COMPARISON OF PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF INDIGENOUS AND CROSSBRED BUFFALOES AT BAGERHAT BUFFALO BREEDING AND DEVELOPMENT FARM

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CERTIFICATE

This is to certify that the thesis entitled ***"COMPARISON OF PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF INDIGENOUS AND CROSSBRED BUFFALOES AT BAGERHAT BUFFALO BREEDING AND DEVELOPMENT FARM"*** *submitted to the Department of Animal Nutrition, Genetics and Breeding, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE (MS) in ANIMAL BREEDING AND GENETICS,*** *embodies the results of a piece of bona fide research work carried out by* ***MD. LOKMAN HOSSAIN,*** *Registration No.* ***19-10133*** *under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma in any other institution.*

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

Dated:

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DEDICATED TO
Professor Dr. Lam
Yea Asad and My
Beloved Parents

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The Author

COMPARISON OF PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF INDIGENOUS AND CROSSBRED BUFFALOES AT BAGERHAT BUFFALO BREEDING AND DEVELOPMENT FARM

ABSTRACT

The present study was carried out at Fakhirhat Upazila in Bagerhat district known as Buffalo Breeding and Development Farm with the aid of the Department of Animal Nutrition, Genetics and Breeding, Sher-e-Bangla Agricultural University, Dhaka during the period from July 2020 to December 2020. In this study, Indigenous, Murrah x Indigenous, Nili-Ravi x Indigenous buffalo breeds were used. Total 300 data were collected from different parameters growth performance traits (Birth weight, weight at 6 months, adult body weight) kg for both sexes; productive performance (daily milk yield-liter, lactation milk yield-liter, lactation length-days) and reproductive performance (age at sexual maturity, age at first calving, calving interval) months, service per conception for female buffaloes. The mean birth weight for females was found higher in Nili-Ravi x Indigenous (25.02±0.31) followed by Murrah x Indigenous (23.92±0.36) and Indigenous (23.27±0.37) breed groups respectively with significant ($P<0.05$) difference. The mean weight for males at 6 months of age was found significantly ($P<0.05$) higher in Murrah x Indigenous (92.66 ±0.53) followed by Nili-Ravi x Indigenous (90.46±0.65) and Indigenous (83.22±0.65) breed groups respectively. The mean weight for females, at 6 months of age was found significantly ($P<0.05$) higher in Murrah x Indigenous (86.36±0.65) followed by Nili-Ravi x Indigenous (81.46±0.70) and Indigenous (74.56±0.69) breed groups respectively. The mean adult body weight for males was found significantly ($P<0.05$) higher in Murrah x Indigenous (560.52 ±1.06) followed by Nili-Ravi x Indigenous (503.86±1.11) and Indigenous (455.16±1.13) breed groups respectively. The mean adult body weight for females also significantly ($P<0.05$) higher in Murrah x Indigenous (451.8±1.04) followed by Nili-Ravi x Indigenous (409.22±1.08) and Indigenous (355.92±0.95) breed groups respectively. The mean of daily milk yield (liter) was higher in Murrah x Indigenous (2.66±0.06) followed by Nili-Ravi x Indigenous (2.51±0.04) and Indigenous (2.39±0.04) respectively with significant ($P<0.05$) difference. Murrah x Indigenous (784.44±28.33) and Nili-Ravi x Indigenous (878.2±17.25) were significantly ($P<0.05$) different (784.4±28.33) for indigenous buffalos. The lactation lengths (days) in Nili-Ravi x Indigenous (351.06±7.31) was significantly ($P<0.05$) different from Indigenous (326.62±9.71). The mean age at sexual maturity (months) Murrah x Indigenous (35.23±0.22) and Nili-Ravi x Indigenous (35.51±0.24) were significantly ($P<0.05$) different but they were significantly different in Indigenous buffaloes (34.532±0.13). The overall means of the production parameters estimated in this study indicates that Murrah x Indigenous and Nili-Ravi x Indigenous crossbred buffaloes perform well in comparison to Indigenous buffaloes, but the reproductive performance was not significantly different.

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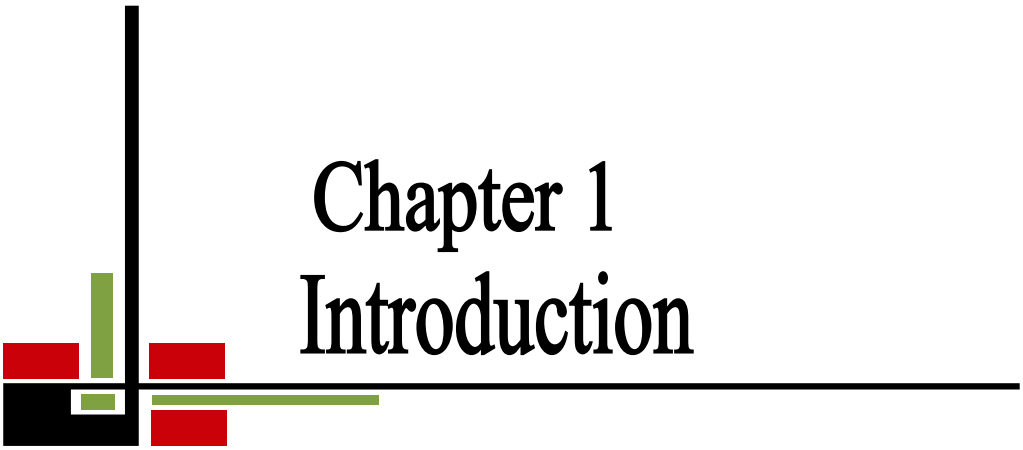
LIST OF ABBREVIATIONS AND SYMBOLS

>	=	Greater than
<	=	Less than
±	=	Plus-minus
^{o}C	=	Degree Celsius
%	=	Percentage
AI	=	Artificial insemination
BAU	=	Bangladesh Agricultural University
BBS	=	Bangladesh Bureau of Statistics
B.C.	=	Before Christ
BCSRI	=	Bangladesh Council of Scientific and Industrial Research.
BW	=	Birth weight
Ca	=	Calcium
cm	=	Centimeter
DLS	=	Department of Livestock Services
et al.,	=	And others
e.g.	=	exempli gratia (L), for example
etc.	=	Etcetera
FAO	=	Food and Agricultural Organization
g	=	Gram (s)
Kg	=	Kilogram (s)
L	=	Liter
MOET	=	Multiple Ovulation Embryo Transfer
MS	=	Mean Square
NaOH	=	Sodium hydroxide
NBF	=	Nucleus Breeding Flock
No.	=	Number
NS	=	Non-significant
SAU	=	Sher-e-Bangla Agricultural University
SAS	=	Statistical Analysis System
SEM	=	Standard Error Mean
var.	=	Variety
USA	=	United States of America
Viz.	=	Namely
WHO	=	World Health Organization



Chapter 1
Introduction

CHAPTER 1

INTRODUCTION

The domestication of buffaloes has been recorded in ancient writings and sculptures and it has been reported that buffaloes were in the service of man as early as 2500 to 2100 B.C. **(**Zhang *et al.*, 2020). Buffaloes are larger in size compared to cattle. It is a triple-purpose animal, used for milk, meat, and draught (Ranjana, 2015). Farmers prefer to use buffaloes for farm work because of their great draught power, long working life, and docile temperament. Most of them are kept by small-scale farmers for draught purposes. Domestic buffaloes play an important role in the animal agriculture of the South Asian region. Around ninety-three percent of the world's river buffalo population is found in Asia (Hamid *et al*., 2016) and buffaloes are almost exclusively raised by smallholders and landless farmers. Two types of domestic buffalo (*Bubalus bubalis*) are known as the riverine and the swamp types. The important breeds of the riverine type are Murrah and Nili-Ravi representing India and Pakistan. This type is classified as a milking type and is characterized by a forehead, swirled horns, and black skin. The swamp type which has grey skin, a flat forehead, and widely curved horns is found in Southeast Asian countries from China to Indonesia. This is kept for Draught and meat purposes (Cockrill, 1974). The Crossing of swamp and river buffaloes usually occurs only when the animals are reared together from birth or where such breeding is deliberately promoted, e.g., by artificial insemination. The resulting offspring are intermediate between the swamp and river breeds in body size, conformation, horn shape, and milk yield (Yore *et al.*, 2018).

In spite of such importance very little emphasis has been placed on efforts to increase the farm-level output from buffaloes through a program of better feeding and management combined with breeding and selection. In Bangladesh, the buffalo breeding program would definitely be a logical development strategy to make such an "Indigenous genetic resource" more productive and more efficient by breeding (Habib *et al*., 2017). Today buffalo development program is directed mainly to increase its population, productivity, and breeding quality in order to improve farmers' income, power supply, milk, and meat production. To achieve these objectives, the policy is focused on the development of appropriate technology (Sarkar *et al*.,2013). According to the Department of Livestock Services (DLS) (2021), the total buffalo population is 1.457 million heads**.** However, the FAO estimate (2020) indicates

that the country now possesses 1.493 million. Buffaloes in Bangladesh may be classified into 3 categories: (i) Riverine types found in the sugarcane belt of the country and mainly migrated from India, (ii) Swamp types found in the coastal areas and marshy land of the country and mainly indigenous in nature though a small number might have migrated from Burma, (iii) Crossbred type (swamp x river type) found in the coastal area of the country (Amin *et al*., 1987; Faruque *et al*., 1985, 1990; Faruque, 1994; Faruque and Amin, 1994, 1995). The significant difference in these types of buffaloes is the chromosome number, the riverine type has 50, and the swamp type 48 chromosome (Ulbrich and Fischer, 1968; Chunachi and Luesakul, 1985).

Buffalo's production system is closely integrated with the farming system in Asia. These systems are common in highly populated areas associated with intensive land use. They include irrigated/rainfed wetland used for double cropping with rice or with wheat followed by rice or leguminous pulse crops. Similar systems are also widely practiced in dryland since draught animal provides power in cultivation. The buffaloes are fed crop residues or weeds. They may be herded on marginal fallow land not occupied by the agricultural crop. The shortfall in feed resources may occur during the crop (rice, wheat) growing season followed by a dry season (Siddiky *et al.,* 2017). The indigenous buffaloes are medium in size having live weight from 350 to 550 kg with a birth weight of 20 kg. The buffalo cows yield 600 to 1000 litter milk in 275 days lactation period and have 10.5% fat and 21% total solid in milk (Sachan *et al*., 2015). They are seasonal breeders calving in the winter and early spring. They can utilize very low-quality roughages and have a high degree of resistance against common diseases though evidence of high calf mortality has been reported (Hussain and Chowdhury, 1989; Faruque *et al*., 1985, 1990; Faruque, 1994; Faruque and Amin, 1994, 1995). In fact, buffaloes have a better capacity for converting coarse feedstuffs into quality milk and meat. Though they can utilize roughage in the same ability as the cattle, their ability to process and communicate forages appears to be associated with the relief of protein deficiencies rather than extracting energy (Kennedy, 1988). Buffaloes have a number of advantages over cattle in the utilization of low-quality roughages to produce more protein and to gain more body weight, more disease resistance power and outstanding draught capacity, and longer life span (Siddiky *et al.,* 2017). These advantages with buffaloes are also noticed in the indigenous buffaloes. They are around 2 to 3 times heavier than indigenous cattle. Indigenous buffalo cows produce 2 times more milk than cows, with more milk fat and total solids. It seems now widely accepted that buffaloes under harsh condition are capable of digesting fiber and

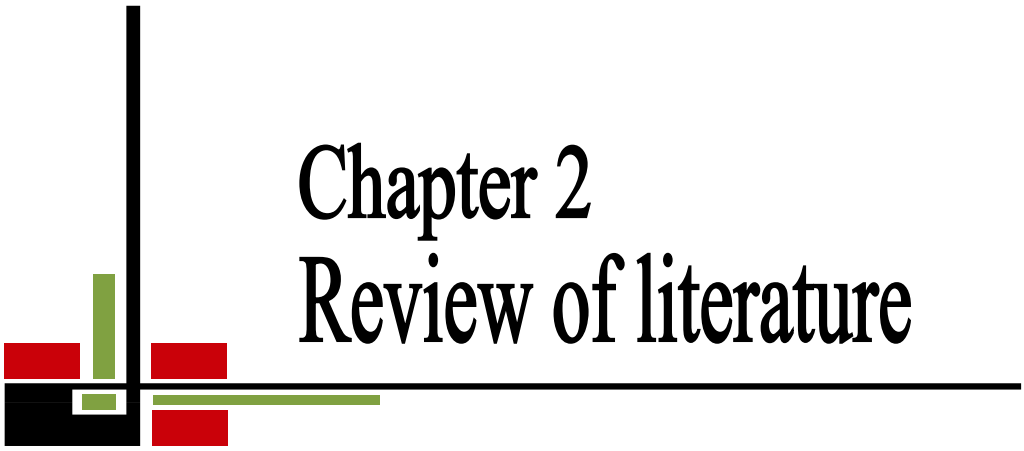
cellulose better than cattle. They are more versatile and hence popular among rural farmers since they are able to continue to work in hot, muddy filed much longer than oxen. Buffalo milk covers around 13% of the total market milk of the world (Sarkar *et al*., 2013).

The productivity of indigenous buffaloes in terms of milk production is low. Their reproductive efficiency is very low and 2 calves in 3 years are common (Faruque et al., 1990; Faruque, 1994; Faruque and Amin, 1994, 1995). This means indigenous buffaloes cannot produce a high quantity of milk. Characterization and evaluation of indigenous buffalo in some places have been done by (Amano *et al*., 1987; Faruque and Amin,1994;1995; Hasnath,1985; and Hussen 1990). The Characterization and evaluation of exotic improved buffaloes (Nili-Ravi and Murrah) and their crossbred progenies farms which generally produce more milk, may contribute better to fulfilling the demand. There is a scope to study their phenotypes, productivity and reproductive potentialities, and genetic merits before considering them as dairy animals in Bangladesh. The facts, narrated so far, demand that attempts should be made immediately to characterize and document the indigenous buffaloes of Bangladesh. It may be mentioned here that characterization and documentation of indigenous animals of any species is the first step for improving the animals through a scientific breeding program. Production of buffalo in farm conditions of Bangladesh is not much common, though some buffaloes; indigenous, exotics, and their crosses are being maintained in small numbers at Buffalo Breeding and Development Farm at Bagerhat and a few regional farms.

Keeping in mind the state of affairs as to buffalo husbandry an attempt was made to conduct this research with the following objectives:

1) To compare the productive performance of Indigenous and crossbreed buffaloes.

2) To compare the reproductive performance of Indigenous and crossbreed buffaloes.



Chapter 2
Review of literature

CHAPTER 2

REVIEW OF LITERATURE

Many researchers and scientists in different countries and region of the world have been carried out substantial research works related to the productive and reproductive performance of buffalo. This type of work also has been done in different areas of our country but its few. For this reason, I have selected this topic for my study. This chapter includes selective review of research work which is done by previous researcher and scientist related to the study.

2.1 Buffalo Domestication and Population

Buffalo, also known as 'Asian Animal,' plays a vital role in farmers' economic life, being an integral part of the farming system. It is economically important in this region and could be used as a 'small tractor' for farmers, and its milk and meat are rich in nutrients. It seems that the domestication of buffaloes was recorded in ancient writings and sculptures, and it has been suggested that buffaloes were in service of man as early as 2500 to 2100 B.C. ago. According to the latest estimate, the total world population of buffaloes is more than 177.247 million (FAO, 2012), of which about 144 million are found in Asia.

2.2 Growth Performance

Azmi *et al*. (2021) conducted a study to compare indigenous swamp type and Murrah crossbred in Malaysia. They found birth weight (kg) and age at six months (kg) of both Indigenous swamp type and Murrah crossbred were 34.7±0.50, 132.6±3.50 and 36.6± 0.40, 160.5±2.70 respectively. Pramod S. *et al.* (2018) analyzed the growth performance of Murrah buffalo (n=120) in different age stages. They found birth weight and weight at three months(kg) are 34.76±0.54 and 86.94±1.65 respectively. Rahman *et al.* (2016) also analyzed average birth weight (kg) of (105) buffaloes was 23.77±5.20. Charlini and Sinniah (2015) carried out a performance analysis of Murrah and Nili-Ravi buffaloes and their crosses. There they found birth weight (kg) of Murah was 27.7±2.94 and Nili-Ravi buffalo was 44.3±3.89. Paul *et al.* (2015) studied the performance of indigenous buffaloes of the Pirojpur and Barguna area in Bangladesh and found birth weight (kg) was 24.21±4.00 and 24.12±3.60. Chingamai *et al.* (1998) reported that the birth weight of buffalo at Lamphyaklang of Thailand was 31.20±6.17 kg and at Surin was 29.85±5.09 kg. Jogi and Lakhni (1996)

mentioned that the average birth weight for Murrah male and female calves was 26.0 to 34.4 kg and 26.2 to 34.0 kg respectively. Faruque and Amin (1995) mentioned that the birth weight of indigenous buffaloes in the coastal area ranged from 18 kg to 26 kg. Khan (1995) analyzed data on growth potentialities of buffaloes and found that the average birth weight of Nili-Ravi and Cross (Nili-Ravi X Indigenous) were 32.76±0.80 kg, 28.50±0.79 kg respectively. Abeygunwardena *et al.* (1995) mentioned that the average birth weight of Surti, Murrah, Nili-Ravi and Lankan buffaloes was 27.1 kg, 27.6 kg, 30.1 kg, and 17.9 kg respectively. Momongon *et al.*(1994) described that the average birth weight of crossbred of Murrah and Nili-Ravi with the Philippines Carabao was about 35±1 kg. Faruque *et al.* (1990) reported that the birth weight of indigenous buffaloed of Bangladesh was 20 kg. Bhat and Sing (1988) observed that the birth weight varied from 27kg to 41kg in large breeds. Xuong (1981) reported that the average live weight at birth of Murrah buffalo in Vietnam was 27.7±3.4 kg for females and 29.7±4.09 kg for males.

2.3 Productive Performance

Hamid *et al*. (2016) mentioned that the total lactation milk yield, Age of first calving and calving interval of Murrah buffalo was 2478±54.36 kg, 44.48±1.42 months, and 16.3±.30 months respectively. Rahman *et al.* (2016) analyzed production data of 161 buffaloes. He found lactation length (days) and milk yield (liter) were 242.60±41.46 and 2.35 ±0.703. Paul *et al.* (2015) studied the performance of indigenous buffaloes of the Pirojpur and Barguna area in Bangladesh and found Lactation length (days) were 286.12±11.27 and 290.44±10.92, milk yield (liter) was 3.43±0.744 and 3.33±0.68. Charlini and Sinniah (2015) carried out a performance analysis of Murrah and Nili-Ravi buffaloes and their crosses. There they found lactation length (days) and total milk yield (kg) of Murrah buffalo were 298±70.1 and 1249±542 and for Nili-Ravi were 238±78.8 and 1187±543 respectively. Thiruvenkadan *et al*. (2014) conducted a study of Murrah buffalo in different time period. Where analyze data (n=119) in between 2003 to 2006 and found Lactation length (days), Lactation milk yield (kg) and Milk yield per day of lactation (kg) were 292.5±5.6, 1983.2±47.4 and 6.66±0.11 respectively. Sahana and Sadana (1998) studied the performance of first lactation production traits of 424 Murrah buffaloes in India and stated that 305-days milk yield, lactation yield, lactation length, milk yield per lactation and milk yield per calving interval averaged 1785.19±22.41 kg, 1967.70±27.91 kg, 302.68±3.08 days, 6.25±0.06 kg and 4.39±0.06 kg respectively. Khan and Akhter (1999) analyzed production data of 47 Nili-Ravi buffaloes and found that average lactation milk yield, lactation length, and calving interval were

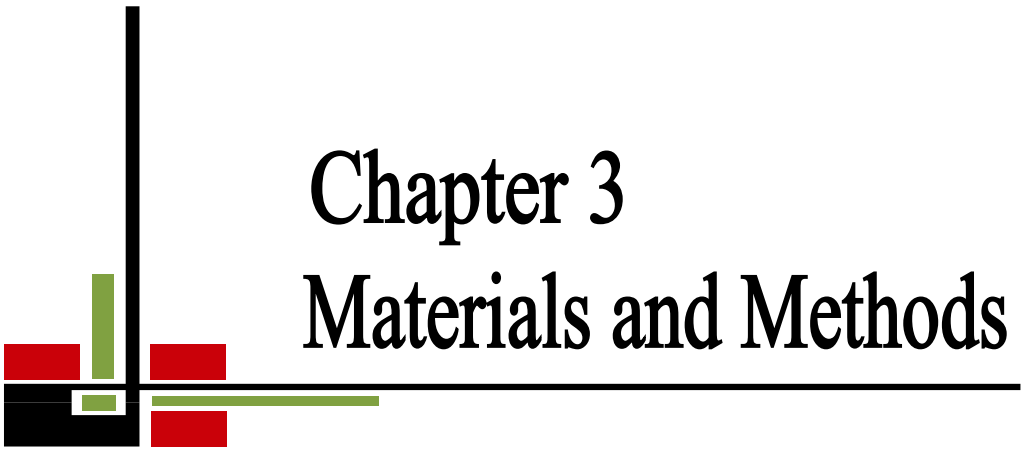
2020.04±44.59 liters, 277.42±5.70 days and 467.10±11.58 days respectively. The ranges of these parameters respectively were 609-3591 liters, 122-614 liters and 228-982 days. They also described that year of calving and lactation length had a significant effect on total milk yield ($p<0.01$), whereas other factors such as the month of calving, lactation number and calving interval had no effect on total lactation milk yield. Rossi (1998) observed that the lactation yield of Khozestani and Azeri buffalo in Iran were 1865 kg and in 210 days lactation period. Patel and Tripathi (1998) observed that average lactation yield, 305 days lactation yield and lactation length of Surti buffaloes were 1552.2±27.1 kg, 1474±23.4 kg and 226.7±10.4 days respectively. They also described that buffaloes in different parties differed significantly with respect to 305-day lactation yield. It was also reported that Surti buffaloes continuously improved their production performance up to 5^{th} lactation. Thu (1997) reported that average daily milk yield of swamp buffaloes from the first to the fifth month of lactation in the Mekong delta was 1050 kg. Thevamanoharan (1997) mentioned that milk yield in lactation 1 to 4 respectively was 1501 kg, 1533 kg, 1444 kg and 1346 kg for pure Murrah and 1359 kg, 1342 kg, 1271 kg and 1258 kg for Grade Murrah buffaloes. Tailor and Banarjee (1996) in their experiment for first lactation of Surti buffaloes in India showed that the average initial milk yield in the first month was 146.20±1.69 kg. The peak yield was attained in the second month averaging 152.8±1.69 kg and thereafter it declined to a minimum of 82.66±1.30 kg in the seventh month. Rao and Sreemannaryana (1994) analyzed the data recorded on 149 Murrah buffaloes in India. They found the average first lactation milk yield and duration of lactation period were 1861.5 kg and 329.4 days respectively. Kolte and Sodeka (1996) observed that the average milk yield and lactation length of Nagpuri buffaloes were 1243 liters and 270.5 days respectively. Khan (1994) reported that the Nili-Ravi and Kundi buffaloes in Pakistan possessed good potential of milk and meat. They also stated that the top 5% of buffaloes yielded above 400 kg milk per lactation. Faruque (1994) reported that the average lactation yield of buffalo cows in the Mymensingh district was 712 liter in a 274-day lactation period. Faruque and Amin (1994) mentioned that the average lactation yield of indigenous cows in coastal area was only 280 liters in 270 days lactation period. Shabade *et al.* (1993) conducted an experiment on the dairy performance of 114 Murrah buffaloes from 1952 to 1991 and found that the average lactation yield was 1832.2 kg per lactation of 357.9 days with per day yield of 3.5 kg. Neog *et al.* (1993) conducted an experiment for the per lactation of Murrah buffaloes with least square means of 1067±60.1 kg for total milk yield, 274.6±12.6 days for duration of lactation, 6.34±0.16 kg per day for peak yield. Subramanian and Shanmugasundaram (1990) reported that the average lactation length and milk yield for

an unspecified number of buffaloes on 2 farms were 311.2, 337.5 days and 1533, 1824 kg respectively. Khan, *et al.* (1990) analyzed data of 929 Nili-Ravi buffaloes in Pakistan and found that the first lactation milk yield averaged 1904.2±61 kg. Hussain (1990) reported that the average lactation period of buffaloes in the Tangail district as 328.98±28.57 days with a lactation yield of 730±153.65 liters. He found that the daily average milk yield of those buffaloes was 2.3±0.63 liters. Ranjan *et al.* (1989) found that the milk production of swamp buffalo was about 600-900 liters per lactation. The milk yield of Murrah and Nili-Ravi in China was 1975±753 kg in 272 days and 2076±843 kg in 275 days respectively. They also observed that the Murrah cross with Swamp Chinese breed produced 1153±397 kg in 270 days with 75% exotic blood 50% Nili-Ravi and 25% Murrah, while the cross buffalo produced 2662 kg in 311 days. Ranawana (1989) stated that the average milk yield of Srilankan buffaloes under farm conditions was 381 liters over a lactation of 250 days. Mudgal (1989) found that Murrah yielded on average 1975 liters in a lactation period of 338 days in India. He also reported that Nili-Ravi in Pakistan yielded up to 4500 liters per lactation or about 10 liters per day. Tripathi *et al.* (1988) showed that the average lactation length, actual lactation yield, 305-day milk yield and age at first calving of Murrah buffalo were 307.66±8.28 days; 1822.38±69.53 kg; 1741.53±52.03 kg and 1406.18±23.22 days respectively. Munir *et al.* (1988) observed that the mean lactation length of Nili-Ravi buffaloes was 297±10.85 days. He also found that the 305-day lactation yield averaged 1819.66±74.43 kg. Bhat and Sing (1988) observed that the average first lactation yield in Murrah buffaloes varied between 1521 kg and 1968 kg. In Nili-Ravi it was 1707 kg. The first lactation length in Murrah and Nili-Ravi was about 300 days.

2.4 Reproductive Performance

Rashid *et al.* (2019) conducted a study on production and reproduction records of total 1072 indigenous, Nili and Murrah buffalo cows in Bangladesh. He found Sexual maturity (months), First calving age (months), the number of services per conception, and Calving interval (months) of indigenous buffaloes were 34.4±2.02, 46.12±1.66, 1.64±0.78, and 19.36±2.39 respectively. Sexual maturity (months), First calving age (months), number of services per conception, and Calving interval (months) of Nili buffaloes were 34.12±1.65, 47.06±1.64, 1.88±0.70 and 19.41±1.66 respectively and sexual maturity (months), first calving age (months), number of services per conception, and calving interval (months) of Murrah buffaloes were 34.53±1.96, 46.56±1.46, 1.38±0.59 and 18.31±1.97 respectively. Rahman *et al.* (2016) analyzed reproduction data of 161 buffaloes and found that age of

puberty (months), first age at calving (months) and calving interval (days) were 45.03±6.97, 55.33±7.20 and 650.93±79.57 respectively. Paul *et al.* (2015) studied the performance of indigenous buffaloes of the Pirojpur and Barguna area in Bangladesh and found age at first calving (months) were 50.88±1.71 and 51.00±1.80 and calving interval (days) were 547.92±10.88 and 547.24±14.32 respectively.Charlini and Sinniah (2015) carried out a performance analysis of Murrah, Sutri, Nili-Ravi buffaloes and their crosses. There they found age at first calving (months), calving interval (days) of Murrah buffalo were 61.5±12.0 and 479±140, Nili-Ravi buffalo were 44.3±3.89, 412±91.6 respectively. Usmani and Atahar (1997) reported that post partum heat period, service per conception and conception rate for treated with recombinant bovine Somatotropin and control group of Nili-Ravi buffaloes were 96.4 days, 92.5 days, 1.70, 1.87 and 66.7%, 62.5% respectively. Barkawi *et al.* (1998) mentioned that the average number of services per conception for Egyptian buffaloes was 1.45. Thevamanoharan (1997) mentioned that the average Age at first calving of pure Murrah and Grade Murrah was 50.7 months and 48.7 months respectively. Kolte and Sodeka (1996) observed that the age at first calving and gestation period of Nagpuri buffaloes were 55 months and 309.7 days respectively. Shah (1995) found that calving interval of Nili-Ravi buffaloes ranged from 471 to 585 days. He also reported that milk yield of Nili-Ravi buffaloes was 1602 kg to 4353kg. Parvez *et al.* (1994) analyzed data recorded during 1934-86 on Nili-Ravi buffaloes in Pakistan. The post-partum estrus interval averaged 171.79±4.01 days, first service period 215.12±4.99 days and the first calving interval 520.27±2.58 days. The calving rate was 70.27±0.12. Gupta *et al.* (1994) found the reproductive efficiency of 716 Murrah buffaloes in India. They observed that average Age at first calving, first service, dry period, gestation length and inter calving periods were 1374.48±15.99 days, 45.8 months, 1999.12±9.76 days, 184.63±7.12 days, 310.79±0.64 days and 492.40±11.61 days respectively. They also found that sire effects were highly significant for age at first calving and gestation period only. Butchaian *et al.* (1975) reported that the average post-partum estrus of Murrah buffaloes in India was 87.3 days. El-Fouly *et al*. (1976) observed that fifty days post-partum estrus occur in 85.7% of suckled and 95.2% of milked buffaloes in Egypt. Basu *et al.* (1978) described the positive correlation between gestation period and birth weight suggestion that a shorter gestation period result in reduced birth weight of calves.



Chapter 3
Materials and Methods

CHAPTER 3

MATERIALS AND METHODS

3.1 Selection of the Farm

There is only one buffalo farm under the Government in Bangladesh. This farm is located at Fakhirhat Upazila in Bagerhat district and is known as Buffalo Breeding and Development Farm. This farm was set up by the Department of Livestock Services (DLS) under the Ministry of Livestock and Fisheries to produce outstanding buffalo bulls and cows for increasing the productivity of these animals in the country. Besides, there are some areas in Bangladesh where buffalo can be found scattered, mainly in the coastal region. So, Buffalo Breeding and Development Farm at Fakhirhat thana in Bagerhat district was selected for the present study.

3.2 Animals

The Buffalo Breeding farm was commissioned in 1985. The initial stock consisted of some 30 Murrah and Nili-Ravi buffalo cows and bulls transferred from Savar Dairy farm and Tejgaon Dairy Farm (now abolished). Hundred indigenous buffalo cows of river type were purchased for this farm between 1986 and 1987. In addition, 60 Nili-Ravi pregnant heifers and first lactating cows and 40 Nili-Ravi bulls were imported from Pakistan in 1990. The Buffalo population thus consists of Nili-Ravi, Murrah, and indigenous river type and their crosses. There are about 420 buffaloes of different ages and sex. All the animals maintained in the past and present were considered in the present study. Characteristics of three breed groups are given in Table 1.

Table 1. Characteristics of Indigenous, Murrah and Nili-Ravi buffaloes

Sl No	Traits	Breed		
		Indigenous	**Murrah**	**Nili-Ravi**
01	**Color**	Black	Jet-black	Black but white markings are found on the forehead, face, mouth and lower parts of the legs.
02	**Horn**	Long and curved	Short, tight, turning backward and upward and finally spirally curving inward.	Small and curly.
03	**Eye**	Walled	Not walled	walled
04	**Tail**	Long and black switch	Long reaching up to fetlock joint (2, 3, and 6) with black or white switch.	long and white switch.
05	**Forehead**	Small and long	Comparatively small	The forehead is heavy head convex at the center.

Plate 1: Indigenous buffalo.

Plate 2: Murrah buffalo.

Plate 3: Nili-Ravi buffalo.

3.3 Management of the Farm

The farm is being supervised and managed by a manager assisted by an Assistant Manager and Fodder Cultivation Officer. At the onset of the farm in 1985, there was scarcity of water supply and fodder production in the farm. The water supply and fodder production become normal in 1990. From the start, the dry cow and milch cow (after milking) are allowed to graze in the field until noon. After wallowing for about 1 hour, they are driven back to the barn, oilcake, and salt. The quantity of concentrate fed varies depending on sex and Age. The buffaloes are identified by an ear tag. Record of traits of buffalo is maintained in the farm record book. Birth weight, Milk production, and other information are recorded in separate record books.

3.4 Data used

Information on the records of different productive and reproductive traits was collected from Bagerhat Buffalo Breeding and Development Farm. Both productive and reproductive traits of buffalo were considered in this study.

The Growth traits were:

1. Birth weight(kg)
2. Weight at six months (kg)
3. Adult Body weight (kg)

The Productive traits were

1. Daily milk yield (liter)
2. Lactation milk yield (liter)
3. Lactation length (days)

Reproductive Traits were:

1. Age of sexual maturity (Months)
2. Age at first calving (Months)
3. Calving Interval (Months)
4. Service per Conception

3.4.1 Birth weight

Birth weight means the weight of newborn calves. The birth weight of calves was taken immediately after birth by weighing the calves by measuring scale and recorded in kilogram.

3.4.2. Weight at 6 months

Measurement of body weight at 6 months of Age for both sexes. It helps to observe the growth of the new offspring.

3.4.3. Adult Body weight

Body weight of a buffalo cow or bull in adult ages. It can be measured by measuring scale and recorded in kilogram.

3.4.4. Daily milk yield

The daily milk yield means the quantity of milk drawn separately in the morning and afternoon. Milk yield was measured in liters.

3.4.5. Lactation milk yield

The total quantity of milk from first milking to the end of milking in a lactation. It was counted in liters.

3.4.6. Lactation length

The number of days from the first milking to the end of the milking of a cow is called lactation length. It was counted in days.

3.4.7. Age of sexual maturity

The Age at which a heifer becomes sexually matured or shows estrus is the Age of sexual maturity. It was counted on months.

3.4.8. Calving Interval

The term "calving interval" refers to the period from one calving to the next calving. It was counted in months.

3.4.9. Service per Conception

The average number of services required per conception is called Service per Conception.

In the study birth weight records, 6 months and adult weight records, Age at sexual maturity, Milk yield and lactation length record, calving interval, and Al record were considered and analyzed. The number of animals in different groups, Indigenous, Nili-Ravi X Indigenous, and Murrah X Indigenous has been shown in;

Table 2. The number of animals for different groups of buffaloes

Sl. No.	Traits	Indigenous	Nili-Ravi x Indigenous	Murrah x Indigenous
01	Birth weight(kg) (male)	55	55	55
02	Birth weight(kg) (female)	55	55	55
03	Weight at 6 months (kg) (male)	50	50	50
04	Weight at 6 months (kg) (female)	50	50	50
05	Adult Body weight (kg) (male)	50	50	50
06	Adult Body weight (kg) (female)	50	50	50
07	Daily milk yield (liter)	45	45	45
08	Lactation milk yield (liter)	45	45	45
09	Lactation length (days)	45	45	45
10	Age of sexual maturity (Months)	50	50	50
11	Age at first calving (Months)	50	50	50
12	Calving Interval (Months)	50	50	50
13	Service per Conception	50	50	50

3.5 Genetic Group

- Indigenous
- Murrah X Indigenous
- Nili-Ravi X Indigenous

3.6 Design of Experiment

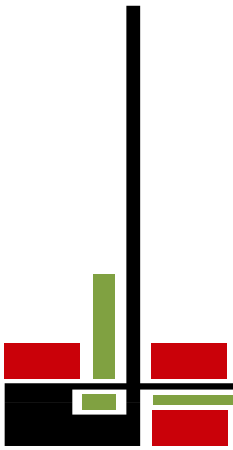
Available for growth, production and reproduction traits were employed in this study. The data covered three (3) different genetic groups with the number of animals on the farm and groups being inequal. Data were analyzed with the t-test in MS Excel.

3.7 Model:

$$t = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{(s^2(\frac{1}{n_1} + \frac{1}{n_2}))}}$$

In this formula, t is the **t-value**, x_1 and x_2 are the means of the two groups being compared, s_2 is the pooled standard error of the two groups, and n_1 and n_2 are the numbers of observations in each of the groups.

Plate 4: Data collection on different parameters of buffaloes.



Chapter 4
Results and Discussion

CHAPTER 4

RESULTS AND DISCUSSION

The present work Comparison of productive and reproductive performance of indigenous and crossbred buffaloes at Bagerhat buffalo breeding and development farm was conducted under the Department of Animal Nutrition, Genetics and Breeding, Sher-e-Bangla Agricultural University, Dhaka. The growth performance (birth weight, weight at six months and adult body weight), production performance (daily milk yield, lactation milk yield and lactation length) and reproductive performance (age at sexual maturity, age at first calving, calving interval and service per conception) of Indigenous, Murrah x Indigenous, Nili-Ravi x Indigenous were studied. The data were collected from Buffalo Breeding and Development Farm, Fakhirhat, Bagerhat. A total 300 number of buffalo data were analyzed and summarized in Tables 2 to 5.

4.1 Growth Performance:

4.1.1 Birth Weight (kg), weight at 6 months (kg), adult body weight (kg) of male buffaloes

Table 3. Growth Performance of Male Buffaloes

Sl. No.	Breed	Traits		
		Birth Weight (kg) (Mean±SEM) (n=55)	Weight at 6 Months (kg) (Mean±SEM) (n=50)	Adult Body Weight (kg) (Mean±SEM) (n=50)
1	Indigenous	25.87^{b} ±0.33	83.22^{c} ±0.65	455.16^{c} ±1.13
2	Murrah x Indigenous	29.81^{a} ±0.42	92.66^{a} ±0.53	560.52^{a} ±1.06
3	Nili-Ravi x Indigenous	29.74^{a} ±0.42	90.46^{b} ±0.65	503.86^{b} ±1.11

Mean values in the same column with different superscripts (a, b, c) differ significantly at $p<0.05$. SEM= Standard error mean. Figure in the parenthesis indicates the total number.

Among different parameters obtained from different breed groups weight at 6 months (kg), adult body weight (kg) was found significant (P<0.05) also for birth weight (kg) (Table 2 and Figure 1). The mean birth weight was found higher in Murrah x Indigenous 29.81±0.42 followed by Nili-Ravi x Indigenous 29.74±0.42 and Indigenous 25.87±0.33 breed groups respectively with significant (P<0.05) difference. The mean weight at 6 months age was found significantly (P<0.05) higher in Murrah x Indigenous 92.66±0.53 followed by Nili-Ravi x Indigenous 90.46±0.65 and Indigenous 83.22±0.65 breed groups respectively. The mean adult body weight was found significantly (P<0.05) higher in Murrah x Indigenous 560.52 ±1.06 followed by Nili-Ravi x Indigenous 503.86±1.11 and Indigenous 455.16 ±1.13 breed groups respectively.

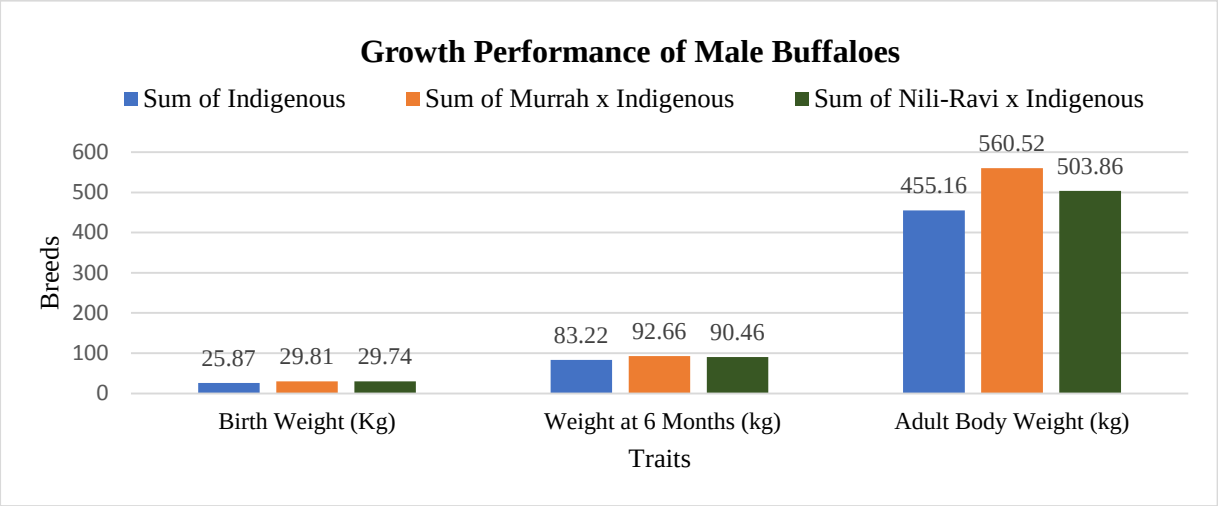


Figure 1. Growth performance traits of different breed groups (male).

4.1.2 Birth Weight (kg), weight at 6 months (kg), adult body weight (kg) (female)

Table 4. Growth Performance of Female Buffaloes

Sl. No.	Breed	Traits		
		Birth Weight (kg) (Mean±SEM) (n=55)	Weight at 6 Months (kg) (Mean±SEM) (n=50)	Adult Body Weight (kg) (Mean±SEM) (n=50)
1	Indigenous	23.27^{b} ±0.37	74.56^{c} ±0.69	355.92^{c} ±0.95
2	Murrah x Indigenous	23.92^{b} ±0.36	86.36^{a} ±0.65	451.8^{a} ±1.04
3	Nili-Ravi x Indigenous	25.02^{a} ±0.31	81.46^{b}±0.70	409.22^{b} ±1.08

Mean values in the same column with different superscripts (a, b, c) differ significantly at $p<0.05$. SEM= Standard error mean. Figure in the parenthesis indicates the total number.

Among different parameters obtained from different breed groups birth weight (kg), weight at 6 months (kg) and adult body weight (kg) was found significant ($P<0.05$) (Table 3 and Figure 2). The mean birth weight was found higher in Nili-Ravi x Indigenous (25.02±0.31) followed by Murrah x Indigenous (23.92±0.36) and Indigenous (23.27±0.37) breed groups respectively with significant ($P<0.05$) difference. The mean weight at 6 months age was found significantly ($P<0.05$) higher in Murrah x Indigenous (86.36±0.65) followed by Nili-Ravi x Indigenous (81.46±0.70) and Indigenous (74.56±0.69) breed groups respectively. The mean adult body weight was found significantly ($P<0.05$) higher in Murrah x Indigenous (451.8±1.04) followed by Nili-Ravi x Indigenous (409.22±1.08) and Indigenous (355.92±0.95) breed groups respectively.

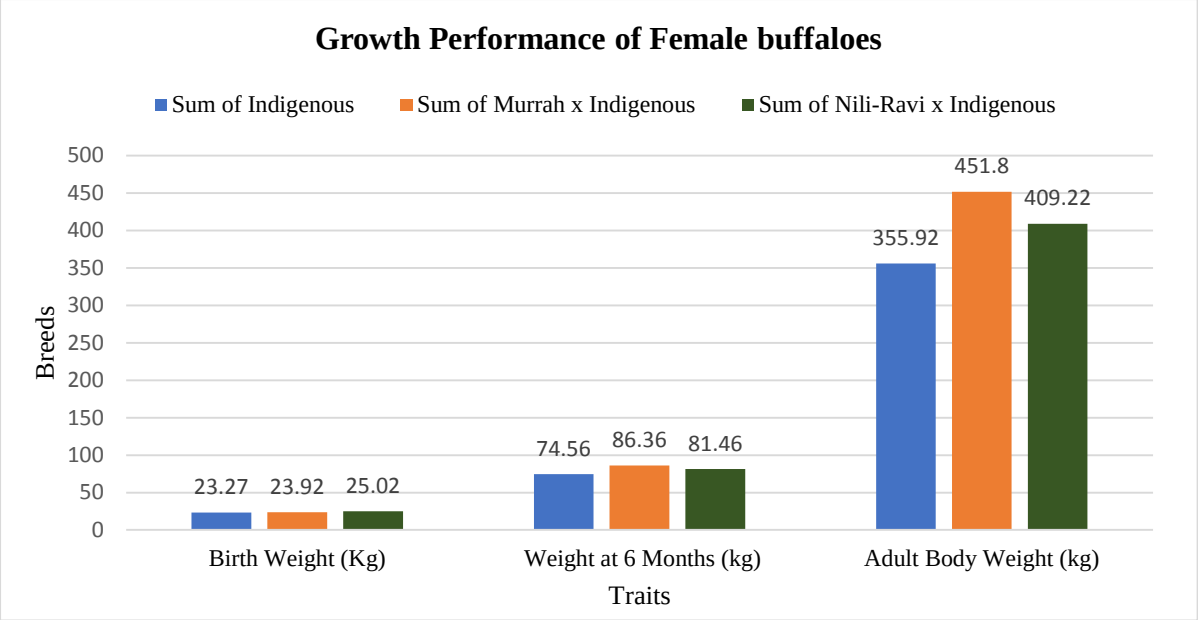


Figure 2. Growth performance traits of different breed groups (female).

In the present study, the birth weight and weight at 6 months of Indigenous and Murrah x Indigenous were less similar to the findings of Azmi *et al*. (2021) reported that the birth weight (kg) and age at six months (kg) of both Indigenous swamp type and Murrah crossbred were (34.7±0.50, 132.6±3.50) and (36.6±0.40, 160.5±2.70) respectively. Pramod *et al.* (2018) mentioned that birth weight and weight at three months (kg) of Murrah buffalo are (34.76± 0.54 and 86.94±1.65) respectively. Paul *et al.* (2015) mentioned that the birth weight (kg) of indigenous buffaloes of the Pirojpur and Barguna was (24.21±4.00 and 24.12±3.60). Jogi and Lakhni (1996) mentioned that the average birth weight for Murrah male and female calves was 26.0kg to 34.4 kg and 26.1kg to 34.0 kg respectively. Khan (1995) observed that the average birth weight of Nili-Ravi and Nili-Ravi x Indigenous were 32.76±0.86 kg, 28.50±0.79 kg. Faruque and Amin (1995) mentioned that the birth weight of Indigenous buffalo in the coastal area was 18 kg to 26 kg. Abeygunawardena *et al.* (1995) mentioned that the average birth weight of Surti, Murrah, Nili-Ravi and Lankan buffaloes were 27.10 kg, 30.10 kg and 17.90 kg.

4.2 Productive Performance:

Table 5. Production Performance of Female Buffaloes

Sl. No.	Breed	Traits		
		Daily Milk Yield (Liter) (Mean±SEM) (n=45)	Lactation Milk Yield (Liter) (Mean±SEM) (n=45)	Lactation Length (Days) (Mean±SEM) (n=45)
1	Indigenous	2.39^{c} ±0.04	784.44^{b} ±28.33	326.62^{b}±9.71
2	Murrah x Indigenous	2.66^{a} ±0.06	888.44^{a} ±21.83	336.8^{ab}±7.66
3	Nili-Ravi x Indigenous	2.51^{b} ±0.04	878.2^{a} ±17.25	351.06^{a} ±7.31

Mean values in the same column with different superscripts (a, b) differ significantly at p<0.05. SEM= Standard error mean. Figure in the parenthesis indicates the total number.

The significant (P<0.05) difference was found among the different breeds daily milk yield (liter), Lactation milk yield (liter) and lactation length (days) (Table 4, Figure 3). The mean for daily milk yield (liter) along with standard error was higher in Murrah x Indigenous (2.66±0.06) followed by Nili-Ravi x Indigenous (2.51±0.04) and Indigenous (2.39±0.04) respectively with significant (P<0.05) difference. The mean of Lactation milk yield on a single lactation (liter) was higher in Murrah x Indigenous (888.44±21.83) followed by Nili-Ravi x Indigenous (878.2±17.25) with non-significance (P<0.05) difference but were significantly different from Indigenous buffalo (784.4±28.33). Among these three different breed group lactation lengths (days) higher in Nili-Ravi x Indigenous (351.06±7.31) was significantly (P<0.05) different from Indigenous (326.62±9.71). The Murrah x Indigenous breed has different (336.8±7.66) value though it was non-significant to Nili-Ravi x Indigenous (351.06±7.31) and Indigenous (326.62±9.71) respectively.

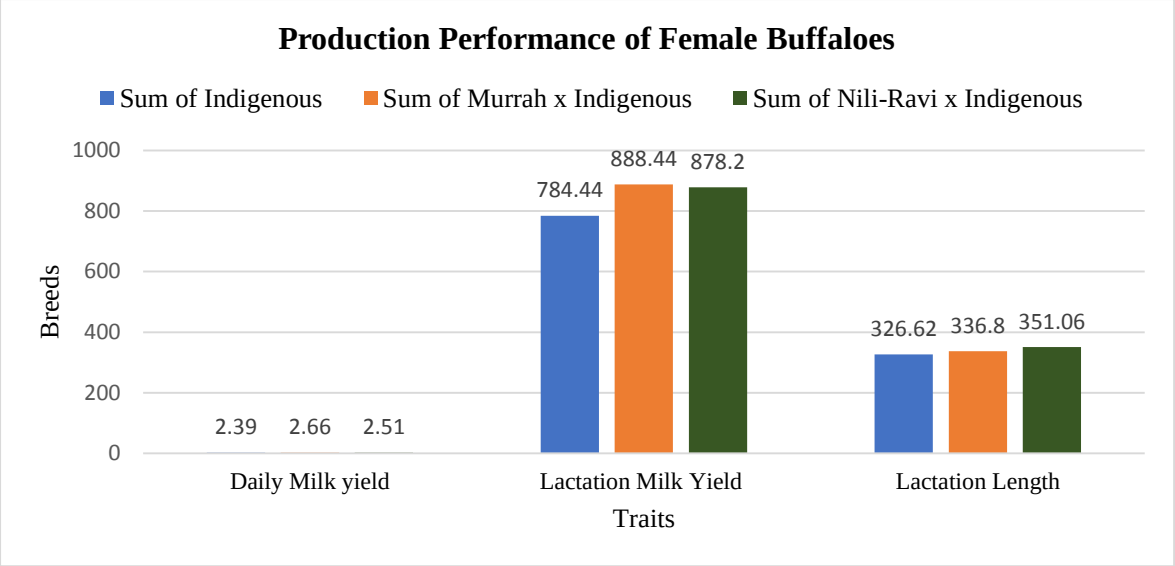


Figure 3. Production performance traits of different breed groups (female).

The findings of the present study are more or less similar to the findings of RC Paul *et al.* (2015) mentioned that lactation length (days) and milk yield (liter) of indigenous buffalo were (286.12±11.27 and 290.44±10.92), (3.43±0.744 and 3.33±0.68) respectively in Pirojpur and Barguna area in Bangladesh. Charlini and Sinniah (2015) observed the lactation length (days), total milk yield (kg) of Murrah and Nili-Ravi buffaloes were (298±70.1, 1249±542) and (238±78.8, 1187±543) respectively. Thiruvenkadan *et al*. (2014) conducted in Murrah buffalo and stated that lactation length (days), lactation milk yield (kg) and milk yield per day of lactation (kg) were (292.5±5.6, 1983.2±47.4 and 6.66±0.11) respectively. Khan and Akhter (1999) reported that lactation milk yield and lactation length of Nili-Ravi buffalo were (2020.04±44.59 liters and 277.42±5.70 days) respectively. Khan *et al.* (1997) reported that the lactation length of Nili-Ravi buffalo was 281 days to 285 days. Faruque (1994) reported that the buffalo of Mymensingh district lactation length was 274 days. Faruque and Amin (1994) mentioned that the lactation length of indigenous buffalo in the coastal area was 270 days. Neog *et al.* (1993) reported that the lactation length of Murrah buffaloes was 274±12.6 days. Ranjhan *et al.* (1989) observed that the lactation length of Murrah and Nili-Ravi was 272 and 275 days.

4.3 Reproductive Performance

Table 6. Reproduction Performance of Female Buffaloes

Sl. No.	Breed	Traits			
		Age at Sexual Maturity (Months) (Mean±SEM) (n=50)	Age at First Calving (Months) (Mean±SEM) (n=50)	Calving Interval (Months) (Mean±SEM) (n=50)	Service Per Conception (Mean±SEM) (n=50)
1	Indigenous	34.53^{b} ±0.13	46.94^{a} ±0.28	19.37^{a} ±0.20	1.98^{a} ±0.11
2	Murrah x Indigenous	35.23^{a} ±0.22	47.34^{a} ±0.27	19.61^{a} ±0.20	2.12^{a} ±0.09
3	Nili-Ravi x Indigenous	35.51^{a} ±0.24	47.23^{a} ±0.24	18.74^{b} ±0.14	2.1^{a}±0.09

Mean values in the same column with different superscripts (a, b) different significantly at ($p<0.05$). SEM= Standard error mean. Figure in the parenthesis indicates the total number.

Among different traits obtain from different breed groups Age at Sexual Maturity, Age at First Calving, Calving Interval and Service Per Conception were significantly($p<0.05$) different (Table 5, Figure 4). The mean age at sexual maturity (months) of Indigenous (34.532±0.13), Murrah x Indigenous (35.23±0.22) and Nili-Ravi x Indigenous (35.51±0.24) where between Murrah x Indigenous and Nili-Ravi x Indigenous were non significant ($p<0.05$) difference but significantly different was found in Indigenous buffaloes.

The mean value of age at first calving (months) was the lowest for Indigenous (46.94 ±0.28) and the mean value for Murrah x Indigenous (47.34±0.27) and Nili-Ravi x Indigenous (47.23±0.24) were different but there were no significant ($p<0.05$) differences found.

The means of the calving interval (days) for different breed groups were found highest in Murrah x Indigenous (19.61±0.20) which is significant ($p<0.05$) different with the lowest Nili-Ravi x Indigenous (18.74±0.14) but non-significant to Indigenous (19.37±0.20) respectively. However calving interval difference between Indigenous and Nili-Ravi x Indigenous was significantly ($p<0.05$) different.

The mean value found of service per conception of different breed groups. Murrah x Indigenous (2.12±0.09) was the highest one followed by Nili-Ravi x Indigenous (2.1±0.09) and Indigenous (1.98±0.11). Besides the differences, there was no significant ($p<0.05$) difference found.

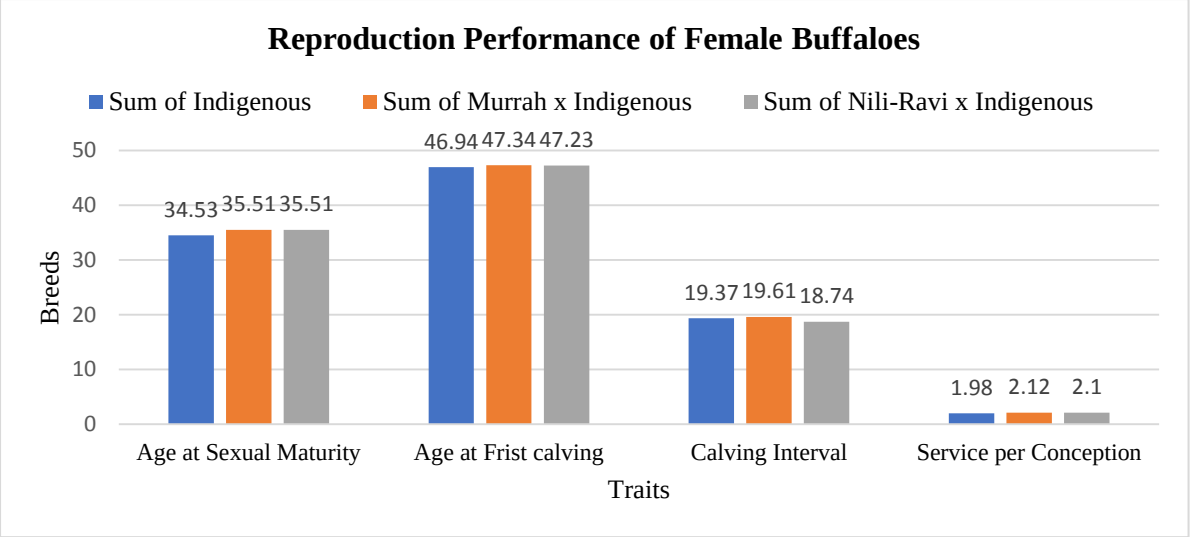
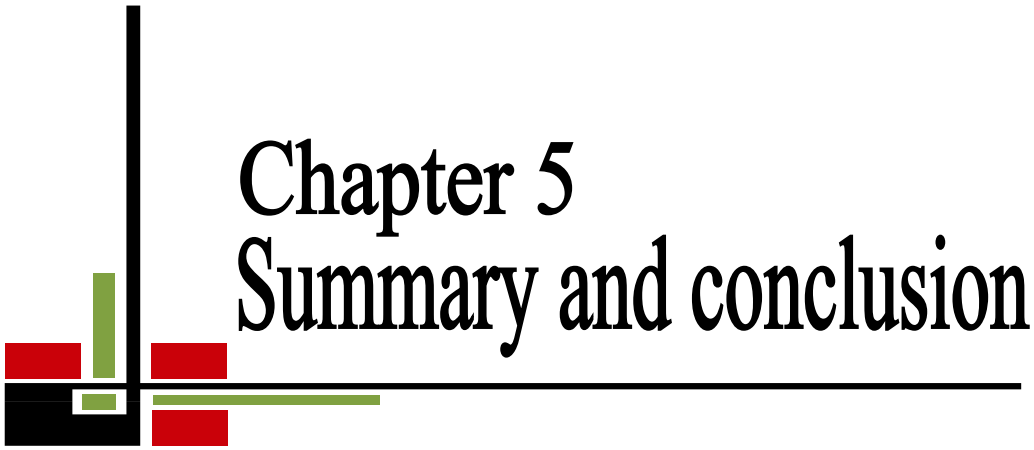


Figure 4. Reproduction performance traits of different breed groups (female).

The findings of present study are similar to those observed by Rashid *et al.* (2019) reported Sexual maturity (months), First calving age (months), the number of services per conception, and Calving interval (months) of indigenous buffaloes were 34.4±2.02, 46.12±1.66, 1.64±0.78 and 19.36±2.39 respectively. Sexual maturity (months), First calving age (months), number of services per conception, and Calving interval (months) of Nili buffaloes were 34.12±1.65, 47.06±1.64, 1.88±0.70 and 19.41±1.66 respectively and sexual maturity (months), first calving age (months), number of services per conception, and calving interval (months) of Murrah buffaloes were 34.53±1.96, 46.56±1.46, 1.38±0.59 and 18.31±1.97 respectively. Rahman *et al.* (2016) found that age of puberty (months), first age at calving (months) and calving interval (days) were 45.03±6.97, 55.33±7.20 and 650.93±79.57 respectively. Paul *et al.* (2015) reported that in Pirojpur and Barguna, age at first calving (months) were 50.88±1.71 and 51.00±1.80 and calving intervals (days) were 547.92±10.88 and 547.24±14.32 respectively. Charlini and Sinniah (2015) carried out performance analysis and stated that age at first calving (months), calving interval (days) of Murrah and Nili-Ravi buffalo are 61.5±12.0, 479±140 and 44.3±3.89, 412±91.6 respectively.



Chapter 5
Summary and conclusion

CHAPTER 5

SUMMARY AND CONCLUSION

The research was carried out by the Department of Animal Nutrition, Genetics and Breeding, Sher-e-Bangla Agricultural University, Dhaka. The present study data was collected from Buffalo Breeding and Development Farm, Fakirhat, Bagerhat district in Bangladesh. Indigenous and exotic crossbreds' productive and reproductive performance was evaluated in different groups. Data on (300) buffaloes were analyzed for birth weight, weight at six months, adult body weight, daily milk yield, lactation milk yield, lactation length, age at sexual maturity, age at first calving, calving interval, Service Per Conception covering the period of six months. Genetic groups consider were Indigenous, Indigenous x Nili-Ravi and Indigenous x Murrah.

T-test analysis of variance showed that the genetic group had a significant ($p<0.05$) effect on birth weight, weight at six months, adult body weight, daily milk yield, lactation milk yield, lactation length, age at sexual maturity, age at first calving, calving interval, Service Per Conception. The average birth weight of the Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffalo male calves were 25.87±0.33, 29.81±0.42 and 29.74±0.42 respectively. There was significant difference ($p<0.05$) found in Murrah x Indigenous and Nili-Ravi x Indigenous to Indigenous birth weight of male calves among three genetic groups. However significant difference was found among female calves. Where average birth weight (kg) of, Murrah x Indigenous and Nili-Ravi x Indigenous buffalo female calf were 23.27±0.37, 23.92 ±0.36, 25.02±0.31 respectively. The Nili-Ravi x Indigenous calves are heavier and significantly different from other two genetic groups. The average body weight (kg) of Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffalo males at six months were 83.22 ±0.65, 92.66 ±0.53 and 90.46 ±0.65 respectively. There was significant difference ($p<0.05$) in both sexes among three genetic groups. Nili-Ravi x Indigenous are heavier than Indigenous and Murrah x Indigenous buffalos. In between Indigenous and Murrah x Indigenous buffalo, Murrah x Indigenous buffalo are heavier than Indigenous buffalo at six months. The average body weight (kg) of Murrah x Indigenous and Nili-Ravi x Indigenous buffalo females at six months were 74.56±0.69, 86.36 ± 0.65 and 81.46 ±0.70 respectively. The average body weight (kg) of

male adult buffaloes of three different genetic groups were 455.16 ±1.13, 560.52 ±1.06, 503.86 ±1.11 of Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffaloes respectively. There was a significant difference ($p<0.05$) among three genetic groups. Murrah x Indigenous are heavier than Indigenous, Indigenous x Nili-Ravi buffaloes. Nili-Ravi x Indigenous too heavier than Indigenous buffaloes and significantly different. We found same result on females in case of body weight where all three genetic groups are significantly different and Murrah x Indigenous are heavier than all and Indigenous x Nili-Ravi are heavier than Indigenous and significantly different. The average female adult body weight (kg) of Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffaloes were 355.92±0.95, 451.8 ±1.04, 409.22 ±1.08 respectively.

The average daily milk yield (liter) Indigenous, Murrah x Indigenous and Indigenous x Nili-Ravi buffalo were 2.39 ±0.04, 2.66 ±0.06 and 2.51±0.04 respectively. There was significant difference ($p<0.05$) among the three genetic traits where all are significantly different from each other. Milk yield of Murrah x Indigenous was higher than Indigenous and Nili-Ravi x Indigenous yield of Nili-Ravi x Indigenous was higher than Indigenous Buffalo cows. The average lactation milk yield (liter) of Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffalo were 784.44 ±28.33, 888.44 ±21.83 and 78.2 ±17.25 respectively. There was no significant different between Murrah x Indigenous and Nili-Ravi x Indigenous buffalo but yield more milk than Indigenous buffalo cows and showed a significant ($p<0.05$) difference. The average lactation length(days) of Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffalo were 326.62±9.71, 336.8±7.66 and 351.06 ±7.31 respectively. The lactation length of Indigenous x Nili-Ravi was higher than Indigenous and Murrah x Indigenous. There was no significant($p<0.05$) difference in lactation length found between Indigenous and Murrah x Indigenous or Murrah x Indigenous and Nili-Ravi x Indigenous but lactation length between Nili-Ravi x Indigenous and Indigenous buffalo was significantly different.

The average age(months) at sexual maturity of Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffalo were 34.532±0.13, 35.23±0.22 and 35.51±0.24 respectively. There was no significant ($p<0.05$) difference between Murrah x Indigenous and Nili-Ravi x Indigenous but age at sexual maturity of Indigenous buffalo was less and significantly different from Murrah x Indigenous and Nili-Ravi x Indigenous. The average age (months) at first calving of Indigenous,

Murrah x Indigenous and Nili-Ravi x Indigenous buffalo were 46.94 ±0.28, 47.34 ±0.27 and 47.23±0.24 respectively. The average age of first calving of Indigenous buffalo was lower Murrah x Indigenous and Nili-Ravi x Indigenous but here was no significant ($p<0.05$) difference found among them.The average Calving Interval (Months) of Indigenous, Murrah x Indigenous, and Nili-Ravi x Indigenous buffalo were 19.37±0.20, 19.61±0.20 and 18.74 ±0.14 respectively. The average calving interval of Nili-Ravi X Indigenous buffalo was less than Indigenous x Murrah and there was a significant ($p<0.05$) difference found. No significant difference was found between Indigenous and Indigenous x Murrah. Service per Conception of Indigenous, Murrah x Indigenous and Nili-Ravi x Indigenous buffalo were 1.98±0.11, 2.1±20.09 and 2.1±0.09 respectively. The service per conception of Indigenous buffalo was less but there was no significant ($p<0.05$) difference found among them. From the observed result, it may be concluded that the growth and productive performance of crossbreds (Murrah x Indigenous and Nili-Ravi x Indigenous) were better in comparison to Indigenous buffalo. However, the reproductive performance was not so significantly different. The study of productive potential indicates that both the record-keeping system, as well as husbandry practice in buffalo breeding farm, must be improved if the animal is to be used for breeding and reproductive purpose.

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Appendices

APPENDICES

Appendix 1:

Questionnaire on different parameters of different buffalo breeds

ID No.									
Name of the Farm					Buffalo Breeding and Development Farm				
Location					Fakirhat, Bagerhat.				
Types of Breeds					Indigenous	Murrah x Indigenous		Nili-Ravi x Indigenous	
Sex					Male		Female		
Age									
Types of service					Natural			Artificial	
Birth weight (kg)	Birth Weight up to 6 months (kg)	Adult Body Weight(kg)	Daily milk yield (liter)	Milk yield per lactation (liter)	Lactation length (days)	Age at Sexual Maturity (months)	Age at first Calving (months)	Calving Interval (months)	Services per Conception