pregnancy and parturition are prerequisite for the initiation and maintenance of lactation. It is generally assumed that sub-fertility is a major problem of dairy cows than the beef cattle (Arthur *et al.,* 1998). One of the major constraints of profitable dairy farming is low pregnancy rate (Alam and Ghosh, 1994; Shamsuddin *et at.,* 2001) and this low pregnancy rate is mainly due to different pathological disorders in reproductive system of cows. Reproductive disorders create a remarkable economic loss to the farmers (Mia and Islam, 1967). The common gynaecological problems leading to pregnancy failure are cystic ovarian degeneration (Bierschwal, 1966), retained fetal membrane (Dewan and Rahman, 1987; Shamsuddin *et al.*, 1988), uterine infection (Ghosh and Alam, 1988), abortion (Roche *et al.,* 1981), anoestrus (Hopkins, 1990), cervicitis and vaginitis (Youngquist, 1985). Considerable studies have been conducted on reproductive tract abnormalities of cows in many countries of the world and reported several abnormalities with different prevalence rates (Rogers *et al.,* 1972; Kanjilal *et al*., 1984; Biolatti *et al*., 1986; Kiran *et al*., 1995; Timurkaan and Karadas, 2000; Saxena *et al.,* 2006).

Specific and non-specific infectious agents during pre and post-partum periods frequently invade the reproductive organs and produce various diseases. Bacterial infection is the most important among the various causes of the sub-fertility (Dholakia *et al.,* 1987). Such a condition may cause cervicitis or endometritis of various degrees, which in turn may lead to embryonic death and repeat breeding problems (Elliott *et al*., 1968). The histopathological study of reproductive organs after slaughtering is known to be of paramount importance in the diagnosis and prognosis of the infection.

It is accepted that bovine genital infections, either specific or non-specific in nature, account for large number of pregnancy failure in cows. Generally non-specific infection of the genitalia is considered to be the main cause of repeated conception failure (Singh *et al*., 1996). Poor reproductive performances, a greatest economic treat, are often associated with failure in conception, infertility, embryonic deaths and abortion, and other gynecological disorders (Mia and Islam, 1967; Talukder *et al*., 2005; Banglapedia, 2013). It is particularly widespread among dairy cattle which are most valuable (Arthur *et al*., 1988). The incidence of endometritis has increased menacingly along with the introduction of intensive crossbreeding programme. Among the major causes of reproductive failure in cows in Bangladesh, endometritis is a major concern (Shamsuddin *et al*., 1988).

Reproductive inefficiency is the major problems but limited work done to address these problems in cows particularly in Rajshahi area. Investigation of reproductive abnormalities of cows based on slaughter house survey provides information on the prevalence of reproductive disorders and their occurrence (AL-Dahash & David, 1977). In Bangladesh, many female cattle are slaughtered year round. Under the circumstances, the female reproductive organs were collected from the slaughter houses at Rajshahi area with following objectives:

Objectives:

- To identify the prevalence of diseases in reproductive tract of cows at slaughter houses in Rajshahi.

- To study the gross examination of female genitalia collected from slaughter house animals.

- To evaluate the histopathological changes of the important pathological disorders.

Chapter 2

REVIEW OF LITERATURE

The reproductive performance of dairy herd depends on several factors, among them breed, body weight, age at puberty, age at first calving, post-partum heat period, service per conception, days open and calving interval are important for successful dairy rearing. In Bangladesh, the important reproductive disorders encountered are anoestrus, repeat breeder, endometritis and repeated conception failure (Samad *et al.,* 1978; Vale, 1997)) causing considerable economic loss (Jainuddin and Hafez, 1993). The importance of the study on the clinical trends (reproductive performance and reproductive disorders) in cows due to the various factors which have been recorded in the broad and abroad by many authors which are discussed under the different section.

2.1.1 Overall the reproductive performances of dairy cows

The reproductive performance of a dairy herd has a significant effect on the profitability of that herd. The best cows are clearly those that have their first calf at an early age, have minimum calving intervals, and live a long time. Thus the most important measures of reproductive performance in the female are age at first calving, days open, services per conception, length of calving interval, and estrus detection rate. Several factors influence reproductive performance, but none require more visual attention than heat or estrus detection (Dayyani *et al.,* 2013).

Fertility is the ability of male and female animals to produce viable germ cells, mate, conceive and deliver normal living young (Ensminger, 1969). The lifetime productivity of a cow is influenced by age at puberty, age at first calving and calving interval. First calving marks the beginning of a cow's productive life. Age at first calving is closely related to generation interval and, therefore, influences response to selection. Under controlled breeding, heifers are usually mated when they are mature enough to withstand the stress of parturition and lactation. This increases the likelihood of early conception after parturition. In traditional production systems, however, breeding is often uncontrolled and heifers are bred at the first opportunity. This frequently results in longer subsequent calving intervals. In zebu cattle, calving interval is longest in first-calf heifers and older cows, and shortest in cows of intermediate age (6-9 years old).

Puberty is defined as the process/time in which the young female become sexually maturated and capable of reproduction. In case of cattle, the onset of the first ovulation is considered as the time of puberty. Well-grown Holstein heifer will shows puberty 10-12 months of age. However, the time for the first insemination should be decided according to their body growth. Too early (young) pregnancy will cause dystocia at the time of delivery, because of the narrowness of the birth canal. In Japan, the recommended standard for the first insemination is body weight 350kg in pure Holstein. If the heifer reached this body weight at 15-month age and was pregnant, we can respect the first delivery at 2-year (24 months) of age. Age at first calving denotes the age when a heifer gives birth a viable calf. The cost associated with rearing heifers depends on their age at first calving, which in turn reflects the management choices and by farmers (Seegers and Beaudeau, 1996). First heat show after calving is called post-partum heat period. Average post-partum heat period i.e. interval from calving to first service must be less than 2.33 months to maintain a 12 month calving interval (Morrow, 1980). The interval to first service was found frequently to exceed 100 days in herds with reproductive problems due to poor heat detection (Morrow, 1980). The same author also reported that the interval to first service should not be longer than 60 days in herd which start breeding at 45 days. Early cyclicity after calving is of great importance in maintaining a profitable cattle industry. Service per conception is the average number of inseminations required for a successful conception (Hafes and Hafes, 2001). Minimum service per conception saves time and AI cost and therefore is desirable to dairy farmers. It is an important indicator of fertility (Payne, 1970). It is also a useful tool in analyzing the cost for servicing the cow and in comparing the fertility of cows (Sasaki *et al.*, 1991). An economic loss of the farmers results from the cost of semen and from misconception (Alam and Ghosh, 1988). The days open or calving to conception interval is the period from parturition to the subsequent service which results in pregnancy **(**John *et al*., 1997). In physiological events, days open period is dependent on the onset of ovarian cyclicity after calving, the occurrence of behavioral estrus and adequate fertility at mating. The interval from calving to conception that means days open in a commercial herd should be within 2-3 months post-partum. Pregnancy failure is common in cows that had a longer calving to first service interval. In Bangladesh, calving to conception interval i.e. days open at organized farm and in rural areas were recorded to be 5.9 months and 12.9 months, respectively (Alam and Ghosh, 1988). Calving interval may be defined as the interval between two successive calving. Successive calving must not exceed 365 to 395 days in a single cow to achieve maximum economic benefit **(**Haresign *et al*., 1983; Coleman *et al*., 1985).

Salisbury and Vendemark (1961) observed the S/C means the ratio number of services to animals and number of animal pregnant. Expressing relative fertility by service per conception was common practice for herds in which the outcome could readily be observed. The records of dairy herd improvement for primiparus Holstein cows of North Carolina state University herd and obtained on an average 2.4 service per conception. In a good fertility farm, the number of S/C should be a maximum of 1.3 (De Kruif, 1978). However, if it reaches to 2.0, the herd fertility should be considered as poor (Salisbury *et al*., 1978). Ideally, a dairy farm would run with good economic return when it could achieve 1.3 services per conception and 85 days interval between parturition and subsequent conception (De Kruif, 1978; Morrow, 1980).

Plasse *et al.* (1972) reported a maximum calving interval of 496 days in 12 to 16-year-old cows, with similar values for young cows 3-6 years old. Calving interval was shortest (424 days) in cows of intermediate age (6-9 years old). In the earlier, Plasse *et al.*, (1968) had also observed a tendency for calving intervals to shorten with increasing age in Brahman cows, as did Hinojosa *et al.,* (1980) in a commercial zebu herd in Mexico. In traditional production systems, however, breeding is often uncontrolled and heifers are bred at the first opportunity. This frequently results in longer subsequent calving intervals.

Coleman *et al*. (1985) observed the calving interval plays an important role on the profitability of a dairy herd. It may be defined as the interval between two successive calving. Successive calving should not exceed 365 to 395 days in a single cow to achieve maximum economic benefit.

Rawson (1986) stated that in a profitable dairy herd, achievable reproductive goal is 85 (days) days open.

Alderete *et al.* (1998) found that the values for the interval between calving and first service that means post-partum heat period and days open were 79 to 88 days and 90.9 days.

Shieferaw *et al.* (2003) found that the mean calving to first service interval that means post-partum heat period and days open were 132.4 ± 63.0 days and 154.9 ± 79.7 days in Ethiopia.

Williamson (1986) stated that if the conception occurred at 90 days post-partum heat compared to at 115 days post-partum that would have resulted 8426 kg of additional milk in a small midestran farm (50 cows/farm) of USA. He also reported that 25 days earlier conception of herd resulted in 18960 pounds of extra milk from cows for decreasing calving interval in a small mideastern farm of USA.

Alam and Ghosh (1988) stated the number of S/C is a simple, mostly practiced method of expressing fertility. The services (s) per conception is a useful tool in analyzing the cost for servicing the cow and in comparing the fertility of individual cow which eventually conceive after insemination with same ejaculate or ejaculates from bulls of known fertility. If conception and initiation of pregnancy do not result from the minimum number of services, there will be an economic loss to the farmers resulting from the cost of semen and the wastage days before conception.

Esslemont (1993) observed that the length of dry period and delay to next calving makes a farm uneconomic. This may be due to extra cost of feed for prolonged calving interval without any production.

Duschletta and Ern (1993) reported that monthly cost for delayed calving interval was FS 300-400.

Rahman *et al.* (1993) reported that the cows with retained placenta, abortion, pyometra, endometritis, uterine prolapsed, pneumonia, follicular cyst, mastitis, milk fever, lameness, dystocia and weakness had an extended calving to conception interval i.e. days open in Bangladesh. The author also stated that in

Sindhi and Friesian cross-bred cows the average calving interval was 420.4 ± 1.6 and 450.03 ± 1.9 days, respectively.

Wilson *et al.* (1994) considered a suboptimal reproductive performance of dairy herds as a major cause of financial loss. It is important to improve the viability and profitability of dairy herds in Bangladesh by identifying and removing the major causes of suboptimal reproductive performance. The review of related studies serves as a guideline in increasing income from dairy farming. There were a limited number of studies on cost and total opportunities of small holder dairy in Bangladesh. A few earlier attempts, such as studies by Hassain (2001) has focused on economics and fertility management of small holdering dairy farms in a contact dairy farming system maintained on high level concentrates supplementation in Bajitpur, Kishoreganj areas of Bangladesh.

Rahman *et al.* (1995) conducted a study to evaluate the reproductive status of the Zebu heifers and cows of Tangail Milk shed area. About 265 heifers and 900 cows of 25 to 90 months old by different societies of Milk Vita were included in this study. The heifers were studied for determining the age at puberty and the data on the cows were analyzed to determine the age at first calving, post-partum heat period and days open. In average, the age at puberty, age at first calving, post-partum heat period and days open were as 47.3 ± 0.6, 56.3 ± 0.5 months, 360.1 ± 0.5 and 360.6 ± 0.4 days, respectively.

Opsomer *et al.* (1996) suggested that calving interval of 365 days for maximum profit from a dairy farm. The achievement of a 365 days calving interval require early resumption of ovarian activity, an excellent rate of estrus detection and a high first service conception rate.

John *et al*. (1997) stated that the days open or calving to conception interval is the period from parturition to the subsequent service which results in pregnancy. This is the most widely used parameter to assess overall reproductive performance in a herd. They also stated that the pregnancy failure causes longer days open. Days open can be reduced by increasing efficiency of estrus detection. If estrus detection were improved from 50 to 70 percent, the net effect would be 24 less days open.

Jainudeen and Hafez (2001) observed that the genotype of calves, failure to detect estrus, anoestrus due to poor nutrition, early embryonic death, sale or death of calves, environment of the farms and periparturient diseases like retained placenta, abortion, pyometra, endometritis, uterine prolapse, pneumonia, follicular cyst, mastitis, milk fever and dystocia were important factors, which influences the days open. He also stated that to maintain a 12-13 months calving interval in a dairy herd, at least 90% of cows should show estrus by day 60 post-partum and conceived by 85 days post-partum. The author suggested an optimum calving interval from 360 to 390 days. Shorter calving interval is helpful for greater profitability through increased calf and milk sales.

Shiferaw *et al.* (2005) conducted to estimate the proportion of reproductive disorders and to determine factors affecting reproductive performance of cross-bred dairy cows under four different production systems in the central highlands of Ethiopia. The principal post-partum reproductive disorders were retained fetal membranes (14.7%) and uterine infection (15.5%). Anoestrus was the major post-partum reproductive problem in the mixed crop-livestock production system (38.6%) and was significantly associated with this production system. Cows with reproductive disorders in each production system, lactation group and suckling and non-suckling group had longer post-partum heat period and days open and required more services per conception. Pregnancy rate and conception to first service were 84.7% and 51.7%, respectively, for cows without reproductive health problems; and 64.2% and 15.1%, respectively, for cows with reproductive disorders. Overall, post-partum heat period were shorter than in younger cows. Cows with a good body condition score (>3.5) at calving had shorter post-partum heat period and days open than cows in poor condition.

Montiel and Ahuja (2005) reviewed the effect of body condition on duration of post-partum anoestrus in cattle. The main factors affecting the duration of post-partum anoestrus in cattle were the nutritional status (measured by BCS). Some other factors such as breed, age, number of calving, milk yield, calving season, presence or absence of the bull, delayed uterine involution, dystocia and general health status influenced duration of post-partum anoestrus. Low body energy reserves of cows greatly increase the probability of suffering from metabolic disorders, reproductive failure, reduction in milk yield and delayed puberty.

Dairy cows with excessive fat reserves or over-conditioned at calving were found to have a greater risk of health and reproductive disorders, such as dystocia.

Haider (2007) studied on reproductive performance of dairy cows using an observational study of 500 cow data from 50 farms of four upazila of northern Bangladesh. The author recorded the calving to first service, calving to conception and calving interval were 96.3± 64.1, 132.5 ±87.2 and 524.3 ±195.2 days, respectively. The number of services required per conception was 2.5 ±2.4. About 71% cows (n = 201) received first service within 90 days post-partum and 52% cows (n =151) conceived within 115 days post-partum. The study found that breed, BCS, seasons of calving had a significant role in influencing the reproductive performance of dairy cows. The study also indicated that planned reproductive health management is essential for ensuring better reproduction of co-operative dairying.

Hossain (2013) studied to evaluate the reproductive performances of dairy cows at different upazila in Sylhet, viz: Beanibazar, Biswanath, Kanighat, Companigong and Golapgong. A total of 190 cows were selected to collect data in respect of breeding age, calving age, calving interval, and first service conception rate, number of service per conception, calf mortality yield and effect of breed and seasons on reproduction through a questionnaire. The highest age at puberty and age at first calving of cows in month (28.7 ± 6.5) and (41.5 ± 6.3) were observed in Biswanath upazila compared with lowest Golapgong (26.0 ± 5.5) and (38.0 ± 5.7) ($P<0.05$). The highest post-partum heat period was observed in Beanibazar (90.4 ± 19.2) compared with lowest (80.7 ± 21.3) days in Golapgong. The days open was the highest (107.5 ± 27.4) in Companigong upazila compared with lowest (99.5 ± 41.9) days in Golapgong ($P>0.05$). The cows in Kanaighat upazila took longer calving interval (417.4 ± 110.4) compared with lowest (395.1 ± 54.6) days in Beanibazar upazila. The cows in Biswanath needed the highest number of services per conception (1.54 ± 0.9), whereas the lowest (1.27 ± 0.7) was in Kanaighat.

2.1.1.1 Breed of cows

Sharma and Singh (1980) observed that breed might influence calving interval. He found short calving interval was in Jersey × Haryana, Friesian × Haryana and Brown Swiss × Haryana cows. In Zebu cows, calving interval ranges from 366 to 789 days (Mukasa-Mugerwa, 1989) and it is longest between first and second parity and older age, but it is shorter in intermediate age (Kumar and Bhat, 1979; Singh *et al.,* 1983).

Rahman *et al.* (1987) reported that 385.13 ± 25.5 to 495.75 ± 74.56 days calving interval in various types of Zebu cows and their crosses with *Bos taurus* cows. In Friesian x Local crosses calving interval was 430.20 ± 3.75 days in India (Butt and Deshpande, 1986).

Trial and Gregory (1981) observed shorter calving interval in Sahiwal cows than that in Brown Swiss cows. Calving interval is longer in dairy breed than in beef breeds. It was 512.5 and 352.6 days in suckled and non-suckled cows, respectively (Eduvie and Dowuda, 1986). Chaudhuri *et al.,* (1984) showed 2.8 ± 0.03 services per conception in Haryana cattle.

Eduvie (1985) stated that the extensive selection of different breeds of cattle has been made in favour of production traits ignoring their fertility. Therefore, it is likely that the fertility of different established breeds and their crosses may differ from one another. For instances, high producing Sahiwal-cross cows ovulated earlier than Holstein cross (Fonseca *et al*., 1983). Dairy breeds usually had shorter post-partum heat period than beef breeds (Garcia, 1988).

Filfo *et al*. (1986) examined the average age at first calving in Red Sindhi in Brazil was 46.6 months, where as in India, it was in between 36.6 and 51 months (Gurani *et al.,* 1971). Jabber and Green (1983) stated an extended age at first calving in Bangladesh because of using heifers in draught work; the heifers took up to 4 years to calf for the first time. Age at first calving delays, if young animals are used in heavy work and/or suffer from nutrition deficiency.

Garcia (1988) stated that the interval between the calving and onset of first observe post-partum estrus that means post-partum heat period depends of breed and parity of the cow. PPHP in cattle of nine different types using the data collected from Savar Dairy and cattle improvement farm was studied. The author observed the longest average post-partum heat period (PPHP) 223.5 ± 40.1 day was obtained in $^{1}/4$L × F cross-bred and lowest 117.2±7.2 days was in $^{1}/2$L × SL. The author also stated the crosses of zebu with *Bos taurus* tend to have a better conception rate and thereby a lower number of services per conception in comparison to the zebu cattle.

Jabbar and Ali (1988) studied the productive performance of local and cross-bred (L × HF and L × SL) cows in Bangladesh and the average value of service per conception were 1.7 ± 0.8 and 1.9 ± 0.7, respectively. The value of s/c of cross-bred, local (milk) and local (draft) were 1.6 ± 0.5, 1.2 ± 0.3 and 1.7 ±0.5, respectively.

Shamsuddin (1988) worked with a total of 626 pregnancies among 660 cows and 137 pregnancies among 142 heifers reported service per conception to be 1.69 and 1.86, respectively. Some factors affecting number of service per conception in purebred Friesian and its cross with native Iraqi cattle and found that cows those yields less than 2000 litre of milk per lactation required 3.0 services per conception.

Khan (1990) examined the number of insemination per conception increased with age of sexual maturity from 1.1 to 2.8 in Holstein-Friesan, 1.0 to 2.48 in Ayrshire and from 1.0 to 3.3 in Brown Swiss. An average 1.59 services were required for each conception for local cows. This value for Sindh x Sahiwal, Local x Friesian, Local x Jersey, Local x Holstein, Sahiwal x Friesian and Sindhi x Friesian was found to be 1.8, 1.8, 1.7, 1.8, 1.7 and 1.8 respectively. The average conception rate of local and cross-bred cows was 77.7 and 74.5%, respectively and service per conception was 1.3 and 1.4, respectively.

Halim (1992) observed the average calving interval of local and cross-bred dairy cows was 445 and 425 days, respectively.

Roy and Tripathy (1992) stated that the genotype is one of the main influencing factors on age at first calving. The other influencing factors are adaptability to the local environmental conditions and management practices including nutrition, body weight, methods of feeding, sanitation, housing, ventilation, and disease prevention, parasite control, breeding and rearing practices of cows (Rawson, 1986; Kunzi *et al.,* 1996; Singh *et al.,* 1999 and Goni, 1999).

Tiboo *et al.* (1994) stated that the mean performance for Jerseys and Friesian respectively were age at first calving 29.4 months and 31.2 months, days open 157 and 147 days, calving interval 416 and 423 days, service per conception 2.0 and 1.5 and concluded that the Jersey crosses were superior in tropics in relation to the Friesian or Sahiwal and indigenous breeds.

Rahman *et al.* (1995) stated that the age at first calving varies between breeds and within breed maintained in different countries age at first calving was 56.3 ± 0.5 months in Tangail milk shed area.

Pellerin *et al.* (1995) suggested a reduction of age at first calving from 28-29 months to 25-26 months, to reduce the rearing cost of heifers in Canada.

Sultana (1995) collected date on the basis of S/C of 540 animals of various genetic group and observed that S/C of local (L), Sahiwal (SL), Sahiwal x Friesian, Jersey (J), Local x Sahiwal and Local x Friesian were to be 1.8 ± 0.2, 1.1 ± 0.7, 2.1 ± 0.0, 2.0±0.3, 1.2 ± 0.0 and 1.7 ± 0.2, respectively.

Ghosh (1995) observed the number of S/C were 1.6 ± 0.2, 1.7 ± 0.2, 1.6 ± 0.2, 1.7 ± 0.2 and 1.8 ± 0.2 for F x L, SL x L, F x SL x F, J x L and S x L, respectively.

Tesfu Kasa (1996) investigated post-partum reproductive activity of 72 cows, 41 indigenous Zebu and 31 Friesian x Zebu cross-bred, from 14 small holder farms by using plasma progesterone profiles determined by solid-phase radio immunoassay. Post-partum intervals (Mean ± SD) and days open were 110.4± 23.5 and 199.8± 61.8 days for Zebu and 97.5 ± 25.1 and 157.8 + 55.5 days for cross-bred cow. These values were significantly ($p<0.05$) affected by nutritional status in both genotypes. The pregnancy rates of zebu and cross-bred were 48.8 and 54.8 percent, respectively. The findings indicate that the Friesian blood as well as better nutritional status considerably reduces the interval for resumption of post-partum ovarian cycles and the interval between calving to conception i.e. days open.

Kunzi *et al.* (1996) observed the weight and age at first calving for Holstein, Jersey and Simmental breeds were 580 kg and 24 months, 380 kg and 24 months and 640 kg and 30 months, respectively.

Sarder *et al.* (1997) found Holstein-Friesian cross-bred cows requiring the longest time (149 days) to onset of post-partum estrus compared with the local ones (119 days); consequently, the Holstein-Friesian crossbred cows remained open for the longest period (158 days). The author also reported the local cows required fewer services per conception (1.4) than the cross-bred animals (1.8).

Japri *et al.* (1997) studied the calving interval of cross-bred dairy cattle at the institute, Malaysia, during the period from 1974-91. The sires were as Friesian, Gir, Sahiwal, Australian Friesian × Sahiwal, Brahman × Holstein or Sahiwal x Friesian crossed with *Bos indicus* dams and noted that the cross-bred sired cows had slightly longer calving interval (20 days longer).

Nagare and Patel *et al.* (1997) observed that there were not found any difference between breeds of Holstein x Ayreshire and pure breeds of Holstein and Ayreshire in age at first calving.

Mondal (1998) observed the average calving interval of Jersey cross, Sahiwal cross, Sindhi cross, Holstein cross and Red-Chittagong cows respectively in Bangladesh Agricultural University Dairy Farm were as 501.4 ± 86.4, 446.0 ± 95.3, 414.1 ± 51.6 and 469.3 ± 123.8 days, respectively.

Rahman (1999) reported the fewest days open in cross-bred Friesian than local cows (148.6 ± 89.2) and (188 ± 106.7) days, respectively.

Hoque *et al.* (1999) obtained the average calving interval of Pabna, Sahiwal × Pabna and Friesian × Pabna were 16.3 ± 4.3, 15.5 ± 4.1 and 13.7 ± 3.6 months, respectively, in Baghabari milk producing area of Bangladesh. Calving interval is longer in dairy breeds than in beef breeds. It was 17.0 and 11.7 months in suckled and non-suckled Bunaji cows, respectively (Eduvie and Dawuda, 1986).

Shamsuddin *et al.* (2001) reported a shorter calving to conception interval that means days open in cross-bred Sahiwal cows than that in cross-bred Friesian and local. The author also observed the calving to conception interval i.e. days open was shorter in cows used for only dairy (181 days) than in that used for dairy +

draught (233 days). He also stated that breed, body condition at artificial insemination (AI), weaning, purpose of rearing cows (dairy vs. dairy + draught), number of suckling and month of calving had significant effect on interval between calving to conception. The author also reported an average service per conception of 2.2 in selected areas of Bangladesh.

Goni *et al.* (2001) collected a total of 146 cross-bred dairy cows (112 Sahiwal × local and 34 Holstein-Friesian × Local) were selected and observed for their productive and reproductive performance. It was found that the productive and reproductive performances of HF × L were better than of SL × L cross-bred cows.

Sarder (2001) observed reproductive performance of 313 progenies. Information were collected from 40 artificial insemination subentries or points under the District AI centre, Rajshahi at greater Rajshahi district over a period from 1993 to 2002. The mean reproductive and productive parameters such as age at puberty, age at first calving, service per conception in heifer, onset of post-partum estrous, service per conception, days open and caving intervals were 27.9 months, 38.7 months, 1.68, 139 days, 1.6, 160 days and 438 days, respectively.

Haque *et al.* (2002) studied on some indigenous cows, which reared in urban area to evaluate reproductive performances. The effects of management level were significant on PPHP ($P<0.001$) and CI ($P<0.001$). The overall mean values were 35.3±0.40 months for AFP, 37.2±0.7 month for conception, 46.2 ±0.4 month for AFC, 1.3± 0.1 for no. of services for conception, 182.9± 4.8 days for PPHP and 450.5±0.2 days for CI.

Shamsuddin *et al.* (2006) investigated a opportunities for interventions to increase dairy farmer's income in four areas of Bangladesh, inludung the district of Mymensingh, Khulna-Satkhira, Sirajgonj-Pabna and Chittagong. Age at first calving was 37 months in Sirajgonj-Pabria, district while it was 40, 35 and 33 months for Mymensing, Khulna-Satkhira and Chittagong, respectively.

Auldist *et al.* (2007) have done a comparative study on the reproductive performance of Local x Holstein cows in predominantly Holstein herds in a pasture based dairying system of Australia. The author compared Holstein cows with L×5 H cows which had higher first service conception rates (52 vs. 42%).

The author suggested that the improved reproductive performance of L × H cows compared with Holstein cows may render them more suitable for use in dairy herds with better management system.

Asimwe and Kifaro (2007) conducted a study was to evaluate the effects of breed level and non-genetic factors on reproductive performance of dairy cattle under small holder farms in Bukoba district, Tanzania. Data on age at first calving (AFC), number of services per conception (NSC), days open (DO) and calving interval (CI) were collected from Kagera Dairy Development Trust (KADADET) in Bukoba district. The fixed effects considered in the analyses were genetic group, parity and calving. The overall mean for AFC was 35.1 ± 9.7 months, NSC was 1.66 ± 0.0. Further, the mean DO was 205.2 ± 2.6 days and CI averaged 480.4 ± 2.4 days. AFC was significantly affected by period of birth ($P<0.001$) and level of exotic blood ($P<0.05$). Genetic group significantly influenced NSC, CI ($P<0.05$) and DO ($P<0.001$). F_1 crosses performed better than high-grades in all the traits with 34.6 months of AFC, 182 days of DO, and 455 days of CI. Parity and period of calving significantly affected NSC ($P<0.05$), DO ($P<0.01$ and $P<0.001$), CI ($P<0.05$ and $P<0.001$) respectively. For these traits, performance was improving by advancement in age of cows.

Kollalpitiya *et al.* (2012) conducted a study to assess the production and reproductive performance of up country dairy cattle breeds in Sri Lanka. A total of 200 dairy cows were selected for the study from 4 breeds (Friesian, Ayrshire, Sahiwal and Cross-bred). The traits studied were age at puberty, age at 1st calving, post-partum heat period and calving interval for 6 lactation periods. It was revealed that the age at puberty (23 months) and age at 1st calving (33 months) of Friesian were lower ($p<0.05$) than those of other breeds. Mean lowest ($P<0.05$) post-partum heat of 75 days was recorded from Sahiwal. The lowest ($p<0.05$) calving interval of 403 days was reported from Sahiwal compared to other breeds. Reproductive and productive performances of Friesian and Sahiwal breeds were better than Ayrshire and Cross-bred cows. Lowest average age at puberty and age at 1st calving were reported from Friesian, whereas, the lowest mean post-partum heat and calving interval were recorded from Sahiwal.

Tsegaye *et al.* (2014) revealed that age at first calving, calving interval and number of service per conception of Arsi zebu, cross less than 50%, greater than or equal 50%, boran and Jersey were 36.39, 24.78, 24.29, 12.88 and 24.54 months, 420.2, 360.4, 330.3, 330.8 and 360.4 days, and 1.18, 1.50, 1.72, 2.17 and 2.29, respectively. The age at first calving, calving interval and number of service preconception in the different breeds were statistically significant ($P<0.05$). On the other hand, the major factors that were found to influence the reproductive performance of cattle in the study area were feeding system, breeding type (AI or natural) and daily milk yield. Besides, this study showed that the most commonly encountered health problem with their prevalence rate were retained fetal membrane 8.4%, milk fever 4% and uterine prolapsed 1%.

Rahman and Kalita (2015) observed the production and reproductive performance of local cattle of Mizoram state of India. A total 300 dairy cattle were studied from all the eight the districts of the state by using survey method. They recorded that the average age at puberty (31.45± 0.87) months, age at first service (32.65±0.96) months, age at first calving (43.60±0.96) months, calving interval (533.63± 0.87) days, post-partum heat period (210.1±0.19) days and service per conception 2.47±0.11.

2.1.1.2 Age of the cows

The age of the cows is an important determinant of the fertility. It is apparently influences the onset of estrus and fertility after calving (Galina and Arthur, 1989) and it has been seen that older cows resume cyclicity earlier than younger ones (Bulman and Lamming, 1978). Huszenicza *et al.*, (1987) observed an increased acyclic period in cows after their fourth calving. Larsson *et al.*, (1984) and Eldon (1988) reported that post-partum ovarian activity varied insignificantly with age and parity. The detection of estrus in cows and skill of inseminator were the important determinant of service per conception for conception (Ashraf, 1998; Talukder *et al.,* 2001). Number of service per conception depends on the age and reproductive efficiency of cows (Azzaam *et al.*, 1989), parity (Izaike *et al.*, 1984) and body weight at the time of service (Yaudan and King, 1997) and management of cows (Coleman *et al.*, 1985; Shamsuddin *et al.*, 2001).

Tenable and Salisbury (1946) observed from their of 12621 cows and heifers bred by artificial insemination, that fertility increase up to 2 years of age, leveled off unit 6 years of age, then gradually declined.

Spalding *et al.* (1975) reported slight increase in the fertility of cows up to 3 to 4 years of age and a decline after 4 years of age. They found a marked decline in fertility in the cow over 7 years of age.

Gwasdawskas *et al.* (1975) found that conception rate declined with age as follows: heifers 47.6%, young cows 42.7% and older cows 31.9%.

Coleman *et al.* (1985) reported that reproductive performance had become poor with the advancement of age. The effect of age is not clear, but some other reports show that the interval to first estrus is shorter for middle aged cows and it increases in older animals. The pregnancy rate is lower in animals which have calved for the first time than in animals over 7 years of age (De Kruif, 1975).

Garcia (1988) studied the effect of breed, parity and age of calving on the calving to first service interval and observed that calving to first service interval in Zebu cattle, undefined cross-bred and European × Zebu cross-bred were 300.04, 210.62 and 240.69 days, respectively. The calving to first service interval i.e. post-partum heat period was earlier in old cows than that in the first calver cows. Alam and Ghosh (1989) reported the post-partum heat period in non-descript Zebu cattle to be 120.15 days in an organized farm in Bangladesh.

Xhag *et al.* (1994) studied the Black and White cows in China and found a relatively low survival of calves when the dams were <24 months old (60-88.8%); the survival rate increased with the increasing age of the dams. The calves of cows aged 24-36 months at first calving had a survival rate of 90.7 to 92%. The mortality of newborn calves of 17 to 24 months old cows was mainly due to dystocia. They suggested an optimum age at first calving of 25-28 months.

2.1.1.3 Parity of cows

The parity of cows over a period of time is an important index of reproductive efficiency. Parity may be obtained through recording, but a direct measure of parity where no records are available would be a valuable manage mental tool.

Parity is found to exert an effect on the onset of post-partum ovarian cyclicity in dairy cattle (Alam and Ghosh, 1988; Chanteraprateep and Humbert, 1993; Pereira *et al.*, 1995). First parity cows had longer intervals from calving to first post-partum ovulation and calving to first estrus than cows of >3rd parity. The cows of 2nd and 3rd parity showed the best performance (McDougall *et al.,* 1995). The interval from calving to onset of ovarian activity became progressively longer as the number of parities increased (Darwash *et al.,* 1996). Cows in their 2nd and 3rd lactation had best performance with regard to onset of ovarian cyclicity (McDougall *et al.,* 1995; Pereira *et al.,* 1995). The cows of >4 parities had longer anoestrus period after calving (Alam and Ghosh, 1993; Darwash *et al.,* 1996), but Grohn and Rajawala (2000) did not find any significant effect with parity in relation to the onset of post-partum ovarian cyclicity. On the other hand, Barcellos *et al.,* (1996) reported a higher conception rate in multiparous cows than that in primiparous cows.

Eduvie (1985) observed that the post-partum first ovulation was earlier in cows that had >2 calving or of over 5 years old than in those of 3-5 years old cows.

Rao and Rao (1996) studied in 47 Jersey cows that had completed 5 lactations from a farm in Andhra Pradesh and reported a average age at first calving of 25.1± 0.3 months (ranged from 19.3 to 30.8). Howlader *et al*., (1996) observed the onset of post part-partum ovarian cyclicity and calving to conception interval in dairy cattle due to parity influence.

Okeyo *et al.* (1998) observed a total of 16 220 calving intervals (CI), calving rates (CR), and 12 532 weaning weight records of Kenya Boran cows and calves from five ranches, distributed in three different ecological zones were analyzed to estimate effects of parity, previous parous status (PPS), and sex of calf on reproductive and productive traits. Reproductive traits were CI and CR, while productive traits comprised 270-day weaning weight (calf 270) and two different productivity indices: cow index I and cow index II. Parity significantly affected CI and CR (P<0.01) and 270-day adjusted weaning weight and the four indices (P<0.01). Mean CI estimates ranged from 434 ± 6.1 days for first parity cows to 426.8 ± 8.0 days for cows in their 4th parity, while cows in the 7th parity and above average 421.5 ± 15.5 days. Cows that did not calve in the previous parity had mean CI of 422.2 ± 11.4 days while those that had weaned calves, aborted, or had still birth had mean CI estimates of 425.7 ± 2.9, 412.7 ± 14.9 and 423.6 ± 9.8 days, respectively. Calving rates ranged from 82.7 to 91.9% for 1st and 6th parity cows, respectively, with cows in their 7th parity and over, recording 89.4% for this trait.

Fourichon *et al.* (2000) stated that the lactational anoestrus significantly influences days open. The author also blamed estrus to be associated with 41 more days to conception. They observed that there were no effect of still birth, milk fever, displacement of abomasums and mastitis on reproduction.

Than *et al*. (2001) reported an increased conception rate with advancing parity from parity 2 upto 6, and then declined at parities 7 and 8. Interval between estrus detection and AI influences the conception rate. The calving interval is longer between first and second parity and at older ages and shorter in intermediate age (Singh *et al.*, 1999). Zu and Zun (1997) reported a first service conception rate of 63-71% in cows at their first 3 parities; this was higher than that in later parities. However, the trend for decreasing conception rate was evident as age increased.

Sattar *et al.* (2005) collected the data concerning reproductive and productive performance parameters of Holstein-Friesian cows being maintained at the Livestock Experiment Station, Bhunikey (Pattoki), District Kasur during the period from 1991 to 2000. The parameters of reproductive and productive performance, i.e. age at puberty, age at first conception, age at first calving, services per conception, days open and calving interval were studied. The average values for age at puberty, age at first conception and age at first calving were 20.70 ± 6.98, 23.74 ± 9.72 and 32.87 ± 9.81 months, respectively. The average days open and calving interval in these cows were 113.34 ± 3.45 and 505.02 ± 8.28 days, respectively. Effect of parity on these parameters was statistically non-significant. The average number of services per conception was 3.07 ± 0.10. The differences of the number of services per conception during 6th lactation with those of 1st and 8th lactation were statistically significant ($P<0.05$).

Goshu *et al*. (2007) a retrospective study was carried out at Stella Dairy Farm, Ethiopia, using 13 years data (1993 to 2006) to estimate number of services per conception (NSC), days open (DO), calving interval (CI) and productive age

(PA). Fixed factors considered were parity (8+) and year (13). The overall mean for NSC, DO and CI were 1.72 ± 0.05 (n=619), 177 ± 5.4 (n=448) days and 456 ± 5.4 (n= 423) days, respectively. Parity had significant effect ($P<0.05$) on NSC, DO and CI ($P<0.001$). Birth year significantly affected the variables. About a third of the heats inseminated required two or more services.

Hammoud *et al*. (2010) studied some factors affecting reproductive performance of a locally-born Friesian herd in Egypt. A total data of 2096 reproductive records representing 482 Friesian cows daughters of 38 sires raised at the Dairy Unit of Milk and Meat Project of Faculty of Agriculture, Alexandria University, Egypt, between 1985-2002 were utilized to study the effects of sire of the cow, age at first calving and year of calving/birth and parity on post-partum heat period, days open, calving interval, number of services per conception, age at first calving and breeding efficiency. The overall means of post-partum heat period, days open, calving interval, number of services per conception, age at first calving and breeding efficiency were 88.4 ± 1.1, 130.7 ± 1.9, 403.1 ± 1.9 days, 2.1 ± 0.1 services, 30.7 ± 0.1 months and 90.1 ± 0.6 %, respectively. The influence of age at first calving on post-partum heat period was highly significant ($P<0.01$) and not significant on days open, calving interval, service per conception and breeding efficiency. A decreasing efficiency in reproductive performance of cows was observed over time. Parity had highly significant effect ($P<0.01$) on post-partum heat period, days open and calving interval and had insignificant effect on service per conception. Generally, post-partum heat period, days open and calving interval decreased with increasing parity.

Lemma1 *et al.* (2010) conducted a study to assess the reproductive performance of cattle in Wolaita Sodo State Dairy Farm, Southern Ethiopia. The study breed was mainly kept in the farm on pasture land and with some supplementary feeds. The results revealed an overall mean of age at puberty, age at first calving, calving interval, days open and number of services per conception of 24.24 months, 34.51 months, 450.09 days, 174.68 days and 1.79, respectively. All the traits were significantly influenced by year of birth ($P<0.001$). Age at puberty was significantly lower in imported cattle while calving interval was lower in on-farm raised cattle ($P<0.001$). Calving interval and days open were decreasing significantly with parity number ($P<0.001$). Both traits were influenced significantly by year, sex of calves and parity of the dam (P<0.01).There was a trend of increased birth weight of calves as the parity number of the dam increased.

Bahmania, *et al*. (2011) conducted a study to identify the reproductive performance, and genetic and non-genetic factors affecting the performance of Kurdi crosses with Holstein and Brown Swiss under rural small holder management. The cross breeding data were related to 210 herds, 885 cows and 970 calving intervals from two calving periods of 1998-2001 and 2004-2007. The traits of interest were age at first calving (AFC), days open (DO) and calving interval (CI). The means of AFC, DO and CI for cross-bred cows were 27.9 ± 5.4 months and 113.16 ± 47.3 and 390.19 ± 47.1 days, respectively. Parity number had significant effect on next DO and CI (P<0.01).

Motlagh *et al*. (2013) carried out a study to evaluate the reproductive performances of Iranian dairy cattle at Tehran and Ghazvin Provinces. Reproductive traits included: calving interval, days open, and service per conception. A total of 2500 cows were used in this trial. Cows were classified into seven groups according to the age at calving (22 to 23, 24 to 25, 35 to 36, 47 to 48, 59 to 60, 71 to 72 and 93 to 104 months, respectively). The effect of age at calving and parity on reproductive performance was significant (P<0.05). Reproductive performance decreased from parity ≥6.

Zewdu *et al.* (2015) evaluated the effect of non-genetic factors on reproductive performance of Holstein Friesian × Deoni crossbreeding cows. A total of 254 HF × Deoni cross-bred cows from cattle crossbreeding project with 1485 total records of lactation over a 30 years period. The parameters used as indicators of reproductive performance in this study were age at first calving, post-partum heat period, days open and calving interval. The overall mean of age at first calving, post-partum heat period, days open and calving interval were as 39.54 ± 8. 18 months, 126.90 ± 1.76, 149.15 ± 3.87 and 422.95 ± 2.53 days, respectively. First parity cows had longer post-partum heat period, days open and calving interval.

2.1.1.4 Body weight and body condition score of cows

Body size is an important genetic factor in beef cattle production. Historically, size was first estimated by measurements such as height or length. As scales were developed, weight became more common as a measure of size. Measurement and weight are related but their rates of maturity differ. By 7 months of age, cattle reach about 80 percent of mature height but only developed 35 to 45 percent of mature weight. At 12 months, about 90% of mature height is reached, compared to only 50 to 60% of mature weight. Weight is often used to characterize body size, but a mature cow weighing 1,100 pounds in moderate fatness or body condition weighs only 800 pounds when extremely thin and 1,500 pounds when extremely fat. So, size is more accurately characterized by including relevant factors other than weight, such as skeletal size and body condition.

Body condition scores are an excellent indicator of reproductive performance. Evaluating cows/heifers early allows producers to change BCS as needed. The most practical method to estimate the energy reserves of cows is by evaluating the proportion of body fat via body condition scoring (BCS). Reproductive performance is greatly impacted by total body energy reserves (body condition) at specific times during the production cycle. If cows are thin at calving, reproductive performance in the subsequent breeding season will suffer, resulting in reduced yearly profits per cows.

The Body condition score (BCS) at calving and initiation of luteal activity negatively influenced the interval to the onset of ovarian function (Shamsuddin *et al.,* 1998). Cows calving at good BCS were capable to resume ovarian cyclicity within 60 days post-partum regardless pre and post calving change in body weight (Randel, 1990; Bolanos *et al.,* 1997). Changes in BCS between days 7-10 before and day 7 after calving may affect normal hypothalamo-pituitary function (Osawa *et al.,* 1996).

Houghton *et al.* (1990) found that poor body condition cows gaining condition score increased the probability of cows becoming pregnant, however, fleshy (fat) cows losing condition improved pregnancy rates, and fleshy (fat) cows (obese) increasing condition score decreasing the probability of becoming pregnant. The key to maintaining BCS for optimum reproductive performance is maintaining the cows in moderate condition. Cow BCS at calving affected length of the PPHP with thin cows (BCS <5) exhibiting an extended PPHP of over 80 days, which represents a post-partum anoestrus interval 28 to 58 days longer than that exhibited by either moderately conditioned or fleshy cows (BCS >5). For optimum production (one calf per year per cow) cows need to maintain an acceptable PPHP of 60 days or less.

Osoro and Wright (1992) collected a total of 321 spring-calving cows to observed the effects of body condition, live weight, cow age (from 4 to 13 yr), and breed (237 Hereford x Friesians and 84 Blue-Greys) on reproductive performance. Body condition at calving and breed were the most significant factors affecting reproductive performance. Cows calving in higher body condition had shorter ($P<0.001$) calving intervals (11.2 d per unit of body condition at calving). Blue-Grey cows became pregnant in a higher proportion (90%) and calving interval was shorter (364 d) than in Hereford x Friesians (83%; 374 d). Body condition at the start of mating was less important and body condition at the end of mating had no effect.

Senators *et al.* (1996) observed the balanced diet and body weight were important determinant of the interval between calving and first ovulation in cows

Brosaster and Broaster (1998) stated that the condition score at calving is dependent upon pre and post calving feeding programme and early lactation performances of the cows. Cows with a body condition score of 3.5 have the shortest interval between calving and onset of post-partum heat period (Ribeiro *et al.,* 1997). The effect of level of feeding on the duration of anoestrus period after calving is significant in the thin conditioned cows. Both body condition at calving and feeding after calving influence the duration of length of post-partum anoestrus period (Wright *et al.,* 1992). Cows with poor body condition score had lower LH pulse frequencies than did cows in good condition (Wright *et al.,* 1992).

Shamsuddin *et al.* (2001) reported that cows with body condition score 3.5 or more at AI used only for dairy and suckled twice or less had shorter interval between calving and conception that means days open compared with cows having ≤2.5 body condition score, used for dairy+draught and suckled continuously.

Drennan and Berry (2006) collected a total of 925 records on 299 cows during the period from 1987 to 1999 to identify the factors affecting live weight (LW), body condition score (BCS), calving rate and calving interval in spring-calving suckler cows. Cows calving early in the year (<day 65 of the year) were significantly heavier at the start of winter, had greater BCS at the subsequent calving but lost most LW in winter. Trends in BCS were similar to LW but there was no effect of calving date on annual BCS change. Cows in parity 1, 2, 3 to 7 and >7 had initial LW of 523, 549, 614 and 623 kg, winter LW losses of 61, 52, 65 and 67 kg and LW gains at pasture of 81, 99, 94 and 75 kg, respectively. First parity animals had higher BCS at the start of winter but had greater BCS loss in winter and lower BCS gain at pasture than the other three parity groups. Mean calving interval was 367 days and was affected by previous calving date but there was no effect of either cow parity or previous calving difficulty. Mean calving interval for cows calving early, mid-season or late were 378, 364 and 353 days, respectively. The results show that good reproduction performance can be achieved in spring-calving suckler cows subjected to low feeding levels during the winter period but grazed on well-managed pasture in summer.

Walker and Perry (2007) observed that the body condition scores are an excellent indicator of reproductive performance. Evaluating cows/heifers early allows producers to change BCS as needed.

Siddiqui (2008) reported that progesterone as an indication of corpus luteum, development that follows ovulation of cows with lower body condition score had longer days open and less detected estrus than cows with a higher body condition score. Similar reports are available on post-partum cows brought for first service (Shamsuddin *et al*., 2001).

Anonymous (2011) stated that the body condition score in dairy cattle is a subjective assessment based on the scoring of cattle out of 5 points according to the appearances of tail head, hooks, pins, back and ribs. Body fat reserve of cows is a criterion that can be accepted as the indicator of their milk yield, reproductive performance, feed consumption and health condition. Condition scoring is based on the visual and manual check of certain body parts in order to control fatness of cows. Cows having undesired body condition score (BCS) over the course of lactation may decrease milk yield and reproductive performance, and increase metabolic problems (Treacher *et al*., 1986).

2.1.1.5 Effect of socio-economic status of farmers on reproductive performance

Hossain *et al*. (2004) studied the educational level of private dairy farms at Rangpur sadar thana in Bangladesh. They found 19% of farmers had no schooling compared to 27% having primary education, 16% secondary level education, 21% higher secondary level and 17% higher secondary above.

Erdouan *et al.* (2004) surveyed to determine farmer characteristics and production traits on dairy farms in Kars, Turkry and found that the majority of farmers had primary (62.3%) and high school (33.3%) education and also found that farming experience of farmer's varied from 1 to 60 years.

Uddin *et al.* (2012) reported that the highest percentage (72.5%) of the farm householders in Bangladesh had higher primary level of education followed by secondary level education (13.8%) and higher secondary and above (9.5%).

Chaussa (2013) assessed the factors affecting reproductive performance and reported that majority of the respondents (78.57%) did not get training on dairy cattle husbandry before engaging in the project while 21.43% of the respondents were trained before engaging in the dairy cattle enterprise. The amount of milk yield per cow per day for respondents who were trained was higher (9.05 litres) compared to 7.9 litres for respondents who did not get training before engaging in dairy cattle enterprise. The author also found 41.7% of the respondents had attained Primary School education while 39.3% had attained Ordinary Secondary School education in his study.

Benon *et al.* (2015) conducted a survey in Uganda and found a non-significant effect of farming experience between ≤2 years and >2 years on calving rate was not significant.

2.1.1.6 Farm size

Farm size is an important consideration for profitable farming. In Bangladesgh, the most common herd size ranges 1 and 2 cows per farm (Hemme *et al.,* 2004). Saadullah (2000) estimates that over 70% of the dairy farms would have an average of 3.5 dairy cows in Bangladesh. Islam *et al.,* (2014) also found the average number of breedable females (cows) per farm was 2 (range, 1 to 3) at char areas in Northern Bangladesh. Nalunkuuma (2013) reported that the average herd size was 3.28 (± 0.10) with a maximum 21 in Western Kenya.

Hossain (1998) examined the calving interval of different cross-bred cows at the present management condition and prospects of the existing private dairy farm of Rangpur Sadar Thana were recorded 1.2 years.

Estrada and Perez (2001) reported average services per conception of 3.5 with the first service rate of 41.9% in Costa Rica. On the other hand, Abeygunawardena *et al.,* (2001) found an overall service per conception of 1.99 in smallholdings and 1.9 in large farms in Sri-Lanka.

Xu and Burton (2003) stated that herd size had only a very small, although statistically significant, negative effect on reproductive performance. An increase of 50 cows in herd size led to reduction in the odds for all reproductive parameters to 0.98. Coleman *et al.,* (1985) also stated that incidence of reproductive disorders and reproductive performance is affected by farm size.

Lobago *et al.* (2006) reported that the overall calving to conception interval that means days open was 187 days in small holder dairy farm and average number of service per conception was 1.6 ± 1.0 in selallo, central Ethiopia.

Lemma and Kebede (2011) conducted a retrospective data analysis and a cross sectional survey to study the effect of mating system and herd size, on reproductive performances of cows in small holder market oriented urban dairy farms in Addis Ababa. A total of 33 dairy farms (comprising of 232 cows) were classified according to their herd size into small farms (1-10 animals), medium farms (11-20 animals) and large farms with more than 20 animals. Farms were also classified based on the mating method they employ as NS or AI farms. The mean (±SD) age at puberty (AP), age at first calving (AFC), service per conception (S/C) and days open (DO) were 23.1±6.4 months, 33.2±6.7 months, 2.0±1.2 and 176.8±79.0 days, respectively. Both AP and AFC were significantly different ($P<0.05$) between farms and mating systems. There was a significant difference ($P<0.05$) in the NSC between farms and between the mating systems ($P<0.001$). The first service per conception rate for pregnant cows (n=77) was 45.5% for all farms, 60.0% for AI (Artificial insemination) farms, and 40.0% for NS (Natural service) farms with significant difference ($P<0.05$) between mating methods.

Asaduzzaman (2015**)** studied the occurrence of repeat breeding on three different farm categories such as small, medium and large having 1-5, 6-10 and 11 or more breedable cows, respectively. Small farms (n=57) faced repeat breeding significantly ($P<0.05$) lower than medium (n=53) and large farms (n=62).

2.1.1.7 Rearing system

The environment in which we keep our dairy cows has dramatic effects on their health and welfare. Designing clean comfortable housing and hygiene of the cow is the key in determining the health and longevity of the dairy cows on the farm (Cook, 2005). The author used a system of hygiene scoring which charts the distribution of manure over three areas of the body, udder, lower legs, upper legs and flank. The practical relevance of quantifying hygiene is described in relation to prevalence of mastitis and other disease. The study demonstrated a significant ($R^2=0.47$, $P=0.004$) relationship between the score of hygiene and the occurrence of mastitis. In previous study (Barkema *et al.*, 1999) association between clean housing, clean cows and lower heard bulk tank somatic cell count had been made. Both the study conceded higher reproductive performance for good hygiene score.

Misostov and Konovalova (1994) suggested an intensive rearing of heifers and insemination at an early age (18-22 vs. 24 or 30 months) for extending the productive live span.

Shamsuddin (1995) stated that the most of the farms in Bangladesh are so small that only one cow can be kept together in a stable or on available grazing land. They are used for draught work as well as milk production. These management practices promote the occurrence of post-partum anoestrus and limit behavioral manifestations of estrus. This is explained by the fact that in intensive farming or in small holdings having one cow, estrus cannot be detected by primary signs such as standing to be mounted as the cows are always tied up. The author also documented the detection of estrus and of the return to estrus after unsuccessful artificial insemination of dairy cows.

Khan *et al*. (2010) found 63% farmers followed stall feeding and 37% farmers followed both stall and grazing system in their study.

Muller *et al*. (2014) recorded a total of 69181 AI services and pregnancy check results of 9 046 cows in 14 South African Holstein herds in the period between 1991 and 2007. Herds consisted of cows in both zero-grazing and pasture-based production systems in the Western, Southern and Eastern Cape and Kwazulu-Natal regions of South Africa. Profitable milk production and genetic improvement in dairy herds depend largely on fertile cows calving annually to initiate a new lactation period. Over the last 30 years, several studies have indicated a decline in the reproductive performance of dairy cows. From the perspectives of many farmers and Veterinarians, the reproductive performance of cows is related to the calving interval (CI) and services per conception (S/C). Using these traits as cow fertility indicators is problematic as CI is dependent on subsequent calving dates, while S/C is strongly linked to inseminator proficiency. In this paper, non-genetic factors affecting fertility traits other than CI in Holstein cows are discussed. (Means±SD) for the interval traits, namely calving to first insemination (CFI) and days open (DO) were 77 ± 30 and 134 ± 74 days, respectively, while the number of S/C was 2.55 ± 1.79. The lactation number, calving year and calving season affected reproduction traits significantly; herds (management) had the largest effect.

Sarder *et al*. (2015) found that a significant effect ($P<0.05$) of rearing system on the prevalence of obstetrical disorders (ODs). The ODs were found higher in traditional condition of rearing system (17.26%) and lower in farming condition (8.51%).

Islam *et al*. (2015) studied the effect of rearing system on productive & reproductive performance of dairy cows in Barind tract, Bangladesh and reported that the mean values of age at puberty in intensive, semi intensive and loose rearing system were 28.14±0.47, 26.37±0.40 and 28.67±1.22 months, respectively. The average values of age at first calving were 38.35±0.48, 36.72±0.44 and 39.05±1.18 months, respectively. The average services per conception were 1.50±5.61, 1.52±4.05 and 1.98±0.16, respectively. The average post-partum heat period was 88.93±3.09, 90.09±2.22 and 82.98±7.51 days, respectively. The average days open were 106.70±3.77, 114.03±2.74 and 103.04±6.98 days, respectively. The average calving interval was 387.17±5.59, 413.88±11.30 and 391.54±11.62 days, respectively. Rearing systems of cows had significant ($P<0.05$) effect on age at puberty, age at first calving and service per conception.

2.1.1.8 Location of farm

Romaniuk (1994) observed that the delayed conception after parturition in cows at rural areas could be due to malnutrition and improper Veterinary care. Retention of placenta (>6 hours) caused an addition 26 days to the first service after calving.

Kumar *et al.* (2014) conducted a study of 411 milch animals comprising of 172 indigenous and 239 Holstein-Friesian (HF) cross-bred cows maintained under farmer's manage mental system from 86 small holder dairy farmers in and around Gondar (Ethiopia). Collected data were analyzed according to Least Squares Analysis to study the magnitude as well as direction of variation in their days open (DO), calving interval (CI) and number of services per conception (NSC) due to genetic and some non-genetic factors. The overall means for DO, CI and NSC were estimated to be 116.52 ± 42.51 days, 439.03 ± 66.34 days and 1.8 ± 0.3, respectively. The genetic constitution of the animals influenced DO, CI and NSC significantly ($P<0.01$). Location of herd had also significant ($P<0.05$) effect on DO, CI and NSC. Lactation order had significant ($P<0.01$) effect on CI and NSC. Its effect on DO was also found to be significant ($P<0.05$). Variations in all the traits due to herd-size and farming system were statistically non-significant.

2.1.1.9 Floor type

A lot of factors affecting reproduction of dairy cows that includes herd management (40%), feeding (30%), hygiene/infection/diseases (10%), housing (5%) and genetics (15%) (Kumlu, 2011).

There are indications that floor type and construction has a high impact on walking and lying comfort of animals and on reproduction (De Belie, 1997). The effect seems to be exerted through a two-way mechanism; the effect of the floor roughness and the presence of moisture (urine and feces), as summarized by De Belie & Rombaut (2003) and Laech *et al*., (2005). According to Chaplin *et al*., (2000) floor material should improve cow comfort when lying down and yet provide enough support for cows to rise and lie down without slipping.

The effect of flooring surface on feeding behavior is variable. Some studies have reported cows spent more time feeding when softer flooring was provided (Tucker *et al.,* 2006), while other studies have found no difference in the feeding time of cows on concrete and alternative flooring surfaces (Haufe *et al*., 2009; Pempek and Botheras, 2009). The flooring surface can also influence expression of estrus behavior (Phillips and Schofield, 1994). Display of estrus behavior is of value to the producer as it indicates the correct time for insemination. Standing immobile when mounted is the most reliable visual sign of estrus. However, if the floor is too slippery for safe mounting, visual estrus detection may be of limited effectiveness, and this may influence reproductive success (Kerbrat and Disenhaus, 2004). Changes in the feeding behavior of dairy cows housed in pens where softer alternative flooring surfaces are provided in front of the feed bunk may benefit milk production (Botheras, 2010). However, Kremer *et al.,* (2007) found no difference in the mean daily milk yield of cows housed on concrete or rubber slats, and no changes in the mean daily milk yield over a 305 d lactation period.

About 14% of their cows experienced an episode of lameness for concrete floor (USDA, 2007) and lameness is also associated with considerable economic losses because lameness reduces milk production (Green *et al.,* 2002) and decreases reproductive efficiency (Hernandez *et al.*, 2005). There is also the time and expense associated with treating lameness, and lameness is an important cause of culling, either through its direct effects on the cow or by its indirect effects on reproductive performance (Botheras, 2010).

Rahman and Hoque (2001) reported that longer the period of calving to conception longer the calving interval. The calving interval also extended due to poor management.

Hossain *et al.* (2004) studied the floor condition of private dairy farms at Rangpur Sadar thana in Bangladesh. They found 63% paved (with brick) floor and 37% unpaved/muddy floor. Khan *et al.*, (2010) reported that 65% of farmhouse was found with pacca (with bricks) and the rest had unpaved floor.

Erdouan *et al*. (2004) surveyed to determine farm characteristics and production traits on dairy farms in Kars, Turkry and found that animals were housed in traditional type cowsheds (made of stones and muddy, 68.9%), modern type cowsheds (well planned and structured, made of concrete, 22.2%) or both types (8.9%). All buildings had a system of ventilation (holes or chimney in the roof and windows).

Mureda and Zeleke (2008) conducted a survey in Eastern Ethiopia and found that small scale dairy farms mainly prefer hardened soil floor (67.9%), medium scale dairy farms prefer hardened soil and concrete floor equally(52.4% & 47.6%, respectively) whereas large scale dairy farms prefer 100% the concrete floor.

Botheras (2010) observed that the most of the farmer having low number of cows prefer muddy/ semi-concrete floor but approximately 70% of all medium and large (>100 cows) dairy herds primarily house lactating cows in free-stalls and concrete is the principal flooring surface used in these barns. Concrete flooring offers many advantages for the dairy producer, being relatively inexpensive in comparison to other flooring surfaces because of its durability and long life, and it is easy to clean. However, concrete flooring can be problematic for dairy cows, due to the hardness of the surface, and the potential for the floor to be too slippery or too abrasive, depending on the quality of the surface finish and the amount of manure slurry present.

Kirkland (2003) examined the preferred choice of animals for a particular floor type when offered a choice of lying areas. The floor types tested were slats, slats covered with rubber mats, slats covered with rubber strips, sawdust and straw. When offered a choice of flooring type, there was a very clear preference for animals to choose straw rather than any of the other options (particularly when lying). Floor type has a small effect on the incidence of damage to feet.

Islam *et al.* (2013) reported that farm size, farming experience and manage mental factors (like housing system, floor type and feed quality) had no significant effect (P>0.05) on retained placenta of dairy cows.

Begum *et al.* (2014) made a cross sectional study at Rangpur and Gaibandha districts of Northern rural areas of Bangladesh and they found the brick floor and muddy floor of cowsheds were found 69 (56%) and 46 (44%), respectively.

Rahman *et al*. (2014) recorded the significantly (P<0.05) higher prevalence of hoof disorders in cows reared under concrete floor (68.4%) compared to brick (13.27%) and concrete with rubber bedding (18.3%).

2.1.1.10 Ventilation system

Heat stress has a significant impact on dairy cattle in hot and humid climates like Bangladesh. Heat stress affects reproductive performance both by direct action on reproduction and by indirect actions mediated through alterations in energy balance. There is an interaction between dry matter intake (DMI), stage of lactation, milk production, energy balance and heat stress, that result in reduced luteinizing hormone (LH) secretion and a decreased diameter of the dominant follicle in the post-partum period, this results in reduced oestradiol secretion from the dominant follicle, leading to poor expression of estrus. The post-partum anovulatory interval of dairy cow is characterized by a variable period of negative energy balance that is reported to modulate the recrudescence of ovarian cyclicity (Staples *et al.*, 1990). In heat stressed cows, motor activity and other manifestations of estrus are reduced and the incidence of anoestrus and silent ovulation are increased (Gwazdauskas *et al.*, 1981). Lactating dairy cows are susceptible to heat stress because of the elevated internal heat production which is associated with lactation. During periods of heat stress, milk production, feed intake, and physical activity are decreased (Fuquay, 1981). A number of studies have shown that housing systems in hot climates can be modified by the use of evaporative cooling to improve both milk production and reproductive efficiency of dairy cows (Ryan *et al*., 1992; Armstrong *et al*., 1993).

A study conducted in Saudi Arabia on 3 different farms observed an improvement in peak milk production (90.9 vs. 87.2 lb), decreased services per conception (3.1 vs. 3.7 services), and reduced culling for reproductive failure (7.7 vs. 19 %) for dry cows evaporative cooled vs. shade only (Wiersma and Armstrong, 1988). More recently, Avendano-Reyes *et al.* (2006) concluded that cooling dry cows with shades, fans, and water spray vs. cows with only shade decreased services per conception and days open, while milk yield increased during the post-partum period.

Urdaz *et al*. (2006) observed that dry cows with feed line sprinklers, fans, and shade compared to cows with only feed line sprinklers had an increased 60 d milk yield with no difference in body condition score (BCS) changes, incidence of post-parturient disorders, or serum non-esterified fatty acid (NEFA) concentrations.

Suadsong *et al.* (2008) reported that cooled cows due to proper ventilation had greater ($P<0.05$) dry matter intake and milk production than uncooled cows and cooled cows had more persistent milk production than uncooled cows.

Islam *et al*. (2015) studied the effect of ventilation on productive & reproductive performance of dairy cows and reported that the mean values of age at puberty in proper ventilated, fairly ventilated and poor ventilated were 26.46±.55, 26.80±.37 and 26.31±.66 months, respectively. The overall mean values of age at first calving for the same ventilations were 37.39±.48, 37.7±.48 and 36.83±.76 months, respectively. The average service per conception was 1.76±1.49, 1.61±5.50 and 1.64±.10, respectively. The average post partum heat period was 78.61±3.41, 84.13±2.44 and 87.20±5.79 days, respectively. The average days open were 116.32±2.95, 108.88±2.83 and 122.13±5.92 days, respectively. The average calving interval was 401.25±3.75, 390.23±4.04 and 428.31±7.84 days, respectively. Ventilation of cow shed had significant ($P<0.05$) effect on post partum heat period, days open and calving interval.

2.1.1.11 Feed quality

Food scarcity is one of the main problems in Bangladesh and is an important cause of anoestrus. Beginning from the onset of puberty to the whole reproductive life of a cow, nutrition plays an important role. Many workers have studied the influences of nutrition on the resumption of ovarian activity, post-partum and hormonal interaction during different reproductive phases (Ghosh *et al.,* 1988; Sasser *et al*., 1989; Butler and Smith, 1989; Galina and Arthur, 1989). Adequate nutrition before and during post-partum period is essential if acceptable estrus and rebreeding performance are to be achieved in cattle. Alam *et al*., (2001) studied the effect of urea-molasses-mineral block (UMMB) on the ovarian cyclicity in zebu cattle. It was suggested that UMMB could be used as feed supplementation in zebu heifers for enhancing earlier sexual maturity. The main cause of poor reproductive performance could be due to poor health management, incorrect nutrition during and after calving. Inadequate dietary intake and decreased utilization of some nutrition may result in delayed onset of ovarian activity by preventing release of gonadotropin from the pituitary (Nolan *et al.,* 1988; Randel, 1990; Osawa *et al.,* 1996). Balanced nutrition with better management help to maintain general health condition of the cow that stimulate the endocrine system through the activation of the hypothalamo-pituitary-ovarian axis to work properly and thereby improved reproductive performance (Morrow, 1980; Fitzpatrick, 1994). Feeding programmes at pre and post calving period helped in initiating the earlier post-partum onset of ovarian cyclicity. The restriction of nutrient supplementation both in pre and post-partum period causes weight loss and decreases body fat reserve a calving, delayed onset on post-partum estrus and ovulation (Brosaster and Broaster, 1998). Energy deficient diet in the late pregnancy and early lactation is associated with reduced ovarian function (Lalman *et al*., 1997). Accordingly the interval between calving to first post-partum service varies between the cows with or without supplementation of concentrates (Shamsuddin *et al.,* 1997).

It is well established that cows in early lactation cannot consume enough energy-yielding nutrients to meet the demand of production and maintenance. Energy balance is the difference between net energy consumed minus the net energy required for maintenance and production (Butler and Smith, 1989). The importance of nutrition and energy balance with respect to post-partum ovarian activity has been reported elsewhere (Sasser *et al.,* 1988; Britt, 1995; Ferguson, 1996).

Gorgulu (2012) stated that the feeding conditions causing the animals to be too fat or too thin may lead to some problems relating to reproductive performance. Cows with high condition mostly suffer from post-partum problems such as retained placenta and metritis. Cows with low condition are more prone to insemination/breeding and pregnancy problems due to the failure of uterus, ovary and follicles to prepare for a new estrus and ovulation. As is known, cows should be impregnated within 60-90 days after calving, which is the most problematic period in terms of energy balance. Severe negative energy balance may decreases LH secretion and delays the first estrus, first ovulation and prolongs service period, leading to an increased calving interval.

Negative energy balance in cows also leads to reduce ovarian function (Coleman *et al.,* 1985) with or without extension of anoestrus period (Eley *et al.,* 1981).

More menacing are the ‘management/production’ diseases such as under nutrition (poor quality of feed, poor BCS or loss of BCS), hypocalcaemia and mastitis that all lead to reduced reproductive performance compared to unaffected contemporaneous herd-mates. Cows with high milk yields and poor feeding, low BCS in the early post-partum period, take >10 days longer to conceive (Lopez-Gatius *et al.*, 2003; Garnsworthy, 2006), and those succumbing to hypocalcaemia take 13 extra days to get pregnant (Parker, 1992). Indeed, the calving-to-pregnancy interval is extended for at least 7, 8, 26 and 31 days in cows treated for mastitis, retained fetal membranes, hypocalcaemia or endometritis, respectively, compared to healthy herd-mates (Borsberry and Dobson, 1989; Schrick *et al*., 2001). In part, these poor fertility data may be related to delayed resumption of ovarian cyclicity after calving. For example, if cows have mastitis soon after calving, luteal activity starts 7 days later than healthy animals (Huszenicza *et al.,* 2005). Breed differences probably reflect differences in management conditions. The time taken by an animal to attain puberty and sexual maturity depends on the quality and quantity of feed available, which affects growth rate.

Butler *et al.* (1981) observed in late pregnancy or even in early lactation, energy balance is the most important factor for the onset of ovarian cyclicity. The author also reported a prolonged post-partum anoestrus in cows maintained with low level of nutrition or poor quality of feed before calving.

Mukasa-Mugerwa (1989) observed the puberty is a stage when replacement heifers manifest estrus signs and ovulate for the first time. Nutrition is a major determinant of when puberty occurs. Nutrition related infertility (also called sub-fertility) in dairy animals can cause delayed puberty in heifers and prolonged calving interval in mature cows. For example, with good nutritional management crossbred heifers can be bred at 15-18 months. The age at puberty of zebu cattle in South Asia varies from 24-36 months.

Currado *et al.* (1991) stated that in Holstein Friesian cows, the highest milk yielders had longer calving interval because of delayed return to post-partum due to negative energy balance to supply the poor quality of feed.

Shamsuddin *et al.* (2006a) studied a total of 1440 small holder dairy farms in Bangladesh, the age at first calving varied from 33-40 months, depending on the area studied, irrespective of cattle breeds, feed quality and nutrition on the best 20% of farms. This author estimated a yearly economic gain of US$ 561 for farm with 3.6 cross-bred heifers, if the heifers could have an age at first calving of 37 months. The target of a dairy farm is to get one calf from a cow every year. The closer a farm gets to this target, the better will be the economic return, but it is seldom achieved in the dairy industries of Bangladesh. Other than cattle genetics, diseases, hot and humid climate and underfeeding have all been claimed to prolong the calving interval. Post-partum cows with poor quality of feeding and poor body condition score often remain anoestrus for about a year, which prolongs the interval from calving to first service and subsequently to the next calving.

Shamsuddin *et al.* (2006b) stated an economic opportunity survey showed that the management (especially feeding practice) improvements directed towards increasing milk production, increasing lactation length, decreasing age to first calving, decreasing calf mortality and decreasing calving interval could increase income by US$ 329-807 per farm per year, depending on the location. Missing one estrus extends the calving interval in cows and the age at first calving in heifers by 21 days and it is estimated economic losses of US$ 43 and US$ 11 occur when there is a delay of 21 days in age at first calving and calving interval, respectively.

Shamsuddin and Arya (2009) observed the nutritional effects of puberty and sexual maturity is initiated prenatally and continues through postnatal and post weaning development of heifers. In typical production system of Bangladesh, calves are allowed to suckle only to stimulate milk letdown and suckling often continues until the cow dries off. Since small dairy farmers would prefer to increase net income from their dairy animals, little attention is paid to calf nutrition. Calves are often fed poor quality milling by products and crop residues during their first 8-12 months of life when the reproductive organs are developing.

Khan *et al.* (2009) stated that the traditional feeding system for dairy cattle in Bangladesh is based on the use of rice straw, natural grasses supplemented with a little or no concentrates. In Bangladesh, the small-scale farmers have a limited skill on feed and feeding management for their cows during peri-parturient period or more specifically transition period. The quantity and quality of fodder available from natural pasture shows seasonal fluctuation. The author also observed that there is an acute shortage of feed supply during the dry season and the available feed during this period is of very poor quality. Poor nutrition results in low production and reproductive performance slow growth rate, loss of body condition and increased susceptibility to diseases and parasites. Rice straw is the main roughage for dairy cows, which is low in nutritive value and palatability but it contributes 90% of the roughage feed to animals.

Smith and Chase (2010) stated that the feeding is a fundamental aspect in dairy cattle production. The relationship between nutrition and reproduction is a topic of increasing importance and concern among dairy producers, veterinarians, feed dealers and extension workers. The interaction between nutrition and reproduction has long been known to have important implications for the reproductive performance. Under nutrition results in the loss of body weight and body condition, delays the onset of puberty, increases the post-partum interval to conception, interferes with normal ovarian cyclicity by decreasing gonadotropin secretion and increases infertility Boland *et al.,* (2001).

Chaussa (2013) assessed the factors affecting reproductive performance and reported that 81% of the respondents supply mineral to the lactating cows during milking while 19% of the respondents do not supply mineral to their lactating cows and 92.9% of the respondents supply concentrates to their lactating cows whereas 7.1% of the respondents do not supply.

Alam (2013) studied the effect of feeding practices on occurrence of reproductive diseases in cross-bred dairy cows and found there is no significant relation between feeding practice and occurrence of reproductive diseases. The highest occurrence of reproductive diseases was recorded in cows fed with straw + green grass (45.3%) and the lowest occurrence was in cows fed with straw + green grass + concentrates (30.4%).

Mollah *et al*. (2015) documented the effect of feeding practices on conception rate of indigenous zebu cattle. The conception rate with respect to different feeding practice ranged from 50.0-67.2%. A significant ($P<0.05$) variation was found in conception rate of cows under different feeding practices and the highest conception rate was found in cows fed with combination of roughages, concentrate and grazing. Haque *et al.,* (2015) also reported a significant effect of feeding practices on pregnancy rate in artificially inseminated cows. The pregnancy rate in cows fed with combination of green grass, straw and concentrate feed was the highest (63.5%) and the pregnancy rate in cows fed with only straw was the lowest (38.5%).

Islam *et al*. (2015) studied the effect of feed quality on productive & reproductive performance of dairy cows and reported that the average values of age at puberty in concentrate + straw + green grass, concentrate + straw, concentrate + green grass and straw + green grass feed quality were 26.37±.36, 28.90±.52, 27.38±1.11 and 25.69±.61 months, respectively. The average age at first calving for the same quality of feed was 36.71±.38, 39.73±.52, 38.0±1.87 and 35.56±.64 months, respectively. The average services per conception were

1.55±0.01, 1.51±0.04, 1.69.20 and 1.35±.88, respectively. The overall mean values of post-partum heat period were 92.80±2.88, 98.96±3.78, 74.61±11.50 and 78.44±3.34 days, respectively. The average days open were 109.93±2.95, 110.54±3.64, 101.23±8.40 and 102.33±4.16 days, respectively. The average values of calving interval were 405.4±3.61, 399.61±5.55, 435.84±13.31 and 394.05±7.93 days, respectively. Feeds and feeding had significant ($P<0.05$) effect on age at puberty, age at first calving, post partum heat period and calving interval.

2.1.1.12 Preventive measure

Islam *et al.* (2000) conducted a study on productive & reproductive performances of dairy cows at semi-urban area of Bangladesh where three types of management were adopted like, Management-1: Vaccination and preventive measures were not adopted. Sick animals were not usually taken to veterinary doctors rather treated traditionally; Management-2: Vaccination and preventive measures were not adopted. Sick animals were treated traditionally and often veterinary doctors were consulted and Management-3: Vaccination and other preventive measures were provided regularly and veterinary doctors usually provided medication for sick animals. They found that the effect of taking preventive measures was significant ($P<0.01$) on age at first heat /puberty (AP), age at first calving (AFC), number of service per conception (S/C), post-partum heat period (PPHP), calving interval (CI). The overall mean values were 37.29±0.33 months for AP, 47.62±0.34 months for AF calving, 1.30±0.02 for NSPC, 191.57±3.92 days for PPHP, 510.02±0.15 days for CI.

Denbarga (2012) observed the reproductive performance of dairy cows at Tatesa Cattle Breeding Center in central Ethiopia, based on individual cow records during the period from November 2009 to April 2010. The overall mean values of age at first calving, calving interval, days open and number service per conception were 57.9 months, 622.6 and 340.3 days and 1.6, respectively. Both parity and season of previous calving had significant ($P<0.01$) effect on calving interval.

2.1.1.13 Breeding methods

Reproductive efficiency in the dairy herd is the most important factor for its economic success and a major concern for dairy farmers when using artificial insemination (AI) or natural service (NS) (Valergakis *et al.*, 2007).

Artificial insemination (AI) has proven to be a reliable technology for dairy producers to make genetic progress and control venereal diseases in their herds. However, despite these advantages many dairy producers prefer to use natural service (NS) as a component of their herds breeding program. Producers that use NS believe that more cows can be bred by NS than AI because human errors in estrous detection are avoided when bulls are used. However, several studies have shown that this perceived increased in estrus detection and thus more cows bred when bulls are used, does not result in better reproductive performance when compared to AI. Dairy producers must consider that a successful reproductive program based on NS is dependent on fertile bulls that require proper management which can be labor intensive.

Demiraj *et al*. (2000) stated that the nutrition, breeding methods, management and stress factors during the post calving period were relevant to the reproductive cycle of dairy cows.

Shahmsudin *et al.* (2001) stated that the main constraints of cattle reproduction is prolonged post-partum intervals to conception and low conception rate (CR), which were the results of inefficiencies in the management of nutrition, estrus and artificial insemination (AI) services.

Valergakis *et al.* (2007) conducted a survey from 120 dairy cattle farms to estimate, compare and analyze the costs associated with breeding cattle by AI and NS in Greece. Different scenarios were employed to estimate costs associated directly with AI and NS as well as potentially extended calving intervals (ECI) due to AI. Results showed that bull maintenance costs for NS were €1440 to €1670 per year ($1,820 to $2,111). Direct AI costs were higher than those for NS for farms with more than 30 cows and ECI constituted a considerable additional burden. Semen, feed and heifer prices had a very small effect. When, hypothetically, use of NS bulls results in a calving interval of 12 months, AI daughters with a calving interval of 13.5 months have to produce about 705 kg of additional milk in order to cover the extra cost. Their actual milk production, however, exceeds this limit by more than 25%. When real calving intervals are considered (13.0 v. 13.7 months for NS and AI, respectively). It was concluded that even under less than average management conditions, AI is more profitable than the best NS scenario.

Bezdicek *et al.* (2008) observed that the breeding values of bulls in artificial insemination (AI) and bulls in natural service (NS) in the Czech Republic. Examined bulls were of Holstein breed, born between the years 1996 and 2001. Concerning a breeding value for kg of milk (AI=177.54; NS=50.12) and a relative breeding value (BV) for kg of protein (AI=100.03; NS=97.23) significant higher values (P>0.05) in AI bulls compared to NS bulls. Other indicators of milk production (kg, % of fat and protein) showed not significant values. NS bulls showed not significant more positive breeding values of reproduction indicators compared to AI bulls.

Lima *et al.* (2009) conducted a study to compare reproductive performance of lactating dairy cows bred by natural service (NS) or timed AI (TAI). A total of 1055 cows were blocked by parity and enrolled to receive either NS or TAI. Cows in both groups were resynchronized with 2 injections of PGF-α given at 42 and 56 d post-partum. The daily rate of pregnancy was 15% greater for NS than TAI because cows in NS had a greater RP, which resulted in fewer median days open (111 vs. 116 d). Proportion of pregnant cows at 223 d post-partum was greater in the NS than TAI group (84.2 vs. 74.8%, respectively). Cows with body condition score ≥2.75 had greater proportion of pregnant cows in the first 21 d of breeding and daily RP in the first 223 d post-partum primiparous cows had greater proportion of pregnant cows and daily RP than multiparous cows at 223 d post-partum. In conclusion, the greater proportion of pregnant cows in the NS group was attributed to more opportunities for breeding than in the TAI group.

Malik *et al.* (2012) studied to investigate the pregnancy rate following artificial insemination (AI) or natural service (NS) in post-partum estrous synchronized beef cattle. Pregnancy was determined using transrectal ultrasonography 32 days after NS and AI. The pregnancy rate was higher in the NS group (28.6%) than in the AI group (18.0%), but the difference was not significant (P>0.05).

Khan *et al.* (2012) observed successful farmers produce almost one calf per animal annually through natural and artificial mating in Pakistan. A total of 795 cross-bred cattle were collected to investigate the effect of mating/breeding method on calf sex and post-partum reproductive performance in cross-bred cattle. Breeding method had significant effect on calf sex ratio. Male births were significantly (P<0.01) higher as a result of artificial insemination (59 vs 51 %) as compared to natural service (NS). Among post-partum reproductive performance indicators the incidence of assisted births i.e. dystocia was significantly (P <0.01) higher (23 vs 15 %) in AI as compared to NS. Similarly the incidence of retained fetal membrane was also higher (P<0.01) in births resulted from AI (10 vs 5 %). Service period (44.25 vs 35.40 days) and number of services per conception (1.43 vs 1.14) were also significantly higher in animals served through AI. Calf sex significantly affected service period and it was prolonged in the animals which gave birth to male calves. Number of services per conception had positive and significant (P<0.01) correlation with possibility of RFM (r 0.094) and service period (r 0.088). Post-partum reproductive problems were lower as a result of natural mating.

Filho *et al.* (2013) conducted a study to compare reproductive performance of breeding programs that used natural service (NS), AI after estrus detection (ED), and timed AI (TAI). In experiment 1,597 suckled beef cows were randomly allocated to one of four groups such as cows in the TAI + NS group (N = 150), cows in the TAI + ED + NS group (N = 148), cows in the ED+NS group (N = 147) and cows in the NS group (N = 149). Cows in the ED+NS or NS groups had a decreased (P<0.001) hazard of pregnancy compared with cows in the two groups bred by TAI at the onset of breeding season (BS).

Tesfaye *et al.* (2015) investigated the effect of some factors on the reproductive performance of small holder dairy cows under artificial insemination (AI) in two regions of Ethiopia. A cross-sectional study and retrospective data analysis were conducted on 428 farm characteristics and management, 644 cow reproductive histories and 613 inseminations by examining records and a questionnaire survey. They found the mean days for post-partum heat period (PPHP) and days open (DO) were 222 (n=320) and 257(n=234) days, respectively. Service per conception (S/C) was 1.54.

2.1.2 Overall the reproductive disorders of dairy cows

Incidence, predisposing factors, and implications of various reproductive disorders (dystocia, still birth, retained placenta, cystic ovaries, anovulation, infections of the reproductive tract, metritis, and abnormal health status) are reviewed as to their interrelationships and collective impact on reproductive performance, milk yield, and predisposition to other diseases or disorders in the peri-parturient dairy cow. All reproductive disorders reviewed reduce reproductive performance either directly or indirectly. Concurrent milk yield was reduced marginally in a few studies as a consequence of twinning, retained placenta, cystic ovaries, metritis, or other uterine disorders, and in cows with an abnormal health status. It was conclude that most peri-parturient disorders occur as a complex, rather than as a single abnormality (Stevenson and Call, 1988).

Kaikini *et al*. (1983) studied reproductive disorders in Holstein Friesian × Gir F_1 crossbred cows. They found that metritis is very important reproductive disorder which results in the huge economic loss to the farmer. The overall incidence of reproductive disorders was 36.50%. Such disorders were the lowest during 3rd lactation (29.17%) and the highest (60.53%) during 5th lactation. They observed (8.8%) metritis followed by (7.05%) retained placenta, (6.21%) cystic ovaries and (5.4%) dystocia.

Hossain *et al.* (1986) conducted a survey on surgical diseases and reproductive disorders recorded at the Veterinary Hospital of Bangladesh Agricultural University, Mymensingh. Tha authors studied a total of 13694 animals which were brought to the Veterinary Hospital for treatment. Among the various species presented, cattle along constitute 13,324 (97%) of the total followed by goat 24 (2%) and 117 (1%) buffalo. The incidence of reproductive disorders was worked out in the study and also presented 25.41% (3484) were surgical and obstetrical cases. Among the reproductive problems, infertility itself constituted 89%, retained placenta 9.1%, dystocia 0.4%, uterine prolapsed 0.4% and pyometra 0.6%. Among other reproductive problems 383 animals (35%) were brought to the clinic for pregnancy diagnosis.

Paragaonkar and Bakshi (1987) examined a total of 354 Red Khandari (RK) and Jersey × RK cows to detect the reproductive disorders. The incidence of anoestrus was 3 and 2% respectively that of repeat breeding 8 and 3% that of dystocia 2 and 1.5%, that of retained placenta 3 and 2.5% and that of cervico-vaginal prolapsed 0.5 and 0.5%.

Shamsuddin *et al.* (1988) examined cross-bred cows to detect various reproductive disorders. The study was undertaken to find out the relative incidence of reproductive disorders after birth in cows of Savar Dairy Farm. The relative percentage of retained placenta, metritis, pyometra, endometritis, cervicitis, persistent corpora lutea, cystic ovaries and non functional ovaries were 42.26%, 10.38%, 8.15%, 27.39%, 1.52%, 1.17%, 3.13% and 5.98%, respectively.

Das (1990) reported that gynaecological diseases of Zebu cattle which were metritis 22.3%, retained placenta 12.6%, pyometra 7.4%, and abortion 6.9%.

Rahman *et al.* (1993) carried out a study on the incidence of reproductive disorders on 2280 cows and heifers in six AI pocket areas namely Hazirhat (Rangpur), Puthia (Rajshahi), Avoynagar (Jessore), Comolla, Manikganj and Moshurikhola (Savar) during the period from July, 1990 to June 1991. The reproductive problems recorded were anoestrus 29.69%, metritis 5.66%, pyometra 6.80%, cervicitis 1.58%, uterine prolapsed 1.6%, abortion 4.87% and dystocia 1.6%.

Das *et al.* (1995) investigated a study on the gynaecological disorders of nondescript local Zebu cattle of Tangail milk shed area (Milk vita). The most common reproductive disorders were diagnosed by clinical examination of animals. The animals affected with uterine infection about 8.21% among the total infection. The author recorded (26.1%) endometritis which is the highest followed by (22.3%) metritis, (12.6%) retained fetal membranes, (7.4%) pyometra and (1.6%) abortion.

Shahabuddin (1996) collected a total of 457 clinical cases from Panchagarh Veterinary Hospital to observe the pathological disorders of female reproductive of cows. Of the 457 clinical cases examined the highest incidence was found to be that of anoestrus (22.97%) followed by repeat breeding syndrome (20.13%), uterine prolapsed (5.47%), retained placenta (3.50%), mastitis (3.06%), metritis (2.63%), pyometra (1.53%), vaginal prolapsed (1.31%), still birth (0.67%) and abortion (0.44%).

Fourichon *et al.* (2001) determined the incidence of health disorders in 205 dairy farms in Pays de la Loire (France) in 1995-1997. Median and mean values in cases per 100 calving were 8.1 and 8.8 for retained placenta, 5.2 and 6.6 for dystocia, 4.9 and 5.6 for milk fever, 1.9 and 5.1 for chronic metritis; the total AI return rate was 50.4%. Health status was characterized by low incidences for all disorders in 28% of the herds, whereas high incidence for most disorders was reported in 10% herds. The incidence of chronic metritis was 21%, retention of fetal membranes 14%, milk fever 15% and mastitis 11%.

Faruq (2001) investigated the occurrence of different clinical diseases and disease conditions of the reproductive system of cows. A total of 302 clinical cases were collected from the saline area (Three District of Bangladesh viz. Khulna, Satkhira and Bagerhat) during the farm survey of ‘‘Field Fertility Clinic” from May to October 2001. The cows and heifers were examined to detect various reproductive diseases complained by the owner. Tentative diagnosis was made by taking history from the owner, observing physiological parameters and body condition score. The incidence of various reproductive diseases were recorded 31.46% repeat breeding syndrome, 27.48% anoestrus, 11.92% metritis and endometritis, 6.95% retained placenta, 2.32% dystocia, 1.66% pyometra, 1.32% vaginal prolapsed 0.99% uterine prolapsed, 0.99% abortion and 0.66% still birth.

Gizaw *et al.* (2007) conducted a study to determine the prevalence of major reproductive problems in small holder 403 dairy cows (114 local and 289 cross-breeds) in and around Nazareth town from November 2004 to April 2005. The regular clinical examination was found to be affected either with one or more of clinical reproductive problems. Endometritis, retained fetal membrane (RFM), repeat breeding and dystocia were found to be the major clinical reproductive problems with prevalence rates of 16.63%, 12.91%, 8.91% and 6.95%, respectively. Abortion (2.23%), anoestrus (1.48%) and prolapses (1.24%) were minor clinical reproductive problems observed in small holder dairy cows. The prevalence of clinical reproductive problems showed significant differences

($P<0.05$) with respect to breed, parity, production system (intensive and semi-intensive) and body condition score of dairy cows. This study indicated clinical reproductive problems, which included endometritis, RFM, repeat breeding and dystocia were one of the major factors responsible for the low reproductive performance of small holder dairy cows in and around Nazareth town, Central Ethiopia.

Sarder (2008) examined the occurrence of reproductive disorders of dairy cows in relation to breed, age, parity, body weight, housing system and body condition of 500 dairy cows belonging to F (Friesian) × L (Lacal: n-342), SL (Sahiwal) × (L: n=91, SL × F×L: n=67) from 10 different upazilas of the Rajshahi district. The data were collected directly from the dairy cow owners by using questionnaires and diagnosis of disorders was made on the basis of the history, clinical signs, and response to treatment. The incidence of still birth, retained placenta, dystocia and repeat breeding were highest in SL×F×L cows and lowest in F×L cows. Breed of the cows had significant effect only on silent heat ($P<0.05$) while age had significant effect on the incidence of still birth ($P<005$), metritis ($P<0.05$), ovaries with non-significant structure (NSS) ($P<005$) and anoestrus ($P<0.05$). The incidence of abortion, metritis, cystic ovary, vaginal prolapse, uterine prolapse, retained placenta, dystocia, anoestrus and repeat breeding were higher in >8 years old cows and lower in <4 and 4-6 years aged cows. Incidence of still birth, retained placenta and dystocia were higher ($P<0.05$) in >6th parity cows than 3rd parity cows. Incidence of retained placenta was higher body weight over 350 kg than body weight under 250 kg. Retained placenta occurred more common in cows with poor housing system. Still birth had significantly higher incidence in poor body condition cows compared to the fair and very good body conditions.

Bitew and Prasad (2010) studied the questionnaire survey and regular follow up were conducted to determine the major reproductive health problems of dairy cows in and around Bedelle, South Western Ethiopia from November 2003 to April 2004. From 302 cows which were under investigation and 80 (26.5%) had at least one of the reproductive problems. The reproductive problems according to their relative importance in the study area were as metritis 51 (16.9%), abortion 42 (13.9%), retained fetal membrane 26 (8.6%), dystocia 20 (6.6%), repeat breeding 9 (3%), anoestrus 5 (1.7%), vaginal prolpse 3 (1%) and uterine prolapsed 2 (0.7%). The prevalence rates of reproductive problems had significant difference ($P<0.05$) between semi-intensive production system (38.8%) and extensive production system (24.4%).

Kabir *et al.* (2010) investigated a total of 348 cattle to determine the prevalence of diseases and disorders in cattle at the Upazilla Veterinary Hospital (UVH), Ulipur under Kurigram district during the period from October to December, 2008. The author detected 17 different types of diseases and disorders in cattle by clinical examinations. Among them clinical mastitis (1.14%), uterine prolapse (0.57%), repeat breeding (1.14), anoestrus (1.44%), were recorded. Age wise prevalence in young and adult cattle were (33.45%) & (66.96%), respectively.

Sarder *et al.* (2010) studied the prevalence of reproductive disorders of dairy cows. The author reported that the prevalence of abortion (5.0%), still birth (3.6%), metritis (7.6%), pyometra (1.8%), silent heat (15.8%), cystic ovary (1.4%), vaginal prolapse (2.2%), uterine prolapes (1.4%), retained placenta (8.8%), dystocia (3.0%), anoestrus (20.4%) and repeat breeding (20.2%) in dairy cows.

Kader (2010) conducted a study to evaluate the prevalence of reproductive diseases in dairy cows. The data were collected directly from the dairy farms owners by using questionnaires and diagnosis of reproductive diseases was made on the basis of the history, clinical signs and response to treatment during the period from June 2010 to June 2011 at Bogra district of Bangladesh. Out of 1500 cows, 770 clinical reproductive cases were registered from individual questionnaire in four upazilas under the district of Bogra. The major clinical conditions were abortion 1.0%, still birth 1.0%, retained fetal membrane 7.1%, meteitis 1.5%, pyometra 1.7%, vaginal prolapsed 1.1%, uterine prolapsed 1.3%, dystocia 1.6%, milk fever 0.9%, mastitis 6.6%, repeat breeding 12.8% and anoestrus 14.7% in dairy cows. The overall reproductive diseases were lower in L and higher in L × F genotypes. The prevalence of RDs were lower in <3 years of age group except anoestrus which observed in >7 years age of cows. The better result observed all the RDs were the cows having <200 kg body weight than 200 to <300 kg. The prevalence of RDs association with body condition, educational qualification of owners of farms, farming experience, floor type, the low incidence were recorded in poor body conditions, illiterate farmers, having no farming experience, and earthen floor, respectively. Heifer, 5^{th}, 6^{th} and 7^{th} parity of cows were observed the lowest rate of incidence in all the RDs except anoestrus which was the lowest in 5^{th} and 7^{th} parity of cows. Extensive housing system showed the lowest influences on various RDs of cows at study area. The cows of poor ventilated housing and the farm having <3 cows (small farm) and poor feed quality showed the lowest prevalence of RDs.

Al Nahian (2011) collected a total of 201 reproductive cases from different Veterinary hospitals over a period of one year (April 2010 to March 2011) in five upazilas of Mymensingh district to observe the major reproductive disorders in cattle. The author recorded the prevalence of reproductive disorders were 25.9% anoestrus, 21.4% mastitis, 15.4% pyometra, 12.8% retained placenta, 7.5% dystocia, 6% repeat breeder, 5% abortion and 5% vaginal prolapsed.

Sarder (2011) examined a total of 333 cows in the mini dairy farm and reported 79 were affected by different types of reproductive disorders. He observed abortion (2.2%), still birth (1.3%), dystocia (2.9%), uterine prolapse (1.6%), vaginal prolapse (0.6%), retention of fetal membrane (4.5%), metritis (2.9%), pyometra (4.5%) and cystic ovary (3.5%) in dairy cows.

Debnath *et al.* (2012) observed that the clinical trends of reproductive diseases and disorders of cows at three upazilas in the Mymensingh district with particular emphasis on vaginal culture during the period from April 2011 to March 2012. Records of 7679 reproductive cases were collected from official stock book from veterinary hospitals of 3 upazilas namely Fulbaria, Mymensingh Sadar and Fulpur of Bangladesh. Microbiological samples (vaginal swab=20) collected from the selective cows which were suffering from various reproductive disorders. The occurrence of reproductive disorders was higher in cross-bred cows (1.27%) than that of indigenous cows (0.69%). The proportion of individual reproductive disorders in post parturient cows recorded were retained placenta (44.1%), pyometra (16.8%), endometritis (11.8%), metritis (10.3%), uterine prolapse (8.9%), vaginal prolapse (5.9%) and vaginitis (2.9%).

Yusuf *et al.* (2012) conducted a study to assess the small holder dairy production system and to determine the major reproductive problems of 44 Holstein

Friesian cow in a dairy herd in Sinjai Regeny, Indonesia. They reported that the incidence of reproductive disorders were 38.6%.

Dinka (2013) conducted a study to determine the prevalence of major reproductive disorders of dairy cows in and around Asella town, Central Ethiopia. A total of 82 owners and/or attendants of dairy cow herds were interviewed using structured questionnaire. They recorded the prevalence of reproductive disorders in the study area were repeated breeding (26.8%) and abortion (14.6%). It was also revealed that abortion is mostly common in exotic breeds (48.8%) and relatively less in local cows (9.8%) varying among parity and stage of pregnancy.

Khair *et al*. (2013) conducted a study to determine the incidence of some reproductive diseases (RD) like abortion, anoestrus, metritis, repeat breeder, retained placenta and one production disease like clinical mastitis in cross-bred dairy cattle in Shahjadpur upazila of Sirajgonj district in Bangladesh. A total of 250 farms having at least two cross-bred dairy cattle were randomly selected for this study during the period from March 2012 to February 2013. The recorded reproductive disorders were diagnosed and treated by the veterinarians on the basis of history, physical examination, clinical and laboratory findings. The recorded the incidence was highest for repeat breeder (32.76%) followed by mastitis (25.86%), anoestrus (20.69%), retained placenta (6.9%), metritis (8.62%) and abortion (5.17%).

Benti and Zewdie (2014) conducted a study to identify the major reproductive health problems and its associated risk factors in indigenous Borena breed cows in Borena zone in Southern Ethiopia during the period from September 2013 to February 2014. A total of 409 cows examined, of which 195 (47.7%) were having at least one of the reproductive problems. The major reproductive health problems identified in the present study were mastitis (21.3%), abortion (12.2%), repeat breeder (10.3%), anoestrus (10.3%) and retained fetal membrane (RFM) (7.6%).

Alam *et al.* (2014) determined the prevalence of reproductive diseases and its associated risk factors in cross-bred dairy cows in selected areas of Bangladesh. A total of 197 dairy farms having 488 breedable cross-bred dairy cows (395 cows + 93 heifers) were randomly selected from eight villages of Ullapara Upazila under Sirajganj district. A questionnaire as well as examination of cows was made to collect data on occurrence of reproductive diseases. The overall prevalence of reproductive disease was 39.4%. The recorded diseases were 8.6% anoestrus, 6.8% delayed puberty, 5.7% repeat breeding, 4.7% retained placenta, 3.9% metritis, 3.3% dystocia, 2.7% vaginal prolapsed, 2.1% abortion and 1.6% uterine prolapsed. The body condition score (BCS) of cows significantly ($P<0.05$) influenced the occurrence of reproductive disease. However, feeding practice, suckling and parity did not influence significantly ($P>0.05$) the occurrence of reproductive diseases in cross-bred dairy cows.

Mahmud *et al.* (2014) investigated the prevalence and comparison of reproductive diseases and disorders of cows in BAU Veterinary Clinic and Sadar Veterinary Hospital, Jamalpur. A total of 319 and 184 cases of cows of BAU Vet. Clinic and Jamalpur hospital were recorded, respectively during the period from September 2009 to August 2011. Among the clinical cases, highest percentages was repeat breeding syndrome (35.5), followed by anoestrous (30.1), metritis (13.8), mastitis (8.5), retained placenta (4.7) and others in BAU Vet. Clinic. However, in Jamalpur hospital the highest incidence was anoestrus (20.1), followed by retained placenta (17.9), mastitis (17.4), repeat breeding (15.7), metritis (12.5), pyometra (7.6), dystocia (3.8) and others. Comparison of prevalence percentages showed that the occurrence of anoestrus and repeat breeding were higher in BAU Vet. Clinic than Jamalpur hospital (30.1 vs 20.1 and 35.5 vs 15.7) and retained placenta (17.9 vs 4.7), pyometra (7.6 vs 1.5) and mastitis (17.4 vs 8.5) were higher in Jamalpur Hospital than in BAU Vet. Clinic. Anoestrus, repeat breeding, retained placenta and dystocia may be occurred in early (2 to <5 years of age and late (8 years age).

Maruf *et al.* (2014) conducted a study to find out the reproductive disorders (RD) in dairy cows that markedly influences the reproductive performances in aspect of Bangladesh. A total number of 1658 dairy cows were selected according to their body condition score (BCS) in different farms at the Southern part of Bangladesh during the period of 2011 to 2012. Overall prevalence of reproductive disorders at that area were 23%, among of these anoestrus 5.1%, repeat breeder 3.7%, metritis 4.4%, poor heat detection 1.6%, ovarian cyst 0.36%, retained placenta 4.6%, dystocia 1% and pyometra 0.24%. RD had shown significantly higher incidence in low BCS (≤2) than that of fair (2.5) and very good (≥ 3~3.5).

Haile *et al.* (2014) conducted a study both questionnaire and observational survey in urban and semi-urban area of Hossana to determining the prevalence of major reproductive health problems of dairy cattle during the period from November 2013 to April 2014. A total of 390 dairy cattle (349 cross and 41 local breed) which were kept under different management system (256 intensively, 60 semi intensively and 74 were grazing on pasture land) were included, out of which 43.07% were found to be affected either with one or more of reproductive problems. The prevalence of repeat breeder, anoestrus, retained fetal membrane (RFM) and dystocia were found to be the major reproductive health problems were 13.08%, 12.06%, 7.18% and 5.9%, respectively and other reproductive health problems observed with lower prevalence include vaginal prolapsed, abortion, still birth and uterine prolapsed having 3.44%, 2.56%, 1.03%, and 0.76%, respectively. The overall prevalence of reproductive problems showed significant difference ($P<0.05$) with respect to body condition and parity of dairy cattle where major reproductive health problems were observed more frequently in poor body conditioned and pluriparus cows. Whereas breed and management system were not found to have a significant influence ($P>0.05$) on the occurrence of reproductive problems in the area.

2.1.2.1 Abortion

The expulsion of dead fetus or recognizable size before full term of the gestation period is called abortion or it is a condition in which the fetus is delivered live or dead before reaching the stage of viability and in which the delivered fetus is generally visible by naked eyes (Roberts, 1986; Hafez, 1993). All cases where the pregnancy terminates early and the fetus is expelled are called abortions. It may be defined as fetal loss between day 42 and 271 of pregnancy, with fetal loss before this stage defined as early embryonic death (before day 14) and late embryonic death (between days 14 and 42). There are multiple potential causes of abortion and the detection of abortions in a herd can vary significantly depending on the husbandry system and pattern of calving. Therefore, the reported incidence of abortion at herd level also varies markedly. The incidence of abortion in UK organic dairy herds has been reported to be 1.3 cases per 100 cows (Weller and Bowling, 2000).

Bostedt and Himstedt (1983) examined 30 cows aged 2 to 12 years at three days interval for two months following abortion due to various infectious and non-infectious causes at 2 to 8 months pregnancy. Irregular ovarian activity due to persistent corpus luteum, follicular atresia and ovarian cysts was observed in 80% of cow upto 69 days of such abortion.

Lobago *et al.* (2006) recorded that the prevalence of different disorders were abortion 1.4%, dystocia 1.3%, retained fetal membrane 5.4% and endometritis 2.8%.

Swai *et al*. (2007) analyzed reproductive performance and factors influencing reproductive efficiency of cross-bred cows in small holder farms in Amani, Tanzania. A retrospective questionnaire based study to estimate the frequency and determinants of long calving interval, retention of fetal membrane (RFM), dystocia, and abortion. Of the 123 cows that were reported to have calved more than once in their lifetime 3.3% were associated with abortion and 2.4% were associated with dystocia and 12.2% of the animals suffered from retention of fetal membrane. Older cows were less prone to retention of fetal membrane.

Esheti and Moges (2014) conducted to estimate the major reproductive health disorders of dairy cows in Ada’a district, Debre Zeit town, South east of Addis Ababa during the period from November 2013 to April 2014. A total of 245 cows which were under investigation (37.1%) had at least one of the reproductive disorders. The reproductive disorders according to their relative importance in dairy farms were repeat breeding (15.9%), abortion (5.3%), dystocia (3.3%), clinical endometritis (1.2%), retained fetal membrane (RFM) (0.8%), respectively also the overall mixed disorder was (10.6%).

2.1.2.2 Retained placenta

Bovine retained fetal membranes (RFM) have been defined as failure to expel fetal membranes within 12 hours after calving. There is reduced uterine contraction (the reduced force to push it out) 12 hours after calving, which results in retained placenta. According to Key (1978) retention of afterbirth in cows may be defined as failure of the fetal placenta (tufts) to separate from maternal placenta (crypts) and retention for more than 12 hours after parturition. Generally retained placenta is considered to be one of the major problems and its effects are not restricted to a single reproductive cycle but extend much further (Erb *et al.*, 1985; Stevenson and Call, 1988).

Unhygienic calving conditions are an obvious risk for both retained placenta and metritis. A variety of nutritional risk factors are associated with RFM (Roche, 2006). Milk fever and even sub-clinical calcium deficiency can be associated with an increased risk of RFM (Zhang *et al.,* 2002; Melendez *et al.,* 2004) with older cows more at risk of lower blood calcium. Over fat cows and vitamin E/selenium deficiencies have also been associated with increased incidence of retained afterbirth, although micronutrient imbalances are unlikely to be the most important cause of RFM (Mee, 2004).

According to Merck Veterinary Manual the incidence of retained placenta is higher in bovines than in any other species of animals and it is much more common in dairy breeds than in beef breeds (Roberts, 1986). Mutiga (1992) reported 21.9% retained placenta, 0.5% pyometra and 14% uterine prolapsed. The incidence of retained fetal membrane appears to be varying from breed to breed (Roberts, 1986 and Youngquist, 2007). Ali (1997) reported retained placenta with age of dairy cows in <4 years, 4 to <7 years, 7 to <10 years and >10 years were 9.4%, 19.2%, 38.1% and 51.9%, respectively. The retained placenta was increases with advancing age except in heifer (Erb *et al*., 1985; Stevenson and Call, 1988).

Hatch *et al.* (1968) conducted a clinical study on retained fetal membranes and metritis in dairy cows. During 4 years study they examined 360 cows of which 140 animals were treated for retained fetal membranes. Among 140 treated animals 17 (12.14%) developed acute septic metritis, 10 (7.14%) developed chronic metritis or endometritis. The remaining 113 (80.7%) animal conceived without further treatment while 80% and 60% cows having septic metritis and chronic infections respectively conceived after treatment.

Roberts (1977) observed retention of fetal membranes is a common post-partum complication in farm animals and, if untreated, is likely to result in permanent sterility due to pyometra, salpingitis, ovaritis and severe damage to the endometrium. Prolapse of the uterus occurs more often immediately after parturition and occasionally upto several hours afterward. In rare case it may occur 48 to 72 hours after parturition.

Sethi and Balaine (1978) reported 1.4% incidence of retention of fetal membranes in Hariana cows and 22.9 to 28.2% in cross-bred cows with Holstein, Brown Swiss and Jersey. However, Sinha *et al.,* (1978) reported the incidence of retention of fetal membranes as 14.1% and significantly higher incidence of retention of fetal membranes (61.4%) was observed in parturitions associated with dystocia, still births and abortions in comparison to the uneventful parturitions (14.1%). However, Pandit *et al.,* (1981) found that the overall incidence of retention of fetal membranes in the herd of Gir cows and their crosses was 8.8%. He found that parity wise difference in the incidence of retention of fetal membranes was highly significant ($P<0.01$) and incidence of retention of fetal membranes increased with increasing age in crossbred cows. They also revealed the significant effect of season on incidence of retention of fetal membranes. Kaikini *et al.,* (1983) worked on 96 Friesian × Gir F_1 crossbred cows and showed that the incidence of reproductive disorders (mainly metritis and retention of fetal membranes) was lowest during third lactation and highest during fifth lactation.

Dutta and Dugwekar (1983) observed the incidence of retention of fetal membranes in cows and buffaloes as 18.56 and 4.69%, respectively. Agarwal *et al.,* (1984) reported the incidence of retention of fetal membranes as 7.82% among 460 calving in cross-bred cattle.

Saloniemi *et al.* (1986) observed the incidence of dystocia, retention of fetal membranes and metritis as 0.9%, 4.5% and 2.3%, respectively in Finnish Ayrshire cattle. He found that the incidence of retention of fetal membranes, metritis and dystocia was lowest in second parity. Saini *et al.* (1988) reported that the incidence of retention of fetal membranes was 17.48% in different cross-bred cattle of Holstein Friesian, Brown Swess and Jersey with Hariana. He also reported that the incidence of retention of fetal membrane was significantly affected by parity, which was the highest in first and second lactation. Mukherjee *et al.* (1993) reported that a high (15.57%) incidence of retention of fetal membranes in Karan Fries cattle at NDRI herd in India. He reported the retention of fetal membrane to be less prevalent during first and second lactation while it was more prevalent during latter lactations. Satya pal (2003) calculated the incidence of retention of fetal membranes as 27.7% in Karan Fries cows.

Samad *et al.* (1989) reported that the cross-bred groups, Sahiwal and Friesian crosses had the lowest (9.43%), where as local and Friesian crosses had the highest (60.20%) incidence of retained placenta followed by miscellaneous group which had an incidence of 39.69%.

Scheidegger *et al.* (1993) studied the effect of retained fetal membrane and other puerperal reproductive disorders on post-partum fertility in Holstein cattle. From calving of Holstein cows from 3 high production dairy farms (>6500 kg/lactation) in central chile. A total of 822 parturition were selected of which 422 calving showed retention of fetal membrane (RFM), reproductive system infection, ovarian cyst or recombination of these disorders. Four thousand calving were kept record as control. The author recorded the incidence of 12.6% retention of fetal membrane, 13.6% ovarian cyst and 23.8% reproductive system infection, respectively.

Jamil (1995) showed the highest incidence of retained fetal membrane as 35.07% in 1st parity followed by 33.71% in 5th parity, 26.23% in 4th parity, 20.44% in 3rd parity and 20.34% in second parity.

Rahman *et al*. (2000) observed the overall incidence of retention of afterbirth was 46.1%. The incidence of retention of afterbirth was higher (36.6%) among European × Zebu cross and fewer (11.7%) in local breeds.

Gabr *et al.* (2005) stated that the effect of live body weight of Friesian cows on the percentage of retained placenta increased significantly ($P<0.05$) with increasing live body weight of cows, which varied from 20.70% at body weight of 350-400 kg to 31.20% at body weight of 600-650 kg with an average of 24.90%.

Han and Kim (2005) determined the risk factors for retained placenta by evaluating several reproductive factors in individual cows. The data was also analyzed for the effects of retained placenta on the occurrence of post-partum diseases and subsequent reproductive performance in dairy herds. The health status, cow parity, calving, and breeding dates were recorded from 805 calving in nine dairy herds from October 2000 to March 2004. The occurrence of endometritis and metabolic disorders was greater ($P<0.01$) in the group with retained placenta than in the control group. The overall incidence of retained placenta among the 805 calving was 18.3% and ranged from 8.3 to 28.1% among nine dairy herds.

Balasundaram (2008) reported that none of the non-genetic factors (period and parity) had significant effect on incidence of metritis and retained placenta in Karan Fries cow. He also reported that high (18.67%) incidence of retention of fetal membranes in Karan Fries cows.

Chatikobo *et al*. (2009) studied the effects of feed quality, education of the farmers and breeding method on the occurrence of reproductive disorders mainly retained placenta of dairy cows. The author reported about 33% retained placenta where extensive system (76%) being the most common followed by semi-zero or mixed grazing (15%) and zero grazing (9%) of feeding system.

Azad (2010) stated that the reproductive disease was most frequently recorded in cross-bred cows (36.7%) followed by indigenous (23.3%) and pure breed exotic cows (19.7%). The author showed the rates of retention of placenta in 3 to 5 years and >5 years age groups were 16.3% and 12.9% for treatment group and 33.3% and 37.5% for control group. He also observed that the rates of retention of placenta in 1^{st} -2^{nd} and 3^{rd} -5^{th} parity were 15%, 15.0% and 33.3%, 37.5% for treatment and control group, respectively.

Gaafar *et al.* (2010) reported the prevalence of retained placenta in Friesian cows increased significantly ($P<0.05$) from 14.20% for 1^{st} parity to 54.60% for 8^{th} parity. They observed the prevalence of reproductive disorders related with body weight of cows at different group as follows 250 kg to 300 kg, 300 kg to 350 kg, 350 kg to 400 kg, 400 kg to 450 kg, 450 kg to 500 kg and 500 kg to 550 kg were 20.7%, 22.4%, 24.85%, 26.5%, 28.2% and 31.2%, respectively and also observed in feeding practice such as Green feeding and Grain feeding were as 26.2% and 22.90%.

Sarder *et al*. (2010) studied the effects of breeds, ages, parity and body condition score on the occurrence of reproductive disorders of dairy cows. The author found that the prevalence of retained placenta recorded at various breeds such as Local × Friesian, Local ×Sahiwal and Local ×Sahiwal×Friesian cows as 6.7%, 13.2% and 13.4%, respectively. They recorded the incidence of retained placenta at various ages such as <4 years, 4 to <6 years, 6 to <8 years and >8 years were 4.4%, 10.4%, 8.7%, and 15.2%, respectively. He observed the reproductive disorders in different parities such as 1st parity, 2nd parity, 3rd parity, 4th parity, 5th parity and >6 parity were 8.5%, 13.3%, 6.1%, 9.4%, 20% and 28.7%, respectively and related with body condition score at poor, fair and very good were 12.6%, 6.87% and 13.8%, respectively.

Islam *et al. (*2012) observed that the retained placenta is an economically important reproductive disorder which occurs at the end of the reproductive cycle and has repercussions on the next. The study was conducted a total 1205 dairy cows from 9 upazila and 4 metro thana of Rajshahi during the period from July 2010 to June 2011. The overall prevalence of retained placenta was 13.4%. The influencing factors including breed, age, parity, body condition score had significant effect ($P<0.05$) on retained placenta. The highest prevalence was 10.7%, 4.5%, 5.6% and 7.1% observed in cross-breed, >3 years age, 1st parity and fair body condition group of cows, respectively.

Islam *et al. (*2013) observed that the incidence of retained placenta of dairy cows in relation to individual animal level and farm management factors such as farm type, farm size, housing system, floor type, feed quality, time of parturition, farming experience of farmer and delivery pattern of cow. The overall incidence of retained placenta was 13.4%. The incidence was significantly higher in Local × Sahiwal genotype (4.6%). The large farm (6.0%) had higher incidence and had no significant effect than medium and individual household. Similarly animals housed in Tin shed building with poor ventilation facilities (6.6%), animal housed in unscientific concrete floor (6.8%), animals mostly grassed along with small amount of straw supplied (5.4%) and a farmer had less than one year farming experience (5.3%) had not significant statistically show higher incidence of retained placenta.

2.1.2.3 Still birth

Still birth in dairy cattle is one of the functional traits that receive more and more attention. A case in which a nonviable fetus is delivered at full term or the fetus dies immediately before or during the delivery process. Berglund *et al.* (2003) stated that the definition of a stillborn calf was dead at birth or within 24 h after birth after at least 260 days of gestation. In Sweden the rate of stillbirth has gradually increased during recent years due to the introduction of American Holstein Friesian genes (Berglund, 1996). The overall mean was 6.7%. Still birth was higher in heifers (10.1%) as opposed to cows (5.0%) (Berger *et al.*, 1997). About 0.66% still birth was recorded by (Shamsuddin, 1996).

Economic values of still birth are often part of the economic value of dystocia. Dystocia has an economic value of 1.33 per cow per year percentage increase in difficult calving (Groen *et al.*, 1995). This economic value is based on the extra cost due to veterinary fee, farmer, labor and still birth. Furthermore, dystocia and still birth have indirect costs as well. These costs are associated with health and fertility problems and it reduced production. Increased culling rate, decreased annual welfare and increased concern on consumer acceptance of dairy products (Groen *et al.*, 1995).

McDermott (1992) examined a total of 180 samples from 123 herds which maintained individual-animal records in Ontario cow-calf herds to evaluate the calving problems in beef cows and heifers. They found 5.8% dystocia and 2.8% still birth. Still births for both cows and heifers were associated with calving assistance, particularly hard assistance.

Correa *et al*. (1993) conducted a prospective field study during the period from March 1981 to April 1985. They recorded the overall incidence of calving related disorders were dystocia 8.9%, retained placenta 9.5%, uterine prolapse 0.3% and still birth was 6% of the total calving.

Chassagne *et al.* (1999) stated that the still birth as birth of a dead calf or a calf dead within 24 h after parturition. Data were collected from an overall 4-yrs prospective survey in French dairy herds in Holstein heifers. They found the incidence of still birth was 6.9%.

Bicalho *et al*. (2007) conducted a study to evaluate the effect of still birth on survival and reproductive performance of lactating dairy cows. The final analysis included 13,608 calving of which 93.4% were live calves and 6.6% still births. A significant decreasing trend in the incidence of still birth by parity group was detected. The incidence of still birth increased as the calving difficulty scores increased.

2.1.2.4 Metritis

Metritis is the inflammation of the uterus, generally caused by infection. Cows normally have a red-to-brown discharge during the first 2 weeks after calving, if discharge persist beyond 2 weeks or if the discharge is foul-smelling, this is an evidence of metritis. Metritis is mostly septic following parturition and is observed usually within 1 to 10 days after parturition. It is usually associated with removal of retention of fetal membranes, prolonged dystocia and abortion (Morrow, 1986; Roberts, 1986). Metritis is very important reproductive disorder which results in the huge economic loss to the farmer.

Acute puerperal metritis is relatively uncommon and is defined as acute inflammatory changes in the endometrium (uterine lining), myometrium (uterine wall) and peritoneal (outer) layers of the uterus within 10 days of calving (Sheldon *et al.*, 2004). It is due to either an excessive bacterial challenge (often associated with RFM, infectious abortion, dystocia which required assistance, dirty calving equipment) or due to a reduced ability of the cow's defence mechanism to clear infection (concurrent disease such as milk fever or dystocia) (Sheldon *et al.,* 2004).

Metritis and endometritis are highly prevalent in high producing dairy cows and have been associated with decreased pregnancy per AI, extended interval to pregnancy, increased culling, and economic losses (Sheldon and Dobson, 2004; Gilbert *et al*., 2005). Metritis affects about 20.0% of lactating dairy cows, with the incidence ranging from 8 to >40% in some farms (Hammon *et al.,* 2006; Huzzey *et al*., 2007; Galvao *et al*., 2009). Retention of fetal membranes is a condition where the cow fails to release the placenta 12 or 24 hrs after calving. Although retention of fetal membranes is not a disease pursue, many researchers have tried to treat (systemically or intrauterine) this condition because it is a major risk factor for metritis (Risco and Hernandez, 2003; Drillich *et al.*, 2006).

Sandals *et al.* (1979) conducted a survey of 293 dairy cows and 652 calving to observe the effects of retained placenta and metritis complex on reproductive performance. The overall incidence rate of retained placenta was 11.2%. Metritis complex was diagnosed following 54.8% of retained placenta cases. Retained placenta alone did not significantly impair reproductive performance. Metritis complex, in the presence or absence of retained placenta, caused a significant ($P \leq 0.05$) increase in days open, services per conception, calving to first heat intervals and days from calving to first service. There is an indication (interaction $P \leq 0.1$) that cows with both retained placenta and metritis complex are more severely affected than cows with either retained placenta or metritis complex alone.

Kaikini *et al.* (1983) studied reproductive disorder in Holstein × Gir F_1 cross-bred cows and observed that the overall incidence of reproductive disorders was 36.50%. They observed that, most frequent disorder was metritis (8.8%) followed by placental retention (7.06%), cystic ovaries (6.21) and dystocia (5.4%).

Franzet *et al.* (1988) reported the incidence of endometritis in Germanblack Pied first calf heifers to be 20.7% and in cows as 17.4%, respectively. Mukherjee *et al.* (1993) recorded that the incidence (14.11%) of metrites was in Karan Fries. Kulkarni *et al.* (2002) observed the incidence of metritis and endometritis 0.7% in indigenous Gir, half breeds, 3/4 breeds and reciprocal crosses. Satya (2003) observed the incidence of metritis was 29.7% in cows. However, Balasundaram (2008) reported the overall incidence of metritris was the most severe reproduction disorder in both first calvers (28.90%) and all calvers (38.93%) in Karan Fries cow.

Kim and Kang (2003) determined the risk factors for post-partum endometritis by evaluating several reproductive parameters in individual cows and analyzing the effect of endometritis on the subsequent reproductive traits in dairy herds in Korea. A total of 320 data were collected from eight dairy herds calving from January 2001 to October 2002 including health status, parity, body condition and calving date. The data revealed that retained placenta, metabolic disorders and parity were important risk factors for endometritis. The number of services per conception was higher in the endometritis group (1.9%) than in the non-endometritis group (1.6%). It was concluded that retention of placenta and cow parity were strongly correlated with the development of post-partum endometritis, which was negatively influence reproductive traits in dairy herds in Korea.

2.1.2.5 Pyometra

Pyometra is characterized by the accumulation of pus or muco-purulent meter in the uterus. It is characterized by a pus filled uterus in the presence of a corpus luteum (CL) and a closed cervix (Sheldon *et al.,* 2006). Pyometra can be considered a sub-set of endometritis where cows ovulate in the presence of a contaminated uterus.

Pyometra is defined as an accumulation of pus in the uterus and by the persistence of a functional corpus luteum. Pyometra is often due to chronic endometritis with the normal cycling of the cow disrupted by the presence of infection in the uterus. Affected cows do not appear ill but may be presented as not seen in heat. There will be an obviously enlarged, doughy uterus, which may potentially be mistaken as a pregnancy but if ultrasound scanned will show a content of pus rather than foetus and foetal fluids (Sheldon *et al.,* 2004). According to Tahawy and Fahmy, (2011) pyometra is defined as an accumulation of pus in the uterus and is associated with infertility and postpartum anoestrus. In cows, it is usually associated with a persistent corpus luteum.

Roberts (1986) observed pyometra is an abscessed and pus-filled infected uterus. It is characterized by the persistence of corpus luteum in one or both ovaries. It may occur either post-partum or post-service. It is usually occur following an abnormal parturition, a uterine infection, abortion, premature birth, twin birth, dystocia, retained placenta and metritis. Toxins and bacteria leak across the uterine walls and into the bloodstream causing life threatening toxic effects without treatment death is inevitable.

Grohn *et al*. (1990) collected data on the epidemiology of 10 reproductive disorders from 61,124 Finnish Ayrshire cows. They reported the incidence of different reproductive disorders were (1.2%) dystocia, (0.2%) uterine prolapse, (4.4%) retention of fetal membranes, (2.3%) early metritis, (0.1%) vaginal prolapse, (1.1%) late metritis, (0.4%) abortion, in each lactation. The risk of dystocia and retained placenta increased with increasing parity. Parity did not explain the incidences of the other reproductive disorders. High herd milk yield in the previous lactation increased the risks of retained placenta, early metritis and late metritis. High herd yield in the current lactation increased risk of dystocia. Most of the reproductive disorders were interrelated. Parturient paresis was a risk factor for dystocia, uterine prolapse, retention of fetal membranes and early metritis.

2.1.2.6 Utero-vaginal prolapse

Uterine prolapse refers to a post-partum condition in which part or the entire uterus is reversed and prolapsed from the cervical canal to the outside of the vulva.

Morrow (1989) stated that the coming out of the uterus through the vulva commonly shortly after parturition and hanged out with the inner surface outer most.

Roberts (1971) observed cervicovainal prolapsed was occurred in all species of domestic animals but most commonly in the cow. In this case prolapsed of the floor, the lateral walls and a portion of the roof of the vagina through the vulva with the cervix were observed.

Roberts (1986) stated that the vaginal prolapsed is the protrusion of the vagina and sometimes with the cervix through the vulva. It tends to occur during the mid to late gestation period and sometimes after delivery.

Gardner *et al.* (1990) collected data on the incidence, time of occurrence and etiology of the uterine prolapse in 2,20,000 primiparous cows. It was reported that the most of the uterine prolapsed cases occurred within 24 hours following parturition.

Soonwuk *et al*. (1996) observed a total of 800 cows with reproductive disorders and they recorded 10% vaginal prolapsed, 3% retained placenta, 9.8% abortion, 2.3% uterine disease and 2% repeat breeder cases.

Kalbe and Schulz (2002) examined the incidence of uterine prolapse in a total of 52505 calving on a large dairy farm showing 167 cases of uterine prolapse (0.3%) from 1987 through 1999. In primiparous cows 24.8% of the prolapse were preceded by dystocia, while in older cows incidence was less (8.9%). Post parturient paresis (mainly due to hypocalcaemia) occurred in 39 cases (23.4%) of uterine prolapse.

Erdogan *et al.* (2004) determined the vaginal discharge (84.4%), infertility (40%), mastitis (55.6%), retained placenta (42.2%), dystocia (31.1%), weight loss (46.7%) and anorexia (31.1%) were the most common clinical problems encountered at farm level and animal level in the post-partum period.

Bhattacharyya *et al*. (2012) stated the vaginal prolapse mostly occurred during advanced pregnancy and uterine prolapse following parturition. At the time of examination, most of the animals with uterine prolapse were recumbent, while those with vaginal prolapse were standing. The highest prevalence of genital prolapse was recorded in cross-bred cows around the 2nd parturition.

2.1.2.7 Dystocia

An abnormal and difficult birth in which the first or specially the second stage of parturition was markedly prolonged and subsequently found impossible for the dam to deliver without artificial aid is called dystocia (Roberts, 1986). Verma and Mishra, (1984) reported the incidence of various reproductive disorders i.e. dystocia, retained placenta and uterine prolapse was 10.18%.

Curtis *et al.* (1985) conducted a study to identify direct and indirect relationships among clinical peri-parturient disorders (within 30 days after calving) retained placenta, metritis, veterinary assisted dystocia, parturient paresis, mastitis and estimated nutrient intakes (protein, calcium, phosphorus, energy) in the last 3 week of the dry period. For the purpose, data on 1374 multiparous Holstein lactation records were collected from 31 commercial herds in central New York through March 1981 to February 1982. Peri-parturient disorders occurred as a complex and odd ratios for the multiplicative effects of parturient paresis on incidence of assisted dystocia, retained placenta and clinical mastitis were 7.2%, 4.0% and 5.4%, respectively.

Verma *et al*. (1986) reported various reproductive disorders i.e. dystocia, retained placenta and uterine prolapse of cattle in India. Determine relative relationships among factors affecting dystocia in Brahman-cross heifers in subtropical Southeastern United States. Dystocia incidence was 6.9% in 1992 and 10.5% in 1993, with higher incidence in males than in females.

Rahman *et al.* (1994) described a case of dystocia due to non-opening cervix in a six years old Zebu cow at her third parity with pathological gestation (>280 days). The cow showed loss of appetite, restlessness, flaccid vulva without any evidence of discharge and relaxation of the pelvic ligament with signs of abdominal pain. Caesarean section was performed to remove the fetus.

Bellows *et al.* (1996) conducted a study to determine the relative relationships among factors affecting dystocia in Brahman-cross heifers in subtropical southeastern United States. The author recorded the incidence of dystocia was 6.9% in 1992 and 10.5% in 1993, that was higher incidence in males than in females.

Kakar *et al.* (1997) studied the occurrence of clinical cases of uterine infections, anoestrus and obstetrical problems in cattle during the period between July 1980 to June 1995 recorded by the Livestock and Dairy Development Department, Balochistan, Pakistan. Among obstetrical problems, genital prolapse was reported to be about 31.3% followed by the incidence of dystocia at 26.9%, retention of fetal membranes at 23.9% and non-specific abortions about 17.8%.

Nix *et al.* (1998) determined the factors affecting calf mortality, malpresentation and dystocia in beef cattle calving. Malpresentation was reported in only 0.91% parturitions which involved posterior presentation, leg deviations, head deviations and breech birth. Dystocia affected calf mortality within 24 hours of birth. Mortality increased with increasing severity of dystocia. Dystocia was greater in primiparous than in multiparous dams.

Lodhi *et al*. (1999) collected and analyzed 19644 cows to determine the effect of parity on the occurrence of various reproductive disorders in dairy cows. A total of 1251 cases of reproductive disorders were recorded making an overall occurrence of 6.36% over a 6 years period. The relative occurrence of endometritis was 80.65% followed by retained fetal membrane 4.65%, dystocia 2.79%, vaginal prolapsed 1.87% and abortion 0.87%. The occurrence of dystocia was highest in primiparous animals.

Johanson *et al*. (2003) determined the effect of birth weight and dystocia on perinatal mortality. Data comprised of 4528 calving recorded between 1968 and 1999 from the Iowa State University research dairy farm in Ankeny. The incidence of perinatal mortality was 7.1% and dystocia was 23.7%. For dystocia parameters included were the effects of year of birth, season, sex of calf, perinatal mortality, parity and birth. 1st parity cows had 4.7 times high risk of dystocia compared with cows in later parities.

2.1.2.8 Milk fever

Milk fever is generally seen in adult and high yielding cows within 3 days after calving. It may also be observed within 1-2 days before calving or sometimes up to the 7th day after calving. The cause of milk fever is high Ca requirement after calving due to high requirement with lactation.

Milk fever, also known as parturient paresis, is a well-known metabolic disorder that occurs at or near calving, particularly in high producing cows. A fairly common problem, it’s estimated to occur at the rate of 5.10% nationwide (Horst, 1986). Recently, the economic loss associated with milk fever was estimated at $334 per occurrence (Guard, 1996), including cost of treatment and loss in milk production. Incidence tends to increase with age and is higher in Jerseys compared to Holsteins. Cows that recover from milk fever are less productive and more susceptible to other health disorders such as ketosis, mastitis, retained placenta, displaced abomasums and uterine prolapse. Whitaker *et al.* (2004) reported the average annual incidence of clinical milk fever in British dairy herds was 5%. Similarly, Weller and Cooper, (1996) showed the incidence of milk fever in organic cows was low in the UK. One of the main reasons for this may be the generally lower milk yield on organic dairy farms and due to reduced use of potassium based fertilizers (Hardeng and Edge, 2001). About 15% milk fever was recorded by Fourichon *et al.*, (2001).

2.1.2.9 Mastitis

Mastitis, or inflammation of the mammary gland, is predominately due to the effects of infection by bacterial pathogens, although mycotic or algal microbes play a role in some cases. Pathologic changes to milk-secreting epithelial cells from the inflammatory process often bring about a decrease in functional capacity. Depending on the pathogen, functional losses may continue into further lactations, which may reduce productivity and potential weight loss for suckling offspring. Mastitis has been reported in almost all domestic mammals and has a worldwide geographic distribution. Climatic conditions, seasonal variation, bedding, housing density of livestock populations, and husbandry practices may affect the incidence and etiology of mastitis. However, it is of greatest frequency and economic importance in species that primarily function as producers of milk for dairy products, particularly dairy cattle (reviewed by Erskine, 2014).

Mastitis occurs when white blood cells (leukocytes) are released into the mammary gland, usually in response to bacteria invading the teat canal. Milk-secreting tissue and various ducts throughout the mammary gland are damaged due to toxins released by the bacteria. Mastitis can also occur as a result of chemical, mechanical, or thermal injury to the cow's udder. This disease can be identified by abnormalities in the udder such as swelling, heat, redness, hardness, or pain (if it is clinical) and abnormalities in milk such as a watery appearance, flakes, or clots. When infected with subclinical mastitis, a cow does not show any visible signs of infection.

Wilson and Richards (1980) reported the results of a national survey of mastitis in England. A total of 500 herds were examined to determine the prevalence of sub-clinical mastitis in British dairy herds. The prevalence of various infectious diseases recorded were as *Streptococcus agalactiae* 3.4% of quarters, *Str. Dysagalactiae* 1.1%, *Str. Uberis* 1.5% and *Staphylococcus pyogenes* 8.1%. The national prevalence of sub clinical mastitis as per the criteria of the International Dairy Federation was 9.6% of all quarters. Udder infections were less prevalent in herds which practiced mastitis control measures. The prevalence of infections reduced as the size of the herds increased. However, as the adoption of mastitis control measures was greater in the larger herds, it seems likely to be widespread use of control measures. The most important factor responsible for the low prevalence of sub clinical mastitis is bigger herds.

Bansal *et al.* (1995) investigated milk samples which were collected from 154 cows in different herds and 117 buffaloes in 5 herds in the Indian Punjab province. They found that the sub-clinical mastitis was 48% in cows and 27.1% in quarters of cow and 23.9% in buffaloes and 11.3% in quarters of buffalo, respectively.

Sargeant *et al.* (1998) conducted a study of 65 dairy farms, which included recording all clinical mastitis cases and milk sampling of quarters with clinical mastitis to observe the frequency of occurrence of clinical mastitis in dairy herds in Ontario. Lactational incidence risks of 9.8% for abnormal milk, 8.2% for abnormal milk with a hard or swollen udder, and 4.4% for abnormal milk plus systemic signs of illness related to mastitis were calculated for 2840 cows and heifers. Overall, 19.8% of cows experienced one or more cases of clinical mastitis during location. The majority of 1^{st} cases of clinical mastitis occur early in lactation, and the risk of clinical mastitis increases with increasing parity.

Qazi *et al.* (1999) conducted a survey of 45 different small livestock units/herds in Lahore (Pakistan) for epidemiologic data on mastitis. Analysis of data showed a prevalence of 8.8% in herds and 8.3% in lactating animals. Highest prevalence of mastitis was recorded in 6-8 year old cows and buffaloes. Out of positive cases the prevalence was highest (53.63%) during early lactation followed by moderate (21.97%) and late lactation (24.4%). The prevalence was higher in high yielding animals. Using a modification of California mastitis test, Lalrinthuanga *et al.*, (2003) screened 987 quarters of 248 cows in various dairy pockets and villages of Aizawl area of Mizoram province (India). The results indicated that 37.5% of the animals and 11.65% of quarters were positive for mastitis. Among them, only 2.6% of quarters were positive for clinical mastitis, that rest (9.05%) had sub clinical mastitis.

Kanuyaa *et al.* (2000) studied the reproductive performance and reproductive disorder of dairy cattle kept in small holder herds under a zero-grazing system in a rural highland area of Tanzania. Data on the occurrence of all normal and abnormal reproductive events were collected for 215 adult animals belonging to 74 households. The cumulative incidence risk reported were abortion 16%, dystocia 1.7%, prolapse 2.5%, retained fetal membranes 4.2%, mastitis 5% and milk fever 1.7%.

Seegers *et al.* (2003) observed that the mastitis is the most prevalent production disease in dairy herds world-wide and is responsible for several production effects. Milk yield and composition can be affected by a more or less severe short-term depression and, in case of no cure, by a long-acting effect, and, sometimes, an overlapping effect to the next lactation. The values in the literature for losses of milk production were proposed at 375 kg for a clinical case (5% at the lactation level) and at 0.5 kg per 2-fold increase of crude SCC of a cow. Due to the withdrawal period after treatment, composition changes in milk can almost be neglected in economic calculations. The economics of mastitis needs to be addressed at the farm level and, perse, depends on local and regional epidemiological, managerial and economic conditions.

Biffa *et al.* (2005) carried out a study from February 2001 to March 2002 in a total of 974 milking cows using California Mastitis Test and clinical inspection of udder and associated risk factors in lactating dairy cows in Southern Ethiopia. The results were recorded as 34.9% mastitis, 11.9% clinical and 23.0% subclinical mastitis. Cows managed under semi-intensive rearing system were more affected (43.8%) than those managed under extensive (25.8%) and intensive (28.9%) systems. Holstein-Fresian cows were affected at a higher rate (56.5%) compared with local zebu (30.9%) and Jersey cows (28.9%). Inadequate sanitation of dairy environment, poor animal health service, and lack of proper attention to health of the mammary glands were important factors contributing to high prevalence of mastitis.

Karimuribo *et al.* (2006) conducted a cross-sectional study of 400 randomly selected small holder dairy farms in the Tanga and Iringa regions of Tanzania and reported that 14% of cows had developed clinical mastitis. The point prevalence of sub clinical mastitis, defined as a quarter positive by the California Mastitis Test (CMT) or by bacteriological culture was 46.2% and 24.3%, respectively. In a longitudinal disease study in Iringa, the incidence of clinical mastitis was 31.7 cases per 100 cows-years.

Osteras *et al.* (2007) studied on the reproductive diseases of Norwegian cattle health recording system, which has been in place for the entire country since 1975 and reported that the most common diseases were acute clinical mastitis, chronic clinical mastitis, ketosis, milk fever, teat injuries, retained placenta, anoestrus, indigestion, eystic ovaries, and metritis. According to Kalara and Dhanda (1964), in the rural areas of the North West India, and reported that the overall incidence of clinical mastitis was 7.5% in buffaloes and 8.80% in cows. In urban areas, the corresponding value was 10.23% in buffaloes and 11.08% in cows.

2.1.2.10 Repeat breeding

Cows failing to conceive after a defined number of inseminations (generally three or more) with fertile semen have been classified as repeat breeders (Zemjanis, 1980; Gunther, 1981; Levine, 1999). A condition in which no abnormality is detected in the reproductive organs but no conception occurs even after three or more times of mating or artificial insemination. Repeat breeder (RB) cows are a heterogeneous group of sub-fertile cows with no anatomical abnormalities or infections that exhibit a variety of reproductive disturbances in a consistent pattern over three or more consecutive heat cycles of normal duration (17-25 days). One of the major constraints of profitable dairy farming is low conception rate (Alam and Ghosh, 1994; Shamsuddin *et al.*, 2001). Early embryonic death (<42 days) is a major factor in reproductive failure, which in turn causes economic loss to the dairy industries (Rahman *et al.*, 1996). Shamsuddin (1995) reported 5% repeat breeding cases in Bangladesh.

Chatterjee *et al.* (1985) carried out a study on cases of abnormal termination of the pregnancy, a total of 194 cows in 13 organized dairy herds and 795 cows in individual holding in West Bengal for a period of four years. The overall incidence of abnormal termination of pregnancy was 16.1%. The causes of such disorders were as abortion (9.7%) and still birth (4.4%). The author also recorded abnormalities were as cervicitis, endometritis, repeat breeding and anoestrus for brucellosis, campilobacteriosis, leptospirosis and trichomoniasis.

Hossain (1987) examined 571 bovine species consisting of 119 local cows, 241 cross-bred cows and 211 buffalo cows over a period of two years in order to determine various reproductive disorders. The author observed that the incidence of smooth ovaries among cross-bred cows (17.73%) was comparatively less than that of local cows (56.60%), whereas cystic ovary, metritis and repeat breeding was comparatively less among local cows than those of cross-bred cows. He also recorded repeat breeders was 8.06%.

Alam *et al.* (2007) observed that bacterial and fungal infections in varying proportions in repeat breeder cows in Bangladesh.

Sah and Nakao (2006) stated that repeat breeding is the most important reproductive disorders in livestock population and also assessment the failure of estrous detection and management of mating with bulls. The major clinical features of repeat breeding include a high incidence of cervicitis, and a high or moderate response to treatment with PGF2α and GnRH or vitamin/mineral mixture.

Gani *et al*. (2008) observed positive correlation (r=0.94) between repeat breeders and bacterial infection of uterus. They detected bacteria in 62% repeat breeding cases in contrast to only 28% bacterial infections from normal fertile cows.

Gebrekidan *et al*. (2009) observed the major causes of slaughtering of female cattle in Addis Ababa Abattoir Enterprise, for ante and post mortem examined. Of the total 235 female cattle that came for slaughtering, the most prevalent reason of culling, accounted for 39.1%, were reproductive problems of which 36.6% were anoestrus cows and 28% were repeat breeders.

2.1.2.11 Anoestrus

Anoestrus is lack of expression of the estrus at an expected time. Clinically, if a heifer is 18 or more months old or a cow has passed 60-70 days after post-partum but did not show estrus the condition is referred to as anoestrus. According to McDougall and Rhodes (1999) a cow diagnosed as anoestrus in the field, may or may not be ovulating. A single rectal examination as performed by the veterinarian on non-cycling cows is often insufficiently discriminatory.

Hafez (1993) observed a state of complete sexual inactivity with no manifestation of estrus for more than two months.

Kudlac (1965) studied the causes of anoestrus and stimulation of estrus in heifer. He examined about 71 heifers, 18-30 months old, weighing between 350-450 kg and the author found 70.58% acyclic, 3.92% developmental genital anomalies, 3.92% ovarian insufficiency and 21.56% were in silent heat.

Aranjo *et al*. (1973) examined a total of 2500 cows in 20 herds to determine the causes of post-partum anoestrus. The author found 1065 (42.6%) cows did not exhibit the signs of estrus for more than five months after calving in which 70 had smooth inactive ovaries and 3.3% had uterine infection with persistent corpus luteum.

Francos (1974) made a observation on the frequency of reproductive disorders in dairy herd in Israel. The author examined 4811 Friesians cows in seven intensive dairy herds. The disorders recorded were 10% retention of placenta, 11% endometritis, 12% anoestrus, 2% ovarian cysts and 5% animals inseminated at least four times with success.

Kruif (1977) carried out a study on anoestrus in dairy cows. The author examined 2720 cows in different herds and 20 farms which had recently calved. Of which 438 (16%) failed to reach estrus within 50-60 days after parturition. The failure was attributed to the following causes: ovary not contained within the uterus (sub-estrus) 76%, ovary very small and hard (genuine anoestrus) 9%, pyometra 6%, ovarian cysts 7% and gestation 1%.

Kumar *et al.* (1986) performed a survey on reproductive disorders in non-descript cattle. A total of 810 indigenous cattle of which 52% were found normal and 48% had reproductive disorders. The author recorded 19% anoestrus, 1.7% ovarian hypoplasia, 7% atrophy or hypoplasia of uterus, 5% cervicitis and 1.2% metritis cases.

Ghosh *et al.* (1993) observed the most cows should initiate their ovarian cycles early enough to allow them breeding by 60 days after calving. However, estrus cycles are sometimes delayed in cows due to the negative energy balance following calving. Nutrition, especially the level of energy intake plays an important role in determining post-partum reproductive performance.

Grohn *et al*. (1995) observed the body weight at calving and subsequent weight changes during the post-partum period influence the onset of post-partum reproductive function. This condition affects the developmental rate of large follicles (non functional ovaries), the timing of first ovulation and resulted in extending period of acyclicity.

Shamsuddin *et al.* (2001) evaluated the ovarian cyclicity by assaying progesterone in two milk samples collected every month at 10 day intervals and showed that 40% of post-partum cows were not detected in estrus when they completed one or more ovarian cycles. Another important issue is that AI technicians often state that a cow is in estrus when she is not. In their earlier studies 30% of cows were stated to be in estrus when they were not.

Ahmed (2007) stated that many factors can predispose to and exacerbate the anoestrus problem such as parasites, adverse climatic conditions manage mental stress and diseases. These factors compounded with lactation can further extend the post-partum anoestrus period.

2.2 Biometrical measurement of reproductive organs in cows

2.2.1 Morphological studies of reproductive organs of cows

The female genitalia situated in the pelvic cavity. The generative organs of the female cow considering of the ovaries and the tubular portion of the reproductive tract including the oviduct, uterus, cervix and the cranial portion of the vagina (Figure 1).

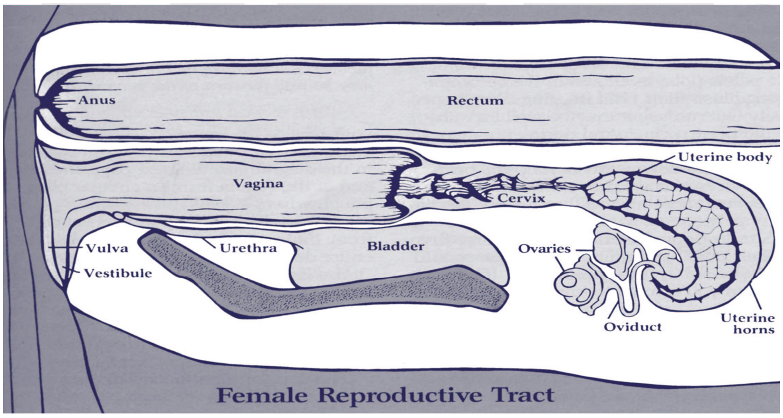


Figure 1 Overall view of the cow's reproductive system with anatomy.

2.2.2 Ovary

The ovaries are the primary organs in a cow's reproductive tract (Figure 2). They are generally ovoid in shaped. They have two functions: to produce the female's gametes (ova) and sex hormones, namely estrogen and progesterone, throughout the different stages of the estrus cycle. They are usually situated near the middle of the lateral margin of the pelvic inlet cranial to the external iliac artery. On the surface of the ovary, two different types of structures were found. Follicles, which are fluid filled, blister like structures that contain developing oocytes or eggs. The other structure found on the ovarian surface is the corpus luteum or CL. The CL is the site where ovulation occurred during the previous cycle. The ovaries are lined by surface (germinal) epithelium, and further consist of a cortex and a medulla. The cortex contains the preliminary stages of the gametes (oocytes), which are surrounded by somatic cells to form a follicle.

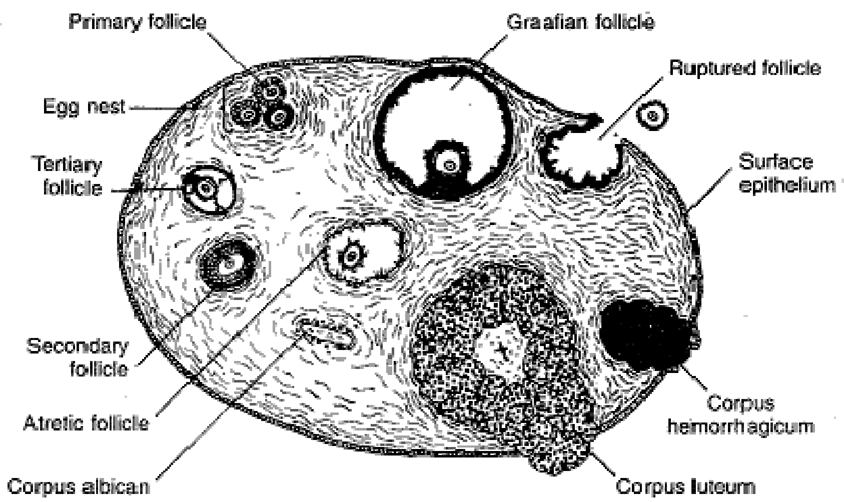


Figure 2 Schematic diagram of mature ovary in cow.

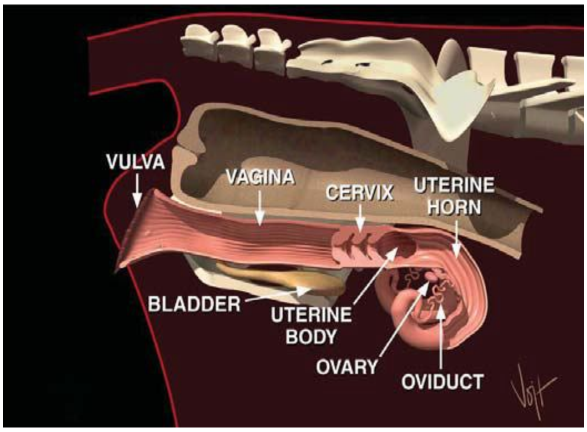


Figure 3 Side view of the cow's reproductive system.

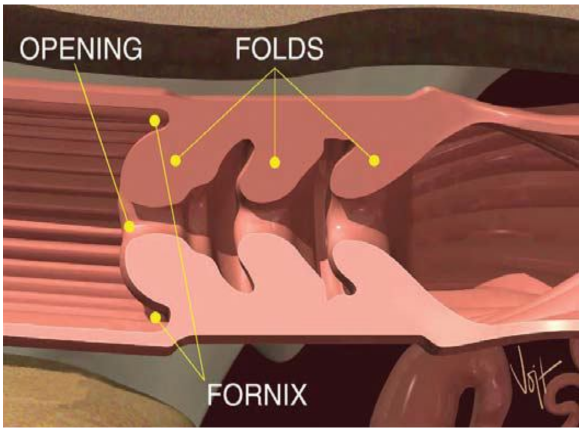


Figure 4 Close-up view of the cervix of cow.

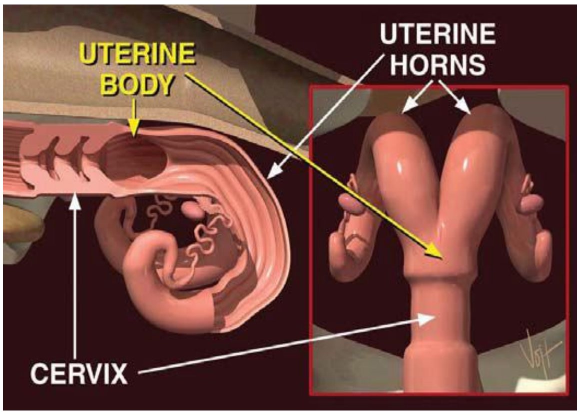


Figure 5 The short uterine body divides into two long uterine horns.

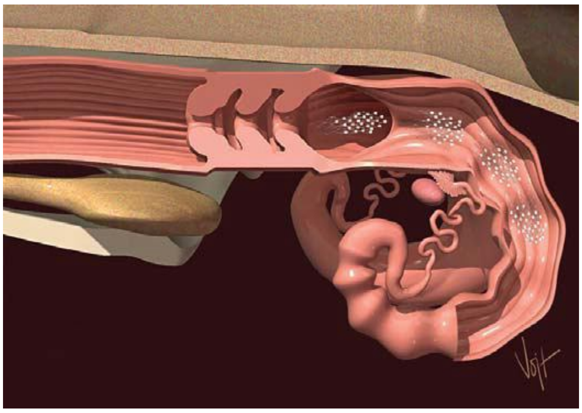


Figure 6 Uterine contractions aid in sperm transport.

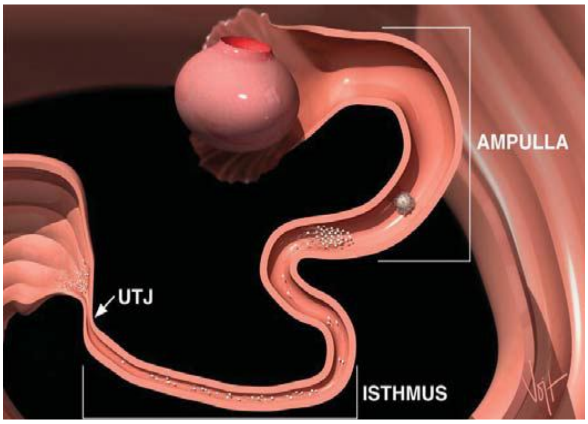


Figure 7 The utero-tubal junction(UTJ), isthmus and ampulla are functionally different regions of the oviduct.

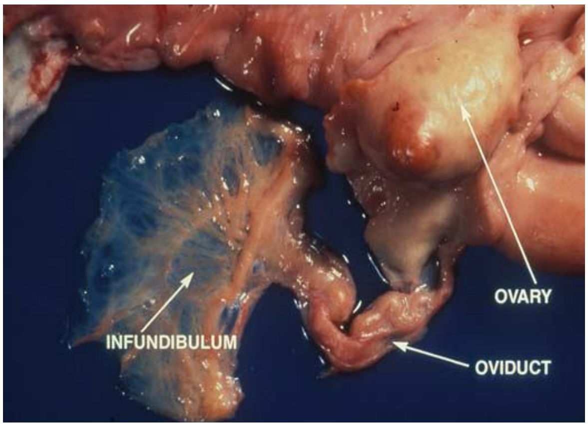


Figure 8 The infundibulum catches the egg from the ovary and guides it into the oviduct.

Drennan and Macpherson (1966) examined a total of 300 hundred specimens for measuring the biometrical study and to observe the incidence and types of abnormalities of component parts of the bovine female reproductive tract within an age group of 15 to 30 months. The author recorded the length, width and thickness of right ovary were as 3.31, 2.42 cm and 6.34 gm and that of left ovary were as 3.09, 2.29 cm and 5.37 gm. The length of right and left oviduct was 16.45 and 16.72 cm, respectively. The length of right and left uterine horn was 23.2 and 23.9 cm, respectively. The length and width of body of uterus was 2.52 and 2.06 cm, respectively. The length, inside diameter and no. of annular rings were as 4.77, .22 cm and 4.03. The length and width of vagina was 23.57 and 4.48 cm, respectively.

Getty (1975) observed that the ovary of the cows appeared much smaller than those of the mare. The author recorded in ovary about 3.5 to 4.0 cm in length, 2.5 cm in width and about 1.5 cm thick in their largest part i.e. thickness; the weight was 15 to 20 g. The length of the oviduct of the cow recorded about 25 to 30 cm. The body of uterus is only about 3 to 4 cm in length and horns are about an average length of 35 to 40 cm. The length of vagina of cow is about 25 to 30 cm, respectively.

Kunbhar *et al.* (2003) collected a total of fifty female genital organs of adult Thari cows from Mirpurkhas slaughter-house. Nineteen (38%) tracts were found apparently normal with no any macroscopic abnormalities and were used for biometrical studies of different parts of the tract. The mean length of vulva, vagina, cervix and corpus uterus was recorded as 10.24, 20.67, 7.80 and 1.7 cm, respectively. Corresponding values for the width were 8.94, 5.08, 2.72 and 2.17 cm, respectively. The mean length of right uterine horn was 21.63 and that of left horn it was 20.90 cm. The mean length of right and left oviduct was 21.78 and 21.31 cm, respectively. The mean length, width and thickness of right ovary were 2.56, 1.33 and 1.46 cm and that of left it was 2.50, 1.3 and 1.4 cm, respectively. The weight of right ovary was 3.83 g and that of left ovary it was 3.58 g in Thari cattle.

Carvalho *et al.* (2005) collected twenty one bovine reproductive tracts from abattoir and examined biometrical values. They observed that the average length of right ovary was 3.3 ± 0.1 cm and that of left ovary was 2.9 ± 0.1 cm. The average width of right ovary was 2.2 ± 0.1 cm and that of left ovary 2.0 ± 0.1 cm. The average thickness of right ovary was 1.4 ± 0.1 cm and that of left ovary was 1.2 ± 0.1 cm. The average weight of right and left ovaries was 8.9 ± 0.9 and 7.1 ± 0.7 g, respectively. The average length of the right oviduct was 18.8 ± 0.7 cm and that of the left oviduct was 18.8 ± 0.5 cm. The average length of the uterine body was 3 ± 0.2 cm. The average length of cervix and vagina of cow were 8.0 ± 0.3 cm and 35.7 ± 1.5 cm, respectively.

Ali *et al.* (2006) collected a total of 110 reproductive tracts of non descriptive cows from Faisalabad abattoir and studied for biometrical values. The average length of right ovary was 2.40 ± 0.06 cm and that of left ovary was 2.31 ± 0.05 cm. The average width of right ovary was 1.15 ± 0.02 cm and that of left ovary 1.14 ± 0.03 cm. The average thickness of right ovary was 1.61 ± 0.04 cm and that of left ovary was 1.52 ± 0.03 cm. The average weight of right and left ovaries was 4.29 ± 0.29 and 3.97 ± 0.24 g, respectively. The average size of right and left uterine horns were 20.69 ± 0.59 and 19.76 ± 0.58 cm, respectively. The average length, circumference and number of cervical rings were as 6.0 ± 0.22, 8.40 ± 0.21 and 4.62 ± 0.09 cm, respectively.

Ahmed (2011) studied to determine morphology and pathological disorders of reproductive system of cows. A total of 40 female genital organs were randomly collected during November 2010 to May 2011 from local slaughter house at Balashpur, Mymensingh Sadar upazila. The morphology of the female reproductive tracts i.e. vagina, cervix, uterus, oviducts and ovaries were measured. The mean length, width and weight of the right and left ovaries were recorded as 3.2 ± 0.2 cm, 1.7 ± 0.2 cm, 4.3 ± 0.3 g and 2.9 ± 0.2 cm, 1.5± 0.2 cm, 4.0 ± 0.3 g, respectively. The mean length of the vagina, cervix, uterine horn, body of uterus, right oviduct and left oviduct were as 20.2 ± 0.3 cm, 6.7 ± 0.2 cm, 23.5 ± 0.3 cm, 2.8 ± 0.2 cm, 16.9 ± 0.3 cm and 16.8 ± 0.3 cm, respectively. The author found that the mean length, width and weight were higher in right organs than those of left organs.

Bello *et al*. (2012) a study was carried out on the morphometry of reproductive genitalia of 45 African Zebu Cattle (AZC) using standard laboratory procedure, with special reference to heifers and cows. The overall mean weight of the genitalia of heifers and cows were 0.43 ± 0.03 kg and 0.79 ± 0.02 kg respectively. The mean ovarian weights of the heifer for left and right were 3.80 ± 0.12 g and 4.88 ± 0.04 g; that of the cows were 3.53 ± 0.10 g and 5.48 ± 0.04 g, respectively. The mean length of the cow oviduct for left and right were 30.04 ± 0.08 cm and 30.21 ± 0.07 cm; that of the heifer were 21.68 ± 0.18 cm and 22.14 ± 0.16 cm, respectively. There was no significant difference in the diameter of the oviduct and between the right and left length of the oviduct ($P > 0.05$). The length and diameter of the cervix of heifer were 7.38 ± 0.10 cm and 3.18 ± 0.07 cm; and that of the cows were 8.08 ± 0.04 cm and 3.48 ± 0.02 cm, respectively.

Jaji *et al*. (2012) carried out on apparently normal ovaries and uteri of 30 pregnant (10 per trimester) and 10 non-pregnant adult Red Bororo cows at the Maiduguri metropolitan abattoir. All the animals were of variant ages and weights. The organs were collected immediately after slaughter by cutting off the broad ligament attaching them to the body wall. In the adult non-pregnant Red Bororo cows, the author measured that the left ovary 3.52 ± 0.33 cm in the length, 2.21 ± 0.31 cm in diameter, 1.25 ± 0.05 cm in thickness and 3.03 ± 0.11 g in weight, while the right ovary 4.33 ± 0.74 cm in length, 3.01 ± 0.40 cm in diameter, 1.35 ± 0.10 cm in thickness and 4.89 ± 0.18 g in weight. The left uterine horn was 13.50 ± 1.22 cm in length and 3.74 ± 0.50 cm in diameter, while the right uterine horn 16.30 ± 1.42 cm in length and 5.32 ± 0.56 cm in diameter. The uterine body was 12.64 ± 1.02 cm in length and 4.65 ± 0.41 cm in diameter. The cervix measured 7.25 ± 0.57 cm in length and 2.88 ± 0.23 cm in diameter.

Leal *et al*. (2013) observed the ovarian morphometry and the number of surface ovarian follicles in bubaline and bovine species at different phases of reproductive activity. Ovaries from 86 (33 pregnant and 53 non-pregnant) buffaloes and 95 (36 pregnant and 59 non-pregnant) cows were collected in slaughter houses and transported to the laboratory in saline solution enriched with penicillin and streptomycin at 36ºC. Most ovaries were pinkish in the bubaline and yellowish in the bovine species. The dimensions and weight of ovaries were lower ($P<0.001$) in buffaloes (24.4 mm length x 17.1 mm width x 13.1 mm thickness, and 4.0 g) than in cows (30.9 mm length x 21.7 mm width x

15.4 mm thickness, and 7.7 g). The number of surface ovarian follicles was also smaller ($P< 0.001$) in buffaloes (21.5 ± 14.1) than in cows (35.6 ± 18.5).

2.2.3 Oviduct

The oviducts of the cow are paired convoluted tubes that reach the ovaries to the tapped ends of the uterine cornua or horn. The oviducts are also commonly referred to as the fallopian tubes. This tube lay in a peritoneal fold derived from the lateral layer of the broad ligament. The oviduct has several distinct regions when examined microscopically. The lower segment, closest to the uterus is called the isthmus. The connection between the uterus and the isthmus is called the utero-tubal junction or UTJ. The UTJ functions as a filter of abnormal sperm and the isthmus as a reservoir for healthy sperm (Figure 7). The upper portion of the oviduct, closest to the ovary, is referred to as the ampulla. The interior of the ampulla is more open than the isthmus allowing for easier passage of ova. It is within this segment of the oviduct that fertilization actually occurs. It is believed that a chemical signal released at the time of ovulation, stimulates the release of spermatozoa from the walls of the isthmus allowing them to continue their journey to the site of fertilization in the ampulla. The large funnel-like structure on the open end of the oviduct, called the infundibulum, surrounds the ovary, to recover the ova and keeps them from falling into the body cavity (Figure 8). The oviducts serve to transport ova or unfertilized eggs from the ovary to the uterus and pursue a convoluted course through a secretion of the broad ligament the mesosalpinx.

2.2.4 Uterus:

The uterus of dairy cow is a hollow muscular organ consisting of a body and divided anteriorly into two horns. From the uterine body on, the reproductive tract separates and all further structures come in pairs (Figure 5). The two uterine horns consist of three layers of muscle and a heavy network of blood vessels. Inner to the muscular membranous structure, there is mucosa and sub-mucosa designed for the reception of the fertilized ovum, for the nutrition and protection of the fetus and for the initial stage of it expulsion at parturition. The main function of the uterus is to provide a suitable environment for fetal development. When a cow is bred, either naturally or by artificial insemination, the uterine muscles, under the influence of hormones oxytocin and estrogen, rhythmically contract to aid in sperm transport to the oviducts (Figure 6).

The endometrium of the uterus in domestic animal is the only structure that can form sufficient placental attachment to support the normal development of the embryo and fetus. Uterus of cows had cornuate in shape, the two uterine horns leaving the body of the uterus at an acute angle and lying nearly parallel to each other. The body of uterus was 2.5 to 4 cm long. Depending on the age and breed of the cow the horns were 20 to 40 cm (Robert, 1971).

2.2.5 Cervix

The cervix is a thick walled organ forming a connection between the vagina and uterus (Figure 4). It is composed of dense connective tissue and muscle and will be the primary landmark when inseminating cattle. Its wall is harder and more rigid than the walls of either the uterus or the vagina. The cervix forms a barrier between the external and internal environment. It has a very thick fibrous wall. Cervical canal is convoluted and normally tightly closed except at parturition although it also dilates slightly at estrus. The opening into the cervix protrudes back into the vagina. This forms a 360º blind-ended pocket completely around the cervical opening. This pocket is referred to as the fornix. The interior of the cervix contains three to five muscular fibrous transverse annular rings or folds that have an almost cartilaginous consistency and also facilitate the main function of the cervix, which is to protect the uterus from the external environment. The cervix opens anteriorly into the uterine body. About an inch long, the body of the uterus serves as a connection between the two uterine horns and the cervix. The uterine body is the site where semen should be deposited during artificial insemination.

2.2.6 Vagina

The vagina of the cow is a musculo-membranous structure lying in the pelvic cavity dorsal to the bladder that act as a copulatory organ and also serve as part of the birth canal at the time of calving / parturition. The vagina extends from the urethral opening to the cervix. During natural mating, semen is deposited in the anterior portion of the vagina. The vagina connects the cervix to the vestibule. It receives the erected penis, conveying uterine secretions to the outside and transports the fetus during birth. Its wall consists of mucosa, sub-mucosa and outer fibrous coats. The vagina is capable of great dilation. The hymen is a slight circular constriction between the vagina and the vulva. The length of the vagina depends whether the animal is pregnant or non-pregnant. The overall average length of the vagina of the cow was 25 to 30 cm (Roberts, 1971).

2.2.7 Vulva

The vulva is the external opening to the reproductive system. It has three main functions: such as the passage of urine, the opening for mating and serves as part of the birth canal. Included in this structure are the lips and clitoris. The vulva lips are located at the sides of the opening and appear wrinkled and dry when the cow is not in estrus. As the animal approaches estrus, the vulva will usually begin to swell and develop a moist red appearance.

2.3 Gross and histopathological changes of reproductive organs in cow

For obtaining the distinct evidences and key information, the whole review of literature on the research title “Pathological disorders in the female reproductive system of cows collected from the slaughter house of Rajshahi district” has been conveniently reviewed under following headings.

2.3.1 Abnormalities in female reproductive system in cows

Narasimha Rao (1982) examined a total of 1396 Zebu ×Taurus cross-bred heifers and cows of small and marginal farmers in Andhra Pradesh, over a period of one year for various causes of reproductive failure. The author revealed that 6.01% anatomical, 73.14% functional and 20.85% non-specific infectious nature. The most frequent single disorders were ovarian acyclia (58%) and endometritis (13.97%). The incidence of other conditions was cervicitis (5.52%), genital infantilism (4.51%), an ovular heat (4.15%), cystic follicular degeneration (3.65%), silent ovulations (3.08%), repeat breeders (2.29%), and a lower frequency of other conditions. The incidence of disorders that led to sterility was 5.73%.

Ahmed and Khan (1993) stated that the pathological disorders in the reproductive system consist of pathologic lesions in the ovary, oviduct, uterus, vagina and cervix. Such disorders consist of cystic follicle, cystic corpus luteum, ovarian hypoplasia, hydrosalpinx, endometritis, mucometra, cervicitis, fibrotic cervix, ovario-bursal adhesions, metritis, pyometra, oophoritis and salpingitis.

Kotowski (2001) carried out a study in Poland in 1999 on 84 black and white cows on the basis of mammary glands and reproductive organs of cows selected for slaughter houses. He found that 49% cows suffered from mammary gland irritation. In post slaughter examination 7.2% cows were found fetus in uterus. Various pathological changes in the reproductive organ were recorded in 58.4%. He also found that uterus was more often affected (59.2%) than ovaries (40.8%).

Gustafsson *et al.* (2004) described the common reproductive disturbances during the peri and early postpartum period, such as dystocia, still birth, uterine prolapsed, retained fetal membranes, metritis and endometritis etc.

McDougall (2005) described the gross pathology; bacteriology and histopathology of the reproductive tracts of dairy cows that failed to conceive or maintain pregnancy. The author observed that 34% cows had one or more gross lesions which involved the ovary, uterine tube, uterus or vagina. In only five cows were both gross pathology and bacteria detected. There was no relationship between the isolation of bacteria and the diagnosis of gross pathology of the uterus.

Abalti *et al*. (2006) collected and examined 201 reproductive tracts of Zebu cattle of Fogera type (161 cows and 40 heifers) from slaughtered at Bahir-Dar town, north-west Ethiopia. Out of 201 female genital tracts, the prevalence of abnormalities was recorded in 74 (36.8%). The most common abnormalities encountered were ovario-bursal adhesion (5.5%), endometritis (3.9%) and cystic ovaries (3.5%). Other abnormalities recorded were ovarian hypoplasia, vaginitis, cervicitis, mucometra, parovarian cyst, hypoplastic cervical rings, closed external cervical os, uterine and oviducts adhesion, cystic uterine tube, remnant of retained fetal membrane and cyst in the uterine.

LeBlanc (2008) stated that the occurrence of retained placenta, metritis and endometritis in dairy cows largely depended on immune function in the transition period. They showed that retained placenta affects 5-10% of calving and greatly increases the risk of metritis and endometritis. Clinical endometritis affects 15-20% of cows at 4-6 weeks of post-partum and 30-35% has subclinical endometritis between 4 and 9 weeks of post-partum.

Alam (2010) studied a total of 42 female genital were randomly collected during January-September, 2010 from eight slaughter houses of Mymensingh district with a view to determine the pathological disorders. All samples were collected from the cows irrespective of ages. Among these samples, 80% samples showed gross and histopathological changes. The gross pathological changes in the reproductive system were 9.5% granular vulvo-vaginitis, 11.9% cervicitis, 16.7% endometritis, 2.4% mucometra, 2.4% pyometra and 7.1% follicular cyst. The representative samples were preserved in 10% buffered neutral formalin for histopathological examination. The relative incidences of various histopathological disorders were 21.4% endometritis, 17.9% cervicitis, 14.3% vaginitis, 10.7% follicular cyst, 3.6% uterine fibroma and 3.6% luteinoma in ovary.

Nahar (2010) observed the occurrence of bacteria as well as pathological lesions in the uterus of slaughtered cattle. A total of 20 selected samples from 30 randomly collected samples were taken from the uteri with grossly identifiable lesions such as congested, hemorrhagic, cystic and mucus filled uteri. The histopathological samples were collected in 10% buffered neutral formalin. The mostly observed gross lesions were hemorrhagic, congested and mucus filled uterus with some abnormalities on the ovary. All the gross lesions were not found in all uteri. The author recorded the occurrence of acute endometritis was 33.33%, chronic endometritis 26.66% and adenomyosis 6.66%. Microscopically, acute endometritis was characterized by thickening of the epithelial layer, infiltration of neutrophil in the submucosal layer, dilatation of endometrial glands and congestion of blood vessels. In chronic endometritis, infiltration of lymphocytes, macrophages, plasma cells in the sub-mucosal layer and proliferation of fibrous connective tissue within the myometrium. The microscopic lesions were variable in uteri.

Ahmed (2011) examined the pathological disorders in the reproductive system of cows. A total of 40 female genital organs were randomly collected during

November 2010 to May 2011 from local slaughter house at Balashpur, Mymensingh Sadar upazila. All samples were collected from the cows irrespective of ages. The gross pathological conditions recorded in reproductive system were granular vulvo-vaginitis (7.5%), cervicitis (10%), endometritis (15%), mucometra (2.5%), pyometra (5%), follicular cyst (7.5%), luteal cyst (2.5%), hydrometra (2.5%) and ovario-bursal adhesion (2.5%). The representative samples were preserved in 10% buffered neutral formalin for histopathological examination. The relative incidences of various histopathological disorders were endometritis (15%), cervicitis (12.5%), vaginitis (10%) and follicular cyst (7.5%) in the ovary.

2.3.2 Pathology of vulva, vagina and cervix

There are several path-morphological disorders in the vulva, vagina and cervix affecting fertility in cows. In a study of genital organs of 2230 cows, the malformations in the cervix and vagina were 4.8% and 2.5%, respectively (Settergen and Glloway, 1965). About 5% cervicitis in indigenous cows was reported by (kumar *et al.,* 1986).

Zafrakas (1969) examined 842 sterile cows in Kardista region to detect the diseases of the reproductive tract during the period from 1965-67. In his studies, he found that 72 (8.56%), 52 (6.18%) and 48 (5.70%) cows were suffering from cervicitis, endometritis and pneumovaginitis.

Roberts (1971) observed that vaginitis in cows is a primary or secondary condition. The secondary condition often associated with metritis and cervicitis. It may occur following trauma, lactation and bacterial, viral or protozoal infections produced or introduced at the time of service, abortion, dystocia, fetotomy, retained placenta, prolapsed of the vagina and postpartum metritis. He also observed that cervicitis or inflammation of the cervix is a common in association with metritis and frequently follows abnormal parturition such as abortion, premature birth and dystocia. Most of the cases of cervicitis originate at the time of or following parturition and often associated with metritis. Prolapse of the external transverse cervical rings or cervical ectropion was a possible factor causing cervicitis in older cows

Nair and Raja (1975) examined a total of 1250 genitalia of non-descriptive cows from slaughter houses and observed some of the pathological conditions of the cervix, vagina and vulva such as 0.6% cervicitis, 0.2% vaginitis and 2.4% granular vulvo-vaginitis, respectively.

Alam and Rahman (1979) examined a total of 300 female genital tracts of non-descriptive cows aged between 6 to 10 years from at Hazaribagh Slaughter house, Dhaka. He observed 7% granular vulvo-vaginitis, 5% small contracted cervix and 1% mucocervix. The author also examined the pathological condition of the ovary were 43% cystic Graafian follicle, 11% cystic corpus luteum, 5% hydropic ovary and 3% multiple hemorrhage.

Rahman *et al*. (1993) observed that the incidence of reproductive disorders of 2280 cows and heifers and 2.45% cystic ovaries, 1.6% cervicitis and 2.04% vaginitis were recorded.

Soonwuk *et al.* (1996) examined 800 cows and they observed 24% luteal cyst, 10% follicular cyst, 1% persistent CL, 0.6% ovarian adhesion and 11.1% cervicitis.

Jones *et al.* (1997) observed grossly in case of granular vulvo-vaginitis, eruptions appear as both pale and pink elevated papules, a few millimeters in diameter, usually covered by a catarrhal exudates that exudes from the vulva and microscopically, each papule consists of a hyperplastic lymphoid follicle that often is congested or contains areas of hemorrhage. The germinal centers of the reactive follicles are usually mitotically active. The author also found microscopically, in case of infectious bovine pustular vulvo-vaginitis, necrotic foci of vaginal epithelium with eosinophilic, intranuclear inclusion bodies were located at the adjacent of ballooned epithelial cells and large number of neutrophils was present within and adjacent to mucosal lesions. Lymphoid follicles in the mucosa undergo extensive reactive hyperplasia.

Hatipoglu *et al*. (2002) examined the pathological conditions of uterus, cervix and vagina of 1113 cows slaughtered at Konya abattoirs in Turkey. Pathological change were 36 (3.23 %) in uterus, 28 (2.51%) in cervix and 33 (2.96 %) in vagina were observed. The most common lesion of the uterus was inflammatory changes. The pathological conditions of uterus were classified as follows;

segmental aplasia (0.45 %), hydrometra (0.09 %), mucometra (0.36 %), glandular hyperplasia (1.16 %), endometritis (1.26%), perimetritis (0.09 %) and parametritis (0.09 %). Pathological changes of cervix were double cervix (0.18 %), post cervical band (0.72 %), cervical cyst (0.09 %), metaplasia (0.18 %), gland formation (0.27 %) and cervicitis (1.35 %). Vaginal abnormalities were cystic Gartner's ducts (1.07 %), dorsoventral vaginal band (0.54 %) and vaginitis (1.35%).

Anita *et al.* (2013) collected a total of 390 female genital tracts of cattle during the period from May 2009 to October 2009 in different age and breeds. Out of these, 27 samples showing gross lesions and these samples were collected for histopathological examination. Cervix revealed pathological conditions in 11.53% cases as chronic cervicitis. Vagina and vulva revealed pathological condition in 5.76% cases as granular vulvo-vaginitis.

2.3.3 Pathology of uterus

Uterus is the most important organ of the female genital system. Many pathological conditions of the uterus cause infertility and sub-fertility of the animals.

Frie *et al*. (1984) observed 7% endometritis and 1.86% incidence of ovarian cyst were diagnosed in their studies.

Kucharski and Zdunchzyk (1984) found 11% ovarian cyst and 41% endometritis were diagnosed in their studies.

Gonzalez *et al.* (1985) conducted a survey 98 cows of reproductive tracts from non-pregnant cows at an abattoir. They studied microscopically and evaluated with a grading system to determine the severity of pathologic changes. Inflammatory reaction (type and distribution), fibrosis, gland morphology, quantified, and scored (1 to 4). Category 1 endometrium (normal) was found in 18 cows, category 2 in 23, category 3 in 34, and category 4 in 23. The category of endometrium was then compared with the retrospective reproductive status, and it was found that reproductive problems had occurred in 6 cows (33.3%) in category 1, in 13 cows (56.5%) in category 2, in 25 cows (73.5%) in category 3, and in 21 cows (91.3%) in category 4. Cervicitis was found in 43(43.8%) genital tracts; 16 cows (16.3%) had salpingitis. Ovarian lesions were not observed.

Morrow (1986) stated that metritis is mostly septic following parturition and is observed usually within 1 to 10 days after parturition. It is the inflammation of the muscle layers of uterus. It is usually associated with removal of retention of fetal membranes, prolonged dystocia and abortion. The author also observed grossly endometritis is the inflammation of the inner layer (endometrium) of uterus characterized by reddish brown, white or whitish to yellow muco-purulent foetid vaginal discharge along with thickness of uterine wall detected in transrectal palpation.

Obwolo and Ogaa (1990) conducted a study on 2065 on cows in 3 abattoirs in 1987 of which 1085 (52.5%) cows were pregnant. 175 (8.47%) abnormalities were found in the genital tracts. They diagnosed that 25 (1.21%) mucometra, 10 (0.48%) pyometra and 5 (0.24%) endometritis.

Ahmed (1992) observed that the pathological disorders are more common in uterus. Underdeveloped or infantile uterus is the common findings followed by pyometra in Bangladesh.

Tafti and Darahshiri (2000) examined 470 uteri of cows from Fars Province of Iran, among them 270 uteri of non-pregnant adult cows were chosen. From these uteri, 100 cows were grossly abnormal and selected for microscopic examination. Out of them 58% showed microscopic lesions of which 39% had endometritis. They also observed lesions were 4% endometrial hyperplasia, 4% metritis, 2% macerated fetus, 1% hydrometra and 1% mummified fetus.

Kubar and Jalakas (2003) examined the pathological changes in the reproductive organs of 39 cows where 1(2.6%) mucometra, 1 (2.6%) adenoma of the oviduct and 9 (23.1%) ovarian cysts. Most ovarian cysts were follicular cysts and only one third of the animals also (33.3%) luteal cysts, 3 (33.3%) cows had chronic endometritis.

Kunbhar *et al.* (2003) collected 100 genitalia of Thari cows were collected from Mirpurkhas slaughter house, Mirpurkhas, Sindh, Pakistan, for gross-pathological studies. Sixty five percent tracts collected of the samples were found abnormal having one or more abnormalities and 19 percent tracts normal without any visible abnormality. 16% animals were found pregnant. The most affected part of the tract was (70.8%) uterus followed by (64.6%) cervix, (60.0%) oviduct, (49.2%) ovaries and (38.5%) vagina. The incidence of follicular cyst 10.8%, luteal cyst 7.7%, ovarian hypoplasia 4.6% and ovaro-bursal adhesion 4.6%. The incidence of oviduct abnormalities were pyosalpinx 26.2%, salpingitis 23.1% and hydrosalpinx 10.8%. In uterus, pyometra 43%, endometritis 38.5%, metritis 30.8%, hydrometra and mucometra 12.3% and cysts on uterine wall 6.2%. The cervical abnormalities included prolapsed of cervical rings 29.2%, cervicitis 27.7%, pus in cervix 18.5%, twisted cervix 15.4%, cysts on cervical wall 3%, mechanical injuries 1.5% and abnormal discharge 10.8%. In vagina, they recorded 18.5% vaginitis, 10.89% valvo-vaginitis, 4.6% mechanical injuries and 12.3% abnormal discharges.

Patel *et al.* (2007) examined a total of 1618 cows, where (0.9%) uterine adhesion. The author also observed (1.5%) cystic ovarian degeneration, the pathological causes included as (0.4%) salpingitis, (5.8%) endometritis, (0.8%) pyometra, (10.4%) metritis and (0.1%) mummification in cattle.

Balasundaram (2008) observed that the overall incidence of metritis was the most severe reproductive disorder in both first calves (28.9%) and all calves (38.9%).

Talebkhan Garoussi *et al.* (2010) evaluated the uterine (biopsy of the endometrium and sub-mucosa) histopathological changes in Holstein dairy cows, within the range of 90-145 day in milk, with or without clinical history of reproductive disorders. A total of 133 lactating Holstein cows with 92 (69.17%) or without 41 (30.82%) clinical signs of reproduction diseases were recorded and examined. The cows in treatment group were inseminated artificially for 3 times after calving and not inseminated in control group. The inseminated cows were at various stages of the estrus cycle. They recorded that 64.13% and 46.34% of cows with or without clinical reproductive disorder had histopathological lesions, respectively. There were no significant differences in histopathological changes between cows with or without reproductive disorder history ($P \geq 0.05$). Chronic endometritis was the most common microscopic lesion in cows with (34.61%) or without (17.94%) recorded reproductive disease. Clinical endometritis was the most common reproductive disorder (20.65%) followed by repeat breeder 18.47%, retention of fetal membrane 15.21%, abortion 11.59%, dystocia 9.78%, metritis 5.43%, vaginitis 4.34% and cervicitis 3.26

LeBlanc (2012) reviews recent data and concepts on the development of inflammation in the reproductive tract of dairy cows during the first 2 months after calving. The incidence of metritis is 10-20%, with 5-15% of cows having purulent vaginal discharge (PVD), 15-40% having cervicitis approximately 1 month after calving, and 10-30% having cytological endometritis between 1 and 2 months after calving. Endometritis, cervicitis and PVD are distinct conditions, each of which is associated with significantly increased time to pregnancy. Cumulatively, 35-50% of cows have at least one form of pathological reproductive tract inflammation between 3 and 7 weeks post-partum.

Sayyari *et al.* (2012) observed that the common pathological condition of cattle and buffaloes' uteri in the Ahwaz region and also to compare uteri-lesions. A total of 138 cattle and 101 buffalo uteri were examined for macroscopic lesions. The prepared tissue sections were stained with Hematoxylin & Eosin. Depending on the severity of the lesions, endometritis was scored from mild (level 1) to severe (level 4). Level 1 including 39 (19.69%) and 36 (28.8%); Level 2 including 37 (18.68%) and 28 (22.4%); Level 3 including 23 (11.61%) and 22 (17.6%); and, Level 4 including 17 (8.58%) and 5 (4%) cows and buffaloes, respectively. Other lesions includes acute metritis: (4.54% and 0.8%); chronic metritis (2.02% and 2.4%); granulomatous metritis (0.5% and 0.8%); perimetritis (3.3% and 1.6%); pyometra: (0.5% and 0.8%) and haemangioma: ((0.5% and 0.8%) cows and buffaloes, respectively. No significant correlation was found among the lesions, except for acute metritis, (P=0.475).

Akhter *et al*. (2013) confirm the diagnosis of different pathological conditions of cow's genital tract and to monitor the treatment outcome and conception rate for the improvement of reproductive disorders by used of ultrasonography. A total of 54 sub-fertile cows were selected with different types of reproductive problems. 42 cows received specific treatment against their reproductive disorders. The cyclic cows (n=43) were bred using frozen semen and pregnancy was confirmed by ultrasonography at day 30-35 after breeding. The problems were diagnosed as endometritis (27.8%), metritis (7.4%), pyometra (11.1%), mucometra (3.7%), follicular cyst (9.2%), luteal cyst (1.9%), mummified fetus (1.9%), anoestrus (22.2%), repeat breeding (3.7%) and poor heat detection (11.1%). 31 cows out of 42, receiving appropriate treatments, showed cyclicity with overall 73.8% effectiveness of the treatment. Among 43 bred cows, 37 became pregnant giving an overall 86.0 % conception rate.

Talib and Faraidoon (2014) investigated the effects of uterine infections on the pregnancy rate and dairy cows were culled due to infertility which was evaluated by the histopathological lesions of infected uterus. In clinical study, a total of 75 dairy cows were examined of which 19 (25.33%) pregnant, 40 (53.33%) normal uterus and 16 (21.33%) were suffered from uterine infection. Out of 150 bovine genital tracts during macroscopic examination, 45(30%) were pregnant uterus and 78 (52%) were found normal non pregnant uterus. The results of the microscopic and histopathological studies reached 27 (18%) of endometritis represented by 8 (29.62%) acute and 19 (70.37%) chronic endometritis. In microscopic examination, acute endometritis characterized by infiltration of PMN (polymorphonuclear cells) in the sub-mucosal and among the uterine glands and chronic endometritis characterized by infiltration of mononuclear inflammatory cells represented by plasma cells, macrophage and lymphocyte in sub-mucosal layers with proliferation of fibrin, as well as presence of necrotic debri inside the lumen of uterine glands.

2.3.4 Pathology of oviduct and ovary

Disorders in the fallopian tube are relatively less common in cows. Ovaries are the main organs of reproduction and as well as the source of ovum and various hormones for maintaining reproductive cycle and thus ovarian abnormalities are the major cause of anestrous, infertility and repeat breeding. The pathologic conditions in the ovary are variable.

Guraya (1979) reported normal and atriatic follicles of various sizes were found in anestrous ovary but there was absence of mature graafian follicle that was thought to be the cause of anestrous.

Izquierdo and Angelov (1984) studied a total of 117 oviducts from 59 infertile Cuban zebu cows were selected to detect the pathological conditions of the oviducts. The result revealed that the cows were suffering from acute salpingitis, sub-acute salpingitis and chronic salpingitis. They found the salpingitis were unilateral in 29 and bilateral in cows.

Kang *et al.* (1994) examined 60 cattle and recorded 33.3% inactive ovaries, 11.7% follicular cyst, 11.7% luteal cyst, 11.7% persistent CL and 1.7% cystic corpus luteum.

Fathalla *et al.* (2000) conducted a survey to determine the incidence of gross abnormalities of reproductive tract in cattle in Northern Jordan. A total of 200 specimens of bovine reproductive tracts were collected from cows slaughtered at a local abattoir in Irbid, Jordan during the period from 1993-1994. He found that 27 (13.5%) of slaughtered cows were pregnant. A total of 27 (13.5%) specimens had lesions. The pathological lesions such as 21(10.5%) ovarian inactivity, 16 (8%) ovario-bursal adhesions, 14 (7%) cysts, 20 (10%) metritis and pyometra, 7 (3.5%) hydrosalpinx, pyosalpinx and hemosalpinx were recorded.

Kubar and Jalakas (2002) studied the reproductive organs of 20 Estonian Holstein Breed (EHF) cows and three heifers, culled because of infertility, were examined by palpation per rectum and ultrasonography. In addition, pathoanatomical and pathohistological studies were carried out after slaughtering. The pathohistological study revealed that small cysts often (12 animals) existed in culled cows, whose diameter was less than 2.5 cm. These cysts were frequently accompanied by changes in secondary and Graafian follicles, rete ovarii, ovarian stroma, and the endometrium. They recorded 13.0% follicular cysts, which were 25-35 mm in diameter, 8.7% luteal cysts in the ovaries, 4.34% vaginal prolapsed. One heifer had been culled because of two abscesses in the vaginal wall close to the cervix and 4.34% chronic endometritis. The research findings indicate that the most common cause of infertility in the culled cows was cystic degeneration in ovaries (85%), accompanied by pathological changes elsewhere in the reproductive organs.

Hatipoglu *et al.* (2002) investigated the pathologic conditions of ovary and oviduct of cows slaughtered at abattoir in Konya, Turkey. A total of 1113 reproductive tracts of cows from different breeds were examined and 67 cases (6.02 %) of pathological changes were detected. The incidences of the pathological changes in and around ovary were found as 5.21%. These lesions were classified as follows; follicular cyst (1.88 %), cystic corpora lutea (2.51 %), parovarian cyst (0.72 %), periovaritis and adhesions (0.27 %), granulosa cell tumor (0.27 %) and hemangioma (0.09 %). In 9 cases (0.81 %) pathological changes were found in oviduct, and these lesions were hydrosalpinx (0.36 %), mesosalpingitis-adhesions (0.09 %) and salpingitis (0.45 %).

Ali *et al.* (2006) collected 110 reproductive tracts of non descriptive cows from Faisalabad abattoir, were studied for pathological changes during disease condition. The incidence of pathological conditions observed were 7.27% ovario-bursal adhesions, 2.72% cystic ovary, 0.9% cystic corpus luteum, 1.81% parovarian cysts, 6.36% pyometra, 9.09% metritis, 6.36% cervicitis, 3.63% tortuosity of cervix and 1.81% double cervices.

Gebrekidan *et al*. (2009) observed that the major causes of slaughtering of female cattle in Addis Ababa Abattoir Enterprise. Of the total 235 female cattle that came for slaughtering, the most prevalent reason of culling, accounted for 39.1%, were reproductive problems of which 36.6% were anoestrus cows and 28% were repeat breeders. The second most 32.3% was associated with udder problems followed by low milk yield, age, lameness and others with the occurrence rate of 5.9%, 11.4%, 3.4% and 8.1%, respectively. The author observed that 31.5% were found with one or more gross abnormalities where 15.3% ovarian abnormalities are the major ones followed by 10.7% uterine, 3.4% oviductal and 3.4% cervico-vaginal abnormalities. The first three predominant abnormalities were 8.1% ovario-bursal adhesions, 6.4% endometritis and 5.5% ovaian cyst were recorded. In the present study, parity and age of animals showed statistically significant association ($P<0.05$) with the occurrence of overall reproductive abnormalities.

Bah *et al*. (2010) assessed that the reproductive status (RS) of 2,103 cows slaughtered at the Ngaoundere Municipal Slaughter House in view of highlighting potential losses resulting from the slaughtering of pregnant cows (PC). At the same time, 390 of the cows evaluated for RS were randomly selected for possible causes of infertility from the gross reproductive pathologies (GRP) observed in the reproductive tract. Data were collected between July and December, 2004. A total of 2,426 animals slaughtered, 2,103 (86.6%) were cows. The prevalence of PC slaughtered was 37.3%. Majority (83%) of the cows slaughtered were below 9 years of age 33% percent of the slaughtered cows were infertile. The common GRP observed were 24.8% ovarian inactivity and 5.1% metritis.

Simenew *et al.* (2011) collected a total of 640 female reproductive tracts of cattle from Sululta town slaughter house for examined abnormalities and pregnancy status. They showed that 143 (22.3%) reproductive tract with one or more abnormalities. The major reproductive abnormalities are 7.7% atrophied ovary, 3.3% cystic ovaries and 2.5% ovario-bursal adhesions. Breed and age significantly ($P<0.05$) affected the prevalence rates of these abnormalities. They also found that 28.9% uterus were pregnant, 66.6% were cycling ovarian activities of which 7.5% were pregnant, 65.4% of the fetus were at early (<3 months), 30.3% were mid (3-6 months) and the rest 4.3% were at late (>6 months) ages of pregnancies.

Mohammad (2013) conducted to assess type and prevalence of abnormalities of gross genital tract in cows slaughtered at Dhamar abattoir over a period of 6 months from October 2010 to March 2011. The author collected and examined 160 genital tracts of cows where 21 (13.13%) of gross abnormalities were recorded. These abnormalities include 8.13% ovarian cysts, 1.87% pyometra, 1.25% hydrosalpinx, 1.25% paraovarian cysts and 0.63% hemangioma.

Mekibib *et al.* (2013) conducted to assess the type and prevalence of reproductive abnormalities and pregnancy status of cows slaughtered at Hawassa municipality abattoir and Tula slaughter house. Out of the 345 genital tracts examined, one or two gross abnormalities with different degrees of severity were observed in 124 (35.9%) cases. The most common abnormalities encountered were ovario-bursal adhesions 22 (6.38%), endometritis 17 (4.93%) and follicular cysts 15 (4.35%). On anatomical basis, ovarian abnormalities 51 (14.78%), were more frequent followed by uterine 36 (10.43%), cervico-vaginal 25 (7.25%) and oviductal 17 (4.93%) abnormalities. Both breed and study area showed no statistically significant effect in the prevalence of reproductive abnormalities. The large number of cyclical (36.52%) and pregnant cows (26.67%) slaughtered without any gross abnormalities indicates the absence of proper gynecological examination prior to slaughtering.

Kilinc and Oruc (2014) determined the pathological changes, macroscopic and microscopic features of the ovary and uterine tissues of cows slaughtered in an abattoir in Erzurum. A total of 224 cows were examined of which 41 samples were processed for histopathological examination. They observe lesions in the ovaries were atrophy (1.34%), follicular cyst (3.57%), luteinized cyst (0.89%), cystic corpora lutea (1.34%), epithelial cyst (0.89%), granulomatous inflammation (0.89%), other oophorities (0.45%) and tumor-like structures (0.89%). In the uterus, adenomyosis (0.89%), atrophy (0.89%), endometrial hyperplasia (2.23%), squamous metaplasia of the endometrium (0.45%), hydrometra (0.89%), mucometra (1.34%), pyometra (0.89%), catarrhal-purulent endometritis (3.13%), chronic endometritis (1.34%) and metritis (0.45%) were determined. The most common pathological changes observed in the uterus and ovaries were uterine inflammations and follicular cysts, respectively.

Hasan *et al*. (2015) the present study was aimed to investigate the gynaeco-pathological disorders by post-mortem and histopathological examination, and to identify the associated bacteria. A total of 310 genital tracts of cows were collected from slaughter house of Dinajpur Sadar Upazilla during April 2009 to March 2010. Among the 310 samples, 31.29% endrometritis, 8.37% cystic ovary, 6.77% ovary hyperplasia, 4.84% pyometra, 4.84% parovarian cyst, 4.52% hydrometra, 4.84% ovary hypoplasia, 3.55% ovario-bursal adhesion, 1.29% vaginal cyst and 0.66% hemorrhagic uterine horn were detected by post-mortem examination; the cases were reconfirmed by histopathological studies.

Chapter 3

MATERIALS AND METHODS

The aim of the present study was to evaluate the clinical trends of reproductive disorders of cows in Rajshahi district of Bangladesh. The whole study was divided in three experiments:

Experiment I: Study on reproductive trends of dairy cows in Rajshahi district

3.1.1 Study period

The present study was conducted of 500 dairy cows at Rajshahi district to determine the clinical trends of reproductive disorders during the period from 1st July, 2013 to 30th June, 2014.

3.1.2 Study areas and population

The study was conducted at 6 upazilas and 4 metro thanas of Rajshahi district in Bangladesh. Rajshahi district are located at the North side and 261 kilometers away from Dhaka city, having low, flat, and fertile land with 26^{0}C mean annual temperature and average annual rainfall varies from 1429 to 4338 mm (BBS, 2002). The cows were selected from 6 upazilas viz. Charghat, Puthia, Poba, Godagari, Tanore, Mohanpur and 4 metro thanas were Motihar, Boalia, Rajpara, Shahmukdhm at Rajshahi district (Figure 9 and 10). Fifty cows were collected from each upazila and metro thana.

3.1.3 Study design

Records of clinical cases were inter reviewed using by questionnaire (Appendix 1) from owner/farmers/attendant of dairy cows during the period from 1st July 2013 to 30th June, 2014. Six upazilas and four metro thanas of Rajshahi district.

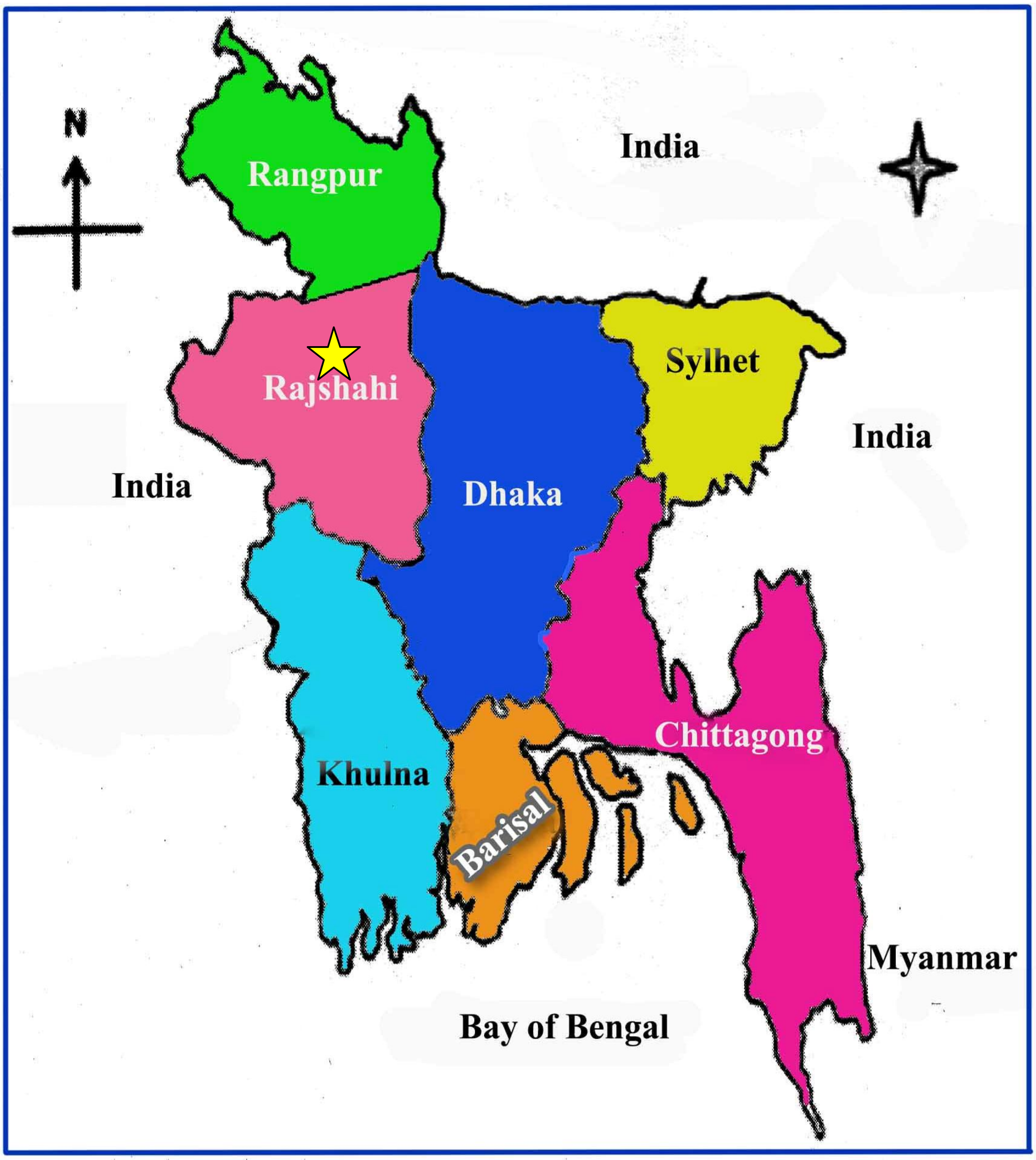


Figure 9 Map of Bangladesh indicating the location of study area (star mark).

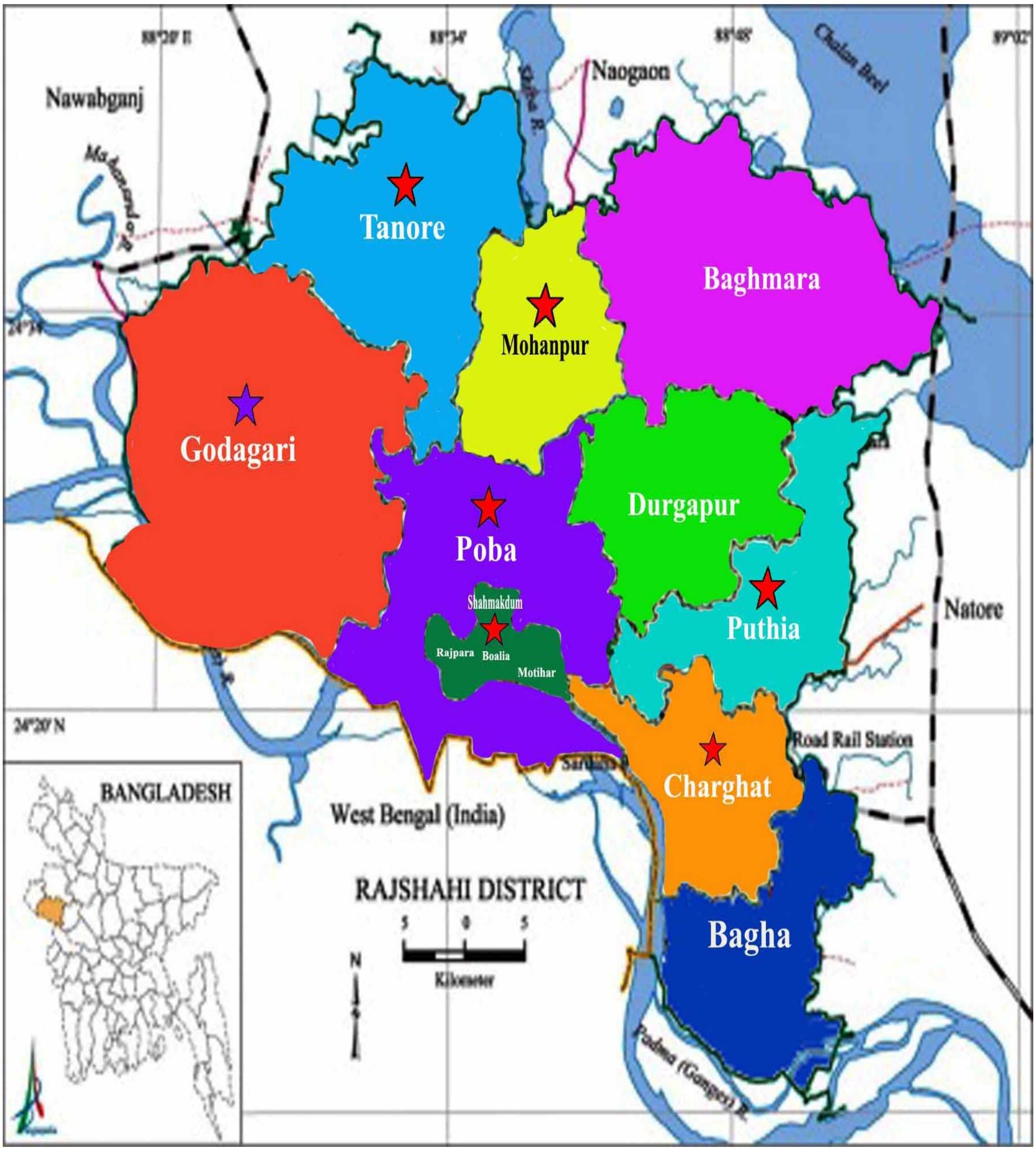


Figure 10 Map of Rajshahi district indicating sampling sites at different upazila and metro thana (star mark).

3.1.3.1 Method of data collection

The data were collected directly from the dairy cows owners/farmers/attendant by using questionnaires and diagnosis of reproductive disorders were made on the basis of the history, clinical signs and response to treatment. The questionnaires have been attached under the appendix-1. The data were collected from the selected farms by the researcher every three (3) months interval in year. The researcher recorded the important diseases time to time by the contact of the farmers by mobile or self visited. After collecting the questionnaire, preliminary sorting and checking, data were prepared for analysis.

3.1.3.2 Management of studied animals

Small holder farmers maintain the majority of the animals adjunct to crop agriculture as having significant dependence on livestock with little or no outside labor and with returns that provide subsistence but little for saving, capital investment or for the purchase of external agriculture inputs. The animals are generally maintained on crop residues and other agricultural by-products. Rice straw is the basic feed item satisfying over 80% roughage needs throughout the country. Grazing animals on roadside, fallow land, riverbank or on lands from where crops has been harvested when available partially fulfilling the green roughage requirement. Rice polish, wheat / pulse bran etc. as concentrate sources are playing important role in livestock enterprises throughout the country in variable level. In farm conditions improved feeding and management practices are followed throughout the year. Anthelmintics and vaccination programme were not properly maintained most of the farms. Estrus detection was carried out by herdsmen and cows observed in estrus were artificially inseminated by high grade or purebred Friesian bulls and Sahiwal. Hand milking after a brief stimulation, commonly by the calf, was practiced twice daily. Farmers practice routine de-worming and vaccination against FMD and sometimes anthrax or not against contagious bacterial and viral diseases.

3.1.4 Experimental design

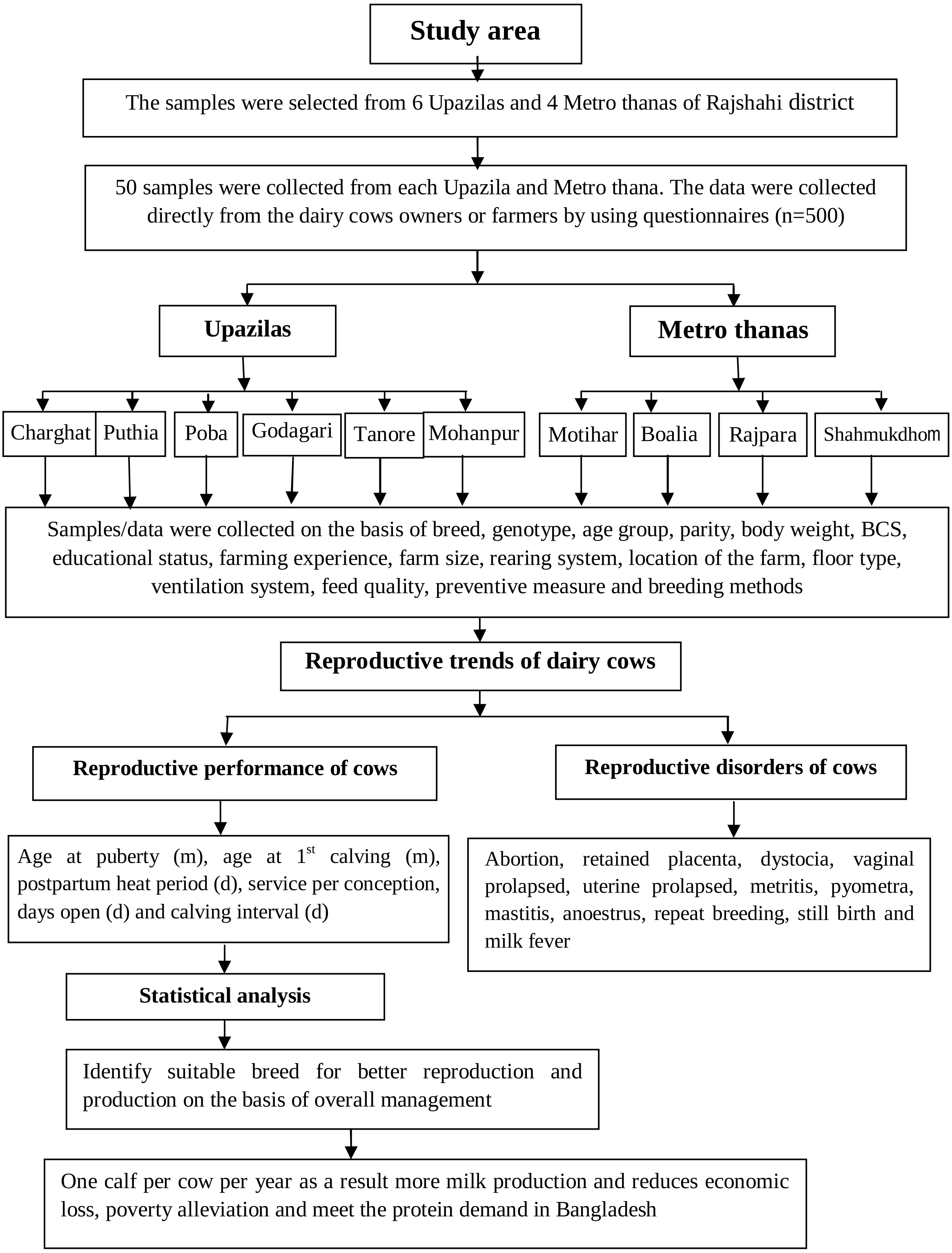


Figure 11 Flow diagram of the experimental design-I

3.1.5 Description of animals

Cross-bred cattle are mainly Holstein Friesian and Sahiwal. Approximately 20% animals are crossed in Bangladesh. Indigenous cattle are found everywhere of the country has no definite characteristics and constitute about 80% of indigenous cattle population of the country. Their coat color varies from red, grey, white, black or a mixture of them in different proportion. They are of various sized animals possessing high level of phenotypic variation for most of the economic traits. They are of sole source of draught power of the subsistence farming system of the country.

3.1.6 Grouping of experimental animals

To achieve the goal, animals were grouped according to following considering factors:

3.1.6.1 Breed

The cow was classified broadly in Indigenous or Local and Cross-bred. Selected cows were further group into their genetic composition. These were

Group I **:** Local (n = 100)
Group II **:** Local × Friesian (n = 324)
Group III **:** Local × Sahiwal (n = 76)

3.1.6.2 Age group

Ages of the cows were measured by examination of teeth and counting number of horn ring and birth record kept by the farmers/register book. After confirmation of age of these cows and then divided in the following groups:

Group I **:** <3 years (n = 75)
Group II **:** 3 to <5 years (n = 214)
Group III **:** 5 to <9 years (n = 133)
Group IV **:** >9 years (n = 78)

3.1.6.3 Parity

The cows those did not give any calf considered as heifer (P_0), those gave 1st calf considered as parity 1 (P_1), those gave 2nd calf consider as parity 2 (P_2), 3rd calf as parity 3 (P_3) and so on. Cows were different parities and up to 5 parities cows were considered for the study. The cows were divided in the following groups considering parity:

Group I : Heifer (n = 26)
Group II : 1^{st} calving (n = 138)
Group III : 2^{nd} calving (n = 116)
Group IV : 3^{rd} calving (n = 89)
Group V : 4^{th} calving (n = 58)
Group VI : 5^{th} calving and above (n = 73)

3.1.6.4 Body weight

The body weights of dairy cows were calculated according to the Shaeffer's formula adopted by Mc Nitt (1983).

$$\text{Body weight} = \frac{L'' \times (G'')2}{300 \times 2.2} \text{ kg}$$

Where,

L = Length from point of elbow to pin bone in inch
G = Length of heart girth in inch

The selected cows were classified according to their body weight such as:

Group I : <200 kg (n = 116)
Group II : 200 to <300 kg (n = 259) and
Group III : >300 kg (n = 125)

3.1.6.5 Body condition score (BCS)

Effect of body condition on the reproductive performance and disorders were studied. Cows of different body condition were considered for the study and BCS were determined by Nicholson and Butterworth (1986) with some modified technique. The cows were divided in the following groups considering body conditions:

Group I : Poor (n = 108)
Group II : Medium (n = 120) and
Group III : Good (n = 272)

Where,

Poor: Heads of vertebral process (HVP) were visible, the pad on tuber coxae and ischiatic tuberosity was thicker than that of the under conditioned animal.

Medium: Flank and covering well balanced. The gap between thighs was filled up by fat apparently looks lat not round.

Good: The gap between thighs was filled up by fat apparently looks fatty and well muscled.

3.1.6.6 Educational status of the owner

Educational statuses of different farmers were divided into the following groups:

Group I (Illiterate)	:	The farmers had no literacy knowledge (n = 123)
Group II (Primary)	:	The farmers having educational knowledge up to primary (n = 106)
Group III (Secondary)	:	The farmers having educational knowledge up to SSC (n = 112)
Group IV (Higher secondary)	:	The farmers having educational knowledge up to HSC (n = 159)

3.1.6.7 Farming experience of farm owners

Farm owners have different length of farming experience. Farms were divided into the following groups considering length of farming experience.

Group I (None) : Farmer having less than one year farming experience (n = 100)

Group II (Little) : Farmer having 1 to 5 years farming experience (n = 99) and

Group III (Vast) : Farmer having >5 years farming experience (n = 301)

3.1.6.8 Farm size

Different farms were belonging to different number of cows. Farms were divided into the following groups considering number of cows in the farm.

Group I (Small)	:	Farm owner having 1 to 5 cows (n = 191)
Group II (Medium)	:	Farm owner having 6 to 10 cows (n = 134)
Group III (Large)	:	Those farm having more than 10 cows (n = 175)

3.1.6.9 Rearing system

Cows were reared in different housing system. The cows were divided into the following groups considering rearing system.

Group I (Intensive)	:	Cows were install feeding (n = 256)
Group II (Semi-intensive)	:	Both stall feeding and grazing (n = 169)
Group III (Grazing on pasture land)	:	Grazing feeding (n = 75)

3.1.6.10 Geographical location of farm

Farms which are located in 6 upazila and 4 metro thanas were selected for this study. Farms were divided into the following groups considering location of farms.

Group I **:** Urban (n = 209)
Group II **:** Semi-urban (n = 151) and
Group III **:** Rural (n = 140)

3.1.6.11 Floor type

Cows were reared in different floor type. The cows were divided in the following groups considering floor type.

Group I (Muddy) **:** The cows were kept in farm with traditional floor (n = 113)

Group II (Semi-concrete) **:** The cows were kept in farm with little facilities of concrete floor and manger but not scientifically made and poor drainage system (n = 122)

Group III (Concrete) **:** The cows were kept in farm with concrete floor, scientifically made and good drainage system (n = 265)

3.1.6.12 Ventilation system of farm house

Farm houses have different ventilation systems. The cows were divided in the following groups considering ventilation systems of farm house.

Group I (Poor) : No proper ventilation (n = 93)
Group II (Medium) : Only one side was ventilated (n = 177)
Group III (Good) : Both sides were ventilated (n = 230)

3.1.6.13 Feed quality

On the basis of feed quality the studied cows were divided into the following groups

Group I (Poor) **:** Cows were traditional feed supply (only grazing and little straw feeding) (n = 99)

Group II (Medium) **:** The cows were supplied some concentrate and straw (n = 168)

Group III (Good) **:** The cows were supplied balanced feed (concentrate, vitamin and mineral mixture before calving) diet including green grass and straw (n = 233)

3.1.6.14 Preventive measure of cows

The studied cows were divided according to the following preventive measures

Group I (Veterinarian)	:	The cows were treated only veterinarian (n = 251)
Group II (Quack)	:	The cows were treated not veterinarian only quack (n = 165)
Group III (Traditional)	:	The cows were treated others not veterinarian or quack (n = 84)

3.1.6.15 Breeding methods

The cows were group on the basis of servicing. The services were-

Group I : Natural service (n = 112) and

Group II : Artificial insemination (n = 388)

3.1.7 Reproductive Traits of cows studied:

Reproductive traits of dairy cows were considering factors viz. breed, age and parity etc. in this study. The reproductive traits were given below.

- **Age at puberty (AP):** The age at which a heifer first shows estrous sign and behavior may be defined as age at puberty (Hafez, 1974). It was measured in month (m) and total number of observation was 500.

- **Age at first calving (AFC):** It is defined as the age when a heifer first calving a newborn calf. It was measured in month (m).

- **Post-partum heat period (PPHP):** It is considered as the interval between date of calving and the date of first insemination or first heat show after parturition. It was calculated in days (d).

- **Service per conception (S/C):** In this study the average number of services or inseminations required for each successful conception in case of heifer and cows were used as reproductive efficiency of heifer or cows.

- **Days open (DO):** In this study day's open was measured in days. Day's open is referred as interval from parturition to date of conception of cows.

- **Calving interval (CI):** The number of days between two successful calving of the same cows or the period from one calving to the next was termed as calving interval. In this study calving interval was measured in days.

3.1.8 Reproductive disorders (RD) of cows

Following reproductive disorders (RD) were recorded-

- **Abortion:** It refers to a condition in which the fetus is delivered live or dead before reaching the stage of viability and in which the delivered fetus is generally visible by naked eyes.
- **Retained placenta:** When a cow fails to expel her placenta (afterbirth) within twelve (12) hours after calving, the condition is known as retained placenta.
- **Dystocia:** It is refers to a condition during the delivery process in which the first stage (opening period) or the second stage (expulsion period) is so prolonged that delivery is difficult or impossible without assistance.
- **Vaginal prolapse:** This refers to a condition in which part or the entire vaginal wall protrudes from the vulva. It tends to occur during the mid to late gestation period and sometimes after delivery.
- **Uterine prolapse:** It refers to a post-partum condition in which part or the entire uterus is reversed and prolapsed from the cervical canal to the outside of the vulva.
- **Metritis:** Inflammation of the uterus, generally caused by infection, is known as metritis. Cows normally have a red to brown discharge during the first 2 weeks after calving, usually cloudy discharge was found. If discharge persists beyond 2 weeks or if the discharge is foul-smelling, this is an evidence of metritis.
- **Pyometra:** Pyometra is the accumulation of pus in the uterus. It is characterized by the persistence of corpus luteum in one or both ovaries.
- **Still birth:** A case in which a nonviable fetus or dead fetus is delivered at full term or the fetus dies immediately before or during the delivery process.
- **Anoestrus:** Lack of expression of the estrus at an expected time is called anoestrus. Clinically, if a heifer is 18 or more months old or a cow has passed 60-70 days post-partum but did not show estrus the condition is referred to as anoestrus.

- **Repeat breeding:** A condition in which no abnormality was detected in the reproductive organs but no conception occurs after three or more times of mating with a fertile bull or AI with proven semen.

- **Mastitis:** Inflammation of the mammary gland is called mastitis. This is occur predominately due to the effects of infection by bacterial pathogens, although mycotic or algal microbes play a role in some cases.

- **Milk fever:** Milk fever, also known as parturient paresis, is a well-known metabolic disorder that occurs at or near calving, particularly in high producing cows.

3.1.9 Data management and analysis

The data obtained from the questionnaire was entered into the Microsoft Excel 2007 and transferred to SPSS version, 17.0. Data were statistically analyzed to calculate the effect of breed, genotype, age, parity, body weight, body condition score, educational status of the owner, farming experience, farm size, rearing system, geographical location of farm, floor type, ventilation system, feed quality, preventive measure and breeding methods on reproductive performance and reproductive disorders of cows. Various standard statistical procedures (percentages, mean and chi-square test etc.) had been adopted in this study. The mean and standard error of mean for the reproductive traits namely, age at puberty, age at first calving, post-partum heat period, service per conception, days open and calving interval as well as reproductive disorders such as abortion, retained placenta, dystocia etc. were calculated with help of a computer package programme (SPSS) version, 17.0. Mean of different traits were then tested by using Analysis of Variance (ANOVA) by Duncan Multiple Range Test (DMRT). Descriptive statistics was done to explore the clinical trends of reproductive disorders of cows at Rajshahi district. Data were presented as Mean±SE. $P<0.05$ was considered as significant. Simple ANOVA was performed considering the age of dairy cows and to observe the significant differences among the mean values, Duncan's multiple range test (DMRT) was performed to observer significant differences of reproductive traits in different breed, genotype, age, parity, body weight etc. of dairy cows.

A Intensive rearing cross-bred cows

B Intensive rearing cross-bred cows

C Grazing on pasture land

D Intensive rearing cross-bred cows and after 13th parity

Photograph 1 (A-D) Experimental cows at study area

Experiment-II: Study on biometrical measurement of reproductive organs in cows at study area

3.2.1 Study area

The reproductive organs of cow's were collected freshly from different slaughter houses under the Rajshahi City Corporation area from January, 2014 to December, 2014. The biometrical study was conducted at the Laboratory of the Department of Animal Husbandry and Veterinary Science, University of Rajshahi, Rajshahi.

3.2.2 Selection of samples

A total of 100 non-gravid female reproductive organs of dairy cows from slaughter house of Rajshahi City Corporation area were selected for this study.

3.2.3 Procedure for collection of sample

After slaughtering, the female reproductive tract were separated from the pelvic viscera by dissection after sawing through the pelvic symphysis, the broad ligaments, the loose connective tissue and fat surrounding the vulva and the retroperitoneal part of the vagina was removed as far as possible. Excess fat and other tissues surrounding the reproductive organs were discarded by careful dissection to clear the organs for a better examination. The flexures of the fallopian tubes were straightened out by freeing them from the mesosalpinx.

3.2.4 Methods of gross observation and measurement of reproductive organs

The observations of various parts of the reproductive organs were done under broad day light. Grossly the entire reproductive system from ovary to vulva was examined for the presence of any detectable abnormalities. After separating the broad ligaments and straightening the oviducts and horn, genitalia were cut to open and the measurements of the organ were taken.

3.2.5 Experimental layout

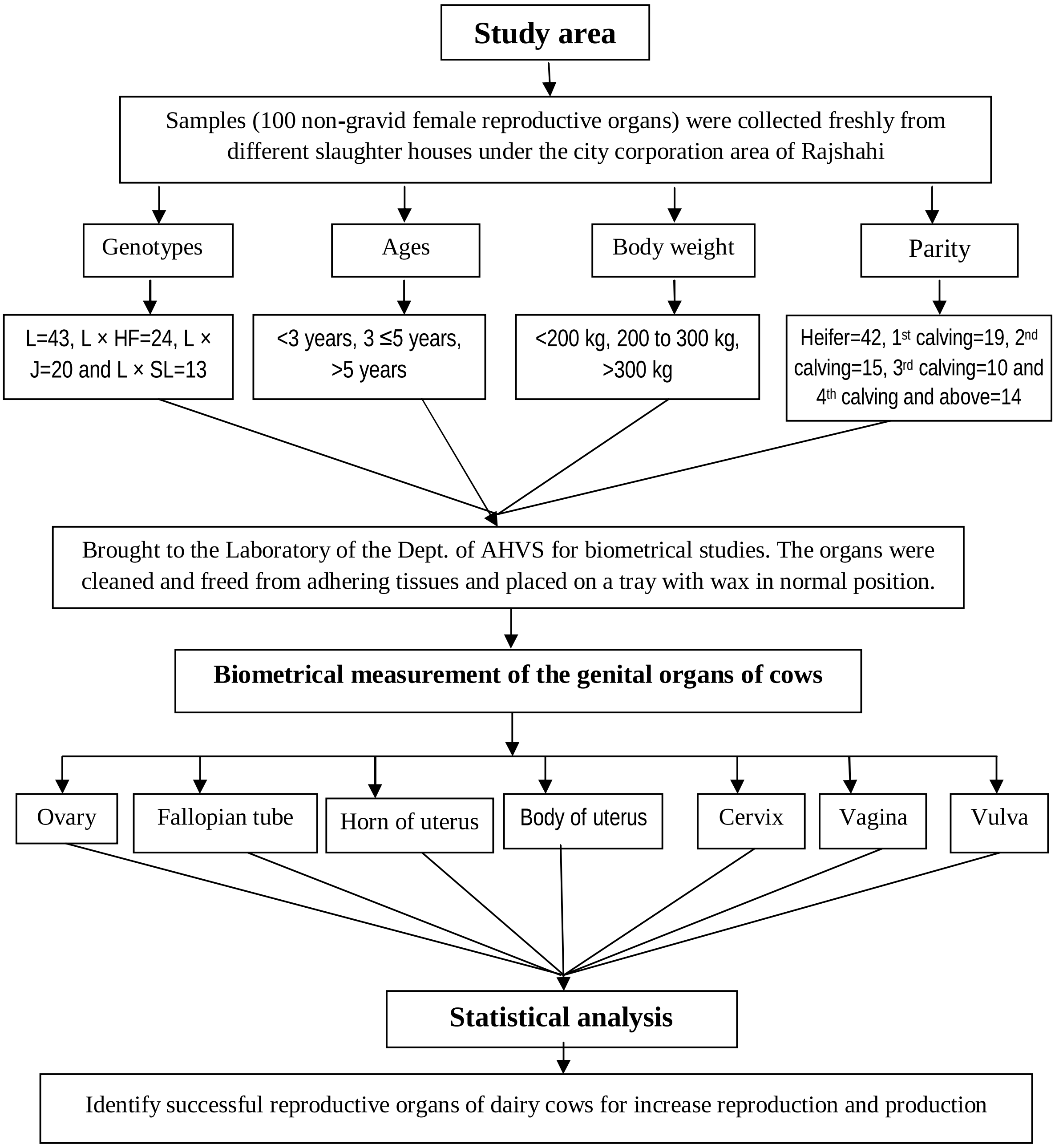


Figure 12 Flow diagram of the experiment-II

3.2.6 Sample grouped

The present study was conducted on 100 non-gravid female reproductive organs of different genotypes (Local, n=43; Local × Holstein Friesian, n=24; Local × Jersey, n=20; and Local, n=13), age and body weight groups as <3 years, 3 to ≤5 years, >5 years and <200 kg, 200 to 300 kg, >300 kg, respectively and parities as (heifer, 1st calving, 2nd calving, 3rd calving, 3rd calving and 4th calving and above) of dairy cows, at different slaughter-houses in Rajshahi were randomly collected during the routine slaughtering operations and brought to the Laboratory of the Department of Animal Husbandry and Veterinary Science. Reproductive organs included ovaries (length, width, thickness and weight), oviducts (length), uterine horns (length), body of uterus (length and width), cervix (length, width and ring), vagina (length and width) and vulva (length and width). Cervical rings and folds were considered as the number of rings/folds from *os externum* to *os internum*.

The body weight of each dairy cow was recorded in kg in the morning before the animals were slaughtered. The body weight was measured by means of a measuring tape applying the formula of Rahman *et al.* (2004) before slaughtering the animals.

$$\text{Live body weight (W)} = \frac{L \times G^2}{300} \text{ pounds}$$

Where, L = Length from the point of shoulder to pin bone in inches

G = Chest girth in inches

Then, the body weights were converted from pound to kg, dividing by 2.2

3.2.7 Examination procedure

After collection of reproductive organs are transferred to the laboratory in physiological saline of 30 to 38ºc within 30 minutes of slaughter. As documented by Wilson, 1995; the ovaries were removed at their junction with the ovarian ligament as close to the ovarian tissue as possible after the fimbria was removed. The following parameters were observed. The length of ovary was taken along the excision from the ovarian ligament with the help of Electronic Digital Calliper (Stainless Hardened) (Figure 13). The width was taken as the greatest line perpendicular to the length line. The thickness was the distance between the medial and lateral surfaces of the ovary. The weight of ovary was taken in gm separately for the right and left with the help of electrical weighing balance (Figure 14). Also observed presence of adhesion, types of cyst, number of follicles and presence of corpus luteum.

The oviducts were dissected out and a measurement taken on their extended length from the top of the fimbria to the tubal-uterine horn junction (Figure 15). The uterine horns were dissected free of their ligamentous attachments and extended their full length for measurement. Each uterine horn was incised along its dorsal surface to expose its lumen from the oviduct tubal junction to the bifurcation of the body of the uterus (Figure 16). The body of the uterus was also incised and this dorsal incision continued in a straight line to the dorsal commissure of the vulva in order to fully expose the cervical canal and the vagina. This method of exposure gave the relative thickness of the walls of the uterine horns, body of the uterus, cervix and vagina. The length of the uterine body was taken from its bifurcation to the internal os of the cervix (Figure 17). The length and diameter of the cervix was recorded. The length of the vagina was taken as the distance from the external os of the cervix to the ventral commissure of the vulva (Figure 18). A measurement of the vaginal width was regularly taken at a point from the external os of the cervix, prior to extending the dorsal incision through the vagina. All measurements were taken with a thin, flexible, graduated steel tape. Measurement errors due to variation in operator technique were kept to a minimum by following a standard procedure of dissection as adopted by Chibuzor (2006) with each tract in an identical position. All measurements were recorded in centimeters with the help of Electronic Digital Calliper, China (Stainless Hardened) and measuring tape. All weights were recorded in grams by using electrical weighing balance (Unilab Instruments, USA).

Figure 13 Measurement of the ovarian length taken along the excision line from the ovarian ligament.

Figure 14 Measurement of the ovary weight with the help of electrical weighing balance.

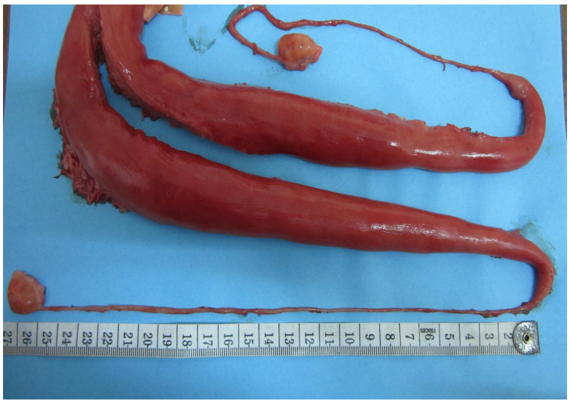


Figure 15 Measurement of the oviduct length taken from the top end of the fimbria to the uterine-tubal junction.

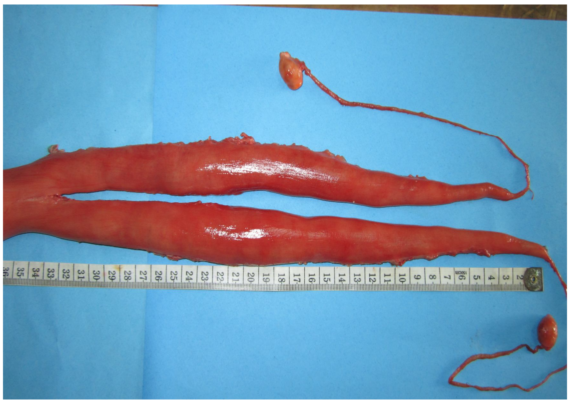


Figure 16 Measurement of the uterine horn length taken from the bifurcation of the uterine body (arrow) to the uterine-tubal junction.

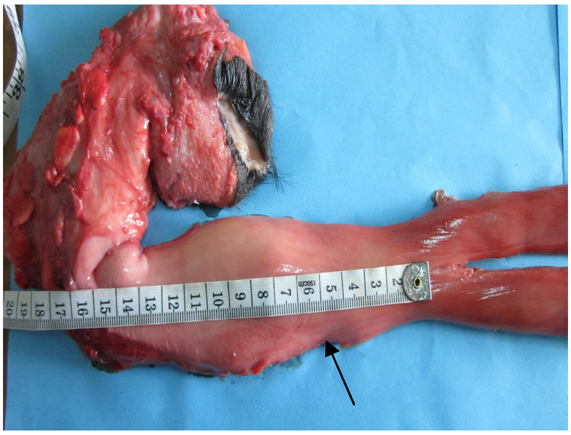


Figure 17 Measurement of the uterus body length taken from its bifurcation to the internal os of the cervix (arrow).

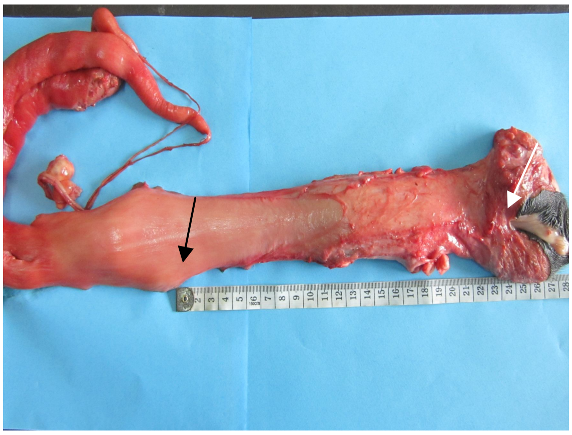


Figure 18 Measurement of the vaginal length taken from distance of the external os of the cervix (black arrow) to the ventral commissure of the vulva (white arrow).

3.2.8 Statistical analysis

The measurement of different parts of genital organs of dairy cows was recorded using computer package programme. Simple ANOVA was performed considering the age of dairy cows and to observe the significant differences among the mean values. The Duncan's multiple range test (DMRT) was performed to observe significant differences of ovaries and genital tract in between different genotypes, age, body weight groups and parities of dairy cows. Data were presented as Mean±SE. All analysis was performed using SPSS software version 17.0. $P<0.05$ was considered as significant.

Experiment-III: Study on the gross and histopathological changes of the affected organs

The proposed research work was carried out in the Department of Animal Husbandry and Veterinary Science, Faculty of Agriculture, University of Rajshahi, Rajshahi after collection of samples from eight slaughter houses of Rajshahi district.

3.3.1 Materials

3.3.1.1 Study area

The proposed research was carried out in the selected eight (08) slaughter houses of Rajshahi region namely Shaheb Bazar, Katakhali, Binudpur, NewMarket, Laximpur, Naodapara, Shalbagan and Horogram bazar under the Rajshahi City Corporation (RCC), which are located at the north side and 261 kms away from Dhaka city.

3.3.1.2 Study populations and periods

The study was carried out on the 115 cows of Rajshahi district. The research work was conducted from March, 2014 to June, 2015.

3.3.1.3 Sampling workflow

Grossly identifiable lesions such as congested, hemorrhagic and elevated vagina, swollen and edematous cervix, cystic and mucus filled uteri, pus filled horn of uterus, sub-active ovary, haemorrhage in ovary, multicystic ovary and mesovarian cyst in ovary from slaughtered cattle of different ages from selected slaughterhouses of Rajshahi district at regular intervals between March 2014 to June, 2015 used for this investigation.

3.3.2 Methods

3.3.2.1 Brief description of the experimental design

i. One hundred fifteen (115) samples were collected randomly from female reproductive system of cows

ii. Collected tissues were fixed and processed for histopathololgical examination

EXPERIMENTAL DESIGN

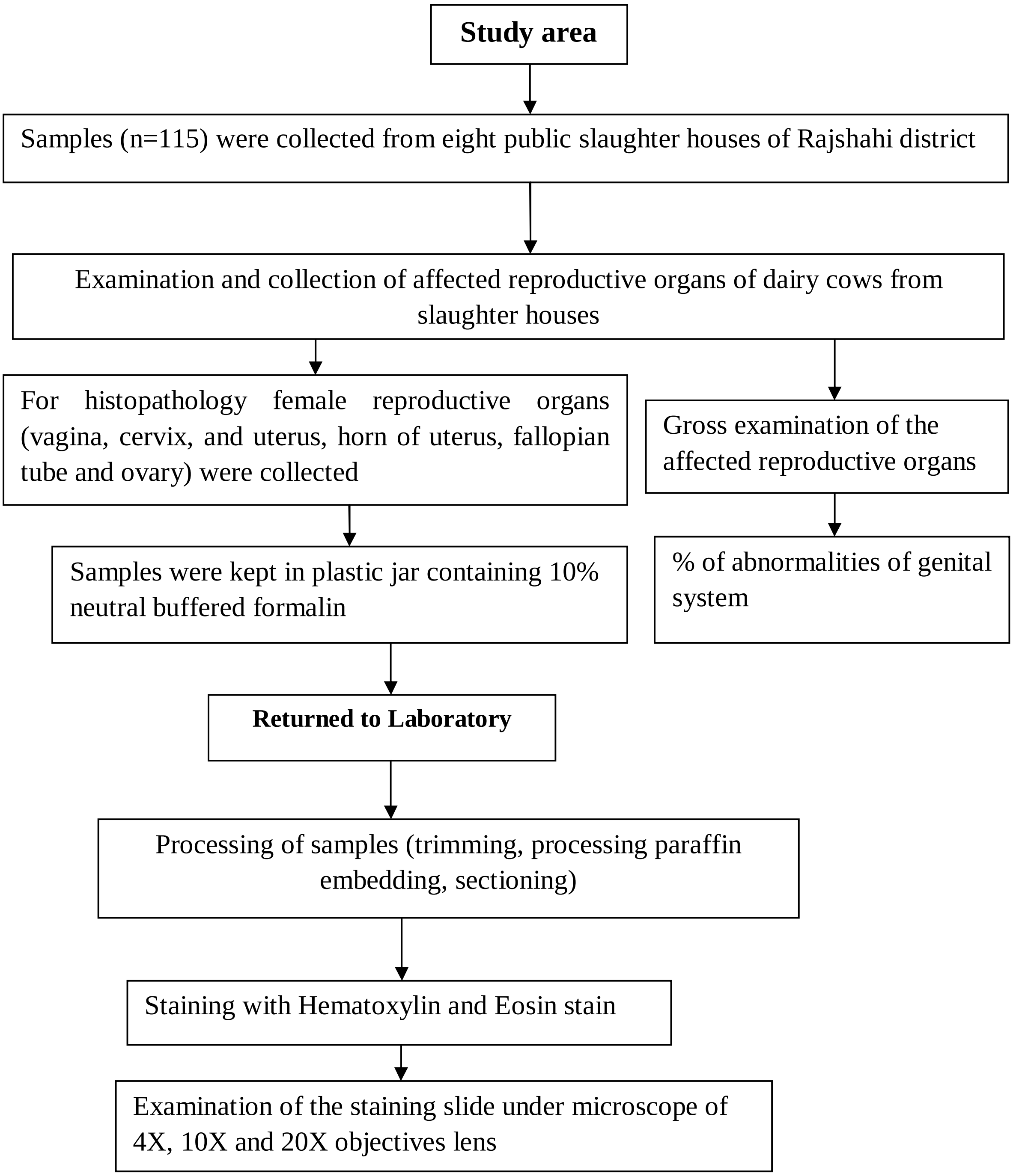


Figure 19 Flow diagram of the experiment-III

3.3.2.2 Collection and transportation of samples

One hundred fifteen (115) samples were collected randomly from slaughterhouses and the samples of different parts of the reproductive system containing gross lesions (vagina, cervix, uterus, fallopian tube and ovary) were collected for histopathological examination in plastic jar containing 10% neutral buffered formalin. These samples were carried to the Department of Animal Husbandry and Veterinary Science, University of Rajshahi, Rajshahi.

3.3.2.3 Examination of female reproductive organs

3.3.2.3.1 Gross pathological examination of affected organs

The observations of various parts of the reproductive organs were done under broad day light. Grossly the entire reproductive system from vulva to ovary was examined for the presence of any detectable abnormalities as previous described (AL-Dahash & David, 1977; Roine, 1977; Garcia, 1988 and Assey *et al*., 1998). In order to diagnose different pathological disorders a total of 115 female genitalia were collected from slaughterhouses. That time gross tissue changes were carefully observed and recorded. The following parameters were observed. In vagina, color of the vaginal mucosa, presence of granulomas, pus, cyst and any inflammatory lesion in the vagina. In cervix, prolapsed of the cervical ring, pus, exudates and inflammatory changes. In uterus and fallopian tube, color of mucosa, content such as water, mucus, pus etc., adhesion, cyst, obstruction and both the horns were examined for inflammatory changes, and other pathological abnormalities. The ovaries that did not show any developmental medium or large sized follicle and did not exhibit the presence of corpus luteum were diagnosed as true anestrus. The ovaries which exhibited developmental Graafian follicle of medium size were considered as sub-active. Both the ovaries were also examined externally and internally for presence of different kinds of cysts and other pathologic conditions including ovario-bursal adhesions, mesovarian cyst and persistent corpus luteum. The result was presented as percentage.

3.3.2.3.2 Processing of reproductive organs for histological procedure

After gross examination, representative tissue samples containing lesions were preserved in 10% neutral buffered formalin and transported to the laboratory within 1 hr after collection. Prevalence rate was recorded on the basis of histopathological examination. Adipose tissues surrounding the reproductive organs were removed by careful dissection to clear the organs for a better examination. The formalin-fixed tissues were trimmed, processed, sectioned and stained by Routine staining (H & E) technique following standard histological techniques (Luna, 1968). Specific lesions containing samples from each group were used in histopathological study. The stained sections of reproductive organs were studied thoroughly under compound microscope using 4X, 10X, & 20X objectives.

In brief,

i. The formalin fixed tissue samples were trimmed at 1.5 × 1 cm in size with scalpel, handle and blade and fixed for 48-72 hrs in fresh neutral buffered formalin.

ii. To remove the fixative, the tissues were washed overnight in running tap water.

iii. The tissues were dehydrated in ascending grades of alcohol using 50%, 70%, 80%, 95% and in absolute alcohol, the tissues were changed at every 1 hour interval.

iv. Xylene was used to clear the tissues, a most rapid reagent for displacing the absolute ethanol. After proper dehydration, pieces of tissues were immersed in a mixture of equal parts of xylene and alcohol for one hour and again immersed in 100% xylene for 1 hr.

v. The tissues were transferred from the clearing agent to a paraffin bath at a temperature of 56^0C and then transferred to pure paraffin wax in the oven for embedding for one and half an hour for each.

vi. Paraffin blocks containing tissue pieces were made using templates.

vii. The tissues were sectioned with a rotary microtome at 5-μm thickness. Then the sections were allowed to spread on warm water bath (45^0C) and taken on oil-and grease-free glass slide. A small amount of gelatin was added to the water bath for better adhesion of the sections to the slide. The slides containing sections were air dried and kept in cool place until staining.

3.3.2.3.2.1 Preparation of stains

i. Preparation of Harris Hematoxylin solution

Hematoxylin crystals	5.0g
Alcohol, 100%	50.0ml
Ammonium or potassium alum	100.0g
Distilled water	1000.0 ml
Mercuric oxide (red)	2.5g

The Hematoxylin was dissolved in the alcohol and the alum in the water by the aid of heat. The two solutions were removed from heat and thoroughly mixed and boiled as rapidly as possible. After removal from heat, mercuric oxide was added slowly. It was reheated to similar until it became dark purple, removed from heat immediately and plunged the vessel into a basin of cold water until became cool. Just before using, 2-4 ml of glacial acetic acid was added per 100 ml of solution to increase the precision of the nuclear stain. Before using, the prepared solution was filtered.

ii. Preparation of Eosin Solution

1% Stock alcoholic eosin

Eosin Y, water soluble	1.0g
Distilled water	20.0ml
Dissolved and added 95% alcohol	80.0ml

b) Working eosin solution

Eosin stock solution	1 part
Alcohol, 80%	3 parts

Just before use 0.5 ml of glacial acetic acid was added to each 100 ml of stain and stirred.

3.3.2.3.2.2 Routine Hematoxylin and Eosin staining procedure

i. The sectioned tissues were deparaffinized in 3 changes of xylene (3 minutes in each).
ii. Then the sectioned tissues were rehydrated through descending grades of alcohol. (3 changes in absolute alcohol, 3 minutes in each; 95% alcohol for 2 minutes; 80% alcohol for 2 minutes; 70% alcohol for 2 minutes) followed by a dip in distilled water and then in tap water for 5 minutes.
iii. The tissues were stained with Harris Hematoxylin for 15 minutes.
iv. Slide containing tissues was washed in running tap water for 10-15 minutes.
v. After washing the tissues were differentiated in acid alcohol: 2 to 4 dips (1 part HCL and 99 parts 70% alcohol).
vi. Then washed in tap water for 5 minutes followed by two to four dips in ammonia water until sections were bright blue.
vii. Stained with eosin solution for 1 minutes.
viii. Differentiated and dehydrated in alcohol: 95% alcohol: 3 changes, 2-4 dips each; absolute alcohol: 3 changes 2-3 minutes for each.
ix. Cleaned in xylene: 3 change (5 minutes for each).
x. Finally the sections were mounted with coverslip using DPX then air dry.

3.3.2.3.2.3 Examination under a microscope

The lesions in the tissues were examined under a low power (4X, 10X) and high power objectives. The representative lesions were observed for photomicrography.

3.3.2.3.2.4 Photomicrography

Photomicrography was taken at the Department of Genetic Engineering and Biotechnology Laboratory using OPTICA Microscopes, ITALY, MICROSCOPY DIGITAL USB CAMERA.

3.3.2.3.3 Data interpretation

The percentage of the occurrence of various lesions was termed as the prevalence of the reproductive diseases. At the end of the study period all findings were compiled, scrutinized and analyzed for comprehensive interpretation.

A Gross examination of follicular cyst

B Examination of histological slide under microscope

Photograph 2 (A-B) Gross and histopathological examination of reproductive organs of cow.

Chapter 4

RESULTS

The aim of the present study was to evaluate the "Clinical trends of reproductive disorders of cows in Rajshahi district of Bangladesh" under three (3) separate experiments.

Experiment I: Study on reproductive trends of dairy cows in Rajshahi district

A total of 500 dairy cows were studied for the clinical trends of reproductive disorders of cows from 6 upazilas and 4 metro thanas of Rajshahi district. The following factors viz. breed, genotype, age, parity, body weight, body condition score, educational status of the owner, farming experience, farm size, rearing system, geographical location, floor type, ventilation system, feed quality, preventive measure and breeding methods of farm are the potential influencing factors in dairy cows on clinical trends (reproductive performances and reproductive disorders). The reproductive performances and the reproductive disorders were investigated in these animals and results and ANOVA were presented in tables 1-33 and figures 20-42 and in tables 34-52 and figures 43-50, respectively.

4.1.1 Factors affecting the reproductive performance of dairy cows

4.1.1.1 The reproductive performance of dairy cows in different upazilas and metro thanas

The reproductive performance of dairy cows in different upazilas and metro thanas are presented in Table 1-2 and Figure 20-21. These table are also shows the significance in different upazilas and metro thanas, which is marked by superscripts. The higher age at puberty (28.46 ± 0.55 m) and age at first calving (37.39 ± 0.57 m) were observed in Godagari upazila whereas the lower (24.52 ± 0.71 m) and (33.54 ± 0.69 m) in Boalia metro thana. The lowest value of post partum heat period (92.08 ± 5.3 d) was obtained in Rajpara metro thana and the highest value (148.82 ±11.45 d) was in Godagari upazila. The lower service per conception (1.62 ±0.11) was observed in Boalia thana and the higher (2.46 ±0.13) was in Mohanpur upazila. The higher value of days open and calving interval (158.82±11.41 d and 422.31±12.34 d) were observed in Godagari upazila and the lower values (115.13±6.82 d) were in Rajpara and (373.46±12.88 d) was in Poba upazila.

Table 1 Reproductive performance of dairy cows in different Upazilas and Metro thanas of Rajshahi district.

Name of Upazilas and Metro thanas	Reproductive performances					
	Age at puberty(m)	Age at 1^{st} calving(m)	Post-partum heat period (d)	Service/ conception	Days open (d)	Calving interval (d)
Charghat	27.28 ± 0.59^{ab} (n=50)	36.08 ± 0.63^{abc} (n=46)	142.74 ± 8.14^{ab} (n=35)	2.20 ± 0.12^{ab} (n=50)	151.2 ± 8.30^{ab} (n=35)	420.64 ± 11.27^{a} (n=25)
Puthia	27.06 ± 0.70^{ab} (n=50)	36.43 ± 0.68^{ab} (n=48)	125.48 ± 12.43^{abc} (n=41)	1.68 ± 0.13^{c} (n=50)	152.79 ± 13.93^{a} (n=39)	415.56 ± 14.92^{a} (n=32)
Poba	25.70 ± 0.80^{bcd} (n=50)	35.13 ± 0.76^{bcd} (n=46)	125.40 ± 11.30^{abc} (n=45)	2.22 ± 0.20^{ab} (n=50)	129.33 ± 13.87^{ab} (n=39)	373.46 ± 12.88^{b} (n=32)
Godagari	28.46 ± 0.55^{a} (n=50)	37.39 ± 0.57^{a} (n=48)	148.82 ± 11.45^{a} (n=46)	1.82 ± 0.12^{bc} (n=50)	158.82 ± 11.41^{a} (n=46)	422.31 ± 12.34^{a} (n=38)
Tanore	24.86 ± 0.73^{cd} (n=50)	33.95 ± 0.74^{cd} (n=49)	111.50 ± 8.00^{bc} (n=46)	1.98 ± 0.12^{bc} (n=50)	130.20 ± 8.78^{ab} (n=45)	401.81 ± 8.83^{bc} (n=43)
Mohanpur	26.06 ± 0.71^{bcd} (n=50)	35.08 ± 0.73^{bcd} (n=49)	123.41 ± 15.18^{abc} (n=46)	2.46 ± 0.13^{a} (n=50)	134.32 ± 14.85^{ab} (n=46)	400.55 ± 17.73^{bc} (n=38)
Motihar	26.92 ± 0.66^{abc} (n=50)	35.85 ± 0.68^{abc} (n=49)	117.27 ± 9.85^{abc} (n=44)	1.94 ± 0.11^{bc} (n=50)	127.70 ± 10.43^{ab} (n=41)	389.93 ± 12.25^{bc} (n=29)
Boalia	24.52 ± 0.71^{d} (n=50)	33.54 ± 0.69^{d} (n=48)	110.71 ± 13.38^{bc} (n=42)	1.62 ± 0.11^{c} (n=50)	130.02 ± 10.78^{ab} (n=44)	394.10 ± 11.22^{bc} (n=37)
Rajpara	27.22 ± 0.34^{ab} (n=50)	36.22 ± 0.34^{ab} (n=50)	92.08 ± 5.3^{c} (n=46)	1.76 ± 0.14^{c} (n=50)	115.13 ± 6.82^{b} (n=46)	382.71 ± 8.06^{bc} (n=35)
Shahmukdhm	26.12 ± 0.94^{bcd} (n=50)	35.14 ± 0.96^{bcd} (n=49)	125.85 ± 9.26^{abc} (n=41)	1.66 ± 0.15^{c} (n=50)	142.52 ± 9.91^{ab} (n=40)	410.13 ± 10.65^{bc} (n=36)
Grand Total	26.42 ± 0.22 (n=500)	35.48 ± 0.22 (n=482)	121.85 ± 3.48 (n=432)	1.93 ± 0.04 (n=500)	136.80 ± 3.57 (n=421)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b,c,d, Mean ± SE with different superscript letters in the same column differs significantly with each others ($P<0.05$).

Table 2 Analysis of variance (ANOVA) for the reproductive performances in dairy cows of different Upazilas and Metro thanas of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between Upazila and Metro group	649.120	9	72.124	2.976	.002
	Within Upazila and Metro group	11874.680	490	24.234		
Age at 1st calving (m)	Between Upazila and Metro group	584.117	9	64.902	2.766	.004
	Within Upazila and Metro group	11076.250	472	23.467		
Post-partum heat period (d)	Between Upazila and Metro group	102438.039	9	11382.004	2.225	.020
	Within Upazila and Metro group	2159079.063	422	5116.301		
Service per conception	Between Upazila and Metro group	35.642	9	3.960	4.067	.000
	Within Upazila and Metro group	4.77.18	490	.974		
Days open (d)	Between Upazila and Metro group	72347.742	9	8038.638	1.514	.141
	Within Upazila and Metro group	2182688.286	411	5310.677		
Calving interval (d)	Between Upazila and Metro group	78005.564	9	8667.285	1.641	.102
	Within Upazila and Metro group	1769576.599	335	5282.318		

D.F= Degree of freedom, F= Factorial value, P= Probability value

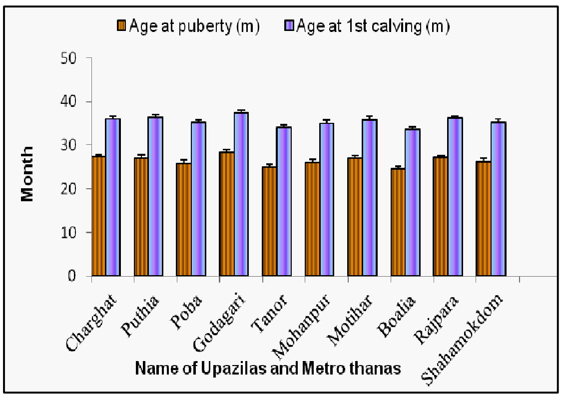


Figure 20 Graphical representations of age at puberty and age at 1st calving of dairy cows in different Upazilas and Metro thanas.

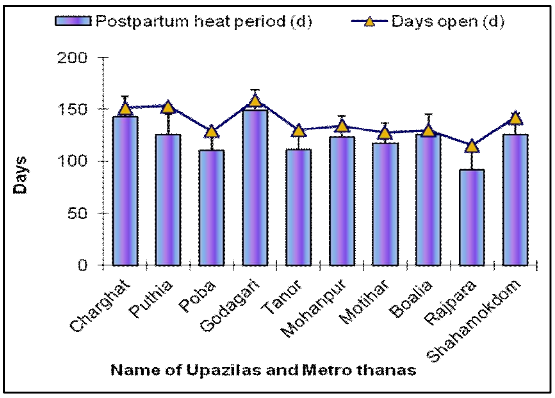


Figure 21 Graphical representation of post-partum heat period and days open of dairy cows in different Upazilas and Metro thanas.

4.1.1.2 The reproductive performance of dairy cows in between upazilas and metro thanas

The reproductive performance of dairy cows in between upazilas and metro thanas are presented in Table 3 and Figure 22. The higher value of age at puberty, age at first calving, post-partum heat period, service per conception, days open and calving interval (26.57 ± 0.28 m, 35.67 ± 0.28 m, 126.73 ± 4.91 d, 2.06 ± 0.06, 142.56 ± 5.02 d, and 405.34 ± 5.52 d) were observed in upazila and the lower value of (26.19 ± 0.35 m, 35.20 ± 0.35 m, 114.76 ± 4.66 d, 1.74 ± 0.06, 128.38 ± 4.78 d and 394.52 ± 5.30 d) were observed in metro thana. There was only significant effect ($P<0.05$) of among upazila and metro thana on service per conception of dairy cows, other reproductive traits were not significant ($P>0.05$).

Table 3 The comparison of reproductive parameters of dairy cows between Upazilas and Metro thanas of Rajshahi district.

Reproductive parameters	**Name of Upazilas and Metro thanas**		**Grand Total**	**Chi-Square**	**C.V**	**T.V**	**D.F**	**Significance**
	Upazila	Metro thana						
Age at puberty (m)	26.57 ± 0.28 (n=300)	26.19 ±0.35 (n=200)	26.42±0.22 (n=500)	χ^2	38.91	41.33	28	NS
Age at 1st calving (m)	35.67 ± 0.28 (n=286)	35.20 ± 0.35 (n=196)	35.48 ± 0.22 (n=482)		33.83	38.89	26	NS
Post-partum heat period (d)	126.73±4.9 (n=256)	114.76±4.66 (n=176)	121.85±3.48 (n=432)		33.90	52.19	37	NS
Service per conception	2.06 ± .06 (n=300)	1.74 ± .06 (n=200)	1.93 ± .04 (n=500)		13.71	11.07	5	*
Days open (d)	142.56±5.02 (n=250)	128.38±4.78 (n=171)	136.80±3.57 (n=421)		96.60	108.64	86	NS
Calving interval (d)	405.34±5.52 (n=208)	394.52±5.30 (n=137)	401.04±3.94 (n=345)		78.57	88.25	68	NS

χ^2=Chi-Square, m=months, d=days, n=no. of observation, C.V= Calculated value, T.V= Tabulated value, D.F= Degree of freedom, NS=Non-significant, * ($P<0.05$).

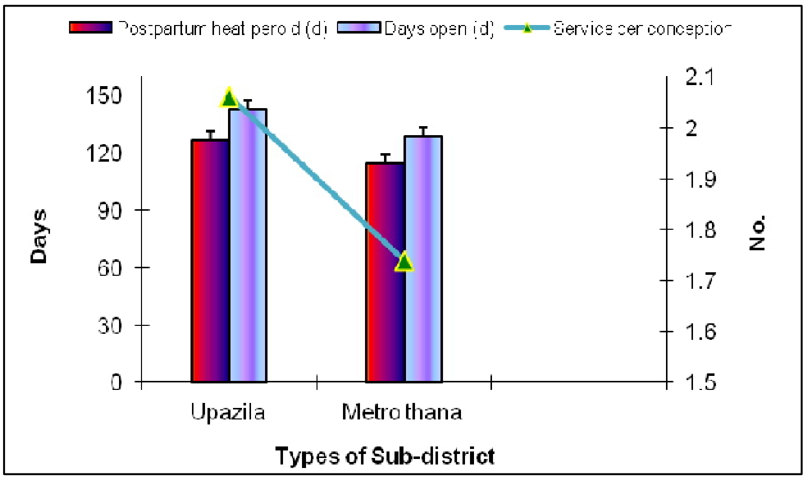


Figure 22 Graphical representation of post-partum heat period, days open and service per conception of dairy cows in sub-district of Rajshahi.

4.1.1.3 Effects of breeds/genotypes on reproductive performance of dairy cows

The effects of breeds on reproductive performance of dairy cows are summarized in Table 4 and Figure 23. The higher value of age at puberty, age at first calving, post-partum heat period, days open and calving interval (27.88 ± 0.47 m, 36.76 ± 0.47 m, 147.84 ± 7.83 d, 155.96 ± 7.17 d and 414.31 ± 8.76 d) were observed in local breed cows and the lower value of (26.05 ± 0.25 m, 35.16 ± 0.25 m, 115.67 ± 3.82 d, 132.24 ± 4.04 d and 398.42 ± 4.38 d) were observed in cross-bred cows. The higher value of service per conception (1.95 ± 0.05) was observed in crossbred cows and the lower value (1.84 ± 0.08) was observed in local breed cows. There was only significant effect ($P<0.05$) of breed on post-partum heat period of dairy cows, other reproductive traits were not significant. When compared with genetic composition the lower value of age at puberty and age at first calving (25.84 ± 0.27 m and 34.94 ± 0.27 m) were observed in Local × Friesian cows and (26.93 ± 0.61 m and 36.09 ± 0.62 m) and (27.88 ± 0.47 m and 36.76 ± 0.47 m) were in Local × Sahiwal and Local type, respectively (Table 5 and Figure 24 & 25). The higher value of post-partum heat period (147.84 ± 7.83 d) was observed in local type of cows and the lower value (112.43 ± 8.55 d) was in Local × Sahiwal. Maximum and minimum number of services were required for successful calving in dairy cows respectively were (1.96 ± 0.05) in Local × Friesian cows and (1.84 ± 0.08) in local. The higher value of days open and calving interval (155.96 ± 7.17 d and 414.31 ± 8.76 d) were observed in local type of cows and the lower value (128.28 ± 9.37 d) and (396.89 ± 10.96 d) were in Local × Sahiwal.

Genotype had significant (P<0.05) effect on age at puberty, age at first calving, post partum heat period, days open and calving interval and had no significant (P>0.05) effect on service per conception (Table 6).

Table 4 Effect of breeds on reproductive performances of dairy cows of Rajshahi district.

Reproductive performances	Breed		Grand Total	Chi-Square	C.V	T.V	D.F	Significance
	Local	Cross breed						
Age at puberty (m)	27.88±0.47 (n=100)	26.05±0.25 (n=400)	26.42 ± .22 (n=500)	χ^2	33.85	41.33	28	NS
Age at 1st calving (m)	36.76±0.47 (n=97)	35.16±0.25 (n=385)	35.48 ± .22 (n=482)		36.50	38.89	26	NS
Post-partum heat period (d)	147.84±7.83 (n=83)	115.67±3.82 (n=349)	121.85±3.48 (n=432)		54.100	52.19	37	*
Service per conception	1.84 ± 0.08 (n=100)	1.95 ± 0.05 (n=400)	1.93 ± 0.04 (n=500)		5.13	11.07	5	NS
Days open (d)	155.96±7.17 (n=81)	132.24±4.04 (n=340)	136.80±3.57 (n=421)		97.01	108.64	86	NS
Calving interval (d)	414.31±8.76 (n=57)	398.42±4.38 (n=288)	401.04±3.94 (n=345)		71.72	88.25	68	NS

χ^2 =Chi-Square, m=months, d=days, n=no. of observation, C.V= Calculated value, T.V= Tabulated value, D.F= Degree of freedom, NS=Non-significant, * (P<0.05).

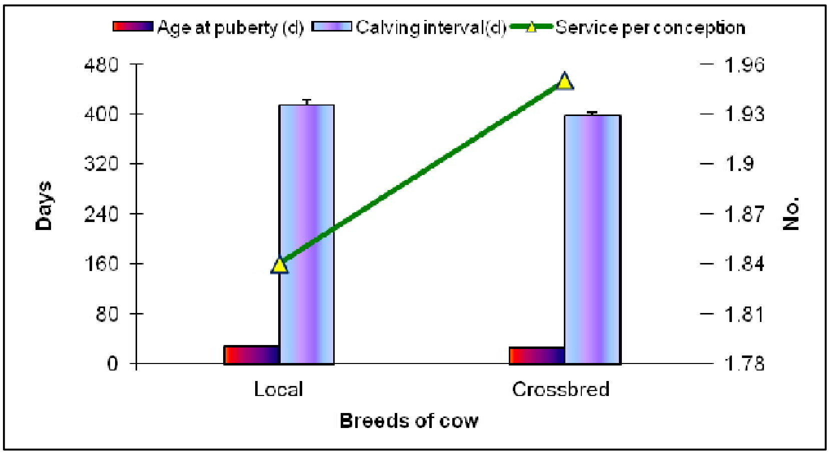


Figure 23 Graphical representation of post-partum heat period, days open and service per conception in different breeds of dairy cows in Rajshahi district.

Table 5 The influence of genotypes on reproductive performances of dairy cows of Rajshahi district.

Reproductive performances	**Genotype**			**Grand Total**
	Local	Local × Friesian	Local × Sahiwal	
Age at puberty (m)	27.88 ± 0.47^{a} (n=100)	25.84 ± 0.27^{b} (n=324)	26.93 ± 0.61^{ab} (n=76)	26.42 ± 0.22 (n=500)
Age at 1st calving (m)	36.76 ± 0.47^{a} (n=97)	34.94 ± 0.27^{b} (n=314)	36.09 ± 0.62^{ab} (n=71)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	147.84 ± 7.83^{a} (n=83)	116.37 ± 4.27^{b} (n=287)	112.43 ± 8.55^{b} (n=62)	121.85 ± 3.48 (n=432)
Service per conception	1.84 ± 0.08 (n=100)	1.96 ± 0.05 (n=324)	1.90 ± 0.10 (n=76)	1.93 ± 0.04 (n=500)
Days open (d)	155.96 ± 7.17^{a} (n=81)	133.08 ± 4.48^{b} (n=280)	128.28 ± 9.37^{b} (n=60)	136.80 ± 3.57 (n=421)
Calving interval (d)	414.31 ± 8.76 (n=57)	398.73 ± 4.79 (n=239)	396.89 ± 10.96 (n=49)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 6 Analysis of variance (ANOVA) for the reproductive performances by various genotypes of cow at Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	338.979	2	169.490	6.913	.001
	Within groups	12184.821	497	24.517		
Age at 1st calving (m)	Between groups	275.326	2	137.663	5.792	.003
	Within groups	11385.041	479	23.768		
Post-partum heat period (d)	Between groups	70173.537	2	35086.769	6.869	.001
	Within groups	2191343.565	429	5108.027		
Service per conception	Between groups	1.335	2	.668	.649	.523
	Within groups	511.487	497	1.029		
Days open (d)	Between groups	37952.188	2	18976.094	3.578	.029
	Within groups	2217083.840	418	5304.028		
Calving interval (d)	Between groups	12154.963	2	6077.482	1.132	.323
	Within groups	1835427.199	342	5366.746		

D.F= Degree of freedom, F= Factorial value, P= Probability value

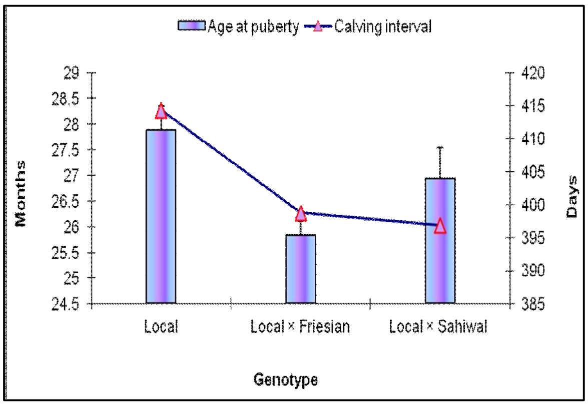


Figure 24 Graphical representation of age at puberty and calving interval of dairy cows in different genotypes.

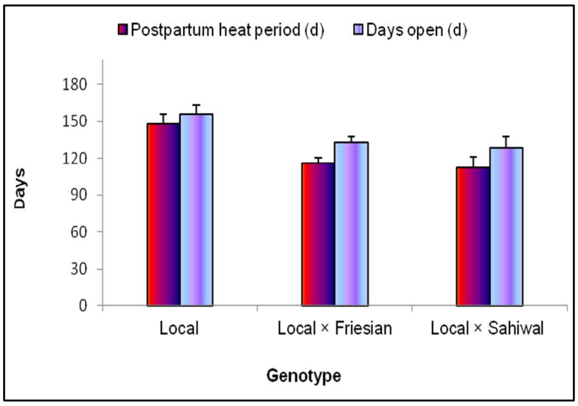


Figure 25 Graphical representation of postpartum heat period and days open of dairy cows in different genotypes.

4.1.1.4 The effects of age group on reproductive performance of dairy cows

The effects of age group on reproductive performance of dairy cows are presented in Table 7 and Figure 26 & 27. The lower value of age at puberty and age at first calving (24.46 ± 0.53 m and 33.62 ± 0.56 m) were observed in 3 to <5 years of age and the higher (27.13 ± 0.41 m and 36.24 ± 0.39 m) were in >9 years. The shorter post-partum heat period (114.79 ± 7.78 d), minimum number of service per conception (1.81 ± 0.7) and days open (124.44 ± 8.18 d) were found in 5 to <9 years of age and the longest post-partum heat period (141.60 ± 9.35 d) was in <3 years, maximum number of service per conception (1.96 ± 0.12) was in 3 to <5 years and days open (148.40 ± 9.47 d) was in <3 years. The higher calving interval (409.59 ± 7.64 d) was found in >9 years of age and the lower (372.00 ± 19.84 d) was in 3 to <5 years.

Age group had significant ($P<0.05$) effect on age at puberty, age at first calving and had no significant ($P>0.05$) effect on post partum heat period, service per conception days open and calving interval (Table 8).

Table 7 Effect of age groups on reproductive performances of dairy cows of Rajshahi district.

Reproductive performances	Age group				Grand Total
	< 3 years	3 to <5 years	5 to <9 years	>9 years	
Age at puberty (m)	26.68 ± 0.35^{a} (n=75)	24.46 ± 0.53^{b} (n=214)	26.35 ± 0.54^{a} (n=133)	27.13 ± 0.41^{a} (n=78)	26.42 ± .22 (n=500)
Age at 1st calving (m)	35.62 ± 0.35^{a} (n=64)	33.62 ± 0.56^{b} (n=208)	35.35 ± 0.54^{a} (n=132)	36.24 ± 0.39^{a} (n=78)	35.48 ± .22 (n=482)
Post-partum heat period (d)	141.60 ± 9.35 (n=28)	119.97 ± 4.82 (n=196)	114.79 ± 7.78 (n=130)	124.67 ± 7.42 (n=78)	121.85 ± 3.48 (n=432)
Service per conception	1.90 ± .11 (n=75)	1.96 ± .12 (n=214)	1.81 ± .07 (n=133)	2.00 ± .07 (n=78)	1.93 ± .04 (n=500)
Days open (d)	148.40 ± 9.47 (n=27)	134.83 ± 4.98 (n=187)	124.44 ± 8.18 (n=129)	144.69 ± 7.39 (n=78)	136.80 ± 3.57 (n=421)
Calving interval (d)	396.48 ± 5.31 (n=5)	372.00±19.84 (n=135)	396.91 ± 7.90 (n=127)	409.59 ± 7.64 (n=78)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 8 Analysis of variance (ANOVA) for the reproductive performances at different age groups of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	369.228	3	123.076	5.022	.002
	Within groups	12154.572	496	24.505		
Age at 1st calving (m)	Between groups	302.181	3	100.727	4.239	.006
	Within groups	11358.186	478	23.762		
Post-partum heat period (d)	Between groups	16540.402	3	5513.467	1.051	.370
	Within groups	2244976.700	428	5245.273		
Service per conception	Between groups	2.926	3	.975	.949	.417
	Within groups	509.896	496	1.028		
Days open (d)	Between groups	24301.819	3	8100.606	1.514	.210
	Within groups	2230734.210	417	5349.483		
Calving interval (d)	Between groups	17637.378	3	5879.126	1.096	.351
	Within groups	1829944.784	341	5366.407		

D.F= Degree of freedom, F= Factorial value, P= Probability value

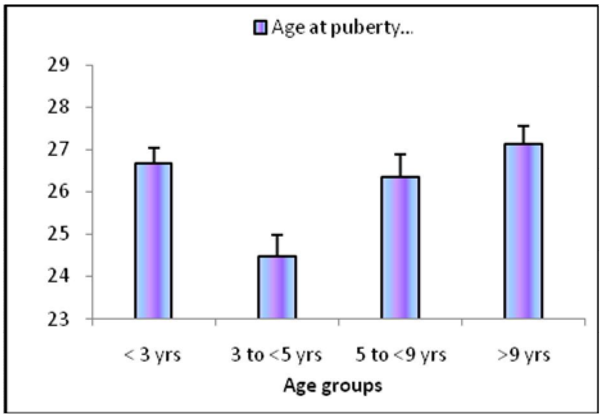


Figure 26 Reproductive performance of age at puberty of dairy cows among age groups.

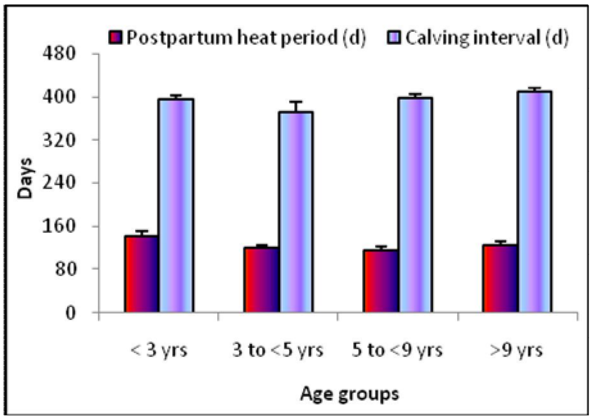


Figure 27 Reproductive performance of post-partum heat period and calving interval of dairy cows among age groups.

4.1.1.5 The effects of parity on reproductive performance of dairy cows

To determine the variation of reproductive parameters of dairy cows due to parity effect are presented in Table 9 and Figure 28. The lower value of almost reproductive traits of age at puberty (25.57 ± 0.91 m), age at first calving (34.97 ± 0.46 m), post-partum heat period (109.16 ± 7.11 d), service per conception (1.77 ± 0.09) and calving interval (392.67 ± 7.60 d) were found in 3rd calving except days open (125.98 ± 9.23 d) which was found in 4th calving. The higher value of age at puberty (27.25 ± 0.62 m) and age at first calving (36.27 ± 0.62 m) were found in 4th calving, post-partum heat period (181.25 ± 50.01 d), service per conception (2.30 ± 0.25) and days open (190.00 ± 48.47 d) were found in heifer and calving interval (413.96 ± 7.81 d) was found in 2nd calving.

Parity had significant (P<0.05) effect on post-partum heat period, service per conception days open and had no significant (P>0.05) effect on age at poverty, age at first calving and calving interval (Table 10).

Table 9 Reproductive parameters of dairy cows of Rajshahi district in different parities.

Reproductive Parameters	Parity						Grand Total
	P_0	P_1	P_2	P_3	P_4	$>P_5$	
Age at puberty (m)	25.83±0.48 (n=26)	26.52±0.43 (n=138)	26.75±0.47 (n=116)	25.57±0.91 (n=89)	27.25±0.62 (n=58)	26.05±0.63 (n=73)	26.42±0.22 (n=500)
Age at 1st calving (m)	35.44±1.35 (n=9)	35.44±0.43 (n=137)	35.75±0.47 (n=116)	34.97±0.46 (n=89)	36.27±0.62 (n=58)	35.12±0.61 (n=73)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	181.25±50.01^{a} (n=4)	145.43±6.93^{ab} (n=92)	121.00±7.71^{b} (n=116)	109.16±7.11^{b} (n=89)	109.98±8.82^{b} (n=58)	115.15±7.44^{b} (n=73)	121.85±3.48 (n=432)
Service per conception	2.30 ± 0.25^{a} (n=26)	1.94 ± 0.08^{ab} (n=138)	1.97 ±.09^{ab} (n=116)	1.77 ± .09^{b} (n=89)	2.00 ±.14^{ab} (n=58)	1.84 ± .10^{b} (n=73)	1.93 ± .04 (n=500)
Days open (d)	190.00±48.47^{a} (n=4)	156.62±6.99^{ab} (n=82)	140.02±7.96^{b} (n=115)	127.22±7.33^{b} (n=89)	125.98±9.23^{b} (n=58)	126.83±7.53^{b} (n=73)	136.80±3.57 (n=421)
Calving interval (d)		393.45±16.52 (n=11)	413.96 ±7.81 (n=114)	392.67 ±7.60 (n=89)	399.39 ±8.96 (n=58)	393.54±7.31 (n=73)	401.04±3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days, P_0=heifer, P_1=1st calving, P_2=2nd calving, P_3=3rd calving, P_4= 4th calving and P_5=5th calving and above; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others (P<0.05).

Table 10 Analysis of variance (ANOVA) for the reproductive performances at different parities of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	113.896	5	22.779	.908	.476
	Within groups	12409.904	494	25.121		
Age at 1st calving (m)	Between groups	77.124	5	15.425	.634	.674
	Within groups	11583.243	476	24.335		
Post-partum heat period (d)	Between groups	91128.946	5	18225.789	3.577	.004
	Within groups	1270388.156	426	5094.808		
Service per conception	Between groups	6.868	5	1.374	1.341	.245
	Within groups	505.954	494	1.024		
Days open (d)	Between groups	66931.311	5	13386.262	2.539	.028
	Within groups	2188104.718	415	5272.541		
Calving interval (d)	Between groups	30160.063	4	7540.016	1.411	.230
	Within groups	1817422.099	340	5345.359		

D.F= Degree of freedom, F= Factorial value, P= Probability value

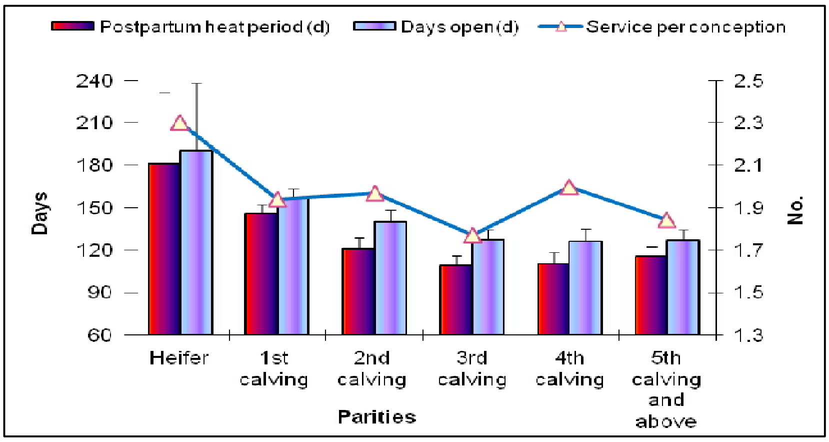


Figure 28 Reproductive performance of post-partum heat period, days open and service per conception in different parities of dairy cows in Rajshahi district.

4.1.1.6 The effects of body weight on reproductive performance of dairy cows

The effects of body weight on reproductive performance of dairy cows are presented in Table 11 and Figure 29 & 30. The lower value of all reproductive traits of age at puberty (25.43 ± 0.44 m), age at first calving (34.53 ± 0.42 m), post-partum heat period (101.44 ± 5.44 d), service per conception (1.88 ± 0.09), days open (115.80 ± 5.38 d) and calving interval (382.78 ± 5.79 d) were found in >300 kg body weight of cows and the higher value of almost reproductive traits of age at puberty (27.37 ± 0.39 m), age at first calving (36.45 ± 0.40 m), post-partum heat period (136.14 ± 8.05 d), service per conception (1.99 ± 0.07), days open (150.15 ± 8.04 d) were found in <200 kg body weight of cows except calving interval (409.57 ± 5.83 d) which was found in 200 to <300 kg.

Body weight had significant ($P<0.05$) effect on age at puberty, age at first calving, post-partum heat period, days open and calving interval and had no significant ($P>0.05$) effect on service per conception (Table 12).

Table 11 Reproductive parameters of dairy cows of Rajshahi district by the different body weight groups.

Reproductive Parameters	Body weight			Grand Total
	<200 kg	200 to <300 kg	>300 kg	
Age at puberty (m)	27.37 ± 0.39^{a} (n=116)	26.47 ± 0.32^{ab} (n=259)	25.43 ± 0.44^{b} (n=125)	26.42 ± .22 (n=500)
Age at 1st calving (m)	$36.45 \pm .40^{a}$ (n=107)	35.53 ± 0.32^{ab} (n=251)	34.53 ± 0.42^{b} (n=124)	35.48 ± .22 (n=482)
Post-partum heat period (d)	136.14 ± 8.05^{a} (n=88)	127.29 ± 5.04^{a} (n=223)	101.44 ± 5.44^{b} (n=121)	121.85 ± 3.48 (n=432)
Service per conception	1.99 ± .07 (n=116)	1.93 ± .06 (n=259)	1.88 ± .09 (n=125)	1.93 ± .04 (n=500)
Days open (d)	150.15 ± 8.04^{a} (n=86)	142.56 ± 5.25^{a} (n=220)	115.80 ± 5.38^{b} (n=115)	136.80 ± 3.57 (n=421)
Calving interval (d)	409.20 ± 9.97^{a} (n=58)	409.57 ± 5.83^{a} (n=178)	382.78 ± 5.79^{b} (n=109)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 12 Analysis of variance (ANOVA) for the reproductive performances by various body weight groups of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	227.535	2	113.767	4.598	.001
	Within groups	12296.265	497	24.741		
Age at 1st calving (m)	Between groups	214.545	2	107.273	4.489	.012
	Within groups	11445.822	479	23.895		
Post-partum heat period (d)	Between groups	74966.068	2	37483.034	7.354	.001
	Within groups	2186551.034	429	5096.856		
Service per conception	Between groups	.746	2	.373	.362	.696
	Within groups	512.076	497	1.030		
Days open (d)	Between groups	73311.093	2	36655.547	7.023	.001
	Within groups	2181724.935	418	5219.438		
Calving interval (d)	Between groups	53136.948	2	26568.474	5.064	.007
	Within groups	1794445.215	342	5246.916		

D.F= Degree of freedom, F= Factorial value, P= Probability value

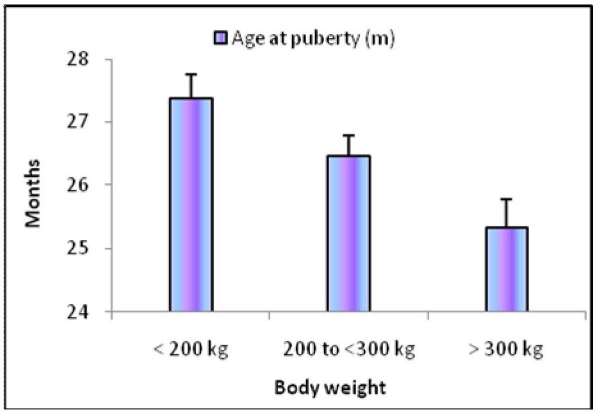


Figure 29 Reproductive performance of age at puberty of dairy cows among body weight groups.

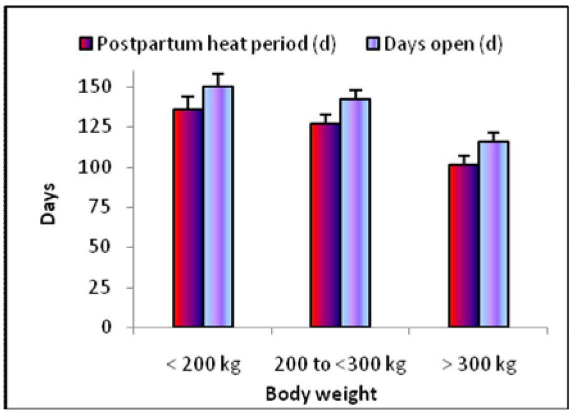


Figure 30 Graphical representation of post-partum heat period and days open of dairy cows in different body weight groups.

4.1.1.7 The effects of body condition score on reproductive performance of dairy cows

The effects of body condition score on reproductive performance of dairy cows are presented in Table 13 and Figure 31 & 32. Effect of good type of body condition resulted the lower value of all reproductive traits of age at puberty (25.54 ± 0.31 m), age at first calving (34.64 ± 0.31 m), post-partum heat period (108.76 ± 3.71 d), service per conception (1.76 ± 0.06), days open (124.58 ± 3.88 d) and calving interval (392.18 ± 4.18 d) were found in good body condition of cows and the higher value of almost reproductive traits of age at puberty (28.77 ± 0.33 m), age at first calving (37.70 ± 0.35 m), post-partum heat period (143.62 ± 8.52 d), days open (154.96 ± 8.68 d) and calving interval (415.73 ± 10.25 d) were found in poor body condition of cows except service per conception (2.15 ± 0.09) which was found in medium body condition of cows.

Body condition score had significant ($P<0.05$) effect on age at puberty, age at first calving, post-partum heat period, service per conception, days open and calving interval (Table 14).

Table 13 Effect of body condition score (BCS) on reproductive parameters of dairy cows of Rajshahi district.

Reproductive Parameters	Body condition score (BCS)			Grand Total
	Poor	Medium	Good	
Age at puberty (m)	28.77 ± 0.33^{a} (n=108)	26.29 ± 0.47^{b} (n=120)	25.54 ± 0.31^{b} (n=272)	26.42 ± .22 (n=500)
Age at 1st calving (m)	$37.70 \pm .35^{a}$ (n=105)	35.36 ± 0.48^{b} (n=114)	34.64 ± 0.31^{b} (n=263)	35.48 ± .22 (n=482)
Post-partum heat period (d)	143.62 ± 8.52^{a} (n=93)	132.19 ± 8.61^{a} (n=103)	108.76 ± 3.71^{b} (n=236)	121.85 ± 3.48 (n=432)
Service per conception	$2.11 \pm .09^{a}$ (n=108)	$2.15 \pm .09^{a}$ (n=120)	$1.76 \pm .06^{b}$ (n=272)	1.93 ± .04 (n=500)
Days open (d)	154.96 ± 8.68^{a} (n=91)	147.69 ± 8.65^{a} (n=103)	124.58 ± 3.88^{b} (n=227)	136.80 ± 3.57 (n=421)
Calving interval (d)	415.73 ± 10.25^{a} (n=68)	410.40 ± 10.17^{ab} (n=80)	392.18 ± 4.18^{b} (n=197)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 14 Analysis of variance (ANOVA) of body condition score on reproductive performances of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	812.787	2	406.393	17.247	.000
	Within groups	11711.013	497	23.563		
Age at 1st calving (m)	Between groups	703.879	2	351.940	15.386	.000
	Within groups	10956.488	497	22.874		
Post-partum heat period (d)	Between groups	95506.975	2	47753.488	9.458	.000
	Within groups	2166010.127	429	5048.975		
Service per conception	Between groups	17.222	2	8.611	8.636	.000
	Within groups	495.600	497	.997		
Days open (d)	Between groups	76158.215	2	38079.108	7.305	.001
	Within groups	2178877.813	418	5212.626		
Calving interval (d)	Between groups	37148.306	2	18574.153	3.509	.031
	Within groups	1810433.857	342	5293.666		

D.F= Degree of freedom, F= Factorial value, P= Probability value

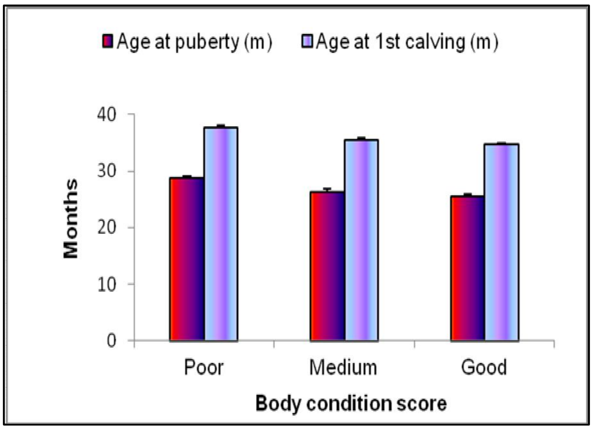


Figure 31 Reproductive performances of age at puberty and age at 1st calving of dairy cows among body condition score.

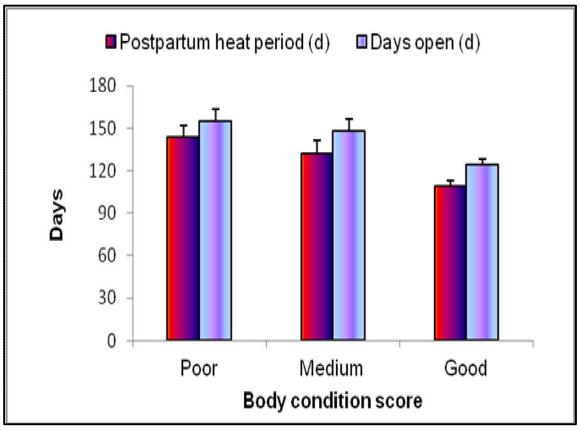


Figure 32 Graphical representation of post-partum heat period and days open of dairy cows between body condition score.

4.1.1.8 The effects of educational status of the owner on reproductive performance of dairy cows

The effects of educational status of the owner on reproductive performance of dairy cows are presented in Table 15 and Figure 33. The higher value of age at puberty (26.97 ± 0.35 m) and age at first calving (36.21 ± 0.34 m) were found in higher educational status, post-partum heat period (137.90 ± 6.91 d), service per conception (2.22 ± 0.06), days open (148.19 ± 6.82 d) and calving interval (413.48 ± 6.72 d) were in illiterate and the lower value of age at puberty (25.63 ± 0.52 m), age at first calving (34.68 ± 0.52 m) and days open (129.47 ± 8.81 d) were observed in secondary educational status and post-partum heat period (110.90 ± 5.28 d) and calving interval (393.21 ± 5.96 d) were found in higher educational status. The fewer number required of service per conception (1.81 ± 0.09) which was found in secondary educational status of the owners.

Educational status of the owner had significant ($P<0.05$) effect on age at first calving, post-partum heat period and service per conception and had no significant ($P>0.05$) effect on age at puberty, days open and calving interval (Table 16).

Table 15 Reproductive performances of dairy cows due to educational status of the owner at study area.

Reproductive Parameters	**Educational status of the owner**				**Grand Total**
	Illiterate	Primary	Secondary	Higher secondary	
Age at puberty (m)	26.90 ± 0.45 (n=123)	25.85 ± 0.49 (n=106)	25.63 ± 0.52 (n=112)	26.97 ± 0.35 (n=159)	26.42 ± .22 (n=500)
Age at 1st calving (m)	35.89 ± 0.46^{ab} (n=119)	34.80 ± 0.49^{b} (n=103)	34.68 ± 0.52^{b} (n=110)	36.21 ± 0.34^{a} (n=150)	35.48 ± .22 (n=482)
Post-partum heat period (d)	137.90 ± 6.91^{a} (n=104)	121.36 ± 7.06^{ab} (n=95)	120.29 ± 8.86^{ab} (n=99)	110.90 ± 5.28^{b} (n=134)	121.85 ± 3.48 (n=432)
Service per conception	$2.22 \pm .06^{a}$ (n=123)	$1.79 \pm .07^{b}$ (n=106)	$1.81 \pm .09^{b}$ (n=112)	$1.88 \pm .10^{b}$ (n=159)	1.93 ± .04 (n=500)
Days open (d)	148.19 ± 6.82 (n=103)	139.91 ± 7.45 (n=94)	129.47 ± 8.81 (n=99)	130.88 ± 5.69 (n=125)	136.80 ± 3.57 (n=421)
Calving interval (d)	413.48 ± 6.72 (n=86)	402.31 ± 8.63 (n=76)	396.44 ± 10.28 (n=83)	393.21 ± 5.96 (n=100)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 16 Analysis of variance (ANOVA) of educational status of the owner on reproductive performances of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	108.203	3	60.068	2.414	.066
	Within groups	12343.597	496	24.886		
Age at 1st calving (m)	Between groups	217.634	3	72.545	3.030	.029
	Within groups	11442.733	478	23.939		
Post-partum heat period (d)	Between groups	43123.714	3	14374.571	2.773	.041
	Within groups	2218393.388	428	5183.162		
Service per conception	Between groups	14.731	3	4.910	4.890	.002
	Within groups	498.091	496	1.004		
Days open (d)	Between groups	23965.474	3	7988.491	1.493	.216
	Within groups	2231070.555	417	5350.289		
Calving interval (d)	Between groups	21333.157	3	7111.052	1.328	.265
	Within groups	1826249.005	341	5355.569		

D.F= Degree of freedom, F= Factorial value, P= Probability value

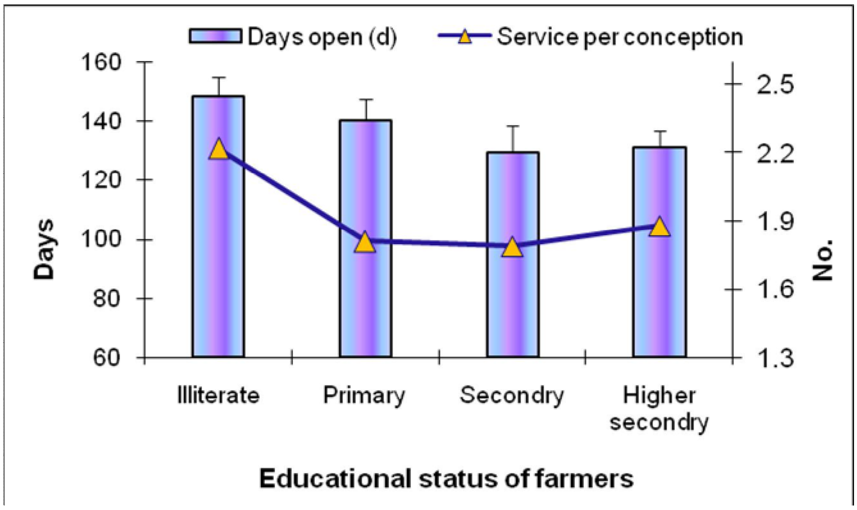


Figure 33 Reproductive performance of days open and service per conception of dairy cows among educational status of farmers in Rajshahi district.

4.1.1.9 The effects of farming experience of farmers on reproductive performance of dairy cows

The effects of farming experience of farmers on reproductive performance of dairy cows are presented in Table 17 and Figure 34. The lowest value of age at puberty (26.18 ± 0.27 m), age at first calving (35.19 ± 0.28 m), post-partum heat period (116.10 ± 4.20 d), service per conception (1.91 ± 0.06), days open (131.21 ± 4.34 d) and calving interval (393.87 ± 4.63 d) were found in vast farming experience of farmers and the highest value of age at puberty (26.93 ± 0.53 m), age at first calving (36.01 ± 0.52 m), post-partum heat period (131.50 ± 9.11 d), service per conception (1.99 ± 0.07) and days open (145.77 ± 8.95 d) were observed in none farming experience and the calving interval (411.67 ± 10.07 d) were found in little farming experience of farmers.

Farming experience of farmers had no significant (P>0.05) effect on age at puberty, age at first calving, post-partum heat period, days open, service per conception and calving interval (Table 18).

Table 17 Reproductive parameters of dairy cows of Rajshahi district by the farming experience of farmers.

Reproductive Parameters	Farming experience			Grand Total
	None	Little	Vast	
Age at puberty (m)	26.93 ± 0.53 (n=100)	26.61 ± 0.51 (n=99)	26.18 ± 0.27 (n=301)	26.42 ± .22 (n=500)
Age at 1st calving (m)	36.01 ± .52 (n=99)	35.81 ± 0.49 (n=95)	35.19 ± 0.28 (n=288)	35.48 ± .22 (n=482)
Post-partum heat period (d)	131.50 ± 9.11 (n=87)	129.11 ± 7.72 (n=88)	116.10 ± 4.20 (n=257)	121.85 ± 3.48 (n=432)
Service per conception	1.99 ± .07 (n=100)	1.94 ± .08 (n=99)	1.91 ± .06 (n=301)	1.93 ± .04 (n=500)
Days open (d)	145.77 ± 8.95 (n=86)	144.01 ± 8.14 (n=86)	131.21 ±4.34 (n=249)	136.80 ± 3.57 (n=421)
Calving interval (d)	411.45 ± 9.48 (n=73)	411.67 ± 10.07 (n=67)	393.87 ± 4.63 (n=205)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days, none=<1 year, little=1 to 5 years, vast=>5 years.

Table 18 Analysis of variance (ANOVA) of farming experiences on the reproductive parameters of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	46.294	2	23.147	.922	.398
	Within groups	12477.506	497	25.106		
Age at 1st calving (m)	Between groups	61.677	2	30.838	1.274	.281
	Within groups	11598.690	479	24.214		
Post-partum heat period (d)	Between groups	21236.328	2	10618.164	2.033	.132
	Within groups	2240280.774	429	5222.100		
Service per conception	Between groups	.506	2	.253	.246	.782
	Within groups	512.316	497	1.031		
Days open (d)	Between groups	19167.949	2	9583.974	1.792	.168
	Within groups	2235868.080	418	5348.967		
Calving interval (d)	Between groups	26016.602	2	13008.301	2.442	.088
	Within groups	1821565.561	342	5326.215		

D.F= Degree of freedom, F= Factorial value, P= Probability value

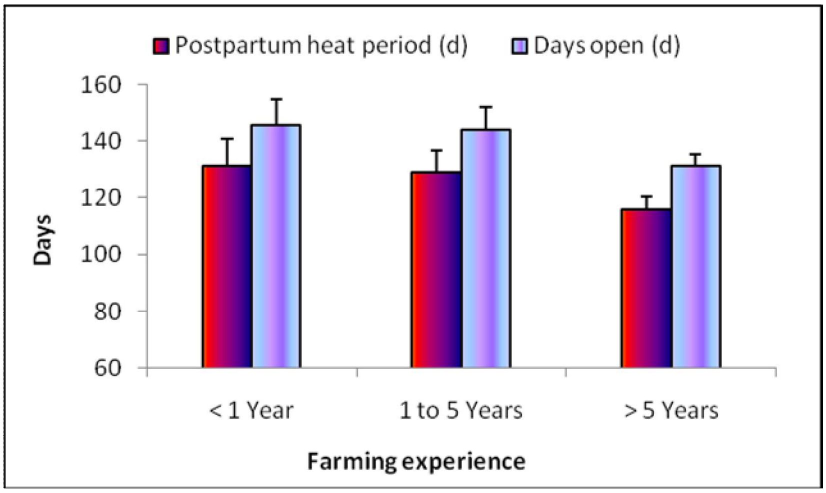


Figure 34 Reproductive performance of postpartum heat period and days open of dairy cows among farming experience in Rajshahi district.

4.1.1.10 The effects of farm size on reproductive performance of dairy cows

The effects of farm size on reproductive performance of dairy cows are presented in Table 19 and Figure 35. The highest value of age at puberty (27.42 ± 0.34 m) and age at first calving (36.51 ± 0.34 m) were found in large size of farm and post-partum heat period (134.56 ± 6.58 d), service per conception (1.98 ± 0.06), days open (146.73 ± 6.65 d) and calving interval (413.90 ± 7.57 d) were found in small size of farm. The lowest value of age at puberty (25.56 ± 0.36 m) and age at first calving (34.59 ± 0.36 m) were found in small size of farm and post-partum heat period (108.39 ± 4.66 d), service per conception (1.89 ± 0.09) and days open (128.66 ± 5.24 d) were observed in large size of farm and the calving interval (392.38 ± 6.23 d) were found in medium size f farm.

Farm size had significant ($P<0.05$) effect on age at puberty, age at first calving, post-partum heat period and calving interval and no significant ($P>0.05$) effect on service per conception and days open (Table 20).

Table 19 Reproductive characteristics of dairy cows of Rajshahi district among the different farm size.

Reproductive Parameters	Farm size			Grand Total
	Small	Medium	Large	
Age at puberty (m)	25.56 ± 0.36^{b} (n=191)	26.33 ± 0.46^{b} (n=134)	27.42 ± 0.34^{a} (n=175)	26.42 ± 0.22 (n=500)
Age at 1st calving (m)	34.59 ± 0.36^{b} (n=185)	35.43 ± 0.45^{ab} (n=131)	36.51 ± 0.34^{a} (n=166)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	134.56 ± 6.58^{a} (n=164)	121.42 ± 6.40^{ab} (n=117)	108.39 ± 4.66^{b} (n=151)	121.85 ± 3.48 (n=432)
Service per conception	1.98 ± 0.06 (n=191)	1.90 ± 0.07 (n=134)	1.89 ± 0.09 (n=175)	1.93 ± 0.04 (n=500)
Days open (d)	146.73 ± 6.65 (n=159)	133.40 ± 6.30 (n=117)	128.66 ±5.24 (n=145)	136.80 ± 3.57 (n=421)
Calving interval (d)	413.90 ± 7.57^{a} (n=132)	392.38 ± 6.23^{b} (n=93)	393.62 ± 5.84^{b} (n=120)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days, small=1 to 5, medium=6 to 10, large=more than 10 no. of cow; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 20 Analysis of variance (ANOVA) of farm size on reproductive performances of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	318.146	2	159.073	6.477	.002
	Within groups	12205.654	497	24.559		
Age at 1st calving (m)	Between groups	322.098	2	161.049	6.804	.001
	Within groups	11338.269	479	23.671		
Post-partum heat period (d)	Between groups	53872.132	2	26936.066	5.234	.006
	Within groups	2207644.970	429	5146.026		
Service per conception	Between groups	.956	2	.478	.464	.629
	Within groups	511.866	497	1.030		
Days open (d)	Between groups	26650.562	2	13325.281	2.500	.083
	Within groups	2228385.467	418	5331.066		
Calving interval (d)	Between groups	35396.253	2	17698.127	3.340	.037
	Within groups	1812185.909	342	5298.789		

D.F= Degree of freedom, F= Factorial value, P= Probability value

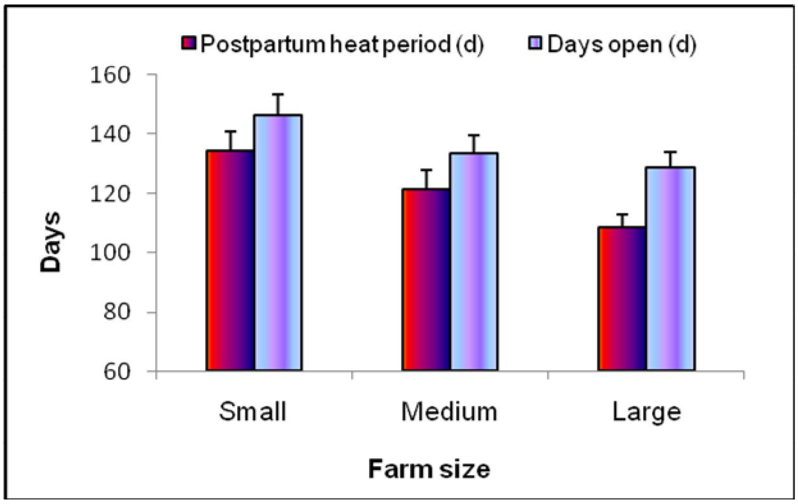


Figure 35 Reproductive performance of postpartum heat period and days open of dairy cows among farm size in Rajshahi district.

4.1.1.11 The effects of rearing system on reproductive performance of dairy cows

The effects of rearing system on reproductive performance of dairy cows are presented in Table 21 and Figure 36. The lowest value of age at puberty (26.06 ± 0.28 m), age at first calving (35.14 ± 0.29 m), service per conception (1.84 ± 0.05) and calving interval (399.85 ± 5.80 d) were found in intensive rearing system and post-partum heat period (120.08 ± 5.63 d) and days open (134.58 ± 5.93 d) were found semi-intensive rearing system and the highest value of age at puberty (26.81 ± 0.39 m) and service per conception (2.04 ± 0.08) were observed in semi-intensive, age at first calving (35.85 ± 0.65 m), post-partum heat period (126.18 ± 9.05 d), days open (140.19 ± 8.92 d) and the calving interval (406.72 ± 9.18 d) were observed in grazing on pasture land.

Rearing system had no significant (P>0.05) effect on age at puberty, age at first calving, post-partum heat period, days open, service per conception and calving interval (Table 22).

Table 21 The influences of rearing system in reproductive traits of dairy cows of Rajshahi district.

Reproductive Parameters	**Rearing system**			**Grand Total**
	Intensive	Semi-intensive	Grazing on pasture land	
Age at puberty (m)	26.06 ± 0.28 (n=256)	26.81 ± 0.39 (n=169)	26.74 ± 0.67 (n=75)	26.42 ± 0.22 (n=500)
Age at 1st calving (m)	35.14 ± 0.29 (n=244)	35.82 ± 0.39 (n=164)	35.85 ± 0.65 (n=74)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	121.81 ± 5.08 (n=216)	120.08 ± 5.63 (n=152)	126.18 ± 9.05 (n=64)	121.85 ± 3.48 (n=432)
Service per conception	1.84 ± 0.05 (n=256)	2.04 ± 0.08 (n=169)	1.98 ± 0.09 (n=75)	1.93 ± 0.04 (n=500)
Days open (d)	137.34 ± 5.17 (n=211)	134.58 ± 5.93 (n=147)	140.19 ±8.92 (n=63)	136.80 ± 3.57 (n=421)
Calving interval (d)	399.85 ± 5.80 (n=167)	400.13 ± 6.63 (n=123)	406.72 ± 9.18 (n=55)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, m=months, d=days, n=no. of observation

Table 22 Analysis of variance (ANOVA) of rearing system on reproductive performances of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	65.801	2	32.901	1.313	.270
	Within groups	12457.999	497	25.066		
Age at 1st calving (m)	Between groups	57.151	2	28.575	1.180	.308
	Within groups	11603.216	479	24.224		
Post-partum heat period (d)	Between groups	1677.505	2	838.753	.159	.853
	Within groups	2259839.596	429	5267.691		
Service per conception	Between groups	4.464	2	2.232	2.182	.114
	Within groups	508.358	497	1.023		
Days open (d)	Between groups	1507.196	2	753.598	.140	.870
	Within groups	2253528.833	418	5391.217		
Calving interval (d)	Between groups	2115.345	2	1057.673	.196	.822
	Within groups	1845466.817	342	5396.102		

D.F= Degree of freedom, F= Factorial value, P= Probability value

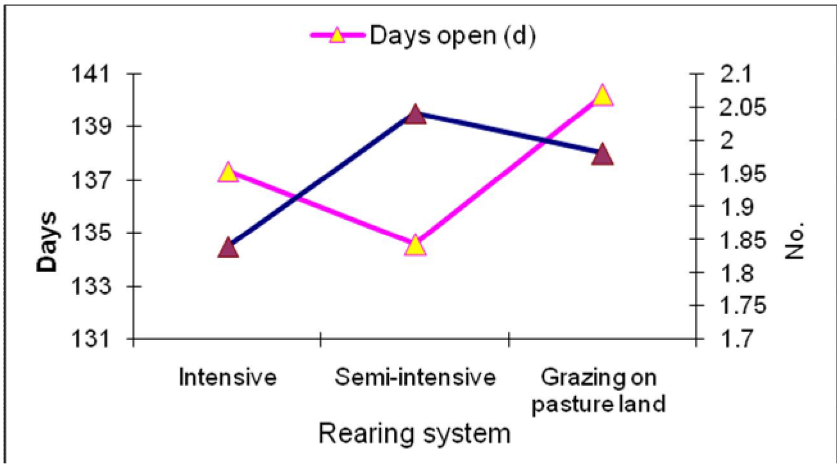


Figure 36 Reproductive performance of days open and service per conception of dairy cows in between rearing system.

4.1.1.12 Effects of geographical location of farm on reproductive performance of dairy cows

The effects of geographical location of farm on reproductive performance of dairy cows are presented in Table 23 and Figure 37. The highest value of age at puberty (26.91 ± 0.46 m), age at first calving (36.02 ± 0.45 m) and calving interval (404.55 ± 7.87 d) were found in rural type of farm, post-partum heat period (125.10 ± 5.59 d) was found in urban type of farm, service per conception (2.03 ± 0.09) and days open (138.66 ± 5.73 d) were found in semi-urban type of farm and the lowest value of age at puberty (25.80 ± 0.33 m) and age at first calving (34.90 ± 0.33 m) were observed in urban type of farm and post-partum heat period (117.55 ± 5.38 d) and the calving interval (397.89 ± 6.14 d) were observed in semi-urban type of farm, service per conception (1.87 ± 0.06) and days open (134.98 ± 7.19 d) were observed in rural type of farm.

Geographical location of farm had no significant ($P>0.05$) effect on age at puberty, age at first calving, post-partum heat period, days open, service per conception and calving interval (Table 24).

Table 23 Effect of geographical location of farm on reproductive parameters of dairy cows of Rajshahi district

Reproductive Parameters	Geographical location of farm			Grand Total
	Urban	Semi-urban	Rural	
Age at puberty (m)	25.80 ± 0.33 (n=209)	26.81 ± 0.38 (n=151)	26.91 ± 0.46 (n=140)	26.42 ± .22 (n=500)
Age at 1st calving (m)	34.90 ± .33 (n=204)	35.78 ± 0.39 (n=140)	36.02 ± 0.45 (n=138)	35.48 ± .22 (n=482)
Post-partum heat period (d)	125.10 ± 5.59 (n=185)	117.55 ± 5.38 (n=120)	121.19 ± 6.96 (n=127)	121.85 ± 3.48 (n=432)
Service per conception	1.89 ± 0.06 (n=209)	2.03 ± 0.09 (n=151)	1.87 ± 0.06 (n=140)	1.93 ± 0.04 (n=500)
Days open (d)	136.87 ± 5.58 (n=183)	138.66 ± 5.73 (n=114)	134.98 ±7.19 (n=124)	136.80 ± 3.57 (n=421)
Calving interval (d)	400.37 ± 6.13 (n=154)	397.89 ± 6.14 (n=85)	404.55 ± 7.87 (n=106)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days

Table 24 Analysis of variance (ANOVA) of geographical location of the farm on reproductive performances of cow of Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	137.064	2	68.532	2.750	.065
	Within groups	12386.736	497	24.923		
Age at 1st calving (m)	Between groups	121.681	2	60.841	2.526	.081
	Within groups	11538.686	479	24.089		
Post-partum heat period (d)	Between groups	4230.274	2	2115.137	.402	.669
	Within groups	2257286.827	429	5261.741		
Service per conception	Between groups	2.162	2	1.081	1.052	.350
	Within groups	510.660	497	1.027		
Days open (d)	Between groups	807.372	2	403.686	.075	.928
	Within groups	2254228.656	418	5392.892		
Calving interval (d)	Between groups	2219.799	2	1109.900	.206	.814
	Within groups	1845362.363	342	5395.796		

D.F= Degree of freedom, F= Factorial value, P= Probability value

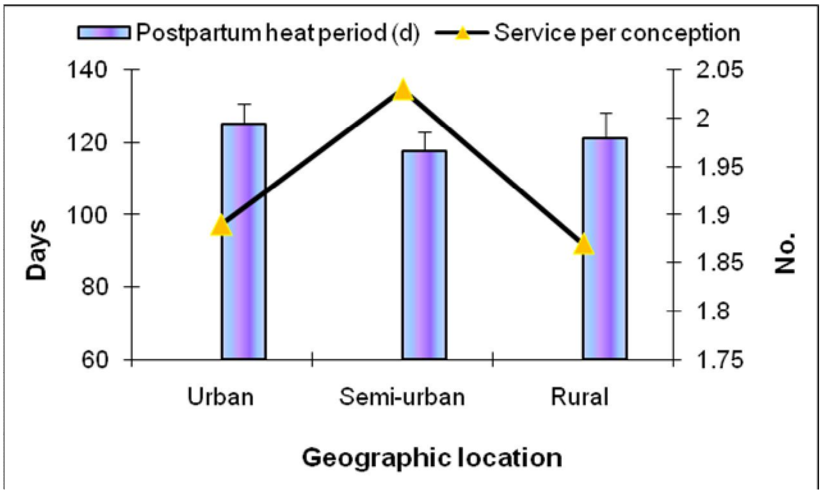


Figure 37 Reproductive performances of post-partum heat period and service per conception of dairy cows at geographical location of farm.

4.1.1.13 The effects of floor type on reproductive performance of dairy cows

The effects of floor type on reproductive performance of dairy cows are presented in Table 25 and Figure 38. The lowest value of age at puberty (26.07 ± 0.30 m), age at first calving (35.15 ± 0.30 m), post-partum heat period (117.67 ± 4.54 d), service per conception (1.75 ± 0.05), days open (131.42 ± 4.66 d) and calving interval (396.11 ± 5.11 d) were found in concrete type of floor and the highest value of age at puberty (27.31 ± 0.52 m), age at first calving (36.44 ± 0.52 m) and post-partum heat period (127.21 ± 7.48 d) were observed in muddy type of floor and service per conception (2.26 ± 0.10), days open (142.80 ± 7.69 d) and calving interval (406.58 ± 8.11 d) were observed in semi-concrete type of floor.

Floor type had significant ($P<0.05$) effect on age at puberty, age at first calving and service per conception and no significant ($P>0.05$) effect on post-partum heat period, days open and calving interval (Table 26).

Table 25 Effect of floor type on reproductive performances of dairy cows of Rajshahi district

Reproductive Parameters	Floor type			Grand Total
	Muddy	Semi-concrete	Concrete	
Age at puberty (m)	27.31 ± 0.52^{a} (n=113)	26.32 ± 0.39^{ab} (n=122)	26.07 ± 0.30^{b} (n=265)	26.42 ± 0.22 (n=500)
Age at 1st calving (m)	$36.44 \pm .52^{a}$ (n=109)	35.31 ± 0.40^{ab} (n=116)	35.15 ± 0.30^{b} (n=257)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	127.21 ± 7.48 (n=98)	125.74 ± 7.62 (n=108)	117.67 ± 4.54 (n=226)	121.85 ± 3.48 (n=432)
Service per conception	2.01 ± 0.08^{b} (n=113)	2.26 ± 0.10^{a} (n=122)	1.75 ± 0.05^{c} (n=265)	1.93 ± 0.04 (n=500)
Days open (d)	142.45 ± 7.71 (n=97)	142.80 ± 7.69 (n=105)	131.42 ±4.66 (n=219)	136.80 ± 3.57 (n=421)
Calving interval (d)	406.38 ± 8.96 (n=77)	406.58 ± 8.11 (n=87)	396.11 ± 5.18 (n=181)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b,c, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 26 Analysis of variance (ANOVA) on reproductive performances by different floor type of cow at Rajshahi district

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	123.048	2	61.524	2.466	.086
	Within groups	12400.752	497	24.951		
Age at 1st calving (m)	Between groups	130.903	2	65.451	2.719	.067
	Within groups	11529.464	479	24.070		
Post-partum heat period (d)	Between groups	8390.441	2	4195.220	.799	.451
	Within groups	2253126.661	429	5252.043		
Service per conception	Between groups	22.662	2	11.331	11.489	.000
	Within groups	490.160	497	.986		
Days open (d)	Between groups	13197.534	2	6598.767	1.230	.293
	Within groups	2241838.494	418	5363.250		
Calving interval (d)	Between groups	9268.184	2	4634.092	.862	.423
	Within groups	1838313.979	342	5375.187		

D.F= Degree of freedom, F= Factorial value, P= Probability value

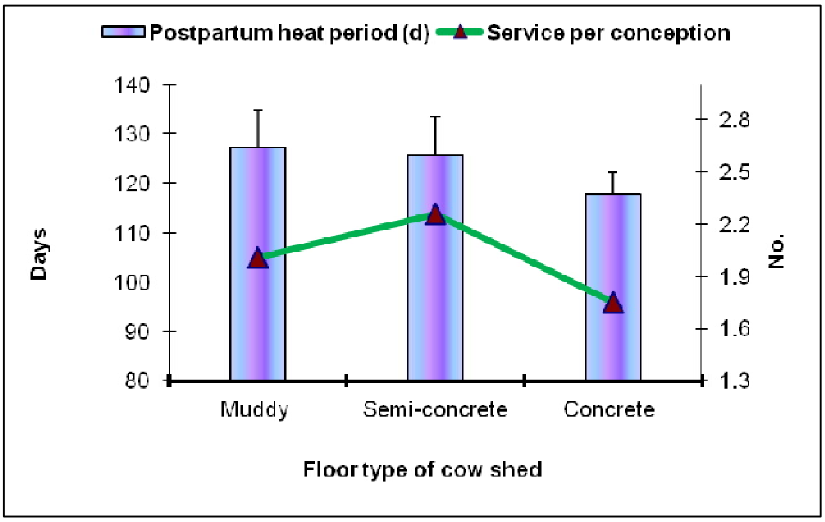


Figure 38 Reproductive performances of post-partum heat period and service per conception of dairy cows among floor type.

4.1.1.14 The effects of ventilation system on reproductive performance of dairy cows

The effects of ventilation system on reproductive performance of dairy cows are presented in Table 27 and Figure 39. The highest value of age at puberty (27.47 ± 0.58 m), age at first calving (36.54 ± 0.57 m), post-partum heat period (133.15 ± 7.85 d), service per conception (2.16 ± 0.09), days open (148.32 ± 8.16 d) and calving interval (412.41 ± 9.10 d) were found in poor type of ventilation and the lowest value of age at puberty (26.16 ± 0.39 m) was found in medium, age at first calving (35.17 ± 0.29 m), post-partum heat period (113.77 ± 4.62 d), service per conception (1.86 ± 0.07), days open (133.59 ± 4.84 d) and calving interval (396.25 ± 4.95 d) were observed in good type of ventilation.

Ventilation system had significant ($P<0.05$) effect on age at puberty, age at first calving, post-partum heat period and service per conception and no significant ($P>0.05$) effect on days open and calving interval (Table 28).

Table 27 Effect of ventilation system on reproductive parameters of dairy cows of Rajshahi district

Reproductive Parameters	Ventilation System			Grand Total
	Poor	Medium	Good	
Age at puberty (m)	27.47 ± 0.58^{a} (n=93)	26.16 ± 0.39^{b} (n=177)	26.19 ± 0.29^{b} (n=230)	26.42 ± 0.22 (n=500)
Age at 1^{st} calving (m)	$36.54 \pm .57^{a}$ (n=92)	35.30 ± 0.39^{b} (n=171)	35.17 ± 0.29^{b} (n=219)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	133.15 ± 7.85^{a} (n=78)	126.30 ± 6.50^{ab} (n=158)	113.77 ± 4.62^{b} (n=196)	121.85 ± 3.48 (n=432)
Service per conception	2.16 ± 0.09^{a} (n=93)	1.90 ± 0.07^{b} (n=177)	1.86 ± 0.07^{b} (n=230)	1.93 ± 0.04 (n=500)
Days open (d)	148.32 ± 8.16 (n=78)	134.90 ± 6.51 (n=155)	133.59 ±4.84 (n=188)	136.80 ± 3.57 (n=421)
Calving interval (d)	412.41 ± 9.10 (n=63)	401.22 ± 7.57 (n=128)	396.25 ± 4.95 (n=154)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 28 Analysis of variance (ANOVA) of ventilation system on reproductive performances of cow at Rajshahi district

Reproductive performances	**Sources of variation**	**Sum of square**	**D.F**	**Mean square**	**F-value**	**P-value**
Age at puberty (m)	Between groups	126.786	2	63.393	2.541	.080
	Within groups	12397.014	497	24.944		
Age at 1st calving (m)	Between groups	129.562	2	64.781	2.691	.069
	Within groups	11530.806	479	24.073		
Post-partum heat period (d)	Between groups	25879.408	2	12939.704	2.483	.085
	Within groups	2235637.694	429	5211.277		
Service per conception	Between groups	6.052	2	3.026	2.968	.052
	Within groups	506.770	497	1.020		
Days open (d)	Between groups	12840.216	2	6420.108	1.197	.303
	Within groups	2242195.812	418	5364.105		
Calving interval (d)	Between groups	11681.339	2	5840.670	1.088	.338
	Within groups	1835900.823	342	5368.131		

D.F= Degree of freedom, F= Factorial value, P= Probability value

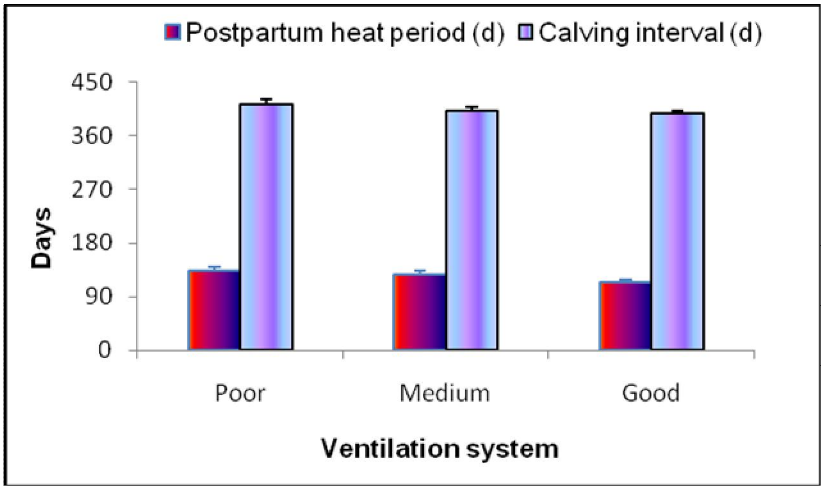


Figure 39 Reproductive performance of post-partum heat period and calving interval of dairy cows among ventilation system.

4.1.1.15 The effects of feed quality on reproductive performance of dairy cows

The variation in the reproductive traits following feeding quality of feeds of dairy cows are presented in Table 29 and Figure 40. The effect of good quality feed resulted in the minimum value of age at puberty (26.07 ± 0.31 m), age at first calving (35.18 ± 0.31 m), post-partum heat period (110.63 ± 4.60 d), service per conception (1.85 ± 0.07), days open (127.34 ± 4.88 d) and calving interval (391.15 ± 5.42 d) were obtained in good type of feed and the maximum value of age at puberty (27.25 ± 0.53 m), age at first calving (36.28 ± 0.52 m), post-partum heat period (136.30 ± 9.52 d), service per conception (2.19 ± 0.10), days open (148.87 ± 9.70 d) and calving interval (415.02 ± 10.72 d) were obtained in poor type of feed.

Feed quality had significant ($P<0.05$) effect on post-partum heat period, service per conception, days open and calving interval and no significant ($P>0.05$) effect on age at puberty and age at first calving (Table 30).

Table 29 The comparative study of reproductive performances of dairy cows of Rajshahi district among the feed quality

Reproductive Parameters	Feed quality			Grand Total
	Poor	Medium	Good	
Age at puberty (m)	27.25 ± 0.53 (n=99)	26.40 ± 0.39 (n=168)	26.07 ± 0.31 (n=233)	26.42 ± 0.22 (n=500)
Age at 1st calving (m)	36.28 ± .52 (n=97)	35.40 ± 0.39 (n=162)	35.18 ± 0.31 (n=223)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	136.30 ± 9.52^{a} (n=82)	129.29 ± 5.86^{a} (n=147)	110.63 ± 4.60^{b} (n=203)	121.85 ± 3.48 (n=432)
Service per conception	2.19 ± 0.10^{a} (n=99)	1.89 ± 0.07^{b} (n=168)	1.85 ± 0.07^{b} (n=233)	1.93 ± 0.04 (n=500)
Days open (d)	148.87 ± 9.70^{a} (n=82)	142.64 ± 5.79^{ab} (n=145)	127.34 ±4.88^{b} (n=194)	136.80 ± 3.57 (n=421)
Calving interval (d)	415.02 ± 10.72^{a} (n=70)	406.43 ± 6.23^{ab} (n=114)	391.15 ± 5.42^{b} (n=161)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 30 Analysis of variance (ANOVA) of feed quality on reproductive performances of cow of Rajshahi district

Reproductive performances	**Sources of variation**	**Sum of square**	**D.F**	**Mean square**	**F-value**	**P-value**
Age at puberty (m)	Between groups	96.027	2	48.014	1.920	.148
	Within groups	12427.773	497	25.006		
Age at 1st calving (m)	Between groups	83.249	2	41.624	1.722	.180
	Within groups	11577.118	479	24.169		
Post-partum heat period (d)	Between groups	50806.277	2	25403.139	4.930	.008
	Within groups	2210710.824	429	5153.172		
Service per conception	Between groups	8.358	2	4.179	4.117	.017
	Within groups	504.464	497	1.015		
Days open (d)	Between groups	34270.350	2	17135.175	3.225	.041
	Within groups	2220765.679	418	5312.837		
Calving interval (d)	Between groups	32751.031	2	16375.516	3.086	.047
	Within groups	1814831.131	342	5306.524		

D.F= Degree of freedom, F= Factorial value, P= Probability value

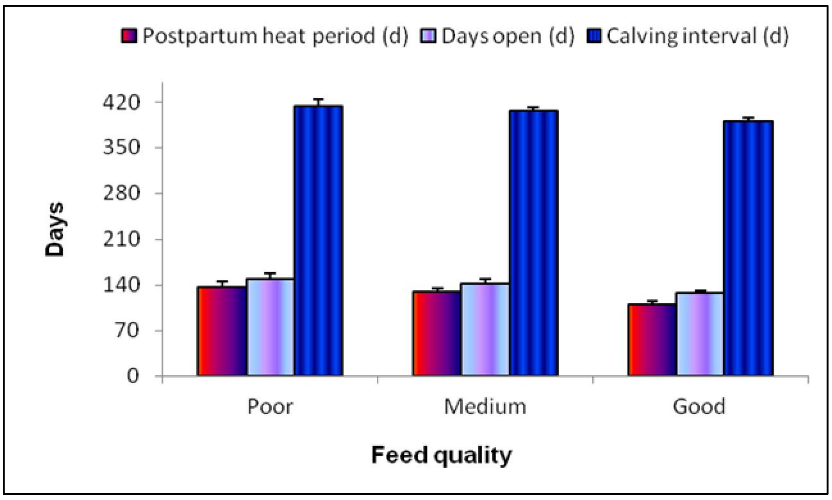


Figure 40 Reproductive performance of post-partum heat period, days open and calving interval of dairy cows among feed quality.

4.1.1.16 The effects of preventive measure on reproductive performance of dairy cows

The effects of preventive measure on reproductive performance of dairy cows are presented in Table 31 and Figure 41. The maximum value of age at puberty (27.92 ± 0.58 m), age at first calving (36.92 ± 0.58 m), post-partum heat period (133.48 ± 7.74 d), service per conception (2.01 ± 0.09), days open (150.35 ± 8.25 d) and calving interval (423.77 ± 9.98 d) were found in traditional healer and the minimum value of age at puberty (25.98 ± 0.39 m), age at first calving (35.05 ± 0.37 m), post-partum heat period (118.44 ± 4.55 d), service per conception (1.90 ± 0.06), days open (132.62 ± 4.65 d) and calving interval (394.93 ± 5.01 d) were found in veterinarian.

Preventive measure had significant ($P<0.05$) effect on age at puberty, age at first calving and calving interval and no significant ($P>0.05$) effect on post-partum heat period, service per conception and days open (Table 32).

Table 31 Reproductive parameters of dairy cows of Rajshahi district by the preventive measure

Reproductive Parameters	Preventive measure			Grand Total
	Veterinarian	Quack	Traditional healer	
Age at puberty (m)	25.98 ± 0.39^b (n=251)	26.21 ± 0.30^b (n=165)	27.92 ± 0.58^a (n=84)	26.42 ± 0.22 (n=500)
Age at 1^{st} calving (m)	35.05 ± 0.37^b (n=238)	$35.27 \pm .31^b$ (n=160)	36.92 ± 0.58^a (n=84)	35.48 ± 0.22 (n=482)
Post-partum heat period (d)	118.44 ± 4.55 (n=217)	121.00 ± 6.94 (n=141)	133.48 ± 7.74 (n=74)	121.85 ± 3.48 (n=432)
Service per conception	1.90 ± 0.06 (n=251)	1.93 ± 0.07 (n=165)	2.01 ± 0.09 (n=84)	1.93 ± 0.04 (n=500)
Days open (d)	132.62 ± 4.65 (n=207)	135.92 ± 6.95 (n=141)	150.35 ±8.25 (n=73)	136.80 ± 3.57 (n=421)
Calving interval (d)	394.93 ± 5.01^b (n=172)	398.95 ± 7.51^b (n=116)	423.77 ± 9.98^a (n=57)	401.04 ± 3.94 (n=345)

The values are Mean ± SE, SE=Standard Error of Mean, n=no. of observation, m=months, d=days; a,b, Mean ± SE with different superscript letters in the same row differs significantly with each others ($P<0.05$).

Table 32 Analysis of variance (ANOVA) of preventive measure on reproductive performances of cow at Rajshahi district.

Reproductive performances	Sources of variation	Sum of square	D.F	Mean square	F-value	P-value
Age at puberty (m)	Between groups	231.211	2	115.605	4.674	.010
	Within groups	12292.589	497	24.734		
Age at 1st calving (m)	Between groups	213.561	2	106.780	4.468	.012
	Within groups	11446.807	479	23.897		
Post-partum heat period (d)	Between groups	12640.093	2	6320.046	1.206	.301
	Within groups	2248877.009	429	5242.138		
Service per conception	Between groups	.735	2	.367	.357	.700
	Within groups	512.087	497	1.030		
Days open (d)	Between groups	17133.389	2	8566.695	1.600	.203
	Within groups	2237902.639	418	5353.834		
Calving interval (d)	Between groups	36378.180	2	18189.090	3.435	.033
	Within groups	1811203.982	342	5295.918		

D.F= Degree of freedom, F= Factorial value, P= Probability value

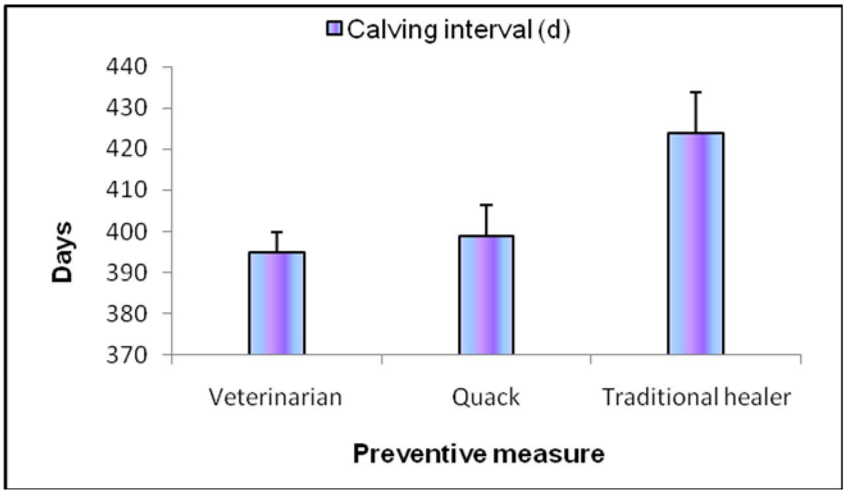


Figure 41 Reproductive performance of calving interval of dairy cows among preventive measure.

4.1.1.17 The effects of breeding methods on reproductive performance of dairy cows

The effects of breeding methods on reproductive performance of dairy cows are presented in Table 33 and Figure 42. The lower value of age at puberty (25.87 ± 0.25 m), age at first calving (34.95 ± 0.25 m), post-partum heat period (120.20 ± 4.06 d), service per conception (1.93 ± 0.05), days open (132.82 ± 4.08 d) and calving interval (395.84 ± 4.44 d) were observed in artificial insemination of cows and the higher value of age at puberty (28.30 ± 0.44 m), age at first calving (37.26 ± 0.45 m), post partum heat period (127.35 ± 6.66 d), service per conception (1.93 ± 0.09), days open (150.10 ± 7.24 d) and calving interval (418.56 ± 8.26 d) were observed in natural services of cows. There were significant effect ($P<0.05$) of breeding methods on age at puberty, age at first calving and calving interval and the remaining traits were not significant.

Table 33 Effect of breeding methods on reproductive parameters of dairy cows of Rajshahi district

Reproductive Parameters	Breeding methods		Grand Total	Chi Square	C.V	T.V	D.F	Significance
	Natural service	Artificial insemination						
Age at puberty (m)	28.30±0.44 (n=112)	25.87 ± 0.25 (n=388)	26.42±0.22 (n=500)	χ^2	43.63	41.33	28	*
Age at 1st calving (m)	37.26 ± 0.45 (n=110)	34.95 ± 0.25 (n=372)	35.48 ± 0.22 (n=482)		40.68	38.89	26	*
Post-partum heat period (d)	127.35 ±6.66 (n=100)	120.20±4.06 (n=332)	121.85±3.48 (n=432)		38.41	52.19	37	NS
Service per conception	1.93 ± 0.09 (n=112)	1.93 ± 0.05 (n=388)	1.93 ± 0.04 (n=500)		0.610	11.07	5	NS
Days open (d)	150.10 ±7.24 (n=97)	132.82±4.08 (n=324)	136.80±3.57 (n=421)		96.80	108.64	86	NS
Calving interval (d)	418.56 ±8.26 (n=79)	395.84±4.44 (n=266)	401.04±3.94 (n=345)		89.73	88.25	68	*

χ^2 =Chi-Square, m=months, d=days, n=no. of observation, C.V= Calculated value, T.V= Tabulated value, D.F= Degree of freedom, NS=Non-significance, * ($P<0.05$).

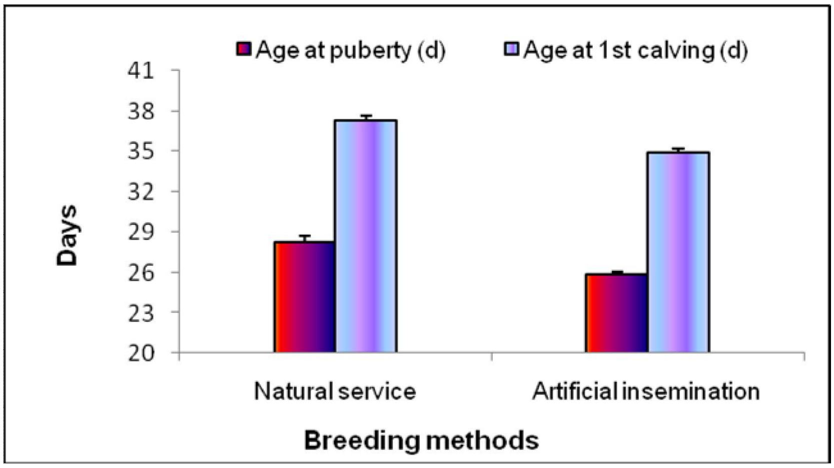


Figure 42 Reproductive performances of age at puberty and age at 1st calving of dairy cows among treatment pattern.

4.1.2 Factors influencing the reproductive disorders of dairy cows

4.1.2.1 Overall reproductive status of dairy cows

The overall reproductive statuses of dairy cows at study area are presented in Table 34 and Figure 43. The total numbers of cows affected with different reproductive and productive diseases are 393 (78.6%) and non affected cows are 107 (21.4%).

Table 34 Overall reproductive statuses of dairy cows in Rajshahi district

Cow status	No. of animal	% of cases
Non-affected cows	107	21.4%
Reproductive diseases affected cows	393	78.6%
Grand Total	500	100

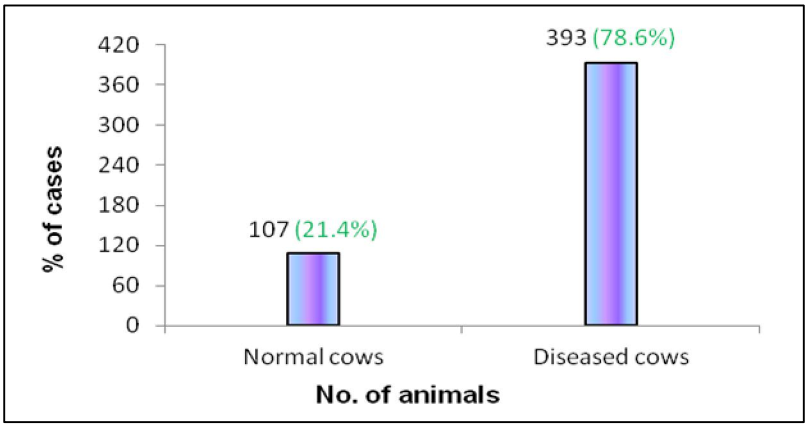


Figure 43 Reproductive statuses of dairy cows in Rajshahi district.

4.1.2.2 The prevalence of various reproductive disorders of dairy cows at study area

The prevalence of various reproductive disorders of dairy cows has been summarized in Table 35 and Figure 44. Five hundred cows were examined clinically, which led the diagnosis of abortion (13.4%), retained placenta (10.2%), dystocia (5.4%), vaginal prolapse (2.4%), uterine prolapse (1.4%), metritis (1.6%), pyometra (1.8%), still birth (0.8%), anoestrus (24.6%), repeat breeding (11.4%), mastitis (4.4%) and milk fever (1.2%).

❖ **Abortion**

Abortion was recorded in 13.4% cases. It was the second highest incidence in this study. Both early and late abortion was observed (Photograph 3 & 4).

❖ **Retained placenta**

Retained placenta was observed in 10.2% cases. A portion of the fetal membrane was hanging from the vulva 12 hours or more after calving (Photograph 5).

❖ **Dystocia**

Dystocia were recorded in (5.4%) cases. These were mainly due to fetal and maternal causes (Photograph 6).

❖ **Vaginal prolapsed**

Out of 500 cases 2.4% cows were suffering from vaginal prolapse. Prolapsed vagina was observed by naked eyes especially when the animal was in lying condition.

❖ **Uterine prolapse**

Uterine prolapse was recorded in 1.4% cases. It was mostly found immediately after parturition (Photograph 7).

❖ **Metritis**

Inflammation of the uterus, generally caused by infections. Cows normally have a red to brown discharge during the first 2 weeks after calving, usually cloudy discharge was found. 1.6% cases of cows suffering from metritis in this study.

❖ **Pyometra**

1.8% cases of pyometra were recorded in this study. There was present of CL in every cases and expulsion of pus during rectal palpation. The amount of pus varied according to the severity of the case.

❖ **Still birth**

0.8% cases of still birth were recorded out of 500 cases in this study.

❖ **Anoestrus**

Anoestrus were recorded 24.6% cases of cows. It was the highest incidence in this study. Lack of expression of the estrus at an expected time is called anoestrus. Clinically, if a heifer is 18 or more months old or a cow has passed 60-70 days post-partum but did not show estrus the condition is referred to as anoestrus.

❖ **Repeat breeding**

11.4% cases of cows showing repeat breeding syndrome. It was the second highest incidence in this study. The animals those have no abnormality was detected in the reproductive organs but no conception occurs after three or more consecutive services with proven semen or with a fertile bull.

❖ **Mastitis**

Mastitis was recorded in 4.4% cases of cows in this study. It is the inflammation of mammary gland. Mammary gland usually appeared hard to touch and swollen and also change the composition of milk (Photograph 8).

❖ **Milk fever**

Milk fever was recorded in 1.2% cases of cows in this study.

Table 35 Prevalence of various reproductive disortders of dairy cows in Rajshahi district (n=500).

Name of reproductive disorders	**No. of cases**	**% of cases on the basis of population**	**% of cases on the basis of diseases**
Abortion	67	13.4	17.04
Retained placenta	51	10.2	12.97
Dystocia	27	5.4	6.87
Vaginal prolapse	12	2.4	3.06
Uterine prolapse	7	1.4	1.79
Metritis	8	1.6	2.04
Pyometra	9	1.8	2.30
Still birth	4	0.8	1.02
Anoestrus	123	24.6	31.30
Repeat breeding	57	11.4	14.50
Mastitis	22	4.4	5.60
Milk fever	6	1.2	1.52
Grand Total	393	78.6	100.00

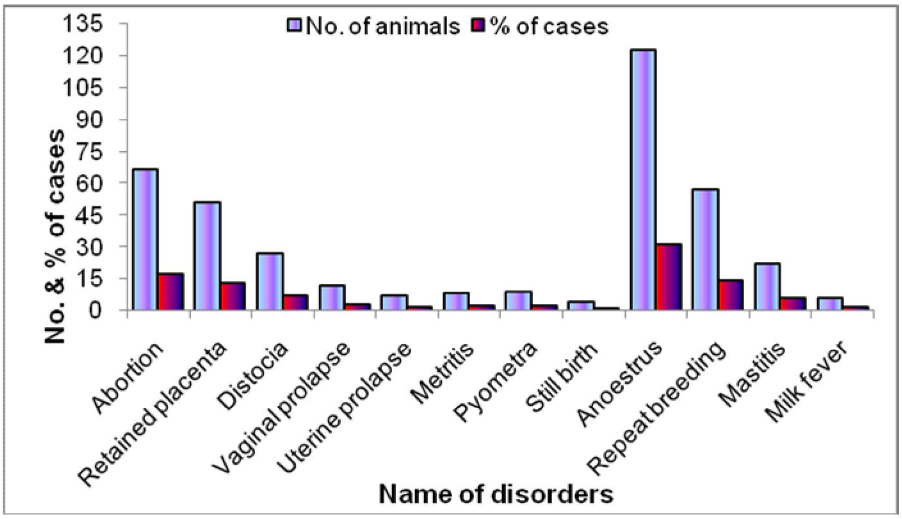
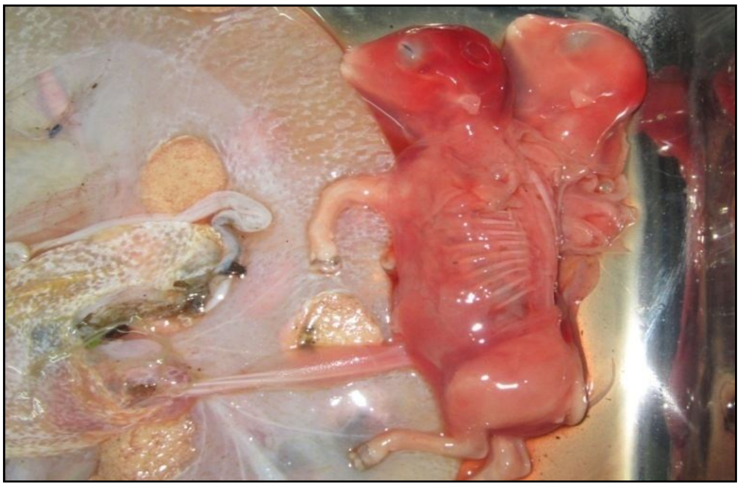


Figure 44 Prevalence of different reproductive disorders of dairy cows in Rajshahi district.



Photograph 3 Three months abortion in cross bred cow.

Photograph 4 Eight months abortion in cross bred cow.

Photograph 5 Retained placenta in cross bred cow.

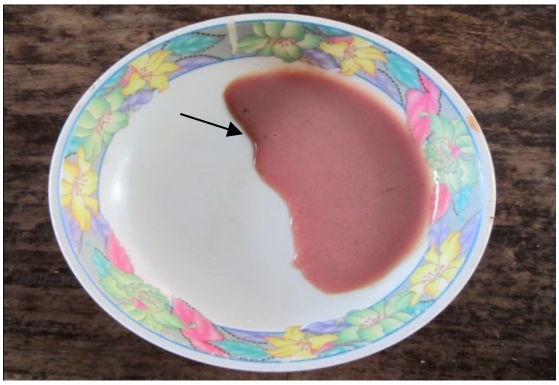
Photograph 6 Dystocia in cross bred in cow.

Photograph 7 Uterine prolapsed in cow.

A After recovery of mastitis in cow, one butt is atrophied

B Hind quarter of mammary gland and one butt is very hard in cow

C Mastitis in one butt cross bred cow



D Changes of milk in mastitis affected cow

Photograph 8 (A-D) Mastitis in cows.

4.1.2.3 The prevalence of reproductive disorders of dairy cows in different upazilas and metro thanas

The prevalence of reproductive disorders of dairy cows in different Upazilas and Metro thanas have been summarized in Table 36. The prevalence of reproductive disorders was higher in Tanor upazila (9.2%) followed by Motihar (8.4%), Godagari (8.4%), Puthia (8.2%), Mohanpur (8%), Rajpara (7.8%), Boalia (7.8%), Charghat (7.6%), Shahmukdhom (7.0%), and lower in Poba upazila (6.2%).

Table 36 Prevalence of reproductive disorders of dairy cows in different Upazilas and Metro thanas of Rajshahi district (n=500).

Name of reproductive disorders	**Name of Upazilas and Metro thanas**										**Total**	**% of cases**
	Charghat	Puthia	Poba	Godagari	Tanore	Mohanpur	Motihar	Boalia	Rajpara	Shahmukdhom		
Abortion	8	4	10	2	5	4	12	5	12	5	67	13.4
Retained placenta	7	7	3	3	4	5	8	7	4	3	51	10.2
Dystocia	2	0	3	1	3	4	4	3	5	2	27	5.4
Vaginal prolapsed	1	1	2	0	1	1	2	1	3	0	12	2.4
Uterine prolapsed	0	0	2	1	1	0	0	1	1	1	7	1.4
Metritis	1	1	2	1	1	0	1	0	0	1	8	1.6
Pyometra	0	0	0	0	3	3	2	1	0	0	9	1.8
Still birth	1	0	0	0	1	1	0	1	0	0	4	0.8
Anoestrus	9	15	4	27	13	14	7	14	5	14	123	24.6
Repeat breeding	9	10	5	5	8	3	4	3	5	6	57	11.4
Mastitis	0	2	0	2	5	4	2	2	3	2	22	4.4
Milk fever	0	1	0	0	1	1	0	1	1	1	6	1.2
Grand Total	38(7.6%)	41(8.2%)	31(6.2)	42(8.4%)	46(9.2%)	40 (8%)	42(8.4%)	39(7.8%)	39(7.8%)	35 (7.0%)	393	78.6

4.1.2.4 The prevalence of reproductive disorders of dairy cows in between upazilas and metro thanas

The prevalence of reproductive disorders of dairy cows in between upazilas and metro thanas has been summarized in Table 37 and Figure 45. The prevalence of reproductive disorders was higher in upazila (47.6%) and lower in metro thana (31%). In upazila, abortion (7%), retained placenta (5.8%), dystocia (2.6%), vaginal prolapse (1.2%), uterine prolapse (0.8%), metritis (1%), pyometra (1.2%), still birth (0.6%), anoestrus (16.4%), repeat breeding (7.8%), mastitis (2.6%), milk fever (0.6%) and in metro thana, abortion (6.4%), retained placenta (4.4%), dystocia (2.8%), vaginal prolapse (1.2%), uterine prolapse (0.6%), metritis (0.6%), pyometra (0.6%), still birth (0.2%), anaestrus (8.2%), repeat breeding (3.6%), mastitis (1.8%) and milk fever (0.6%) reproductive cases were recorded.

Table 37 Prevalence of reproductive disorders between Upazilas and Metro thanas in dairy cows of Rajshahi district (n=500).

Name of reproductive disorders	**Name of Upazilas and Metro thanas**		**Total**	**% of cases**
	Upazila	Metro thana		
Abortion	35 (7%)	32 (6.4%)	67	13.4
Retained placenta	29 (5.8%)	22 (4.4%)	51	10.2
Dystocia	13 (2.6%)	14 (2.8%)	27	5.4
Vaginal prolapse	6 (1.2%)	6 (1.2%)	12	2.4
Uterine prolapse	4 (0.8%)	3 (0.6%)	7	1.4
Metritis	5 (1%)	3 (0.6%)	8	1.6
Pyometra	6 (1.2%)	3 (0.6%)	9	1.8
Still birth	3 (0.6%)	1 (0.2%)	4	0.8
Anoestrus	82 (16.4%)	41 (8.2%)	123	24.6
Repeat breeding	39 (7.8%)	18 (3.6%)	57	11.4
Mastitis	13 (2.6%)	9 (1.8%)	22	4.4
Milk fever	3 (0.6%)	3 (0.6%)	6	1.2
Grand Total	238 (47.6%)	155 (31%)	393	78.6

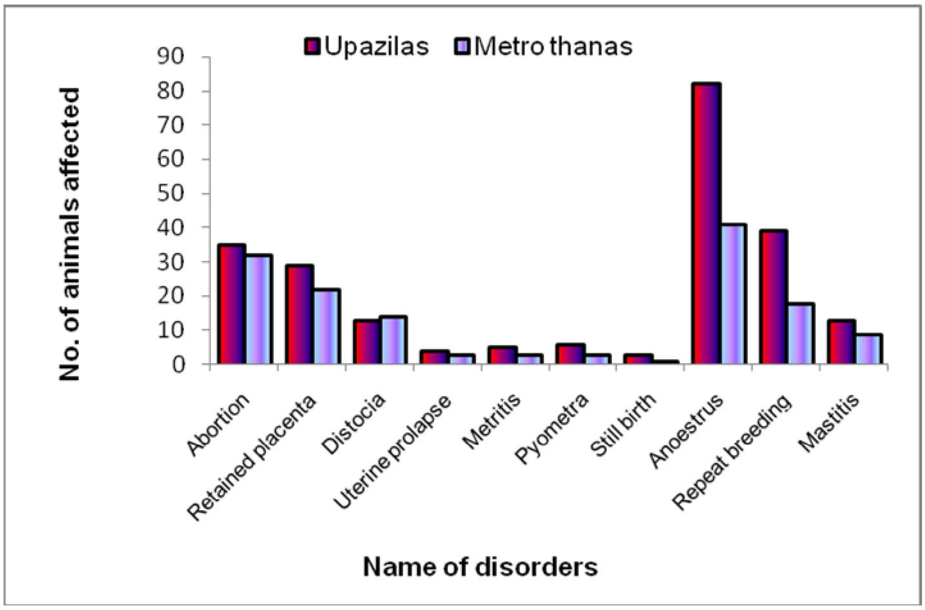


Figure 45 Prevalence of reproductive disorders of dairy cows among upazilas and metro thanas.

4.1.2.5 The effects of breeds on the prevalence of reproductive disorders of dairy cows

The effects of breeds on prevalence of reproductive disorders of dairy cows are presented in Table 38 and Figure 46. The prevalence of reproductive disorders was lower in local cows (18%) and higher in cross-bred cows (60.6%). In local cows, abortion (3.2%), retained placenta (1.8%), dystocia (0.6%), vaginal prolapse (0.6%), uterine prolapse (0.2%), metritis (0.4%), pyometra (0.4%), still birth (0.2%), anoestrus (7.6%), repeat breeding (2.2%), mastitis (0.8%), milk fever (0.0%) and in cross-bred cows, abortion (10.2%), retained placenta (8.4%), dystocia (4.8%), vaginal prolapse (1.8%), uterine prolapse (1.2%), metritis (1.2%), pyometra (1.4%), still birth (0.6%), anoestrus (17%), repeat breeding (9.2%), mastitis (3.6%) and milk fever (1.2%) reproductive cases were recorded.

Table 38 Prevalence of various reproductive disorders among breeds in dairy cows of Rajshahi district (n=500).

Name of reproductive disorders	**Breed**		**Total No.**	**% of cases**
	Local	Cross breed		
Abortion	16 (3.2%)	51 (10.2%)	67	13.4
Retained placenta	9 (1.8%)	42 (8.4%)	51	10.2
Dystocia	3 (0.6%)	24 (4.8%)	27	5.4
Vaginal prolapse	3 (0.6%)	9 (1.8%)	12	2.4
Uterine prolapse	1 (0.2%)	6 (1.2%)	7	1.4
Metritis	2 (0.4%)	6 (1.2%)	8	1.6
Pyometra	2 (0.4%)	7 (1.4%)	9	1.8
Still birth	1 (0.2%)	3 (0.6%)	4	0.8
Anoestrus	38 (7.6%)	85 (17%)	123	24.6
Repeat breeding	11 (2.2%)	46 (9.2%)	57	11.4
Mastitis	4 (0.8%)	18 (3.6%)	22	4.4
Milk fever	0	6 (1.2%)	6	1.2
Grand Total	90 (18%)	303 (60.6%)	393	78.6

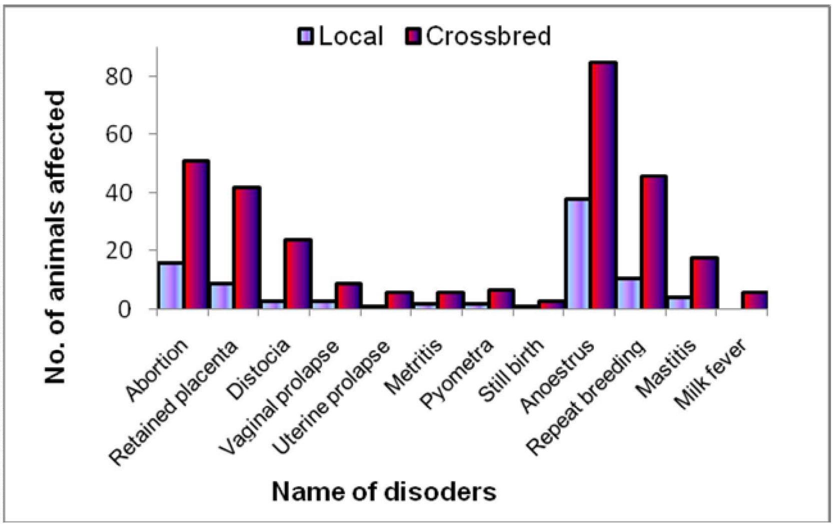


Figure 46 Prevalence of reproductive disorders of dairy cows among the different breed.

4.1.2.6 The effects of genotypes on the prevalence of reproductive disorders of dairy cows

The effects of genotype on prevalence of reproductive disorders of dairy cows are presented in Table 39. The prevalence of abortion (6%), retained placenta (5%) and dystocia (3.2%) were the highest in Local × Friesian and lowest in (3.2%), (1.8%) and (0.6%) in local, respectively. The prevalence of vaginal prolapse (1.4%) was maximum in Local × Friesian and minimum in Local × Sahiwal. The prevalence of uterine prolapse (1%) higher in Local × Friesian and lower in Local × Sahiwal and local (0.2%). The prevalence of metritis (0.6%) was higher in Local × Sahiwal and lower in local (0.4%). The prevalence of pyometra (1%) was higher in Local × Friesian and lower in local (0.4%). The prevalence of still birth (0.6%) was maximum in Local × Friesian and absent in (0.0%) in Local × Sahiwal. The prevalence of anoestrus (10%) was higher in Local × Friesian and lower in (7%) in Local × Sahiwal. The prevalence of repeat breeding (5.6%), mastitis (1.8%) and milk fever (1%) were the highest in Local × Friesian and lowest in (2.2%), (0.8%) and absolutely absent (0.0%) in local, respectively.

Table 39 The effects of genotypes on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of reproductive disorders	**Genotypes**			**Total**	**% of cases**
	Local	Local × Friesian	Local × Sahiwal		
Abortion	16 (3.2%)	30 (6%)	21 (4.2%)	67	13.4
Retained placenta	9 (1.8%)	25 (5%)	17 (3.4%)	51	10.2
Dystocia	3 (0.6%)	16 (3.2%)	8 (1.6%)	27	5.4
Vaginal prolapse	3 (0.6%)	7 (1.4%)	2 (0.4%)	12	2.4
Uterine prolapse	1 (0.2%)	5 (1%)	1 (0.2%)	7	1.4
Metritis	2 (0.4%)	3 (0.6%)	3 (0.6%)	8	1.6
Pyometra	2 (0.4%)	5 (1%)	2 (0.4%)	9	1.8
Still birth	1 (0.2%)	3 (0.6%)	0	4	0.8
Anoestrus	38 (7.6%)	50 (10%)	35 (7%)	123	24.6
Repeat breeding	11 (2.2%)	28 (5.6%)	18 (3.6%)	57	11.4
Mastitis	4 (0.8%)	9 (1.8%)	9 (1.8%)	22	4.4
Milk fever	0	5 (1%)	1 (0.2%)	6	1.2
Grand Total	90 (18%)	186 (37.2%)	117 (23.4%)	393	78.6

4.1.2.7 The effects of age group on the prevalence of reproductive disorders of dairy cows

The effects of age group on prevalence of reproductive disorders of dairy cows are presented in Table 40 and Figure 47. The prevalence of abortion (6%) and retained placenta (4.4%) were the highest in >9 years of age and the lowest (1.8%) and (0.4%) in <3 years of age. Prevalence of dystocia (2.6%) was the highest in >9 years of age and the lowest in (0.2%) in 3-5 years of age. The prevalence of vaginal prolapsed (1.4%) was maximum in >9 years of age and absent in <3 years of age. The prevalence of uterine prolapse (0.6%) and metritis (0.8%) were higher in >5-9 years and lower (0.2%) and (0.2%) in <3 years. The prevalence of pyometra (1%) was higher in >9 years and absent (0.0%) in <3 years. The prevalence of still birth (0.6%) was maximum in >5-9 years and absent (0.0%) in 3-5 years. The prevalence of anoestrus (12%) and repeat breeding (5.8%) were higher in >9 years and lower (2.8%) in 3-5 years and (0.8%) in <3 years of age, respectively. The prevalence of mastitis (1.8%) was the highest in 3-5 years and lower (0.2%) in <3 years. The prevalence of milk fever (0.4%) was higher in >9 years and lower (0.2%) in <3 years. The prevalence of all reproductive diseases (35.4%) was higher in >9 years age groups and lower (8.6%) was in <3 years age group cows.

Table 40 The effects of age groups on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Age groups**				**Total**	**% of cases**
	< 3 years	3-5 years	>5-9 years	>9 years		
Abortion	9 (1.8%)	10 (2%)	18 (3.6%)	30 (6%)	67	13.4
Retained placenta	2 (0.4%)	15 (3%)	12 (2.4%)	22 (4.4%)	51	10.2
Dystocia	4 (0.8%)	1 (0.2%)	9 (1.8%)	13 (2.6%)	27	5.4
Vaginal prolapse	0	2 (0.4%)	3 (0.6%)	7 (1.4%)	12	2.4
Uterine prolapse	1 (0.2%)	2 (0.4%)	3 (0.6%)	1 (0.2%)	7	1.4
Metritis	1 (0.2%)	2 (0.4%)	4 (0.8%)	1 (0.2%)	8	1.6
Pyometra	0	2 (0.4%)	2 (0.4%)	5 (1%)	9	1.8
Still birth	1 (0.2%)	0	3 (0.6%)	0	4	0.8
Anoestrus	19 (3.8%)	14 (2.8%)	30 (6%)	60 (12%)	123	24.6
Repeat breeding	4 (0.8%)	5 (1%)	19 (3.8%)	29 (5.8%)	57	11.4
Mastitis	1 (0.2%)	9 (1.8%)	5 (1%)	7 (1.4%)	22	4.4
Milk fever	1 (0.2%)	2 (0.4%)	1 (0.2%)	2 (0.4%)	6	1.2
Grand Total	43 (8.6%)	64(12.8%)	109 (21.8%)	177(35.4%)	393	78.6

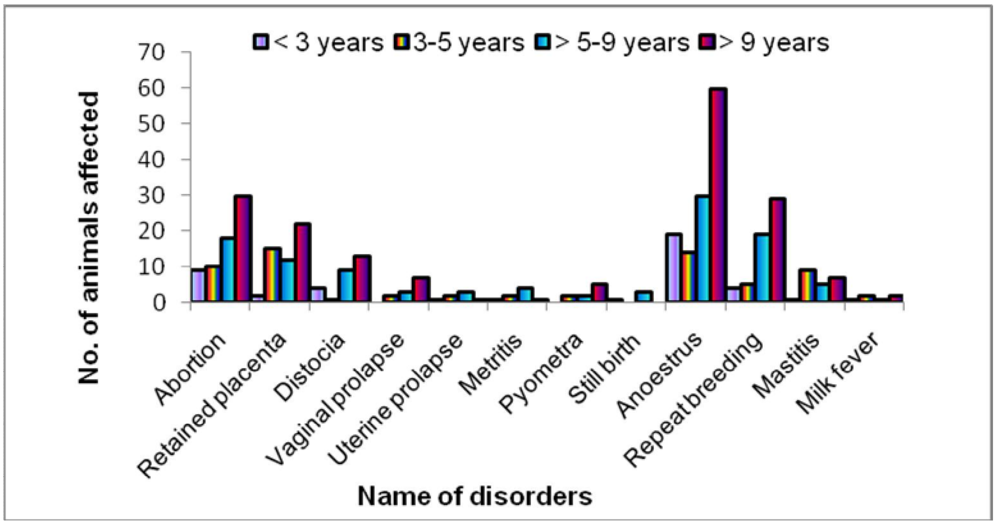


Figure 47 Prevalence of reproductive disorders of dairy cows among the different age groups.

4.1.2.8 The effects of parity on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders of dairy cows due to the parity effect is presented in Table 41. The prevalence of abortion (3.4%) was the highest in 1st calving and the lowest (0.2%) in heifer. The prevalence of retained placenta (3%) was higher in 5th calving and above and lower (0.0%) in heifer. The prevalence of dystocia (1.8%) was the highest in 2nd calving and the lowest in (0.2%) in heifer. The prevalence of vaginal prolapsed (1%) was maximum in 2nd calving and absent (0.0%) in heifer. The prevalence of uterine prolapse (0.6%) was higher in 4th calving and lower (0.0%) and (0.0%) in heifer and 2nd calving. The prevalence of metritis (0.8%) was higher in 1st calving and absent (0.0%) in heifer and 4th calving. The prevalence of pyometra (0.8%) was maximum in 2nd calving and absent (0.0%) in heifer and 4th calving. The prevalence of still birth (0.2%) was higher in 1st calving, 2nd calving, 3rd calving and 5th calving and above and lower (0.0%) in heifer and 4th calving. The prevalence of anoestrus (6.4%) was the highest in 2nd calving and lower (0.6%) in heifer. The prevalence of repeat breeding (3.2%) was higher in 2nd calving and lower (1%) in 4th calving. The prevalence of mastitis (1.8%) was higher in 5th calving and above and absent (0.0%) in heifer. The prevalence of milk fever (0.4%) was higher in 2nd calving and 4th calving and absolutely absent (0.0%) in heifer and 3rd calving.

The prevalence of all reproductive diseases (20.2%) was higher in 2nd calving groups and lower (2.4%) was in heifer group cows.

Table 41 The effects of parity on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	Parity						Total	% of cases
	P_0	P_1	P_2	P_3	P_4	P_5 and above		
Abortion	1 (0.2%)	17 (3.4%)	14 (2.8%)	7 (1.4%)	16 (3.2%)	12 (2.4%)	67	13.4
Retained placenta	0	12 (2.4%)	14 (2.8%)	3 (0.6%)	7 (1.4%)	15 (3%)	51	10.2
Dystocia	1 (0.2%)	4 (0.8%)	9 (1.8%)	6 (1.2%)	5 (1%)	2 (0.4%)	27	5.4
Vaginal prolapse	0	1 (0.2%)	5 (1%)	2 (0.4%)	2 (0.4%)	2 (0.4%)	12	2.4
Uterine prolapse	0	2 (0.4%)	0	1 (0.2%)	3 (0.6%)	1 (0.2%)	7	1.4
Metritis	0	4 (0.8%)	1 (0.2%)	1 (0.2%)	0	2 (0.4%)	8	1.6
Pyometra	0	2 (0.4%)	4 (0.8%)	1 (0.2%)	0	2 (0.4%)	9	1.8
Still birth	0	1 (0.2%)	1 (0.2%)	1 (0.2%)	0	1 (0.2%)	4	0.8
Anaestrus	3 (0.6%)	20 (4%)	32 (6.4%)	20 (4%)	22 (4.4%)	26 (5.2%)	123	24.6
Repeat breeding	7 (1.4%)	8 (1.6%)	16 (3.2%)	15 (3%)	5 (1%)	6 (1.2%)	57	11.4
Mastitis	0	1 (0.2%)	3 (0.6%)	3 (0.6%)	6 (1.2%)	9 (1.8%)	22	4.4
Milk fever	0	1 (0.2%)	2 (0.4%)	0	2 (0.4%)	1 (0.2%)	6	1.2
Grand Total	12 (2.4%)	73(14.6%)	101(20.2%)	60 (12%)	68(13.6%)	79(15.8%)	393	78.6

P_0=heifer, P_1=1st calving, P_2=2nd calving, P_3=3rd calving, P_4= 4th calving and P_5=5th calving and above

4.1.2.9 The effects of body weight on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders in different body weight of dairy cows is presented in Table 42 and Figure 48. The prevalence of abortion (5.6%) was the highest in 200-300 kg body weight and the lowest (2.8%) in >300 kg. The prevalence of retained placenta (5%) was higher in 200-300 kg and lower (1%) in <200 kg. The prevalence of dystocia (3.2%) and vaginal prolapsed (1.2%) were the highest in 200-300 kg and the lowest in (0.8%) and (0.2%) in <200 kg. The prevalence of uterine prolapse (0.8%) was maximum in 200-300 kg and minimum (0.2%) in >300 kg. The prevalence of metritis (0.6%) and pyometra (1.2%) were higher in 200-300 kg and lower (0.4%) and (0.2%) in >300 kg. The prevalence of still birth (0.6%) was higher in 200-300 kg and absent (0.0%) in <200 kg body weight. The prevalence of anoestrus (14.2%) and repeat breeding (7.4%) were the highest in 200-300 kg and the lowest (4.8%) and (0.2%) in >300 kg. The prevalence of mastitis (2.2%) was higher in 200-300 kg and lower (0.8%) in <200 kg. The prevalence of all reproductive diseases (42.4%) was higher in 200-300 kg body weight groups and lower (17.2%) was in <200 kg body weight group of cows.

Table 42 The effects of body weight on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Body weight**			**Total**	**% of cases**
	<200 kg	200-300 kg	>300 kg		
Abortion	25 (5%)	28 (5.6%)	14 (2.8%)	67	13.4
Retained placenta	5 (1%)	25 (5%)	21 (4.2%)	51	10.2
Dystocia	4 (0.8%)	16 (3.2%)	7 (1.4%)	27	5.4
Vaginal prolapse	1 (0.2%)	6 (1.2%)	5 (1%)	12	2.4
Uterine prolapse	2 (0.4%)	4 (0.8%)	1 (0.2%)	7	1.4
Metritis	3 (0.6%)	3 (0.6%)	2 (0.4%)	8	1.6
Pyometra	2 (0.4%)	6 (1.2%)	1 (0.2%)	9	1.8
Still birth	0	3 (0.6%)	1 (0.2%)	4	0.8
Anoestrus	28 (5.6%)	71 (14.2%)	24 (4.8%)	123	24.6
Repeat breeding	10 (2%)	37 (7.4%)	10 (2%)	57	11.4
Mastitis	4 (0.8%)	11 (2.2%)	7 (1.4%)	22	4.4
Milk fever	2 (0.4%)	2 (0.4%)	2 (0.4%)	6	1.2
Grand Total	86 (17.2%)	212 (42.4%)	95 (19%)	393	78.6

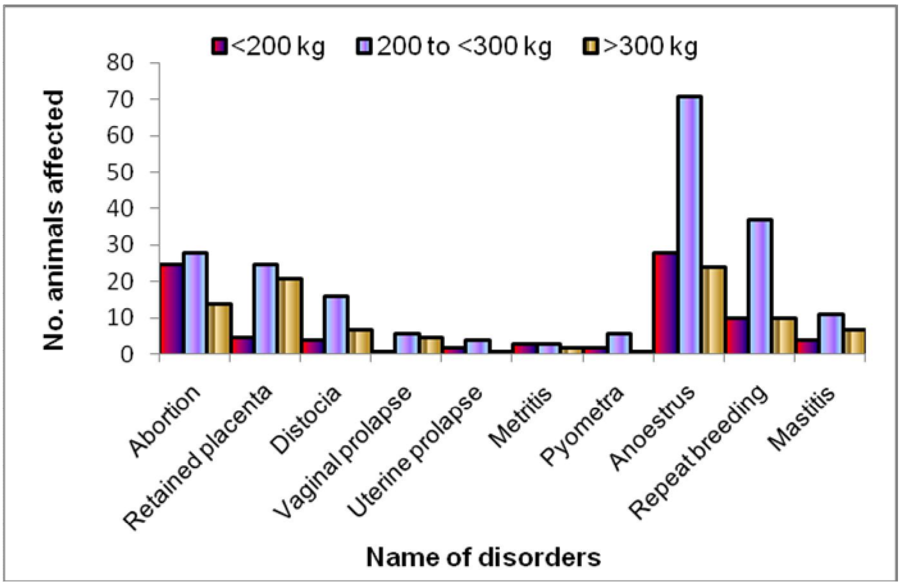


Figure 48 Prevalence of reproductive disorders of dairy cows among the body weight.

4.1.2.10 The effects of body condition score on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders in different body condition score of cows are presented in Table 43 and Figure 49. The prevalence of abortion (6.8%) was the highest in poor body condition and the lowest (2.6%) in medium. The prevalence of retained placenta (6.6%), dystocia (2.4%), vaginal prolapsed (1.8%), uterine prolapse (0.6%), metritis (0.6%) and still birth (0.4%) were higher in poor body condition and lower (1.4%), (1.2%), (0.2%), (0.2%), (0.4%) and (0.2%) in good body condition of cows. The prevalence of anoestrus (12.8%) was maximum in poor and minimum in (5%) in medium. The prevalence of repeat breeding (5.8%) was the highest in poor and the lowest (1.6%) was in good. The prevalence of mastitis (2.6%) was higher in poor and lower (0.8%) in medium. The prevalence of milk fever (0.8%) was higher in poor and lower in (0.2%) in medium and good body condition score. The prevalence of all reproductive diseases (41.8%) was higher in poor body condition groups and lower (17.8%) was in good body condition group of cows.

Table 43 The effects of body condition score on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	Body condition score			Total	% of cases
	Poor	Medium	Good		
Abortion	34 (6.8%)	13 (2.6%)	20 (4%)	67	13.4
Retained placenta	33 (6.6%)	11 (2.2%)	7 (1.4%)	51	10.2
Dystocia	12 (2.4%)	9 (1.8%)	6 (1.2%)	27	5.4
Vaginal prolapse	9 (1.8%)	2 (0.4%)	1 (0.2%)	12	2.4
Uterine prolapse	3 (0.6%)	3 (0.6%)	1 (0.2%)	7	1.4
Metritis	3 (0.6%)	3 (0.6%)	2 (0.4%)	8	1.6
Pyometra	3 (0.6%)	3 (0.6%)	3 (0.6%)	9	1.8
Still birth	2 (0.4%)	1 (0.2%)	1 (0.2%)	4	0.8
Anoestrus	64 (12.8%)	25 (5%)	34 (6.8%)	123	24.6
Repeat breeding	29 (5.8%)	20 (4%)	8 (1.6%)	57	11.4
Mastitis	13 (2.6%)	4 (0.8%)	5 (1%)	22	4.4
Milk fever	4 (0.8%)	1 (0.2%)	1 (0.2%)	6	1.2
Grand Total	209 (41.8%)	95 (19%)	89 (17.8%)	393	78.6

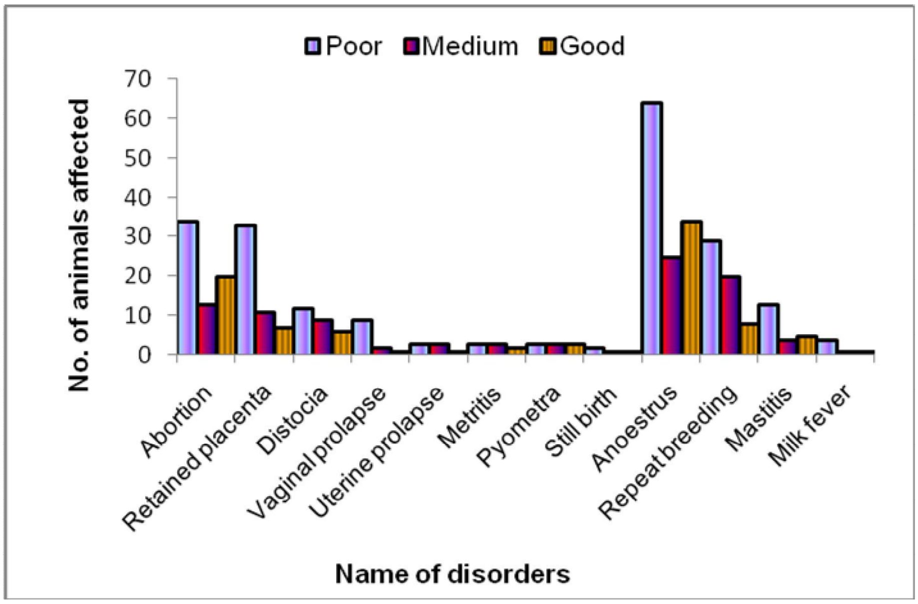


Figure 49 Prevalence of reproductive disorders of dairy cows among the body condition score.

4.1.2.11 The effects of educational status of the owner on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on the educational status of the owner of dairy cows is presented in Table 44. The prevalence of abortion (4%) was the highest in illiterate group and the lowest (2.8%) in primary education. The prevalence of retained placenta (3.2%) was higher in illiterate group and lower (1.6%) in secondary education. The prevalence of dystocia (1.8%) was maximum in primary education and minimum (0.8%) in illiterate group. The prevalence of vaginal prolapsed (1%) was the highest in illiterate group and the lowest in (0.2%) in primary education. The prevalence of uterine prolapse (0.8%) was maximum in primary education and absent (0.0%) in secondary education. The prevalence of metritis (0.8%) was in higher education and absent (0.0%) in illiterate group. The prevalence of pyometra (1%) were higher in higher education and lower (0.2%) in primary education. The prevalence of still birth (0.4%) was higher in secondary education and absent (0.0%) in primary and illiterate group. The prevalence of anoestrus (8.8%) was maximum observed in primary education and minimum (3.6%) was in higher education. The prevalence of repeat breeding (6.2%) was the highest in illiterate group and the lowest (1.4%) was in primary group. The prevalence of mastitis (2.2%) was higher in illiterate and lower (0.2%) in primary group. The prevalence of milk fever (0.6%) was higher in higher education and absent (0.0%) in illiterate group of owner. The prevalence of all reproductive diseases (25.2%) was higher in illiterate groups and lower (16.4%) was in secondary education group of owners of cows.

Table 44 The effects of educational status of the owner on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Educational status of the owner**				**Total**	**% of cases**
	Illiterate	Primary	Secondary	Higher secondary		
Abortion	20 (4%)	14 (2.8%)	17 (3.4%)	16 (3.2%)	67	13.4
Retained placenta	16 (3.2%)	13 (2.6%)	8 (1.6%)	14 (2.8%)	51	10.2
Dystocia	4 (0.8%)	9 (1.8%)	6 (1.2%)	8 (1.6%)	27	5.4
Vaginal prolapse	5 (1%)	1 (0.2%)	3 (0.6%)	3 (0.6%)	12	2.4
Uterine prolapse	2 (0.4%)	4 (0.8%)	0	1 (0.2%)	7	1.4
Metritis	0	2 (0.4%)	2 (0.4%)	4 (0.8%)	8	1.6
Pyometra	1 (0.2%)	1 (0.2%)	2 (0.4%)	5 (1%)	9	1.8
Still birth	0	0	2 (0.4%)	2 (0.4%)	4	0.8
Anoestrus	36 (7.2%)	44 (8.8%)	25 (5%)	18 (3.6%)	123	24.6
Repeat breeding	31 (6.2%)	7 (1.4%)	10 (2%)	9 (1.8%)	57	11.4
Mastitis	11 (2.2%)	1 (0.2%)	5 (1%)	5 (1%)	22	4.4
Milk fever	0	1 (0.2%)	2 (0.4%)	3 (0.6%)	6	1.2
Grand Total	126 (25.2%)	97 (19.4%)	82 (16.4%)	88 (17.6%)	393	78.6

4.1.2.12 The effects of farming experience of the owner on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on the farming experience of the owner of dairy cows is presented in Table 45. The prevalence of abortion (8.6%) was the highest in no farming experience of farmers and the lowest (2.2%) in low farming experience. The prevalence of retained placenta (5.6%), dystocia (3.2%), vaginal prolapsed (1.2%) and uterine prolapsed (0.6) were higher in no farming experience of farmers and lower (2.2%), (1%), (0.6%) and (0.2%) were in more farming experience of farmers. The prevalence of metritis (0.8%) was higher in no farming experience of farmers and absent (0.0%) in low farming experience. The prevalence of pyometra (1%), still birth (0.6%), anoestrus (14.4%), repeat breeding (7%) and mastitis (2.2%) were maximum in no farming experience of owner and minimum (0.2%), (0.0%), (5%), (1%) and (0.8%) in more farming experience of owner of cows. The prevalence of milk fever (0.8%) was higher in more farming experience of owner and absent (0.0%) in low farming experience of owner. The prevalence of all reproductive diseases (45.6%) was higher in no farming experience of owner groups and lower (15.2%) was in more farming experience of owner group of cows.

Table 45 The effects of farming experience on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Farming experience**			**Total**	**% of cases**
	None	Little	Vast		
Abortion	43 (8.6%)	11 (2.2%)	13 (2.6%)	67	13.4
Retained placenta	28 (5.6%)	12 (2.4%)	11 (2.2%)	51	10.2
Dystocia	16 (3.2%)	6 (1.2%)	5 (1%)	27	5.4
Vaginal prolapse	6 (1.2%)	3 (0.6%)	3 (0.6%)	12	2.4
Uterine prolapse	3 (0.6%)	3 (0.6%)	1 (0.2%)	7	1.4
Metritis	4 (0.8%)	0	4 (0.8%)	8	1.6
Pyometra	5 (1%)	3 (0.6%)	1 (0.2%)	9	1.8
Still birth	3 (0.6%)	1 (0.2%)	0	4	0.8
Anoestrus	72 (14.4%)	26 (5.2%)	25 (5%)	123	24.6
Repeat breeding	35 (7%)	17 (3.4%)	5 (1%)	57	11.4
Mastitis	11 (2.2%)	7 (1.4%)	4 (0.8%)	22	4.4
Milk fever	2 (0.4%)	0	4 (0.8%)	6	1.2
Grand Total	228 (45.6%)	89 (17.8%)	76 (15.2%)	393	78.6

None=<1 year, little=1 to 5 years, vast=>5 years

4.1.2.13 The effects of farm size on the prevalence of reproductive disorders of dairy cows

The effects of farm size on the prevalence of reproductive disorders of dairy cows are presented in Table 46 and Figure 50. The prevalence of abortion (5.4%) was the highest in large and the lowest (3.4%) in medium size of farms. The prevalence of retained placenta (4.2%) and dystocia (2.4%) were higher in large and lower (2.2%) and (1.2%) were in small size of farms. The prevalence of vaginal prolapsed (1.2%) was the highest in medium and the lowest in (0.2%) in large size of farms. The prevalence of uterine prolapse (0.6%) was maximum in large and minimum (0.2%) in medium and small size of farms. The prevalence of metritis (1.2%) was higher in small and absent (0.0%) in medium size of farms. The prevalence of still birth (0.6%) was higher in large and absent (0.0%) in small size of farms. The prevalence of anoestrus (10.6%) was maximum observed in large and minimum (6.2%) was in small size of farms. The prevalence of repeat breeding (6%) was the highest in medium and the lowest (1.6%) was in small size of farms. The prevalence of mastitis (2.6%) was higher in medium and lower (0.6%) in large size of farms. The prevalence of milk fever (0.6%) was higher in small and large and absent (0.0%) in medium size of farms. The prevalence of all reproductive diseases (30.2%) was higher in large size of farms and lower (20.6%) was in small size of farms.

Table 46 The effects of farm size on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Farm size**			**Total**	**% of cases**
	Small	Medium	Large		
Abortion	23 (4.6%)	17 (3.4%)	27 (5.4%)	67	13.4
Retained placenta	11 (2.2%)	19 (3.4%)	21 (4.2%)	51	10.2
Dystocia	6 (1.2%)	9 (1.8%)	12 (2.4%)	27	5.4
Vaginal prolapse	4 (0.8%)	6 (1.2%)	2 (0.4%)	12	2.4
Uterine prolapse	2 (0.4%)	2 (0.4%)	3 (0.6%)	7	1.4
Metritis	6 (1.2%)	0	2 (0.4%)	8	1.6
Pyometra	3 (0.6%)	3 (0.6%)	3 (0.6%)	9	1.8
Still birth	0	1 (0.2%)	3 (0.6%)	4	0.8
Anoestrus	31 (6.2%)	39 (7.8%)	53 (10.6%)	123	24.6
Repeat breeding	8 (1.6%)	30 (6%)	19 (3.8%)	57	11.4
Mastitis	6 (1.2%)	13 (2.6%)	3 (0.6%)	22	4.4
Milk fever	3 (0.6%)	0	3 (0.6%)	6	1.2
Grand Total	103 (20.6%)	139 (27.8%)	151 (30.2%)	393	78.6

Small=1 to 5, medium=6 to 10, large=more than 10 no. of cow

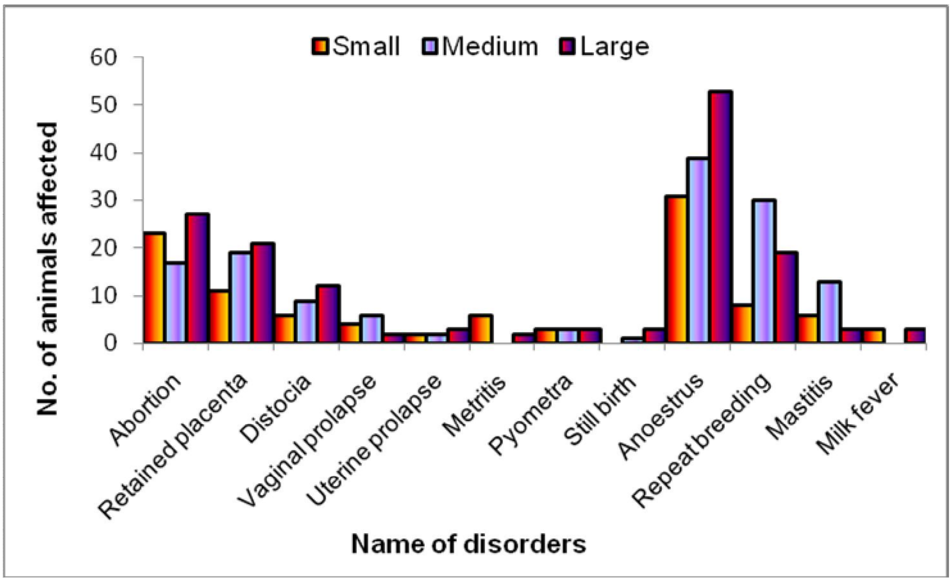


Figure 50 Prevalence of reproductive disorders of dairy cows among the farm size.

4.1.2.14 The effects of rearing system on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on the rearing system of dairy cows are presented in Table 47. The prevalence of abortion (7.6%), retained placenta (4.8%) and dystocia (2.8%) were the highest in intensive rearing system and the lowest (1.8%), (1.8%) and (1.2%) were in grazing on pasture land rearing system. The prevalence of vaginal prolapsed (1.4%) was the highest in intensive rearing system and the lowest in (0.4%) in semi-intensive. The prevalence of uterine prolapse (0.6%) was maximum in intensive and semi-intensive and minimum (0.2%) in grazing on pasture land rearing system. The prevalence of metritis (0.8%) was higher in intensive and lower (0.2%) was in semi-intensive and grazing on pasture land rearing system. The prevalence of still birth (0.4%) was higher in intensive and lower (0.2%) was in semi-intensive and grazing on pasture land rearing system. The prevalence of anoestrus (11.4%), repeat breeding (6.4%) and mastitis (2.2%) were maximum observed in intensive and minimum (4%), (1.4%) and (0.4%) were in grazing on pasture land rearing system. The prevalence of milk fever (0.6%) was higher in intensive and lower (0.2%) in semi-intensive rearing system of cows. The prevalence of all reproductive diseases (39.8%) was higher in intensive rearing system of cows and lower (12.6%) was in grazing on pasture land rearing system of cows.

Table 47 The effects of rearing system on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Rearing system**			**Total**	**% of cases**
	Intensive	Semi-intensive	Grazing on pasture land		
Abortion	38 (7.6%)	20 (4%)	9 (1.8%)	67	13.4
Retained placenta	24 (4.8%)	18 (3.6%)	9 (1.8%)	51	10.2
Dystocia	14 (2.8%)	7 (1.4%)	6 (1.2%)	27	5.4
Vaginal prolapse	7 (1.4%)	2 (0.4%)	3 (0.6%)	12	2.4
Uterine prolapse	3 (0.6%)	3 (0.6%)	1 (0.2%)	7	1.4
Metritis	4 (0.8%)	2 (0.4%)	2 (0.4%)	8	1.6
Pyometra	4 (0.8%)	4 (0.8%)	1 (0.2%)	9	1.8
Still birth	2 (0.4%)	1 (0.2%)	1 (0.2%)	4	0.8
Anoestrus	57 (11.4%)	46 (9.2%)	20 (4%)	123	24.6
Repeat breeding	32 (6.4%)	18 (3.6%)	7 (1.4%)	57	11.4
Mastitis	11 (2.2%)	9 (1.8%)	2 (0.4%)	22	4.4
Milk fever	3 (0.6%)	1 (0.2%)	2 (0.4%)	6	1.2
Grand Total	199 (39.8%)	131 (26.2%)	63 (12.6%)	393	78.6

4.1.2.15 The effects of geographical location of farm on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on the geographical location of farm of dairy cows is presented in Table 48. The prevalence of abortion (5.6%) was higher in urban location and lower (3%) was in semi-urban location of farm. The prevalence of retained placenta (3.8%) was higher in rural location and lower (3%) was in urban location of farm. The prevalence of dystocia (2%) was the highest in urban and rural type and the lowest (1.4%) was in semi-urban. The prevalence of vaginal prolapsed (1%) was the highest in semi-urban and the lowest in (0.6%) in rural type location. The prevalence of uterine prolapse (1%) was maximum in urban type and minimum (0.2%) in semi-urban and rural type. The prevalence of metritis (0.8%) was maximum in urban type and minimum (0.4%) in semi-urban and rural type. The prevalence of pyometra (0.8%) was maximum in rural type and minimum (0.4%) in semi-urban. The prevalence of still birth (0.6%) and anoestrus (11.6%) were higher in urban and absent (0.0%) and lower (6.2%) were in rural type of location of farms. The prevalence of repeat breeding (5.2%) was higher in semi-urban and lower (3%) was in rural. The prevalence of mastitis (1.8%) was maximum observed in urban and minimum (1%) was in rural type of location. The prevalence of milk fever (0.6%) was higher in urban and rural and absent (0.0%) in semi-urban. The prevalence of all reproductive disorders (31.6%) was higher in urban and lower (23%) was in semi-urban type of location of farms.

Table 48 The effects of geographical location of farm on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Geographical location of farm**			**Total**	**% of cases**
	Urban	Semi-urban	Rural		
Abortion	28 (5.6%)	15 (3%)	24 (4.8%)	67	13.4
Retained placenta	15 (3%)	17 (3.4%)	19 (3.8%)	51	10.2
Dystocia	10 (2%)	7 (1.4%)	10 (2%)	27	5.4
Vaginal prolapse	4 (0.8%)	5 (1%)	3 (0.6%)	12	2.4
Uterine prolapse	5 (1%)	1 (0.2%)	1 (0.2%)	7	1.4
Metritis	4 (0.8%)	2 (0.4%)	2 (0.4%)	8	1.6
Pyometra	3 (0.6%)	2 (0.4%)	4 (0.8%)	9	1.8
Still birth	3 (0.6%)	1 (0.2%)	0	4	0.8
Anoestrus	58 (11.6%)	34 (6.8%)	31 (6.2%)	123	24.6
Repeat breeding	16 (3.2%)	26 (5.2%)	15 (3%)	57	11.4
Mastitis	9 (1.8%)	5 (1%)	8 (1.6%)	22	4.4
Milk fever	3 (0.6%)	0	3 (0.6%)	6	1.2
Grand Total	158 (31.6%)	115 (23%)	120 (24%)	393	78.6

4.1.2.16 The effects of floor type on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on the floor type of dairy cows are presented in Table 49. The prevalence of abortion (9%) and retained placenta (4.6%) were higher in muddy type and lower (1.8%) and (2.2%) were in semi-concrete type of floor. The prevalence of dystocia (3.4%) was the highest in muddy type and the lowest (0.8%) was in concrete type of floor. The prevalence of vaginal prolapse (1%) and uterine prolapse (0.8%) were the highest in muddy type and the lowest in (0.6%) and (0.2%) in concrete type floor. The prevalence of metritis (0.8%) was maximum in concrete type and minimum (0.4%) in semi-concrete and muddy type of floor. The prevalence of pyometra (1%) was maximum in muddy type and minimum (0.2%) in semi-concrete. The prevalence of still birth (0.6%) was higher in muddy and absent (0.0%) was in concrete type of floor. The prevalence of anoestrus (11.8%) was the highest in muddy and the lowest (5%) was in concrete type of floor. The prevalence of repeat breeding (6.2%) was higher in muddy type and lower (2.6%) was in semi-concrete and concrete type of floor. The prevalence of mastitis (2.2%) was maximum observed in muddy type and minimum (1%) was in semi-concrete type of floor. The prevalence of all reproductive disorders (41.4%) was higher in muddy type of floor and lower (18.2%) was in concrete type of floor of farm.

Table 49 The effects of floor type on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Floor type**			**Total**	**% of cases**
	Muddy	Semi-concrete	Concrete		
Abortion	45 (9%)	9 (1.8%)	13 (2.6%)	67	13.4
Retained placenta	23 (4.6%)	11 (2.2%)	17 (3.4%)	51	10.2
Dystocia	17 (3.4%)	6 (1.2%)	4 (0.8%)	27	5.4
Vaginal prolapse	5 (1%)	4 (0.8%)	3 (0.6%)	12	2.4
Uterine prolapse	4 (0.8%)	2 (0.4%)	1 (0.2%)	7	1.4
Metritis	2 (0.4%)	2 (0.4%)	4 (0.8%)	8	1.6
Pyometra	5 (1%)	1 (0.2%)	3 (0.6%)	9	1.8
Still birth	3 (0.6%)	1 (0.2%)	0	4	0.8
Anoestrus	59 (11.8%)	39 (7.8%)	25 (5%)	123	24.6
Repeat breeding	31 (6.2%)	13 (2.6%)	13 (2.6%)	57	11.4
Mastitis	11 (2.2%)	5 (1%)	6 (1.2%)	22	4.4
Milk fever	2 (0.4%)	2 (0.4%)	2 (0.4%)	6	1.2
Grand Total	207 (41.4%)	95 (19%)	91 (18.2%)	393	78.6

4.1.2.17 The effects of ventilation system on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on types of ventilation of the farm of dairy cows is presented in Table 50. The prevalence of abortion (7%) and retained placenta (4.2%) were higher in poor quality of ventilation and lower (1.8%) and (2%) were in good quality of ventilation. The prevalence of dystocia (2.4%) was the highest in medium quality of ventilation and lower (1%) was in good quality of ventilation. The prevalence of vaginal prolapse (1.8%) was in maximum poor quality of ventilation and lower (0.2%) was in good quality of ventilation. The prevalence of uterine prolapse (0.6%) was maximum in medium quality of ventilation and lower (0.2%) was in good quality of ventilation. The prevalence of metritis (1.2%) was higher in good quality of ventilation and absent (0.0%) was in medium quality of ventilation. The prevalence of pyometra (0.8%) was in medium type and minimum (0.4%) in good type. The prevalence of still birth (0.4%) was higher in medium and lower (0.2%) was in good. The prevalence of anoestrus (10.8%), repeat breeding (6.6%) and mastitis (2%) were the highest in poor and the lowest (4.6%), (1.8%) and (1%) were in good type of ventilation. The prevalence of all reproductive disorders (36.4%) was higher in poor quality of ventilation and lower (15%) was in good quality of ventilation of farm.

Table 50 The effects of ventilation system on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	Ventilation system			Total	% of cases
	Poor	Medium	Good		
Abortion	35 (7%)	23 (4.6%)	9 (1.8%)	67	13.4
Retained placenta	21 (4.2%)	20 (4%)	10 (2%)	51	10.2
Dystocia	10 (2%)	12 (2.4%)	5 (1%)	27	5.4
Vaginal prolapse	9 (1.8%)	2 (0.4%)	1 (0.2%)	12	2.4
Uterine prolapse	2 (0.4%)	3 (0.6%)	2 (0.4%)	7	1.4
Metritis	2 (0.4%)	0	6 (1.2%)	8	1.6
Pyometra	3 (0.6%)	4 (0.8%)	2 (0.4%)	9	1.8
Still birth	1 (0.2%)	2 (0.4%)	1 (0.2%)	4	0.8
Anoestrus	54 (10.8%)	46 (9.2%)	23 (4.6%)	123	24.6
Repeat breeding	33 (6.6%)	15 (3%)	9 (1.8%)	57	11.4
Mastitis	10 (2%)	7 (1.4%)	5 (1%)	22	4.4
Milk fever	2 (0.4%)	2 (0.4%)	2 (0.4%)	6	1.2
Grand Total	182 (36.4%)	136 (27.2%)	75 (15%)	393	78.6

4.1.2.18 The effects of feed quality on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on feed quality of farms is presented in Table 51. The prevalence of abortion (8.2%), retained placenta (4.2%), dystocia (2.4%) and vaginal prolapse (1.4%) were higher in poor quality of feed and lower (2.4%), (3%), (1.4%) and (0.4%) were in good quality of feed. The prevalence of uterine prolapse (0.8%) was maximum in medium quality of feed and lower (0.2%) was in good quality of feed. The prevalence of metritis (0.8%) was higher in good quality of feed and lower (0.2%) was in poor quality of feed. The prevalence of pyometra (1%) was maximum in poor and minimum (0.2%) in medium quality of feed. The prevalence of still birth (0.6%) was higher in medium and lower (0.2%) was in good. The prevalence of anoestrus (11.6%)

was the highest in medium and the lowest (4.2%) was in good. The prevalence of repeat breeding (5.6%) was the highest in poor and the lowest (1.6%) was in good. The prevalence of mastitis (2.4%) was the highest in poor and the lowest (1%) was in medium and good quality of feed. The prevalence of milk fever (0.6%) was the highest in medium and the lowest (0.2%) was in good quality of feed. The prevalence of all reproductive disorders (35.4%) was higher in poor quality of feed and lower (16%) was in good quality of feed of farm.

Table 51 The effects of feed quality on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Feed quality**			**Total**	**% of cases**
	Poor	Medium	Good		
Abortion	41 (8.2%)	14 (2.8%)	12 (2.4%)	67	13.4
Retained placenta	21 (4.2%)	15 (3%)	15 (3%)	51	10.2
Dystocia	12 (2.4%)	8 (1.6%)	7 (1.4%)	27	5.4
Vaginal prolapse	7 (1.4%)	3 (0.6%)	2 (0.4%)	12	2.4
Uterine prolapse	2 (0.4%)	4 (0.8%)	1 (0.2%)	7	1.4
Metritis	1 (0.2%)	3 (0.6%)	4 (0.8%)	8	1.6
Pyometra	5 (1%)	1 (0.2%)	3 (0.6%)	9	1.8
Still birth	2 (0.4%)	3 (0.6%)	1 (0.2%)	4	0.8
Anoestrus	44 (8.8%)	58 (11.6%)	21 (4.2%)	123	24.6
Repeat breeding	28 (5.6%)	21 (4.2%)	8 (1.6%)	57	11.4
Mastitis	12 (2.4%)	5 (1%)	5 (1%)	22	4.4
Milk fever	2 (0.4%)	3 (0.6%)	1 (0.2%)	6	1.2
Grand Total	177 (35.4%)	136 (27.2%)	80 (16%)	393	78.6

4.1.2.19 The effects of breeding methods on the prevalence of reproductive disorders of dairy cows

The prevalence of reproductive disorders on breeding methods of cows is presented in Table 52. The prevalence of all reproductive disorders (59.6%) was higher in artificial insemination and lower (19%) was in natural service of cows.

Table 52 The effects of breeding methods on the prevalence of reproductive disorders in dairy cows of Rajshahi district (n=500).

Name of Reproductive disorders	**Breeding methods**		**Total**	**% of cases**
	Natural service	Artificial insemination		
Abortion	14 (2.8%)	53 (10.6%)	67	13.4
Retained placenta	16 (3.2%)	35 (7%)	51	10.2
Dystocia	7 (1.4%)	20 (4%)	27	5.4
Vaginal prolapse	4 (0.8%)	8 (1.6%)	12	2.4
Uterine prolapse	4 (0.8%)	3 (0.6%)	7	1.4
Metritis	3 (0.6%)	5 (1%)	8	1.6
Pyometra	2 (0.2%)	7 (1.4%)	9	1.8
Still birth	0	4 (0.8%)	4	0.8
Anoestrus	27 (5.4%)	96 (19.2%)	123	24.6
Repeat breeding	11 (2.2%)	47 (9.4%)	57	11.4
Mastitis	5 (1%)	17 (3.4%)	22	4.4
Milk fever	2 (0.4%)	3 (0.6%)	6	1.2
Grand Total	95 (19%)	298 (59.6%)	393	78.6

Experiment-II: Study on biometrical measurement of reproductive organs in cows at study area

4.2.1 Gross morphmetric analysis of the reproductive organs of different genotypes, age and body weight groups and parities of cows collected from slaughter house in Rajshahi

4.2.1.1 Ovary

The ovaries of mature cow were cylindrically oval, round in shape, had no ovulation fossa and located at the cranial portion of the oviduct. Major anatomic deviation of ovary especially in length, width, thickness and weight were not seen. The measurements of ovaries in different genotypes, age and body weight groups and parities of cows shown in Table 53, Table 55, Table 57 and Table 59, respectively and Figure 51. The results of the study revealed that the average mean length, width and thickness of right ovary were recorded as 2.48 ± 0.98, 1.84 ± 0.59 and 1.48 ± 0.10 cm and that of the left ovary 2.33 ± 0.56, 1.62 ± 0.26 and 1.27 ± 0.59 cm, respectively. The weight of right and left ovary was recorded as 3.75 ± 0.18 and 3.09 ± 0.15 g, respectively. The comparison of the morphometric values of both ovaries in the different genotypes (Local, Local × Holstein Friesian, Local × Jersey and Local × Sahiwal), age and body weight groups as <3 years, 3 ≤5 years, >5 years and <200 kg, 200 to 300 kg, >300 kg and parities such as (heifer, 1st calving, 2nd calving, 3rd calving and 4th calving and above), respectively, showed significant differences ($P<0.05$) in length, width, thickness and weight (Table 53, Table 55, Table 57 and Table 59). Local × Holstein Friesian has a significantly higher values ($P<0.05$) on most of the parameters measured, followed by the Local × Jersey, Local × Sahiwal and the Local. Age groups >5 yrs and body weight groups >300 kg and 3rd parities had significantly higher values ($P<0.05$) on most of the parameters measured, followed by the age groups 3 ≤5 yrs & <3 yrs and body weight groups 200 to 300 kg & <200 kg and others parity, respectively.

Table 53 The mean length, width, thickness and weight of ovaries in different genotypes of cow.

Organs	Measurements	Genotypes				Average
		Local n=43	L × F n=24	L × J n=20	L × SL n=13	
Right ovary	Length (cm)	2.25±0.33^{b}	2.79±0.89^{a}	2.53±0.10^{b}	2.56±0.13^{a}	2. 48±0.98
	Width (cm)	1.70±0.56^{b}	2.02±0.10^{a}	1.85±0.07^{ab}	1.96±0.16^{ab}	1.84±0.59
	Thickness (cm)	1.50±0.24	1.42±0.85	1.51±0.10	1.44±0.30	1.48±0.10
	Weight (gm)	2.96±0.16^{b}	5.31±0.50^{a}	3.76±0.33^{b}	3.46±0.31^{b}	3.75±0.18
Left ovary	Length (cm)	2.15± 0.42^{b}	2.65±0.72^{a}	2.34± 0.10^{b}	2.35±0.11^{b}	2.33±0.56
	Width (cm)	1.54±0.69	1.75±0.96	2.34±0.10	1.65±0.21	1.62±0.26
	Thickness (cm)	1.18±0.48^{b}	1.36±0.73^{a}	1.29±0.61^{ab}	1.32±0.08^{ab}	1.27±0.59
	Weight (gm)	2.63±0.17^{b}	3.85±0.35^{a}	3.15±0.40^{ab}	3.12±0.49^{ab}	3.09±0.15

n=Total, L=Local, F=Holstein Friesian, J=Jersey, SL=Sahiwal, ± = Standard error, a,b means superscripts are statistically significant (P<0.05) in between the column.

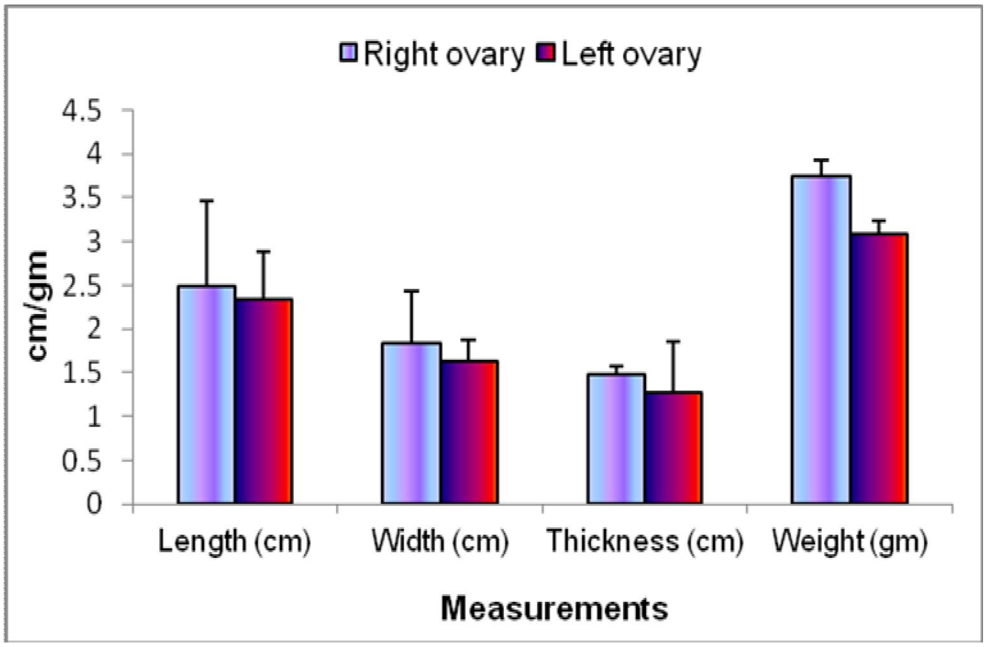


Figure 51 The average means length, width, thickness and weight of both ovaries.

Table 54 Measurements of tubular parts of reproductive tract of different genotypes of cows.

Name of Reproductive tract	Measurements (cm)	Genotypes				Average
		Local n=43	L×F n=24	L×J n=20	L×SL n=13	
Right oviduct	Length	19.48±0.57^{b}	23.79±0.76^{a}	21.55±0.84^{b}	20.38±0.68^{b}	21.05±0.39
Left Oviduct	Length	19.62±0.53^{b}	23.54±0.79^{a}	21.20±0.86^{b}	20.53±0.77^{b}	21.00±0.38
Right uterine horn	Length	22.72±1.05^{b}	29.20±1.65^{a}	26.60±1.42^{ab}	24.92±1.23^{ab}	25.34±0.72
Left uterine horn	Length	22.83±1.0^{c}	29.87±1.75^{a}	27.50±1.46^{ab}	25.38±1.16^{bc}	25.79±0.73
Body of uterus	Length	2.90±0.12	3.42±0.20	3.10±1.17	3.34±0.24	3.12±0.72
	Width	2.30±0.46^{b}	2.83±1.40^{a}	2.46±0.13^{ab}	2.69±0.24^{ab}	2.51±0.59
Caruncle	Number	94.95±2.39	99.54±2.90	97.55±4.82	98.15±3.08	96.99±1.61
Cervix	Length	4.65±0.16^{b}	5.64±0.24^{a}	5.27±0.26^{ab}	4.69±0.26^{b}	5.02±0.11
	Width	4.36±0.20	4.89±0.23	4.57±0.27	4.61±0.28	4.56±0.12
Cervical ring	Number	3.65±0.12	4.04±0.14	3.95±0.18	3.92±0.23	3.84±0.13
Vagina	Length	21.81±0.47^{b}	24.66±0.64^{a}	22.50±0.85^{b}	21.46±0.88^{b}	22.59±0.34
	Width	4.83±0.17^{b}	6.08±0.36^{a}	5.70±0.45^{ab}	5.84±0.54^{ab}	5.44±0.16
Vulva	Length	8.50±0.26	9.37±0.24	9.10±0.28	8.69±0.28	8.85±0.14
	Width	4.55±0.21^{b}	5.00±0.26^{ab}	5.45±0.28^{a}	4.50±0.32^{b}	4.83±0.13

n=Total, L=Local, F=Holstein Friesian, J=Jersey, SL=Sahiwal, ± = Standard error, a,b,c means superscripts are statistically significant (P<0.05) in between the column.

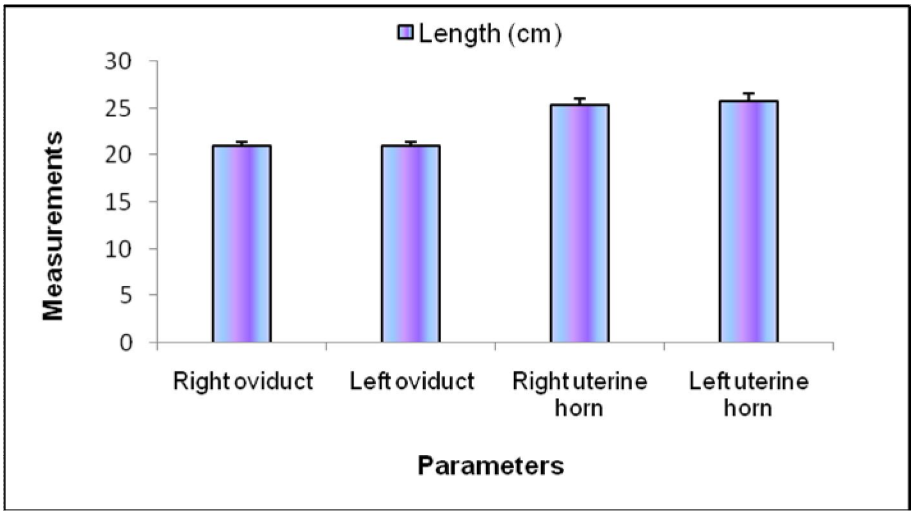


Figure 52 The average means length of right oviduct, left oviduct, right uterine horn and left uterine horn.

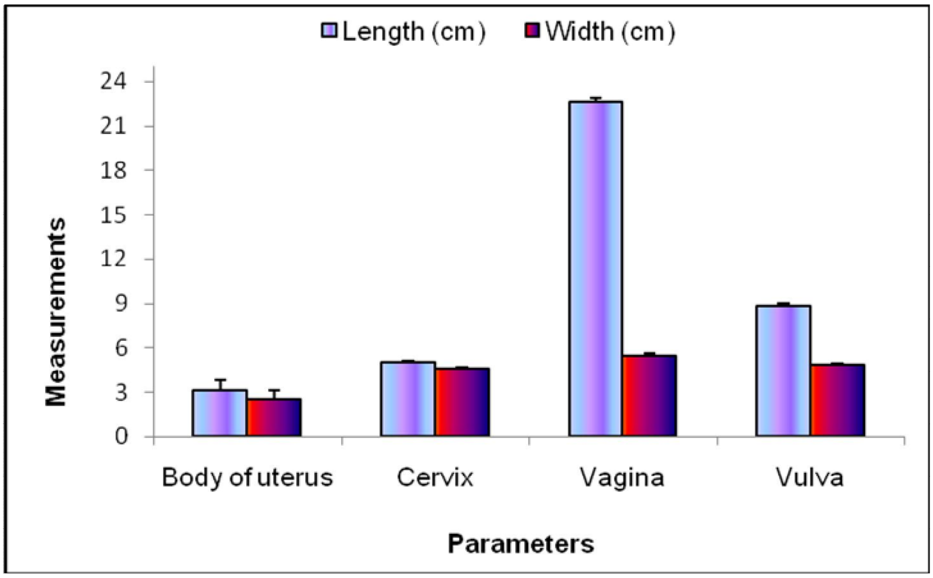


Figure 53 The average means length, width of body of uterus, cervix, vagina and vulva.

Table 55 Effects of age on ovarian biometry in dairy cows.

Organs	Measurements	Age groups < 3 yrs n=23	3 ≤ 5 yrs n=38	> 5 yrs n=39	Average
Right ovary	Length (cm)	2.14 ± 0.93[b]	2.31 ± 0.24[b]	2.84 ± 0.38[a]	2.48 ± 0.98
	Width (cm)	1.61 ± 0.64[b]	1.71 ± 0.78[b]	2.09 ± 0.28[a]	1.84 ± 0.59
	Thickness (cm)	1.20 ± 0.39	1.62 ± 0.27	1.50 ± 0.13	1.84 ± 0.10
	Weight (gm)	2.70 ± 0.20[b]	3.72 ± 0.32[a]	4.38 ± 0.29[a]	3.75 ± 0.18
Left ovary	Length (cm)	2.09 ± 0. 47[b]	2.17 ± 0.76[b]	2.63 ± 0.05[a]	2.33 ± 0.56
	Width (cm)	1.51 ± 0.27[b]	1.52 ± 0.05[b]	1.77 ± 0.86[a]	1.62 ± 0.27
	Thickness (cm)	1.19 ± 0.06[b]	1.20 ± 0.05[b]	1.36 ± 0.21[a]	1.27 ± 0.59
	Weight (gm)	2.55 ± 0.25[b]	2.95 ± 0.27[ab]	3.55 ± 0.25[a]	3.09 ± 0.15

n=Total, ± = Standard error, a,b means superscripts are statistically significant ($P<0.05$) in between the column.

Table 56 Measurements of tubular parts of reproductive tract in different ages of dairy cows.

Name of reproductive tract	Measurements (cm)	Age groups			Average
		< 3 yrs n=23	3 ≤ 5 yrs n=38	> 5 yrs n=39	
Right oviduct	Length	19.04 ± 0.72^{b}	20.94 ± 0.62^{ab}	$22.33 \pm .63^{a}$	21.05 ± 0.39
Left oviduct	Length	19.47 ± 0.65^{b}	20.94 ± 0.66^{ab}	21.94 ± 0.60^{a}	21.00 ± 0.38
Right uterine horn	Length	22.34 ± 1.31^{b}	24.84 ± 1.24^{ab}	27.58 ± 1.08^{a}	25.34 ± 0.72
Left uterine horn	Length	22.17 ± 1.27^{b}	25.28 ± 1.22^{ab}	28.41 ± 1.12^{a}	25.79 ± 0.73
Body of uterus	Length	2.69 ± 0.14^{b}	3.22 ± 0.14^{a}	3.28 ± 0.14^{a}	3.12 ± 0.72
	Width	2.21 ± 0.85^{b}	2.53 ± 0.12^{ab}	2.66 ± 0.24^{a}	2.51 ± 0.59
Caruncle	Number	91.91 ± 3.49^{b}	96.42 ± 2.96^{ab}	100.53 ± 2.02^{a}	96.99 ± 1.61
Cervix	Length	4.45 ± 0.17^{b}	4.77 ± 0.15^{b}	5.58 ± 0.21^{a}	5.02 ± 0.11
	Width	4.19 ± 0.25^{b}	4.36 ± 0.18^{ab}	4.97 ± 0.20^{a}	4.56 ± 0.12
Cervical ring	Number	3.52 ± 0.15^{b}	3.92 ± 0.12^{ab}	3.94 ± 0.13^{a}	3.84 ± 0.13
Vagina	Length	21.17 ± 0.55^{b}	21.63 ± 0.52^{b}	24.35 ± 0.54^{a}	22.59 ± 0.34
	Width	4.60 ± 0.17^{b}	5.65 ± 0.28^{a}	5.71 ± 0.29^{a}	5.44 ± 0.16
Vulva	Length	8.30 ± 0.23^{b}	8.62 ± 0.27^{b}	9.41 ± 0.20^{a}	8.85 ± 0.14
	Width	4.21 ± 0.27^{b}	5.02 ± 0.22^{a}	5.01 ± 0.20^{a}	4.83 ± 0.13

n=Total, ± = Standard error, a,b means superscripts are statistically significant (P<0.05) in between the column.

Table 57 Effects of body weight on ovarian biometry in dairy cows of Bangladesh.

Organs	Measurements	Body weight groups < 200 kg n=31	200 to 300 kg n=33	> 300 kg n=36	Average
Right ovary	Length (cm)	2.23 ± 0.48[b]	2.40 ± 0.69[b]	2.76 ± 0.87[a]	2.48 ± 0.98
	Width (cm)	1.68 ± 0.06[b]	1.80 ± 0.49[ab]	2.00 ± 0.99[a]	1.84± 0.59
	Thickness (cm)	1.61 ± 0.33	1.42 ± 0.43	1.41 ± 0.87	1.48 ± 0.10
	Weight (gm)	3.60 ± 0.24[b]	3.87 ± 0.34[ab]	4.23 ± 0.31[a]	3.75 ± 0.18
Left ovary	Length (cm)	2.12 ± 0.86[b]	2.24 ± 0.00[b]	2.60 ± 0.09[a]	2.33 ± 0.56
	Width (cm)	1.51 ± 0.01[b]	1.53 ± 0.11[b]	1.79 ± 0.53[a]	1.62 ± 0.27
	Thickness (cm)	1.21 ± 0.76[b]	1.17 ± 0.15[b]	1.39 ± 0.67[a]	1.27 ± 0.59
	Weight (gm)	2.56 ± 0.19[b]	2.98 ± 0.27[ab]	3.66 ± 0.30[a]	3.09 ± 0.15

n=Total, ± = Standard error, a,b means superscripts are statistically significant ($P<0.05$) in between the column.

Table 58 Measurements of tubular parts of reproductive tract in different body weight of dairy cows.

Name of Reproductive tract	Measurements (cm)	Body weight groups <200 kg n=31	200 to 300 kg n=33	>300 kg n=36	Average
Right oviduct	Length	18.87±0.61[b]	21.91± 0.54[a]	22.15 ± 0.77[a]	21.05± 0.39
Left oviduct	Length	19.51±0.57[b]	21.51± 0.80[a]	21.80 ± 0.54[a]	21.00± 0.38
Right uterine horn	Length	23.29 1.31[b]	25.45±1.35[ab]	27.00 ± 1.05[a]	25.34± 0.72
Left uterine horn	Length	23.48 1.24[b]	25.78±1.39[ab]	27.77± 1.12[a]	25.79± 0.73
Body of uterus	Length	3.08 ± 0.13	3.06 ± 0.17	3.22 ± 0.15	3.12 ± 0.72
	Width	2.35 ± 0.73	2.50 ± 0.14	2.65 ± 0.10	2.51 ± 0.59
Caruncle	Number	92.45±3.66[b]	96.96±2.54[ab]	100.91±1.98[a]	96.99± 1.61
Cervix	Length	4.53 ± 0.15[b]	4.83 ± 0.19[b]	5.61 ± 0.20[a]	5.02 ± 0.11
	Width	4.09 ± 0.22[b]	4.46 ± 0.19[b]	5.05 ± 0.20[a]	4.56 ± 0.12
Cervical ring	Number	3.67 ± 0.13[b]	3.57 ± 0.13[b]	4.22 ± 0.13[a]	3.84 ± 0.13
Vagina	Length	21.74±0.43[b]	21.90± 0.70[b]	23.94± 0.54[a]	22.59± 0.34
	Width	5.20 ± 0.30	5.27 ± 0.24	5.79 ± 0.31	5.44 ± 0.16
Vulva	Length	8.57 ± 0.31	8.63 ± 0.26	9.30 ± 0.17	8.85 ± 0.14
	Width	4.96 ± 0.24	4.56 ± 0.27	4.97 ± 0.18	4.83 ± 0.13

n=Total, ± = Standard error, a,b means superscripts are statistically significant ($P<0.05$) in between the column.

Table 59 The mean length, width, thickness and weight of ovaries in different parities of cow.

Organs	Measurements	Parities					Average
		Heifer n=42	1st calving n=19	2nd calving n=15	3rd calving n=10	4th calving and above n=14	
Right ovary	Length (cm)	2.18±0.71^{d}	2.44±0.11^{cd}	2.66±0.97^{bc}	3.00±0.19^{a}	2.87±0.64^{ab}	2.48±0.98
	Width (cm)	1.73±0.58^{c}	1.84±0.10^{bc}	1.82±0.50^{bc}	2.38±0.20^{a}	2.10±0.13^{ab}	1.84±0.59
	Thickness (cm)	1.24±0.26	1.38±0.76	1.53±0.19	1.98±0.53	1.59±0.11	1.48±0.10
	Weight (gm)	3.20±0.25	3.90±0.38	4.06±0.59	4.60±0.90	4.21±0.22	3.75±0.18
Left ovary	Length (cm)	2.06± 0.77^{c}	2.38±0.24^{b}	2.50± 0.10^{ab}	2.75±0.16^{a}	2.63±0.45^{ab}	2.33±0.56
	Width (cm)	1.47±0.39^{c}	1.63±0.09^{bc}	1.70±0.50^{ab}	1.88±0.12^{a}	1.80±0.44^{ab}	1.62±0.26
	Thickness (cm)	1.28±0.00^{b}	1.16±0.60^{ab}	1.31±0.86^{ab}	1.42±0.28^{a}	1.38±0.96^{a}	1.27±0.59
	Weight (gm)	2.51±0.17^{b}	3.48±0.44^{ab}	3.02±0.29^{ab}	3.86±0.68^{a}	3.86±0.43^{a}	3.09±0.15

n=Total, ± = Standard error, a,b,c,d means superscripts are statistically significant (P<0.05) in between the column.

Table 60 Measurements of tubular parts of reproductive tract of different parities of cows.

Name of Reproductive tract	Measurements (cm)	Parities					Average
		Heifer n=42	1st calving n=19	2nd calving n=15	3rd calving n=10	4th calving and above n=14	
Right oviduct	Length	19.55±0.54	21.94±1.02	21.92±0.88	22.46±0.85	22.30±1.58	21.05±0.39
Left oviduct	Length	19.92±0.53	20.00±0.82	21.52±1.08	22.20±1.42	21.50±0.94	21.00±0.38
Right uterine horn	Length	22.76±0.98^{b}	26.31±2.03^{ab}	26.07±1.88^{ab}	29.20±1.44^{a}	27.50±2.31^{ab}	25.34±0.72
Left uterine horn	Length	22.98±0.99^{b}	26.52±1.98^{ab}	30.20±1.54^{a}	27.70±2.33^{ab}	27.14±1.89^{ab}	25.79±0.73
Body of uterus	Length	2.97±0.13^{b}	2.99±0.19^{b}	3.33±0.21^{ab}	3.85±0.33^{a}	3.07±0.18^{b}	3.12±0.72
	Width	2.35±0.10	2.43±0.16	2.73±0.13	2.75±0.20	2.67±0.17	2.51±0.59
Cervix	Length	4.44±0.12^{c}	4.87±0.22^{bc}	5.73±0.30^{a}	6.10±0.48^{a}	5.42±0.30^{ab}	5.02±0.11
	Width	4.36±0.18	4.40±0.27	4.63±0.28	5.30±0.56	4.42±0.29	4.56±0.12
Cervical ring	Number	3.61±0.11^{b}	4.05±0.17^{ab}	4.26±0.15^{a}	3.80±0.29^{ab}	3.79±0.26^{ab}	3.84±0.13
Vagina	Length	21.19±0.38^{b}	22.90±0.77^{ab}	23.80±1.13^{a}	24.50±1.36^{a}	23.71±0.85^{a}	22.59±0.34
	Width	5.13±0.22	5.73±0.38	5.57±0.44	6.10±0.88	5.35±0.32	5.44±0.16
Vulva	Length	8.23±0.28^{b}	9.10±0.20^{ab}	9.73±0.31^{a}	9.50±0.52^{a}	9.00±0.25^{ab}	8.85±0.14
	Width	4.55±0.21	4.73±0.26	4.95±0.55	5.40±0.34	5.14±0.29	4.83±0.13

n=Total, ± = Standard error, a,b,c means superscripts are statistically significant (P<0.05) in between the column.

4.2.1.2 Oviduct

The oviducts of the cows were paired convoluted tubes that reached the ovaries to the tapped ends of the uterine cornua or horn. The oviduct was torturous, wiry and hard and embedded in fat of mesosalpinx and opened into the fimbria. This tube lay in a peritoneal fold derived from the lateral layer of the broad ligament. It serves to transport ova or unfertilized eggs from the ovary to the uterus. The average mean length of right and left oviducts were 21.05± 0.39 and 21.00 ± 0.38 cm, respectively in different genotypes, age and body weight groups and parities of cow (Table 54, Table 56, Table 58 and Table 60 and Figure 52). Genotype had significance effect (P<0.05) on the length of both of right and left oviducts. The values of right and left oviducts were higher in Local × Holstein Friesian (23.79 ± 0.76 and 23.54 ± 0.79 cm) than other groups.

The size of the both oviduct varied in different age and body weight groups and even in between left and right oviduct of same age and body weight groups in the present study. In the present study, the length of both oviducts of age group >5 yrs was significantly (P<0.05) higher than that of age group <3 yrs, but the length of age group 3 ≤5 yrs, did not differ significantly (P>0.05) with that of other two age groups (Table 56). Among the three different body weight groups, it was observed that body weight group >300 kg was significantly (P<0.05) higher than that of body weight group <200 kg, but no significant difference (P>0.05) was observed with that of body weight group 200 to 300 kg (Table 58). Age and body weight had significant effect (P<0.05) on the length of both of right and left oviducts. The values of right and left oviducts were higher in age group >5 yrs (22.33 ± 0.63 and 21.94 ± 0.60 cm) and body weight group >300 kg (22.15 ± 0.77 and 21.80 ± 0.54 cm), respectively than other groups. Among the different parities, it was observed that 3rd parity was higher value than others, but no significant difference (P>0.05) was observed with that of others (Table 60). The values of right and left oviducts were higher in 3rd parity (22.46±0.85 and 22.20±1.42 cm) than others.

4.2.1.3 Uterine horns

The uterus of a cow was ″Y″ shaped hollow muscular organ, relatively long consisting of a body and divided anteriorly into two horns. The average mean length of right and left uterine horns were 25.34 ± 0.72 and 25.79 ± 0.73 cm, respectively in different genotypes, age and body weight groups and parities of cow (Table 54, Table 56, Table 58 and Table 60 and Figure 52). The highest length of right and left uterine horns was observed in Local × Holstein Friesian and it was 29.20 ± 1.65 and 29.87 ± 1.75 cm, respectively.

The size of the both uterine horns varied in different age and body weight groups and even in between left and right uterine horns of same age and body weight groups in the present study. The length of both uterine horn of age group >5 yrs and body weight group >300 kg were significantly ($P<0.05$) higher than that of age group <3 yrs and body weight group <200 kg but the length in age group 3 ≤5 yrs and body weight group 200 to 300 kg were not differ significantly ($P>0.05$) with that of other two age and body weight groups (Table 56 & 58). The highest values of right and left uterine horn were higher in age group >5 yrs (27.58 ± 1.08 and 28.41 ± 1.12 cm) and body weight group >300 kg (27.00 ± 1.05 and 27.77 ± 1.12 cm), respectively than other groups. Among the different parities, it was observed that in case of right uterine horn 3rd parity was significantly ($P<0.05$) higher than that of others and in case of left uterine horn 2nd parity was significantly ($P<0.05$) higher than that of others (Table 60). The values of right uterine horn was higher in 3rd parity (29.20±1.44 cm) and left uterine horn higher in 2nd parity (30.20±1.54 cm), respectively.

4.2.1.4 Body of uterus

The uterus of cows was bicornuate in shape; two horns were joined posteriorly to form a short body of uterus that is situated in between os-internum and true bifurcation of cornea. This is the point where semen is deposited during artificial insemination. Horns were separated internally by a septum of bifurcation; each horn came forwards with a sharp coil. The mean length and width of body of uterus were 3.12 ± 0.72 and 2.51 ± 0.59 cm, respectively in different genotypes, age and body weight groups and parities of cows (Table 54, Table 56, Table 58 and Table 60 and Figure 53). The highest length and width of body of uterus was observed in Local × Holstein Friesian and were 3.42±0.20 and 2.83±1.40 cm, respectively (Table 54). The size of the length and width of body of uterus varied in different age and body weight groups and parities in the present study (Table 56, Table 58 and Table 60).

4.2.1.5 Cervix

Cervix was a sphincter muscle like structure, which formed a physiological barrier between the vagina and uterus. Its wall was harder, thicker and more rigid than the walls of either the uterus or the vagina. It was found larger in relation with the body of uterus. The cervix was consisted of rings and the rings were very hard in structure. The average mean length and width of cervix were recorded as 5.02 ± 0.11 and 4.56 ± 0.12 cm, respectively in different genotypes, age and body weight groups and parities of cow (Table 54, Table 56, Table 58 and Table 60 and Figure 53). The highest length (5.64 ± 0.24 cm) and width (4.89 ± 0.23 cm) of cervix were observed in Local×Holstein Friesian (Table 54).

The size of the length and width of cervix varied in different age and body weight groups in the present study. The length of cervix of age group >5 yrs was significantly ($P<0.05$) higher than that of other two age groups, but there exists no significantly difference ($P>0.05$) among the age groups <3 yrs & 3 ≤ 5 yrs (Table 56). The width of cervix of age group >5 yrs was significantly ($p<0.05$) higher than that of age group <3 yrs, but the width in age group 3 ≤5 yrs, did not differ significantly ($P>0.05$) with that of other two age groups (Table 56). On the other hand, the length and width of cervix of body weight group >300 kg was significantly ($P<0.05$) higher than that of other two body weight groups, but there exists no significantly difference ($P>0.05$) among the body weight groups <200 kg & 200 to 300 kg (Table 58). In the present study, the length and width of cervix of 3rd parity were higher values than that of others parity (Table 60). The values of length (6.10 ± 0.48 cm) and width (5.30 ± 0.56 cm) of cervix were higher in 3rd parity than that of others parity.

4.2.1.6 Vagina

The vagina appeared as a long musculo-membraneous tubular sheath like structure/passage with flashy smooth inner surface, which extends from cervix to the urethral opening. The average mean length and width of vagina were 22.59 ± 0.34 and 5.44 ± 0.16 cm, respectively in different genotypes, age and body weight groups and parities of cow (Table 54, Table 56, and Table 58 and Table 60 and Figure 53). The highest length (24.66 ± 0.64 cm) and width (6.08 ± 0.36 cm) of vagina were observed in Local × Holstein Friesian cows. Age had significant effect ($P<0.05$) on the length and width of vagina of cows (Table 56) and body weight had significant effect ($P<0.05$) on the length of vagina of cows (Table 58).

The highest length and width of vagina were observed in age group >5 yrs (24.35 ± 0.54 and 5.71 ± 0.29 cm) and body weight groups >300 kg (23.94 ± 0.54 and 5.79±0.31 cm), respectively. In the present study, the length and width of vagina in 3rd parity were higher values than that of others parity (Table 60). The values of length (24.50 ± 1.36 cm) and width 6.10 ± 0.88 cm of vagina were higher in 3rd parity than that of others parity.

4.2.1.7 Vulva

Vulva was the external portion of the tract that extends from vagina to the exterior opening. The average mean length and width of vulva were 8.85 ± 0.14 and 4.83 ± 0.13 cm, respectively in different genotypes, age and body weight groups and parities of cow (Table 54, Table 56, Table 58 and Table 60 and Figure 53). The highest length of vulva was observed in Local × Holstein Friesian (9.37 ± 0.24 cm) cows and the highest width of vulva was observed in Local × Jersey (5.45 ± 0.28 cm). Genotype had significant effect ($P<0.05$) on the width of vulva of cows (Table 54). The size of length and width of vagina varied in different age and body weight groups in the present study (Table 56 and Table 58). The highest length and width of vulva of age group >5 yrs and body weight group >300 kg were recorded. In the present study, among the different parities, the highest length and width of vulva were recorded in 3rd parity and that was 9.50 ± 0.52 and 5.40 ± 0.34 cm, respectively.

Experiment-III: Study on the gross and histopathological changes of the affected organs

4.3.1 Results of pathological examination

The observation on pathological disorders of the female reproductive system was performed and the study was conducted with a view to determine the pathological lesions occurrence in the reproductive tract of cows based on gross pathological and histopathological examination.

4.3.1.1 Gross pathological examination

Gross study was performed during collection of samples from slaughter houses primarily and then during trimming of the samples for histopathology. The occurrence of the various disorders of the female reproductive system was shown in Table 61. One hundred and fifteen reproductive tract of cows were examined in eight abattoirs under Rajshahi district of which most of the reproductive tract were infected with one or more lesion (s) and which led the diagnosis of granular vulvo-vaginitis, enlarged, hemorrhage and swollen cervix i.e. cervicitis, aplasia of cervical ring, hemorrhage in uterus i.e. hemorrhagic endometritis, hemorrhage in the horn of the uterus i.e. chronic endometritis, pyometra, mucometra, parasitic cyst within the uterus, sub-active ovary, hemorrhage in ovary, follicular cyst, luteal cyst, multicystic ovary and mesovarian cyst etc.

4.3.1.1.1 Granular vulvo-vaginitis

The vaginas were swollen and reddish in color. Out of 115 cows, 11 (9.57%) were identified with granular vulvo-vaginitis. It was confirmed by observing numerous nodular lesions (0.5 to 1.50 mm in diameter) with congestion and mild catarrhal exudates (C) on the mucosal surface of vagina and vulva (Figure 54) and 9 (7.82%) were identified with vaginitis showing diffuse congestion and mucus exudates on the mucosal surface (D) of vagina (Figure 54).

4.3.1.1.2 Enlarged, hemorrhagic and swollen cervix

The affected cervix appeared edematous swelling and highly congestion (C) as seen is cervicitis (Figure 55). The number of animals suffering from cervicitis was found to be 12 (10.43%). Dilatation and congestion of the cervix with yellowish mucus exudates on the mucosal surface (D) as seen is chronic cervicitis (Figure 55).

4.3.1.1.3 Aplasia of cervical ring

Only the first ring of the cervix was present.

4.3.1.1.4 Endometritis

Endometritis was diagnosed in 22 (19.14%) cases. Hemorrhagic endometritis of the uterus characterized by petechial and ecchymotic haemorrhages in the endometrium (C) (Figure 56) and chronic endometritis characterized by edematous swelling, hemorrhages and highly congestion in the endometrium (D) (Figure 56).

4.3.1.1.5 Mucometra

03 (2.61%) case of mucometra was diagnosed out of 115 genitalia. The uterus appeared to be larger, contain a large amount of yellow reddish color slimy mucus. Reddish colored and purulent mucus was present after opening the uterus or horn of uterus.

4.3.1.1.6 Pyometra

During post-mortem examination, 6 (5.21%) case was recorded as pyometra. The uterus was enlarged in size, highly congested caruncles with horn and contained cream color pus with foul odor (Figure 57).

4.3.1.1.7 Parasitic cyst within the uterus

Parasitic cyst was detected in 01 (0.87%) case. The cyst was present in the entire uterus (Figure 58).

4.3.1.1.8 Mesovarian cyst

Only one (0.87%) case of mesovarian cyst was detected. The cyst was found to be attached to the mesovarium/ mesosalpinx measured 17 mm in diameter as a clear spherical cyst (Figure 59).

4.3.1.1.9 Follicular cyst

Out of 115 genitalia, the follicular cysts were diagnosed in 11 (9.57%) cases. The cyst was 20 mm in diameter, thin walled and soft on palpation. There were cystic structures filled with clear fluid and protruding to the surface of the ovary (Figure 60).

4.3.1.1.10 Sub-active ovary

Sub-active ovaries exhibited developmental small or medium size graafian follicle. 4 (3.48%) case was recorded as sub-active ovary or small ovary. Such ovaries appeared to be somewhat firm in consistency.

4.3.1.1.11 Luteal cyst

03 (2.61%) case was recorded as luteal cyst. The formalin fixed ovary (cystic ovary) showing (6.10 mm in diameter) containing large corpus luteum (CL) that occupying almost entire areas of the ovarian parenchyma (Figure 61).

4.3.1.1.12 Multicystic ovary

During post-mortem examination, 02 (1.73%) cases were recorded as multicystic ovary. The cyst showing multiple cysts ranging from 2.25~4.00 mm (average 2.425 mm) in diameter on the surface of ovary (Figure 62).

4.3.1.1.13 Intact reproductive tract

Intact reproductive tract showing congestion (Figure 63), normal appearance (Figure 64), profuse, transference mucous within the vagina and mature growing follicle in ovary indicating just before ovulation (Figure 65) and showing mature corpus luteum, corpus haemorrhagicum (Figure 66).

Table 61 Percentage of pathological disorders of reproductive system of cows observed during post-mortem examination in the abattoirs.

Sl. No.	Pathological disorder of the reproductive system	No. of affected animals	Percent of disorder (%)	Total no. of genitalia examined
1	Granular vulvo-vaginitis	11	9.57	115
2	Vaginitis	9	7.82	
3	Aplasia of cervical ring	3	2.61	
4	Cervicitis	12	10.43	
5	Endometritis	22	19.14	
6	Pyometra	6	5.21	
7	Mucometra	3	2.61	
8	Parasitic cyst within the uterus	1	0.87	
9	Sub-active ovary	4	3.48	
10	Hemorrhage in ovary	8	6.96	
11	Follicular cyst	11	9.57	
12	Luteal cyst	3	2.61	
13	Multicystic ovary	2	1.73	
14	Mesovarian cyst	1	0.87	

4.3.1.2 Histopathological examination

The relative incidence of various histopathological disorders observed under microscope was shown in Table 62. The prevalence of abnormalities of genital system of dairy cows at slaughter house was 48.7%. The incidence of endometritis was found to be highest (30.36%) followed by vaginitis (23.21%), cervicitis (21.42%), follicular cyst (17.86%) and multicystic ovary (7.14%) which was reconfirmed by histopathological studies.

Endometritis which was the most common pathological disorders encountered during examination characterized by proliferation of fibrous connective tissue and infiltration of lymphocytes, macrophages (arrow) in the endometrium indicating a state of endometritis (C, D) and normal (A, B) (Figure 67) and showing infiltration of lymphocytes and macrophages within the lumen of the endometrial gland (D, E) (arrow) and thickening of the endometrial wall (arrow) showing proliferation of connective tissue associated with infiltration of lymphocytes and macrophages indicating a state of chronic endometritis (C, D), higher magnification of the above slide (E) and normal (A, B) (Figure 68).

The second most common pathological condition observed under microscope was vaginitis characterized by hyperemia and leukocytic infiltration in the lamina propria which is consists of lymphocytes, macrophages and neutrophils (C, D) and normal vagina (A, B) (Figure 69) and showing leukocytic infiltration mainly lymphocytes, neutrophils (arrow) below the epithelial layer of mucosa and in the peri-glandular area (arrow) of lamina propria of vagina (C, D) and inflammatory cells mainly neutrophils and lymphocytes below the stratified squamous epithelia of mucosal layer (arrow) (E) and intraepithelial leukocytic infiltration in the stratified squamous epithelial layer (arrow) (F) of vagina and normal (A, B) (Figure 70).

Cervicitis was characterized by infiltration of lymphocytes associated with connective tissue proliferation indicating a state of chronic cervicitis (C, D) and leukocytic infiltration mainly lymphocytes with erosion of the epithelial layer (arrow) indicating a state of cervicitis (E, F) and normal (A, B) (Figure 71) and higher magnification of the above slide (Figure 72), and intense infiltration of lumphocytes in the muscularis layer indicating a state of cervicitis (C, D, E, F) and normal (A, B) (Figure 73).

Normal structures of mature Graafian follicule which is characterized by presence of potential ovum, corona radiate, cumulus oophorus, antrum, granulose cells and basement membrane (Figure 74).

Follicular cyst, which was common pathological disorders encountered during examination showing by dilatation of the secondary follicles, which is characterized by presence of pink color proteinecious liquor folliculi, thinness of granulose cells and absolutely absence of ovum (A, B) (Figure 75).

Multicystic ovary showing dilatation of the secondary follicles, which is characterized by presence of pink color proteinecious liquor folliculi, thinness of granulose cells and absolutely absence of ovum (C, D) (Figure 75).

Table 62 Histopathological findings of different organs of the reproductive system of cows.

Sl. No.	Histoathological disorders	No. of affected animals	% of cases on the basis of disorder	Total no. of genitalia examined
1	Endometritis	17	30.36	115
2	Cervicitis	12	21.42	
3	Vaginitis	13	23.21	
4	Follicular cyst	10	17.87	
5	Multicystic ovary	4	7.14	
	Total	56	100	

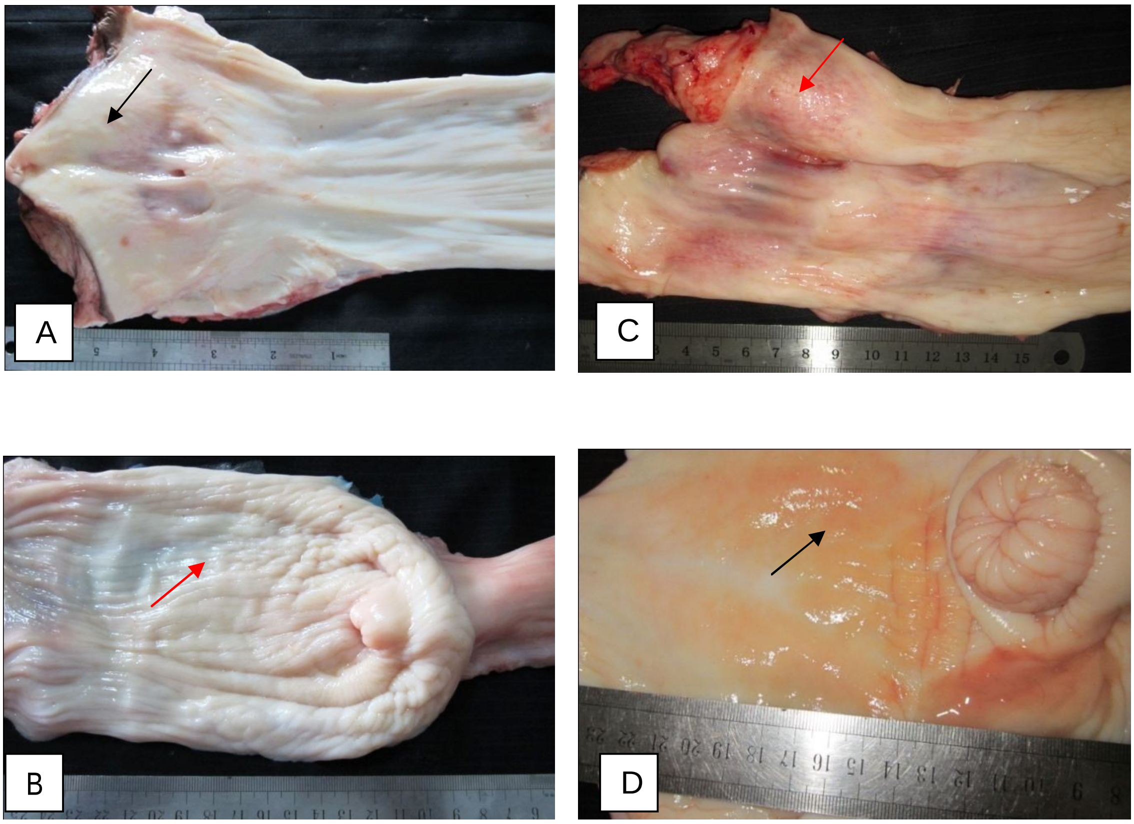


Figure 54 The longitudinal section of healthy vagina showing shiny, smooth and light cream in colour (arrow) on the mucosal surface (A, B) compare to the longitudinal section of vagina of a 7-year-old cow showing numerous nodular lesions (arrow) (0.5 to 1.50 mm in diameter) with congestion and mild catarrhal exudates (C) as seen is granulovulvo-vaginitis and of a 6-year-old cow showing diffuse congestion (arrow) and mucus exudates on the mucosal surface (D) as seen is vaginitis.

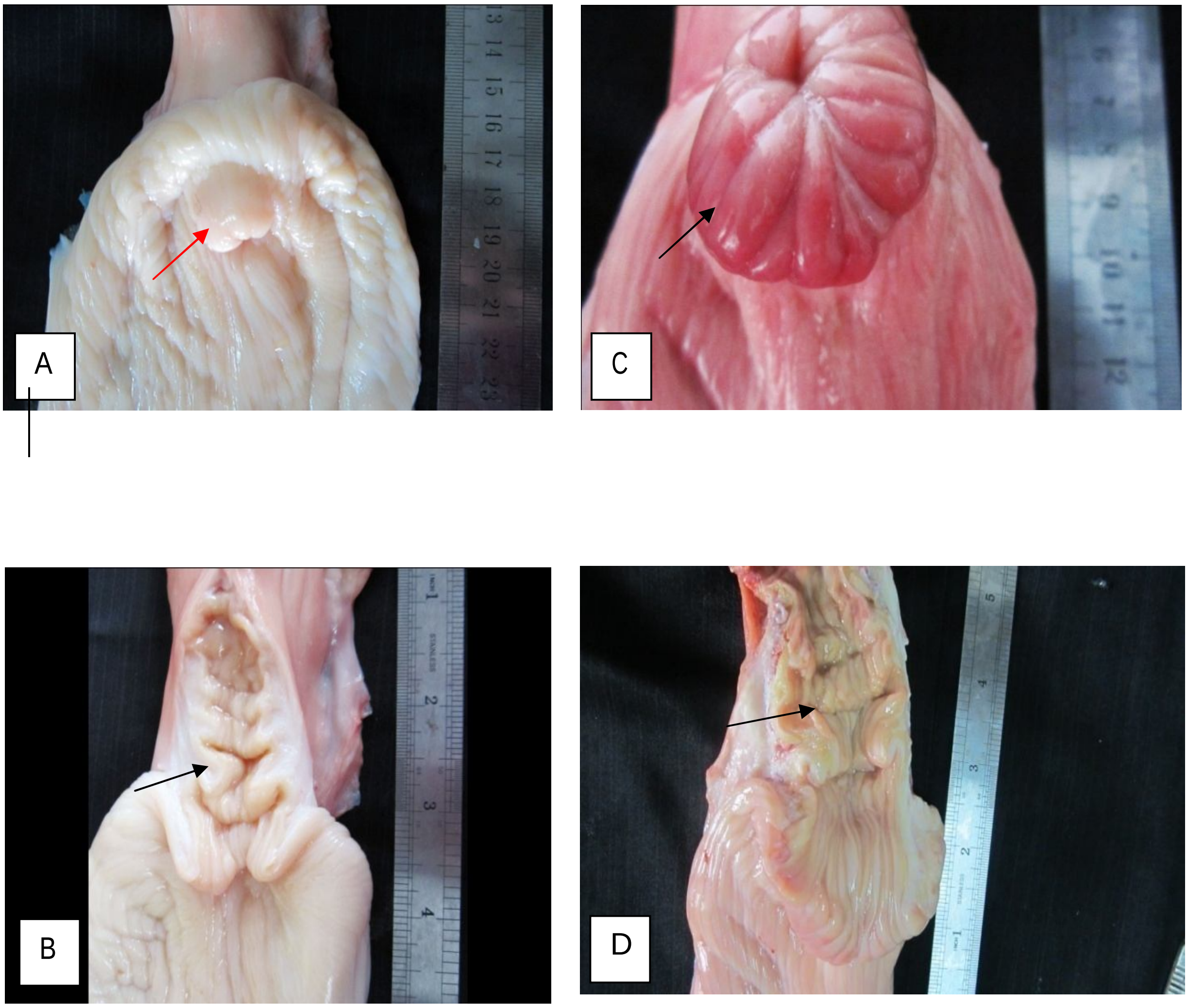


Figure 55 The longitudinal section of healthy cervix showing shiny, smooth and light cream in colour (arrow) on the mucosal surface (A, B) compare to the cervix of a 8-year-old cow showing (arrow) edematous swelling and highly congestion (C) as seen is cervicitis and of a 8-year-old cow showing (arrow) congestion, edematous and yellowish mucus exudates on the mucosal surface (D) as seen is chronic cervicitis.

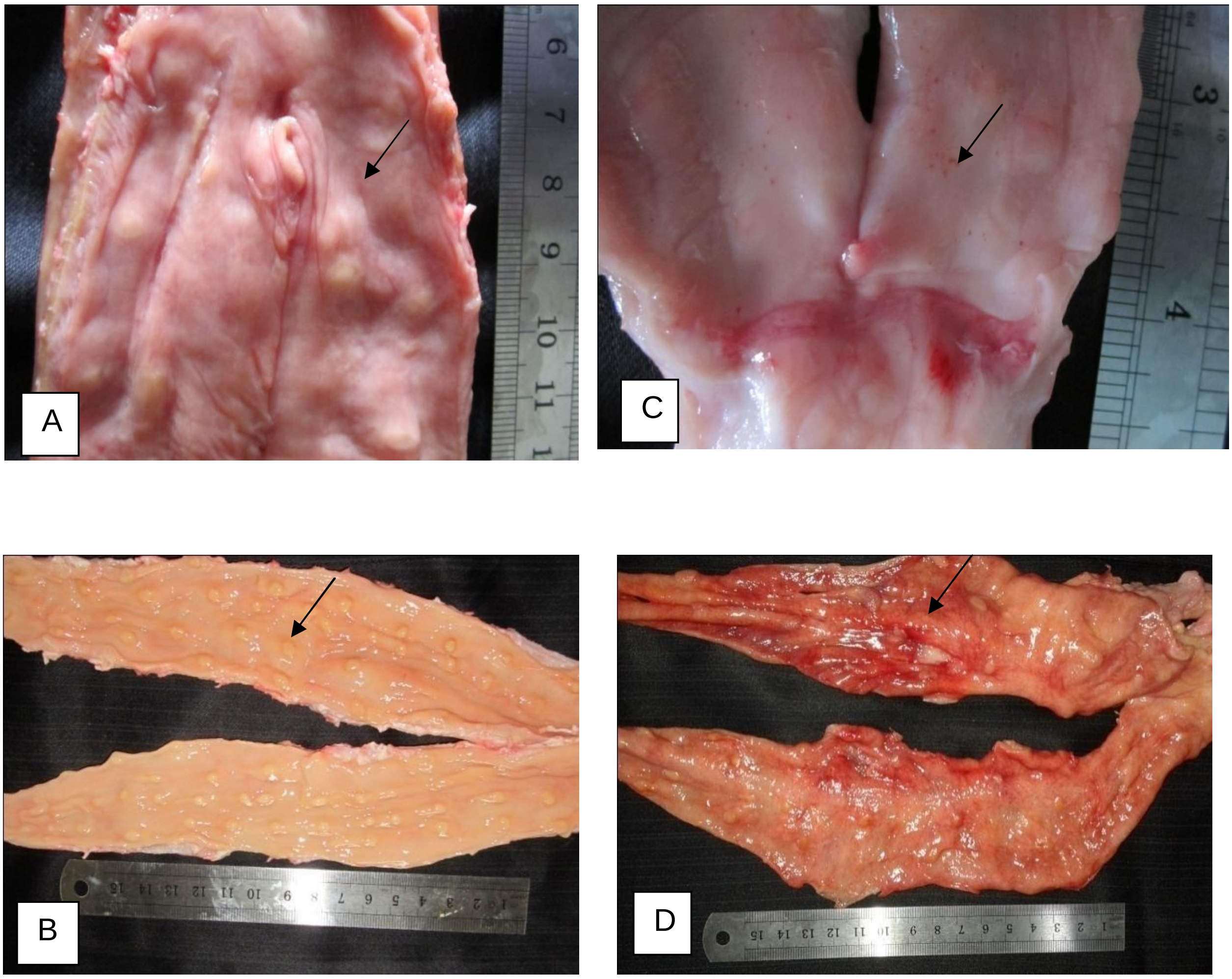


Figure 56 The longitudinal section of healthy uterus and horn showing shiny, smooth and light cream in colour (arrow) in the endometrium (A, B) compare to the longitudinal section of uterus of a 8-year-old cow showing petechial and ecchymotic haemorrhages (arrow) in the endometrium (C) as seen is haemorrhagic endometritis and of a 5-year-old cow showing edematous swelling, haemorrhages and highly congestion (arrow) in the endometrium (D) as seen is chronic endometritis.

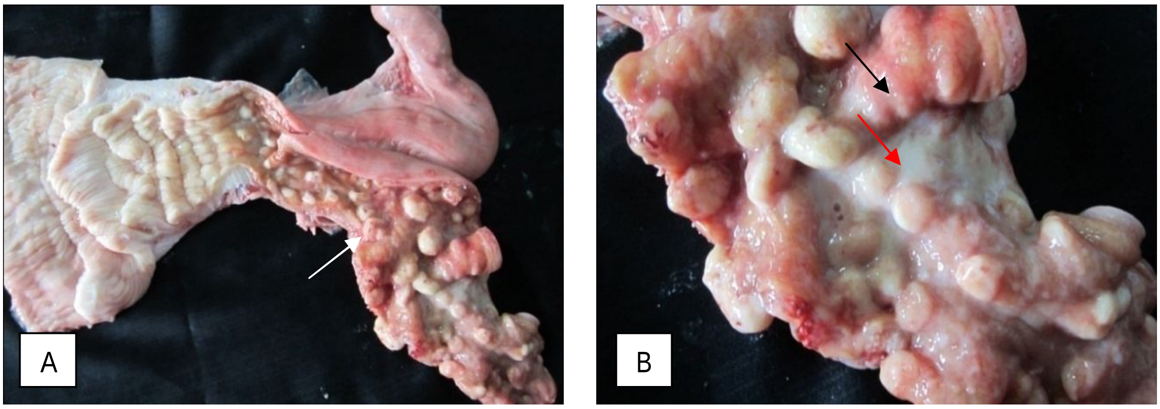


Figure 57 The longitudinal section of uterus and horn of uterus of a 9-year-old cow showing highly congested caruncles with horn (black and white arrow) and contained cream color pus with foul odor (red arrow) both A & B as seen is pyometra.

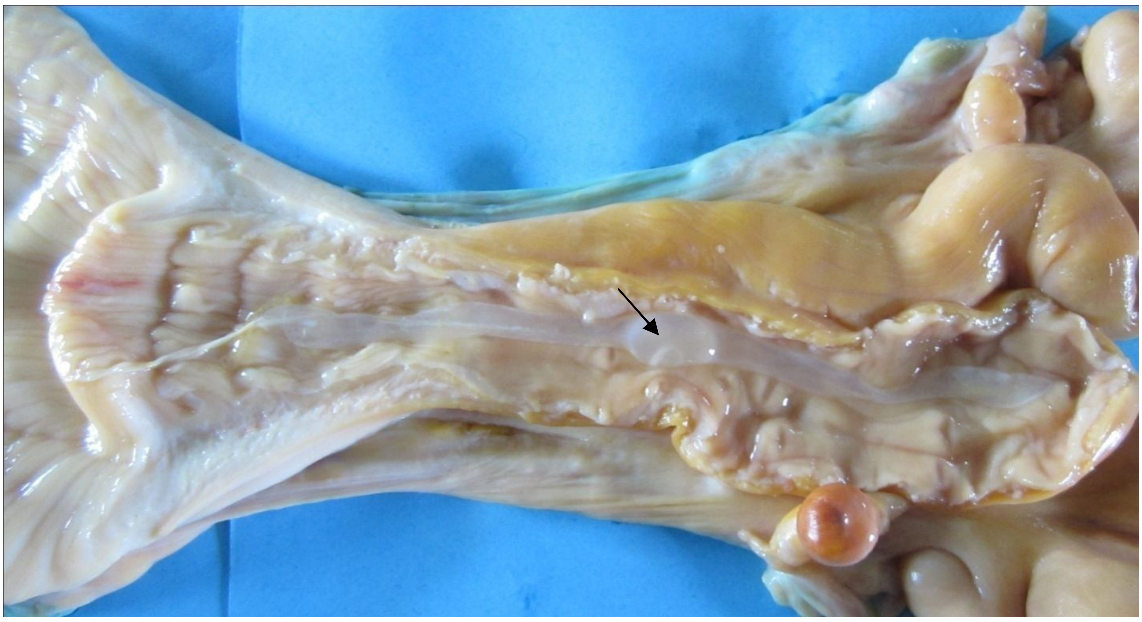


Figure 58 The longitudinal section of uterus and horn of uterus of a 8-year-old cow showing parasitic cyst (arrow) in the entire uterus.

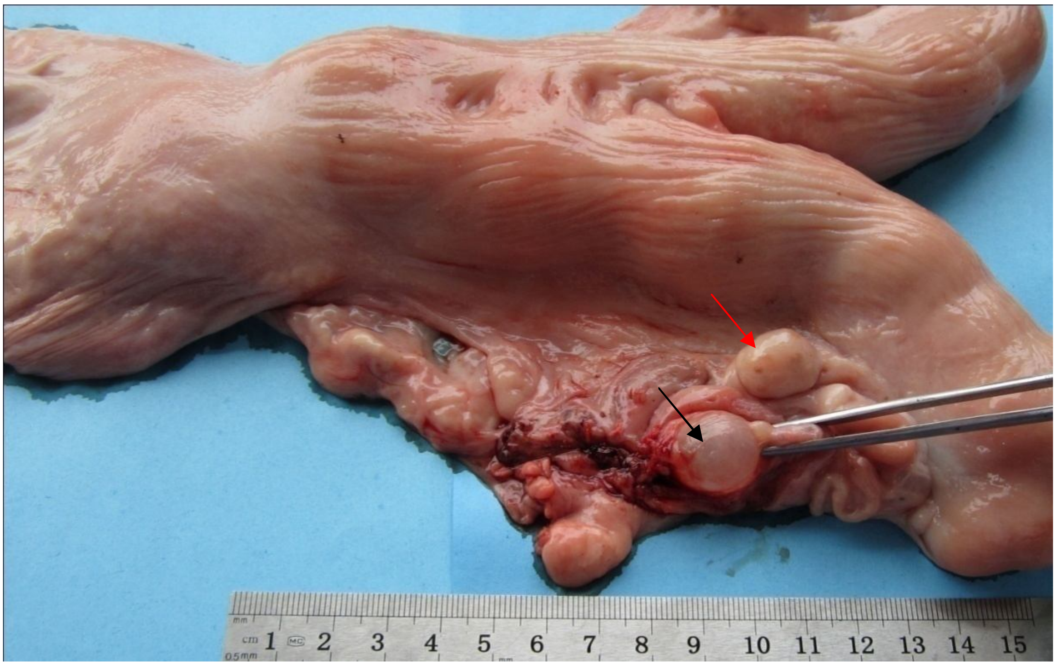


Figure 59 The reproductive tract of a 8-year-old cow showing ovary (red arrow) and mesovarian cyst (black arrow) measured 17 mm in diameter.

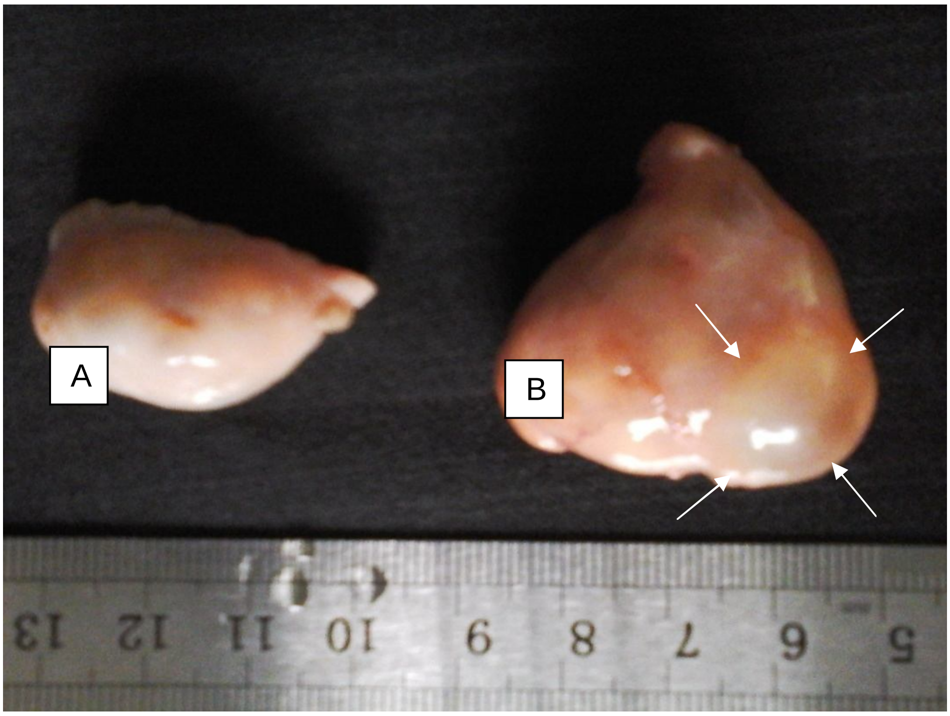


Figure 60 The ovary of a 6-year-old cow containing large follicular cyst (B) was (21 mm in diameter), thin walled, soft on palpation and contain clear fluid (arrow) compare to the left (A) as seen is normal.

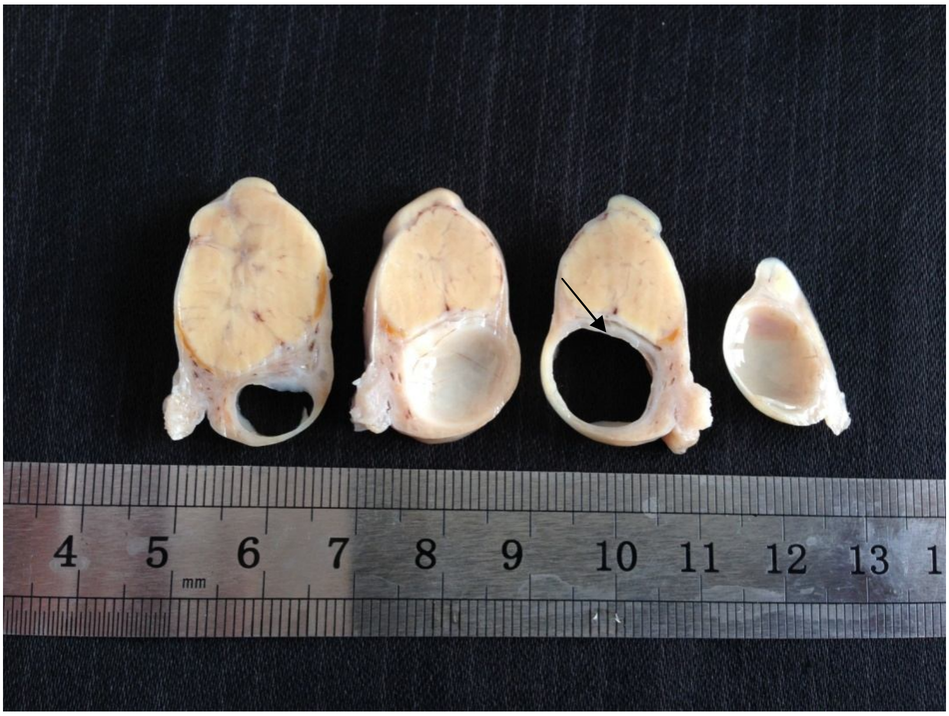


Figure 61 The longitudinal section of luteal cyst of a 7-year-old cow of formalin fixed ovary (cystic ovary) showing (6.10 mm in diameter) containing (arrow) large corpus luteum (CL) that occupying almost entire areas of the ovarian parenchyma.

Figure 62 The ovary of a 8-year-old cow showing (arrow) multiple cysts ranging from 2.25~4.00 mm (average 2.425 mm) in diameter.

Figure 63 The reproductive tract (outer view) of a 8-year-old cow showing (arrow) congestion

Figure 64 The reproductive tract (outer view) of a 8-year-old cow showing (arrow) normal appearance

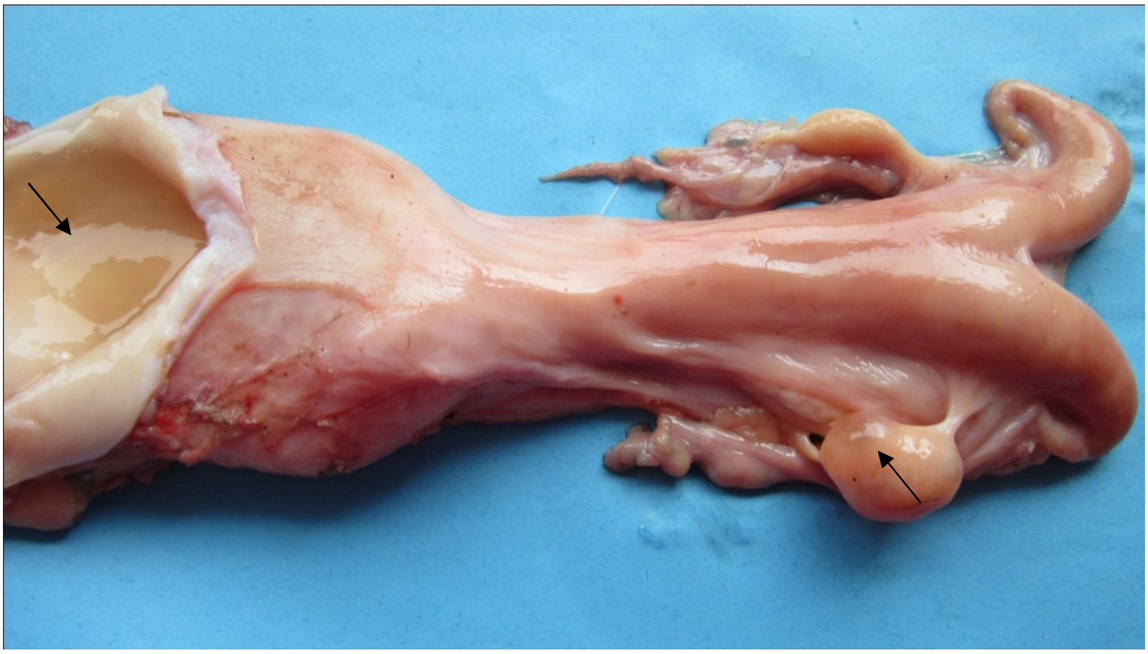


Figure 65 The reproductive tract of 5-year-old-cow showing (arrow) profuse, transference mucous within the vagina and mature growing follicle (arrow) in ovary indicating just before ovulation

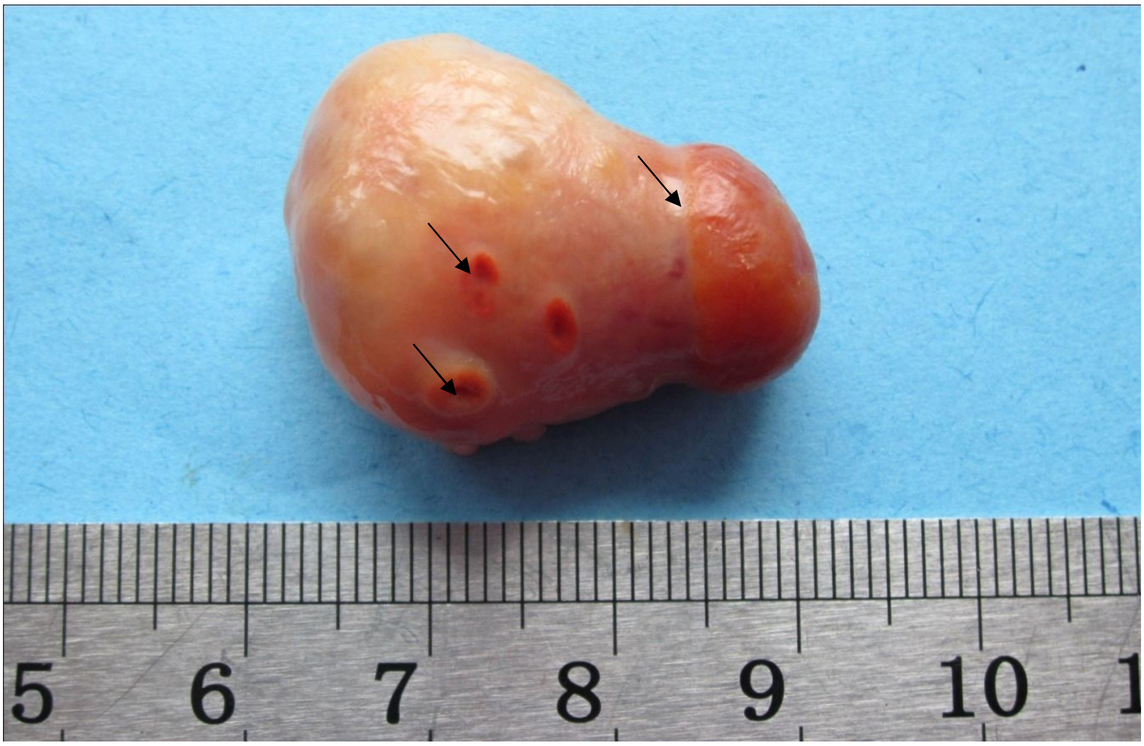


Figure 66 The ovary of 6-year-old cow showing mature corpus luteum, corpus haemorrhagicum.

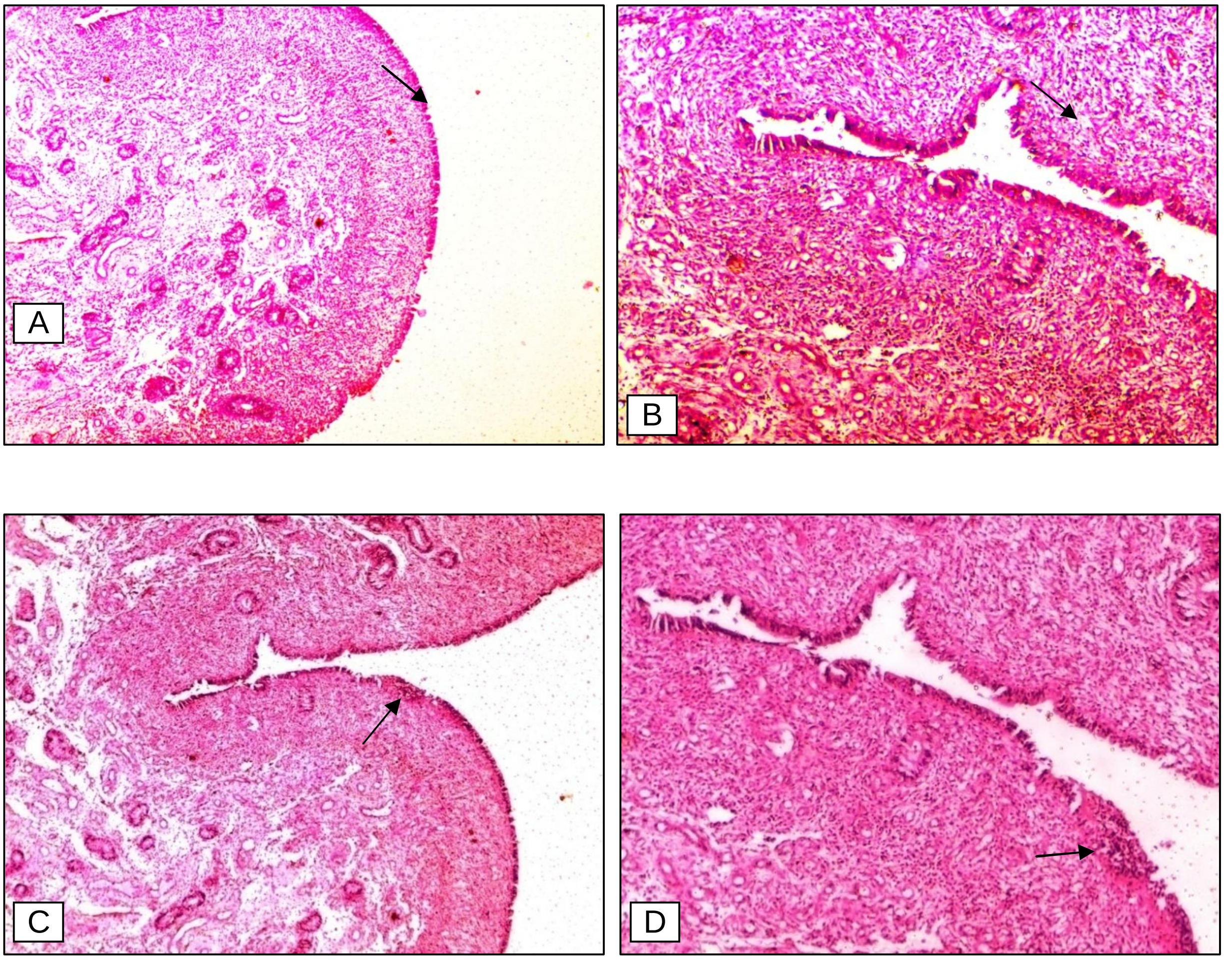


Figure 67 The section of uterus showing proliferation of fibrous connective tissue and infiltration of lymphocytes, macrophages (arrow) in the endometrium indicating a state of endometritis (C, D) and normal (A, B) in (H & E, 4X and 10X).

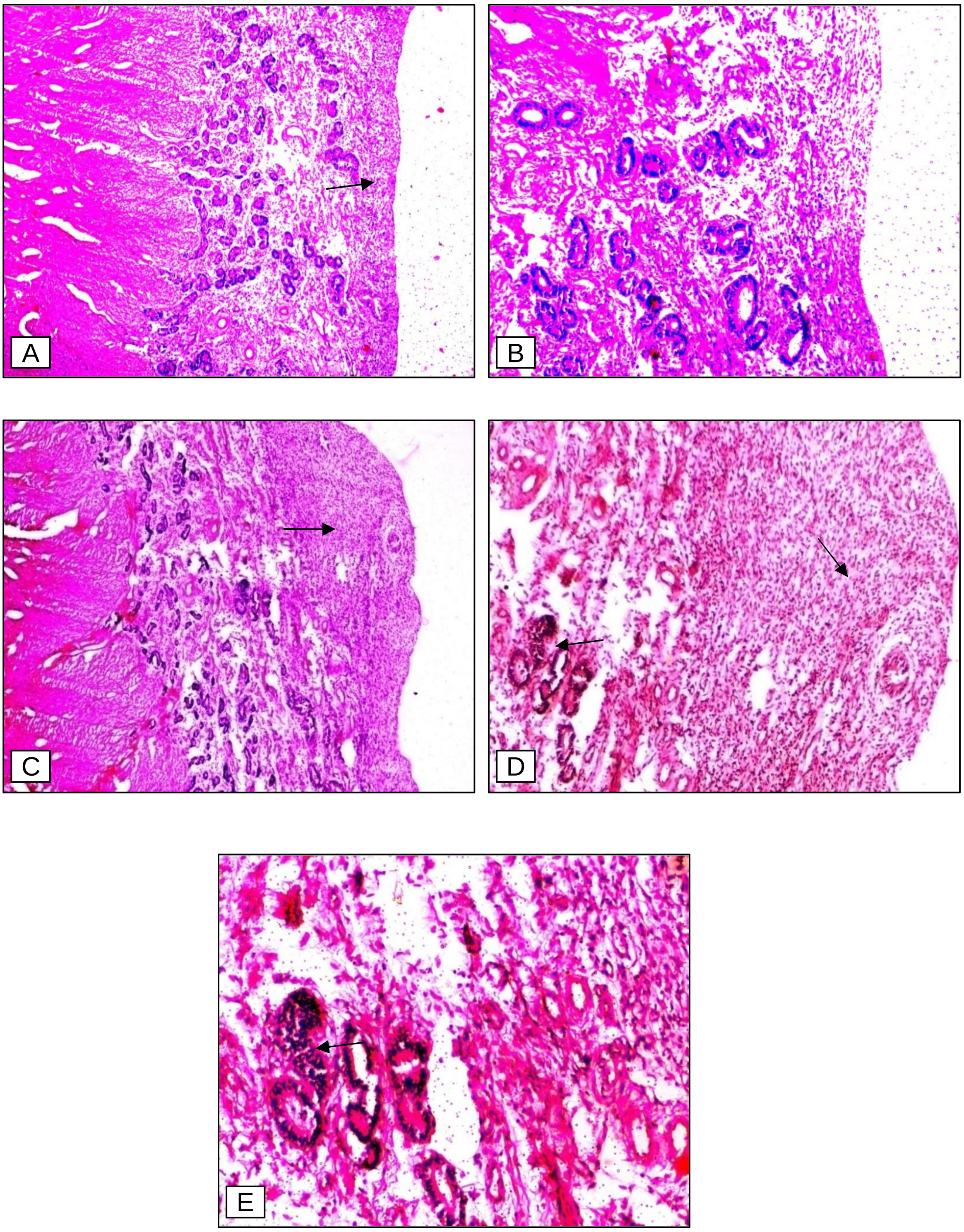


Figure 68 The section of horn of uterus showing infiltration of lymphocytes and macrophages within the lumen of the endometrial gland (arrow) and thickening of the endometrial wall (arrow) showing proliferation of connective tissue associated with infiltration of lymphocytes and macrophages indicating a state of chronic endometritis (C, D), higher magnification of the above slide (E) and normal (A, B) in (H & E, 4X and 10X).

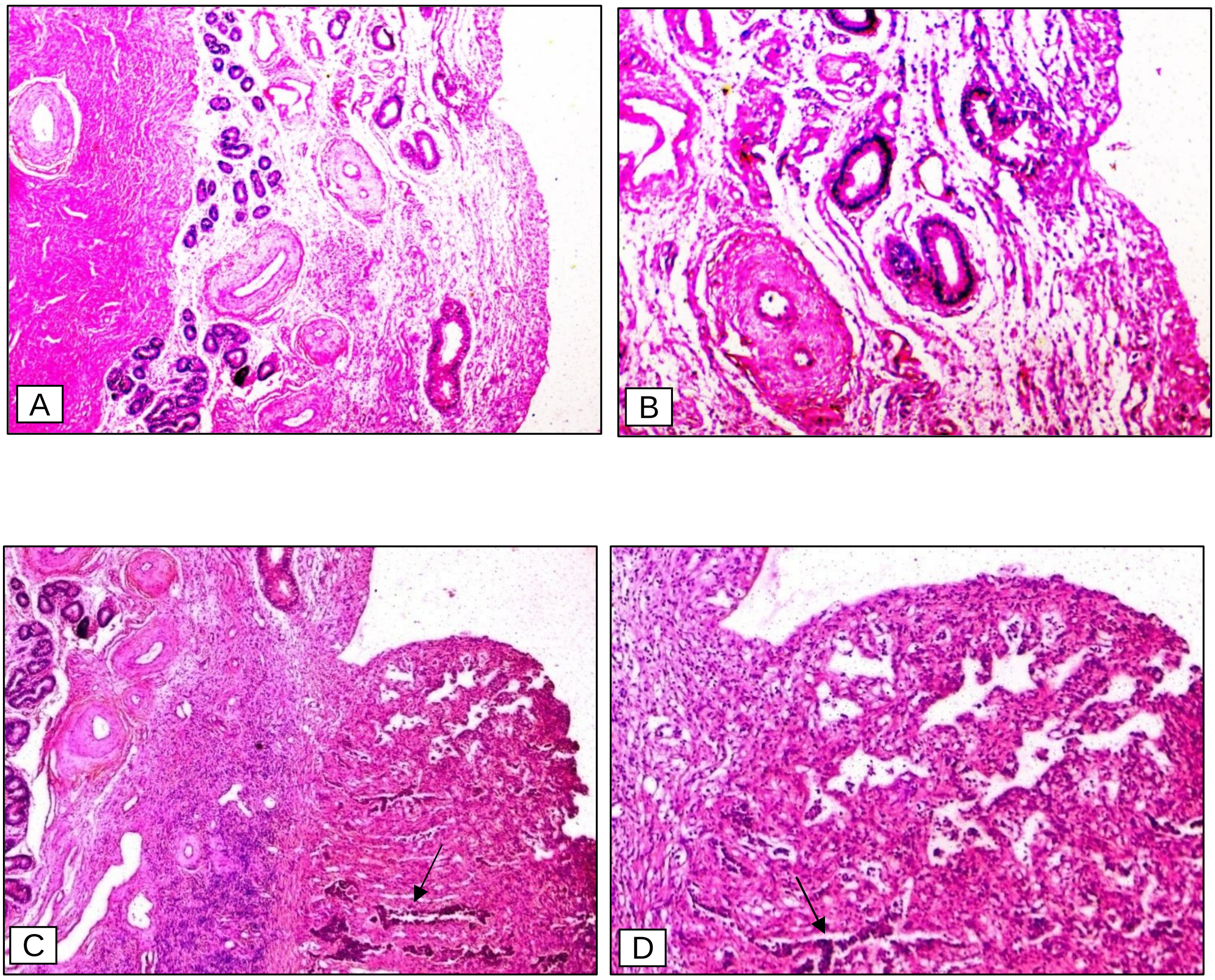


Figure 69 The section of vagina showing leukocytic infiltration in the lamina propria which is consists of macrophages, neutrophils and lymphocytes (arrow) (C, D) and normal (A, B) in (H & E, 4X and10X).

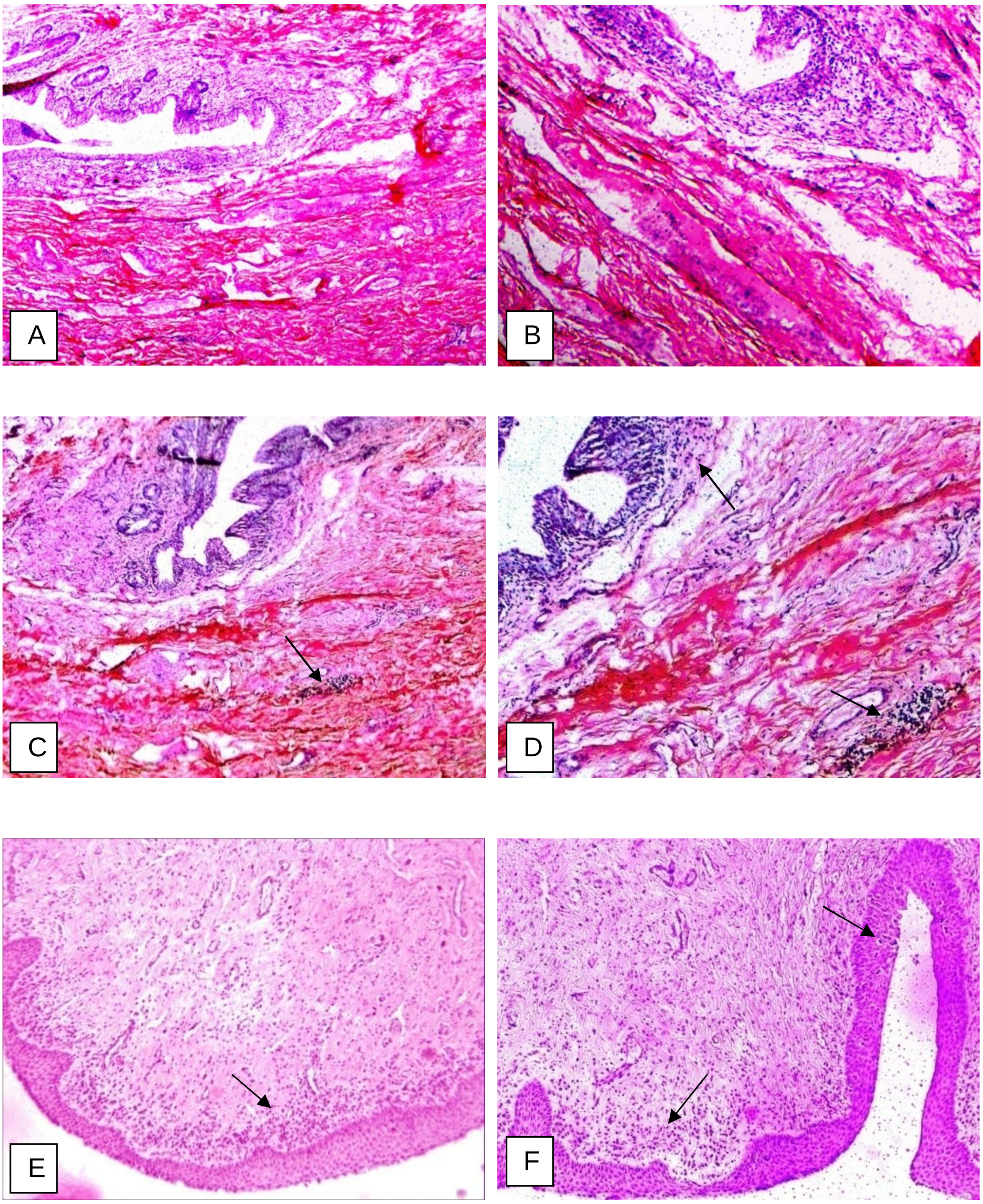


Figure 70 The section of vagina showing leukocytic infiltration mainly lymphocytes, neutrophils (arrow) below the epithelial layer of mucosa and in the peri-glandular area (arrow) of lamina propria of vagina (C, D) and inflammatory cells mainly neutrophils and lymphocytes below the stratified squamous epithelia of mucosal layer (arrow) (E) and intraepithelial leukocytic infiltration in the stratified squamous epithelial layer (arrow) (F) of vagina and normal (A, B) in (H & E, 4X and10X).

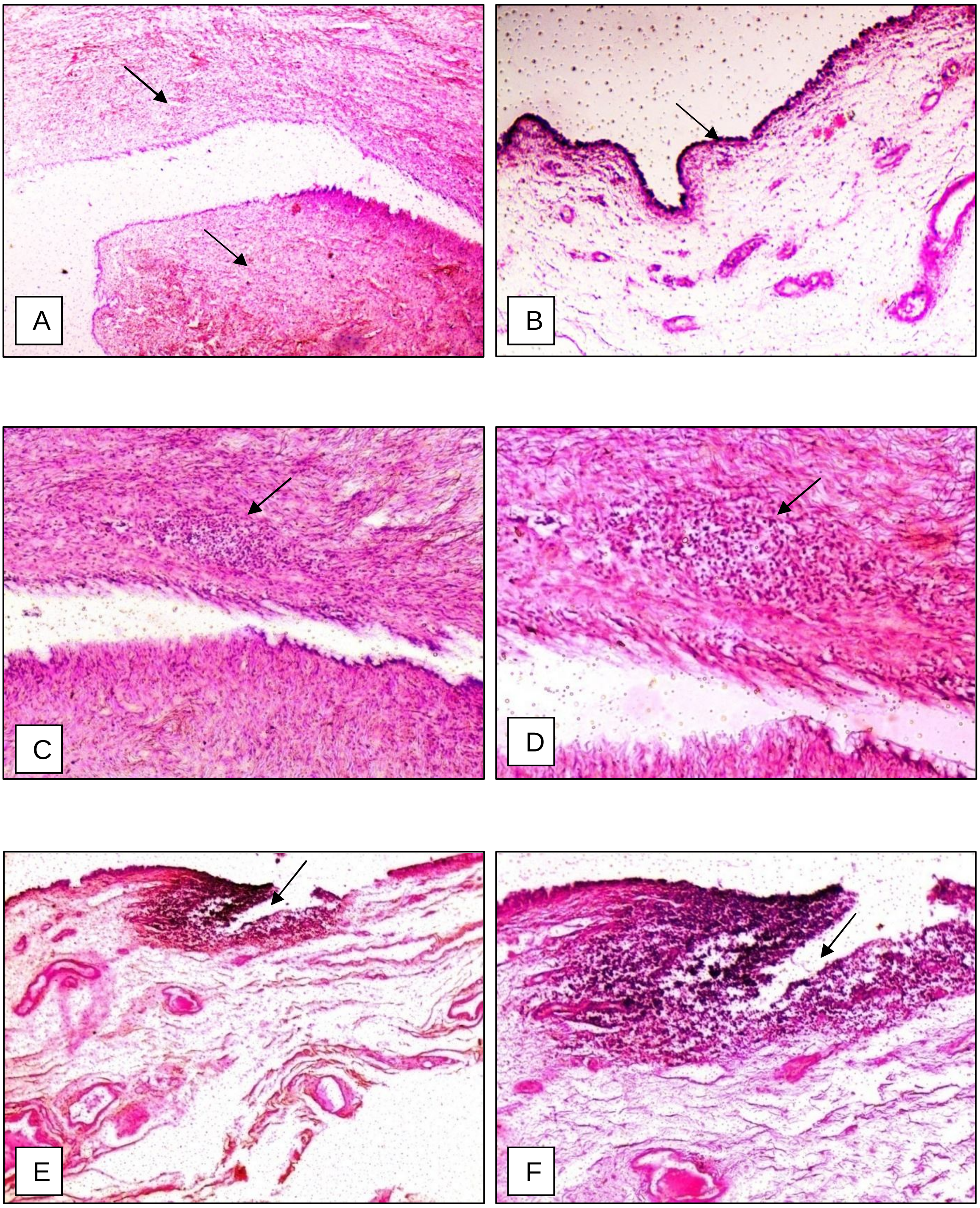


Figure 71 External surface of the cervix showing leukocytic infiltration mainly lymphocytes associated with connective tissue proliferation indicating a state of chronic cervicitis (C, D) and leukocytic infiltration mainly lymphocytes with erosion of the epithelial layer (arrow) indicating a state of cervicitis (E, F) and normal (A, B) in (H & E, 4X and 10X). (H & E, 4X and 10X).

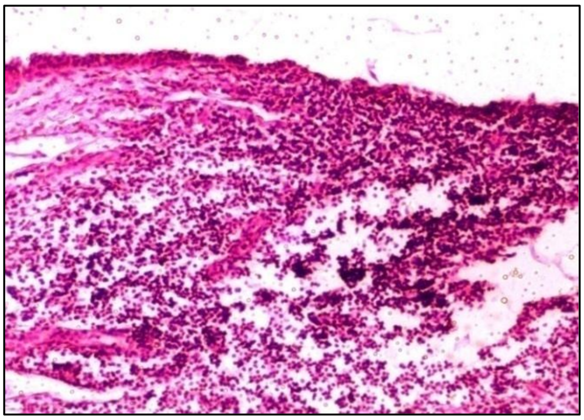


Figure 72 Higher magnification of the above slide (H & E)

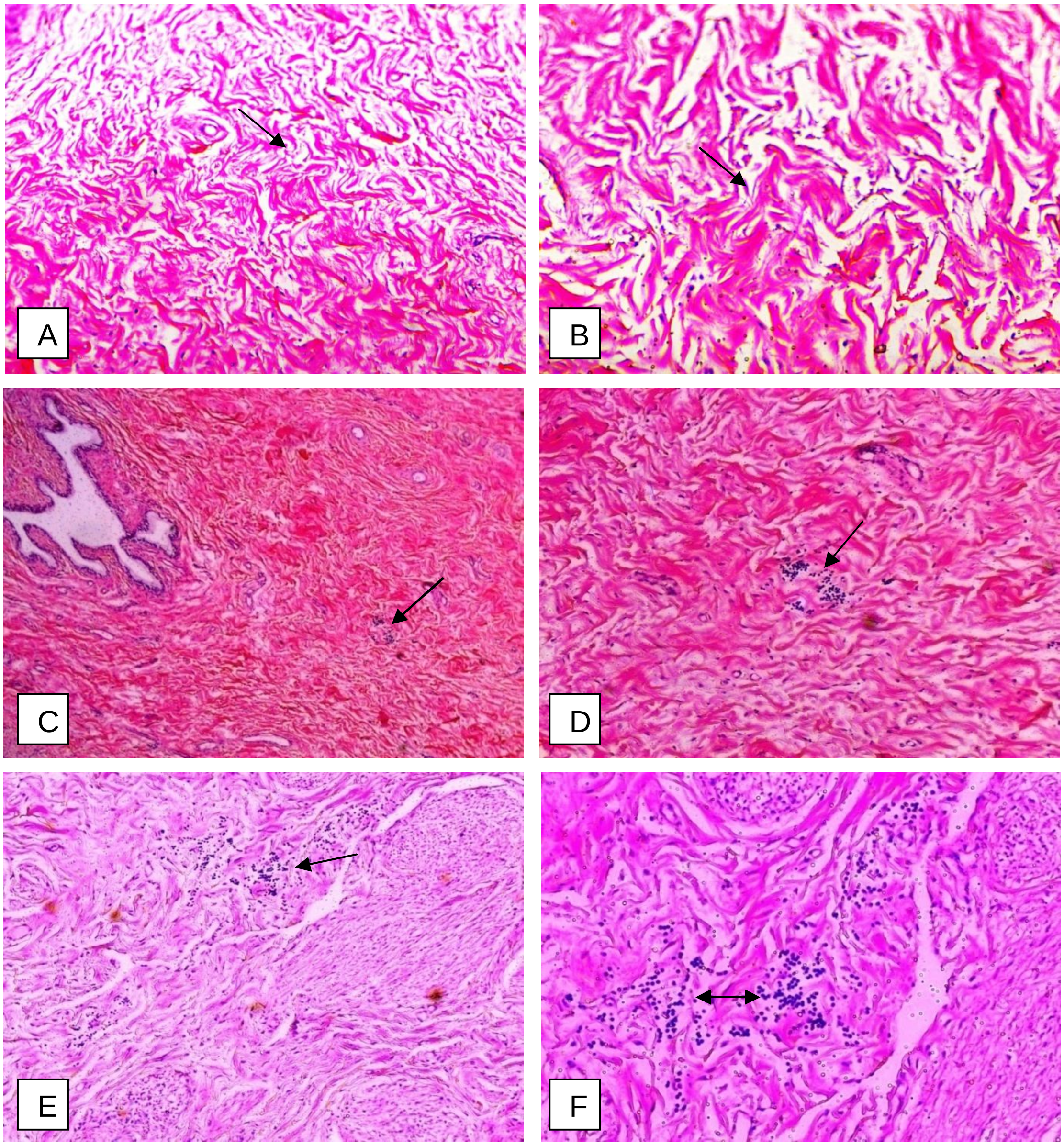


Figure 73 The section of cervix showing lymphocytic infiltration in muscularis layer (arrow) (C), epithelium of the endocervix showing lymphocytic infiltration (arrow) (D), leukocytic infiltration (arrow) mainly lumphocytes and neutrophils in the muscularis layer indicating a state of cervicitis (E, F) and normal (A, B) in (H & E, 4X, 10X and 20X).

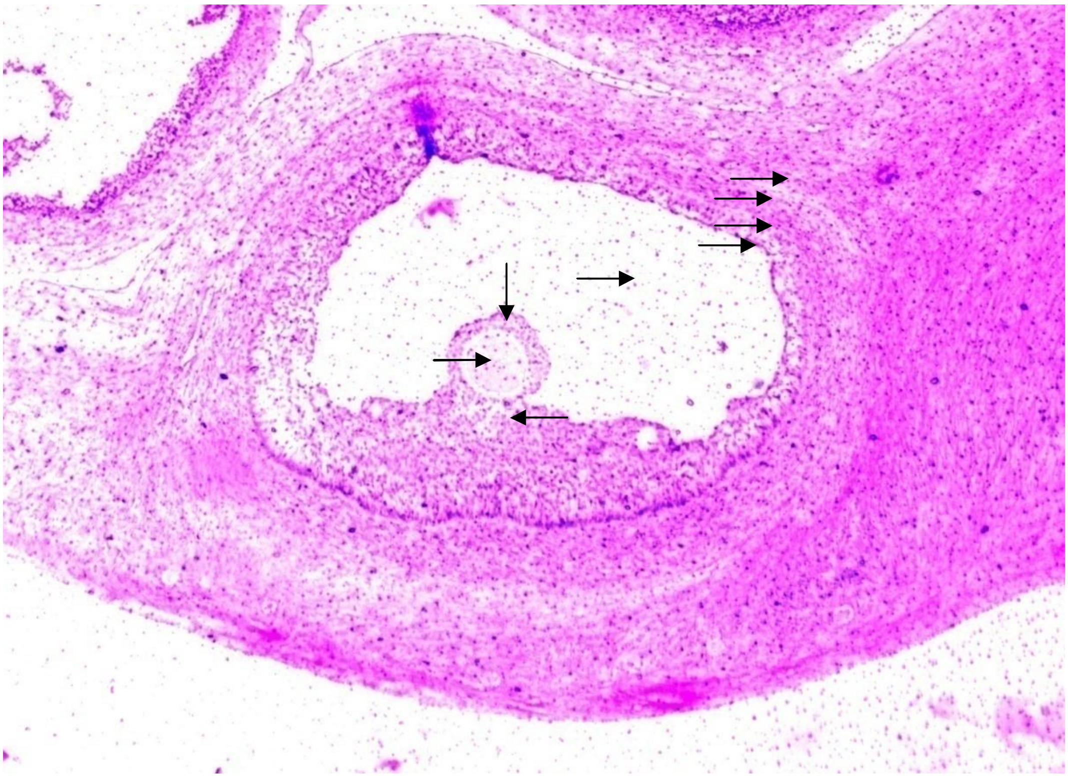


Figure 74 Presence of normal structures of mature Graafian follicule which is characterized by presence of potential ovum, corona radiate, cumulus oophorus, antrum (contain loquor follicle), basement membrane, granulose cells, theca intema and theca externa (H & E, 4X).

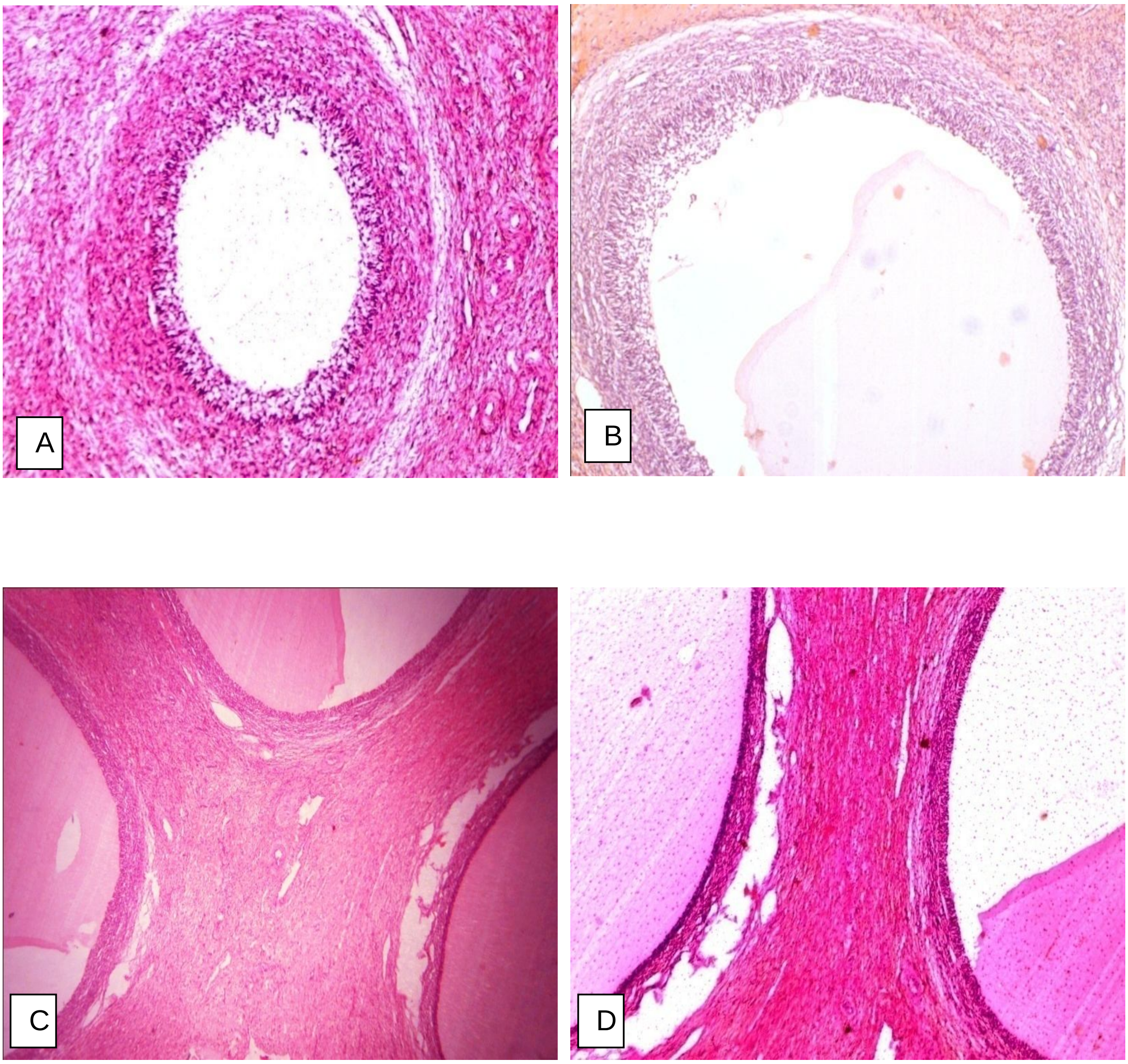


Figure 75 Microscopic figure of follicular cyst in ovary showing dilatation of the secondary follicles, which is characterized by presence of pink color proteinecious liquor folliculi, thinness of granulose cells and absolutely absence of ovum (A, B) and multicystic ovary (C, D) in (H & E, 4X and10X).

Chapter 5

DISCUSSION

Experiment I: Study on reproductive trends of dairy cows in Rajshahi district

The purpose of this study was to investigate the clinical trends of reproductive disorders of cows from 6 upazilas and 4 metro thanas of Rajshahi district. Most of the influencing factors viz. breed, age, parity, body weight, body condition score, management system and socio-economic status of farmers on reproductive performances and various reproductive disorders of dairy cows were discussed below:

5.1.1 Reproductive performance of dairy cows

From tables 1-33 the results of present study revealed the various reproductive performances of dairy cows. Infertility problems are usually overlooked by the farmers and reproductive health management is not ensured. These lead to delayed first calving, long calving interval and poor conception rate, imbalance feed management of dairy cows and calves, unavailability of pasture land, inadequate veterinary services, excessive cost of concentrate and unawareness of farmers in herd health management (Shamsuddin *et al.,* 2001) are burning issues, which seriously affects the farm economy. In present study the higher age at puberty, age at first calving (28.46 ± 0.55 m) and (37.39 ± 0.57 m) were observed in Godagari upazila whereas the lower (24.52 ± 0.71 m) and (33.54 ± 0.69 m) in Boalia metro thana. The lowest value of post-partum heat period (92.08 ± 5.3 d) was obtained in Rajpara metro thana and the highest value (148.82 ±11.45 d) was in Godagari upazila. The lower service per conception (1.62 ±0.11) was observed in Boalia thana and the higher (2.46 ±0.13) was in Mohanpur upazila. The higher value of days open and calving interval (158.82±11.41 d and 422.31±12.34 d) were observed in Godagari upazila and the lower value (115.13 ±6.82 d) was in Rajpara and (373.46±12.88 d) was in Poba upazila. This results show significant in different upazilas and metro thanas, which is marked by superscripts. The highest age at puberty of this study was similar to the result of Nahar *et al.* (1992) where the age at puberty was

28.46 months. Sarder (2001) recorded age at first calving in 38.7 months and 411.3±122.7 days calving interval was observed by Hoque *et al.* (1999) which were similar with the present study. On the other hand, Hossain (2013) studied to evaluate the reproductive performances of dairy cows at different upazila in Sylhet district. He found more or less similar from the present study that the highest age at puberty and age at first calving of cows in month (28.7 ± 6.5) and (41.5 ± 6.3) were observed in Biswanath upazila and the lowest in Golapgong (26.0 ± 5.5) and (38.0 ± 5.7) ($P<0.05$). The highest post-partum heat period was observed in Beanibazar (90.4 ± 19.2) and lower (80.7 ± 21.3) days in Golapgong. The days open was the highest (107.5 ± 27.4) in Companigong upazila and lower (99.5 ± 41.9) days in Golapgong ($P>0.05$). The cows in Kanaighat upazila took longer calving interval (417.4 ± 110.4) compared with lowest (395.1 ± 54.6) days in Beanibazar upazila. The cows in Biswanath needed the highest number of services per conception (1.54 ± 0.9), whereas the lowest (1.27 ± 0.7) was in Kanaighat. Shamsuddin *et al*. (2006) investigated that the age at first calving was 37 months in Sirajgonj-Pabria, district while it was 40, 35 and 33 months for Mymensing, Khulna-Satkhira and Chittagong, respectively. This difference of reproductive performance among the different upazila and metro thana could be due to effects of the differences in management systems, environmental conditions, poor heat detection and poor nutritional and health status of cows.

The breeds of animal is genetically determined that affects production and reproduction. The higher value of age at puberty, age at first calving, post-partum heat period, days open and calving interval in the present study (27.88 ± 0.47 m, 36.76 ± 0.47 m, 147.84 ± 7.83 d, 155.96 ± 7.17 d and 414.31 ± 8.76 d) were observed in local and the lower (26.05 ± 0.25 m, 35.16 ± 0.25 m, 115.67 ± 3.82 d, 132.24 ± 4.04 d and 398.42 ± 4.38 d) were in cross-bred cows. The higher value of service per conception (1.95 ± 0.05) was in cross-bred cows and the lower (1.84 ± 0.08) in local. There was only significant effect ($P<0.05$) of breed on post-partum heat period of dairy cows. In local cows, this value is lower than that of observed by Rahman and Kalita (2015) which were average age at puberty (31.45± 0.87) months, age at first calving (43.60±0.96) months, calving interval (533.63± 0.87) days, post-partum heat period (210.1±0.19) days and service per conception 2.47±0.11. However, Filfo *et al.* (1986) observed the average age at first calving in Red Sindhi in Brazil was 46.6 months, where as in India, it was in between 36.6 and 51 months (Gurani *et al.*, 1971). Jabber and Green (1983) stated an extended age at first calving in Bangladesh because of using heifers in draught work; the heifers took up to 4 years to calf for the first time. Tesfu Kasa (1996) observed post-partum intervals (Mean ± SD) and days open were 110.4 ± 23.5 and 199.8 ± 61.8 days for Zebu and 97.5 ± 25.1 and 157.8 + 55.5 days for cross-bred cow. In comparison, Sarder *et al.* (1997) reported the reverse effect that Holstein-Friesian cross requiring the longest time (149 days) to onset of post-partum estrus compared with the local ones (119 days). The author also reported the local cows required fewer services per conception (1.4) than the cross-bred (1.8). Khan (1990) found the average service per conception of local and cross-bred cows was 1.3 and 1.4, respectively. The author also found an average 1.59 services were required for local cows for each conception. Rahman (1999) reported the fewest days open in cross-bred Friesian than local cows (148.6 ± 89.2) and (188 ± 106.7) days, respectively.

Halim (1992) observed the average calving interval of local and cross-bred dairy cows was 445 and 425 days, respectively. Rahman *et al.* (1987) reported that 385.13 ± 25.5 to 495.75 ± 74.56 days calving interval in various types of Zebu cows and their crosses with *Bos taurus* cows. In Friesian x Local crosses, calving interval was 430.20 ± 3.75 days in India (Butt and Deshpande, 1986). This difference of reproductive traits among the breeds could be due to effects of the differences in management practice, environmental conditions, little rainfall, high ambient temperature, malnutrition and inappropriate semen handling and insemination techniques (Arthur *et al.,* 1989).

When compared with genetic composition the lower value of age at puberty and age at first calving (25.84 ± 0.27 m and 34.94 ± 0.27 m) were observed in Local × Friesian cows and (26.93 ± 0.61 m and 36.09 ± 0.62 m) and (27.88 ± 0.47 m and 36.76 ± 0.47 m) were in Local × Sahiwal and Local type, respectively. The higher value of post-partum heat period (147.84 ± 7.83 d) was observed in local and the lower value (112.43 ± 8.55 d) was in Local × Sahiwal. Maximum and minimum number of services were required for successful calving in dairy cows respectively were (1.96 ± 0.05) in Local × Friesian cows and (1.84 ± 0.08) in local. The higher value of days open and calving interval (155.96 ± 7.17 d and

414.31 ± 8.76 d) were observed in local and the lower value (128.28 ± 9.37 d) and (396.89 ± 10.96 d) were in Local × Sahiwal. Genotype had significant ($P<0.05$) effect on age at puberty, age at first calving, post-partum heat period, days open and calving interval and had no significant ($P>0.05$) effect on service per conception. Asimwe and Kifaro (2007) conducted a study to evaluate the effects of breed level and non-genetic factors on reproductive performance of dairy cattle. The overall mean for AFC was 35.1 ± 9.7 months, NSC was 1.66 ± 0.0, DO was 205.2 ± 2.6 days and CI averaged 480.4 ± 2.4 days. He found F_1 crosses performed better than high-grades in all the traits with 34.6 months of AFC, 182 days of DO, and 455 days of CI. Kollalpitiya *et al.* (2012) revealed that the age at puberty and age at 1st calving 23 and 33 months, respectively in Friesian were lower ($P<0.05$) than those of other breeds in Sri Lanka. On the other hand, the lowest ($P<0.05$) post-partum heat period and calving interval of 75 and 403 days was recorded from Sahiwal. Tsegaye *et al.* (2014) observed that age at first calving, calving interval and number of service per conception of Arsi zebu, cross less than 50%, greater than or equal 50%, boran and Jersey were 36.39, 24.78, 24.29, 12.88 and 24.54 months, 420.2, 360.4, 330.3, 330.8 and 360.4 days, and 1.18, 1.50, 1.72, 2.17 and 2.29, respectively in Hawassa city. Jabbar and Ali (1988) observed the service per conception of cross-bred, local (milk) and local (draft) were 1.6 ± 0.5, 1.2 ± 0.3 and 1.7 ±0.5, respectively. Sultana (1995) observed that service per conception of local (L), Sahiwal (SL), Local x Sahiwal and Local x Friesian were to be 1.8 ± 0.2, 1.1 ± 0.7, 1.2 ± 0.0 and 1.7 ± 0.2 respectively. Ghosh (1995) observed the services per conception were 1.6 ± 0.2 and 1.7 ± 0.2, for F x L and SL x L, respectively. Khan (1990) found the service per conception of Local x Friesian, Local x Jersey, Local x Holstein was found to be 1.8, 1.7 and 1.8, respectively. Shamsuddin *et al*. (2001) reported shorter days open in cross-bred Sahiwal cows than that in cross-bred Friesian and local cows. The author also observed the days open was shorter in cows used for only dairy (181 days) than in that used for dairy + draught (233 days) average service per conception of 2.2 in selected areas of Bangladesh. Mondal (1998) observed the average calving interval of Jersey cross, Sahiwal cross, Sindhi cross, Holstein cross and Red-Chittagong cows were as 501.4 ± 86.4, 446.0 ± 95.3, 414.1 ± 51.6 and 469.3 ± 123.8 days, respectively. Rahman *et al.* (1993) stated that in Sindhi and Friesian cross-bred cows the average calving interval was 420.4 ± 1.6 and 450.03 ± 1.9 days, respectively. Hoque *et* *al*. (1999) obtained the average calving interval of Pabna, Sahiwal × Pabna and Friesian × Pabna were 16.3±4.3, 15.5±4.1 and 13.7±3.6 months, respectively, in Baghabari milk producing area. Calving interval was 17.0 and 11.7 months in suckled and non-suckled Bunaji cows, respectively (Eduvie and Dawuda, 1986). This difference of reproductive parameters could be due to different environment and hormonal imbalance where the cows were reared and management practices. Finally, genetic makeup is the main factor, which in influences this trait remarkable.

At present study, the lower value of age at puberty and age at first calving (24.46 ± 0.53 m and 33.62 ± 0.56 m) were observed in 3 to <5 years and the higher (27.13 ± 0.41 m and 36.24 ± 0.39 m) were in >9 years of age. The shorter post-partum heat period (114.79 ± 7.78 d), minimum number of service per conception (1.81 ± 0.7) and days open (124.44 ± 8.18 d) were found in 5 to <9 years of age and the longest post-partum heat period (141.60 ± 9.35 d) was in <3 years, maximum number of service per conception (1.96 ± 0.12) was in 3 to <5 years and days open (148.40 ± 9.47 d) was in <3 years of age cows. The higher calving interval (409.59 ± 7.64 d) was found in >9 years of age and the lower (372.00 ± 19.84 d) was in 3 to <5 years. Age group had significant ($P<0.05$) effect on age at puberty, age at first calving and had no significant ($P>0.05$) effect on post-partum heat period, service per conception days open and calving interval. Rahman *et al.* (1995) found the age at puberty in heifers 47.3 ± 0.6 and age at puberty, age at first calving, post-partum heat period and days open in cows were as 43 to 48 months 56.3 ± 0.5 months, 360.1 ± 0.5 and 360.6 ± 0.4 days, respectively. Sarder (2001) observed age at puberty, age at first calving, service per conception in heifer, onset of post-partum estrous, service per conception in cows, days open and caving intervals were 27.9 months, 38.7 months, 1.68, 139 days, 1.6, 160 days and 438 days, respectively. Bulman and Lamming (1978) stated that older cows resume cyclicity earlier than younger ones. Tenable and Salisbury (1946) observed of 12621 cows and heifers bred by AI, that fertility increase up to 2 years of age, leveled off unit 6 years of age, then gradually declined. Spalding *et al.* (1975) reported slight increase in the fertility of cows up to 3 to 4 years of age and a decline after 4 years of age. They found a marked decline in fertility in the cow over 7 years of age. Gwasdawskas *et al.* (1975) found that conception rate declined with age as follows: heifers

47.6%, young cows 42.7% and older cows 31.9%. Shamsuddin (1988) observed the service per conception of cows and heifers were 1.69 and 1.86, respectively. Khan (1990) observed the number of insemination per conception increased with age of sexual maturity from 1.1 to 2.8 in Holstein-Friesan, 1.0 to 2.48 in Ayrshire and from 1.0 to 3.3 in Brown Swiss Coleman *et al.* (1985) reported that reproductive performance had become poor with the advancement of age. Plasse *et al.* (1972) reported calving interval of 496 days in 12 to 16-year-old cows, with similar values for young cows 3-6 years old and as shorter (424 days) in cows of intermediate age (6-9 years old). In the earlier, Plasse *et al.* (1968) had also observed a tendency for calving intervals to shorten with increasing age in Brahman cows, as did Hinojosa *et al.* (1980) in a commercial zebu herd in Mexico. Environmental condition, nutrition, care and management, suckling and post calving infection on female reproductive tract may also affect this trait.

The lower value of almost reproductive traits of age at puberty (25.57 ± 0.91 m), age at first calving (34.97 ± 0.46 m), post-partum heat period (109.16 ± 7.11 d), service per conception (1.77 ± 0.09) and calving interval (392.67 ± 7.60 d) were found in 3rd calving except days open (125.98 ± 9.23 d) which was found in 4th calving. The higher value of age at puberty (27.25 ± 0.62 m) and age at first calving (36.27 ± 0.62 m) were found in 4th calving, post-partum heat period (181.25 ± 50.01 d), service per conception (2.30 ± 0.25) and days open (190.00 ± 48.47 d) were found in heifer and calving interval (413.96 ± 7.81 d) was found in 2nd calving. Parity influenced the onset of post-partum ovarian cyclicity and calving to conception interval in dairy cattle (Alam and Ghosh, 1988). This study observed the potential effect of parity on reproduction. Similar findings recorded by McDougall *et al.* (1995) that first parity cows had longer intervals from calving to first post-partum ovulation and calving to first estrus than cows of > 3rd parity. They reported that the cows of 2nd and 3rd parity shown the best performance. Similarly, cows in their 2nd and 3rd lactation had best performance with regard to onset of ovarian cyclicity recorded by (Pereira *et al.*, 1995). In contrast, Darwash *et al.* (1996) found that the interval from calving to onset of ovarian activity become progressively longer as the number of parities increased. The present findings in line with the findings recorded by Zewdu *et al.* (2015). He observed the first parity cows had longer post-partum heat period, days open and calving interval. Sarder *et al.* (1997) studied that parturition to first service period of different parities such as 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} were 147 ± 90, 128 ± 76, 134 ± 117, 121 ± 107 and 149 ± 143 days, respectively. However, Haider (2007) observed the younger cows showed the better performance than the older cows. The younger cows of second parity conceived earlier (120 ± 82.8 days) and those of first parity took less service per conception (2.1±1.6) and they gave an earlier birth (383 ± 25.4 days). The older cows (parity 6-7) were good at one parameter. They received service earlier (83.4 ± 38 days) than their counterparts. Than *et al*. (2001) reported as increased conception rate with advancing parity form parity 2 upto 6 and then declined at parties 7 and 8. The calving interval was longer between first and second parity and at older ages and shorter in intermediate ages (Singh *et al*., 1999). On the other hand, Grohn and Rajawala (2000) did not find any significant effect on parity in relation to the onset of post-partum ovarian cyclicity. Zu and Zun (1997) reported a higher first service conception rate in cows at their first 3^{rd} parity than that in later parities. Barcellos *et al.* (1996) reported a higher conception rate in multiparous cows than that in primiparous cows. Eduvie (1985) observed that the post-partum first ovulation was earlier in cows that had >2 calving or of over 5 years old than in those of 3-5 years old cows. In Zebu cows, calving interval ranges from 366 to 789 days (Mukasa-Mugerwa, 1989) and it is longest between first and second parity and older age, but it is shorter in intermediate age (Kumar and Bhat, 1979; Singh *et al.,* 1983). Larsson *et al.* (1984) and Eldon (1988) reported that post-partum ovarian activity varied insignificantly with age and parity. However, Okeyo *et al*. (1998) observed mean calving interval (CI) ranged from 434 ± 6.1 days for first parity cows to 426.8 ± 8.0 days for cows in their 4th parity, while cows in the 7^{th} parity and above average 421.5 ± 15.5 days. Cows that did not calve in the previous parity had mean CI of 422.2 ± 11.4 days while those that had weaned calves, aborted, or had still-births had mean CI estimates of 425.7 ± 2.9, 412.7 ± 14.9, and 423.6 ± 9.8 days, respectively. Calving rates ranged from 82.7 to 91.9% for 1^{st} and 6th parity cows, respectively, with cows in their 7^{th} parity and over, recording 89.4% for this trait. Lemma1 *et al.* (2010) revealed that calving interval and days open were decreasing significantly with parity number (P<0.001). Motlagh *et al.* (2013) observed the reproductive performance decreased from parity ≥6. Sattar *et al.* (2005) recorded the average number of services per conception was 3.07 ± 0.10. The differences of the number of services per conception during 6^{th}

lactation with those of 1st and 8th lactation were statistically significant ($P<0.05$). However, Hammoud *et al.* (2010) observed the values of post-partum heat period, days open, calving interval, number of services per conception and age at first calving were 88.4 ± 1.1, 130.7 ± 1.9, 403.1 ± 1.9 days, 2.1 ± 0.1 services and 30.7 ± 0.1 months, respectively. Parity had highly significant effect ($P<0.01$) on post-partum heat period, days open and calving interval and had insignificant effect on service per conception. The author observed post-partum heat period, days open and calving interval decreased with increasing parity. The relationship between parity and reproduction is somewhat controversial and appears to vary by hard. There could be numerous reasons that explain the variability in whether parity of cow affects reproduction including competition for resources between older and younger cows, nutritional management, production level, early post-partum care etc.

Body size is an important genetic factor in cattle production. Body condition scores are an excellent indicator of reproductive performance. It is an arbitrary scale for estimating the amount of body fat in cows (Wildman *et al.*, 1982). BCS had a good reflection on the reproduction. Good BCS better performance. This study observed the potential effect of body weight and body condition score on reproduction. In the present study, >300 kg body weight had better reproductive performance compared to the 200 to <300 kg and <200 kg body weight groups of cows and good body condition cows showed the excellent performance than medium and poor body condition score of groups of cows. Another study showed cows loosing most body weight in the early post-partum period, take 30 days longer to display the first post-partum estrus Butler (2003). Haider (2007) observed that cows having a BCS >3.25 were superior in early insemination (82.4±72 days), quicker conception (105.8±72 days), shorter calving interval (397±62.3 days) and fewer numbers of services per conception (2.1±2.3) than their counterparts. For conception within 115 days BCS 3.25 (55%) and BCS >3.25 (54%) shown better performance than BCS 1.5-<3 (49%), BCS 3 (52%). The author also revealed that the higher the body condition score, the better were the reproductive performance. The present study also in line with (Haider, 2007). A previous study by Riberior *et al.* (1997) found that cows with BCS 3.5 have the shortest interval between calving and onset of post-partum estrus. Both body condition at calving and feeding after calving influence the duration of length of post-partum anoestrus period (Wright *et al.,* 1992). Another study found that cows calving at good BCS were capable to resume ovarian cyclicity within 60 days post-partum regardless pre and post calving change in body weight (Randel, 1990; Bolanos *et al*., 1997). A local study by Shamsuddin *et al.* (2001) stated that body condition score 3.5 or more at AI had shorter interval between calving and conception than with cows having ≤2.5 body condition score. Houghton *et al.* (1990) observed that for optimum production (one calf per year per cow) cows need to maintain an acceptable PPHP of 60 days or less. Wiltbank (1982) illustrates the concept of weight gain necessary for cows of varying BCS prior to calving. The higher reproductive performance of good BCS might be due to better hygienic manage mental practice of the farm that reduces the incidence of mastitis and other diseases.

At present study, secondary educational status of the owner had better reproductive performance compared to the higher secondary, primary and the lower in illiterate groups. Educational status of the owner had significant ($P<0.05$) effect on age at first calving, post-partum heat period and service per conception and had no significant ($P>0.05$) effect on age at puberty, days open and calving interval (Table16). Hossain *et al.* (2004) studied the educational level of private dairy farms at Rangpur sadar thana in Bangladesh. They found 19% of farmers had no schooling compared to 27% having primary education, 16% secondary level education, 21% higher secondary level and 17% higher secondary above. Vast farming experience of farmers comparatively better performance than little and none groups. Farming experience of farmers had no significant ($P>0.05$) effect on age at puberty, age at first calving, post-partum heat period, days open, service per conception and calving interval. Another study Erdouan *et al.* (2004) surveyed to determine farmer characteristics and production traits on dairy farms in Kars, Turkry and found that the majority of farmers had primary (62.3%) and high school (33.3%) education and also found that farmer's experience in farming varied from 1 to 60 years (mean 31.1). However, Chaussa (2013) assessed the factors affecting reproductive performance and reported that majority of the respondents (78.57%) did not get training on dairy cattle husbandry before engaging in the project while 21.43% of the respondents were trained before engaging in the dairy cattle enterprise.

The amount of milk yield per cow per day for respondents who were trained was higher (9.05 litres) compared to 7.9 litres for respondents who did not get training before engaging in dairy cattle enterprise. The author also found 41.7% of the respondents had attained primary school education while 39.3% had attained ordinary secondary school education. Benon *et al.* (2015) conducted a survey in Uganda and found a non-significant effect of farming experience between ≤2 years and >2 years on calving rate was not significant.

Farm size is an important consideration for profitable farming. In Bangladesgh, the most common herd size ranges 1 and 2 cows per farm (Hemme *et al.,* 2004). Saadullah (2000) estimates that over 70% of the dairy farms would have an average of 3.5 dairy cows in Bangladesh. Islam *et al.* (2014) also found the average number of breedable females (cows) per farm was 2 (range, 1 to 3) at char areas in Northern Bangladesh. In present study, small size farm comparatively better performance than others. Farm size had significant ($P<0.05$) effect on age at puberty, age at first calving, post-partum heat period and calving interval and no significant ($P>0.05$) effect on service per conception and days open (Table 20). Coleman *et al.* (1985) stated that incidence of reproductive disorders and reproductive performance is affected by farm size. In a study, Lemma and Kebede (2011) found the mean (±SD) age at puberty (AP), age at first calving (AFC), service per conception (S/C) and days open (DO) were 23.1±6.4 months, 33.2±6.7 months, 2.0±1.2 and 176.8±79.0 days, respectively. AP, AFC and S/C were significantly different ($P<0.05$) between farms and mating systems. The first service conception rate for pregnant cows (n=77) was 45.5% for all farms, 60.0% for AI (Artificial insemination) farms, and 40.0% for NS (Natural service) farms with significant difference ($P<0.05$) between mating methods. On the other hand, Abeygunawardena *et al.* (2001) found an overall service per conception of 1.99 in smallholdings and 1.9 in large farms in Sri-Lanka. Lobago *et al.* (2006) reported that the means days open was 187 days in small holder dairy farm and average number of service per conception was 1.6±1.0 in central Ethiopia. Benon *et al.* (2015) conducted a survey in Uganda and reported that calving rates were higher ($P=0.0003$) in small herds (≤3 dairy cows) than in large ones (>3 dairy cows). Another study Asaduzzaman (2015) studied the occurrence of repeat breeding on three different farm categories such as small, medium and large having 1-5, 6-10 and 11 or more breedable cows, respectively. The author observed small farms (n=57) faced repeat breeding significantly ($P<0.05$) lower than medium (n=53) and large farms (n=62). The higher reproductive performance of small size farm might be due to close observation, good management system of the farm and easily heat detection and correct time AI etc.

Overall good reproductive performance was found in intensive rearing system comparing to the semi-intensive and grazing on pasture land. Rearing system had no significant ($P>0.05$) effect on age at puberty, age at first calving, post-partum heat period, days open, service per conception and calving interval (Table 22) in the present study. The value of age at puberty and age at first calving of intensive, semi intensive and grazing on pasture land were 26.06 ± 0.28 m, 26.81 ± 0.39 m, 26.74 ± 0.67 m and 35.14 ± 0.2 m, 35.82 ± 0.39 m, 35.85 ± 0.65 m, respectively. These values were lower than the values recorded by Islam *et al*. (2015). The average values of post-partum heat period in the same rearing system were 121.81 ± 5.08, 120.08 ± 5.63 and 126.18 ± 9.05 days, respectively. The average values of service per conception 1.84 ± 0.05, 2.04 ± 0.08 and 1.98 ± 0.09, respectively. The average values of days open (137.34 ± 5.17, 134.58 ± 5.93 and 140.19 ± 8.92 days, respectively and the average values of calving interval 399.85±5.80, 400.13±6.63 and 406.72±9.18 days, respectively. All these values were higher than the values recorded by Islam *et al*. (2015). He found the average post-partum heat period was 88.93±3.09, 90.09±2.22 and 82.98±7.51 days, respectively. The average services per conception were 1.50±5.61, 1.52±4.05 and 1.98±0.16, respectively. The average days open were 106.70±3.77, 114.03±2.74 and 103.04±6.98 days, respectively. The average calving interval was 387.17±5.59, 413.88±11.30 and 391.54±11.62 days, respectively. Another study Misostov and Konovalova (1994) suggested an intensive rearing of heifers and insemination at an early age (18-22 vs. 24 or 30 months) for extending the productive live span. This variation might be due to manage mental effects, season and other factors.

Geographical location of farm had no significant ($P>0.05$) effect on age at puberty, age at first calving, post-partum heat period, days open, service per conception and calving interval in the present study. Romaniuk (1994) observed that the delayed conception after parturition in cows at rural areas could be due to malnutrition and improper veterinary care.

At present study, concrete type of floor had excellent reproductive performance compared to the semi-concrete and very poor in muddy type of floor. A lot of factors affecting reproduction of dairy cows that includes herd management (40%), feeding (30%), hygiene/infection/diseases (10%), housing (5%) and genetics (15%) (Kumlu, 2011). There are indications that floor type and construction has a high impact on walking and lying comfort of animals and on reproduction (De Belie, 1997). Floor type had significant ($P<0.05$) effect on age at puberty, age at first calving and service per conception and no significant ($P>0.05$) effect on post-partum heat period, days open and calving interval (Table 26). Hossain *et al.* (2004**)** studied the floor condition of private dairy farms at Rangpur sadar thana in Bangladesh. They found 63% paved floor and 37% unpaved/muddy floor. Khan *et al.* (2010) reported that 65% of farm house was found with pacca and the rest had unpaved floor. Rahman and Hoque (2001) observed the calving interval also extended due to poor management. Another study, Botheras (2010) observed that the most of the farmer having low number of cows prefer muddy/ semi-concrete floor but approximately 70% of all medium and large (>100 cows) dairy herds primarily house lactating cows in free-stalls and concrete is the principal flooring surface used in these barns. Concrete flooring offers many advantages for the dairy producer, being relatively inexpensive in comparison to other flooring surfaces because of its durability and long life, and it is easy to clean. However, concrete flooring can be problematic for dairy cows, due to the hardness of the surface, and the potential for the floor to be too slippery or too abrasive cause lameness which indirectly affect the production.

Good type of ventilation system had better reproductive performance compared to the medium and poor in present study. Ventilation system had significant ($P<0.05$) effect on age at puberty, age at first calving, post-partum heat period and service per conception. A number of studies have shown that housing systems in hot climates can be modified by the use of evaporative cooling to improve both milk production and reproductive efficiency of dairy cows (Ryan *et al.*, 1992; Armstrong *et al.*, 1993). In a study, Avendano-Reyes *et al.* (2006) concluded that cooling dry cows with shades, fans, and water spray vs. cows with only shade decreased services per conception and days open, while milk yield increased during the post-partum period. However, Suadsong *et al.* (2008)

reported that cooled cows due to proper ventilation had greater ($P<0.05$) dry matter intake and milk production than uncooled cows and cooled cows had more persistent milk production than uncooled cows. Flamenbaum and Galon (2010) studied the effect of ventilation/ cooling intensity on cow's productive and reproductive traits in Israel. Farms were categorized into three different groups according to the intensity of ventilation/ cooling. Intensive, moderate and no-cooling"at all. The author found the conception rate was 40, 34 and 15%, for primiparous ($P<0.01$) and 34, 34 and 17% for multiparous cows ($P<0.01$), in the "intensive", "moderate", and "no cooling" groups, respectively. Present findings more or less similar with the findings of Islam *et al.* (2015). He observed the mean values of age at puberty in proper ventilated, fairly ventilated and poor ventilated were 26.46±.55, 26.80±.37 and 26.31±.66 months, respectively. The overall mean values of age at first calving for the same ventilations were 37.39±.48, 37.7±.48 and 36.83±.76 months, respectively. The average service per conception was 1.76±1.49, 1.61±5.50 and 1.64±.10, respectively. The average post-partum heat period was 78.61±3.41, 84.13±2.44 and 87.20±5.79 days, respectively. The average days open were 116.32±2.95, 108.88±2.83 and 122.13±5.92 days, respectively. The average calving interval was 401.25±3.75, 390.23±4.04 and 428.31±7.84 days, respectively.

Feeding practice varies in different countries and different places of a same country. Post-partum ovarian activity was closely associated with total digestible nutrient intake (Whitemore *et al.,* 1974). Butler *et al.* (1981); Lalman *et al.* (1997) reported that energy deficient diet in the late pregnancy and early lactation is associated with reduced ovarian function. Here the effect of good quality feed resulted in the minimum value of age at puberty (26.07 ± 0.31 m), age at first calving (35.18 ± 0.31 m), post-partum heat period (110.63 ± 4.60 d), service per conception (1.85 ± 0.07), days open (127.34 ± 4.88 d) and calving interval (391.15 ± 5.42 d) were obtained in good type of feed and the maximum value of age at puberty (27.25 ± 0.53 m), age at first calving (36.28 ± 0.52 m), post-partum heat period (136.30 ± 9.52 d), service per conception (2.19 ± 0.10), days open (148.87 ± 9.70 d) and calving interval (415.02 ± 10.72 d) were obtained in poor type of feed. Feed quality had significant ($P<0.05$) effect on post-partum heat period, service per conception, days open and calving interval. Currado *et al.* (1991) stated that in HF cows, the highest milk yielders had longer calving interval because of delayed return to post-partum due to negative energy balance to supply the poor quality of feed. Mukasa-Mugerwa (1989) observed with good nutritional management cross-bred heifers can be bred at 15-18 months. Alam *et al*. (2001) studied the effect of urea-molasses-mineral block (UMMB) on the ovarian cyclicity in zebu cattle and found the effect of UMMB for enhancing earlier sexual maturity in zebu heifers. In other study, Alam *et al.* (2006) found the UMMB group cow required relatively shorter period of expression of standing estrus (91-101 days, mean 96.2) than non UMMB group (130-135 days, mean 141.6). Haider (2007) observed 3-4 kg/day energy source concentrate per cow per day helped the studied cows (86%) to be inseminated within 90 days post-partum as well as to be conceived (59%) within 115 days post-partum than 1-2 kg/day, 2-3 kg/day, >4 kg/day, respectively. Shamsuddin and Arya (2009) observed the weak or silent heats occur in heifers due to under feeding energy, phosphorus or vitamin A. All these factors limit growth of heifers and delay their age at first calving.

Balanced nutrition with better management help to maintain general health condition of the cow that stimulate the endocrine system through the activation of the hypothalamo-pituitary-ovarian axis to work properly and thereby improved reproductive performance (Morrow. 1980; Fitzpatrick, 1994). Feeding programmers at pre and post calving period helped in initiating the earlier post-partum onset of ovarian cyclicity Brosaster and Broaster (1998).

Alam (2013) observed the highest occurrence of reproductive disorders was recorded in cows fed with straw +green grass (45.3%) and the lowest occurrence was in cows fed with straw + green grass +concentrates (30.4%). On the other hand, Islam *et al*. (2015) reported maximum reproductive traits (age at puberty, age at first calving, services per conception and calving interval) were better performance in straw + green grass type of feed supply except post-partum heat period and days open which were in concentrate + green grass type of feed.

The main cause of poor reproductive performance could be due to poor health management, incorrect nutrition during and after calving. Inadequate dietary intake and decreased utilization of some nutrition may result in delayed onset of ovarian activity by preventing release of gonadotropin from the pituitary (Nolan *et al.,* 1988; Randel, 1990; Osawa *et al.*, 1996).

In present study, better reproductive performance was observed among preventive measures by Veterinarian than quack and very poor in traditional healer. The overall mean values were of age at puberty (26.42 ± 0.22 m), age at first calving (35.48 ± 0.22 m), post-partum heat period (121.85 ± 3.48 d), service per conception (1.93 ± 0.04), days open (136.80 ± 3.57 d) and calving interval (401.04 ± 3.94 d). Preventive measure had significant (P<0.05) effect on age at puberty, age at first calving and calving interval (Table 32). Islam *et al.* (2000) conducted a study on productive & reproductive performances of dairy cows where three types of management were adopted like, Management-1: Vaccination and preventive measures were not adopted. Sick animals were not usually taken to veterinary doctors rather treated traditionally; Management-2: Vaccination and preventive measures were not adopted. Sick animals were treated traditionally and often veterinary doctors were consulted and Management-3: Vaccination and other preventive measures were provided regularly and veterinary doctors usually provided medication for sick animals. They found that the effect of taking preventive measures was significant (P<0.01) on age at first heat /puberty (AP), age at first calving (AFC), number of service per conception (S/C), post-partum heat period (PPHP) and calving interval (CI). The overall mean values were 37.29±0.33 months for AP, 47.62±0.34 months for AFC, 1.30±0.02 for S/C, 191.57±3.92 days for PPHP and 510.02±0.15 days for CI.

Reproductive efficiency in the dairy herd is the most important factor for its economic success and a major concern for dairy farmers when using artificial insemination (AI) or natural service (NS) (Valergakis *et al.,* 2007). Artificial insemination (AI) has proven to be a reliable technology for dairy producers to make genetic progress and control venereal diseases in their herds. The better reproductive performance was observed by Artificial inseminated than natural service in the present study. There were significant effect (P<0.05) of breeding methods on age at puberty, age at first calving and calving interval. In contrast, Malik *et al.* (2012) observed the pregnancy rate was higher in the NS group (28.6%) than in the AI group (18.0%), but the difference was not significant (P>0.05). Valergakis *et al.* (2007) conducted a survey from 120 dairy cattle farms to estimate, compare and analyze the costs associated with breeding cattle by AI and NS in Greece and found that AI is more profitable than the best NS scenario. However, Khan *et al.* (2012) observed the incidence of assisted births i.e. dystocia was significantly ($P<0.01$) higher (23 vs 15 %) in AI as compared to NS. Similarly the incidence of retained fetal membrane was also higher ($P<0.01$) in births resulted from AI (10 vs 5 %). Service period (44.25 vs 35.40 days) and number of services per conception (1.43 vs 1.14) were also significantly higher in animals served through AI and post-partum reproductive problems were lower as a result of natural mating. Tesfaye *et al.* (2015) observed increasing reproductive performance should overcome the challenge of nutritional and AI management.

5.1.2 Reproductive disorders of dairy cows

From table 34-52 the results of present study revealed high proportion of both functional and non-functional problems during gynaecological survey. In the present study most of the animals were affected with one or more types of reproductive and productive disorders of dairy cows. In the present study the overall prevalence of reproductive and productive diseases or disorders or status in dairy cows was 78.6%. Kader (2010) recorded the overall prevalence of reproductive diseases of dairy cows was 51.3%. 47.7% of dairy cows were having at least one of the reproductive problems observed by **(**Benti and Zewdie, 2014) in indigenous Borena breed cows in Borena zone in Southern Ethiopia. Contrasting to the resent finding, 39.4% prevalence of reproductive diseases or disorders was reported in cross-bred dairy by (Alam *et al.*, 2014) at Ullapara upazila under Sirajganj district. The prevalence of reproductive diseases (38.6%) in HF pure breed cows was reported at Sinjai Regency, Indonesia (Yusuf *et al.,* 2012). Haile *et al.* (2014) recorded 43.07 % of cows were found to be affected either with one or more of reproductive problems. 23.0% prevalence of reproductive diseases was reported in cross-bred cows in Chittagong district (Maruf, 2014). Moreover, 36.5% prevalence of reproductive diseases was observed in Holstein × Gir F1 crossbred cows in Tanzania (Kaikini *et al*., 1983). 37.1% had at least one of the reproductive disorders in dairy cows were reported by (Esheti and Moges, 2014) in Ada’a district, Debre Zeit town, south east of Addis Ababa. Bitew and Prasad (2010) observed 26.5% of cows had at least one of the reproductive problems in and around Bedelle, South Western Ethiopia. The variation in prevalence of reproductive and productive diseases in cows in present study differ from only reproductive diseases studied by others may be due to effects of the differences in management (production) systems and environmental conditions including poor sanitation, nutritional status, contamination during calving, the indiscriminate use of broad spectrum antibiotics, corticosteroids for the treatment of reproductive disorders and agro-climatic condition of areas.

In the present study, anoestrus (24.6%) had the highest incidence among the reproductive disorders. Abortion (13.4%) was the second highest followed by repeat breeding (11.4%), retained placenta (10.2%), dystocia (5.4%), mastitis (4.4%), vaginal prolapse (2.4%), pyometra (1.8%), metritis (1.6%), uterine prolapse (1.4%), milk fever (1.2%), and still birth (0.8%).

Reproduction drives the production cycle in dairy enterprises and in of major economic consequences of farming. Maximizing the reproduction potential in cattle require the understanding and application of many principles basic to various disciplines of animal and veterinary science, including genetics, nutrition, physiology, theriogenology as well as management intervention. The main constraints in the enhancement of dairy in Bangladesh are the low reproduction efficiency of dairy cows. Majority of the heifers and cows are sold for slaughter due to reproductive failure or reduced production potentials.

Anoestrus syndrome is the important causes of infertility of cows in Bangladesh. In present study, 24.6% anoestrus syndrome was recorded. Similarly, Al Nahian (2011) collected a total of 201 reproductive cases from different veterinary hospitals over a period of one year (April 2010 to March 2011) in five Upazilas of Mymensingh distrct and observed the major reproductive disorders in cattle. The author recorded the prevalence of anoestrus was 25.9%. Shahabuddin (1996) collected a total of 457 clinical cases from Panchagarh Veterinary Hospital to observe the pathological disorders of female reproductive of cows He found the highest incidence of anoestrus was in (22.97%). The occurrence of anoestrus was higher than these values obtained by Khair *et al*. (2013), Sarder *et al.* (2010) and Kumar *et al.* (1986) which were 20.69%, 20.4%, and 19%, respectively. However, 14.7% 12.06% and 10.3% of anoestrus syndrome were recorded by Kader (2010), Haile *et al.* (2014) and Benti and Zewdie (2014). Francos (1974) made an observation on the frequency of reproductive disorders in dairy herd in Israel. The author examined 4811 Friesians cows in seven intensive dairy herds. They recorded 12% anoestrus. Kruif (1977) carried out a study on anoestrus in dairy cows. The author examined 2720 cows in different herds and 20 farms which had recently calved. He observed the genuine anoestrus 9% was diagnosed mostly in older cows. Very high incidence of anoestrus from the present study 52%, 30.1% 29.69% and 27.48% were detected by Shamsuddin *et al.* (2007), Mahmud *et al.* (2014) Rahman *et al.* (1993) and Faruq (2001), respectively. The occurrence of anoestrus was very lower values from the present study obtained by Alam *et al.* (2014), Maruf *et al.* (2014), Bitew and Prasad (2010), Gizaw *et al.* (2007), Kabir *et al.* (2010) which were 8.6%, 5.1%, 1.7%, 1.48% and 1.44%, respectively. These variations in the prevalence of anoestrus may be due to difference in the number of sample size, the influence of different risk factors such as nutritional status, management conditions, hormonal imbalance, and reproductive tract infections on cows, persistent corpus luteum, breeds of cattle by suppressing estrus and ovulation, causing anoestrus, anovulation and early embryonic death.

About 11.4% cases of repeat breeding were observed, which agrees with the findings of 11%, 12.8%, 10.3%) and 13.08% reported by Shamsuddin *et al.* (2007), Kader (2010), Benti and Zewdie (2014) and Haile *et al.* (2014), respectively. The occurrence of repeat breeding was higher than these values obtained by Gizaw *et al.* (2007), Al Nahian (2011), Alam *et al.* (2014), Tigre (2004), Maruf *et al.* (2014) and Bitew and prasad (2010) which were 8.91%, 6%, 5.7%, 4.6% 3.7% and 3%, respectively and lower than 32.76%, 31.46%, 28%, 28%, 26.8%, 21.8%, 21%, 20.13% and 15.9% reported by Khair *et al.* (2013), Faruq ((2001), Gebrekidan *et al.* (2009), Goni *et al.* (2008), Dinka (2013), Mekonnen (2000), kaikini *et al.* (1983), Shahabuddin (1996) and Esheti and Moges (2014), respectively.

However, Mahmud *et al.* (2014) investigated the prevalence and comparison of reproductive diseases and disorders of cows in BAU Vet. Clinic and Sadar Veterinary Hospital, Jamalpur. They reported repeat breeding syndrome 35.5% in BAU Vet. Clinic and 15.7% in Sadar Veterinary Hospital, Jamalpur. Repeat breeder can be caused by a number of factors, including sub-fertile bulls, endocrine imbalance, malnutrition, reproductive tract infection and poor management practices such as wrong time of insemination or faulty heat detection, inappropriate semen handling and insemination techniques (Arthur *et al.,* 1989). In addition to these, communal use of bull for natural services is also considered as contributing factor.

Jainuddin and Hafez (1993) also reported that incidence of repeat breeding is higher at artificial insemination rather than natural service. Poor quality semen, defective transportation of semen, unhygienic insemination among other is the main cause of repeat breeding syndrome in our country. Error in estrus detection and improper timing of AI, further aggravates the situation (O'farred *et al*., 1983 and Kumaresan, 2001).

Anoestrus and repeat breeding comprises 27.5% of total reproductive diseases of dairy cows. This finding corresponds with the earlier observation of Mia and Islam (1967). The management system of cows like dual purpose use, low feed quality, lack of deworming practices, especially frequent suckling and uncontrolled weaning may be responsible for anoestrus.

Lactation-induced reproductive inactivity varies among different species. Weaning followed by estrus and ovulation occur within 4 to 8 days in cow (Jainuddin and Hafez, 2000). Suckling and under nutrition, prevalent in surveyed area inhibit tonic GnRH and LH secretion. Cessation of suckling in beef cows enhances the amount of LH release in response to LH-RH (Troxel *et al*., 1983). Suckling may associate with cortisol level leading to inhibit of LH release (Wagner and Li, 1982). New evidence suggests that an opiod-mediated mechanism may be responsible for the suckling-induced LH suppression in the suckled cows (Whisnant *et al*., 1986).

Anoestrus and repeat breeding syndrome are also the typical signs of non-specific subclinical uterine infection. The lack of proper hygienic management of post-partum cow and AI carried out without supervision of veterinary personnel predispose to such uterine infections. Unlike to few earlier report of (Mia and Islam, 1967; Rahman *et al.,* 1993) who reported more incidence of repeat breeding syndrome than the anoestrus. This may be due to unskilled AI technician of that region. Moreover, AI was done in the surveyed area with liquid semen and the technician gets the semen about 36 hours later from the production. Shamsuddin *et al.* (1997) reported a low conception rate with liquid semen compared to frozen semen and reduction in spermatozoal integrity as time passes.

The prevalence rate of abortion 13.4% recorded by questionnaire survey in this study similar to the findings of 13.9%, 13.0% and 12.2% reported by Bitew and Prasad (2010), Molalegne and Shiv (2011) and Benti and Zewdie (2014), respectively. Benti and Zewdie (2014) stated that the rate of abortion increased significantly ($P<0.001$) with the increase in the stage of gestation. Dinka (2013) reported 14.6% abortion in and around Asella town, Central Ethiopia. He also revealed that abortion is mostly common in exotic breeds (48.8%) and relatively less in local cows (9.8%) varying among parity and stage of pregnancy. Chatterjee *et al*. (1985) recorded the overall incidence of abnormal termination of pregnancy was 16.1%. The causes of such disorders were as abortion (9.7%) and still birth (4.4%) in West Bengal. The occurrence of abortion was lower than these values obtained by Kakar *et al.* (1997), Chatterjee *et al*. (1985) and Kanuyaa *et al.* (2000) which were 17.8%, 16.1% and 16%, respectively. The occurrence of abortion was higher than these values obtained by Soonwuk *et al*. (1996), Das (1990), Kassahun (2003), Shiferaw (1999), Esheti and Moges (2014), Khair *et al*. (2013), Al Nahian (2011), Sarder *et al*. (2010), Rahman *et al.* (1993), Haile *et al.* (2014) and Gizaw *et al.* (2007) which were 9.8%, 6.9%, 6.30%, 5.3%, 5.3%), 5.17%, 5%, 5.0%, 4.87%, 2.56% and 2.23%), respectively. Higher percentage of abortion may be attributed due to differences in the etiology of abortion in respective regions and its agro-ecology that fairly favors the introduction and development of crossbred dairy cattle, where the problem is more common in exotics than local animals. Abortion is a frequent complication of brucellosis in animals, where placental localization is believed to be associated with erythritol, a growth stimulant for *Brucella abortus* (WHO, 2006). Moreover, abortion in cows may be influenced by infection and stress on animals.

In present study the prevalence of retained placenta 10.2% which is in line with those reported by Correa *et al*. (1993), Hossain *et al.* (1986), Francos (1974), Benti and Zewdie (2014), Sandals *et al.* (1979), Gizaw *et al.* (2007), Al Nahian (2011), Das (1995), Scheidegger *et al.* (1993), Swai *et al*. (2007) and Islam *et al.*

(2013) which were 9.5%, 9.1%, 10%, 10.3% in Southern Ethiopia, 11.2%, 12.91%, 12.8%, 12.6%, 12.6%, 12.2% and 13.4%, respectively. Mahmud *et al.* (2014) reported retained placenta 4.7% in BAU Vet. Clinic and 17.9% in Sadar Vet. Hospital, Jamalpur. Balasundaram (2008) reported 18.67% retained placenta in Karan Fries cow. Saini *et al.* (1988) reported that the incidence of retention of fetal membranes was 17.48% in different crossbred cattle of Holstein Friesian, Brown Swess and Jersey with Hariana. Mukherjee *et al.* (1993) reported 15.57% incidence of retention of fetal membranes in Karan Fries cattle at NDRI herd in India. The occurrence of retained placenta was lower than these values obtained by Rahman *et al.* (2000), Debnath *et al.* (2012), Shamsuddin *et al.* (1988), Erdogan *et al.* (2004), Satya pal (2003), Mutiga (1992), Dutta and Dugwekar (1983), Han and Kim (2005), Saini *et al.* (1988), Mukherjee *et al.* (1993), Sinha *et al.* (1978) and Fourichon *et al.* (2001) which were 46.1%, 44.1%, 42.26%, 42.2%, 27.7%, 21.9%, 18.56%, 18.3%, 17.5%, 15.6%, 14.1% and 14%, respectively. In comparison, Sarder *et al*. (2010), Pandit *et al*. (1981), Bitew and Prasad (2010), Tsegaye *et al.* (2014), Agarwal *et al.* (1984), Haile *et al.* (2014), Kader (2010), Kaikini *et al*. (1983), Faruq (2001), Khair *et al*. (2013), Lobago *et al.* (2006), Alam *et al.* (2014), Maruf *et al*. (2014), Lodhi *et al*. (1999), Saloniemi *et al.* (1986), Grohn *et al*. (1990), Kanuyaa *et al.* (2000), Shahabuddin (1996) and Soonwuk *et al*. (1996) observed lower incidence of retained placenta from the present research were 8.8%, 8.8%, 8.6%, 8.4%, 7.82%, 7.18%, 7.1%, 7.05%, 6.95%, 6.9%, 5.4%, 4.7%, 4.6%, 4.65%, 4.5%, 4.4%, 4.2%, 3.50% and 3 %, respectively. The variation in the incidence of retained placenta may be attributed to variations in predisposing factors to which the animals are subjected and among which nutritional status and management are considered as important factor. The relatively higher prevalence rate of retained placenta in the present study could also be due to dystocia that accounted 5.4% which is an important predisposing factor for occurrence of retained placenta.

The prevalence of dystocia in this study was 5.4%, which agrees with the findings of 5.4%, 5.8% and 6.6% reported by Kaikini *et al*. (1983), McDermott *et al*. (1992) and Bitew and Prasad (2010). This was lower than the prevalence rate of 23.7%, 8.9%, 7.5% and 6.9% reported by Johanson *et al*. (2003), Correa *et al.* (1993), Al Nahian (2011) and Verma *et al*. (1986). However, the current finding was higher than that reported (3.3%, 3.3%, 2.9%, 2.79%, 2.4%, 2.32%, 1.7% and 1.2%, respectively) by Alam *et al.* (2014), Esheti and Moges (2014), Sarder *et al*. (2010), Lodhi *et al.* (1999), Swai *et al*. (2007), Faruq (2001), Kanuyaa *et al.* (2000), Grohn *et al.* (1990). This variation in the occurrence of dystocia may be influenced by factors such as age and parity of cows, breed and individual variations of sires (Morrow, 1986). Inseminating cows with semen collected from exotic bulls that genetically produce large sized calves without considering the size and age of cows often results in dystocia due to fetal over size. Bellows *et al.* (1996) recorded the incidence of dystocia was 6.9% in 1992 and 10.5% in 1993, and was found higher incidence in males than in females calves. Also stated that dam body size was of minor value in determining dystocia, but birth weight of calves was of importance.

Among the infectious cause, pyometra and metritis were most frequently found in this study. During surveyed, it was observed that 1.8% cows showed pyometra and 1.6% of metritis. Similarly, Kader (2010) observed 1.7% cows showed pyometra and 1.5% of metritis. The prevalence of pyometra in the present study was lower than that of 16.8%, 15.4%, 8.2%, 8%, 6.80% and 4.5% respectively reported by Debnath *et al.* (2012), Al Nahian (2011), Shamsuddin *et al*. (1988), Alam & Rahman, (1979), Rahman *et al.* (1993) and Sarder (2011). However, this value was higher than that of reported (0.24, 0.6%, 1.53%), 1.66%, respectively) by Maruf *et al.* (2014), Hossain *et al.* (1986), Shahabuddin (1996) and Faruq (2001). Pyometra can be caused by a number of factors, including *Trichomonas foetus* infection, unhygienic parturition, retained placenta, dystocia, vaginal prolapse and manual removal retained placenta. Hence the difference between the finding of the current study and previous reports might be resulted from variation in predisposing factors.

The incidence of metritis was recorded as 1.6% in the present study. Grohn *et al*. (1990) recorded as 2.3% early metritis and (1.1%) late metritis. This value was lower than that of 21%,16.9%, 11.92%, 10.3%, 7.6%, 5.66%, 4.4%, 3.9% and 2.63% reported by Fourichon *et al.* (2001), Bitew and Prasad (2010), Faruq (2001), Debnath *et al.* (2012), Sarder *et al*. (2010), Rahman *et al.* (1993), Maruf *et al*. (2014), Alam *et al.* (2014) and Shahabuddin (1996), respectively. The lower prevalence of metritis may be due to hygienic calving management, increasing awareness about retained placenta, dystocia and uterine prolapse.

About 2.4% vaginal prolapse were observed which agrees with the findings of 2.2% and 2.7% reported by Sarder *et al*. (2010) and Alam *et al.* (2014), respectively. However, this value was higher than that reported of (1%, 1.1%, 1.32%, 1.31% and 0.1%, respectively) by Bitew and Prasad (2010), Kader (2010), Faruq (2001), Shahabuddin (1996) and Grohn *et al*. (1990). In the other hand, this value was lower than that of 10%, 8.9%, 5.9%, 5%, 5.2% and 3.44% reported by Soonwuk *et al*. (1996), Kalbe and Schulz (2002), Debnath *et al.* (2012), Al Nahian (2011), Mandali *et al.* **(**2004) and Haile *et al.* (2014). The prevalence of uterine prolapse was 1.4% in current study which is fairly agree with the findings of 1%, 1.3% 1.4% and 1.6% obtained by Tsegaye *et al.* (2014), Kader (2010), Sarder *et al*. (2010) and Alam *et al.* (2014), respectively but higher than 0.2%, 0.3%, 0.7%, 0.76% and 0.99% reported by Grohn *et al*. (1990), Correa *et al*. (1993), Bitew and Prasad (2010), Haile *et al.* (2014) and Faruq (2001) and lower than that of 8.9%, 5.47% and 2.3% obtained by Debnath *et al.* (2012), Shahabuddin (1996) and Soonwuk *et al*. (1996), respectively. The lower prevalence rate of vaginal and uterine prolapse may be attributed to the available of calcium supply with feed and less chance to occurred hypocalcaemia. About 0.8% still birth was observed which was similar to the findings of 1% and 1.03%, reported by Kader (2010) and Haile *et al.* (2014), respectively and higher than 0.67%) and 0.66% obtained by Shahabuddin (1996) and Faruq (2001) and lower than that of 6.6%, 6%, 3.6%, reported by Bicalho *et al*. (2007), Correa *et al*. (1993) and Sarder *et al*. (2010), respectively. The productive disordered recorded in this study are 4.4% mastitis and 1.2% milk fever. In line 1.7% milk fever was recorded by Kanuyaa *et al.* (2000). Kader (2010) observed 6.6% mastitis and 0.9% milk fever in cows. However, 21.4%, 21.0, 5% and 3.06% mastitis recorded by Al Nahian (2011), Qazi *et al.* (1999), Kanuyaa *et al.* (2000) and Shahabuddin (1996). About 15% and 4% milk fever reported by Fourichon *et al.* (2001) and Tsegaye *et al.* (2014). The lower prevalence rate of mastitis may be resulted from increasing practice of hygienic milking, keeping the animal in hygienic milking shed in the study area where bio-security was maintained properly. This variation is also attributable to the time and place of study and breed of the cows as well as manage mental and environmental factors. Similar pathological disorders in female reproductive system have also been reported in other countries (Kucharski and Zdunchzyk, 1984; Chatterjee *et al.,* 1985; Pagaonkar and Bakshi, 1987).

The incidence of various reproductive diseases especially uterine infections in the female, metritis and pyometra has increased alarmingly in this subcontinent with the introduction of cross breeding program among high yielding varieties of cows. In addition to this, lack of on proper hygienic management of post-partum cows and limited veterinary service further aggravate the situation. It is suggested that in order to combat the occurrence of reproductive disorders in cows crossbreeding program through artificial insemination (AI) should be done proper hygienic management.

The prevalence of reproductive disorders was higher in Tanore upazila (9.2%) followed by Motihar (8.4%), Godagari (8.4%), Puthia (8.2%), Mohanpur (8%), Rajpara (7.8%), Boalia (7.8%), Charghat (7.6%), Shahmukdhom (7.0%), and lower in Poba upazila (6.2%). In upazila (47.6%) the higher occurrence of reproductive disorders and the lowest were in metro thana (31%) recorded in the present study. The variation in the prevalence of reproductive problems among the different region may be due to effects of the differences in management (production) systems and environmental conditions including poor sanitation, nutritional status, contamination during calving, the indiscriminate use of broad spectrum antibiotics and corticosteroids for the treatment of reproductive disorders or the insemination of animals with contaminated semen that may led to microbial infections of the uterine environment, which greatly affect the occurrence of reproductive problems. Cattle rearing system and environment might be different in each region.

In the present the prevalence of reproductive disorders was observed lower in local and higher in cross-bred cows. Similarly, Al Nahian (2011) observed the higher prevalence of reproductive disorders in cross-bred in comparison to indigenous cattle and Debnath *et al.* (2012) recorded the occurrence of reproductive disorders was higher in cross-bred cows (1.27%) than that of indigenous cows (0.69%). The higher prevalence rate of reproductive problems was in cross-bred cattle than local cattle which may be due to the fact that cross-breeds are less adapted to tropical conditions of high temperature and humidity, disease and low feed quality than local cattle (Mukasa-Mugerwa, 1989) making them more susceptible than indigenous zebu cattle. Besides this, cross-bred require more elaborated management, feeding and better health care than the local cattle to get better reproductive performance (Tekleya *et al.*, 1991).

The highest prevalence of abortion, retained placenta, dystocia, vaginal prolapse, uterine prolapse, metritis, pyometra, still birth, anoestrus, repeat breeding, mastitis and milk fever were 6%, 5%, 3.2%, 1.4%, 1%, 0.6%, 1%, 0.6%, 10%, 5.6%, 1.8% and 1%, respectively in L×F genotype and the lowest in L. This finding is similar with the findings of Kader (2010). He found all the reproductive diseases were the highest prevalence in L × F genotype and the lowest in L but the findings were littlebit differ from Sarder (2008). This difference may be due to breed variation, age, body weight, condition etc.

The age group of >9 years group showed the highest of abortion (6%), retained placenta (4.4%), dystocia (2.6%), vaginal prolapse (1.4%), pyometra (1%), anoestrus (12%), repeat breeding (5.8%), milk fever (0.4%) and age group of >5 to 9 years showed the highest of uterine prolapse (0.6%), metritis (0.8), still birth (0.6%), and age group of 3 to 5 years showed the highest of mastitis (1.8%). All the reproductive disorders were the lowest in <3 years aged group cows except dystocia, still birth and anoestrus which were the lowest in 3 to 5 years age group cows. Kader (2010) observed the age group of 5 to <7 years showed the highest of abortion (0.5%), retained placenta (3.8%), uterine prolapse (0.7%), dystocia (0.8%) and mastitis (4.3%) and age group of 3 to <5 years showed the highest of still birth (0.9%), metritis (0.8), pyometra (1.3%), milk fever (0.5%), repeat breeding (6.3%) and anoestrus (7.7%). The author also observed that all the reproductive diseases were the lowest in <3 years aged group cows except pyometra and anoestrus which were the lowest in >7 years age group cows. Sarder (2008) reported the higher the incidence of abortion, metritis, vaginal prolapse, uterine prolapse, retained placenta, dystocia, anoestrus and repeat breeding were higher in >8 years old cows and lower in <4 and 4-6 years old cows. Bitew and Prasad (2010) also observed the age wise prevalence in young and adult cattle were (33.45%) & (66.96%), respectively. The variation of results might be due to age group, breed, body weight, body condition, manage mental factors and environmental factors etc.

The prevalence of abortion and metritis were the highest (3.4%) and (0.8%) in 1st parity and the lowest (0.2%) and (0.0%) in heifer. The prevalence of retained placenta (2.8%), dystocia (1.8%), vaginal prolapse (1%), pyometra (0.8%), stillbirth (0.2%), anoestrus (6.4%), repeat breeding (3.2%), milk fever (0.4%) were higher incidence in 2nd parity. Similarly uterine prolapse (0.6%) was the highest in 4th parity and mastitis (1.8%) were the highest in 5th and above parity. Present study showed the most of the reproductive disorders were higher in 2nd parity which is similar with the findings of Bicalho *et al.* (2007). Kader (2010) also observed the prevalence of abortion was the highest (0.6%) in 2nd calving and the lowest (0.0%) in heifer, 1st calving, 6th calving and >7th calving. The prevalence of stillbirth the highest (0.7%) 1st calving and the lowest (0.0%) in heifer, 5th calving, 6th calving and >7th calving. Similarly retained placenta (4.5%), metritis (1.1%), pyometra (1.1%), uterine prolapse (0.5%), dystocia (0.7%), milk fever (0.5%) and repeat breeding (5.2%) were higher incidence in 2nd parity, vaginal prolapse (0.7%) and mastitis (2.8%) was the highest in 3rd parity and anoestrus (6.9%) in heifer. In comparison, Alam *et al.* (2014) recorded the highest occurrence of reproductive diseases was in cows at 4th to 8th parity and the lowest occurrence was in cows with 2nd to 3rd parity and Sawa *et al*. (2012) stated the lowest occurrence of reproductive diseases was reported in 2nd and 3rd parity cows than that of 4th to 7th parity. It is likely that first parity cows may have dystocia and older cows may have retained placenta and ovarian cysts (Grohn *et al.,* 1990). Sardar *et al*. (2010) found higher incidence of metritis in >8 years old cows. Similarly Huffman (1984) reported higher incidence of pyometra in older cows. Usually, the risk of retained placenta, metabolic disorder and endometritis may increase with advancing parity.

In the present study, 200 to 300 kg body weight of cows showed the highest incidence of all the reproductive disorders and the lowest in <200 kg body weight of cows. Present study showed that all the reproductive disorders were highest in 200 to 300 kg body weight cows and lowest in <200 kg body weight cows which are more or less similar with the findings of Kader (2010). He obtained 300 to <400 kg body weight of cows showed the highest incidence of all the reproductive diseases except anoestrus which was the highest in 200 to <300 kg body weight of cows and the lowest in <200 kg body weight of cows. All the reproductive disorders were the highest in 200 to 300 kg weight cows due to age, season, parity, feeding and nutritional status, environmental condition etc.

Poor body condition of cows showed the highest incidence of all the reproductive disorders were as abortion 6.8%, retained placenta 6.6%, dystocia 2.4%, vaginal prolapsed 1.8%, uterine prolapsed 0.6%, metritis 0.6%, pyometra

0.6%, still birth 0.4%, anoestrus 12.8%, repeat breeding 5.8%, mastitis 2.6%, and milk fever 0.8% and good body condition of cows showed the lowest incidence of all reproductive disorders. In line with the present finding, the lowest occurrence of reproductive disorders in cows with high BCS and the highest occurrence of reproductive disorders in cows with low BCS were observed (Alam *et al.* 2014). Similarly, Sarder *et al.* (2010) reported the highest incidence of reproductive disorders were in poor body condition cows compared to the fair and very good body conditions but Kader (2010) reported the reverse effect that is significantly higher incidence of reproductive disorders were in good body condition cows compared to the fair and poor body conditions of cows. The influence of BCS on occurrence of various reproductive disorders was also reported elsewhere (Shamsuddin *et al.,* 2006a). The authors reported that cows with lower BCS had longer intervals from calving to first ovulation and less detected estrus. Similar reports are available on post-partum cows brought for first service (Shamsuddin *et al.,* 2001; Siddiqui, 2008). Low body energy reserves of cows greatly incerase the probability of suffering from metabolic disorders, reproductive failure, reduction in milk yield and delayed puberty (Montiel and Ahuja, 2005). Moreover, cows with low BCS may have poor quality oocytes, which do not fertilize normally. Even if fertilized, oocytes of poor BCS cows often do not sustain development to term (Siddiqui *et al.,* 2002). This might due to age, parity, body weight, season and consequence of other disorders.

The higher prevalence of reproductive disorders in cows of farmers having no education and lower in cows of farmers having higher secondary education. In comparison, Kader (2010) reported the reverse effect that is significantly higher incidence of reproductive disorders were in cows of farmers having secondary education and lower in cows of farmers having no education. The highest incidence of reproductive disorders were recorded in cows of farmers having no educational qualification of farmers group causes may be due to farm size, data collection error, environment, population of the farm and, management system variation etc.

Researcher observed that all reproductive disorders were higher in non farming experience of farmer and lower in vast farming experience group of farmers. In contrast, Kader (2010) reported the reverse effect that is significantly higher incidence of reproductive disorders were in cows having little experience of farmer compared to the vast and non farming experience group of farmers. This result was found due to maximum local cow owner had no farming experience, variation in body weight of cows; body condition, age and other manage mental factors.

Large farm size showed more frequency and small size showed less frequency of reproductive disorders of cows in this study. Similarly, Kader (2010) reported the highest frequency of reproductive diseases was in large farm size compared to the medium and small farm size. The variation of results might be due to inadequate veterinary supervision, management error etc.

The highest prevalence of reproductive disorders was in intensive rearing system of farm and the lowest were in grazing on pasture land rearing system of farm. Similarly, Kader (2010) reported the highest prevalence of reproductive diseases was in intensive farm and the lowest were in extensive farm i.e. grazing on pasture land rearing system of farm. This may be due to diseases transmitted rapidly in intensive rearing system and slow in grazing on pasture land rearing system of farm.

The prevalence of all reproductive disorders was higher in urban and lower was in semi-urban type of location of farms. The prevalence of all reproductive disorders was higher in muddy type of floor that means poor type of floor and lower was in concrete type of floor of farm. In distinction, Kader (2010) reported the reverse effect that the higher incidence of reproductive disorders was in cows with good floor type of farms and lower in poor floor type of farms. The higher incidence in muddy floor type of farms may be due to manage mental fault, data error, environmental effect of high yielding cows, lack of close supervision.

Poor quality of ventilation of farms showed higher prevalence of all reproductive disorders and the lower in good quality of ventilated farms. In difference, Kader (2010) reported the reverse effect that the higher prevalence of reproductive diseases was in cows with good ventilation of farms compared to the medium and poor ventilation system of farm. The lower incidence of reproductive diseases in good quality of ventilated farms in the present study might be due to owner of cows having one or two cows, given more attention in management system of cows, genotypes especially, local breed are more resistance to reproductive diseases.

In Bangladesh, due to lack of available grazing lands, sometimes cattle are tethered on the roadsides and fallow land. Seasonal and fluctuating supply of rice straw and green grass also creates a great problem in feeding dairy cattle (Rahman *et al*., 1998). In the current study, the prevalence of all reproductive disorders was observed higher in poor quality of feed and lower was in good quality of feed. Similarly, Sardar (2008) reported that the lowest reproductive disorders for excellent quality feed with the highest in poor quality of feed. The result of present study controvertory from Kader (2010). High milk production and imbalanced feeding are the factors for reproductive disorders in cross-bred cows (Shamsuddin *et al.,* 1988). The variation of the result may be default classification, food management, study area, pattern of feeding, quality breed, age of cows etc.

The prevalence of all reproductive disorders was higher in artificial insemination and lower was in natural service of cows. This may be due to diseases transmitted rapidly during artificial insemination; high yielding cross-bred cows are vulnerable to occur disease.

Experiment II: Study on biometrical measurement of reproductive organs in cows at Rajshahi

5.2.1 Morphological studies of reproductive system of cows

Genotypes of parents influence the genetic composition of offspring. Genotype and Environmental factors play a crucial role in productive and reproductive performance of dairy cows.

5.2.2 Ovary

The results of the study revealed that the average mean length, width and thickness of right ovary in different genotypes, age and body weight groups and parities of cows were recorded as 2.48 ± 0.98, 1.84 ± 0.59 and 1.48 ± 0.10 cm and that of the left ovary 2.33 ± 0.56, 1.62 ± 0.26 and 1.27 ± 0.59 cm, respectively. The weight of right and left ovary was recorded as 3.75 ± 0.18 and 3.09 ± 0.15 g, respectively.

In the present study, genotype, age and body weight groups and parity of cows had a significant effect on most of the parameters of reproductive tract of dairy cows of different genotypes, age and body weight groups and parities.

The average mean length of the ovary recorded in the present study fall within the range (1.30 to 3.5 cm) of the results of Dobson and Kamonpatana (1986), Kunbhar *et al.* (2003), Carvalho *et al*. (2005), Ali *et al.* (2006), Ahmed (2011) Bello *et al.* (2012) and Leal *et al*. (2013). However the measurement for length recorded in the present study was shorter than the figures (2.8 to 5.0 cm) reported by Salisbury and Vandemark (1961), Settergren (1983), Roberts (1982), Memon (1996) and Jaji *et al.* (2012) in cattle. The width of ovary as recorded in the present study was in agreement with the results (1.1-1.9 cm) of Salisbury and Vandemark (1961), Roberts (1982), Kunbhar *et al.* (2003), Ali *et al.* (2006), Ahmed (2011) and Bello *et al.* (2012) in cattle. However, it was slightly smaller to those (2.2-3.01 cm) reported by Drennan and Macpherson (1966), Sission and Grossman (1972), Getty (1975), Carvalho *et al.* (2005), Jaji *et al.* (2012) and Leal *et al*. (2013) in cattle. The thickness of the ovary found in the present study was in the range of those (0.6-2.0 cm) recorded by Kunbhar *et al.* (2003), Carvalho *et al.* (2005) and Ali *et al.* (2006) Bello *et al.* (2012), Jaji *et al.* (2012) and Leal *et al*. (2013)in cattle.

However, the results obtained by Salisbury and Vandemark (1961), Arthur *et al*. (1989) and Memon (1996) were greater than the present findings. The present findings for the weight of ovary were in agreement to those (3.8 g) reported by McEntee (1983), Arthur *et al.* (1989) and Kunbhar *et al.* (2003) in cattle. On the other hand higher weight (4-19 g) of right and left ovary was reported by Roberts (1982), Carvalho *et al*. (2005), Ali *et al.* (2006), Ahmed (2011), Bello *et al.* (2012), Jaji *et al.* (2012) and Leal *et al*. (2013). The discrepancy in the parameters could be due to age, breed, parity, body weight, body condition score, and manage mental factors variation as it is established fact that the ovaries of *Bos indicus* breeds are generally smaller and lighter than those of the *Bos taurus* breeds. It was concluded that the left ovary is shorter in length, narrower in width and lighter in weight to that of the right ovary in different genotype, age and body weight and parities of dairy cows. This confirms the fact that the right ovary is more active than the left ovary (Rind *et al*., 1999).

Moreover, Local × Holstein Friesian had significantly higher values ($P<0.05$) on most of the parameters of ovary measured, followed by the Local × Jersey, Local × Sahiwal and the Local (Table 53). The comparison of the morphometric values of both ovaries in the different age and body weight groups and parities showed significant difference ($P<0.05$) in length, width, thickness and weight (Table 55 Table 57 and Table 59). Age group >5 years, body weight group >300 kg and 3rd parity had significantly higher values ($P<0.05$) on most of the parameters measured, followed by the age group 3 ≤ 5 years & <3 years, body weight group 200 to 300 kg & <200 kg and others parity, respectively.

5.2.3 Oviduct

The average mean length of right and left oviducts were as 21.05±0.39 and 21.00±0.38 cm, respectively in different genotypes, age and body weight groups and parities of cows. In the present study, Local × Holstein Friesian had significantly ($P<0.05$) higher length of both right and left oviducts than other groups (Table 54). Age and body weight had also significant effect ($P<0.05$) on the length of both of right and left oviducts (Table 56 and Table 58). The length of both oviducts of age group >5 years was significantly ($P<0.05$) higher than that of age group <3 years, but the length of age group 3 ≤5 years, did not differ significantly ($P>0.05$) with that of other two age groups (Table 56). Among the three different body weight groups, it was observed that body weight group >300 kg was significantly ($P<0.05$) higher than that of body weight group <200 kg, but no significant difference ($P>0.05$) was observed with that of body weight group 200 to 300 kg (Table 58). Among the different parities, it was observed that 3^{rd} parity was higher value than others, but no significant difference ($P>0.05$) was observed with that of others parity (Table 60). Higher length of both oviducts in age group >5 years might be due to older age with higher body weight of the animals.

The findings of present study about the length of oviducts were in agreement with the results (20-30 cm) of McEntee (1983) and Petter (1993), Kunbhar *et al.* (2003) and Bello *et al.,* (2012) in cattle. On the other hand lower length (16.8-19.8 cm) of right and left oviducts were reported by Carvalho *et al*. (2005) and Ahmed (2011). These differences might be due to the aforementioned reasons

5.2.4 Uterine horn and body

The average mean length of right and left uterine horns were 25.34 ± 0.72 and 25.79 ± 0.73 cm, respectively and the mean length and width of body of uterus were 3.12 ± 0.72 and 2.51 ± 0.59 cm, respectively in different genotypes, age and body weight groups and parities of cow.

Genotype had significantly ($P<0.05$) affects the length of uterine horns and width of uterine body. The significantly longer uterine horn was observed in Local × Holstein Friesian (29.20 ± 1.65 cm for right horn and 29.87 ± 1.75 cm for left horn) but there was no significant difference between cows of other genotypes. The highest width of body of uterus was observed in Local × Holstein Friesian and it was 2.83 ± 1.40 cm but there was no marked difference between cows of other genotypes (Table 54).

The average length of both uterine horn of age group >5 years and body weight group >300 kg were significantly ($P<0.05$) higher than that of age group <3 years and body weight group <200 kg but the average length in age group 3 ≤5 years and body weight group 200 to 300 kg were not differ significantly

(P>0.05) with that of other two age groups (Table 56 and Table 58). Higher length of both uterine horns in age group >5 years might be due to older age with higher body weight of the animals. Length of uterine horns differed significantly (P<0.05) due to differences of age and body weight of cows. The length of right and left uterine horn was higher in age group >5 years (27.58±1.08 and 28.41±1.12 cm) and body weight group >300 kg (27.00±1.05 and 27.77±1.12 cm), respectively than other groups.

In the present study, the length of body of uterus of age group >5 years was almost similar with that of age group 3 ≤5 years but significantly (P<0.05) higher than that of age group <3 years (Table 56). The width of body of uterus of age group >5 years was significantly (P<0.05) higher than that of age group <3 years, but the width in age group 3 ≤5 years, did not differ significantly (P>0.05) with that of other two age groups (Table 56). On the other hand, the highest length and width were found in body weight group >300 kg than that of other two body weight groups although there was no significant difference (P>0.05) among the body weight groups (Table 58). The highest length and width of body of uterus of the animals of age group >5 years and body weight group >300 kg might be attributed to their higher physiological fitness.

Among the different parities, it was observed that the average length of right uterine horn and uterine body of 3rd parity were significantly (P<0.05) higher than that of others but there were not differ significantly (P>0.05) with that of other parities and in case of left uterine horn 2nd parity was significantly (P<0.05) higher than that of others (Table 60). The values of right uterine horn was higher in 3rd parity (29.20±1.44 cm) and left uterine horn higher in 2nd parity (30.20±1.54 cm), respectively.

The length of uterine horns of present study fall within the range (15-30 cm) reported by Kunbhar *et al.* (2003), Ali *et al.* (2006), Ahmed (2011), Bello *et al.* (2012) and Jaji *et al.* (2012); however higher values (35-40 cm) were recorded by Hafeez (1968), Getty (1975), Sorensen (1988) and Petter (1993). The result for length of uterine body were higher in line with those (2.3-2.8 cm) reported by Petter (1993), Kunbhar *et al.* (2003), Ahmed (2011) and Bello *et al.* (2012) in cows but was in agreement with the values (3-5 cm) were reported by Getty (1975), Sorensen (1988) and Carvalho *et al*. (2005) in cattle. The findings for the width of the present study were in agreement to the results (2.5 cm) reported by Sorensen (1988) and Kunbhar *et al.* (2003) in cows. Whereas, Sission and Grossman (1972), Roberts (1982), Jaji *et al.* (2012) and Bello *et al.* (2012) reported higher values (3.23-4.60 cm) as compared with the present investigation. The difference in values could have been due to age, breed, fertility status and shrinkage of the endometrium. Higher length of both uterine horns in age group C might be due to older age with higher body weight of the animals.

5.2.5 Cervix

The average mean length and width of cervix were recorded as 5.02±0.11 and 4.56 ± 0.12 cm, respectively in different genotypes, age and body weight groups and parities of cow.

Genotype had significant effect $P<0.05$) on the length of cervix of cows (Table 54). The length of cervix of age group >5 years was significantly ($P<0.05$) higher than that of other two age groups, but there exists no significantly difference ($P>0.05$) among the age groups <3 years & 3 ≤5 years (Table 56). The width of cervix of age group >5 years was significantly ($P<0.05$) higher than that of age group <3 years, but the width in age group 3 ≤5 years, did not differ significantly ($P>0.05$) with that of other two age groups (Table 56). On the other hand, the length and width of cervix of body weight group >300 kg was significantly ($P<0.05$) higher than that of other two body weight groups, but there exists no significantly difference ($P>0.05$) among the body weight groups <200 kg & 200 to 300 kg (Table 58). In the present study, the length of cervix in 3rd parity was significantly ($P<0.05$) higher values than that of others parity (Table 60). Age and body weight had significant effect ($P<0.05$) on the length and width of cervix of cows (Table 56 and Table 58).

The length recorded in this study was lower with the results (7.99, 6.7 and 7-10 cm) obtained by Garcia (1988), Memon (1996) and Kunbhar *et al.* (2003), Carvalho *et al.* (2005) Ahmed (2011), Jaji *et al.* (2012) and Bello *et al.* (2012) respectively in cows. The findings of present study were in agreement with the values (4.35-6.12 cm) were reported by Ali *et al.* (2006). Whereas the width recorded during present study were higher to the results 2.3-2.8 cm of Petter

(1993), Kunbhar *et al.* (2003) and Jaji *et al.* (2012) and were in agreement with the results (3.35-6.25 cm) reported by Ali *et al.* (2006) and Bello *et al.* (2012) in cows.

5.2.6 Vagina

The average mean length and width of vagina were 22.59±0.34 and 5.44±0.16 cm, respectively in different genotypes, age and body weight groups and parities of cow.

The highest length of vagina was observed in Local × Holstein Friesian (24.66±0.64 cm) but there is no marked difference between genotypes of Local (21.81±0.47 cm), Local × Jersey (22.50±0.85 cm) and Local × Sahiwal (21.46±0.88 cm). Genotype had significant effect P<0.05) on the length of vagina of cows (Table 54). The highest width of vagina was observed in Local × Holstein Friesian (6.08 ± 0.36 cm) and that of lowest in Local 4.83±0.17 cm) but there is no difference between genotypes of Local × Jersey (5.17±0.45 cm) and Local × Sahiwal (5.84±0.54 cm). Genotype had significant effect P<0.05) on the width of vagina of cows (Table 54).

Age had significant effect P<0.05) on the length and width of vagina of cows (Table 56) and body weight had significant effect P<0.05) on the length of vagina of cows (Table 58). In the present study, the length of vagina of age group >5 years was significantly (P<0.05) higher than that of other two age groups, but there exists no significantly difference (P>0.05) among the age groups 3 ≤5 years & <3 years (Table 56). The width of vagina of age group >5 years was almost similar with that of age group 3 ≤5 years but significantly (P<0.05) higher than that of age group <3 years. On the other hand, the length of vagina of body weight group >300 kg was significantly (P<0.05) higher than that of other two body weight groups, but there exists no significantly difference (P>0.05) among the body weight groups 200 to 300 kg & <200 kg (Table 58). Parity had significantly (P<0.05) affects the length of vagina of cows. In the present study, the length and width of vagina in 3rd parity were higher values than that of others parity and there were not marked difference among them (Table 60).

These results regarding length were in agreement with the results (17.5-25 cm) reported by Roberts (1982), Petter (1993), Kunbhar *et al.* (2003) and Ahmed (2011) in cattle. However the results (25-36 cm) reported by Carvalho *et al*. (2005) was higher than the present findings. The measurement regarding the width of vagina was in agreement with the results (4.50 and 6.50 cm) recorded by Sorensen (1988) and Kunbhar *et al.* (2003) in cattle.

5.2.7 Vulva

The average mean length and width of vulva were 8.85±0.14 and 4.83±0.13 cm, respectively in different genotypes, age and body weight groups and parities of cow.

Genotype also significantly (P<0.05) affects the width of vulva of cows. The highest width of vulva was observed in Local × Jersey (5.45±0.28 cm) (Table 54). The length of vulva of age group >5 years was significantly (P<0.05) higher than that of other two age groups, but there exists no significantly difference (P>0.05) among the age groups 3 ≤5 years & <3 years (Table 56). The width of vulva of age group >5 years was almost similar with that of age group B but significantly (P<0.05) higher than that of age group <3 years. On the other hand, the variation in length and width of vulva were not differ significantly (P>0.05) among the three different body weight groups (Table 58) though the highest length and width were found in body weight group >300 kg.

The highest length and width of vulva of the animals of age group >5 years and body weight group >300 kg might be attributed to their higher physiological fitness. Age had significant effect (P<0.05) on the length and width of vulva of dairy cows. Parity had significantly (P<0.05) affects the length of vulva of cows. On the other hand, the variation in width of vulva were not differ significantly (P>0.05) among the different parities (Table 58) though the highest length and width were found in 3rd parity. The findings regarding vulva of the present study were lower with the values reported by Kunbhar *et al.* (2003) in cattle.

Experiment-III: Study on the gross and histopathological changes of the affected organs

In Bangladesh cattle is an economically important animal. But this economic important animal is often found to suffer from different reproductive disorders (Rahman *et al.,* 1993). Various pathological disorders in reproductive system resulted serious economic loss and reduce production efficiency in cows all over the world. The condition is much worse in our country. The incidence of various reproductive pathologies has increased menacingly in this country probably due to introduction of intensive cross breeding programme through artificial insemination. Improvement of animal production largely depends on proper reproductive efficacy. It is worth to note that for the improvement of reproductive performance availability of base line data on the existing reproductive statuses is an important criteria to formulate a development plan. The present work was therefore undertaken to investigate into the disorders of female reproductive system in cows.

5.3.1 Gross examination

A total of 115 female genitalia were examined grossly and the findings were hemorrhage in uterus and horn of the uterus i.e. endometritis, enlarged, hemorrhage and swollen cervix i.e. cervicitis, granular vulvo-vaginitis followed by follicular cyst, vaginitis, hemorrhage in ovary, pyometra, sub-active ovary, luteal cyst, mucometra, aplasia of cervical ring, multicystic ovary, parasitic cyst within the uterus and mesovarian cyst.

Although very few reports are available on such disorders in cows of Bangladesh and the result of gross study are more or less same with the reports of earlier workers (Ahmed, 1984, Hossain *et al.*, 1986 and Shahabuddin, 1996). Based on gross pathological examination, it can be suggested that endometritis, cervicitis and granular vulvo-vaginitis were most common affections in the reproductive system followed by follicular cyst, vaginitis, hemorrhage in ovary, pyometra, sub-active ovary, luteal cyst, mucometra, aplasia of cervical ring, multicystic ovary, parasitic cyst within the uterus and mesovarian cyst.

The occurrence of endometritis was frequently observed. On gross examination of freshly collected genitalia showed 19.14% endometritis. Endometritis, acute or chronic type, is the most common pathological disorders in the female reproductive system of cattle (Shamsuddin *et al.,* 1988). Shamsuddin *et al.* (1988) recorded 10.38% metritis and Borsberry and Dobson (1989) recorded 14.80% endometritis and they concluded that endometritis is the principal cause of breeding failure in Bangladesh.

Endometritis is a worldwide problem of dairy cows. Fredriksson *et al*. (1985) reported an incidence of 44.0% endometritis among Swedish dairy cattle. Markusfeld (1984) also reported a high incidence of endometritis in Israeli cows.

Alam (2010) examined 42 genitalia and 16.7% endometritis was diagnosed. The present findings were lower than that of others (Rao *et al*., 1993; Shahabuddin, 1996; Kunbhar *et al.*, 2003 and Hasan *et al.*, 2015) which were 32.8%, 32.58%, 38.5% and 31.29%, respectively. Ali *et al.* (2006) collected 110 reproductive tracts of non descriptive cows from Faisalabad abattoir, were studied for pathological changes during disease condition. Occurrence of endometritis was not reported by them however 9.09% metritis was recorded. LeBlanc (2012) reviews recent data and concepts on the development of inflammation in the reproductive tract of dairy cows during the first 2 months after calving. The incidence of metritis is 10-20%, with 5-15% of cows having purulent vaginal discharge (PVD), 15-40% having cervicitis approximately 1 month after calving, and 10-30% having cytological endometritis between 1 and 2 months after calving. The author found that endometritis, cervicitis and PVD are distinct conditions, each of which is associated with significantly increased time to pregnancy. The incidence of metritis was 29.7% in cows reported by Satya (2003). The overall incidence of metritis was the most severe reproductive disorder in both first calves (28.9%) and all calves (38.9%) were reported by Balasundaram (2008). The present findings of the incidence of endometritis are in full agreement with reports of other workers (Franz *et al*., 1988; Gonzalaz *et al.,* 1996; Talebkhan Garoussi *et al*., 2010; Ahmed, 2011 and Sayyari *et al*., 2012). About 27.4% and 27.8% endometritis were recorded by Shamsuddin *et al.* (1988) and Akhter *et al*. (2013), respectively. In this study, the findings are higher than that of others (Kubar and Jalakas, 2002 and 2003; Abalti *et al*., 2006; Patel *et al*., 2007; Gebrekidan *et al*., 2009; Mekibib *et al*., 2013 and Kilinc and Oruc 2014). Hatipoglu *et al*. (2002) recorded 1.26% endometritis which was very low. Narasimha Rao (1982) reported that about 13.97% cows suffered from endometritis among the principal causes of reproductive failure in cows of this country. In a study of Francos (1974) 11% endometritis were diagnosed. Frie *et al*. (1984) observed 7% endometritis in their studies. Zafrakas (1969) recorded 8.56% endometritis. Simeri *et al*. (1991) detected an overall incidence of endometritis as 10.50% which constituted as one of the most important post parturient disorders. These variations in results due to breed, health condition, failure of early detection of diseases or manage mental problems.

The second higher incidence of gross disorder was cervicitis (10.43%). Roberts (1971) stated that prolapse of the external transverse cervical rings or cervical ectropion was a possible factor causing cervicitis in older cows. The results of our study showed similarities with the results obtained by (Soonwuk *et al.*, 1996; Ahmed 2011 and Anita *et al.*, 2013) which were 11.1%, 10% and 11.53%, respectively. 11.9% cervicitis was recorded by Alam (2010). Studies of Narasimha Rao (1982) recorded 5.52% cases of cervicitis. In another study, Nair and Raja (1975) examined 1250 genitalia and 0.6% cervicitis was diagnosed. On the otherhand, Hatipoglu *et al.* (2002) examined the pathological conditions of uterus, cervix and vagina of 1113 cows and pathological changes of cervix were recorded as double cervix (0.18 %), post-cervical band (0.72 %), cervical cyst (0.09 %), metaplasia (0.18 %), gland formation (0.27 %) and cervicitis (1.35 %). Kunbhar *et al.* (2003) examined 100 genitalia and 27.7% cervicitis was recorded. About 6.18%, 1.7%, 3.74%, 6.36% and 3.26% cervicitis were recorded by Zafrakas (1969), Roine (1977), Shahabuddin, (1996), Ali *et al.* (2006) and Garoussi *et al*. (2010). Studies of Shamsuddin *et al*. (1988) recorded 1.52% cases of cervicitis. Rahman *et al*. (1993) observed that the incidence of reproductive disorders of 2280 cows and heifers and 1.6% cervicitis was recorded. A state of 9.57% granular vulvo-vaginitis and 7.82% vaginitis recorded in this study. Jones *et al.* (1997) observed grossly in case of granular vulvo-vaginitis, eruptions appear as both pale and pink elevated papules, a few millimeters in diameter, usually covered by a catarrhal exudates that exudes from the vulva and microscopically, each papule consists of a hyperplastic lymphoid follicle that often is congested or contains areas of hemorrhage. These lesions are almost similar with the present study. In other study, Bah *et al*. (2010) assessed that the reproductive status of 390 cows that were randomly selected for possible causes of infertility from the gross reproductive pathologies

(GRP) observed in the reproductive tract. The common GRP observed were 24.8% ovarian inactivity, 5.1% metritis and 0.8% vaginometritis. The present study is compatible to the findings obtained in the study conducted by Kunbhar *et al.* (2003), Alam (2010) which are 10.89%, 9.5%, respectively and vaginitis by Ahmed (2011) which is 7.5%. In a study, 2.4% granulo-vulvo-vaginitis and 0.2% vaginitis recorded by Nair and Raja (1975), 7% and 5.76%, granular vulvovaginitis reported by Alam and Rahman (1979) and Anita *et al.* (2013). About 2.5%, 2.04%, 1.35% and 4.34% vaginitis were recorded by Obwolo and Ogaa (1990), Rahman *et al*. (1993), Hatipoglu *et al*. (2002) and Telebkhan Garoussi *et al*. (2010), respectively.

Other gross abnormalities in this study, 9.57% follicular cyst, 2.61% luteal cyst, 1.73% multicystic ovary, 0.87% mesovarian cyst, 3.48% sub-active ovary, 6.96% hemorrhage in ovary, 5.21% pyometra, 2.61% mucometra were recorded. Studies of Ahmed (2011) recorded 7.5% follicular cyst, 2.5% luteal cyst, 5% pyometra and 2.5% mucometra. 7.1% follicular cyst, 2.4% pyometra and 2.4% mucometra were recorded by Alam (2010). About 3.5%, 5.61% and 8.6% cystic ovaries were recorded by Abalti *et al.* (2006), Shahabuddin (1996) and Roine (1977). In a study, 3.9%, 3.65%, 13.0%, 1.88 % and 4.35% follicular cyst by El Wisy (1976), Narasimha Rao (1982), Kubar and Jalakas (2002), Hatipoglu *et al.* (2002) and Mekibib *et al.* (2013), 0.36% mucometra by Hatipoglu *et al.* (2002); 0.5% and 0.8% pyometra reported by Sayyari *et al.* (2012) and Patel *et al.* (2007); 1.5% and 2.62% sub-active ovary were recorded by Roine (1077) and Shahabuddin (1996). About 1.4% and 8.7% luteal cyst were recorded by Kubar and Jalakas (2002) and Dwivedi and Singh (1971). In another study, Kubar and Jalakas (2003) examined 39 cows where 1 (2.6%) mucometra, 1 (2.6%) adenoma of the oviduct and 9 (23.1%) ovarian cysts. The author also stated that most ovarian cysts were follicular cysts and only one third of the animals also (33.3%) luteal cysts. In the present report there is also an exceptional finding within uterus i.e. parasitic cyst in the entire uterus. The percentage of the finding is negligible but it focuses the importance of uterine findings. On the other hand, Kunbhar *et al.* (2003) examined 100 genitalia of Thari cows and found that the most affected part of the tract was (70.8%) uterus followed by (64.6%) cervix, (60.0%) oviduct, (49.2%) ovaries and (38.5%) vagina. The author recorded 10.8% follicular cyst, 7.7% luteal cyst, 4.6% ovarian hypoplasia 4.6% ovaro-bursal adhesion and in uterus, 43% pyometra, 12.3% hydrometra and mucometra and 6.2% cysts on uterine wall. 5% mucometra were recorded by Herenda (1987). Many other workers also diagnosed ovarian cyst. For example 1.86% incidence of ovarian cyst were diagnosed by Frie *et al.* (1984) and 11% by Kucharski and Zdunchzyk (1984). 3.13% cystic ovaries and 1.17% persistent corpora lutea were diagnosed by Shamsuddin *et al*. (1988). Mujuni *et al*. (1993) found 18.9% ovarian cysts. 49.7% were diagnosed by Rao *et al*. (1993). Soonwuk *et al*. (1996) examined 800 cows and they recorded 10% follicular cyst and 24% luteal cyst. Kang *et al.* (1994) examined 60 cattle and recorded 33.3% inactive ovaries, 11.7% follicular cyst and 11.7% luteal cyst. In a study, Akhter *et al*. (2013) diagnosed of different pathological conditions of 54 sub-fertile cow's genital tract and the problems were diagnosed as 11.1% pyometra, 3.7% mucometra, 9.2% follicular cyst and 1.9% luteal cyst. In a study, 2.72%, 5.5%, 3.3%, 8.13%, 8.37% ovarian cysts and 6.36%, 1.87%, 4.84% pyometra were recorded by Ali *et al.* (2006), Gebrekidan *et al*. (2009), Simenew *et al*. (2011), Mohammad (2013) and Hasan *et al*. (2015). Kilinc and Oruc (2014) examined 224 cows. They recorded lesions were atrophy 1.34%, follicular cyst 3.57%, luteinised cyst 0.89%, cystic corpora lutea 1.34%, hydrometra 0.89%, mucometra 1.34% and pyometra 0.89%. Besides the other gross pathological disorders recorded in the study were more or less similar with those of Alam (2010) and Ahmed (2011).

5.3.2 Histopathological examination

Again respective organs of 115 female reproductive systems were examined histopathologically and the findings were mainly endometritis, vaginitis, cervicitis, follicular cyst and multicystic ovary. Among the histopathological disorders prevalence of endometritis was highest and the percentage was (30.36%) followed by vaginitis, which was the second highest (23.21%). Tafti and Darahshiri (2000) 39% endometritis was observed by microscopic examination. In a study of Alam (2010) the rate of 21.4% endometritis, 17.9% cervicitis, 14.3% vaginitis, 10.7% follicular cyst and 3.6% luteinoma in ovary were recorded. 27 (18%) endometritis was recorded by Talib and Faraidoon (2014). Chronic endometritis was the most common microscopic lesion in cows with (34.61%) or without (17.94%) recorded reproductive disease by observed Talebkhan Garoussi *et al.* (2010). Nahar (2010) examined 20 uteri histopathologically and recorded 10 (33.33%) acute endometritis and 8 (26.66%) chronic endometritis. In a study of Ahmed (2011) 15% endometritis, 12.5% cervicitis, 10% vaginitis and 7.5% follicular cyst were recorded. 27.39% endometritis were recorded by Shamsuddin *et al*. (1988). 32.8% endometritis were diagnosed by Rao *et al*. (1993) and 22.3% by Gonzalaz *et al*. (1996). The occurrence of endometritis was higher than these values obtained by Abalti *et al*. (2006) and LeBlanc (2008) which were 3.9% and 15-20%, respectively. This variation may be due to number of samples examined, selection of samples and site examined. The histopathological study of endometritis corresponded with the findings os other (Gustafsson *et al.,* 2004).

The relative incidence of other histopathological disorders observed under microscope were vaginitis (23.21%), cervicitis (21.42%), follicular cyst (17.87%) and multicystic ovary (7.14%)

Most researcher agreed that occurrence of different pathological disorders in the reproductive system are more frequent in high milk producing cows (44%) than the medium milk producing (32%) counterparts Nakao *et al*. (1992). A number of factors influence the intensity and prevalence of reproductive disorders including the species and pathogenecity of the causative agent, the cellular and immunological defensive mechanisms, hormonal imbalance, and dietary status of the animal concerned and environmental sanitation.

The incidence of various reproductive disorders especially cervix and uterine infections in the form of vaginitis, cervicitis, haemorrhage in the uterus and horn of uterus i.e. endometritis and chronic endometritis, pyometra and mucometra has increased alarmingly in this subcontinent with the introduction of cross breeding programme among high yielding varities of cows. In addition to this lack of proper education or hygienic management of the postpartum cows and limited veterinary services have aggravated the situation. Therefore, in order to combat the occurrence of reproductive problems cross breeding programme through artificial insemination must be performed by skilled personnel under adequate veterinary inspection and increase cautious farming management. The etiology of having other conditions such as follicular cyst, mucometra, pyometra and hydrometra did not recover but could be due to bacterial infection in the genital tract, nutritional deficiency/imbalance or stresses required further investigation.

Chapter 6

SUMMARY AND CONCLUSIONS

Experiment-I: Study on reproductive trends of dairy cows in Rajshahi district

6.1.1 SUMMARY

A research project was carried out to find out the clinical trends (reproductive performance and disorders) of dairy cows in Rajshahi district of Bangladesh. A total of 500 dairy cows were studied in relation to genotype, age, parity, body weight, body condition score, educational status of the owner, farming experience, farm size, rearing system, geographical location, floor type, ventilation system, feed quality, preventive measure and breeding methods of farms on reproductive performances and disorders in dairy cows. This study was conducted from 6 upazilas and 4 metro thanas such as Charghat, Puthia, Poba, Godagari, Tanore, Mohanpur, Motihar, Boalia, Rajpara and Shahmukdhm metro thana at Rajshahi district over a period from July 2013 to June 2014. Studies were carried out through interview by using questionnaire from owner of dairy cows and private farm. The animals were classified according to various influencing factors. The average reproductive performances were age at puberty (26.42±0.22), age at first calving (35.48± 0.22), post-partum heat period (121.85±3.48), service per conception (1.93±0.04), days open (136.80±3.57) and calving interval (401.04±3.94).

The overall good reproductive performance was found at Boalia and Rajpara thana but poor performance at Godagari upazila. Most of the reproductive traits of cows at metro thanas had better performance than upazilas. The cross-bred cows had shown good reproductive performance than local. Genotype had significant effect on all the reproductive traits except on service per conception. Among the genotypes, Local×Holstein Friesian has attained earlier age at puberty (25.84±0.27 m) and age at first calving (34.94±0.27 m) than Local×Sahiwal (26.93±0.61 m, 36.09±0.62 m) and Local (27.88±0.47 m, 36.76±0.47 m), respectively. Age group had significant ($P<0.05$) effect on age at puberty, age at first calving and other parameters were not significant. Middle age groups of cows had shown better reproductive performance than others groups. Parities of cows, 1^{st} parity, 2^{nd} parity, 3^{rd} parity, 4^{th} parity, 5^{th} parity and above parity had significant effect on post-partum heat period, service per conception days open except on age at puberty, age at first calving and calving interval. Third and fourth parity had better reproductive performance than others. Body weight groups <200 kg, 200 to <300 kg and >300 kg had significant effect on age at puberty, age at first calving, post-partum heat period, days open and calving interval except on service per conception. The best reproductive performance was found in >300 kg body weight groups than 200 to <300 kg and <200 kg, respectively.

Body condition score had significant effect on all reproductive performance. Good body condition score (BCS) had excellent reproductive performance than medium and poor. Educational status of the owner had significant effect on age at first calving, post-partum heat period and service per conception except on age at puberty, days open and calving interval. Secondary educational status farmers had better reproductive performance than other groups. Farming experience, rearing system and geographical location of farm had no significant effect on reproductive performance. Farm size had significant effect on age at puberty, age at first calving, post-partum heat period and calving interval except on service per conception and days open. The best reproductive performance was found in small size farm than large and medium farm size. Floor type had significant effect on age at puberty, age at first calving and service per conception except on post-partum heat period, days open and calving interval. The best reproductive performance was found in concrete type of floor than semi-concrete and muddy floor. Ventilation system had significant effect on age at puberty, age at first calving, post-partum heat period and service per conception except on days open and calving interval. Good ventilation system had good reproductive performance than medium and poor. Feed quality had significant effect on post-partum heat period, service per conception, days open and calving interval except on age at puberty and age at first calving. After feeding three quality feed (Poor, medium and good), good quality fed groups of cow had excellent performance. Preventive measure had significant effect on age at puberty, age at first calving and calving interval except on post-partum heat period, service per conception and days open. Veterinarian treatment had better reproductive performance than quack and poor in traditional healer. There were significant effect of breeding methods on age at puberty, age at first calving and calving interval and the remaining traits were not significant. Artificial insemination, breeding method had better performance than natural service.

The overall prevalence of reproductive and productive diseases or disorders was 78.6% in total population which is alarming in study area. Among the reproductive and productive diseases, abortion 13.4%, retained placenta 10.2%, dystocia 5.4%, vaginal prolapse 2.4%, uterine prolapse 1.4%, metritis 1.6%, pyometra 1.8%, still birth 0.8%, anoestrus 24.6%, repeat breeding 11.4%, mastitis 4.4% and milk fever 1.2%. The highest occurrence of reproductive disorders was recorded in Tanore upazila 46 (9.2%) and the lowest occurrence was in Poba upazila 31 (6.2%). The minimum occurrence of reproductive disorders was recorded in Metro thanas 155 (31%) than upazilas 238 (47.6%). Cross-bred cows (60.6%) was found maximum occurrence of reproductive disorders than in local (18%). Most of the reproductive disorders were found in L×F (37.2%) than in L (18%). The highest prevalence of reproductive disorders was observed in >9 years age groups of cows. Reproductive disorders were observed the highest in 2^{nd} parity of cows. 200-300 kg body weight had shown the highest reproductive disorders than others. Good BCS had the lowest chance of RD than others. Secondary (16.4%) educational status had the lowest occurrence of reproductive disorders than others. The lowest rate of reproductive disorders was observed in vast (>5 yrs) farming experience. The lowest prevalence of reproductive disorders was found in grazing on pasture land (12.6%) and higher in Intensive rearing system (39.8%). The small size farm was found minimum chance (20.6%) to reproductive diseases than others groups. The minimum no. of cows suffering from reproductive disorders in semi-urban (23%) than in urban (31.6%). Less change the reproductive disorders in cows by natural service (19%) than artificial insemination (59.6%).

6.1.2 CONCLUSIONS

Results of the present study led to the following conclusions:

- The overall good reproductive performance was found at Boalia and Rajpara thana but poor performance at Godagari upazila.

- Most of the reproductive traits of cows at metro thanas had better performance than upazilas.
- The cross-bred cows had shown good reproductive performance than local.
- Local×Holstein Friesian has attained earlier age at puberty and age at first calving than Local×Sahiwal and Local.
- 3 to <5 yrs and >5 to 9 yrs old cows had shown better reproductive performance.
- The better reproductive performance was observed in 3rd parity had than others.
- >300 kg body weight had superior performance than 200 to 300 kg and <200 kg, respectively.
- Good body condition score (BCS) had better than medium and poor.
- Secondary educational status farmers had better reproductive performance than other groups.
- Small size farm had good reproductive performance than large and medium farm size.
- Concrete type of floor had better than semi-concrete and muddy floor.
- Good ventilation system and good feed quality had excellent reproductive performance than medium and poor.
- Veterinarian treatment had better reproductive performance than quack and poor in traditional healer.
- Artificial insemination, breeding method had better performance than natural service.
- The highest occurrence of reproductive diseases was recorded in Tanore upazila and the lowest occurrence was in Poba upazila
- The highest occurrence of reproductive disorders was recorded in upazilas than metro thanas
- The maximum occurrence of reproductive disorders was recorded in cross-bred cows than local
- Genotype had the highest occurrence in L×F and the lowest in L
- Age group had the highest occurrence in >9 years and the lowest in <3 years
- Second parity had the highest occurrence and the lowest in heifer
- Body weight had the highest in 200 to 300 kg and the lowest in <200 kg

- Good BCS had the lowest chance of RD than others.
- Secondary educational status had the lowest occurrence of reproductive disorders than others.
- Vast (>5 yrs) farming experience was found less chance to occur reproductive diseases than others.
- Intensive housing system had the highest occurrence of reproductive disorders and the lowest in grazing on pasture land
- The small size farm was found minimum chance to reproductive diseases than others groups.
- The minimum no. of cows suffering from reproductive diseases in semi-urban than in urban
- Less change the reproductive diseases in cows by Natural service than Artificial insemination

Experiment-II: Study on biometrical measurement of reproductive organs in cows at study area

6.2.1 SUMMARY

The present research work was undertaken to determine the biometrical study of female reproductive organs of dairy cows at different genotypes (Local, Local × Holstein Friesian, Local × Jersey and Local × Sahiwal), age (<3, 3 to ≤5, >5 years) and body weight (<200, 200 to 300, >300 kg) groups and parities.

The study was performed on the basis of gross morphology. The right ovary appeared wider, larger in length and heavier in weight as compared to left one, which confirms the fact of right ovary being more active than the left one. These results have established the baseline dimensions of the different segments of the female reproductive tract of the cow and the information will enable us to diagnose various abnormalities. The mean length of vulva, vagina, cervix and body of uterus in different genotypes, age and body weight groups and parities of cows were recorded as 8.85 ± 0.14, 22.59 ± 0.34, 5.02 ± 0.11and 3.12 ± 0.72 cm, respectively and corresponding values for the width were 4.83 ± 0.13, 5.44 ± 0.16, 4.56 ± 0.12 and 2.51 ± 0.59 cm, respectively. The mean length of right uterine horn and oviduct were 25.34 ± 0.72 and 21.05 ± 0.39 cm and that of left one were 25.79 ± 0.73 and 21.00 ± 0.38 cm, respectively. The mean length, width and thickness of right ovary were recorded as 2.48 ± 0.98, 1.84 ± 0.59 and 1.48 ± 0.10 cm and that of the left ovary 2.33 ± 0.56, 1.62 ± 0.26 and 1.27 ± 0.59 cm, respectively. The weight of right and left ovary was recorded as 3.75 ± 0.18 and 3.09 ± 0.15 g, respectively.

The comparison of the morphometric values of both ovaries and tubular parts in the different genotypes, age, body weight groups and parities were measured and shows significant difference ($P<0.05$) in length, width, thickness and weight. From the present study it is concluded that a good number of productive animals is slaughtered, which alarm the need of implementation of sexual health management programme in the area.

It was also observed that the size of genital organs of dairy cows increases with the advancement of age, body weight and parity. This may help to diagnose and

treat various reproductive problems at an early stage to save the animals from sending to slaughter houses.

The biometry of reproductive organs in Local × Holstein Friesian, Local × Jersey, >5 years old, >300 kg body weight and 3rd parity cows is imperative for selection of dairy cows to get the better productive and reproductive performance from crossbreeding and also for genetic improvement in respect of Bangladesh. The data of present study also provide base line information about biometry of various parts of the reproductive organs of cows of available genotypes in Bangladesh that will certainly help in teaching and further research on the anatomy and physiology of the reproductive system of dairy cows.

6.2.2 CONCLUSIONS

On the basis of results and discussion, the present study might be concluded that-

- The right ovary was found greater size in case of length, width, thickness and weight than left ovary.
- The highest average mean ovarian sizes were found in Local×Holstein Friesian crossbred than other groups but thickness and width was found higher in Local×Jersey crossbred cows.
- The average length of tubular parts such as right, left fallopian tube, right, left uterine horns, length, width of body of uterus, length, width of cervix, vagina and vulva were found higher in Local×Holstein Friesian crossbred cows than other groups.
- The maximum biometrical values had shown in >5 years group than other age groups.
- The >300 kg body weight group and 3rd parities of dairy cows had shown higher measurement values of reproductive organs than other groups.

Experiment-III: Study on the gross and histopathological changes of the affected organs

6.3.1 SUMMARY

The present research work was undertaken to detect pathological disorders of female reproductive system in cows based on examining gross and histopathological characteristics. The samples were collected from slaughtered animals. The gross study recorded the highest prevalence of endometritis (19.14%) followed by in descending order by cervicitis (10.43%), granular vulvo-vaginitis (9.57%), follicular cyst (9.57%), vaginitis (7.82%), hemorrhage in ovary (6.96%), pyometra (5.21%), sub-active ovary (3.48%), luteal cyst (2.61%), mucometra (2.61%), aplasia of cervical ring (2.61%), multicystic ovary (1.73%), mesovarian cyst (0.87%) and parasitic cyst within the uterus (0.87%). Grossly, vaginitis showing nodular lesions with congestion and mild catarrhal exudates on the mucosal surface, edematous swelling with highly congestion showing in cervicitis and endometritis showing petechial and ecchymotic hemorrhage with highly congestion in the endometrium of uterus.

The prevalence of abnormalities of genital system of dairy cows under microscopic examination was 48.7%. The incidence of endometritis was found to be highest (30.36%) followed by vaginitis (23.21%), cervicitis (21.42%), follicular cyst (17.87%) and multicystic ovary (7.14%) which was reconfirmed by histopathological studies. Microscopically, vaginitis showing leukocytic infiltration in the lamina propria, cervicitis showing infiltration of lymphocytes with erosion of the epithelial layer and chronic endometritis, which is characterized by thickening of the endometrial wall showing proliferation of connective tissues associated with infiltration of lymphocytes and macrophages. Infection in any segment of female reproductive tract could impair process of fertility. It may be opined that various pathological disorders in the female reproductive system seriously affect the production potentiality and thereby causing economical losses. The problem became more aggravated due to inadequate veterinary coverage and gynaecological knowledge in controlling such problems.

Reproductive disorders seriously affect the production efficiency leading to significant economic loss. These disorders in female reproductive system of cows are probably due to nutritional deficiency, hormonal imbalance and various rough handling of the reproductive system. But the present study could not correlate the disorders with those factors. Thus future study should be designed to find out the correlation between nutritional deficiency, hormonal imbalance and various rough handling of the reproductive system.

6.3.2 CONCLUSIONS

On the basis of results and discussion, the present study might be concluded that-

- Among the various pathological disorders, endometritis top the highest rank in both gross and histopathological examination.

Chapter 7

RECOMMENDATIONS

Diseases are major constraint of livestock development. Due to reproductive disorders there are losses in productivity, interference in agricultural development and human well-being as well as poverty alleviation in many regions of the developing world. The most important and readily measurable direct effects of disease are often losses in productivity. These include the effects due to abortion, dystocia, repeat breeding and anoestrus. Survey of reproductive performance of dairy cows is essential because it helps one to make management and other correction in case of suboptimal productive or the reproductive performance which could be related to individual animal problems and on the other hand to proceed on what is found to be optimal to increase the economic gain. The dairy cows were found to be low reproductive performances which are indicators of the management system in general. Moreover, the extended period for age at first calving and calving interval as well as higher number of service per conception were recorded in the study area. The major encountered factors that influence reproductive performance were service type, feeding system and health problem. The major health problems recorded in the present study were abortion, retained placenta, repeat breeding and anoestrus. The other problem recognized in this study was lack knowledge for estrus detection and right time of insemination of the AI technician. Generally, with a better efficient of heat detection, timely insemination, post-partum reproductive health management and feeding, it is possible to improve the reproductive performance of the cattle. Based on the present findings, the following recommendations are forwarded:

- ❖ Farmers should give priority to select the breeds of dairy cows.
- ❖ The animal must be provided with good quality of feed, proper management of post-partum reproductive problems and early growth management of heifers to enhance the reproductive performance.
- ❖ Farmers should be given attention to detect estrous of dairy cows for service.
- ❖ Awareness should be created about animal health management and AI services.

- AI equipments, technician and quality semen should be sufficient to improve the reproductive potential of the cows.
- Reproductive disorders of dairy cows significantly reduce their productivity which is of great concern of dairy producers worldwide because most reproductive disorders adversely affect the future fertility, So the farmers should alert to prevent RDs for one calf per cow per year.
- The farmers should be maintained herd health management of their cows.
- The farmers should be careful about the treatment, preventive measures and deworming of their cows by efficient veterinarian.
- The biometry of reproductive organs in Local × Holstein Friesian, Local × Jersey, >5 years old, >300 kg body weight and 3^{rd} parity cows is imperative for selection of dairy cows to get the better productive and reproductive performance from crossbreeding and also for genetic improvement in respect of Bangladesh.
- The data of present study also provide baseline information about biometry of various parts of the reproductive organs of cows of available genotypes in Bangladesh that will certainly help in teaching and further research on the anatomy and physiology of the reproductive system of dairy cows.
- Taken together, such monitoring of the reproductive health status of cows is helpful for making decision about treatment or culling of non-productive cows from the herd and also selection of good quality of dairy cows for increase calf and milk production which will be helpful to overcome losses due to reproductive disorders.

REFERENCES

Abalti, A., Bekana, M., Woldemeskel, M. and Lobago, F. 2006. Female genital tract abnormalities of Zebu cattle slaughtered at Bahir Dar Town, north west Ethiopia. Adami Tulu Agricultural Research Centre, Zeway, Ethiopia. Dordrecht, Netherlands: Springer Science and Business Media. *Tropical Animal Health and Production.* 38 (6): 505-510.

Abeygunawardena, H. and Alexander, P. A. B. D. 2001. Al of cattle in Sri Lanka: status, performance and problems. In Radioimmunoassay and related techniques to improve artificial insemination programmes for cattle reared under tropical and sub-tropical conditions. Proceedings of a final Research Co-ordination Meeting organized by the joint FAO/IAEA Division of Muclear Techniques in Food and Agriculture and held in Uppsala, Sweden, 10-14 May 1999.

Adeyinka, I. A. and Mohammed, I. D. 2006. Relationship of live weight and linear body measurement in two breeds of goats of Northern Nigeria. *Journal of Animal and Veterinary advances.* 5(11): 891-893.

Agarwal, S. K., Shankar, U. and Mishra, R. R. 1984. Incidence of retained placenta and effect on fertility in crossed breed cattle. *Livestock Advisor.* 9(12): 49-51.

Ahmed, A. and Khan, M. Z. 1993. Lesions in the female reproductive organs of buffalo. *Indian Veterinary Journal.* 70: 258-260.

Ahmed, J. U. 1984. An abattoir survey of female reproductive disorders in Sweden. *Bangladesh Veterinary Journal*. 18: 55-58.

Ahmed, J. U. 1992. Incidence of reproductive disorders in buffaloes (*Bubalus buablis*). *Bangladesh Agricultural University Research and Progress*. 5: 321-324.

Ahmed, T. 2011. Study on morphology and pathological disorders of reproductive system of cows. MS Thesis. Deptartment of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Ahmed, W. A. 2007. Overview on some factors negatively affecting ovarian activity in large farm animals. *Global Veterinarians*. 1: 53-66.

Akhter, M., Hoque, M. N., Shamsuddin, M., Alam, M. G. S. and Bari, F. Y. 2013. Ultrasonography for the management of reproductive disorders in dairy cows. *Journal of Agriculture and Veterinary Science.* 5(5): pp. 61-66.

Al Nahian, M. Z. B. R. 2011. Prevalence of reproductive disorders of cows in Mymensingh. MS Thesis. Deptartment of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Alam, J. 1991. Livestock development strategies in Bangladesh. The Socioeconomic Perspective. Proceeding of workshop on Livestock Development in Bangladesh. BLRI, Savar, Dhaka.

Alam, J. 1993. The sector for more investment in Bangladesh. *Asian Livestock*. 7: 77-78.

Alam, J. 1995. Livestock resources in Bangladesh: present status and future potential. The University Press Ltd., Dhaka.

Alam, J., Akteuzzaman, M., Rahman, A. and Ahmed, Z. 1994. Comparative performance of local and cross-bred cows in Bangladesh. *Indian Journal of Dairy Science.* 47: 112-117.

Alam, M. A. 2013. Prevalence of reproductive diseases and its associated risk factors in cross-bred dairy cows. MS Thesis. Deptartment of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Alam, M. A., Bhuiyan, M. M. U., Parvin, M. S., Rahman, M. M. and Bari, F. Y. 2014. Prevalence of reproductive diseases and its associated risk factors in crossbred dairy cows. *Research in Agriculture Livestock and Fisheries*. 1(1): 71-79.

Alam, M. G. S. and Ghosh, A. 1988. Reproductive performances in cows, its relation to parity and season. *Bangladesh Veterinary Journal*. 22: 51-61.

Alam, M. G. S. and Ghosh, A. 1989. Studies on current reproductive status with special emphasis on endocrine disorders in cows. Second Annual Report. Department of Surgery and Obstetrics, Bangladesh Agricultural University, Mymensingh.

Alam, M. G. S. and Ghosh, A. 1993. Reproductive patterns of indigenous cows in Bangladesh and effects of Urea-Molasses-Mineral Block (UMMB) on puberty and post-partum ovarian activity. Proc. Final Research Co-ordination Meeting of an FAO/IAEA Co-ordinated Research Programme Organized by Joint FAO/IAEA Division of Nuclear Technique in Food and Agriculture Bangkok, Thailand, 1-5 February, 53-63.

Alam, M. G. S. and Ghosh, A. 1994. Reproductive perforfance in cows: it's relationship to parity and season. *Bangladesh Veterinary Journal*. 22: 51-61.

Alam, M. G. S. and Rahman, A. 1979. Diseases of the genital tract of indigenous cows in Bangladesh. *Tropical Animal Health production* 1:179.

Alam, M. G. S., Ghosh, A., Mondal, A. K and Akbar, M. A. 2001. Supplementation and puberty of Zebu calves of Bangladesh. *The Bangladesh Veterinarian*. 18: 1-8.

Alam, M. G. S., Kamal, M. N. I. and Amin, M. M. 2007. Bacteria and Fungi in uterine infections in cows. *Bangladesh Veteinarian*. 24: 1-12.

Alam, M. G. S., Shakif, M. U. A. and Khan, M. J. 2006. Supplementation with urea molasses and body weight, milk yield and onset of ovarian cyclicity in cows. *Journal of Reproduction and Development*. 52: 529-535.

Alam, M. K. 2010. Pathological disorders in the female reproductive system of cows collected from the slaughterhouse of Mymensingh district. MS Thesis. Department of Pathology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

AL-Dahash, S. Y. A. and David, J. S. E. 1977. Anatomical features of cystic ovaries in cattle found during on abattoir survey. The *Veterinary Records*. 101: 320-324.

Alderete, R. H., Losada, J., Castes, O. and Arand, E. 1998. Reproductive behavior of commercial Zebu cows with calves under a regime of restricted suckling. *Livestock Research for Rural Development.* 10: 112-123.

Ali, M. E. 2002. Energy consumption pattern in rural Bangladesh-the opportunity for New Zealand: A household survey. Discussion Paper no 02.10, Department of Applied and International Economics, Massey University, New Zealand.

Ali, M. H., Bhuiyan, M. K. J. and Alam, M. M. 2011. Retrospective epidemiologic study of diseases in ruminants in Khagrachari Hill Tract District of Bangladesh. *Bangladesh Journal of Veterinary Medicine*. 9(2): 145-153.

Ali, R., Reza, M. A., Jabbar, A. and Rasool, M. H. 2006. Pathological Studies on Reproductive Organs of Zebu Cow. *Journal of Agricultural & Social Sciences*. 2(2): 91-95.

Amle, M. B., Chinchkar, S. R., Hukeri, V. B. and Deopurkar, V. L. 1992. Studies on gravid uteri of buffaloes. *Indian Journal of Animal Reproduction*. 13(2): 150-153.

Anita, R., Anirudh, K., Hemant, D. and Sunita, R. 2013. Pathology of certain conditions of female genital tract in cattle. *Indian Journal of Veterinary Pathology*. 37(1): 70-71.

Anonymous, 2011. Body condition scoring. http://www.vetmed.ucdavis.edu/ vetext/INF-DA/INF-DA BCS.HTML.

Aranjo, P. G., Pizelli, G. N., Carvalho, M. R. de., Reaende, O. de. A. and Britto, D. P. P. des. 1973. Studies of post-partum anaestrus in cattle. *Pesquisa Agropecuaria Brusileira, Serie Veterinaria.* 8: 13-19. (*Veterinary Bullatin).* 45: 1984.

Armstrong, D., DeNise, S., Delfino, F., Hayes, E., Grundy, P., Montgomery, S. and Correa, M. 1993. Comparing three different dairy cattle cooling systems during high environmental temperatures. *Journal of Dairy Science*. 76(Suppl. 1): 24.(Abstr.)

Arthur, G. H., Noakes, D. E. and Pearson, H. 1989. Veterinary Reproduction and Obstetrics. Theriogenology 6th (edn). Bailliere Tindall UK. Pp. 83-85.

Arthur, G. H., Noakes, D. E., Pearson, H. and Parkinson, T. J. 1988. Veterinary Reproduction and Obstetrics. 7th (edn). W.B. Saunders Company Limited, London, Philadephia, Toronto, Sydney, Tokoyo, PP: 345-388.

Asaduzzaman, K. M. 2015. Prevalence of repeat breeding and its effective treatment in cows at selected area of Bangladesh. MS in Thesis. Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Asaduzzaman, M. 2000. Livestock sector, economic development and poverty alleviation in Bangladesh. In: M.A.S. Mandal (edn), *Changing Rural Economy of Bangladesh.* (Bangladesh Economic Association, Dhaka), 42-53.

Ashraf, A. 1998. A study on some economic traits of indigenous and graded cattle in Khulna region. M.S. Thesis. Department of Animal Breeding and Genetics. Bangladesh Agricultural University, Mymensingh.

Asimwe, L. and Kifaro, G. C. 2007. Effect of breed, season, year and parity on reproductive performance of dairy cattle under smallholder production system in Bukoba district, Tanzania. *Livestock Research for Rural Development.* 19:10.

Assey, R. J., Kessy, B. M., Matovelo, J. A. and Minga, U. 1998. Incidence of gross reproductive abnormalities in small east African Zebu cattle. *Tropical Animal Health and Production.* 30: 361-368.

Auldist, M. J., Pyman, M. F., Grainger, C. and Macmillan, K. L. 2007. Comparative reproductive performance and early lactation productivity of Jersey × Holstein cows in predominantly Holstein herds in a posture based dairying system. *Journal of Dairy Science*. 90: 4856-4862.

Avendano-Reyes, L., Alvarez-Valenzuela, F. D., Correa-Calderon, A., Saucedo-Quintero, J. S., Robinson, P. H. and Fadel, J. G. 2006. Effect of cooling Holstein cows during the dry period on postpartum performance under heat stress conditions. *Livestock Science*. 105: 198-206.

Azad, M. A. 2010. Prevention of retained placenta by injecting various drugs immediately after parturition in cows. MS Thesis, Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Azage, T. and Alemu, G. 1998. Prospect for Peri-urban Dairy Development in Ethiopia, Ethiopian Society of Animal Production (ESAP) Publication No. 5. Addis Ababa, Ethiopia.

Azzaam, S. M., Kinder, J. K and Nielsen, M. K. 1989. Conception rate at first insemination in beef cettle, effccts of season, age and previous reproductive performance. *Journal of Animal Science*. 57: 1405-1410.

Bah, G. S., Ebangi, A. L., Niba, E. S., Manchang, T. K., Messine, O. and Achukw, M. D. 2010. Reproductive status of cows slaughtered at the Ngaoundere Municipal Slaughter House and factors responsible for potential losses in herd Productivity. *International Journal of Biological and Chemical Sciences*. 4(4): 916-923.

Bahmania, H. R., Aslaminejada, A. A., Tahmoorespura, M. and Salehib, S. 2011. Reproductive performance of crossbred dairy cows under smallholder production system in Kurdistan province of Iran. *Journal of Applied Animal Research.* 39(4): 375-380.

Balasundaram, B. 2008. Influence of genetic and nongenetic factors on incidence of reproductive disorders in cows. *Indian Veterinary Journal*. 110: 225-237.

Bangladesh Bureau of Statistics (BBS), 1988. The Bangladesh census of agriculture and Livestock-1983/84. Vol.1. Structure of Agricultural holding and Livestock population Statistical Division. Ministry of Planning, GOB, Dhaka.

Bangladesh Bureau of Statistics (BBS), 2002. Statistical Yearbook of Bangladesh. 21st Edn., Bangladesh Bureau of Statistics, Government of Bangladesh, Bangladesh. *Bangladesh Veterinary Journal.* 22: 21-28.

Bangladesh Bureau of Statistics (BBS), 2010. Report of the Household-based Livestock and Poultry Survey, 2009.

Bangladesh Bureau of Statistics (BBS), 2012. Statistical year book of Bangladesh. 21st Bangladesh bureau of statistics, government of Bangladesh, Bangladesh. *Journal of the American Veterinary Medical Association.* 41: 663-670.

Banglapedia, 2013. National Pedia of Bangladesh.

Bansal, K., Singh, K. B., Rohan, R., Joshi, D. V., Nauriyal, D. C and Rajesh, M. 1995. Incidence of sub-clinical mastitis in some cow and buffalo herds in Punjab. *Journal of Research Punjab Agricultural University (India).* 32: 79-81.

Barcellos, J. O. J., Silva, M. D. D. A. and Silva, J. L. C. D. A. 1996. Effects of early weaning on conception rate in Santa Gertrudis cows. *Economics Ecologic Rurales (Toulouse).* 110: 30-44.

Barkema, H. W., Van der Ploeg, J. D. and Brand, A. 1999. Management style and its association with bulk milk somatic cell count and incidence rate of clinical mastitis. *Journal of Dairy Science*. 82: 1655-1663.

Begum, M. R., Anaruzzaman, M., Khan, M. S. I. and Yousuf, M. 2014. Factors affecting the milk production of dairy cattle in Northern rural areas of Bangladesh. *Internatonal Journal of Agricultural Research. Innovative & Technology*. 4 (2): 41-45.

Bello, A., Adamu,Y. A., Umaru, M. A., Garba, S., Abdullahi, A. U., Adamu, M. K., Saidu, B. Ukashatu, S., Hena, S. A. and Mahmuda, A. 2012. Morphometric analysis of the reproductive system of African zebu cattle. *Scientific Journal of Zoology.* 1(2): 31-36.

Bellows, R. A., Genho, P. C., Moore, S. A. and Chase, C. C. 1996. Factors affecting dystocia in Brahman-cross heifers in subtropical southeastern United States. *Journal of Animal Science.* 74(7): 1451-1456.

Benon, K. M., Owiny, D. O., Båge, R., Nassuna-Musoke, M. G., Humblot, P. and Magnusson, U. 2015. Managerial practices and factors influencing reproductive performance of dairy cows in urban/peri-urban areas of Kampala and Gulu, Uganda. *Acta Veterinaria Scandinavica*. 57:35; DOI 10.1186/s13028-015-0122-2.

Benti, A. D. and Zewdie, W. 2014. Major reproductive health problems of indigenous Borena cows in Ethiopia. *Journal of Advanced Veterinary and Animal Research***.** 1(4): 182-188.

BER, 2011. Bangladesh Economic Review. Government of the People's Republic of Bangladesh. Finance Division. Ministry of Finance (MoF), Dhaka, Bangladesh.

BER, 2013. Bangladesh Economic Review. Government of the People's Republic of Bangladesh. Finance Division. Ministry of Finance (MoF), Dhaka, Bangladesh.

Berglund, B. 1996. Ongoing research on the causes of vaiation in calving performance and stillbirth in Swedish dairy cattle. Procceedings Workshop on Genetic Improvement of functional Traits in Cattle, Interbull Bulletin No. 12: 78.

Berglund, B., Steinbock, L. and Elvander, M. 2003.Causes of Stillbirth and Time of Death in Swedish Holstein Calves Examined Post Mortem. *Acta Veterinaria Scandinavica*. 44:111, DOI: 10.1186/1751-0147-44-111.

Bezdicek, J., Zlata Lakomá, Z. and Louda, F. 2008. Comparison between breeding values for milk production and reproduction of bulls of Holstein breed in artificial insemination and bulls in natural service. *Archiva Zootechnica.* 11(2): 29-34.

Bhattacharyya, H. K., Fazili, M. R., Buchoo, B. A. and Akand, H. 2012. Prevalence, clinical changes and management of genital prolapsed in cows. 82(1): 11-24.

Bicalho, R. C., Galvao, K. N., Cheong, S. H., Gilbert, R. O., Warnick, L. D. and Guard, C. L. 2007. Effect of stillbirths on dam survial and reproduction performance in Holstein dairy cows. *Journal of Dairy Science.* 90(6): 2797-2803.

Bierschwal, C. J. 1996. A clinical study of cystic condition of the bovine ovary. *Journal of the American Veterinary Medical Association.* 149: 1591-1595.

Biffa, D., Debela, E. and Beyene, F. 2005. Prevalence and risk factors of mastitis in lactating dairy cows in Southern Ethiopia. *International Journal of Applied Research and Veterinary Medicine*. 3(3): 189-198.

Biolatti, B., Bollo, E., Andruetto, S., Briganti, A. and Sapino, G. 1986. Hypo fertility in cows: in field diagnostic and therapeutic investigations. Part II. Summa, 3: 29-32.

Bitew, M. and Prasad, S. 2010. Study on Major Reproductive Health Problems in Indigenous and Cross Breed Cows in and Around Bedelle, South West Ethiopia. *Journal of Animal and Veterinary Advances.* 10: 723-727.

Boland, M. P., Lonergan, P. and Callaghan, O. 2001. Effect of nutrition on endocrine parameters, ovarian physiology, and oocyte and embryo development, *Theriogenology*. 55: 1323-1340.

Bolanos, J. M., Meneses, A. and Forsberg, M. 1997. Resumption of ovarian activity in zebu cows in the humid tropics. *Tropical Animal Health and Production.* 28: 237-246.

Bongso, T. A., Hassan, M. D and Novelin, W. 1984. Relationship of scrotal circumference and testicular volume to age and body weight in swamp buffalos. *Theriogenology*. 22: 127-134.

Book: Dairy Farm Management And Advisory Systems, Dairy Cattle Nutrition and Feeds, Gorgulu, P. D. M. In Eu And Turkey, Volume 1, Page 158.

Borsberry, S. and Dobson, H. 1989. Periparturient diseases and their effect on reproductive performance in five dairy herds. *Veterinary Records*. 124: 217-219.

Bostedt, H. and Himstedt, R. 1983. Ovarian function in cows after abortion. *Wienern Tierztliche Monatsschrift.* 70: 249-250. (Vet. Bull. 54: 281).

Botheras, N. 2010. Effects of flooring on cow behavior and production. Minnesota Dairy Health Conference, University of Minnesota, St. Paul, Minnesota, USA. May 19-20, 2010.

Britt, J. H. 1995. Relationships between post-partum nutrition, weight loss and fertility. *Cattle Practice*. 3: 79-83.

Brosaster, W. H. and Broaster, V. J. 1998. Body condition score of dairy cows. *Journal of Dairy Research.* 65: 155-173.

Bulman, D. C. and Lamming, G. E. 1978. Milk progesterone levels in relation to conception, repeat breeding and factors influencing a cyclicity in dairy cows. *Journal of Reproduction and Fertility*. 54: 447-458.

Bulter, W. R. and Smith, R. D. 1989. Inter-relationship bettween energy balance and post-partum reproductive function in diary cattle. *Journal of Dairy Science*. 72: 767-783.

Butler, W. R., Everett, R. W. and Coppock, C. E. 1981. The relationship between energy balance, milk production and evaluation in post-partum Holstein cows. *Journal of Animal Sciecne*. 53: 742-748.

Butt, S. V. and Deshpnde, K. S. 1986. Calving interval in Friesian × Sahiwal Crossbred. *Indian journal of Animal Science*. 56:809-810.

Carvalho, N. A. T., Gimens, L. U., Reis, E. L. and Cavalcante, A. K. S. 2005. Biometry of genital system from buffalo (Murrah) and bovine (Nelore) females. Guanabara Kooogan. 31: 879-895.

Chanteraprateep, P. and Humbert, J. M. 1993. Reproductive disorder control and herd health monitoring programme for improvement of dairy production in Thailand. Proceedings of the Final Research Co-ordination meeting of an FAO/IAEA Co-ordinate Research Organized by the Joint FAO/IAEA Division of Nuclear Technologies in Food and Agriculture, held in Bangkok, Thailand. Pp. 10-25.

Chaplin, S. J., Tierney, G., Stockwell, C., Logue, D. N. & Kelly, M. 2000. An evaluation of mattresses and mats in two dairy units. *Applied Animal Behavioral Science*. 66: 263-272.

Chatikobo, P., Manzi , M., Kagarama, J., Rwemarika, J. D. and Umunezero, O. 2009. Benchmark study on husbandry factors affecting reproductive performance of smallholder dairy cows in the Eastern Province of *Rwanda. Livestock Research for Rural Development.* 21: 6-7.

Chatterjee, A., Dey, B. N., Bedyanta, J., Chakraborty, M., Mondal, P. and Sen, G. P. 1985. Studies on the abnormal termination of pregnancy of cattle and buffaloes in the organized herds in West Bengal. *Indian Veterinary Journal*. 62: 586-590.

Chaudhuri, G., Banerjee, G. C. and Guha, H. 1984. Studies on the breeding efficiency traits and some of the factors affecting them in the Hariana type cows. *Indian Veterinary Journal*. 61: 585-590.

Chaussa, K. S. 2013. Assessment of factors affecting performance of dairy cattle kept in smallholder farms in peri-urban areas of temeke municipality. Dissertation for Award of M.Sc Degree at Sokoine University of Agriculture, Morogoro, Tanzania.

Coleman, D. A., Thayne, W. V. and Dailey, R. A. 1985. Factors affecting reproductive performance of dairy cows. *Journal of Livestock Science.* 58:1793-1803.

Cook, N. B. 2005. The influence of barn design on Dairy Cow Hygiene, Lameness and udder health: 2nd international mastitis and milk quality symposium, Vancouver, Canada, 121-125.

Correa, M.T., Erb, H. N. and Scarlett, J. 1993. Path analysis of seven post-partum disorders of Holstein Cows. *Journal of Dairy Science.* 76: 1305-1312.

Currado, E., Rasero, R. I., Saechi, P. A. and Ladetto, G. 1991. Relationship between milk production and length of calving interval in cows reared in the district of Cuneo. *Annli-della–Faclta di Torino*. 33: 119-194.

Curtis, C. R., Erb, H. N., Sniffen, C. J., Smith, R. D and Kronfeld, D. S. 1985. Path analysis of dry period nutrition, post-partum metabolic and reproductive disorders and mastitis in Holstein cows. *Journal of Dairy Science*. 68(9): 2347-2360.

Darwash, A. O., Lamming, G. E. and Williams, J. A. 1996. Estimate of genetic variation in the interval from calving to post-partum ovulation of dairy cows. *Journal of Dairy Science*. 80: 1227-1234.

Das, S. C. 1990. Reproductive performance and therapeutic measures of gynaecological disorders in cows of Tangail milk shed area. M.Sc thesis. Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Das, S. C., Rahman, M.A., Ahmed, J. U. and Alam, M. G. S. 1995. Reproductive disorders in zebu cows of Tangail milk shed area. *Bangladesh Journal of Animal Science*. 24 (1-2): 19-25.

Dayyani, N., Karkudi, K. and Bakhtiari, H. 2013. Reproductive performance definition in dairy cattle: affective factors. *International Journal of Advanced Biological and Biomedical Reserch.* 1(11):1392-1396.

De Belie, N. & Rombaut, E. 2003. Characterization of claw-floor contact pressures for standing cattle and the dependency on concrete roughness. *Biosystems Engineering*. 85: 339-346.

De Belie, N., 1997. On-farm trial to determine the resistance of different concrete slats for fattening pigs. *Journal of Agricultural Engineer and Research.* 68: 311-316.

De Kruif, A. 1975. An investigation of the parameters which determine the fertility of a cattle population and of some factors which influence these parameters. Tijdschr Diergeneesk. 100:1089-1098. Cired trom *Journal of Reproduction and Fertility*. 54: 515.

De Kruif, A. 1978. Factors influeneing the fertility of a cattle population. *Journal of Reproduction and Fertility.* 54: 507-518.

Debnath, S. K., Mattrab, C., Kabirc, S. M. L. and Ahmeda, J. U. 2012. Occurrence of reproductive disorders in post parturient cows with special emphasis on vaginal culture in some selected upazilas of Bangladesh**.** *Scientific Journal of Veterinary Advances.* 1(4): 110-116.

Demiraj, L., Sula, F., Kume, K., Shegani, K., Paci, F. and Gorea, R. 2000. Tests of post-partum assistance during the dry period and the first phase of lactation as a factor for improving productive and reproductive performance in dairy cows. *Journal of Agriculture and Environment for International Development.* 94: 63-72.

Denbarga, Y., Woldegebriel, B. and Sheferaw, D. 2012. Reproductive Performance of Boran Cows at Tatesa Cattle Breeding Center. *Advances in Biological Research.* 6 (3): 101-105.

Dewan, M. L. and Rahman, M. M. 1987. Studies in relation of placenta in Savar dairy farm. *Bangladesh Veterinary Journal.* 21: 49-53.

Dholakia, P. M., Shah, N. M., Purohit, J. H. and Kher, H. N. 1987. Bacteriological study on non-specific genital infection and its antibiotic spectra in repeat breeders. *Indian Veterinary Journal.* 64: 637-640.

Dinka, H. 2013. Major reproductive disorders of dairy cows in and around Asella town, Central Ethiopia. *Journal of Veterinary Medicine and Animal Health.* 5(4): 113-117.

Dobson, H. and Kamonpatana, M. 1986. A review of female cattle reproduction with special reference to a comparison between buffaloes, cows and zebu. *Journal of Reproduction and Fertility.* 77: 1-36.

Dobson, H. and Kamonpatana, M. A. 1986. A review of female cattle reproduction with special reference to comparison between buffaloes, cows and Zebu. *Journal of Reproduction and Fertility*. 77: 1-36.

Drennan, M. J. and Berry, D. P. 2006. Factors affecting body condition score, live weight and reproductive performance in spring-calving suckler cows. *Irish Journal of Agricultural and Food Research.* 45: 25–38.

Drennan, W. G. and Macpherson, J. W. 1966. The reproductive tract of bovine slaughter heifers (A biometrical study). *The Canadian Journal of Competitive Medicine and Veterinary Science*. 30: 224-227.

Drillich, M., Reichert, U., Mahlstedt, M. and Heuwieser, W. 2006. Comparison of two strategies for systemic antibiotic treatment of dairy cows with retained fetal membranes: preventive vs. selective treatment. *Journal of Dairy Science*. 89:1502-1508.

Duschletta, O. and Ern, F. J. 1993. Effect of fertility on the profitability of dairy cattle breeding. *Sehweizer-Braunvich*. pp. 42-44.

Dutta, J. C. and Dugwekar, Y. C. 1983. A note on the incidence of retained placenta in cows and buffaloes. *Livestock Adviser*. 8(3): 14.

Dwivedi, J. N. and Singh, C. M. 1971. Studies on the pathology of the female reproductive organs of Indian buffalo. 1. Ovarian abnormalities. *Indian Journal of Animal Health*. 10: 27-36.

Eduvie, L .O. and Dawuda, P. M. 1986. Effect of suclking on reproductive activities of Bunaji cows during the post-partum period. *Journal of Agricultural Science*. 107: 235-238.

Eduvie, L. O. 1985. Factors affecting post-partum ovarian activity and uterine involution in Zebu cattle, indigenous to Nigeria. *Animal Reproduction Science.* 8: 123-128.

El Wisy, A. B. 1976. A preliminary study of the genital organs of indigenous cows in Uganda. *Beitr Trop Landwirtsch Veterinarmed*. 14(1): 95-107.

Eldon, J. 1988. The Post-partum Reproductive Perfomance of the lcelandic Dairy Cow. Ph.D. Thesis. Dept. of Obstetrics and Gynaecology, Swedish University of Agricultural Sciences. Uppsala, Sweden.

Eley, D. S., Thatcher, W. W., Head, H. H., Collier, R. J. and Call, E. P. 1981. Pre-parturitient and post-parturient endocrine changes of conceptus and maternal units in Jersey cows bred for milk yield. *Journal of Dairy Science.* 64: 312-320.

Elliott, L., McMahon, K. J., Gler, H. T. and Marion, G. B. 1968. Uterus of the cow after parturition: Bacterial content. *American Journal of Veterinary Research.* 29.

Emanuelson, U. and Oltenacu, P. A. 1998. Incidences and effects of diseases on the performance of Swedish dairy herds stratified by production. *Journal of Dairy Science.* 81: 2376-2382.

Ensminger, M. E. 1969. Animal science. Interstate Printers and Publishers, Danville, Illinois, USA. pp. 1253.

Erb, H .N. 1987. Interrelationships among production and clinical disease in dairy cattle: a review. *Canadian Veterinary Journal*. 28(6): 326–329.

Erb, H. N. and Martin, S. W. 1980. Inter-relationships between production and reproduction diseases in Holstein cows. *Journal of Dairy Science.* 63: 1911-1917.

Erb, H. N., Smith, R. D., Oltenacu, P. A., Guard, C. L., Hillman, R., Powers, S. C., Smith, M. C. and White, M. E. 1985. Path Model of reproductive disorders and performance, milk fever, mastitis, milk yield and culling in Holstein cows. *Journal of Dairy Science*. 68: 3337-3349.

Erdouan, H. M., Citil, M. and Guens, V. 2004. Dairy Cattle Farming in Kars District, Turkey: I. Characteristics and Production. *Turkish Journal of Veterinary and Animal Science*. 28: 735-743.

Esheti, G. and Moges, N. 2014. Major Reproductive Health Disorders in Cross Breed Dairy Cows in Ada'a District, East Shoa, Ethiopia**.** *Global Veterinaria.* 13 (4): 444-449.

Esslenmont, R. J. 1993. Relationship between herd calving to conception interval and culling rate for failure to conceive. *Veterinary Records*. 133(7): 163-164 (abs.)

Estrada, S. and Perez, E. 2001. Improving productivity through the use of AI in dual- purpose farms in Costa Rica. In Radioimmunoassay and related techniques to improve artificial insemination programmes for cattle reared under tropical and sub-tropical conditions. Proceedings of a final Research Co-ordination Meeting organized by the joint FAO/IAEA Division of Nuclear Techniques in Food and agriculture and held in Uppsala, Sweden, 10-14 May 1999.

FAO, 2004. Food and Agriculture Organization of the United Nations. Ministry of Fisheries and Livestock. Bangladesh, pp. 65.

FAO, 2005. Livestock policy recommendation for the Government of Bangladesh Initial finding for discussion, Technical co-operation programme, FAO regional office for Asia and Pacific, Bangkok, 4-13.

FAO, 2013. FAO corporate document repository titled Poverty alleviation and food security in Asia: role of livestock, Produced by FAO regional office for Asia and Pacific. http://www.fao.org/docrep/003/x6627e/x6627e01.htm (Cited on 29th March 2013).

Faruq, M. B. H. 2001. Clinical and abattoir studies on reproductive diseases of cows in Bangladesh. MS Thesis. Deptartment of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Fathalla, M., Hailat, N., Lafi, S. Q., Abu Basha, E. and Al-Sahli, A. 2000. An abattoir survey of gross reproductive abnormalities in the bovine genital tract in northern Jordan. *Israel Journal of Veterinary Medicine.* 55(3):

Ferguson, J. D. 1996. Diet, production and reproduction in dairy cows: N. American Nutrition Conferences III animal Feed Science and Technology. 59: 173-184.

Filfo, V. R., Pinherio, L. E. L. and Bashur, P. K. 1986. Reproduction in Zebu cattle. Current Therapy in theriogenology, 2nd Edition by Morrow, D.A., pp. 37-442.

Filho, M. F. S., Luciano Penteado , L., Reis, E. L., Reis, T. A. N. P. S., Klibs N. Galvão, K. N. and Baruselli, P. S. 2013. Timed artificial insemination early in the breeding season improves the reproductive performance of suckled beef cows. *Theriogenology.* 79: 625–632.

Fitzpatrick, L. A. 1994. Advances in the understanding of post-partum anestrus *Bos indicus* cows proc. Final Research Co-ordinating meeting FAO/IAEA Coordinated Research Programme. Bangkok, Thailand, 19-35.

Flamenbaum, I. and Galon, N. 2010. Management of heat stress to improve fertility in dairy cows in Israel. *The Journal of Reproduction and Development.* 56 (Suppl): 36-41.

Fonseca, F. A., Britt, J. H., McDaniel, B.T., Wilk, J. C. and Rakes, A. H. 1983. Reproductive traits of Holsteins and Jerseys. Effects of age, milk yield and clinical abnormalities on involution of cervix and uterus, ovulations, oestrus cycles, detection of estrus, conception rate and days open. *Journal of Dairy Science*. 66: 1128-1147.

Fourichon, C., Beaudeau, F., Barielle, N. and Seegers, H. 2001. Incidence of health disorders in dairy farming systems in Western France. *Livestock Production Science* 68: 157-170.

Fourichon, C., Seegers, H. and Mather, X. 2000. Effect of diseases on reproduction in the dairy cow. *Theriogenology*. 53: 1729-1759.

Francos, G. 1974. Observation on the frequency of reproductive disorders in dairy herds in Israel. *Deutsche Tierarzlliche Wochenschrift*. 81: 135-138. (Vet. Bull. 44: 5138).

Franz, K., Klug, F. and Bethge, B. 1988. Breeding aspects of incidence of mastitis, endometritis and cysts in dairy cows. *Animal Breeding Journal*. 44: 5622-5632.

Franzet, K., Klug, F. and Bethge, B. 1988. Breeding aspects of incidence of mastitis, endometritis and cysts in dairy cows. *Animal Breeding Abstracts*. 44: 5622.

Fredriksson, G., Kindahl, H., Sandsted, K. and Edqvist, L. E. 1985. Intrauterine bacterial findings and release of PGF in the postpartum period in the cow. *Veterinary Medical Association.* 32: 368-380.

Frie, C. G., Bentele, W. and Sommer, H. 1984. Second distribution of ovarian cysts in cattle: observation under practical conditions. *Zuchthygiene.* 19: 83-89.

FSRU, 1985. Farming Systems Research Unit, Department of Research and Specialist Services, Harare. *Annual Report.* 1983/84.

Fuquay, J. W. 1981. Heat stress as it affects animal production. *Journal of Animal Science*. 52:164-174.

Gaafar, H. M. A., Shamiah, S. H. M. A., Shitta, A. and Ganah, H. A. B. 2010. Factors affecting retention of placenta and its influence on post-partum reproductive performance and milk production in Friesian cows. *Slovak Journal of Animal Science.* 4(1): 6-12.

Gabr, S. A., Shamiah, S. M., Abu El-Hamid, M. A. 2005. Factors related to the incidence of retained placenta in Friesian cows kept under Egyptian conditions. *Journal of Agriculture Science Mansoura University*. 30: 6532-6533.

Galina, C. S. and Arther, G. H. 1989. Review of the cattle reproduction in the tropics. Part l. Puberty and Age at First Calving. *Animal Breeding Abstract*. 57: 583-590.

Galvao, K. N., Greco, L. F., Vilela, J. M., Filho, S. M. F. and Santos, J. E. P. 2009. Effect of intrauterine infusion of Ceftiofur on uterine health and fertility in dairy cows. *Journal of Dairy Science.* 92:1532-1542.

Gani, M. O., Amin, M. M., Alam, M. G. S., Kayesh, M. E. H. and karim, M. R. 2008. Bacterial flora associated with repeat breeding and uterine infections in dairy cows. *Bangladesh Journal of Veterinary Medicine.* 6: 79-86.

Garcia, M. A. (1988). Gross morphology abattoir study of genital organs from female Zebu cattle . *Acta Veterinaria ScandinavicaActa*. 29(83): 34-45.

Gardner, I. A., Reynolds, J. P., Risco, C. A. and Hird, D. W. 1990. Patterns of uterine prolapsed in dairy cows prognosis after treatment. *Journal of American Veterinary Medical Association*. 197(8): 1021-1024.

Garnsworthy, P. C. 2006. Body condition score in dairy cows: targets for production and fertility. In: Garnsworthy PC, Wiseman J, editors. Recent advances in animal nutrition. Nottingham University Press; Nottingham.

Gebrekidan, B., Yilma, T. and Solmon, 2009. Major causes of slaughtering of female cattle in addis Ababa abattoir enterprise, Ethiopia. *Indian Journal of Animal Research*. 43 (4): 271-274.

Getty, R. 1995. Bovine female genital organs: Sissoon and Grossman's the anatomy of the domestic animals. 5th edition, W. B. Saunders Company, Philadelphia, Toronto, London. Pp. 946-949.

Ghosh, A. and Alam, M. G. S. 1988. Lugols iodine in the treatment of endometritis in cows. *Bangladesh Veterinary Journal*. 22: 84-87.

Ghosh, A., Alam, M. G. S. and Akbar, M. A. 1993. Effects of urea-molasses-mineral block supplementation in post-partum ovarian activity in Zebu cows. *Animal Reproduction and Science*. 31: 61-67.

Ghosh, A., Alam, M. G. S., Pandit, K. K. and Kamaruddin, K. M. 1998. Seasonally of post-partum reproductivity performance at indigenous cows of Bangladesh. *Bangladesh Veterinarian*. 5: 73-75.

Ghosh, D. K. 1995. Economic traits of cross-bred cattle in the small dairy enterprises of Gazipur district, M.Sc. Thesis Department of Physiology, Bangladesh Agricultural University, Mymensingh.

Gilbert, R. O., Shin, S. T., Guard, C. L., Erb, H. N. and Frajblat, M. 2005. Prevalence of endometritis and its effects on reproductive performance of dairy cows. *Theriogenology*. 64:1879-1888.

Gillespie, J. R. 1997. Modern Livestock and Poultry Production. New York: Delmar Publishers.

Gizaw, Y., Bekana, M. and Abayneh, T. 2007. Major reproductive health problems in smallholder dairy production in and around Nazareth town, Central Ethiopia. DVM thesis. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Goni, M. O. 1999. A comparative study on the productive and reproductive performance of different dairy breeds in Bangladesh milk products cooperative union Limited (BMPCUL) area. MS. Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Goni, M. O., Miah, A. G., Khan, M. A. S. and Islam, M. N. 2001. The performance of crossbred cows available in milk pocket area of Bangladesh. Bangladesh Agricultural University, Mymensingh. *Indian Journal of Animal sciences.* 71: 1166-1168.

Gonzalez, H. E., Crowell, W.A., Caudle, A. B., Thompson, F. N. 1985. Morphometric studies of the bovine uterus: microscopic lesions and retrospective reproductive history. *Animal Journal and Veterinary Research*. 46(12): 2588-95.

Gonzalez, J. L., Gil, A. and Aguero, F. 1996. Priciple reproductive disorders, in 5/8 Holstein × 3/8 zebu cows. *Revista de Salud Animal*. 18: 59-61.

Gorgulu, P. D. M. 2012. Dairy Cattle Nutrition and Feeds, In: Dairy Farm Management and Advisory Systems in Eu and Turkey. Cattle Breeder's Association, EU. Vol. 1. P. 158.

Goshu, G., Belihu, K. and Berihun, A. 2007. Effect of parity, season and year on reproductive performance and herd life of Friesian cows at Stella private dairy farm, Ethiopia**.** *Livestock Research for Rural Development.* 19: 7.

Green, L. E., Hedges, V. J., Schukken, Y. H., Blowey, R. W. and Packington, A. J. 2002. The impact of clinical lameness on the milk yield of dairy cows. *Journal of Dairy Science*. 85: 2250-2256.

Groen, A. F., Brandts, A. G. B. M., Jansen, H. H. and Kanis, E. 1995. Economic value and genetic parameters for calving performance in Dutch dairy cattle breeding. Workshop on Genetic Improvement of functional Traits in Cattle, *Interbull Bulletin*. No. 11.

Grohn, Y. T. and Rajawala, P. J. 2000. Epidemiology of reproductive performance in dairy cows. *Animal Reproductive Science*. 60: 605-614.

Grohn, Y. T., Eicker, S. W. and Hertl, J. A. 1995. The association between previous 305-day milk yield and disease in New York State dairy cows. *Journal of Dairy Science*. 78: 1693-1702.

Grohn, Y. T., Erb, H. N., McCulloch, C. E. and Saloniemi, H .S. 1990. Epidemiology of reproductive disorders in dairy cattle. Associations among host characteristics, disease and production. *Preventive Veterinary Medicine.* 8 (1): 25-39.

Guard, C. 1996. Fresh cow problems are costly: culling hurts the most. Annual Conference of Veterinary Science Cornell University, Ithaca, New York. Pp. 100.

Gunther, J. D. 1981. Classification and clinical management of the repeat breeding cow. *Compendium on Continuing Education for the Practicing Veterinarian* 3: 154–158.

Gurani, M., Bhatnagar, D. S. and Nair, P. G. 1971. Performance of crossbred as compared to their zebu dams at national dairy research institute, kernel. *Indian Veterinary Journal.* 48:1131-1135.

Guraya, S. S. 1979. Morphological and histological observations on the buffalo ovaries during anestrous. *India Journal of Animal Sciences*. 49: 423-432.

Gustafsson, H., Kornmatitsuk, B., Konigsson, K. and Kindahl, H. 2004. Peripartum and early post partum in the cow physiology and pathology. Swedish dairy association, Swedish university of agricultural sciences, SE 750 07 Uppsala, Sweden. *Medical Veterinaire du Quebec.* 34(1/2): 64-65.

Gwazdauskas, F. C., Thatcher, W .W., Kiddy, C. A., Pape, M. J. and Wilcox, C. J. 1981. Hormonal pattern during heat stress following PGF2alpha-tham salt induced luteal regression in heifers. *Theriogenology.* 16: 271-285.

Gwazdauskas, F. C., Wilcox, C. J. and Thatcher, W. W. 1975. Environmental and manage mental factors affecting conception rate in a subtropical climate. *Journal of Dairy Science*. 58: 88-92.

Habib, M. A. 2001. Study on the Red Chittagong Cattle on animal Genetc Resource of Bangladesh. M.S. Thesis. Department of Animal Breeding and Genetics, Faculty of Animal Husbandry, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Hafeez, E. S. E. 1968. Reproduction in Farm Animals. 2nd Edn., Lae and Fabiger, Philadelphia, Pp. 65-69.

Hafez, E. S. 1993. Reproduction in farm anmals, 4th ed. Lea and Febiger, Philadelphia, Pp. 13-15.

Hafez, E. S. E. and Hafez, B. 2001. Reproduction in Farm Animals. Edited by E.SE. Hafez. LEA and FEBRIAER; Philadelphia. 30-80.

Haider, N. 2007. Fctors affecting reproductive performance of dairy cows in milk pocket areas of northem Bangladesh, MS Tesis. Department of Surgery and Obstetrics, Faculty of Veterinary Scicnce, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Haile, A., Tsegaye, Y. and Tesfaye, N. 2014. Assessment of Major Reproductive Disorders of Dairy Cattle in Urban and Per Urban Area of Hosanna, Southern Ethiopia. *Animal and Veterinary Sciences.* 2(5): 135-141.

Halim, B. 1992. Comparative economics analysis of local and cross-bred dairy cows in a selected area of Dhaka district, Bangladesh, Master's Thesis, Deparment of Agricultural economics, Bangladesh Agricultural University, Bangladesh Agricultural University, Mymensingh.

Hammon, D. S., Evjen, I. M., Dhiman, T. R., Goff, J. P. and Walters, J. L. 2006. Neutrophil function and energy status in Holstein cows with uterine health disorders. *Veterinary Immunology and Immunopathology*. 113:21-29.

Hammoud, M. H., El-Zarkouny, S. Z. and Oudah, E. Z. M**.** 2010. Effect of sire, age at first calving, season and year of calving and parity on reproductive performance of Friesian cows under semiarid conditions in Egypt. *Archiva Zootechnica.* 13(1): 60-82.

Han, Y. K. and Kim, I. H. 2005. Risk factors for retained placenta and the effect of retained placenta on the occurrence of post-partum diseases and subsequent reproductive performance in dairy cows. *Jouranal of Veterinary Science*. 6 (1): 53-59.

Haque, M. N., Aziz, S. A., Chanda, S. S., Hossain, M. I. and Baset, M. A. 2002. A study of the Milking and Reproductive Performances of Indigenous Cattle at Urban Area of Bangladesh. *Pakistan Journal of Biological Science*. 5: 97-100.

Haque, M. N., Gofur, M. R., Asaduzzaman, K. M. and Bhuiyan, M. M. U. 2015. Factors limiting the pregnancy rates in artificially inseminated cows in Bangladesh. *International Journal of Dairy Science.* 10 (6): 278-287.

Hardeng, F. and Edge, V. L. 2001. Mastitis, Ketosis and Milk fever in 31 Organic and 93 Conventional Norwegian Dairy Herds. *Journal of Dairy Science*. 84: 2673-2679.

Haresign, W., Foxcorft, G. R. and Lamming, G.E. 1983. Control of ovulation in farm animals. *Journal of Reproduction and Fertility*. 69: 383-395.

Hasan, M. A., Mamun, A. A., Uddin, A. S. M. A., Hassan, M. Z., Hasan, M. and Rahman, M. H. 2015. Investigation into gyneco-pathological disorders and identification of associated bacteria from the genital organs of cows in Dinajpur, Bangladesh. *Journal of Advanced Veterinary Animal Resesrch*. 2(2): 165-169.

Hatch, R. D., Brodie, B. O., Thurmon, J. C. and Erwin, B. G. 1968. A clinical survey of retained foetal membranes aand metritis in dairy cows. *Veterinary Medicine and Small Animal Clinician.* 63: 607-610. (*Veterinary Bullatin*). 39: 417.

Hatipoglu, F., Kiran, M. M., Ortatatli, M., Erer, H. and Ciftci, M. K. 2002a. An abattoir study of genital pathology in cows: I. Ovary and oviduct. *Medical Veterinaire du Quebec*. 153(1): 29-33.

Hatipoglu, F., Ortatatli, M., Kiran, M. M., Erer, H. and Ciftci, M. K. 2002. Abattoir Study of Genital Pathology in Cows : II. Uterus, Cervix and Vagina. *Revue Medicine and Veterinary.*153(2): 93-100.

Haufe, H. C., Gygax, L., Steiner, B., Friedli, K., Stauffacher, M. and Weschsler, B. 2009. Influence of floor type in the walking area of cubicle housing systems on the behaviour of dairy cows. *Applied Animal Behavioral Science*. 116: 21-27.

Hemme, T., Garcia, O. and Khan, A. R. 2004. A review of milk production in Bangladesh with particular emphasis on small-scale production. PPLPI working paper no 7: 1-4.

Herenda, D. 1987. An abattoir survey of reproductive organ abnormalities in beef heifers. *Canadian Veterinary Journal*. 28 (1-2): 33-37.

Hernandez, .J. A., Garbarino, E. J., Shearer, J. K., Risco, C. A. and Thatcher, W. W. 2005. Comparison of the calving-to-conception interval in dairy cows with different degrees of lameness during the prebreeding postpartum period. *Journal of American and Veterinary Medical Association*. 227:1284–1291.

Hinojosa, A., Franco, A. and Bolio, I. 1980. Genetic and environmental factors affecting calving interval in a commercial beef herd in a semi-humid tropical environment. *Tropical Animal Production.* 5: 165-171.

Hoffmann, D. 1999. Asian livestock to the year 2000 and beyond. Working paper series 1/2, FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

Hopkins, S. M. 1990. Bovine Anoestrus. In: Current therapy in Theriogenology. 2nd edn. Edited by Morrow, D.A, W. B. Saunders Company. Philadelphia, London. *Toronto, Mexico*. PP. 247.

Hoque, M. A., Amin, M. R. and Lessen, M. S. 1999. Dairy potential of Pabna cows and crossbred with Sahiwal and Friesian and within and between breed sire effects. *Asian Australian Journal of Animal Science.* 12: 161-164.

Horst, R. L. 1986. Regulation of calcium and phosphorus homeostasis in dairy cows. *Journal of Dairy Science*. 69: 604.

Hossain, M. A. 2013. Evaluation of reproductive performances of cows at different upazilas in Sylhet district. MS in Theriogenology Thesis, Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Hossain, M. A., Shahidulla, M. and Ali, M. A. 1986. A report on surgical diseases and reproductive disorders recorded at the Veterinary Hospital of Bangladesh Agricultural University, Mymensingh. *Bangladesh Veterinary Journal*. 20: 1-5.

Hossain, M. K. 2001. Economics and fertility management of small holding dairy farms. M.S. Thesis. Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Hossain, Z. M. A. 1998. Study on present management condition of private dairy farm in Rangpur district sadar thana. M.S. Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Hossain, Z. M. A., Hossain, S. M. J., Rashid, M. M., Sultana, N. and Ali, M. H. 2004. Study on the Present Management Condition of Private Dairy Farm at Rangpur Sadar Thana in Bangladesh. *Journal of Biological Sciences*. 4(2): 185-188.

Houghton, P. L., Lemenager, R. P., Horstman, L. A., Hendrix, K. S. and Moss, G. E. 1990. Effects of body composition, pre- and postpartum energy level and early weaning on reproductive performance of beef cows and preweaning calf gain. *Journal of Animal Science.* 68:1438-1446.

Howlader, M. M. R., Main, M. F., Rahman, M. F. and Kamal, A. R. M. 1996. Conception rates of dairy cattle breed under artificial insemination and natural service in Bangladesh. Proceedings of the Nineteenth Bangladesh Science Conference, Dhak, Bangladesh. pp. 17-27.

Huffman, E. M. 1984. Risk factors for prebreeding pyometra on four Colorado dairy farms. Preventive Veterinary Medicine. 2(6): 785-790.

Huszenicza, G., Janosi, S., Kulcsar, M., Korodi, P., Reiczigel, J., Katai, L., Peters, A. R. and de Rensis, F. 2005. Effects of clinical mastitis on ovarian function in post-partum dairy cows. *Reproduction in Domestic Animals.* 40: 199-204.

Huszenicza, G., Molnar, L., Solti, L. and Haraszit, J. 1987. Post-partum ovarian function in Holstein and cross-bred cows on large scale farms in Hungary. *Journal of Veterinary Medicine*. 34: 249-263.

Huzzey, J. M., Veira, D. M., Weary, D. M. and Keyserlingk, V. M. A. 2007. Prepartum behavior and dry matter intake identify dairy cows at risk for metritis. *Journal of Dairy Science*. 90: 3220-3233.

Ibrahim, A. A., Aliyu, J., Ashiru, M. and Jamilu, M. 2012. Biometric study of the reproductive organs of three breeds of sheep in Nigeria. *International Journal of Morphology*. 30(4): 1597-1603.

International Livestock Center for Africa - ILCA (1988). Animal reproduction for African countries. Report of a joint seminar by International Foundation for Science and Swedish International Program on Animal Production, ILCA, Addis Ababa, Ethiopia.

Islam, A. B. M. M. 1998. Livestock Development Policy and Production Strategies for Bangladesh. Proceeding of the workshop on Agricultural University, Mymensingh, held on 29th February, 1988.

Islam, M. A., Sarder, M. J. U., Jahan, S. S., Islam, M. R. and Islam, M. H. 2015. Effect of management factors on the productive and reproductive performance of dairy cows. *Bangladesh livestock Journal*. 1: 5-9.

Islam, M. F., Bari, F. Y. and Alam, M. G. S. 2014. Reproductive performances and management effects on productions of indigenous dairy cows raised at *char* areas in Northern Bangladesh. *GSTF Journal of Veterinary Science*. 1(1): 50-58.

Islam, M. H, Sarder, M. J. U., Rahman, M., Kader, M. A. and Islam, M. A. 2012. Incidence of Retained Placenta in Relation with Breed, Age, Parity and Body Condition Score of Dairy cows**.** *International Journal of Natural Sciences*. 2(1): 15-20.

Islam, M. H., Sarder, M. J. U., Jahan, S. S., Rahman, M., Zahan, M., Kader, M. A. and Hossain, K. M. M. 2013. Retained placenta of dairy cows associated with managemental factors in Rajshahi, Bangladesh, *Veterinary World*. 6(4): 180-184, doi: 10.5455/Vet. world. 2013. 180-184.

Islam, S. S., Ashraf, A. and Islam, A. B. M. M. 2000. A study of the milking and reproductive performances of grazing indigenous cattle at semi-urban area of Bangladesh. *Asian-Australian Journal of Animal Science.* 13(6): 837-841.

Izaike, Y., Okano, A., Shkiamada, K. and Oshi, T. 1984. Relationship between post-partum reproductive performance and parity in beef cows. *Japan Journal of Animal Reproduction*. 30: 206-210.

Izquierdo, N. and Angelov, A. 1984. Morphological changes in the oviducts of infertile zebu cows. *Veterinary Nomeditsinski Nauk*. 21: 69-77.

Jabbar, M. A. and Ali, S. Z. 1988. The insemination of cross breeding for improvement of cattle in Bangladesh. *Oxford Agranian Studies*. Vol. 19.

Jabbar, M. A. and Green, D. A. G. 1983. The status and potential of livestock within the context of agricultural development policy in Bangladesh. Department of Agricultural Economics. Aberystwyth. Adran Economy Amaethydol. 37-57.

Jainudden, M. R. and Hafez, E. S. E. 2000. Cattle and Buffalo. In: Reproduction in Farm Animals. Edited by E.SE. Hafez. LEA & FEBRIAER; Philadelphia. pp. 164-167.

Jainuddin, M. R. and Hafez, E. S. E. 1993: Reproductive Failure in Female. In: Reproduction in Farm Animals. 6th edition, Lea & Febiger Philadelphia, USA, pp. 261-286.

Jainudeen, M. R. and Hafez, 2001. Cattle and Buffalo. In: Reproduction in Farm Animals. Edited by E.SE. Hafez. LEA and REBIREAR. Philadelphia, pp: 164-167.

Jaji, A. Z., Boyi, N., Gambo, B., Mahre, M. B., Luka, J. and Kachamai, W. A. 2012. Pregnancy Related Biometrical Changes in the Ovaries and Uterus of the Red Bororo Cattle in Maiduguri, Nigeria**.** *Nigerian Veterinary Journal.* 33 (3): 592-599.

Jamil, M. K. 1995. Effects of hormones on the retention of afterbirth in Zebu cows. M.S. Thesis, Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh. P. 1-23.

Japri, B. M., Majial, A. M., Fauziah, H. E. and Adrien, K. P. 1997. Effects of breed of sire, percentage of BOS Taurus inheritance and season of birth on calving performance of cross-bred dairy cattle. Department of Genetics, Faculty of Life Science, University Kebangsaan, Malaysia, 43600 Bangi, Selangor, Malaysia. *Asian Australasian Journal of Animal Science*. 10: 313-317.

Johanson, J. M. and Berger, P. J. 2003. Birth weight as a predictor of calving case and perinatal mortality in Holstein cattle. *Journal of Dairy Science.* 86: 3745-3755.

John, F., Stewart, S. and Sicker, S. 1997. Reproductive health programs for diary herds. Analysis of Records for Assessment of Reproductive Performance. Current Therapy in Large Animal Theriogenology. Edited by Robert S Youngquist. DVM. W.B. Saunders Company. pp. 234-374.

Jones, T. C., Hunt, R. D. and King, N. W. 1997. Veterinary pathology. 6th edition, Williams & Wilkins. Philadelphia, London, Sydney, Tokyo. Pp. 1149-1221.

Kabir, M. H., Reza, M. A., Razi, K. M. A., Parvez, M. M., Bag, M. A. S. and Mahfuz, S. U. 2010. A report on clinical prevalence of diseases and disorders in cattle and goat at the upazilla veterinary hospital, ulipur, kurigram. *International Journal of Biological Research*. 2(11): 17-23.

Kader, M. A. 2010. Prevalence of reproductive diseases of cows at Bogra district in Bangladesh. MS Thesis, submitted to the Department of Animal Husbandry and Veterinary Science, Faculty of Agriculture, University of Rajshahi.

Kaikini, A. S., Chikalikar, G. K. and Dindorkar, C. V. 1983. Reproductive disorders in Holstein × Gir F_1 crossbred cows. *Indian Journal of Animal Science*. 53(5): 556-558.

Kakar, M. A., Rasool, G. and Ahmad, F. 1997. Clinical incidence of reproductive disorders in crossbred cows in the province of Balochistan. *Pakistan Veterinary Journal.* 17(1): 9-12.

Kalbe, P. and Schulz, J. 2002. Incidence, course and outcome of uterine prolapse in a herd of dairy cows during 13 years. *Tierarztliche Praxis Ausgabe G: Grosstiere-Nutztiere.* 30(4): 220-225.

Kang, B., Choi, H., Choi, S., Son, C. and Chon, H. 1994. Progesterone assays as an aid for improving reproductive efficiency in dairy cattle. II. Use of plasma or milk progesterone profiles for differential diagnosis of ovarian cysts. *Korean Journal of Veterinary Research.* 34(1): 181-188.

Kanjilal, B. C., Chakraborty, A. N. and Basak, D. K. 1984. Study on the clinical and histopathological changes in genital organs of infertile cows. *Indian Veterinary Journal*. 61: 680-682.

Kanuyaa, N. L., Kessy, B. M., Bittegeko, S. B. P., Mdoe, N. S. Y. and Aboud, A. A. O. 2000. Suboptimal reproductive performance of dairy cattle kept in smallholder herds in a rural highland area of northern Tanzania. *Preventive Veterinary Medicine.* 45: 183-192.

Karimuribo, E. D., Fitzpatric, T. L., Bell, C. E., Swai, Kambarage, D. M., Ogden, N. H., Bryant, M. J., and French, N. P. 2006. Clinical and sub-clinical mastitis in smallholder dairy farms in Tanzania: Risk, intervention and knowledge transfer. *Preventive Veterinary Medicine*. 74:84-98.

Kassahun, M. 2003. Major clinical reproductive problems of smallholder dairy cows in and around Awassa. DVM thesis. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Kay, R. M. 1978. Changes in milk production, fertility and calf mortality associated with retained placenta or the birth of twins. *The Veterinary Records*. 102: 477-479.

Ker, A. 1995. Farming Systems in the African Savanna. Ottawa,Canada: IDRC Books.

Kerbrat, S. and Disenhaus, C. 2004. A proposition for an updated behavioural characterization of the oestrus period in dairy cows. *Applied Animal Behavioral Science.* 87: 223-238.

Khair1, A., Alam, M. M., Rahman, A. K. M. A., Islam, M. T., Azim, A. and Chowdhury, E. H. 2013. Incidence of reproductive and production diseases of cross-bred dairy cattle in Bangladesh. *Bangladesh Journal of Veterinary Medicine.* 11 (1): 31-36.

Khan, A. A. 1990. A comparative study on study on the reproductiove efficiency of native and cross-bred cows, M.Sc. Thesis, Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Khan, A. B. M. K. I., Baset, M. A. and Fouzder, S. K. 2010. Study on management and production system of small scale dairy farm in a selective rural area of Bangladesh. *Journal of Science Foundation.* 8(1&2): 13-23.

Khan, M. J., Pters, K. J. and Uddin, M. M. 2009. Feeding strategy for improving dairy cattle productivity in small holder farm in Bangladesh. *Bangladesh Journal of Animal Science*. 38(1&2): 67-85.

Khan, M. K. I., Blair, H. T., Lopez-Villalobos, N. and Johnson, P. L. 2005. Productive, Reproductive and Economic Performance of Dairy Cattle in Bangladesh. *Proceedings of Association Advancement Animal Breeding Genetics.* 16: 124-127.

Khan, S., Qureshi, M. S., Chand, N., Sultan, A., Rafullah, I., Ihsanullah, K., Tanweer , A. J., Sohail , S. M., Hussain, M., Akhtar, A. and Khan, D. 2012. Effect of breeding method on calf sex and postpartum reproductive performance of cattle and buffaloes. *Sarhad Journal of Agriculture*. 28(3): 469-476.

Kilinc, B. and Oruc, E. 2014. The investigation of ovarian and uterine lesions with the pathological methods in cows slaughtered in abattoir. *Ataturk Universitesi Veteriner Bilimleri Dergisi.* 9 (2): pp. 88-96.

Kim, I. H. and Kang, H. G. 2003. Risk factors for postpartum endometritis and the effect of endometritis on reproductive performance in dairy cows in Korea. *Journal of Reproduction and Development*. 49(6): 485-491.

Kiran, M. M., Erer, H., Çiftci, M. K. and Hatipoglu, F. 1995. A survey of pathological conditions of the genital tract of ewes. II. Uterus, cervix and vagina. *Veteriner Bilimleri Dergisi*. 11: 119-129.

Kirk, H. J. 1986. Reproductive Heath Programme for Dairy Cattle. In: Current Therapy in Theriogenology (Diagnosis, Treatment and Provention of reproduetive diseases in small and large animals). Edited by David A. Morrow W.B. Saunders Company, Philadelphia. pp. 418-422.

Kirkland, R. M. 2003. The effect of housing system on performance, behaviour and welfare of beef cattle. *Agriculture Serach*. 6: 1-12.

Kollalpitiya, K. M. P. M. B., Premaratne, S. and Peiris, B. L. 2012. Reproductive and Productive Performance of Up-Country Exotic Dairy Cattle Breeds of Sri Lanka. *Tropical Agricultural Research*. 23 (4): 319–326.

Kotowski, K. 2001. The state of mammary glands and reproductive organs of cows subjected to slaughter. Powiatowy Inspektorat Weterynarii, ul. Graniczna 14: 63-600 Kepno, Poland. *Medycyna Weterynaryjna.* 57(4): 266-267.

Kremer, P. V., Nueske, S., Scholz, A. M. and Foerster, M. 2007. Comparison of claw health and milk yield in dairy cows on elastic or concrete flooring. *Journal of Dairy Science*. 90: 4603-4611.

Kruif, A. D. E. 1977. Studies on anaestrus in cows. *Tijdschrift Voor Diegeneeskunde*. 102: 247-253. (Vet. Bull. 47: 3936).

Kubar, H. and Jalakas, H. 2003. Pathological changes in ovary, oviduct, uterine horn and vagina of cows culled because of infertility. *Agraarteadus.* 14: 3-12.

Kubar, H. and Jalakas, M. 2002. Pathological changes in the reproductive organs of cows and heifers culled because of infertility. *Journal of Veterinary Medicine Series A*. 49(7): 365-72.

Kucharski, J. and Zdunchzyk, S. 1984. Frequency of puerperal disorders in dairy cows. *Zeszyty Naukowe Akandemii rolniczo-techniczejw Olszlunie, Welrynaria*. 15: 149-154.

Kudlac, E. 1965. Causes of anoestrus and stimulation of oestrus in heifers by extrapituitary gonadotrophins. Sb. Vys. Sk. Zemed, Brno, Ser. B. 13: 483-492. (Veterinary Bulletin. 36:2854).

Kulkarni, M. D., Khanvilkar, A. V. and Bansod, R. S. 2002. Incidence of reproductive disorders in indigenous and cross-bred in an organized farm. *Indian Veterinary Journal.* 79: 1196-1197.

Kumar, S. and Bhat, P. N. 1979. Reproductive performance of Hariana cattle. Indian Journal of Animal Science. 49: 1001-1008.

Kumar, S., Agarwal, S. K. and Purbey, L. N. 1986. Studies on reproductive disorders in non descript cattle. *Indian Veterinary Medical Journal.* 10: 174-175.

Kumar, S., Ahmed, F. A. and Bhadwal, M. S. 2004. Biometry of female genitalia of Murrah buffalo (*Bubalus bubalis*). *Indian Journal of Animal Reproduction.* 25(2): 143-145.

Kumaresan, A. 2001. Repeat breeding syndrome in cattle and buffaloes; therapeutic approach at field level. Pashudhan. 16: 4.

Kumaruddin, K. M. 2001. Livestock Research and Development in Bangladesh. Livestock development activities and health management practice. Central Veterinary Hospital Dhaka, Bangladesh. Pp. 1-5.

Kumlu, S. 2011. Dairy farm management and advisory systems in EU and Turkey. Volume 1. Cattle Breeder's Association, Turkey.

Kunbhar, H. K., Samo, M. U., Memon, A. and Solangi, A. A. 2003. Biometrical Studies of Reproductive Organs of Thari Cow. *Pakistan Journal of Biological sciences.* 6(4): 322-324.

Kunbhar, H. K., Samo, M. U., Rind, R. Kaka, I. and Channa, A. D. 2003a. Gross pathological studies on female reproductive organs of Thari cow (*Bos indicus*). *Journal of Animal and Veterinary Advances.* 2(2): 58-63.

Kunzi, N., Wuest, A. and Leuenberger, H. 1996. An economic comparison of 3 dairy cattle breeds: Holstein, Jersey and simmental results of investgations into different dairy cattle breeds conducted by the ETH (pat 4). K-Mitteilungen. 34: 28-29.

Lakshmi, B. S., Gupta1, B. R., Sudhakar, K., Prakash, M. G. and Sharma, S. 2009. Genetic Analysis of Production Performance of Holstein Friesian × Sahiwal cows. *Tamilnadu Journal of Veterinary & Animal Sciences.* 5 (4):143-148.

Lalman, D. L., Scholljegerdes, E. J. and Mallett, D. M. 1997. Influence of post-partum weight and body condition change on duration of anestrus by under nourished suckled beef heifers. *Journal of Animal Science*. 75: 2003-2008.

Lalrintluanga, C., Ralte, E. L. and Hmarkunga, 2003. Incidence of mastitis, bacteriology and antibiogram in dairy cattle in Aizaw, Mizoram. *Indian Veterinary journal.* 80: 931-932.

Larsson, K., Jonson, L. B., Bergland, B., Edqvist, L. E. and Kindahl, H. 1984. Post-partum reproductive perfomance in dairy cows. l. Influnce of animal breed and parity. *Acta Veterinaria Scandinavica*. 25: 455-461.

Leach, K. A., Offer, J. E., Svoboda, I. & Logue, D. N. 2005. Effects of type of forage fed to dairy heifers: Associations between claw characteristics, clinical lameness, environment and behaviour. *Veterinary Journal.* 169: 427-436.

Leal, L. D. S., Araújo, C. F. M., Oba, E. and Prestes, N. C. 2013. Morphometric characterization of bubaline and bovine ovaries at different phases of reproductive activity. *Enciclopédia biosfera, Centro Científico Conhecer, Goiânia*, v.9, n.17; p. 1929-1939.

LeBlanc, S. J. 2008. Postpartum uterine disease and dairy herd reproductive performance. *Veterinary Journal.* 176(1): 102-114.

LeBlanc, S. J. 2012. Interactions of metabolism, inflammation, and reproductive tract health in the post-partum period in dairy cattle**.** *Reprod Domest Animal*. 47(5): 18-30.

Lee, L. K., Vanraden, P. M. and Meinert, T. R. 1997. Relationship of yield during early lactation and days open during current lactation with 305-day yield. *Journal of Dairy Science.* 80: 771-776.

Lemma, A. and Kebede, S. 2011. The effect of mating system and herd size on reproductive performance of dairy cows in market oriented urban dairy farms in and around Addis Ababa. *Revue Medicine and Veterinary*. 162 (11): 526-530.

Lemma1, H., Belihu, K. and Sheferaw, D. 2010. Study on the reproductive performance of Jersey cows at Wolaita Sodo dairy farm, Southern Ethiopia. *Ethiopia Veterinary Journal.* 14 (1): 53-70.

Levine, H. D. 1999. The repeat breeder cow. *The Bovine Practitioner.* 33: 97-105.

Lima, F. S., Risco, C. A., Thatcher, M. J., Benzaquen, M. E., Archbald, L. F., Santos, J. E. and Thatcher, W. W. 2009. Comparison of reproductive performance in lactating dairy cows bred by natural service or timed artificial insemination. *Journal of Dairy Science.* 92(11): 5456-66. doi: 10.3168/jds.2009-2197.

Lobago, F., Bekana, M., Gustafasson, H. and Kindhal, H. 2006. Reproductive performance of dairy in small holder production system in Selalle, Central Ethiopia. *Tropical Animal Health and Production* 38: 333-342.

Lodhi, L. A., Qureshi, Z. I., Ahmed, I., Nawaz, A. and Jamil, H. 1999. The occurrence of various reproductive disorders in cattle with reference to parity and season. *Pakistan Journal of Biological Science.* 2(4): 1575-1578.

Lopez-Gratius, F. and Yanis, J., Madriles-Helm, D. 2003. Effects of body condition score and score change on the reproductive performance of dairy cows: a meta-analysis. *Theriogenology*. 59: 801–812.

Lucy, M. C. 2007. Ferity in high producing dairy cows: reasons for decline and corrective strategies for sustainable improvement: SOC Report of Fertility Supplementation. 64: 237-254.

Luna L. G. 1968. Manuel of Histologic Staining Methods of the Armed Forces Institute of Pathology, 258 pages, 3rd Ed., McGraw-Hill Book Company, New York, USA.

Mahmud, M. K., Rahman, M. K., Maruf, A. A., Sayam, A. S. M., Mutaleb, M. A., Ali, M. I. and Habib, M. A. 2014. Prevalence of reproductive diseases and disorders in cows and goats recorded in two Veterinary hospitals in Bangladesh. *American Rsearch Thoughts*. 1(1): 285-303.

Malik, A., Haron, A. W. Yusoff, R., Kasim, A. and Yusoff, S. M. 2012. Pregnancy rate following artificial insemination or natural service in postpartum estrus synchronized beef cattle. *Turkish Journal of Veterinary and Animal Science.* 36(4): 451-455.

Mandali, G. C., Patel, P. R., Dhami, A .J. and Raval, S. K. 2004. Epidemiological surveillance on effect of housing, hygiene and nutritional status on periparturient disorders in buffaloes. *Indian Journal of Dairy Science*. 57(2): 132-136.

Markusfeld, O. 1984. Factors responsible for postpartum metritis in dairy cattle. *Veterinary Records.* 114: 539-542.

Maruf, A. A., Paul, A. K., Bonaparte, N., Bhuyian, M. H. and Shamsuddin, M. 2014. Reproductive disorders that limit the reproductive performance in dairy cows of Bangladesh. *Journal of Embryo Transfer.* Vol. 29(2): 189-194.

Mason, I. L. and Buvanendran, V. 1982. Breeding plans for ruminant livestock in the tropics. FAO, Animal production and Health Paper. No. 34-89.

Matin, M. A. 1993. Quantitative analysis of milk yield records and genetic ranking of the cows in Savar Dairy Farm. M.Sc. thesis, Department of Animal Breeding and Genetics, BAU, Mymensingh, Bangladesh.

McDermott, J. J., Allen, O. B., Martin, S. W. and Alves, D. M. 1992. Patterns of stillbirth and dystocia in Ontario cow-calf herds. The *Canadian Journal of Veterinary Research.* 56(1): 47–55.

McDojugasll, S., Burke, C. R., Willamsonl, N. B. and MacMillanl, K. L. 1995. The effect of stocking rate and breed on the period of post-partum anoestrum in grazing dairy cattle. *Proceeding of the New Zealand Society of Animal Production.* 55: 236-238.

McDougall, S. 2005. Gross abnormalities, bacteriology and histological lesions of uteri of dairy cows failing to conceive or maintain pregnancy. *New Zealand Veterinary Journal.* 53 (4): 253-256.

McDougll, S. and Rhodes, F. M. 1999. Detection of a corpus luteum in apparently anaestrous cows by manual palpation, transrectal ultrasonography and plasma progesterone concentration. *New Zealand Veterinary journal.* 47:47-52.

McEntee, K. 1983. Reproductive Pathology Notes. FAO, Rome.

Mee, J. F. 2004. The role of micronutrients in bovine periparturient problems. Cattle Practice. 12: 95-108.

Mee, J. F. 2007. The role of the Veterinarian in bovine fertility management on modern dairy farms. *Theriogenology*. doi:10.1016/j.

Mekibib . B., Desta, T. and Tesfaye, D. 2013. Gross pathological changes in the reproductive tracts of cows slaughtered at two abattoirs in Southern Ethiopia. 5(2): pp. 46-50.

Mekonnen, D. 2000. Study on major infertility problems of crossbred dairy herds in Ada'a district of central Ethiopia. DVM Thesis. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Melendez, P., Donovan, A., Risco, C. A. and Goff, J. P. 2004. Plasma mineral and energy metabolite concentrations in dairy cows fed an anionic prepartum diet that did or did not have retained fetal membranes after parturition. *American Journal of Veterinary Research*. 65: 1071-1076.

Memon, M. A. 1996. Diagnosis of Pregnancy and Infertility by Rectal Palpation: Bovine Obstetrics. DVCS Washington State University, Pullman, Pp: 65-68.

Mia, A. S., Islam, H., 1967. A preliminary study on the incidence of bovine infertility and economic loss caused by it. *Pakistan Journal of Veterinary Science*. 1: 5-10.

Ministry of Finance, 2013. Bangladesh economic review 2013. Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Misostov, T. A. and Konovalova, A. A. 1994. The effect of rearing on productive life span of livestock. *Ukrainskil Institute Zhivotnovodstva*. 63: 45-49.

Mohammad, A. G. 2013. Pathological abnormalities in genital tract of cows slaughtered at Dhamar abattoirs, Yemen. *Yemeni Journal of Agriculture and Veterinary Sciences.* 1(1): 1-8.

Molalegne, B. and Shiv, P. 2011. Study on Major Reproductive Health Problems in Indigenous and Cross Breed Cows in and Around Bedelle, South West Ethiopia. *Journal of Animal and Veterinary Advances.* 10(6): 723-727.

Mollah, M. F. K., Gofur, M. R., Asaduzzaman, K. M. and Bhuiyan, M. M. U. 2015. Conception rate of non-descript zebu cows and its attributing factors in Bangladesh. *Research Journal of Veterinary Sciences.* 8 (3): 42-51.

Mondal, S .C. 1998. A comparative study on the production performance of different dairy breeds of BAU Dairy farm. MS Thesis, Department of Dairy Science, Bangladesh Agrcultural University, Mymensingh. Enterprise in 1000 selected area of Bangladesh M.Sc. Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Montiel, F. and Ahuja, C. 2005. Body condition and suckling as factors influencing the duration of post-partum anaestrus in cattle. *A review of Animal Reproduction and Science.* 85: 1-26.

Morrow, D. A. 1980. Analysis of record for reproductive herd heath programmes. In Current Therapy in Theriogenology. Edt. D. A. Morrow W. B. Saunders Company. Philadelphia. Toronto. London. Vol. 1: 559-562.

Morrow, D. A. 1986. Current therapy in Theriogenology. Diagnosis, treatment and prevention of reproductive diseases in animals. W.B. Soundars Company, Philadelphia. Pp. 322-571.

Morton, J. M. 2003. The In Calf Project-Identifying risk factors for reproductive performance in Australian dairy herds. *Cattle Practices*. 11: 201-208.

Motlagh, M. K., Roohani, Z., Shahne, A. Z. and Moradi, M. 2013. Effects of age at calving, parity, year and season on reproductive performance of dairy cattle in Tehran and Qazvin Provinces, Iran. *Research Opinion in Animal & Veterinary Sciences*. 3(10): 337-342.

Mujuni, P. F., Mgongo, F. O. K. and Kanuya, N. L. 1993. Ovarian cysts, a postpartum ovarian disorder affecting dairy cows in tropical area. *Animal Reproductive Science.* 31: 175-186.

Mukasa-Mugerwa, E. 1989. A review of reproductive performance of female *Bos indicus* (Zebu) cattle. ILCA Monograph No. 6. ILCA, Addis Ababa. pp: 20-117.

Mukherjee, K., Tomar, S. S., and Sadana, D. K. 1993. Factors affecting reproductive disorders and their association in Karan Fries herd. *Indian Veterinary Journal.* 70(2): 121-124.

Muller, C. J. C., Potgieter, J. P., Cloete, S. W. P. and Dzama, K. 2014. Non-genetic factors affecting fertility traits in South African Holstein cows. *South African Journal of Animal Science*. 44.

Munn, W. and Zonneveld, J. 1990. Household agricultural survey of the Kanyati and Gatshe Gatshe Communal Lands, 1988/89 Joint report of the Tsetse and Trypanosomiasis Control Branch and the Agricultural Development Authority, Harare.

Mureda, E. and Zeleke, Z. M. 2008. Characteristics and constraints of crossbred dairy cattle production in lowland areas of Eastern Ethiopia. *Livestock Research for Rural Development. Volume 20, Article #57.* Retrieved on March 14, 2016, from http://www.lrrd.org/lrrd20/4/mure20057.htm

Mureda, E. and Zeleke, Z. M. 2008. Characteristics and constraints of crossbred dairy cattle production in lowland areas of Eastern Ethiopia. *Livestock Research for Rural Development. Volume20, Article #57.* Retrieved on March 2, 2016, from http://www.lrrd.org/lrrd20/4/mure20057.htm.

Mutiga, E. R. 1992. Reproductive disorders of dairy cattle in Kenya. Cattle Research Network Zewsletter. 6: 1-5.

Nagare, Q. K. and Patel, A .M. 1997. The comparative performance of Gir cross-bred under Mohrastra conditions. *Indian Journal of Aimal Production and Management.* 13:87-92.

Nahar, M. N. 2010. Pathological investigation of bovine uterus and isolation and identification of bacteria. MS Thesis. Department of pathology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Nahar, T. N., Islam, M. and Hasnath, M. A. 1992. A comparative study on the performance of F cross-bred cows under rural condition. *Asian-Australian Journal of Animal Science.* 5: 435-438.

Nair, K. P. and Raja, C. K. S. V. 1975. Study on the pathological conditions in the reproductive organs of cows. IV. Pathology of cervix, and V. Pathology of the vagina, vulva. *Kerala Journal of Veterinary Science*. 6: 114-120.

Nakao, T., Mariyoshi, M. and Kawata, K. 1992. The effect of post-partum ovarian dysfunction and endometritis on subsequent reproductive performance in high and medium producing dairy cows. *Theriogenology*. 37: 341-349.

Nalunkuuma, J. 2013. Analysis of farmers' adoption of zero grazing and knowledge of cattle reproductive parameters in Western Kenya. MS thesis. Jomo Kenyatta University of Agriculture and Technology, Kenya.

Napolcan, R. and Quayam, S. A. 1997. Biometrical studies on the female genitalia of non-descript buffalo (Bubalus bubalis). *Indian Journal of Animal Science.* 66(12): 1269-1270.

Narasimha Rao, A. V. 1982. Causes and incidence of reproductive disorders among Zebu X taurus cross-bred cows in Andhra Pradesh**.** *Theriogenology*. 17(2): 189-91.

Newham, L. 2001. Beef Cattle: Breeding, Feeding and Showing. Butterworth-Heinemann, Excellent guide to breeding and showing cattle.

Nicholson, M. J. and Butterworth, M. H. 1986. A guide to condition scoring of Zebu cattle. International Livestock Center for Africa Ababa, Ethopia, pp. 29.

Nix, J. M., Spitzer, J. C., Grimes, L. W., Burns, G. L. and Plyler, B. B. 1998. A retrospective analysis of factors contributing to calf mortality and dystocia in beef cattle. *Theriogenology.* 49: 1515-1523.

Nolan, C. J., Bull, R. C., Sasser, R. G., Rudder, C. A., Parilasigui, P. M. and Reevoes, J. J. 1988. Post-partum reproduction in protein restricted beef cows: effect on the hypothalmo-pituitary-ovarian axis. *Journal of Animals Science.* 66: 3208-3211.

O'farrel, K. J., Langley, O. H., Hartigan, P. J. and Steenan, J. M. 1983. Fertilization and embryonic survival rates in dairy cows culled as repeat breeders. *Veterinary Records*. 112: 95.

Obwolo, M. J. and Ogaa, J. S. 1990. An abattoir survey of reproductive organ abnormalities in cows in Zimbabwe. *Bulletin of Animal Health and Production in Africa*. 38: 173-176.

Okeyo, A. M., Mosi, R. O., and Langat, L. K. I. 1998. Effects of parity and previous parous status on reproductive and productive performance of Kenya Boran cows. *Tropical agriculture*. 75(3): 384-389.

Opsomer, G., Mijten, P., Coryn, M. and Kruif, A. D. E. 1996. Post-partum anaestrus in dairy cows. *Veterinary Quarterly.* 18: 68-75.

Osawa, T., Nakao, T., Nakada, K., Moriyoshi, M. and Kawata, K. 1996. Pituitary response to exogenous GnRH on day 7 post-partum in high producing dairy cows. *Reproduction of Domestic Animals*. 31: 343-347.

Osoro, K. and Wright, I. A. 1992. The effect of body condition, live weight, breed, age, calf performance, and calving date on reproductive performance of spring-calving beef cows. *Journal of Animal Science*. 70(6): 1661-6.

Osteras, O., Solbu, H., Refsdal, A. O., Roalkvam, T., Filseth, O. and Minsaas, A. 2007. Results and evaluation of thirty years of health recordings in the Norwegian dairy cattle population. *Journal of Dairy Science.* 90(9): 4483-97.

Pagaonkar, D. R. and Bakshi, S. A. 1987. Reproductive disorders of Red Kandhari cows and their cross-breds. *Indian Journal of Animal Reproduction*. 8: 18-19.

Pandit, R. K., Shukla, S. P. and Parekh, H. K .B. 1981. Incidence of retained placenta in Gir and their crosses with special reference to subsequent f ertility. *Indian Journal of animal Science.* 51: 505.

Parikh, J. K. 1988. Bangladesh: agriculture, biomass and environment. In: Parikh JK, Nijhoff M (eds), *Sustainable Development in Agriculture*, Dordrecht, The Netherlands. Pp. 331-364.

Parker, A. J. C. 1992. Body condition score, milk fever and fertility in dairy cows. DBR dissertation. University of Liverpool.

Patel, S. B., Hadiya, K. K. and Chavan, D. B. 2007. Incidence of reproductive disorders in cattle and buffaloes in Kaira District of Gujarat. *Indian Journal of Field Veterinarians*. 3: 15-17.

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 Research for Rural Development.* 23(3): 1-8.

Payne, W. K. A. 1970. Cattle production in the tropics. I, Longman, London. 120-128.

Pellerin, D., Gilbert, D., Perried, J. P. and Livallois, R. 1995. Bow much does it cost to rear heifers? Producteur- de-Lait-Quebecois. 16: 26-30.

Pempek, J. and Botheras, N. 2009. Effect of rubber flooring in a freestall dairy barn on cow behavior and milk production. *Journal of Dairy Science*. 92 (E-Suppl. 1): 7.

Pereira, M. N., Silva, H. M. and Reis, R. B. 1995. Effect of management on reproductive performance in a dairy herd. *Journal of Animal Science.* 47: 181-190.

Petter, J. 1993. Artificial Breeding Manual Sindh Livestock Development Project. Department of Livestock and Fisheries, Government of Sindh, Pakistan, Pp: 8-10.

Phillips, C. J. C. and Schofield, S. A. 1994. The effect of cubicle and straw yard housing on the behaviour, production and hoof health of dairy cows. *Animal Welfare*. 3: 37-44.

Plasse, D., Koger, M. and Warnick, A. C. 1968. Reproductive behavior of *Bos indicus* females in a subtropical environment. III. Calving intervals from first exposure to conception and intervals from parturition to conception. *Journal of Animal Science* 27: 105-112.

Plasse, D., Pena, N., Verde, O., Koger, M. and Linares, T. 1972. Influencias ambietales sobre la variancia de intervalos entre partos en Brahman registrado. *Memoria, Asociacion Latinoamericana de Produccion Animal* 7: 47.

Qazi, R. L., Zhao, Y. and Pollak, E. J., 1999. Epidemiologic study on mastitis. *Journal of Animal Sciene*. 66:396-399.

Rahman, A., Datta, T. K., Alam, M. G. S., Shamsuddin, M. and Ali, M. S. 2000. Risk factors associated with the incidence of retention of afterbirth and their Reproductive consequences in dairy cows.

Rahman, A., Robina, H. and Ahmed, M. U. 1996 Anaestrus and repeat breeding problems in indigenous cattle in Bangladesh. *Tropical Animal Health Production*. 7: 605-609.

Rahman, M. M. 1999. A comparative study on the productive and reproductive performances of local, pure and crossbred cows at Central Cattle Breeding Station, Savar, Dhaka. MS Thesis, Department of Dairy Science. Bangladesh Agricultural University, Mymensingh.

Rahman, M. A., Alam, M. G. S. and Das, S. C. 1995. Assessment on reproduction status of zebu heifer and cows in Tangail milk shed area. *Bangladesh Veterinary Journal*. 29: 17-24.

Rahman, M. A., Datta, Y. K., Alam, M. G. S. and Shamsuddin, M. 1998. The effect of manual removal of placenta on the onset of post-partum oestrus in cows. *The Bangladesh veterinarian*. 15(1-2): 43-47.

Rahman, M. A., Imtiaz, M. A., Ahaduzzaman, M., Ghosh, K. K., Masud, A. A., Chowdhury, S. and Sikder, S. 2014. Effects of flooring and rearing system on hoof health of dairy cows in some selected areas of Bangladesh. *Bangladesh Journal of Animal Science*. 43(2): 132-137.

Rahman, M. and Hoque, M. N. 2001. Productive and reproductive performance of native cows under farm condition. *Pakistan Journal of Biological Science*. 1(11): 1085-1087.

Rahman, M. F., Hossain, M. S. and Prodhan, M. A. M. 1993. Reproductive problems of cattle in Bangladesh. *The Bangladesh Veterinarian*. 10: 71-73.

Rahman, M. L., Chowdhury, M. K., Hossain, M. S. A., Shamsuddin, M. and Bhuiyan, M. M. U. 2013. Occurrence of reproductive diseases of cattle at Saturia, Manikgonj. *Bangladesh Journal of Veterinary Medicine*. 11(2): 121-125.

Rahman, M. M., Rahman, M. A., Alam, M. G. S. and Hossain, M. A. 1994. Operative mamagement of dystocia due to non-opening cervix in cow. *Bangladesh Veterinary Journal*. 28: 79-82.

Rahman, M. S. 1992. Dairy development in Bangladesh. Proceeding of Fourth National Conf. 1992. Bangladesh Animal Husbandry Association, pp. 84-88.

Rahman, M. S., Ahmed, M. and Ahmed, A. R. 1987. A comparative study on some productive and reproductive performance of dairy cows at Savar Dairy and Cattle Improvement Farm. *Bangladesh Veterinary Journal*. 21:55-61.

Rahman, S. and Kalita, G. 2015. Morphometric, Productive and Reproductive Traits of Local Cattle (Zobawng) of Mizoram. *International Journal of Livestock Research*. 5(7): 50-57. doi: 10.5455/ijlr.20150706045003.

Randel, R. D. 1990. Nutrition and post-partum rebreeding in cattle. *Journal of Animal Science*. 68: 853-862.

Rao, A. V. N. and Rao, H. R. M. 1996. The lifetime milk production and breeding efficiency of Jersey cows in Andhra Pradesh. *Indian Veterinary Journal*. 73: 480-483.

Rao, A. V. N., Reddy, A. C. and Murthy, Y. N. 1993. Incidence of reproductive disorders in relation to exotic inheritance in cross bred cows. *Indian Veterinary Journal*. 70: 722-725.

Rawson, L. C. 1986. Reproductive Management of small dairy farms. In: Current Therapy in Theriogenology (Diagnosis, Treatment and Prevention of reproductive diseases in small and large animals). Edited by David. A. Morrow. W.B. Saunders Company, Philsdelphia. PP. 392-395.

Ribeito, H. F. L., Andrade, V. J. de., Marques, Jr. A. P., Vale, W. G. and De-Andrede, V. J. 1997. Effect of body condition at parturition on the interval to first post-partum oestrus in buffaloes. *Revista Brasileira de Medicina Veterinaria*.19: 213-218.

Rind, R., Brohi, M. A. and Bhatti, W. M. 1999. Studies on biometry of ovary during pregnancy in buffaloes. PASF/PVMA Agro-Livestock Conf. Lahore, Pakistan, 72-74.

Risco, C. A. and Hernandez, J. 2003. Comparison of ceftiofur hydrochloride and estradiol cypionate for metritis prevention and reproductive performance in dairy cows affected with retained fetal membranes. *Theriogenology*. 60:47-58.

Roberts, S. J. 1971. Veterinary Obstetrics and Genital Disease (Theriogenology) 2nd edition, Indian educational scientific book agency, Calcutta-1.

Roberts, S. J. 1971a. Veterinary obstetrics and genital diseases (Theriogenology). 2^{nd} edition, CBS Publishers and Distributors. Pp. 107-511.

Roberts, S. J. 1982. Veterinary Obstetrics and Genital Diseases. Ist Edn., Distributor Edward Brothers Inc., Ann. Arbor, Michigan, USA. Pp: 4-11.

Roberts, S. J. 1986. Veterinary obstetrics and genital diseases. Theriogenology 3^{rd} ed. Edwards's brothers, Inc. Michhigan. Pp.48-104.

Roche, J. F. 2006. The effect of nutritional management of the dairy cow on reproductive efficiency. *Animal Reproduction Science.* 96: 282-296.

Roche, J. F., Boland, M. P. and Megeady, T. A. 1981. Reproductive wastage following artificial insemination of heifers. *The Veterinary Records*. 109: 401-404.

Rogers, R. D., Flanegan, M. and Hill, M. W. M. 1972. A survey of infectious causes of reproductive failure in beef cattle in North- Eastern Australia. *Australian Veterinary Journal*. 48: 207-209.

Roine, K. 1977**.** Observations on genital abnormalities in dairy cows using slaughterhouse material. *Nord Veterinary Medicine*. 29(4-5): 188-93.

Romaniuk, J. 1994. Fertility and longevity of cows having a normal first partuirion or a first parturition with retained placenta. *Israel Journal of Veterinary Medicine*. 49:63-65.

Roy, B. 2001. Pathology of female reproductive system of goats in Mymensingh district of Bangladesh. MS Thesis, Department of Pathology, Bangladesh Agricultural University, Mymensigh, Bangladesh.

Roy, P. K. and Tripathy, V. N. 1992. Factors effecting age at frist calving in Friesian × Sahiwal or Tharparkar crossbred. *Indian Veterinary Journal.* 69: 908-911.

Ryan, D. P., Scland, M., Kopel, E., Armstrong, D., Munyakazi, L., Gorlke, G. and Ingergam, R. 1992. Evaluating two different evaporative cooling management systems for dairy cows in hot dry climate. *Journal of Dairy Science.* 76(Suppl. 1): 240. (Abstr.)

Saadullah, 2000. Small dairy production and marketing in Bangladesh. Department of Animal Science, Bangladesh Agricultural University, Bangladesh.

Sah, S. K. and Nakao, T. 2006. Characteristics of repeat breeding buffaloes in Nepal. *Journal of Reproduction and Development*. 52(3): 335-341.

Saini, M .S., Khanna, A. S. and Chopra, S. C. 1988. Incidence of retention of placenta, its treatment and subsequent fertility in crossbred dairy cattle. *Indian Journal of Animal Production and Management.* 4(2): 61-65.

Salisbury, G. W. and Vendermark, L. N. 1961. Physiolgy of reproduction and Arificial insemination of cattle. Ist Edn., Copyright in 1961 by WH Freeman and Copyman, Printed in the USA.

Salisbury, G. W., Vandemark, N. L. and Lodge, J. R. 1978. Insemination of the Cow. In Physiology of Reproduction and Artificial Insemination of Cattle. 2nd Edn.W.H. Freeman and Company, Sanfransisco, USA. pp. 555-572.

Saloniemi, H., Grohn, Y. and Syvajarvi, J. 1986. An epidemiological and genetic study on registered diseases in Finnish Ayrshire cattle. If. Reproductive disorders. Acta Veterinary Scandinevia 27:196208. (Cited: *Animal Breeding Abstracts* 55: 2020).

Samad, M. A., Rahman, M. H. and Islam, T. S. 1989. Factors associated with placental retention in Savar dairy cattle. *Indian Journal of Dairy Science.* 42: 720-723.

Samad, A., Ali, C. S., Rahman, N., Ahmed, A. and Ahmed, N. 1987. Clinical incidence of reproductive disorders in the buffalo. *Pakistan Veterinary Journal.* 3(2): 16-19.

Samad, M. A., Rhman, A. and Ali, K. M. 1978. A note on certain blood chemical and hematological values of repeat breeding heifers caused by granular vulvovaginitis. *Indian Journal of Animal Science*. 48: 620-622.

Sandals, W. C. D., Curtis, R. A., Cote, J. F. and Martin, S. W. 1979. The Effect of retained placenta and metritis complex on reproductive performance in dairy cattle- A Case Control Study. *Canadian Veterinary Journal.* 20(5): 131–135.

Santos, J. E. P. 2007. Implementation of reproductive programs in dairy herds: Nottingham cattle ferlity conference, 4th September, 2007. *Leicestershire.* P. 1-9.

Sarder, M. J. U. 2001. Reproductive and productive performance of indigenous cows. *The Bangladesh Veterinian*. 18: 123-129.

Sarder, M. J. U. 2008. Occurrence of reproductive disorders of cross-bred cows of Northern Bangladesh. 15th International Congress on Biotechnology in animal Reproduction. 74.

Sarder, M. J. U. 2011. Current Fertility Status in Cattle in Mini Dairy Farm. Verlag Dd. Muller GM8HC co. KG, Germany, ISBN-978-3639-32198-2.

Sarder, M. J. U., Moni, M. I. Z. and Aktar, S. 2010. Prevalence of reproductive disorders of cross-bred cows Rajshahi district of Bangladesh. *SARC Journal of Agriculture.* 8(2): 65-75.

Sarder, M. J. U., Shamsuddin, M., Bhuiyan, M. M. U. and Rahman, M. A. 1997. Individual cow as determination of the fertility and productivity in mini dairy farms. *Bangladesh Veterinary Journal*. 30: 91-98.

Sarder, M. J. U., Uddin, J., Islam, M. H. and Islam, M. R. 2015. Prevalence of obstetrical disorders in dairy cows of northern Bangladesh. *Asian Journal of Medical and Biological Research*. 1(2): 216-221; doi: 10.3329/ ajmbr.v1i 2.25614.

Sargeant, J. M., Scott, H. M. Leslie, K. E. Ireland, M. J. and Bashiri A. 1998. Clinical mastitis in dairy cattle in Ontario: frequency of occurrence and bacteriological isolates. *The Canadian Veterinary Journal*. 39(1): 33-38.

Sasaki, N., Domeki, I., Nakahara, T. and Yamauoni, M. 1991. Plasma estradiol-17β and progesterone concentration in ovarian activity in post-partum cows. *Japan Journal Animal Reproduction.* 80: 80-86.

Sasser, R. G., Williams, R. T., Bull, R. C., Ruder, C. A. and Falk, D. G. 1988. Post-partum reproductive performance in crude protein restricted beef cows: return to estrus and conception. *Journal of Animal Science.* 65:31-42.

Sasser, R. G., Williams, R. T., Bull, R. C., Ruder, C. A. and Falk, D. G. 1989. Post-partum reproductive performance in crude protein restricted beef cows: return to estrus and conception. *Journal of Animal Science.* 66: 3033-3039.

Sattar, A., Mirza, R. H., Niazi, A. A. K and Latif, M. 2005. Productive and reproductive performance of Holstein Friesian cows in Pakistan. *Pakistan Veterinary Journal.* 25(2): 75-81.

Satya pal, 2003. Investigation on health disorders in dairy cattle and buffaloes during pre and post-partum period. Ph.D thesis submitted to NDRI, Karnal.

Satya, P. 2003. Incidence of post parturient utero-vaginal complex. *Wayamba Journal of Animal Science.* ISBN: 2012-578X: 59-61.

Saxena, G., Rani, S., Danodia, H. K. and Purohit, G. N. 2006. Pathological conditions in genital tract of female Buffaloes (Bubalus bubaliS). *Pakistan Veterinary Journal*. 26(2): 91-93.

Sayyari, M., Farhangnia, M., Ghaemmaghami, S. H. and Sharma, R. H. 2012. Acomparative study on bacteriology and pathology in uteri of cattle and buffaloes in Ahwaz region, Iran. *Iranian Journal of Veterinary Medicine.* 6(1): 33-39.

Scheidegger, G. A., Melendezr, P., Duchens, A. M. and Asnis, H. J. 1993. Retained foetal membrane and other puerperal reproductive disorders and their effects on post-partum fertility in Holstein cattle. *Advanced on Clinician Veterinarian*. 8: 18-23.

Schrick, F. N., Hockett, M. E., Saxton, A. M., Lewis, M. J., Dowlen, H. H. and Oliver, S. P. 2001. Influence of subclinical mastitis during early lactation on reproductive parameters. *Journal of Dairy Science*. 84: 1407–1412.

Schumitz, H. S. U. F. 1998. The most important milk recording results in 1996-1997. *Animal Breeding Abstract*. 66: 599, 4729.

Scoones, I. C. 1990. Livestock populations and the household economy: a case study from southern Zimbabwe PhD thesis, University of London.

Seegers, H. and Beaudeau, F. 1996. Replacement the cost of a heifer Production-Laitiere-Moderne. 257: 60-61.

Seegers, H., Fourichon, C. and Beaudeau, F. 2003. Production effects related to mastitis and mastitis economics in dairy cattle herds. *Veterinary Research*. 34: 475-491. DOI: 10.1051/vetres: 2003027.

Senators, E. M., Butler, W. and Oltenacu, P. A. 1996. Relationships between energy balance and post-partum ovarian activity and fertility in first lactation dairy cows. *Animal Sciences*. 62: 17-23.

Sethi, R. K. and Balaine, D.S. 1978. An approach to quantification of threshold traits in dairy cattle. *Indian Journal of Dairy Science.* 48: 344.

Settergren, I. 1983. Sexual Physiology in Female Domestic Animals. 15th FAO/SIDA International Postgraduate Course on Animal Reproduction. Coll. Vet. Med. Uppsala, pp: 03.

Settergren, I. and Galloway, D. B. 1965. Studies on genital malformatioms in female cattle using slaughterhouse material. *Veterinary Medicine*. 17:9-16.

Shahabuddin, M. 1996. Pathological disorders encountered in female reproductive system of cattle. MS Thesis. Department of pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Shahabuddin, M. 1996. Pathological disorders encountered in female reproductive system of cattle. MS Thesis submitted to the department of Pathology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh.

Shamsuddin, M. 1988. Effect of age of semen on conception rate in cattle under farm condition. M.Sc (Vet. sc.) in Surgery Thesis, Department of Surgery and Obstetrics, Faculty of Veterinary Science, BAU, Mymensingh, Bangladesh.

Shamsuddin, M. 1995. Fertility trend and status of oestrus detetion in the bovine under farm conditions in Bangladesh. *Bangladesh Veterinary Journal.* 29: 9-16.

Shamsuddin, M. and Arya, M. P. 2009. Nutrition and Reproductive Management. In: Handbook of Dairy Nutrition Bangladesh, Robinson, P.H. and U. Krishnamoorthy (Eds.) ASA International Marketing, New York, pp: 208-215.

Shamsuddin, M., Alam, M. G. S. and Ahmed, J. U. 1988. Reproductive disorders of crossbred cows. *Bangladesh Veterinary Journal*. 22: 21-28.

Shamsuddin, M., Alam, M. G. S. and Ahmed, J. U. 1988. Reproductive disorder of cross breed cows. *Bangladesh Veterinary Journal*. 22(24): 21-28.

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

Shamsuddin, M., Bhuiyan, M. M. U., Chanda, P. K., Alam, M. G. S. and Galloway, D. 2006a. Radioimmurnoassay of milk progesterone as a tool for fertility control in smallholder dairy farms. *Tropical Animal Health and Production.* 38: 85-92.

Shamsuddin, M., Bhuiyan, M. M. U., Sikedr, T. K., Sugulle, A. H., Chanda, Alam, M. G. S. and Galloway, D. 2001a. Constraints limiting the efficiency of artificial insemination of cattle in Bangladesh. Division of Nuclear Techniques in Food and Agriculture and held in Uppsala, Sweden. pp: 10-14.

Shamsuddin, M., Bhuyan, M. M. U., Sikder, T. K., Sugulle, A. H., Chandra, P. K. and Alam, M. G. S. 2001. Constraints limiting the efficiency of artificial insemination of cattle in Bangladesh. *International Atomic Energy Agency.* 1220: 9-27.

Shamsuddin, M., Goodger, W. E., Hossein, M. S., Azizunnesa, Bennett, T. and Nardlund, K. 2006. A survey to identify economic opportunities for smallholder dairy farms in Bangladesh. *Tropical Animal Health Production*. 38: 131-140.

Shamsuddin, M., Goodger, W. I., Hossein, M. S., Azizunnesa, Bennett, T. and Nordlund, K. 2006b. A survey to identify economic opportunities for smallholder dairy farmers in Bangladesh. *Tropical Animal Health and Production.* 38: 131-140.

Shamsuddin, M., Hossein, M. S., Siddiqui, M. A. R., Khan, A. H. M. S. I. Bari, F. Y., Alam, M. F., Rahman, M., Sayem, A. S. M. and Momont, H. 2007. Use of milk progesterone radioimmunoassay and computer applications for community based reproductive health services in small holder Dairy farms of Bangladesh. Improving the Reproductive Management of Dairy Cattle Subjected to Artificial Insemination. Pp: 9-22.

Sharma, N. C. and Singh, B. 1980. Factors affecting calving interval in cross-bred cows. *Indian Veterinary Journal*. 63: 317-319.

Sheldon, I. M. and Dobson, H. 2004. Post-partum uterine health in cattle. *Animal Reproductive Science.* 82-83: 295-306.

Sheldon, I. M., Lewis, G. S., LeBlanc, S., and Gilbert, R. O. 2006. Defining postpartum uterine disease in cattle. *Theriogenology*. 65: 1516-1530.

Sheldon, I., Barrett, D. and Mihm, M. 2004. The Post Partum Period 508-529. In: *Bovine Medicine, Diseases and Husbandry of Cattle.* Second Edition. Blackwell Publishing, Oxford.

Shieferaw, Y., Teninger, B. A. and Kassa, T. 2003. Reproductive performance of crossbred dairy cows in different production system in the central highlands of Ethiopia. *Tropical Animal Health Production*. 35: 551-561.

Shiferaw, Y. 1999. Fertility status of dairy cows under different production systems in Holetta central Highland of Ethiopia. MSc Thesis, Addis Ababa University and Freie Universitat Berlin, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Shiferaw, Y., Tenhagen, B. A., Bekana, M. and Kassa, T. 2005. Reproductive Disorders of Crossbred Dairy Cows in the Central Highlands of Ethiopia and Their Effect on Reproductive Performance. *Tropical Animal Health and Production.* 37(5): 427-441.

Siddiqui, H. U. R., Ahmad, A. and Khan, M. Z. 2005. Biometrical Studies of Testes of Ram. Short Communication. *Journal of Agriculture and Social Science.* 1(1): 78-79.

Siddiqui, M. A. R. 2008. Laboratory tests to predict bull fertility and the value of sperm nuclear shape analysis. Ph.D. Thesis, Department of Surgery and Obstetrics, Bangladesh Agricultural University, Mymensingh, 108.

Siddiqui, M. A. R., Shamsuddin, M., Bhuiyan, M. M. U., Akbar, M. A. and Kamaluddin, K. 2002. Effect of feeding and condition score on multiple ovulation and embryo production in zebu cows. *Reproduction of Domestic Animal.* 37:37-41.

Siemeri, N. A., Wilcox, C. J., Thatcher, W. W. and Martin, F. G. 1991. Prepartum and peripartum reproductive performance of dairy heifers freshing at young ages. *Journal of Dairy Science.* 74: 1724-1729.

Simenew, K. Bekana, M. Fikre, L. Tilahun, Z. and Wondu, M. 2011. Major gross reproductive tract abnormalities in female cattle slaughtered at Sululta slaughterhouse in Ethiopia. *Global Veterinaria*. 6 (6): 506-513.

Singh, A., Taylor, C. M. and Singh, B. N. 1983. Factors affecting calving interval in Malvi cattle. *Livestock Advisor*. 8: 9-11.

Singh, A., Taylor, C. M. and Singth, B. I. N. 1999. Factors affecting calving interval in Malvi cattle. *Livestock Advisor*. 8: 9-11.

Singh, N. P., Chaturvedi, V. K. and Singh, D. P. 1996. Bacteriological studies on repeat bredder bovines. *Indian Veterinary Journal*. 73: 462-463.

Sinha, A. K., Dhanda, O. P. and Razdan, M. N. 1978. Retained placenta treatment and breeding efficiency in cows. *Indian Veterinary Journal*. 55(12): 982-985.

Sirohi, N. S., Monga, D. P. and Knar, S. K. 1989. Microbiological studies on some reproductive disorders of cattle. *Indian Journal of Animal Sciences*. 59 (5): 537-541.

Sission, S. and Grossman, J. D. 1972. Anatomy of Domestic Animals. 4th edn., W.B. Sounders Co., Philadelphia, Pp. 615-618.

Smith, R. D. and Chase, L. E. 2010. Nutrition and Reproduction, Dairy Integrated Reproductive Management.

Soonwuk, J., Soonseek, Y., Woosub, H., Choi, S. H. and Rhee, J. C. 1996. Prevalence of bovine reproductive disorders in the Korea Republic. *RDA-Journal of Agricultural Science, Veterinary*. 38: 825-829.

Sorensen, A. M. 1988. A Laboratory Manual for Animal Reproduction. 3rd Edn., Repro Lab. Kendall Texas hunt Pub. lishing Comp., Dubuqu Iowa, Pp: 81-83.

Spalding, R. W., Everett, R. W. and Foote, R. H. 1975. Fertility in New York artificially inseminated Holstein herds in dairy improvement. *Journal of Dairy Science*. 58: 718-723.

Staples, C. R., Thatcher, W. W. and Clark, J. H. 1990. Relationship between ovarian activity and energy status during the early postpartum period of high producing dairy cows. *Journal of Dairy Science*. 73: 938-947.

Stevenson, J. S. and Call, E. P. 1988. Reproductive disorders in the peri-parturient dairy cow. *Journal of Dairy Science*. 71(9): 2572–2583.

Suadsong, S., Suwimonteerabutr, J., Virakul, P., Chanpongsang, S. and Kunavongkrit, A. 2008. Effect of improved cooling system on reproduction and lactation in dairy cows under tropical conditions. *Asian-Australian Journal of Animal Science*. 21(4): 555-560.

Sultana, R. 1995. Quantitative analysis of reproductive performance of purebred and their crosses in the Savar Dairy Farm. M.Sc. thesis, Department of Animal Breeding and Gemnetics, BAU, Mymensingh, Bangladesh.

Swai, E. S., Kyakaisho, P. and Ole-Kawanara, M. S. 2007. Studies on the reproductive performance of cross-bred dairy cows raised on smallholder farms in eastern Usambara Mountains, Tanzania. Livestock Research for Rural Development. 19(5): 21-27.

Tafti, A. K. and Darahshiri, M. R. (2000). Studies on the uterine abnormalities of slaughtered non-pregnant adult cows. *Indian Veterinary Journal*. 77: 1059-1062.

Tahawy, A. G. and Fahmy, M. M. 2011. Partial budgeting assessment of the treatment of pyometra, follicular cysts and ovarian inactivity causing postpartum anoestrus in dairy cattle. *Research and Veterinary Science.* 90(1): 44-50.

Talebkhan Garoussi, M., Sasani, F. and Hovareshti, P. 2010. The histopathological survey of uterine tissue in Holstein dairy cows with or without recorded reproductive disorders. *Iranian Journal of Veterinary Science and Technology.* 2(2): 101-108.

Talib, G. M. A. and Faraidoon, A. M. A. 2014. Clinical and histological study of the effects of uterine infections on the pregnancy of dairy cows in Sulaimani Region. *Internationl Journal of Advanced Biological Research.* 4(1): 63-68.

Talukder, M. A. S., Khandoker, M. A. M. Y., Rahman, M. G. M., Islam, M. R., Khan, M. A. A. 2005. Reproductive problems of cow at Bangladesh Agricultural University Dairy Farm and possible remedies. *Pakistan Journal of Biological Science*. 8: 1561-1567.

Talukder, M. S. U., Hoque, M. N., Hossain, M. I., Aziz, S. A. and Rahman, M. R. 2001. Effect of different genotypes of milk yield and reproductive performance of cows. *Pakistan Journal of Biological Science.* 4: 1421-1424.

Taneja, V. K. and Bhat, P. N. 1986. Milk and Beef production in tropical environments. Third World Congress on Genetics Applied to Livestock production. 9: 73-91.

Tekelye, B., Kasali, O. B. and Tsion, A. 1991. Reproductive problems in cross-bred cattle in central Ethiopia. *Animal Reproduction Science*. 26: 41-49.

Tesfaye, A., Alemayehu, L., Tefera, Y. and Endris, A. 2015. Factors affecting the reproductive performance of smallholder dairy cows in two regions of Ethiopia. *Livestock Research for Rural Development*. 27 (3).

Tesfu, K. 1996. Post-partum reproductive activity of Indigenous zebu and Friesian × Zebu cross-bred cows in the Ethiopian central Highlands. *Ethiopian Journal of Agriculture Science.* 12: 45-52.

Than, U. H. L. A., Aungmyatt, U., Daw, S. U. and Yehtun, U. W. I. N. 2001. Improvement of Cattle Production in Myanmar Through the Use of Progesterone RIA to Increase Efficiency and Quality of Artificial Insemination Services. In Radioimmunoassay and related techniques to improve artificial insemination programmes for cattle reared under tropical and sub-tropical conditions. Proceedings of a final Research Co-ordination Meeting organized by the joint FAO/AEA Division of Nuclear Techniques in Food and Agriculture and held in Uppsala, Sweden, 10- 14 may 1999.

The Merck Veterinary Manual. Mastitis in Cattle. http://www. merckvetmanual. com/mvm/reproductive system/mastitis in large animals/ mastitis in cattle.html (Cited on 23 Feb 2016), reviewed by Erskine, R. J. 2014.

Thiruvenkanden, A. K. 2005. Determination of best fitted regression model for estimation of body weight in Kanni Adu kids under farmers' management systems. *Livestock research for rural development*. 17(7): 76-87.

Thrusfiled, M. 1995. Abattoir as a source of data. Vet. Epidemiology, 2nd ed, Blackwell Science, Cambridge, 46-148.

Tibbo, K., Wiener, G. and Fielding, D. 1994. A review of the performance of Jersey breed of cattle and it's crosses in the tropics in relation to the Friesian or Holstein and indigenous breeds: *Animal Breeding Abstract*. 10: 719-726.

Tigre, W. 2004. Major clinical reproductive health problems of dairy cows in and around Holleta. DVM thesis. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Timurkaan, N. and Karadas, E. 2000. Morphological investigations on pathological changes of the female reproductive organs in goats. I. Ovarian and Oviduct. *F. U. Sag. Bil. Derg* . 14: 197-207.

Tolenkhomba, T. C., Konsam, D. S., Shyamsana Singh, N., Prava M., Damodor Singh, Ayub Ali, Y. M. and Motina, E. 2012. Factor analysis of body measurements of local cows of Manipur, India. *International Multidisciplinary Research Journal*. 2(2): 77-82.

Trail, J. C. M. and Gregory, M. E. 1981. Characterization of the Boran and the Shahiwal breeds of cattle for economic characters. *Journal of Animal Science*. 52: 1285-1295.

Treacher, R. J., Reid, I. M. and Roberts, C. J. 1986. Effect of Body Condition At Calving on The Health and Performance of Dairy Cows. *Animal Productions*. 43: 1-6.

Troxel, T. R., Cmarik, G. F., Ott, R. S., Lock, T. F. and Kesler, D. J. 1983. The effect of method of GnRH and short-term calf removal on ovarian function and reproductive performance in post-partum suckled beef cows administered $PGF_{2\alpha}$ for estrus synchronization. *Theriogenology*. 20: 417.

Tsegaye, M., Gebrekidan, B. and Afera, B. 2014. Survey on reproductive performance of smallholder dairy cows in Hawassa city, Ethiopia. *Journal of Reproduction and Infertility*. 5(3): 69-75.

Tucker, C. B., Weary, D. M., de Passillé, A. M., Campbell, B. and Rushen, J. 2006. Flooring in front of the feed bunk affects feeding behavior and use of free stalls by dairy cows. *Journal of Dairy Science.* 89: 2065-2071.

Uddin, M. N., Uddin M. B., Al Mamun. M., Hassan, M. M. and Khan, M. M. H. 2012. Small scale dairy farming for livelihoods of rural farmers: constraint and prospect in Bangladesh. *Journal of Animal Science and Advanced*. 2(6): 543-550.

Udo, H. 1994. Use of Rumunant Genetic Resources in the Tropics. Wageningen Agricultural University.

Urdaz, J. H., Overton, M.W., Moore, D. A. and Santos, J. E. P. 2006. Effects of adding shade and fans to a feed bunk sprinkler system for periparturient cows on health and performance. *Journal of Dairy Science*. 89: 2000-2006.

Vacek, M., Stadnik, L. and Stipkova, M. 2007. Relationships between the incidence of health disorders and the reproduction traits of Holstein cows in the Czech Republic. *Czech Journal of Animal Science.* 52 (8): 227–235.

Vale, W. G. 1997. Reproductive disorders in dairy cows and buffalo females reared in the tropics. Proceedings XII, Congress Brasileiro de Reproducao Animal. *Revista Brasileira de Reproducao Animal*. 2: 70-77.

Valergakis, G. E., Arsenos, G. and Banos, G. 2007. Comparison of artificial insemination and natural service cost effectiveness in dairy cattle. *Animal Consortium*. 1(2): 293-300. 10.1017/S1751731107340044.

Verma, R. P. and Mishra, R. R. 1984. Incidence of certain reproductive disorders in different breeds of cattle. *Indian Veterinary Journal.* 61:169-170.

Verma, R. P., Saxena, S. K. and Mishra, R. R. 1986. Seasonal variation in certain reproductive disorders of dairy cattle. *Indian Journal of Animal Health.* 1: 79-80.

Wagner, W. C. and Li, P. S. 1982. Influence of adrenal corticosteroids on pituitary and ovarian function. In: Factors influencing fertility in the post-partum cow. Kang. H. and Schallenberger, H. (eds). The Hague Martinus Nijhoff.

Walker, J. and Perry, G. 2007. Cow condition and reproductive performance. Proceedings, The Range Beef Cow Symposium XX. December 11-13. Fort Collins, Colorado, USA.

Weller, R. F. and Bowling, P. J. 2000. Health status of dairy herds in organic farming. *Veterinary Records*. 146: 80-81.

Werven, T., Schukken, Y. H., Lioyd, J., Brand, A., Heeriga, H. T., Shea, M. and Vanwerven, T. 1992. The affects of duration of retained placenta on reproduction milk production, post-partum disease and culling rate. *Theriogenology*. 37: 1191-1203.

Whisnant, C. S., Kiser, T. E., Thompson, F. N. and Barb, C. N. 1986. Influence of calf removal on the serum luteinizing hormone response to naloxone in the post-partum beef cow. *Journal of Animal Science*. 62: 1340.

Whitaker, D. A., Macrae, A. I. and Burrough, E. 2004. Disposal and disease rates in British dairy herds between April 1998 and March 2002. *Veterinary Records*. British Veterinary Association, London, UK. 155(2): 43-47.

Whitemore, H. L. W., Tyler, J. and Casida, L. E. 1974. Effect of early post-partum breeding in dairy cattle. *Journal of Animal Science*. 38: 339-345.

WHO, 2006. Brucellosis in humans and animals. WHO Press, 20 Avenue Appia, 1211 Geneva 27, Switzerland.

Wiersma, F. and Armstrong, D. V. 1988. Evaporative cooling dry cows for improved performance. ASAE paper no. 88-4053, St. Joseph, MI.

Wildman, E. E., Jones, G. M., Wanger, P. E. and Lesch, T. N. 1982. A dairy cow body condition scoring system and its relationship to selected production characteristics. *Journal of Dairy Science*. 65: 495-501.

Williamson, N. B. 1986. Economics of Reproductive herd health Programme for Dairy Herds. In: Current Therapy it Theriogenology (Diagnosis, treatment and prevention of reproductive Diseases in smal and large animals). Edited by David A. Morrow. W.B Saunders Company. Philadelphia. 412-413.

Wilson, C. D. and Richards, M. S. 1980. A survey of mastitis the British dairy herds. *Veterinary Records.* 106: 431-435.

Wilson, T. D., Mclean, D. M., Salter, C. F. and Bartsch, B. D. 1994. Reproductive performance in South Australian dairy herds. *Australian Veterinary Journal.* 71: 75-77.

Wiltbank, J. N. 1982. Nutrition and reproduction in the beef female. in:proc. *Symposium on Management of Food Producing Animals*. Pp. 770-787.

Wright, I. A., Rhind, S. M., Smith, A. J. and Whyte, T. K. 1992. Effects of body condition at calving and feeding level after calving on LH profiles and the duration of post-partum anestrus period of beef cows. *Journal of Animal Reproduction.* 55: 41-46.

Xhag-Yuan Yue, Jin-Meitte, Zhang, Y. Y. and Jin, M. H. 1994. Influence of age of cows at first calving on the survival of newborn calves. *China Dairy Cattle*. 2: 29-30.

Xu, Z. and Burton, L. 2003. Reproductive performance of dairy cows in New Zealand. Final report of the monitoring fertility group, Research and development group, Livestock improvement corporation, Hamilton, New Zealand.

Yaudan, P. G. and King, J. O. L. 1997. The effect of body weight changes on fertility during the post-partum period in dairy cows. *British Veterinary Journal.* 133: 635-641.

Youngquist, R. S. 1985. Anoestrus and infertility in cows. In: Fertility and infertility in Veterinary practice. 4th edn. Edited by Laing, L. A., Morgan, W.J.B, Wagner, W.C., Bailliere and Tindall, London, PP. 100-105.

Zadeh, N. G. H. 2013. Effects of main reproductive and health problems on the performance of dairy cows: a review. *Spanish Journal of Agricultural Research.* 11(3): 718-735.

Zafrakas, A. M. 1969. Diseases of the genital tract in cattle. *Hellen Klen Thessaloniki*. 12: 74-80.

Zemjanis, R. 1980. Repeat-breeding or conception failure in cattle. In: *Current Therapy in Theriogenology.* Morrow DA (Ed.), Saunders, New York, pp. 205–213.

Zewdu, W., Thombre, B. M. and Bainwad, D. V. 2015. Studies on some non-genetic factors affecting reproductive oerformance of Holsten Friesian × Deoni crossbreeding cows. *African Journal of Agricultural Research*. 10(12): 1508-1516.

Zhang, W. C., Nakao, T., Kida, K., Moriyoshi, M. and Nakada, K. 2002. Effect of nutrition during pregnancy on calf birth weights and viability and fetal membrane expulsion in dairy cattle. *Journal of Reproduction and Development*. 48: 415-422.

Zu, F. and Zun, F. X. 1997. Conception rate of cows and analysis of its correlation. *China Dairy Cattle.*4: 30-31.

APPENDIX-1

Questionnaire

Title of research: Clinical trends of reproductive disorders of cows in Rajshahi district of Bangladesh

Department of Animal Husbandry and Veterinary Science
University of Rajshahi, Rajshahi

Name of Upazila/Metro thanas:……… .. Date of Visit/Examination: ……......... Month and Year: ………….. Owners name and address: ……………… Cow ID:……………. Phone No:…….................……….

Demographic information:

1. Sex of the owner (who involve in take care of the animal): Male / Female
2. Occupation of the farmer: Agriculture/Business/House wife/Job/Others
3. Age of the owner:…………..............…Yrs
4. Religion of the owner: Muslim /Hindu /Christian /Others
5. How many years of schooling did you complete: Higher Secondary/Secondary/Primary/Illiterate
6. How many year did you involve in cow rearing:……………….
7. What are the objective of cow rearing:
   I. To sell milk, meat
   II. To consume milk
   III. Consume as well as sell
   IV. To sell calf.
   V. Others:

Information about the farm:

1. Type of farm: Intensive/Semi-intensive/Grazing on pasture land
2. Geographical location of the farm: Urban/Semi-urban/Rural
3. No of cows present in the farm:
4. Housing condition: Separate/Dwelling house/Closely dwelling adjacent with house

5. Space in the shed:………………..sq.ft/cow
6. Wall of the shed: Muddy/Concrete /Semi-concrete /Tins /Others
7. Floor of the shed: Muddy /Concrete /Semi-concrete /Others
8. Ventilation system: Poor / Medium / Good

<u>Management of farm:</u>

1. Sources of drinking water: Pond/Tube-well/River/Others
2. Feed quality: Poor/Medium/Good
3. Fodder cultivation: Yes/No
4. Did you de-worm the cow within last 2 month? Yes/No/Don’t know
5. Did you give vaccination to the cow within last 1 yr? Yes/No/Don’t know
6. If your cow become sick from which you seek medical help?: Veterinarian/ Quack /Traditional healer

Questionnaire used for interviewing the dairy cattle owners for each cow:

1. Genotype: L×HF, L× SL, L
2. Age of cow (1-4): <3 yrs/3-5yrs/>5-9yrs/>9yrs
3. Parity: P0/P1/P2/P3/P4/P5 & above
4. Body weights: <200kg/200-300kg/>300kg
5. Body condition(i-iii): i /ii / iii
6. Age of puberty (month):
7. Age of first caving (month):
8. Caving intervals (days):
9. Days open (days):
10. Post partum heat period (days):
11. Service per conception (S/R):
12. Mating: Natural/Artificial insemination

Body condition score (i-iii): i= Poor, ii= Medium, iii= Good, Days open (days): Parturition to date of conception. Post PHP: First heat show after parturition. L=Local, HF=Holstein Friesian, SL=Sahiwal.

Questionnaire used for interviewing the dairy cattle owners about reproductive disorder and diseases:

1. Did you find any reproductive problem to your cow: Yes/No/Don’t know
   (if answer is no then stop the interview)
2. Did you find Anaestrus? Yes/No/Don’t know
3. Did you found Repeat breeder? Yes/No/Don’t know
4. Did you find Metritis? Yes/No/Don’t know
5. Did you find Endometritis? Yes/No/Don’t know
6. Did you find Dystocia? Yes/No/Don’t know
7. Did you find Still birth? Yes/No/Don’t know
8. Did you find Abortion? Yes/No/Don’t know
9. Did you find Mummification of fetus? Yes/No/Don’t know
10. Did you find Retained placenta? Yes/No/Don’t know
11. Did you find Vaginitis? Yes/No/Don’t know
12. Did you find Vulvitis? Yes/No/Don’t know
13. Did you find Milk fever? Yes/No/Don’t know
14. Did you find Prolapsed of vagina? Yes/No/Don’t know
15. Did you find Prolapsed of Uterus? Yes/No/Don’t know
16. Did you find Macerated fetus? Yes/No/Don’t know
17. Did you find ovarian cysts? Yes/No/Don’t know
18. What types of common diseases generally out break: Mention the name of diseases……………………………......................................…………
19. Prevalence Training on livestock management: DLS/YTC/NG
    Problem face by farmer…………………..….…………………………..
    Remarks:………………………...............…..…………………………..
    Signature of the researcher:…………………………………………….

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APPENDIX-I

Questionnaire