Proceedings

Annual Research Review Workshop 2020

Date: 04-05 December, 2020

সুস্থ প্রাণী সমৃদ্ধ দেশ

মুজিববর্ষে বাংলাদেশ

Bangladesh Livestock Research Institute

Ministry of Fisheries and Livestock

Government of people's Republic of Bangladesh

Annual Research Review Workshop 2020

Date: 04-05 December 2020

BLRI Conference Hall

3rd floor, Building 3

PROGRAMME

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

TECHNICAL SESSIONS

Day 1: Friday, 04 December, 2020

Technical Session I : **ANIMAL AND POULTRY DISEASES AND HEALTH**

Chairperson : **Prof. Dr. Nitish Chandra Debnath**
Country Team Leader
Fleming Fund Project, Bangladesh

Co-Chairperson : **Dr. Md. Farhad Hossain**
Director (Research)
Department of Livestock Services

Rapporteurs : Dr. Md. Shahin Alam, SSO, BLRI
DR. Sonia Akther, SO, BLRI

10:30-10:40	Surveillance and molecular evolution of highly pathogenic avian influenza virus (HPAIV) in Bangladesh	MZ Ali SO
10:40-10:50	Adaptation and attenuation of duck plague virus in chicken embryo fibroblast cell as vaccine seed	MS Alam SSO
10:50-11:00	Monitoring of Foot and Mouth Disease Virus circulating in Bangladesh and Molecular Characterization	MZ Ali SO
11:00-11:10	Investigation of Lumpy Skin Disease (LSD) in Bangladesh	M Giasuddin CSO
11:10-12:10	Monitoring of Peste des Petits Ruminants (PPR) virus and PPR like disease in Bangladesh	MA Yousuf SO
12:10-12:20	Molecular Characterization of *Babesia*, *Anaplasma* and *Theileria spp* from Suspected Ruminants and Formulation of Vaccine	MZ Hassan SO
12.20-12.30	Investigation of goat diseases and isolation and identification of Pneumonic Pasteurellosis in goat	MH Rahman SO
12:30-01:00	**Discussion**	
01:00-02:00	**Lunch and Prayer**	

Day 1: Friday, 04 December, 2020

Technical Session II : ANIMAL AND POULTRY BREEDING & GENETICS

Chairperson : **Dr. A. K. Fazlul Haque Bhuiyan**
Professor, Department of Animal Breeding and Genetics
Bangladesh Agricultural University, Mymensingh 2202

Co-Chairperson : **Dr. Md. Azharul Hoque**
Professor, Department of Animal Breeding and Genetics
Bangladesh Agricultural University, Mymensingh 2202

Rapporteurs : Dr. Md. Rakibul Hassan, SSO, BLRI
Md. Faizul Hossain Miraz, SO, BLRI

02:30-02:40	Improving production performance of local buffalo through crossbreeding	GK Deb SSO
02:40-02:50	Conservation and improvement of farm animal genetic resources (FAnGR) at Hilly region at Naikhongchari	R Khatun SSO
02:50-03:00	Conservation and improvement of native chicken: performance of eighth generation	S Faruque SSO
03:00-03:10	Performances study of BLRI improved native duck genotypes: 6th generation	S Sultana SO
03:10-03:20	Production and evaluation of crossbred sheep of Coastal with Damara, Dorper and Parendale	NH Desha SO
03:20-03.30	A comparative study on carcass and meat yield characteristics of different F_1 beef genotypes and BCB-1 at 2 years of age	MP Mostari SSO
03:30-03:40	Conservation and improvement of Black Bengal Goat at Bangladesh Livestock Research Institute	NH Desha SO
03:40-03:50	Conservation and improvement of exotic germ plasms of chicken and development of egg and meat type chicken	MR Hassan SSO
03:50-04:20	**Discussion**	
04:20-04:30	**Tea and Snacks**	
04:30-05:00	**Poster Presentation**	

Day 2: Saturday, 05 December, 2020

Technical Session III : **FEEDS, FODDER AND NUTRITION**

Chairperson : **Dr. Md. Ali Akbar**
Former Vice Chancellor
Bangladesh Agricultural University
Mymensingh 2202

Co-Chairperson : **Dr. Sharif Ahmed Chowdhury**
General Manager, PKSF
Agargaon, Dhaka

Rapporteurs : Nani Gopal Das, SSO, BLRI
Dr. Md. Masud Rana, SO, BLRI

09:30-09:40	Intercropping maize and cow pea as a whole–crop forage: Effects of planting system and ratio on forage yield and quality	BK Roy SSO
09:40-09:50	Effect of weaning age on the post weaning performance of Black Bengal kids	S Ahmed SSO
09:50-10:00	Determination of heavy metals (Pb, Cr, Cd and Pb) in poultry feed and meat both breast and thigh	MSK Sarker SSO
10:00-10:10	Fortification of nutrients (Omega 3 fatty acids) in poultry meat through dietary manipulation	F Sharmin Post-doc Fellow
10:10-10:20	Evaluation of biomass production and nutritional quality of different moringa varieties at different densities	N Sultana PSO
10:20-10:50	**Discussion**	
10:50-11:00	**Tea and Snacks**	
11:00-11:30	**Poster Presentation**	

Day 2: Saturday, 05 December, 2020

Technical Session IV : **BIOTECHNOLOGY, ENVIRONMENT AND CLIMATE RESILIENCE**

Chairperson : **Dr. MAM Yahia Khandoker**
Prof. Dept. of Animal Breeding and Genetics
Bangladesh Agricultural University
Mymensingh-2202.

Co-Chairperson : **Dr. Shaikh Azizur Rahman**
Director (Production)
Department of Livestock Services

Rapporteurs : Dr. Gautam Kumar Deb, SSO, BLRI
Md. Moklesur Rahman, SO, BLRI

11:30-11:40	Identification of candidate gene markers for prediction of RCC sperm quality and fertility	MFH Miraz SO
11:40-11:50	Identification of the polymorphisms in low-density-lipoprotein receptor related protein-8 gene and association study with gastrointestinal nematodes infection in goat	MH Rahman SO
11:50-12:00	Development of microbial silage inoculant and evaluation of its efficacy on ensiling roughages	SM Amanullah SSO
12:00-12:10	Efficient management of livestock and poultry manure for value addition and pollution control	SM Amanullah SSO
12:10-12:20	Measurement of noxious greenhouse gases at the poultry shed and their possible remedies	MAG Rabbani SO
12:20-12:30	Low cost and sustainable approaches of bio-slurry management	JS Khanam SO
12:30-01:00	**Discussion**	
01:00-02:00	**Lunch and Prayer**	

Day 2: Saturday, 05 December, 2020

Technical Session V : **SOCIOECONOMICS AND FARMING SYSTEM RESEARCH**

Chairperson : **Dr. Jahangir Alam Khan**
Former Director General
Bangladesh Livestock Research Institute, Savar, Dhaka

Co-Chairperson : **Dr. Fakir Azmal Huda**
Professor, Department of Agricultural Economics
Bangladesh Agricultural University, Mymensingh-2202

Rapporteurs : Md. Ashadul Alam, SSO, BLRI
Md. Shamim Hasan, SO, BLRI

02:00-02:10	Development of Model village through BLRI Technologies at Dhamrai areas	R Khatun SSO
02:10-02:20	Impact of Feeding Technology Developed by Bangladesh Livestock Research Institute on Dairy Development in Bangladesh	S Yasmin SO
02:20-02:30	Drawbacks in subsistence goat farming at selected regions of Bangladesh	MA Hemayet SO
02:30-02:40	Studies on the farmers innovative technologies for livestock production in Bangladesh	MZ Rahman SSO
02:40-02:50	Impact of training on adoption of BLRI developed technologies for last ten years	KN Monira SSO
02:50-03:20	**Discussion**	
03:20-04.00	**Poster Presentation**	
04:00-05:00	**Closing Session**	
05:00-05:10	**Tea and Snacks**	

POSTER SESSION

Day 1: 02:00-02:30 pm & 04:30-05:00 pm
Day 2: 11:00-11:30 am & 03:20-04:00 pm

Rapporteurs Mr. Ataul Goni Rabbani, SO, BLRI
DR. Habibur Rahman, SO, BLRI
Umme Shiha Alam, SO, BLRI

SL No.	Title	Presenter
ANIMAL AND POULTRY DISEASES AND HEALTH		
1.	Evaluation of Goatpox vaccine produced in Livestock Research Institute, Department of Livestock Services	M Giasuddin CSO
ANIMAL AND POULTRY BREEDING & GENETICS		
2.	Conservation and improvement of Munshiganj cattle	MFH Miraz SO
3.	Collection, conservation and improvement of specialized fowl (Turkey, Guinea fowl and Pigeon) production at BLRI	A Rashid SSO
4.	Conservation and improvement of Quail: Performance of 9th generation	S Faruque SSO
5.	Effect of timing of artificial insemination on fertility and hatchability of native chicken	S Faruque SSO
6.	Production and performance study of mule duck	H Khatun SSO
7.	Adaptation of high yielding exotic sheep breeds and production of upgraded crossbreds	M Ershaduzzzman PSO
8.	Conservation and Improvement of Jamunapari Goat at Bangladesh Livestock Research Institute	NH Desha SO
9.	Conservation and improvement of native sheep at Bangladesh Livestock Research Institute	NH Desha SO
10.	Conservation and Improvement of Black Bengal Goat in Rural Areas	MA Hemayet SO
11.	Development of animal ID and recording system of RCC and their graded cattle through computer and mobile application technology	MA Kabir SO
12.	Development of community breeding model for Red Chittagong Cattle	MFH Miraz SO
13	Development of a system generated database at BLRI cattle and buffalo research farm	S Ahmed SSO

FEEDS, FODDER AND NUTRITION		
14.	Feeds and nutrition of dairy cattle at Sahzadpur, Sirajganj	NG Das SSO
15.	Effect of plant density on biomass yield, quality and morphological characteristics of Napier grass (*Pennisetum purpureum*) under on-station conditions	BK Roy SSO
16.	Implementation of HACCP System at BLRI Research Farm – Effect on Herd Health and Milk Quality	N Sultana PSO
17.	Study on available meat products and quality assessment of canned meat	BK Roy SSO
18.	Design and development of products from Native sheep skin	M Ershaduzzaman PSO
BIOTECHNOLOGY, ENVIRONMENT AND CLIMATE RESILIENCE		
19.	Status of gayal (Bos frontalis) farming in Chittagong Hill tracts and exploring the mitochondrial genome sequence of this unique resource	GK Deb SSO
20.	Adaptation of somatic cell nuclear transfer (SCNT) technologies for cattle in Bangladesh	GK Deb SSO
21.	Developing starter culture for Yoghurt	MA Kabir SO
22.	Screening for causative mutations of major prolificacy genes in Black Bengal Goat	NH Desha SO
23.	Genetic variants of beta-casein in native and crossbred cattle and buffaloes of Bangladesh	MP Mostari SSO
24.	Ovum pick up based technique for production of Red Chittagong calves	MA Kabir SO
25.	Adaptation of Bio-char for sustainable improvement of soil fertility in sandy soil and establishment of fodder germplasms at BLRI regional stations.	R Khatun SSO
SOCIOECONOMICS AND FARMING SYSTEM RESEARCH		
26.	A baseline survey on socioeconomic status of selected sheep farmers at community level	MA Hemayet SO
27.	Developing a model for up-scaling livelihood of the rural poor farmers by rearing Red Chittagong Cattle	MR Amin SO
28.	Impact of dairy initiatives taken at post-2000 in northern Bangladesh on production and consumption status of dairy products	S Yasmin SO
29.	A pilot program for the validation of newly developed Android Apps entitled “Khamarguru”	MN Huda SO

INAUGURAL SESSION

(04 December, 2020)

Chief Guest : **Mr. S M Rezaul Karim, MP**
Hon'ble Minister
Ministry of Fisheries and Livestock

Special Guest : **Mr. Rawnak Mahmud**
Secretary, Ministry of Fisheries and Livestock

Special Guest : **Dr. Abdul Jabbar Sikder**
Director General, Department of Livestock Services

Chairperson : **Dr. Nathu Ram Sarker**
Director General
Bangladesh Livestock Research Institute

08:50 am	Guests take their seats
09:00 am	Recitation from the Holy Qurán and Holy Gita
09:10 am	Welcome Address by **Md Azharul Amin** Additional Director & Convener, Annual Research Review Workshop-2020
09:15 am	Address by the Special Guest **Dr. Abdul Jabbar Sikder** Director General, Department of Livestock Services
09:20 am	Address by the Special Guest **Mr. Rawnak Mahmud** Secretary, Ministry of Fisheries and Livestock
09:30 am	Address by the Chief Guest **Mr. S. M. Rezaul Karim, MP** Hon'ble Minister, Ministry of Fisheries and Livestock
09:50 am	Address by the Chairperson **Dr. Nathu Ram Sarker** Director General, Bangladesh Livestock Research Institute
10:00 am	Refreshment

CLOSING SESSION

(05 December, 2020)

Chief Guest : **Mr. Rawnak Mahmud**
Secretary, Ministry of Fisheries and Livestock

Special Guest : **Dr. Shaikh Mohammad Bokhtiar**
Executive Chairman, Bangladesh Agricultural Research Council

Special Guest : **Dr. Abdul Jabbar Sikder**
Director General, Department of Livestock Services

Chairperson : **Dr. Nathu Ram Sarker**
Director General
Bangladesh Livestock Research Institute

04:00 pm	Recitation from the Holy Qurán and Holy Gita
04:05 pm	Presentation of Workshop Recommendations **by Dr. Md. Giasuddin** Head of Animal Health Research Division
04:20 pm	Open Discussion
04:35 pm	Speech by the Special Guest **Dr. Shaikh Mohammad Bokhtiar** Executive Chairman, Bangladesh Agricultural Research Council
04:40 pm	Speech by the Special Guest **Dr. Abdul Jabbar Sikder** Director General, Department of Livestock Services
04:45 pm	Speech by the Chief Guest **Mr. Rawnak Mahmud** Secretary, Ministry of Fisheries and Livestock
04:55 pm	Concluding remarks by the Chairperson **Dr. Nathu Ram Sarker** Director General, Bangladesh Livestock Research Institute
05:00 pm	Refreshment

CONTENTS

Surveillance and molecular evolution of highly pathogenic avian influenza virus (HPAIV) in Bangladesh

M Giasuddin*, MZ Ali and M Hasan

National Reference Laboratory for Avian Influenza, Animal Health Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka 1341, Bangladesh. *Correspondence at mgias04@yahoo.com

Executive summary

Avian Influenza is a highly contagious viral disease and causing tremendous economic losses to the poultry industries throughout the last decade. It is very difficult to control the disease because of its huge number of serotypes and mutation nature. The virus is zoonotic in nature and easily mutates from LPAI to HPAI. The research was conducted under two objectives- detection and identification of a new strain of avian influenza virus (AIV), and the evolution of avian influenza A/H5N1 and A/H9N2 subtypes. The research methodology was the collection of samples and isolation of AIV from commercial layer farm chickens, chickens of live bird market, and household native chickens. The AIV is identified by Reverse Transcription-Polymerase Chain Reaction (RT-PCR) using a primer specific to the M gene of AIV. Subsequently, subtypes of AIV were determined by running with subtype-specific primers for RT-PCR reactions. The samples were collected from three highly poultry-populated districts namely-Dhaka, Gazipur, and Tangile during the period of 2019 to 2020. A total of 300 individual oropharyngeal swab samples were collected in virus transfer media (VTM) from 100 commercial layer farm chickens, 110 live bird market chickens, and 90 household native chickens. A structured and validated questionnaire was developed and used for the chicken farmers to record farmers' demographic information, followed by farm demography, biosecurity practices, and management practices. Samples were labeled and placed within an insulated ice-box and transferred to the National Reference Laboratory for Avian Influenza (NRL-AI), Bangladesh Livestock Research Institute, Dhaka, and stored at -80 °C for testing. The magnetic bead-based RNA isolation technology was applied for the extraction of RNA from individually collected samples using MagMAX™-96 AI/ND Viral RNA Isolation Kit (Applied Biosystems™, USA) in KingFisher™ Flex 96 well robot (Thermo Scientific™, USA) according to manufacturer protocol. The samples were screened first for the presence of the M gene by RT-PCR reactions using reference specific primers and probes. Then M gene positive samples were further assessed for H5 and H9 sub-typing using primers and probes by an RT-PCR reaction. A total of 10% (31/300) oropharyngeal swabs were found positive for AIV (M gene). By type of samples, the samples were found AIV positive as 8.18% (9/110) in live birds market chickens, 7.77% (7/90) in household native chickens, and 15% (15/100) in commercial layer chickens. Moreover, of the total 31 AIV positive samples, two subtypes A/H5 and A/H9 were identified as 35% (11/31) and 64% (20/31), respectively. The risk factor analysis revealed that poor biosecurity practices was found at 2.92 (95% CI: 1.00-8.53; p=0.042) times more likely to suffer AIV than flocks with practicing good biosecurity. All positive samples were stored for the molecular characterization that will be done in the coming financial year. Enhancing biosecurity along with proper vaccination practices against HPAI H5N1and LPAI H9N2 could be an effective AIVs control measure in Bangladesh.

Adaptation and attenuation of duck plague virus in chicken embryo fibroblast cell as vaccine seed

MS Alam[1]*, MA Yousuf[1], S Akther[2], N Dhar[3] and J Alam[4]

[1]Animal Health Research Division; [2] Goat and Sheep Production Research Division and [3]PBRG Project, Bangladesh Livestock Research Institute, Savar, Dhaka 1341, Bangladesh; [4]National Institute of Biotechnology, Ganakbari, Ashulia, Savar, Dhaka, Bangladesh. *Correspondence at shahin_vet@yahoo.com

Executive summary

The most significant constrain in duck rearing is infectious diseases, of which duck plague (DP) is the most important one. The disease is caused by *Anatid alphaherpesvirus 1* of the family *Herpesviridae*. Duck plague virus (DPV) is a potential threat to all age groups of ducks, which is characterized by high morbidity and mortality varying from 5-100%. DP is spread among ducks through direct contact with infected ducks and contaminated environments. Migratory waterfowl are asymptomatic carriers and play a vital role in spreading DPV. In Bangladesh, DPV was first confirmed in 1980 and a significant number of ducks died each year because of this endemic disease, consequently, huge economic losses occur. Livestock officials in Bangladesh have expressed great concern over outbreaks of DP especially prevailed in Haor areas. Vaccination is only the eminent method for the control of DP but in Bangladesh, the vaccination program is not widely accessible because of the limited volume vaccine. Additionally, very limited study has been conducted on molecular detection, isolation, and adaptation of DPV. To effectively combat this threat, there is a need for the mass production of effective DP vaccine. Hence, the present study was carried out, to isolate, identify and characterize the circulating DPV from duck plague suspected samples and to adapt the virulent DPV strain in developing duck embryo and chicken embryo fibroblast cell (CEF) for the development of live attenuated vaccine seed.

In this study, a total of 86 duck plague suspected samples (liver, spleen, kidney, esophagus, and intestine) were collected and transported to Animal Health Research Laboratory (AHRL), BLRI and simultaneously, 42 questionnaires were filled up through direct interview of duck farmers and analyzed. Of the 86 samples, 69 and 17 were from Hoar area (Kisorgonj) and BLRI duck farm, respectively. The samples were pooled and processed for the extraction of DNA. Then, DNA was extracted from processed samples using the protocol of DNA extraction kit (Monarch®, UK). Polymerase chain reaction (PCR) was performed for the amplification of the DNA polymerase and gC gene (OIE, 2012), followed by sequencing. Inocula were prepared from PCR positive samples according to the method described in OIE (2012) and then 0.2 ml and 0.5 ml were inoculated in 10-12 days old embryonated duck eggs (EDE) and chicken embryo fibroblast (CEF), respectively for the propagation and isolation of DPV.

From our survey, it is found that 73.8% farmers were used DP vaccine and their used vaccine was produced from livestock research institute (LRI), Mohakhali. Of the 69 samples in Kishorgonj, 18 (26.08%) were found positive (Figure 1) by PCR both in DNA polymerases and gC gene. No positive samples were found in the samples of BLRI. In CEF cell, DPV produced cytopathic effect (CPE) at 3 days of post- inoculation (dpi) and cell culture fluid harvested at 7 dpi. CPE comprised of rounding and finally detachment of cells. On the other hand, at 7 dpi infected allantoic fluid (AF) was harvested. All the harvested samples were stored at -80ºC for further propagation and attenuation. Of the 18 positive samples, four samples (BLRI-DPV S1, S2, S3, and S9) were further confirmed as DPV by gene sequencing and found to be closely related to each other's and also with some Chinese and Indian variant of DPV (Figure 2). Therefore, it is presumed that Bangladeshi, Chinese and Indian isolates of DPV may have a common ancestor.

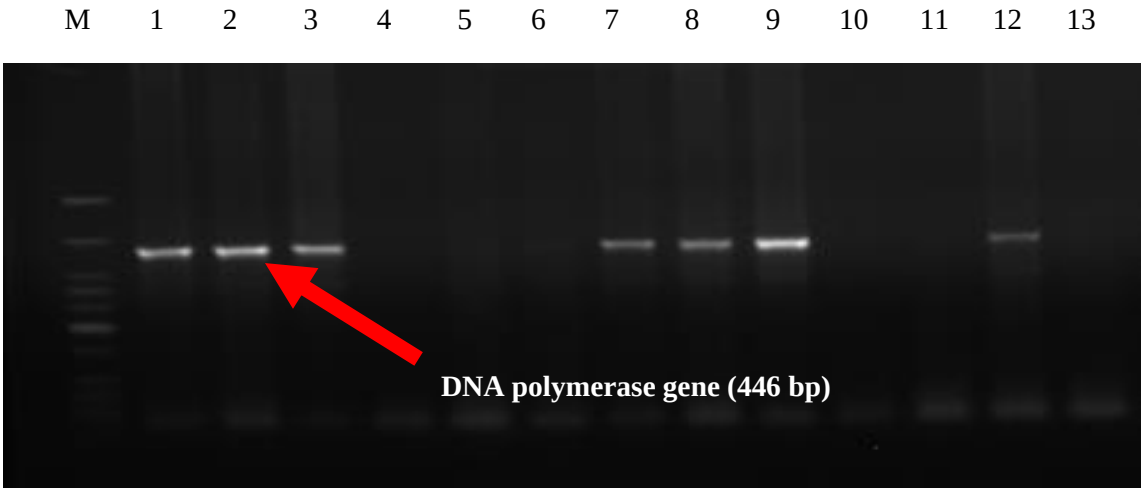

Figure 1. Amplification of the portion of DNA polymerase gene from duck plague virus. Lane M: 50 bp ladder; Lane 1-12: Duck plague suspected field samples; lane 13: Negative control.

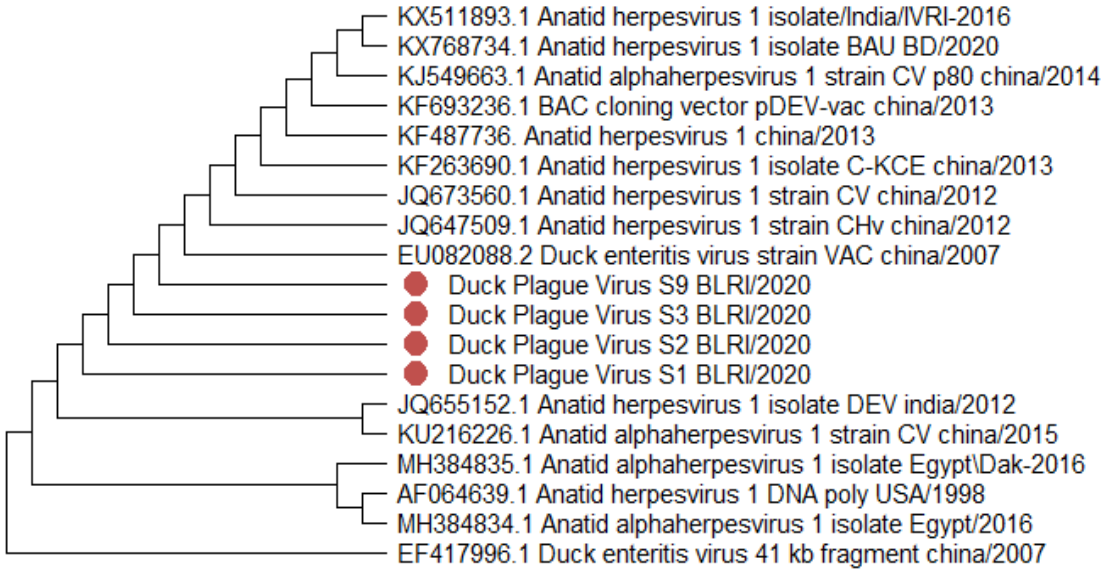

Figure 2. Phylogenetic relationship of DNA polymerase gene of duck plague virus. The tree was prepared using neighbor joining method. Red circle indicates our isolates.

Monitoring of Foot and Mouth Disease virus circulating in Bangladesh and molecular characterization

M Giasuddin[1*], MZ Ali[1], MA Yousuf[1], MZ Hassan[1], M Hasan[1], MN Akter[1] and KN Shithi[1]

[1]Animal Health Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka 1341, Bangladesh.
*Correspondence at mgias04@yahoo.com

Executive summary

Foot-and-mouth disease (FMD) is a viral disease caused by the FMD virus (FMDV), a member of the Aphthovirus genus of the Picornaviridae family. It is an acute, highly contagious disease among cloven hoofed animals, like cattle, buffalo, pigs, sheep, goats, wild ruminants, etc. In the outbreak areas, an overall of 53.89% cases were reported, among which case fatality rates were 2.27% in adults but very high (71.46%) in calves aged below 2 years in Bangladesh. The research objectives were- outbreak investigation and genetic analysis of field FMD virus, and seromonitoring of vaccinated animals. To fulfill the objectives the activities were considered as isolation, identification and molecular characterization of FMD viruses from different outbreak places. For seromonitoring of vaccinated animals a total 80 post vaccinated serum samples were collected from BLRI cattle research farm and tested for conferred immunity against serotype A, O & Asia 1 by ELISA test.

We have conducted five FMD outbreaks investigation from 2019 to 2020 from Doha (Dhaka), Sahajadpur (Sirajganj), Dhamrai (Dhaka), Godagari (Rajsahahi) and Manikgonj Sadar (Manikgonj). Total 40 tongue epithelial specimens were collected from the affected individual cattle of each outbreak places into a virus transfer media and transferred to FMD Laboratory, BLRI and stored at -80^{0}C until test. The genomic total RNA was extracted from an aliquot of processed samples by using QIAamp® Viral RNA kit (QIAGEN, Hilden, Germany), following the manufacturers protocol. The RNAs were subjected to RT-PCR test targeting 5′ UTR and 3D regions for the detection of FMDV, serotypes A, O, and Asia 1 by using QIAGEN One-Step RT-PCR Kit (QIAGEN, Hilden, Germany) with the specific primers. The samples were inoculated into BHK21 cells and incubated for virus isolation. The cell culture supernatant, at 3rd passages were extracted and RNAs were subjected to amplify the VP1 region with three specific sets of forward and one reverse primer developed by Knowles et al. (2016) for FMD serotype O. Then, the amplified products were harvested and extracted and cycle sequencing reactions were carried out on amplified products. A phylogenetic tree was constructed on four isolates of FMDV serotype O sequences by using the Maximum Likelihood phylogenetic tree with Tamura–Nei's model.

In results, all 40 samples were recorded positive for FMDV serotype O. The phylogenetic analysis showed that two isolates were clustered within an emerging novel sublineage Ind2001BD1 under lineage Ind2001 of FMDV serotype O, which was identified during 2012–2016 in Bangladesh (Figure 1). One isolate was clustered within the lineage PanAsia of FMDV serotype O and was closely related to an isolate identified in Nepal in 2009. The phylogenetic reconstruction revealed that all the four isolates belong to the Middle East–South Asia topotype. In serological test about 100% vaccinated cattle shown positive antibody against tested for all three serotypes.

Therefore, multiple lineages of the FMDV serotype O are circulating among the cattle in the outbreak area, which makes it more complex for the FMD control program in Bangladesh.

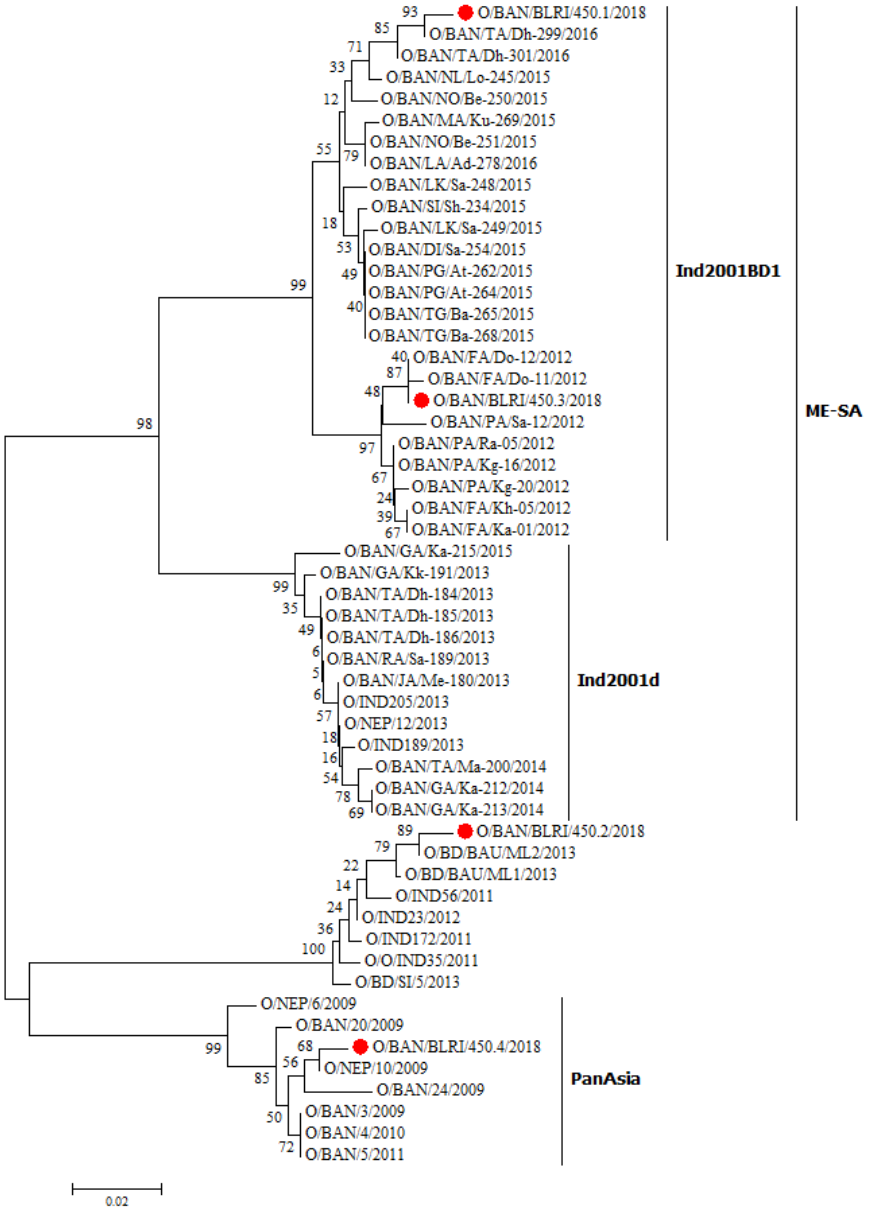

Figure 1. The phylogenetic representation of collected isolates and FMDV serotype O from Bangladesh, India, and Nepal from 2009 to 2016. The nucleotide sequences that were generated for this study are shown in red circles.

Investigation of Lumpy Skin Disease (LSD) in Bangladesh

M Giasuddin[1*], MA Yousuf[1], MZ Ali[1], MH Rahman[2], MZ Hassan[1], M Hasan[1], MN Akter[1] and KN Shithi[1]

[1]Animal Health Research Division and [2]Goat and Sheep Production Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka 1341, Bangladesh. *Correspondence at mgias04@yahoo.com

Executive summary

Lumpy Skin Disease (LSD) is an emerging infectious disease of cattle in Bangladesh but it is endemic in Africa. The disease has widely been spreading in the last few years to many other countries in Asia and some parts of Europe. In Bangladesh, the disease has been detected for the first time in April 2019 in the southern part of the country and then continued to spread all over the country. The disease caused enormous economic losses including little mortality. The research was conducted on two objectives including isolation and identification of LSDV and its molecular characterization. LSD suspected samples were collected from Dhaka (Dhamrai), Jessore, Jhenaidaha, Chattogram, Rajshahi, and Pabna. In this study, a total of 36 clinically suspected LSD samples of skin crust nodules, pus and ocular discharge were collected and stored at -80^{0}C in animal health research laboratory, BLRI. The genomic DNA were extracted by Monarch® Genomic DNA Purification Kit according to manufacturer protocol. Collected samples were tested by PCR with the specific primers and protocol for LSD virus, goat pox virus, and sheep pox virus. Out of 36 samples 28 (78%) samples were found PCR positive. LSD virus was also identified from pus and ocular discharge of infected cattle. The positive samples were cultured into lamb testicular cells and reconfirmed by PCR. Then positive 4 isolates of LSDV was attenuated into the Vero cell line. The RNA polymerase subunit (RPO30) gene (606bp) of Capripoxviridae was sequenced and constructs a phylogenetic tree (Figure 1) and sequences were submitted into Genbank. The phylogenetic analysis has shown that all 4 samples were identical, a single strain circulating in the area of the study. In the Genbank the sequences show an identity of 100% with LSD strain isolated in Kenya (MN072619), a strain used in a commercial vaccine (KSGP 0240) (KX683219) the NI-2490 isolate Neethling 2490 (AF325528) from South Africa. The results indicated that the LSD virus is circulating in outbreak areas which are similar with South African Neethling 2490 strain. It may be concluded that this study facilitates for the development of LSD vaccine as well as control the LSD virus in Bangladesh.

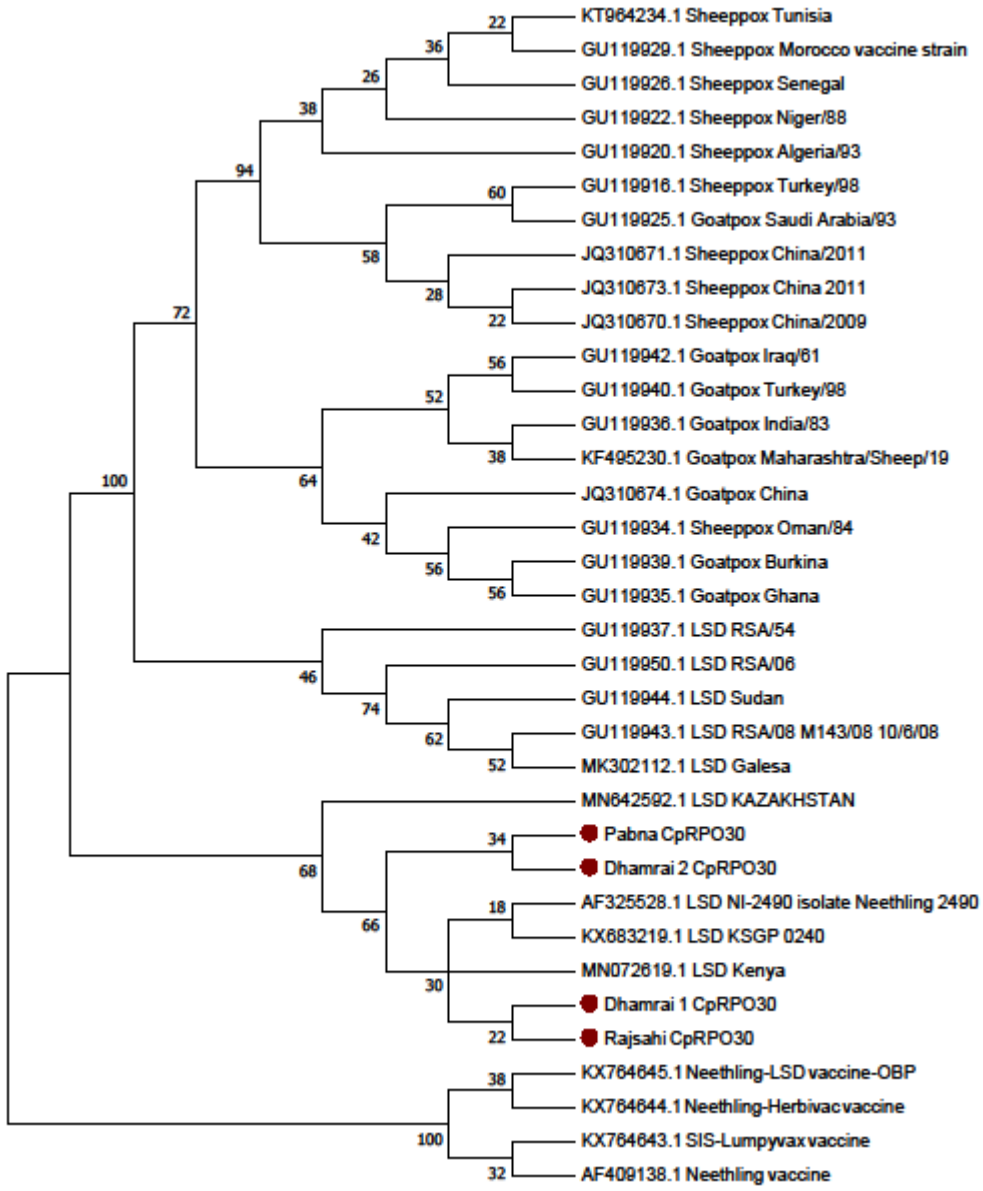

Figure 1. Phylogenetic tree of lumpy skin disease virus on RPO30 gene by the Maximum Likelihood method. The red circles shown the virus sequenced under this research.

Monitoring of Peste des Petits Ruminants (PPR) virus and PPR like disease in Bangladesh

M Giasuddin*, MA Yousuf, MZ Ali, MZ Hassan, N Dhar, MS Alam, MN Akter and KN Shithi

Animal Health Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka 1341, Bangladesh.
*Correspondence at mgias04@yahoo.com

Executive summary

Pestides Petits in Ruminants (PPR) is the most important infectious endemic disease in small ruminants (Sheep and Goat) in Indian subcontinent especially in Bangladesh which causes remarkable economic losses annually. This project was conducted during the period of 2019-20 for aiming, to monitor the PPR control strategy in Bangladesh, surveillance of PPR and PPR like diseases. Blood sera were collected randomly from vaccinated goats and sheep flocks at different age in the selected areas and tested with cELISA kit (ID.Vet, France) to assess the antibody titer.
A total of 512 serum samples were collected from goat by random sampling methods from Misridyara, Bohirampur and Modhukhali villages of Jichogacha upazilla under Jeshore district. Among them, 92 serum samples were from 48 months post vaccination goat in the village of Misridyara and 86 were from unvaccinated goat below 6 month of age in Bohirampur and Modhukhali villages, an checked their seropositivity by c-ELISA (ID.Vet, France). Additionally, outbreak investigation of PPR and PPR like diseases in goat was conducted throughout the country and a total of 25 nasal swabs and feces samples (clinically suspected to PPR and PPR like diseases) were collected from outbreak areas and transported to SAARC Regional Leading Diagnostic Laboratory for PPR and stored at –80ºC. The samples were processed and RNA was extracted using the protocol of RNA extraction kit (Invitrogen, Thermo Fisher scientific®, USA). Reverse transcriptase-polymerase chain reaction (RT-PCR)
The results showed that an overall seroprevalence of PPR in goat was 83.60% (428/512). It is also showed that, out of the 92 and 86 serum samples, the seroprevalence of PPR were 93.47% (86/92) and 32.6% (28/86), respectively in the goat of 48 months post vaccination (Figure 1) and goat of below 6 months age. From the 25 clinical samples of outbreak investigation areas, 68% (17/25) were confirmed PPRV by RT-PCR targeting of the N-gene. In our investigation, it is noticed that the PPR disease outbreak pattern was near to zero in Misridyara village (Figure 2). On the other hand, for the development of PPR vaccine seed, a total of 64 passages in vero cell completed successfully, jointly conducted by BLRI and BAU and is ready for animal trail. In conclusion, it can say that the current study will be helpful for the eradication program of PPR by 2030 to achieve SDG goal 2.

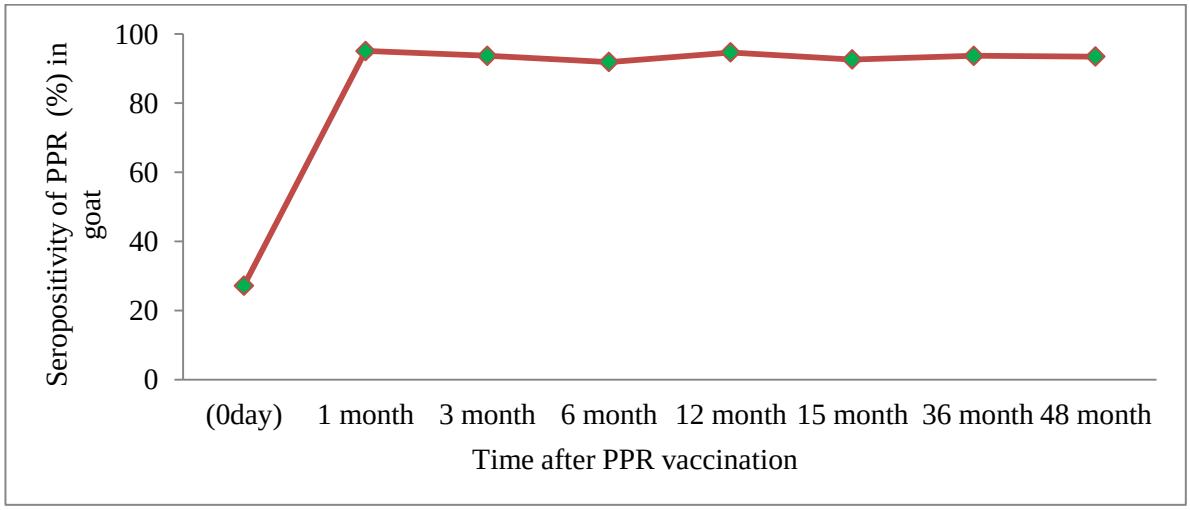

Figure 1. Seropositivity of PPR in goat up to 48 months in the village of Misridyara.

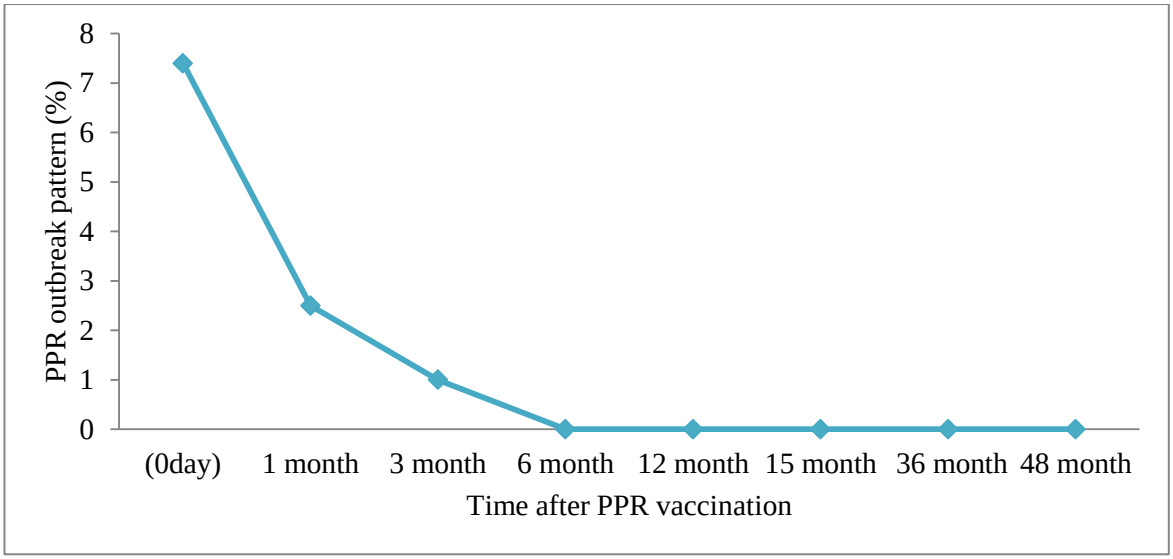

Figure 2. Outbreak of PPR disease up to 48 months post vaccination in Misridyara village.

Molecular characterization of *Babesia*, *Anaplasma* and *Theileria spp* from suspected ruminants and formulation of vaccine

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Executive summary

Babesiosis, Anaplasmosis, and Theileriosis (BAT) are endemic blood protozoan diseases in tropical and sub-tropical countries including Bangladesh. Exotic and high-yielding animals are more susceptible to BAT than the local animals. BAT are the vector-borne blood protozoan diseases that are mainly transmitted by tick biting and affecting the Red Blood Cell (RBC) of an animal. These diseases are transmitted biologically by ticks (vector) and mechanically by biting flies. Usually, local animals act as a persistent carrier but possess a detrimental effect on exotic and high-yielding animals. High humidity and temperature aggravated the multiplication of the protozoa and provoked the outbreaks. Losses directly related to morbidity, mortality, production losses together with the cost of veterinary diagnosis, treatment, and tick control. Moreover, about 21 billion US$ losses globally due to BAT outbreaks in animal health. The local animal has shown a positive response to the line of treatment, but in high-yielding animals, it was very low and even detrimental, and available vaccination is limited against these silent killer diseases. For showing this importance, this research project was mobilized, for the purpose of isolation, identification, and characterization of BAT spp from cattle & sheep, and evenness development and formulation of autogenous blood protozoan vaccine and its field efficacy trial.

A total of 300 blood samples were collected from cattle and exotic sheep in different areas of Bangladesh. Of the 300 samples, 273 and 27 were from cattle and exotic sheep, respectively. Then these samples were screened through positivity in 10% Giemsa's staining thin blood smear microscopy technique. The positive screened blood samples were pooled (10 samples in each). Subsequently, the samples were processed and DNA was extracted using the protocol of DNA extraction kit (Invitrogen Purelink Genomic DNA mini kit, Cat. no. K1820-01) and multiplex Polymerase chain reaction (PCR) was carried out in a final reaction volume of 25 µl in the thin-walled PCR tubes for the amplification of target genomic DNA of Babesia, Anaplasma and Theileria species by Bilgic *et al*., 2019.

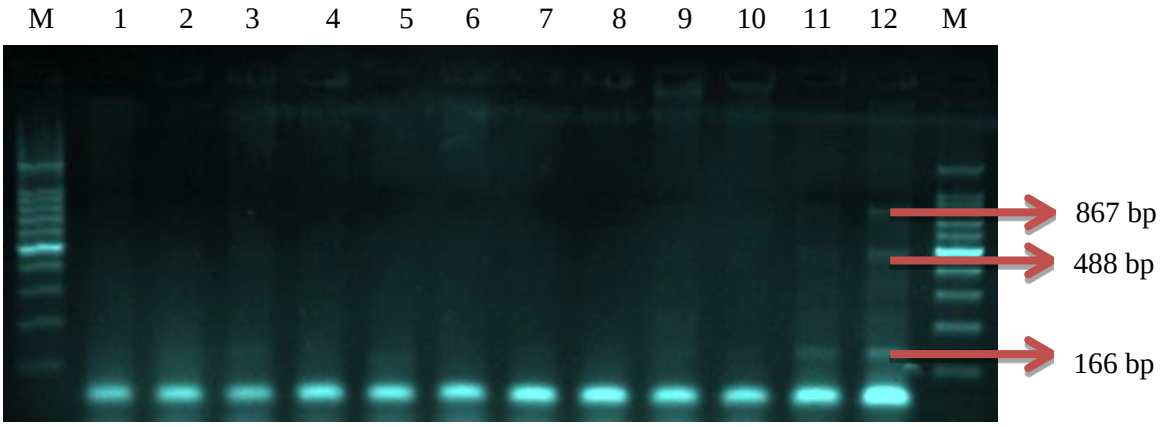

Figure 1. Multiplex PCR of *Babesia bovis*, *Anaplasma ovis*, and *Theileria ovis* showed a positive band at 166bp, 867bp, and 488 bp, respectively (M=ladder, 1-12= samples).

Afterward, the PCR positive blood samples were selected and used for the development of experimental autogenous blood protozoan vaccine (BPV). The blood protozoa were isolated through lysis of RBC by ammonium chloride and, then protozoan fragments were killed by heat treatment. Subsequently, we counted and used a total of 1×10^6 blood protozoan fragments per ml of vaccine

seed. This vaccine seed was mixed with oil adjuvant at the ratio of 1:200 and used for its efficacy trial in the exotic sheep (Dhamara, Dorper, Suffolk, Parendale) in BLRI Sheep Research Farm. During the experimental trial, the vaccine was introduced @3ml (containing 3×10^3 fragments of antigen) subcutaneously in adult exotic sheep. A total of 50 serum samples were collected randomly at 0 days, 4, 8, 12, 16, 20, 24 weeks of post-vaccination and checked the antibody titer by c-ELISA kit (Cat no: 283-2, 182 Reaction, VMRD, USA) against *Babesia ovis* and *Anaplasma margenale*.
Of the total pooled samples, 9 were positive to different blood protozoa by PCR and their expected band were 166 bp, 422 bp, 518 bp, 265 bp, 867 bp, 312 bp, and 488 bp respectively in *Babesia bovis*, *Babesia ovis*, *Babesia motasi*, *Anaplasma marginale*, *Anaplasma ovis*, *Theileria Aannulata*, and *Theileria ovis* (Figure 1). Out of 50 serum samples, the seroprevalence of blood protozoan killed vaccine were 0%, 76.67%, 77.55%, 79.50%, 80.50%, 79.72% and 69.30% respectively at, 0 days, 4, 8, 12, 16, 20, and 24 weeks of vaccination (Figure 2).

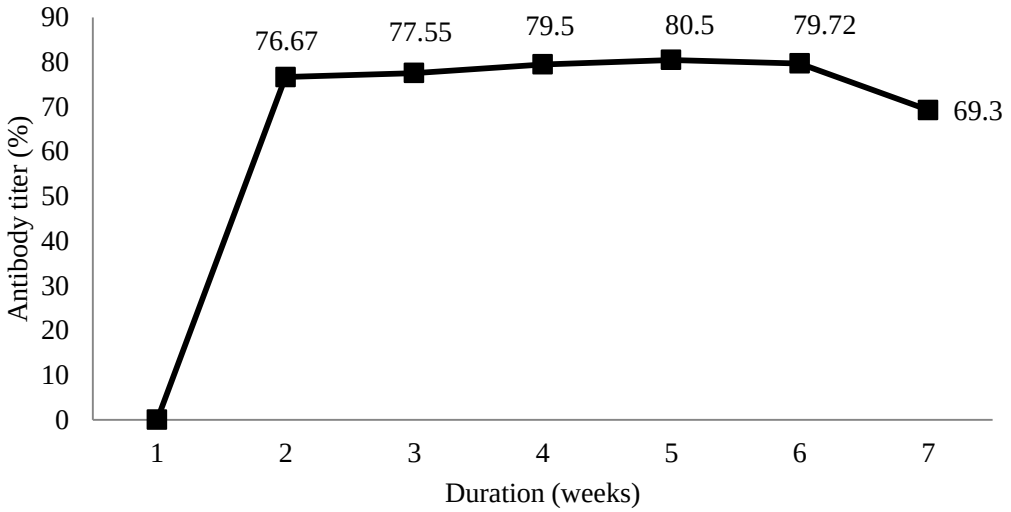

Figure 2. Antibody response against autogenous blood protozoa vaccine in exotic sheep on BLRI research farm.

In conclusion, it can be said that the experimentally developed BP vaccine are working well, but need further research for its extensive field trial and challenge study.

Investigation of goat diseases and isolation and identification of Pneumonic Pasteurellosis in goat

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Executive summary

Goat is secondly important livestock species in Bangladesh. The popularity of goats rearing is increasing in Bangladesh day by day for fulfilling the growing demand of safe animal protein. The occurrences of diseases are an important factor which increasing the morbidity and mortality of goats, losses the productivity and affects the economy of goat farming. For this purpose, the present study was carried out i) to determine the overall diseases prevalence of goat in the selected areas (Muktagacha, Valuka, Savar, Jashore, Chuadanga, Meherpur, Rajshahi, Kustia and Naikhongsori), ii) to isolate and identify the pneumonic Pasteurella in goat (Pasteurellosis). For achieving the objectives, the investigation of the prevalence of common infectious cases of goat was conducted in the selected areas of Bangladesh during the period of July 2019 to June 2020. A record keeping system was developed and data were recorded from the selected areas for drawing a pictorial view to find out the most prevalent diseases. Besides, a total of 105 samples (94 nasal swabs and 11 lungs tissues from dead goats) of goats suspected to pneumonic Pasteurellosis (clinically characterized by prominent respiratory signs such as mucoid nasal discharge, respiratory distress and coughing) were collected aseptically and transported to the small ruminant's research laboratory, BLRI, from the selected areas where all the goats were vaccinated by PPR vaccine. Subsequently, collected samples were processed and cultured in the laboratory for the isolation of Pasteurella spp. Followed by, isolated bacterium was identified by biochemical features (positive for catalase, oxidase, indole production, negative for urease, presence of hemolysis on blood agar, gram negative, no growth on MacConkey agar) later on confirmed by polymerase chain reaction (PCR). The genomic DNA was isolated using DNeasy Blood and Tissue Kit (Qiagen, USA) as per the manufacturer's instructions. PCR amplification was carried out targeting the 16S rRNA gene using universal primer (Macrogen, South Korea). Additionally, antimicrobials susceptibility test was performed to know the sensitivity pattern of different antibiotics towards the bacterium in small ruminant's research laboratory, BLRI.

In this study, we recorded the cases of worm infestation, non-specific pneumonia, abortion, bloat, diarrhea, dystocia, PPR, FMD, mastitis, retention of placenta, lice infestation, lameness and dog bite from above mentioned selected areas. Among these, the most prevalent cases were, worm infestation (29.34%), non-specific pneumonia (14.39%), diarrhea (9.05%) and bloat (8.38%). Of the 105 suspected samples, 51 (48.57%) were confirmed as Pasteurella by PCR targeting gene was 16S rRNA and base pair was 1466 bp. Among confirmed samples 94/45 (47.87%) and 11/6 (54.55%) were nasal swabs and lung tissue, respectively. We found the Pasteurella bacterium showed poor susceptibility to β-lactams, aminoglycosides and fluoroquinolones.

High prevalence of pneumonic pasteurellosis leads to high goat morbidity and mortality. The occurrence of pasteurellosis might have been predisposed due to environmental and nutritional stress. Isolation and identification of Pasteurella spp. confirmed the occurrence of pneumonic pasteurellosis in the affected goats in Bangladesh.

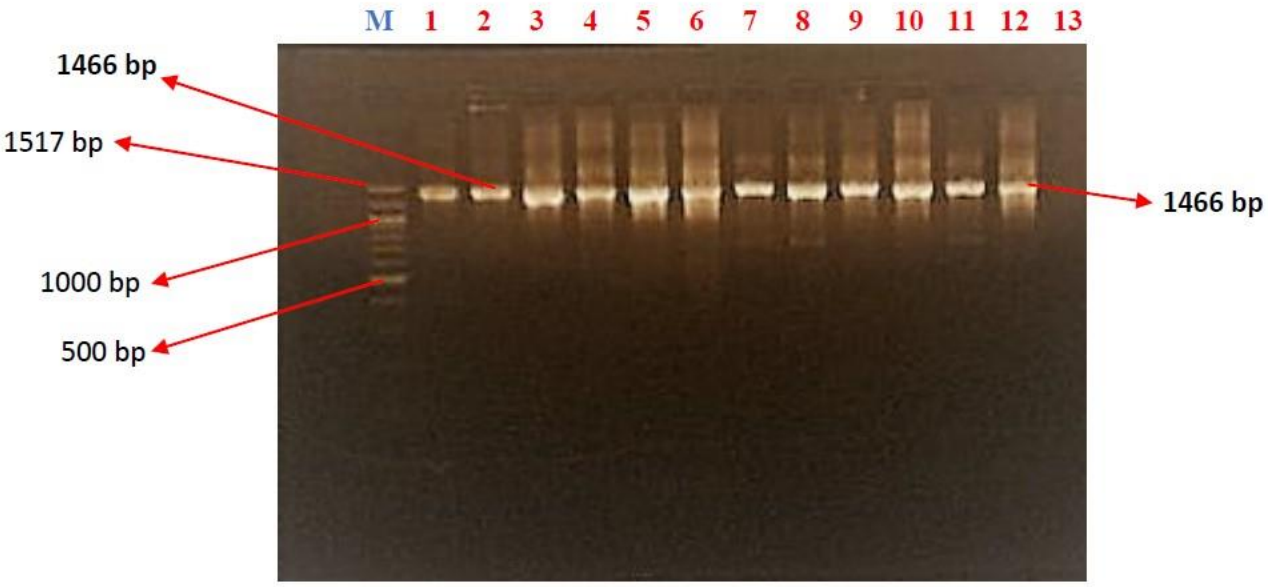

Fig: Amplification of 16S rRNA gene (1466 bp) of Pasteurella sp.
Lane M: 100 bp ladder; Lane 1-12 test positive; lane 13 test negative.

Improving production performance of local buffalo through crossbreeding

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Executive summary

Bangladesh has been adopting crossbreeding in buffalo for improving milk production efficiency of indigenous buffalo since 2013. A number of crossbred buffaloes were born throughout the country. Bangladesh Livestock Research Institute (BLRI) is also conducting research on crossbreeding of indigenous buffalo with Murrah and Nili-Ravi breeds at the institute's buffalo research herd.However, performance of crossbred buffalo in the country is yet to be studied. Considering, above facts, this study aimed to produce crossbred buffalo for evaluating their productive and reproductive performance and to validate estrus synchronization (ES) protocol at BLRI Buffalo Research Farm. To produce crossbred buffalo, indigenous buffalo cows were naturally mated by pure Murrah and Nili Ravi breeding bulls or artificially inseminated with semen of pure Murrah and Nili-Ravi breeding bulls. For this purpose, 3 pure Murrah and 3 pure Nili-Ravi breeding bulls were imported from India in 2017. Body weight from birth to 48 months of age, age at first heat and calving and gestation period were recorded to evaluate performance of Murrah×Indigenous and Nili-Ravi×Indigenous crossbred buffaloes at BLRI. Estrus synchronization (ES) protocol was applied in 10 buffalo cows at BLRI Buffalo Research Farm. The ES protocol included GnRH administration at any stage of the cycle (day 0) followed by administration of $PGF_{2\alpha}$ on day 7. Two times AI were done on day 9 (morning and evening) followed by administration of 2^{nd} dose of GnRH. To detect ovulation time in ES buffalo cows, same ES protocol was applied in 15 buffalo cows. Follicular growths were recorded throughout the experimental period using ultrasonography once daily up to 10^{th} day and daily four times until sign of ovulations were observed. Moreover, total follicles numbers per buffalo cow and diameter of largest follicles and corpus luteum in natural estrous cycle were also evaluated during this experiment. Blood samples were collected from buffalo cows under ES during experiment for studying hormonal profiles including progesterone, FSH and LH.

Total 91 crossbred buffalo calves were born at BLRI since 2016. Among total crossbred buffaloes, 43 crossbred calves (27 Murrah×Indigenous and 16 NiliRavi×Indigenous crossbred buffalo) were born during the experimental period of July 2019 to June 2020. Murrah×Indigenous and Nili-Ravi×Indigenous crossbreds have similar liveweight ($P<0.05$) at birth (30.07±0.64 VS 29.93±0.64 kg), 6-month **(**87.69±24.07 vs 88.16±26.66 kg), 12-month **(**142.43±26.43 vs 153.23±52.36 kg), 18-month (190.65±21.49 vs 175.38±29.37 kg), 24-month (283.50±70.97 vs 216.50±31.23 kg), 30-month (289.75±46.46 vs 282.80±14.79 kg), 36-month (311.20±41.10 vs 362.33±9.29 kg) and 48-month (394.00±14.14 vs 462.67±85.47 kg). Nili Ravi×Indigenous crossbred (472.0±31.95 kg) showed more body weight than Murrah×Indigenous crossbred buffalo (382.0±15.03 kg)at 48 month of age (Table 1). Three Murrah×Indigenous and one Nili-Ravi crossbred heifers showed first heat at 767, 1126, 1238 and 1195 days, respectively. Two Murrah×Indigenouscrossbred heifers delivered their first calf at 1065 and 1457 days with gestation period of 298 and 299 days. About 11crossbred calves (6 Murrah and 5 Nili-Ravi crossbreds) were infected with parasites (ascariasis, coccidiosis, nematode and mite infestation) and 3crossbred calves (1 Murrah and 2Nili-Ravi crossbreds) were infected with bacteria (joint ill and calf scour) under one year of age. Seven calves were died among the infected calves. Hence, the overall calf mortality was 7.96%.

All treated buffalo cows were responded on hormonal administration as measured by estrous behavior and rectal palpation. However, only one buffalo cows conceived and subsequently delivered calf. Therefore, the conception rate on ES was 10%. To find out the reasons behind low conception in ES, the ovulation times were recorded by ultrasonographic examination of buffalo cows. About 33.33 % buffalo cows ovulated 66 to 74 hr after administration of $PGF_{2\alpha}$ and 66.67%

buffalo cows ovulated after 84 to 96 hr. Therefore, low conception in ES might be associated with delayed ovulation. To validate whether delayed ovulation lowered conception in ES, another 5 buffalo cows were subjected to similar ES protocol except AI were done in 9th day evening and 10th day morning. Among 5 cows, 4 showed heat and subjected to AI. Among 4 cows 2 cows returned to estrus after 60 days of AI. The other reasons for low conception rate in ES might be associated with breeding seasons. The ES experiments were conducted during off breeding season of buffalo. Numbers of follicles per buffalo cows in the ovary, diameter of ovulatory follicles and corpus luteum were shown in Figure 1. Ovulatory follicles must reach 11 to 12 mm before ovulation (Figure 1).The average length of estrus cycles were 22.82±1.72 days and average ovulation times were 50.08±13.40 hr after showing first heat during natural estrous cycle. Estrus symptoms were confirmed by observation of uterine tone by rectal palpation.

Table 1. Productive performance (Mean ±SE) of Murrah and Nili Ravi F_1 crossbred buffalo at BLRI Buffalo Research Herd.

Live body weight at (kg)	Murrah×Indigenous	Nili-Ravi×Indigenous
Birth	31.08±4.59 (53)	31.30±4.23 (38)
6-month	87.69±24.07 (32)	88.16±26.66 (25)
12-month	142.43±26.43 (14)	153.23±52.36 (13)
18-month	190.65±21.49 (17)	175.38±29.37 (8)
24-month	283.50±70.97 (16)	216.50±31.23 (5)
30-month	289.75±46.46 (12)	282.80±14.79 (5)
36-month	311.20±41.10 (5)	362.33±9.29 (3)
48-month	394.00±14.14 (2)	462.67±85.47 (3)

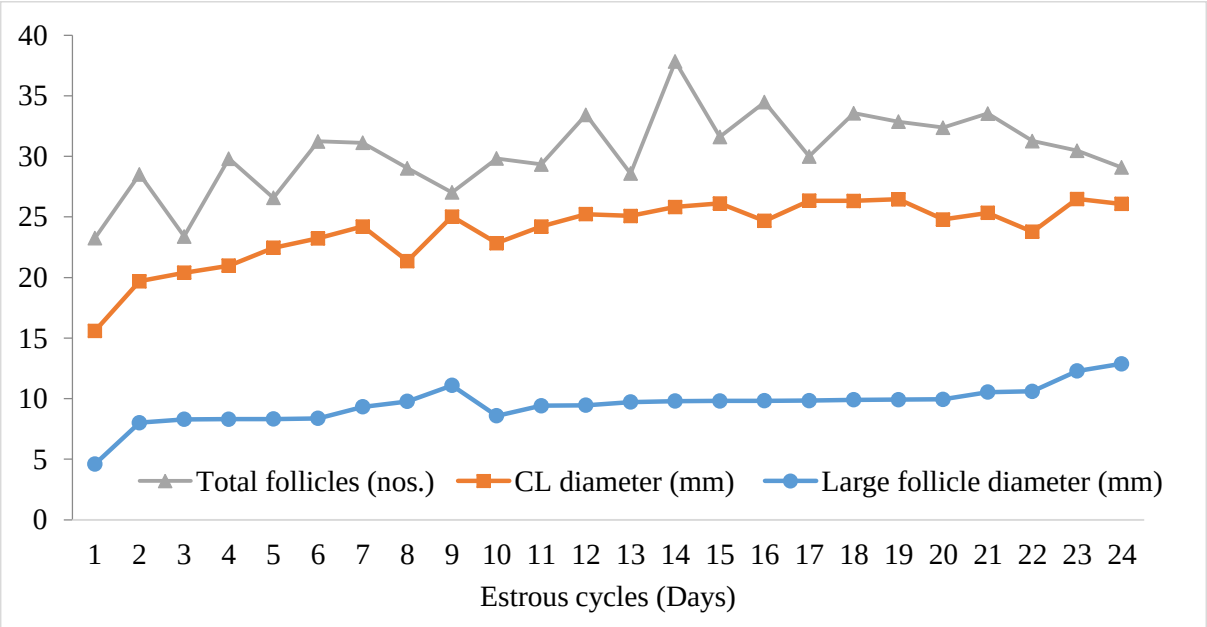

Figure 1. Numbers of follicles, diameter of largest follicle and corpus luteum (CL) during natural cycle of buffalo cows.

Conservation and improvement of farm animal genetic resources (FAnGR) at Hilly region in Naikhongchari

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Executive summary

The objective of this project was to improve the production potentialities of farm animal genetic resources and fodder cultivation technique in the Hilly areas. Under this programme, six experiments were executed. The 1st experiment was validation of Urea Molasses Straw (UMS) for sustainable lamb production at hilly areas. Conducting study for a period of 105 days with 3 dietary treatments; T_1=Green grass *adlibitum*+Concentrate@1%BW; T_2=UMS *adlibitum* + Concentrate @ 1%BW;T_3=Green grass *adlibitum* in morning+UMS *adlibitum* in afternoon+Concentrate@0.5%BW and 4 replications. The 2nd experiment was study on the biomass and DM yield of Napier-4 grass up to 3rd cutting using different doses of fertilizer and there were 4 treatments; T_0=Only Urea 50kg/ha; T_1=T_0+Cowdung 15ton/ha; T_2=T_0+TSP 70kg/ha; T_3 =T_0+Cowdung 15ton/ha+TSP 70kg/ha and 3 replications. The 3rd experiment was comparative study on the productive and reproductive performances of native sheep under farming and household condition. A total of 85 native sheep were distributed among 17farmers in Naikhongchari hilly areas and also were maintained 85 sheep in Naikhongchari BLRI research farm. The 4th experiment was quality evaluation of maize silage incorporated with felon and molasses. There were 4 treatments; T_1=Maize fodder (MF) only; T_2=MF+2% felon+25g molasses/kg MF; T_3=MF+4% felon+50g molasses/kg MF; T_4=MF+5% felon+100g molasses/kg MF. The 5th experiment was economic status evaluation of hilly chicken reared in hilly areas of Naikhongchari. A total of 100 hilly chickens were distributed among 10 farmers and provided vaccine/technical support to the farmer and data were recorded. The 6th experiment was the effect of different doses of fertilizer on zero tillage cultivation of Napier-4 grass in hilly area. There were 4 treatments; T_0=without fertilizer; T_1=Cowdung 15ton/ha; T_2=Urea 50kg/ha; T_3=Cowdung 15ton/ha +Urea 50kg/ha and 3 replications.
Result showed from 1st experiment that average daily gain of sheep for T_1, T_2 and T_3 group were 80.50±2.15, 68.57±5.04 and 70.83±3.69g, respectively. Dry Matter intake is maximum in T_2 and minimum in T_3 group. FCE was most desirable in T_3 group. From 2nd experiment, fertilizer doses have no significant effect on number of propagation for all treatment (Table1).

Table 1. Effect of different doses of fertilizer on production performance of Napier fodder

Cutting	Parameter	T_0	T_1	T_2	T_3	Sig. Level
1st cutting	Fresh yield, ton/ha	35.67±2.0	27.19±2.3	31.63±1.0	34.88±2.4	0.065
	DM (%)	15.70±1.0	16.69±0.2	15.93±0.5	17.65±1.1	0.394
	Plant Height (inch)	69.44±7.9	63.56±8.0	65.78±6.6	75.00±7.9	0.738
	Propagation No.	18.60±3.3	16.53±2.0	18.80±2.8	11.20±3.2	0.528
2nd cutting	Fresh yield, ton/ha	63.02±3.9	62.87±0.8	63.94±2.0	63.51± 2.1	0.989
	DM (%)	13.06±0.8	12.56±0.8	12.49±0.3	12.46±1.1	0.949
	Plant Height (inch	72.22±5.6	68.22±4.9	70.22±5.0	71.22±4.9	0.953
	Propagation No.	27.00±4.4	23.20±3.59	22.47±3.2	25.33±3.8	0.831
3rd cutting	Fresh yield, ton/ha	72.21±11.8	44.09±1.6	32.55±32.5	106.70±4.4	0.066
	DM (%)	19.13±3.1	17.02±0.3	16.46±0.1	17.42±0.3	0.669
	Plant Height (inch)	74.89±5.8	59.44±4.5	81.00±11.8	91.78±6.4	0.005
	Propagation No.	16.20±2.4	11.53±1.8	18.60±5.4	17.47±1.8	0.200

From 3rd experiment, birth weight, litter size, weaning weight, growth rate and mortality rate under farming and household condition were 1.42±0.02 and 1.45±0.04kg; 1.60±0.12 and 1.74±0.20; 7.12±0.6 and 8.20±0.16kg; 64.28±1.42 and 73.34±0.84g/day; 4.60±0.18 and 9.25±0.30, respectively. From 4th experiment, T_3 group silage had better in terms of physical, chemical and

microbiological point of views (color, odor, texture and palatability) than others group. From 5th experiment, adult body weight, eggs production of hilly chicken was 1500-1600g and 152/bird/year. Family eggs and meat consumption is improved as well as to increase family income by selling eggs and live bird. From 6th experiment, T_3 group had higher biomass yield than others group (Table 2)

Table 2. Production potentiality of Napier fodder under zero tillage cultivation.

Cutting	Parameter	T_0	T_1	T_2	T_3	Sig. Level
1st cutting	Fresh yield, ton/ha	42.84±9.0	52.00±13.5	58.20±37.1	56.63±3.5	0.949
	Plant Height (inch)	32.44±3.3	48.33±6.8	59.00±5.1	42.56±4.4	0.008
	Propagation No.	11.56±2.4	11.89±1.8	15.56±3.7	12.67±2.2	0.705
2nd cutting	Fresh yield, ton/ha	35.15±8.7	29.94±15.0	104.28±19.6	54.62±14.9	0.030
	Plant Height (inch)	66.78±7.1	81.56±7.7	94.56±5.3	88.56±7.5	0.050
	Propagation No.	12.11±2.2	8.11±1.2	14.78±2.9	10.22±1.4	0.156
3rd cutting	Fresh yield, ton/ha	42.08±8.9	68.13±14.8	117.49±21.5	62.10±14.3	0.046
	Plant Height (inch)	88.33±9.7	104.89±9.8	112.33±12.9	99.44±8.5	0.429
	Propagation No.	14.00±1.8	16.00±2.2	17.67±2.7	15.22±1.8	0.697

Value indicate-Mean ± Standard Deviation (SD)

From the findings paves the way of cultivating Napier fodder without destroying the nature and straw based sheep production had positive impact on FCE and sheep performances in community showed better results than farm stock and it may be due to lower stocking density and further study should be needed for other FAnGR at hilly region.

Conservation and improvement of native chicken: performance of eighth generation

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Executive summary

The present study was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka with the objectives (i) to assess the performances of three native chicken genotypes under intensive management, (ii) to select parental birds (males and females) and breed them in an assortative plan for the production of eighth generation birds and (iii) to study the comparative performances of three indigenous chickens and Kadaknath chicken. A total of 4983-day-old chicks comprising of 3 types of chicken namely Naked Neck (NN-1698), Hilly (H-1141) and Non-descript Deshi (ND-2144) were hatched to produce eighth generation (G_8**)**. In eighth generation (G_8), selection was practiced at two stages. Firstly at 8 week of age according to 8 week's body weight and secondly, selection was practiced at 40 week of age on the basis of selection index to produce next generation comprising the parameters of body weight (BW) at 40 week, egg production (EP) up to 40 week, egg weight (EW) at 40 week and age at maturity (ASM). For Kadaknath, a total of 400 pedigree hatched day old chicks were identified individually by wing band. A total of 120 eggs were collected at the 72 weeks of age from hens of Non-descript Deshi, Hilly, Naked Neck and Kadaknath genotypes. Internal and external egg quality characteristics were measured. The eggs were broken and the thick albumen heights were measured from at least 3 places in each egg with tripod micrometer. The yolk colors were measured by comparing egg yolk with the Roche Yolk Color Fan manufactured by F. Hoffman La Roche Co.Ltd., Switzerland. All data were analysed by one-way analysis of variance using the PROC GLM procedure in SAS and differences were determined by DMRT.

Chick weights of ND, H and NN were 32.24±0.65, 32.84±0.70, 30.84±0.38g; respectively (Table 1). Non-descript Deshi hens (151.12 days) tend to produce their first egg at a younger age than the Hilly (155.19days) and Naked Neck (155.62 days) (Table 1). Annual egg production was significantly ($p<0.001$) higher in Naked Neck (189.36) than the Hilly (164.11) and Non-descript Deshi (182.55). The percent fertility of eggs obtained from ND hens was significantly ($p<0.001$) higher with the values of 88.22%. On the other hand, the result of the present study also showed that Hilly hens had a non- significantly ($p>0.05$) higher hatchability on fertile eggs of 91.05%. Non-significantly highest shape index (76.52) was found in Hilly genotype and lowest (74.19) in Kadaknath genotype (Table 2). The observed haugh units of the present study were 83.56 for Non-descript Deshi, 77.68 for Hilly, 78.90 for Naked Neck and 77.10 for Kadaknath genotypes. Yolk color was not affected ($p>0.05$) by genotype. The estimated values of yolk color are 7.53 for ND, 7.86 for H, for 7.60 NN and 8.19 for K.

Table 1. Performances of Non-descript Deshi, Hilly and Naked neck genotypes under intensive rearing system

Parameter	Genotype			SEM	Level of sig.
	ND (Mean ±SE)	H (Mean ±SE)	NN (Mean ±SE)		
Chicks weight (g)	32.24±0.653	32.84±0.703	30.84±0.383	0.382	NS
Annual egg production (no)	182.55^{b}±2.117	164.11^{c}±1.37	189.36^{a}±0.746	2.715	p<0.001
Egg Production (%)	50.01^{b}±0.	44.96^{c}±0.376	51.88^{a}±0.204	0.744	p<0.001
Age at sexual maturity (d)	151.12^{b}±0.725	155.19^{a}±0.994	155.62^{a}±0.912	0.687	p<0.01
Fertility (%)	88.22^{a}±0.800	81.60^{c}±1.036	85.26^{b}±0.699	0.855	p<0.001
Hatchability (%) on fertile eggs	85.88±2.018	91.05±1.714	84.38±1.261	1.182	NS

ND=Non-descript Deshi; H=Hilly; NN=Naked Neck; least squares means without a common superscript along the row within a factor differed significantly ($p<0.001$).

Table 2. Comparative egg quality parameter measurements of Common Deshi, Hilly, Naked Neck and Kadaknath chicken at 72 weeks of age.

Parameters	Genotype				SEM	Level of sig.
	ND	H	NN	K		
Egg weight (g)	47.22	47.34	47.72	48.10	0.292	NS
Albumen height (mm)	6.49	5.58	5.80	5.56	0.195	NS
Albumen width (mm)	60.07	66.02	60.62	62.85	1.237	NS
Albumen length (mm)	78.40	82.48	79.70	82.03	1.193	NS
Yolk color	7.53	7.86	7.60	8.19	0.177	NS
Yolk height (mm)	17.19	16.67	17.25	16.71	0.128	NS
Yolk width (mm)	40.96	40.22	39.75	41.48	0.367	NS
Shell weight(g)	5.09	5.32	5.35	7.31	0.509	NS
Shell thickness (mm)	0.52	0.53	0.51	0.46	0.011	NS
Shape index%	75.66	76.52	74.72	74.19	0.442	NS
Albumen index%	6.65	5.56	6.05	5.42	0.290	NS
Yolk index%	39.51	41.55	43.48	38.90	1.118	NS
Haugh unit	83.56	77.68	78.90	77.10	1.336	NS

ND=Non-descript Deshi; H=Hilly; NN=Naked Neck; K=Kadaknath; Sig.=Significance; NS=Non-significant ($p>0.05$)

Findings revealed that Naked Neck is better for egg production though Non-Descript Deshi attains maturity at an earlier age. For further improvement selection should be continued.

Performances study of BLRI improved native duck genotypes: 6th generation

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Executive summary

Genetic improvement of native ducks is our priority for increasing their productivity, as genetic information is inherited from parents to offspring. Two native duck variety, Rupali (Whole body dominant white plumage) and Nageswari (Black plumage with white breast) were selected aiming to increase their laying performances. Therefore, a selective breeding program was undertaken to improve the performance over the generation. Thus, this year sixth generation (G_6) performance of both duck genotypes was evaluated. A total of 1000 ducklings of both genotypes were hatched and brooded in brooder house in poultry research shed at BLRI. Male and female ducks were separated and marked with wing band at 12 weeks of age. Diets containing 20 % CP and 3000 Kcal ME/kg DM; 16% CP and 2750 Kcal ME/kg DM and 17.5% CP and 2750 Kcal ME/kg DM was provided during starter, grower and laying periods, respectively.The drinking water was provided *adlibitum* throughout the day. All the birds were reared in a natural-ventilated duck house and providing 16h photoperiod with 12h sunlight and 4 h artificial lights. All productive, reproductive and egg quality data were recorded. At 40 weeks of age, a total of 200 ducks were selected on the basis of selection Index comprising the parameters of age at first egg, body weight at first egg, egg production % and egg weight. The individual with the higher total score was selected for breeding purposes. The selection intensity and expected selection responses of selection criteria of two duck genotypes were estimated. All recorded data were analyzed by SAS and differences were determined by DMRT.

Table 1. Estimation of genetic parameters of Rupali and Nageswari ducks in sixth generation (G_6).

Genotype	Traits	Before selection	After selection	Selection differential (S)	Selection intensity (i)	Heritability (h^2)	Selection responses ®
Rupali	ASM (d)	149.02	144.40	-4.62	-0.36	0.4	-1.84
	EW(g)	55.36	57.54	2.17	0.38	0.5	1.08
	BW(g)	1705.75	1758.63	52.87	0.38	0.5	26.43
	EP(%)	60.69	63.71	3.02	0.45	0.15	0.45
Nageswari	ASM (d)	144.29	132.64	-11.65	-0.84	0.4	-4.66
	EW(g)	52.07	54.78	2.70	0.69	0.5	1.35
	BW(g)	1606.89	1683.96	77.06	0.74	0.5	38.53
	EP (%)	58.40	63.29	4.88	0.80	0.15	0.733

ASM-Age at sexual maturity, BW-Body weight, EW-Egg weight, EP-Egg production

According to selection criteria, genetic parameters for traits are shown in Table 1. In 6th generation, selection differential of ASM, EW and EP for Rupali and Nageswari were -4.62 and -11.65; 2.17 and 2.70; 3.02 and 4.88, respectively. The intensity of selection for ASM, EW and EP were -0.36 and -0.84; 0.38 and 0.69; 0.45 and 0.80 for Rupali and Nageswari ducks, respectively. As a result of selection, EW, and EP were expected to improve by 1.08 g, 0.45% and 1.35 g, 0.73% and ASM was expected to decrease by 1.84 and 4.66 days for Rupali and Nageswari duck; respectively. Growth and laying performance and egg quality traits of Rupali and Nageswari ducks are presented in Table 2. Growth performances up to 12 weeks of both genotypes did not show any significant differences but in case of laying performances,egg weight and egg mass were significantly higher in Rupali (64.83g, 39g) than Nageswari (61.30. 35.81). Rupali ducks were significantly ($p<0.05$) consumed more (134 g/d) feed than Nagesswari ducks (130.38g/d). The egg quality results showed that shape index% of Rupali (76.60) was significantly higher than Nageswari (75.11). On the other hand

albumen index, yolk index and Haugh unit were not found any significantly difference in both genotypes.

Table 2. Growth performanceand egg production and egg quality performances of selected Rupali and Nageswari ducks (n=200).

Parameters	Rupali	Nageswari	SEM	P value
0-12 weeks of age				
Body weight(g)	1671.00	1589.83	13.10	0.127
Weight gain (g)	1627.36	1548.82	31.28	0.479
Feed Intake (g)	5623.81	5124.91	45.98	0.367
FCR	3.45	3.30	0.06	0.217
24-40 weeks of age				
Egg production %	60.12	58.41	1.03	0.42
Egg weight (g)	64.83[a]	61.30[b]	0.61	0.002
Egg mass (g)	39.00[a]	35.81[b]	0.77	0.038
Feed Intake (g)	134[a]	130.38[b]	0.64	0.003
FCR	3.46	3.75	0.08	0.076
30 weeks of age				
Albumen height (mm)	9.94	9.50	0.38	0.604
Yolkcolor	8.46	8.77	0.16	0.394
Shell thickness (mm)	0.60	0.62	0.01	0.522
Shape index (%)	76.60	75.11	0.34	0.013
Albumen index (%)	10.10	9.23	0.44	0.374
Yolk index (%)	41.94	42.71	0.87	0.690
Haugh unit	96.95	95.56	1.66	0.700

The results revealed that Rupali ducks better in performance (body weight, egg weight, egg production rate) than Nageswari whereas, Nageswari duck lays egg earlier than Rupali through the generation consistently. Thus, both duck genotypes have unique genetic potentialities that could be used for the development of egg type duck genotypes suitable for Bangladesh.

Production and evaluation of crossbred sheep of Coastal with Damara, Dorper and Parendale

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Executive summary

Besides different conventional sheep, crossbred sheep can be a potential resource to minimize the deficiency of animal protein in Bangladesh. Synthetic breed can be developed from a combination of two or more breed and with varying proportion of inheritance from each of the participating breeds. Once the desired blood level reached the synthetic breed can be treated as pure breed in the making and after that, the breeding program will be selective breeding. However, very limited research work has done on synthetic sheep breed development in Bangladesh. Thus, the present study was undertaken to evaluate the productive and reproductive performances and also the adaptability of different crossbred genotypes in hot and humid climatic conditions. The breeding program was conducted at Goat and Sheep Research farm of BLRI. All the ewes and rams were housed in slated floor permanent house raise above the ground level with semi-intensive management system. This cross breeding program was conducted with native Coastal sheep as dam and Damara, Dorper and Parendale sheep as sire. The breeding program was designed in such a way that resists inbreeding and maintain 50% foreign blood. The selection targets of the study were to improve the birth weight and 12 months body weight. Subsequent data on productive and reproductive performances were recorded regularly. The collected data were analyzed by SPSS 17.0 Statistical computer programme.

Table 1. Productive and reproductive performances of different crossbred sheep genotype (Mean ± SE)

Parameters	Crossbred sheep genotypes		
	Damara-Coastal	Dorper-Coastal	Parendale-Coastal
Litter size (no)	1.64±0.06 (132)	1.40±0.13 (15)	1.50±0.15 (12)
Birth weight (kg)	1.96±0.05 (132)	2.29±0.10 (28)	2.28±0.12 (28)
Body weight at 3 months (kg)	9.85±0.32 (86)	11.18±0.59 (25)	10.51±0.39 (25)
Body weight at 6 months (kg)	12.98±0.46 (71)	14.76±0.64 (22)	14.40±0.61(20)
Body weight at 9 months (kg)	17.73±0.69 (59)	19.36±0.77 (17)	19.06±0.97 (11)
Body weight at 12 months (kg)	21.88±0.99 (49)	22.95±1.03 (13)	22.6±1.36 (7)
Average daily weight gain (gm/d)	54.20±2.25 (49)	56.73±2.79 (13)	54.87±3.51 (7)
Significance level	NS	NS	NS

Figure in the parenthesis indicate the number of observations. NS= Non significance (p>0.05)

The production performances of different crossbred sheep genotype are presented in Table 1. The average litter size, birth weight, body weight at 12 months and daily weight gain of Damara-Coastal crossbred genotype were 1.64±0.06, 1.96±0.05 kg, 21.88±0.99 kg and 54.20±2.25 g/d, respectively. In case of Dorper-Coastal crossbred, the average litter size, birth weight, body weight at 12 months and daily weight gain were 1.40±0.13, 2.29±0.10 kg, 22.95±1.03 kg and 56.73±2.79 g/d, respectively. The average litter size, birth weight, body weight at 12 months and daily weight gain of Parendale-Coastal crossbred genotype were 1.50±0.15, 2.28±0.12 kg, 22.6±1.36 kg and 54.87±3.51 g/d, respectively. The highest litter size was found in Damara-Coastal crossbred while the rest production performances were higher in Dorper-Coastal crossbred genotype.

In conclusion, superior rams and ewes will be selected by the individual performance. These findings give us more attention for continuing further research program to produce a suitable synthetic sheep genotype in our country.

A comparative study on carcass and meat yield characteristics of different F_1 beef genotypes and BCB-1 at 2 years of age

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Executive summary

Bangladesh is a very highly cattle dense country which have 188 head cattle per km^2 but cattle density per thousand people is 204 (Huque and Khan, 2017) which is not sufficient to meet the demand of beef in the country. The per capita intake of meat is only 8.6 kg in Bangladesh against 42.1 kg and 32.2 kg for world and developing countries, respectively (Huque, 2012). To meet this gap, meat production of the country must be increased many folds but, because of high density of cattle, there is limited opportunity to increase cattle population instead of increasing productivity of cattle. Thus, on-going program like cattle fattening and crossbreeding for dairy and beef cattle production initiated in Bangladesh for boosting bovine productivity. Brahman crosses are being produced to increase productivity of beef, but strategic approach for breed development that needs screening of multiple genotypes is ignored. On the other hand, recent studies at BLRI and DLS showed that Brahman crossbred bulls had the higher FCR (12.1) compared to native BCB-1 (9.5) or Red Chittagong Cattle (9.9) (Roy *et al*., 2013; Rashid *et al.*, 2014). Considering the facts, the present program was undertaken to evaluate comparative growth performance of different exotic crossbred beef genotypes and selection of suitable candidate beef producer, which will be able to produce at least 150.0 kg of carcass within 2 years of age under on farm feeding and management condition. Therefore, semen from four exotic beef sire i.e. Simmental, Charolais, Limousine and American Brahman were used to inseminate BCB-1 purebred dams for the production of F_1 crossbred progeny. A total of 54 F_1 crossbred progeny were produced, where, 15 Limousine, 15 Simmental, 12 Charolais and 12 Brahman crosses. All F_1 crossbred and BCB-1 (Control group) calves were raised under similar feeding management system and their feed intake, body weight, average daily gains, disease incidence and mortality were recorded and evaluated all over the year. Consequence of this evaluation process a total of 15 cattle(3malesin each group) were slaughtered for a comparative study on carcass and meat yield characteristics of different F_1crossbred beef genotypes and purebred BCB-1at 2 years of age. Carcass characteristics were determined and recorded according to FAO (1991). The recorded carcass traits were compared statistically with Completely Randomized Design using General Linear Model in IBM SPSS (Version 20).

Table 1. Carcass characteristics of different F_1 crossbred beef genotypes and BCB-1

Parameter	Genotype Mean±SD at 2 years of age					Sig
	BCB1Pure (n=3)	Brahman× BCB1(n=3)	Charolais× BCB1(n=3)	Limousin× BCB1(n=3)	Simmental× BCB1(n=3)	
Live wt. (kg)	356.33^{c}±22.36	417.00^{bc}±13.52	487.00^{ab} ±46.13	488.67^{ab} ±21.38	542.33^{a} ±74.52	**
BCS (5 point scale)	4.75±00	4.76±0.02	4.81±0.16	4.83±0.14	4.80±0.20	NS
Warm carcass wt. (kg)	207.95^{c}±9.89	247.38^{bc}±10.97	288.89^{ab}±30.83	286.78^{ab}±15.21	314.13^{a}±45.42	**
Warm dressing %	58.39±1.07	59.30±.71	59.27±.84	58.67±.76	57.88±.48	NS
Chilled carcass wt. (kg)	206.86^{c}±9.30	246.16^{bc}±11.11	287.70^{ab}±30.55	285.70^{ab}±14.85	313.06^{a}±45.40	**
Chilled dressing %	58.09±1.16	59.01±0.75	59.03±0.80	58.45±0.68	57.68±0.49	NS
Meat and bone ratio	4.98^{a}±0.10	3.97^{b}±0.08	4.95^{a}±0.06	4.89^{a}±0.26	4.98^{a}±0.18	***

***Highly significant (p<0.001);**Significant (p<0.01); SD= standard deviation; NS= not significant; value in the parenthesis indicate the number of observation

Carcass characteristics of F_1 crossbred beef genotypes and BCB-1 purebred at 2 years of age were presented in Table 1. Live weight, carcass weight and meat bone ratio showed significant differences among the studied genotypes. Simmental crossbred showed the highest live weight (542 kg) followed by Limousin (488.67 kg), Charolais (487.0 kg) and Brahman (417.00 kg)

crosses and native BCB-1(356 kg) at 2 years of age. No significant difference found among the genotypes for body condition score (BCS) and dressing percentage. Brahman crossbred showed lowest meat bone ratio (3.97) compare to other genotypes. Purebred BCB-1 and Simmental crossbred showed highest and same meat bone ratio (4.98).

Physical and chemical properties of meat of different F_1 crossbred beef genotypes and BCB-1 were presented in Table 2. Here, no significant difference was found for dry matter (DM), ash, crude protein (CP), drip loss and cook loss among the genotypes except pH. Overall mean of DM and CP content of meat of studied genotypes were 25.60% and 20.17%, respectively. The overall mean cook loss of meat was found as 28.64%.

Table 2. Physio-chemical properties of meat of different F_1 crossbred beef genotypes and BCB-1.

Bio Chemical Parameters	Genotype Mean±SD at 2 years of age					Overall mean	SE	Sig
	BCB1Pure (n=3)	Brahman× BCB1(n=3)	Charolais× BCB1(n=3)	Limousin× BCB1(n=3)	Simmental× BCB1(n=3)			
Dry Matter (DM) %	24.93±1.32	27.60±3.26	25.82±0.98	25.25±0.98	24.41±1.76	25.60	.482	NS
Ash %	3.72±0.46	3.10±0.22	3.70±0.57	3.37±0.57	4.02±0.99	3.58	.160	NS
Crude Protein (CP)% on DM	19.97±0.87	20.37±1.00	19.70±1.01	20.28±1.01	20.55±0.54	20.17	.234	NS
Drip loss %	5.21±0.32	6.24±0.93	4.40±2.49	5.84±2.49	5.61±0.57	5.46	.428	NS
Cook loss %	28.00±3.51	28.49±2.13	26.93±6.08	30.44±6.08	29.33±3.93	28.64	1.19	NS
pH	6.62^{a}±0.11	6.39^{a}±0.24	5.82^{b}±0.41	6.06^{ab}±0.41	6.59^{a}±0.08	6.3	.076	*

*Significant ($p<0.05$); SD= standard deviation; NS= not significant; value in the parenthesis indicate the number of observation

Considering the data so far obtained, it may be stated that among the four crosses Simmental×BCB-1 showed the highest live weight at market age (2 yrs). Considering the beef characteristics of the studied 5 genotypes, Simmental crossbred and purebred BCB-1 showed the highest meat and bone ratio. More F_1 male progeny is yet to be produced and required to evaluate the carcass characteristics and meat quality precisely.

Conservation and improvement of Black Bengal Goat at Bangladesh Livestock Research Institute

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Executive summary

Goat is one of the potential livestock species which is contributing meat and skins, and to some extent, milk, fleece and manure. The Black Bengal goat is the heritage and pride of Bangladesh which is popular for higher prolificacy, short generation interval and better adaptability to adverse environmental conditions. But, the breed is being diluted by unwanted crossing all over the country resulting genetic erosion of this valuable goat breed. Considering the fact, the project has designed with the objectives- i) To conserve and improve Black Bengal goat through selective breeding and ii) To evaluate the performance of different coat color variants of Black Bengal goat (Solid Black, White Bengal, Dutch belt, Toggenburg and Brown Bengal). The study was conducted in Goat and Sheep Research Farm of Bangladesh Livestock Research Institute, Savar, Dhaka. The breeding program was conducted through Open Nucleus Breeding System (ONBS) avoiding inbreeding in order to improve the genetic and phenotypic traits of existing breeding goat stock. The selection objectives of the study were to improve the prolificacy, milk production and growth rate of the breed. The targeted prolificacy, milk production and 6 months body weight of Black Bengal goat were, minimum 2 kids per kidding; 0.5 litter/day and 12 kg, respectively. The selection index was calculated by the following equation, $I_B = b_1x_1 + b_2x_2 + \ldots. + b_nx_n$. Where, b_1, b_2,..,b_n were phenotypic values for the traits and x_1, x_2,…, x_n were relative economic values given to each of the traits. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0.
Table 1 and 2 shows the productive and reproductive performance of different coat colour variants of black Bengal goat. The average litter size, dam milk production and 6 months weight of Solid black genotype were 2.16±0.06, 0.25±0.01 L/d and 9.50±0.16 kg, respectively. In case of white Bengal genotype, average litter size, dam milk production and 6 months weight were 2.32±0.08, 0.50±0.06 L/d and 11.52±0.53 kg. The average litter size, dam milk production and 6 months weight of Dutch belt genotype were 2.40±0.22, 0.46±0.09 L/d and 13.21±0.58 kg, respectively. In case of Toggenburg genotype, average litter size, dam milk production and 6 months weight were, 1.97±0.13, 0.42±0.05 lt/d and 10.42±0.57 kg, respectively. The highest milk production was found in White Bengal genotype while the highest litter size and 6 months body weight was found in Dutch belt genotype. Birth weight and milk production had significance effect on the different genotype of black Bengal goat.

Table 1. Productive performance of Black Bengal Goat (Mean ± SE).

Genotype	Birth weight (kg)	3 months body weight (kg)	6 months body weight (kg)	Growth rate at 6 months (g/d)
Solid Black	1.18±0.02[b] (130)	5.35±0.12 (116)	9.50±0.16 (96)	45.33±0.86 (96)
White Bengal	1.14±0.04[a] (48)	6.19±0.26 (35)	11.52±0.53 (28)	45.39±4.33 (28)
Dutch Belt	1.19±0.05[b] (25)	6.18±0.27 (19)	13.21±0.58 (12)	49.13±5.12 (12)
Toggenburg	1.15±0.04[b] (27)	6.44±0.20 (22)	10.42±0.57 (17)	37.25±4.91 (17)
Sig. level	***	NS	NS	NS

Figure in the parenthesis indicate the number of observations. ***= highly significant (p= 0-0.001), NS= Non significance (p>0.05)

Table 2. Reproductive performance of Black Bengal Goat (Mean ± SE).

Genotype	Litter size	Milk production (L/d)	Gestation length (day)	Kidding interval (day)
Solid Black	2.16±0.06 (130)	0.25±0.01[b] (58)	147±1.83 (24)	207.62±4.55 (29)
White Bengal	2.32±0.08 (48)	0.50±0.06[a] (8)	161.82±1.24 (20)	200.18±5.03 (10)
Dutch Belt	2.40±0.22 (25)	0.46±0.09[ab] (8)	172.15±1.10 (17)	240.88±7.48 (8)
Toggenburg	1.97±0.13 (27)	0.42±0.05[ab] (13)	170.83±2.12 (12)	256.84±19.82 (6)
Sig. level	NS	*	NS	NS

Figure in the parenthesis indicate the number of observations. *= significant (p=0.01-0.05), NS= Non significance (p>0.05)

It can be concluded that, White Bengal genotype may be developed as milk type Black Bengal goat. Superior bucks and does will be selected from every genotype by the individual performance score. Therefore, the research program should continue for the coming years to achieve the targeted goal.

Conservation and improvement of exotic germ plasms of chicken and development of egg and meat type chicken

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Executive summary

In Bangladesh, slow growing chicken meat (like Sonali) production increased 3 fold during the last five years due to reduce broiler meat intake by the consumer. Keeping this issues in mind, Bangladesh Livestock Research Institute (BLRI) was undertaken a research program and has developed a meat type chicken called Multi Colour Table Chicken (MCTC) using locally adopted exotic and BLRI improved native chicken through selection and breeding. Day old chicks of MCTC are mixed feather color and have a similar phenotypic appearance to that of native chickens. During the last five years, several experiments were conducted under on station and on farm condition. In 2019-20, the present experiment was carried out to investigate the performance of MCTC parent line, production of MCTC and evaluate the performance under commercial farming condition. Therefore, a commercial company (Aftab Bahumukhi Farms Ltd.) was selected and a bilateral agreement was signed for commercial production of MCTC. The experimental period was divided into two phases, phase I (0 - 20th week), phase II (21th – 45thweek) production. The experiment was carried out in open sided houses and standard management practices of birds were followed during rearing. All data were analysed by one-way analysis of variance using the PROC GLM procedure in SAS and differences were determined by DMRT. A P value of <0.05 was considered significant.

Table 1. MCTC female parent line performance under on station and commercial condition (20-45 weeks)

Parameters	On station	Commercial farm	SEM	P value
Day old chicks weight (g)	39.43	38.17	1.57	0.519
Age at sexual maturity (days)	135.32	136.54	2.22	0.382
5% Egg production (d)	151.08	150.47	0.491	0.729
Egg weight at sexual maturity (g)	44.48	45.40	0.256	0.241
Egg production (%)	67.40	69.40	0.84	0.173
Average egg weight (g)	55.67	56.09	0.194	0.642
Mature Body weight at 40 wks (g)	1855.19	2035.37	33.19	0.017
Average feed intake (g)	110.09	112.92	2.46	0.316
Hatching egg (%)	91.45	90.40	3.19	0.294
Fertility (%)	89.03	70.93	1.79	0.038
Hatchability (%) on setting egg	79.32	63.68	2.97	0.016
Hatchability (%) on fertile egg	88.29	89.78	4.43	0.343
Livability (%)	98.50	96.28	3.47	0.434
Uniformity (%)	91.85	84.43	1.23	0.249

In phase I, the day old body weight of MCTC male parent line was 32.83g. Growth curve of both male and female parent line were found very close between the on station and commercial farming result (0-8 weeks). But during 9-20 weeks of age, body weight of male line was significantly higher in commercial condition than that of on station results. On the other hand, BW of female line was found similar between on station and commercial farming condition. The feed consumption of birds was found similar between on station and commercial farming condition. During phase II, the birds showed sexual maturity at 135-136 days of age in both condition. The variation in rearing system did not influence day old chick's weight, egg production, egg weight, feed intake, livability and uniformity of parent line. But mature body weight was significantly higher ($p<0.05$) in commercial

condition than of on-station condition. In contrast, fertility % was significantly higher in on station condition than that of commercial farming might be due to the variation of rearing and breeding system of the flock.

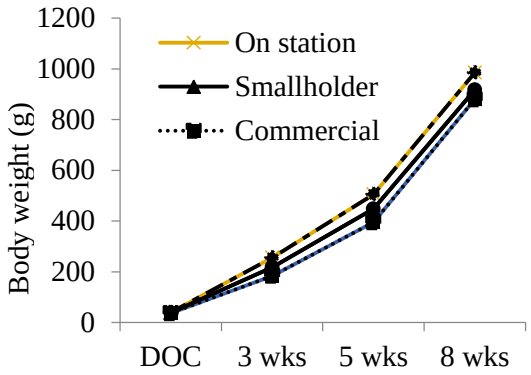

Figure 1. Body weight at different stage of MCTC under on station, commercial and smallholder farming condition

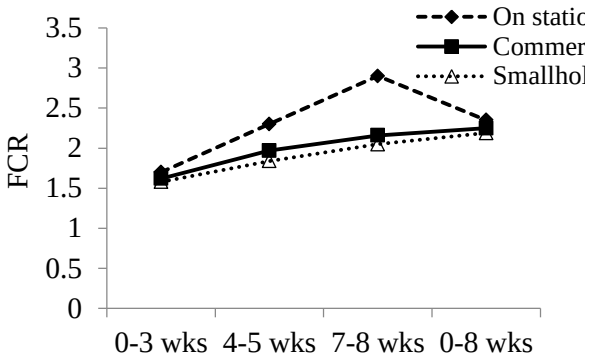

Figure 2. Feed conversion ratio at different stage of MCTC under on station, commercial and smallholder farming condition

When parent line start to lay, hatching egg was collected to produce commercial day old MCTC chicks. After hatching of day old chicks by the company, birds were grouped into two categories farmer. In category 1, chicks were reared by the company and category 2 was reared by the smallholder farmer. Based on the on-station, commercial and smallholder farming condition results of 56 days, average body weight was found higher in on station than that of commercial and smallholder farming condition (Fig. 1). But significantly ($p<0.05$) better FCR was found in smallholder farming condition than that of on station condition (Fig. 2). No significant differences were found between on station and commercial farming of MCTC. These results indicated that production performance of MCTC is consistent and adaptable under smallholder and commercial farmer's condition. It also suggested that MCTC parent line could be reared under open sided houses and their performance is acceptable for the commercial production of day old MCTC chicks.

Intercropping maize and cow pea as a whole–crop forage: Effects of planting system and ratio on forage yield and quality

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Executive summary

Maize-legume intercropping is currently receiving global attention because of its prime importance in World Agriculture. Intercropping system is one of the most common practice used more than one crop together in sustainable agricultural system to increase the productivity and stability of yield in order to improve resource utilization and environmental factors. Cereal-legume intercropping can provide good nutrition to livestock with higher forage yields, when grown in association. Further, it may also be beneficial for improving the fertility status of the soil. Legumes as an intercrop also have a complimentary effect on cereals providing nitrogen to the production system (Ram and Singh, 2001). In this context, the present experiment was undertaken to find out the suitable intercrop combination of cowpea with maize for increasing productivity and quality of fodder.

To achieve the above objective, a field experiment was carried out at Fodder Research Plot of Bangladesh Livestock Research Institute, Savar, and Dhaka during 2020. Maize (*Zea mays* L cv. Pacific-11; Advanta; marketed by BRAC, Bangladesh) and Cowpea (*Vigna unguiculata* L*;* local variety; black seed) were used in the study. The experiment was laid out in two factorial [Intercropping combinations (seed proportions of $M_{100}C_0$, M_0C_{100}, $M_{75}C_{25}$, $M_{65}C_{35}$, $M_{50}C_{50}$, $M_{35}C_{65}$ and $M_{25}C_{75}$) and Planting system (broadcasting and line sowing)] randomized complete block design (RCBD) with tree replications. The density of maize and cowpea are expressed, sole crop densities being 22 and 40 plant m^{-2} maize and cowpea. However, the seed rate for 100 per cent maize and cowpea was 75 and 40 kg per hectare, respectively. The experimental plot size was 5m x 5 m (25 m^2) with 1 m alley and 1 m between plots. Maize and cowpea were sown by hand. Inter-row spacing was 15 and 9 cm in the sole crops of maize and cowpea were used with a between-row spacing of 30 cm. Normal cultural practice was followed uniformly for all experimental units. The plots were hand weeded in different vegetative stages. Irrigation was applied at fortnightly interval. Areas of 4 m^2 from middle rows were hand harvested when the maize component reached dough stage. The data on yield, quality parameters, morphological characteristics and total land equivalent ratios) were analyzed statistically in an ANOVA technique using SPSS, 20 computer software packages. Treatment means were compared using LSD test at 0.05 probability level.

Effect of planting system and ratio on biomass yield, nutritive value and land equivalent ratio of maize intercropped with cowpea are presented in Table 1. The intercropped of maize and cowpea in different planting ratio significantly affected the quantitative and qualitative characters of the forage. The highest ($p<0.001$) yield of green fodder and dry matter yields were obtained by sowing the crops in ratio of 50:50. Sowing of maize seed in combination with cowpea seed in 75:25 ranked second. The cowpeas sown alone produced the lowest ($p<0.01$) green fodder as well as dry matter. Irrespective of planting ratio, the planting system had significant ($p<0.05$) effect on green fodder yield. Maize intercropped with cowpea by line sowing system exhibited greater green forage yield than that of broadcasting system. Data presented in Table 1 demonstrated a highly significant planting ratio × planting system interaction effect on green forage and dry matter yield. Maize intercropped with cowpea either sown by broadcast or in lines did not vary significantly for the DM, OM, Ash, CP, ADF and NDF content (Table 1). Irrespective of planting system, the data revealed that the dry matter content was significantly ($p<0.01$) affected by different planting/seed ratios. The highest ($p<0.01$) DM content was recorded in maize alone and the lowest was observed by cowpea sole cropping. The result also revealed that an increased proportion of cowpea in seed mixture increased the crude protein content. The cowpea sown alone produced more crude protein followed by 25:75 seed combination. Maize sown alone produced minimum crude protein. The highest ($p<0.01$) land equivalent ratio (LER) was obtained by sowing the crops in ratio of 50:50. Table 1 also shows a highly significant ($p<0.01$) planting system × planting ratio interaction effect on both partial and total land equivalent ratio. However, the LER value of maize intercropped with cowpea

did not vary significantly by the system of planting. Irrespective of planting system, the mean plant height and stem diameter for both in maize and cowpea sown alone were relatively higher ($p>0.05$) than rest of all seed combinations. However, the plant height, stem diameter and number of leaves of both maize and cowpea were not influenced significantly ($p>0.05$) by planting system (data not shown).

Table 1. Effect of planting system and ratios on biomass yield, nutritive value and land equivalent ratio of maize intercropped with cowpea.

Planting system, ratios & their interactions		Biomass yield (t ha^{-1})		Chemical composition (%)					Partial LER		Total LER
		Green forage	Dry matter	DM, fresh	CP	OM	ADF	NDF	Maize	Cowpea	
Planting system	Broadcasting	50.4	10.9	21.1	8.94	94.3	40.0	65.2	0.98	0.21	1.19
	Line sowing	53.6	11.5	20.9	9.02	94.3	39.8	65.3	1.03	0.20	1.24
Planting ratio	$M_{100}C_0$	55.3^{a}	13.2^{ad}	23.8^{a}	7.39^{c}	94.7^{a}	39.3	64.7	1.00	-	1.00
	M_0C_{100}	14.8^{c}	2.4^{c}	16.4^{c}	11.8^{a}	91.7^{b}	40.7	66.4	-	1.00	1.00
	$M_{75}C_{25}$	64.0^{de}	13.4^{ad}	20.9^{b}	8.32^{b}	94.7^{a}	39.3	65.0	1.13^{a}	0.12^{d}	1.24^{ad}
	$M_{65}C_{35}$	57.9^{ad}	12.3^{a}	21.0^{b}	8.34^{b}	94.5^{a}	40.3	64.3	1.01^{b}	0.13^{cd}	1.14^{cd}
	$M_{50}C_{50}$	68.8^{e}	14.8^{d}	21.5^{b}	8.71^{be}	95.0^{a}	40.3	65.3	1.20^{a}	0.17^{c}	1.37^{b}
	$M_{35}C_{65}$	59.7^{ad}	12.6^{a}	21.2^{b}	9.02^{de}	94.8^{a}	39.6	65.3	1.00^{b}	0.28^{b}	1.28^{ab}
	$M_{25}C_{75}$	43.5^{b}	9.7^{b}	22.4^{ab}	9.27^{de}	94.6^{a}	39.9	65.8	0.70^{c}	0.33^{a}	1.03^{c}
SED		1.16	0.30	0.30	0.12	0.09	0.51	0.52	0.02	0.008	0.03
Level of sig.	PS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
	PR	***	***	***	***	***	NS	NS	***	***	***
	PS x PR	**	*	NS	NS	*	NS	NS	**	**	**

The results revealed the beneficial effects of maize-cowpea intercropping for forage yield and quality. Intercropping is more productive than sole cropping. Maize-cowpea intercropping increasing green fodder yield and forage quality of maize. Finally, the planting ratio of 50: 50 maize and cowpea may be mixed to attain higher green forage as well as higher dry matter yield. Similarly, maize intercropped with cowpea by line sowing system exhibited greater yield than that of broadcasting system.

Effect of weaning age on the post weaning performance of Black Bengal kids

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Executive summary

Weaning is normally a stressful period in the young kid's life and is often characterized by a decrease in weight gain, total cease in growth and in some cases even weight loss. In Bangladesh, farmers weaned their kids in different ages and often claimed for above mention problems as well as higher kid mortality. Thus, the objective of the present study was to know the effect of weaning age on the post weaning growth performances of Black Bengal kids. A trail was conducted with 4 groups (A, B, C and D) of kids having 8 kids in each group where 4 lactating does with 2 kids (one male and one female). The birth weights of the kids in different groups were similar. The kids under group A, B, C and D were weaned at 90, 75, 60 and 45 days, respectively and reared until 6 months of age. The feeding regime was similar for each group where kids were allowed to stay with dams and suckling. After weaning, kids were fed *adlib* Maize fodder and a concentrate mixture at the rate of 1.5% of their body weight and reared in individual pen. The parameters like birth weight, weaning weight, 06 month weight, dry matter intake (DMI), daily growth rate at different stages, disease incidence and kid mortality were recorded. Data were analyzed statistically in an ANOVA of a Completely Randomized Design (CRD) using SPSS (2020) and Duncan's LSD test was used to find out the differences between means.

Table1. Post weaning Performances of different groups of kids

Parameters	Treatment groups				SEM	Level of Sig.
	A	B	C	D		
Birth weight, kg	1.15	1.10	1.03	1.07	0.044	NS
Weaning weight, kg	5.52^{a}	$4.88a^{b}$	4.33^{ab}	3.15^{b}	0.299	*
6 month weight, kg	10.35^{a}	8.84^{ab}	8.19^{ab}	7.32^{b}	0.448	*
Total DMI, g	170.27	166.09	151.01	130.03	7.36	NS
Daily weight gain up to weaning, g	48.52	50.44	55.00	46.30	3.07	NS
Daily weight gain from weaning to 6 months, g	53.70^{a}	37.71^{b}	32.15^{b}	30.90^{b}	2.78	**
Overall daily gain from birth to to 6 months, g	51.11^{a}	43.02^{ab}	39.77^{ab}	34.75^{b}	2.43	*

The post weaning performances of different groups of kids weaned at different weaning ages are presented in Table 1. The birth weight of different selected group was same ($p>0.05$) but the average weaning weight differ significantly ($p<0.05$) as different groups of kids weaned at different weaning age. Interestingly, 06 months weight of kids also differ significantly ($p<0.05$). Higher 06 months weight observed when kids weaned at 90 days of age and the body weight decreasing with the increasing of weaning age. Total per day DM intake was also decreasing ($p>0.05$) with the decreasing of weaning age. All kids were sucked their mother milk until the weaning period and there was no significant ($p>0.05$) difference observed for daily weight gain of the kids until the weaning period. But highly significant ($p<0.01$) differences were observed for the daily growth rate during weaning to their 06 months of age. Significantly ($p<0.05$) higher post weaning growth rate was observed for kids weaned at 90 days of their age. Similarly, overall daily weight gain from birth to 06 months of age was also higher ($p<0.05$) in kids rear under the group A. The results suggest that kids performances affects due to their weaning age. The health problems were also monitored during the experimental period for different groups of kids (Table 2). The common diseases or health problems observed during the experimental period were

Pneumonia, Coccidiosis/Diarrhea, Dermatitis and Lameness. At the stage of weaning to 6 months of age, 01 kid from the group C and 2 kids from the group D were died, respectively due to Coccidiosis, Pneumonia and Dermatitis with weakness. Whereas, no kid mortality observed in the group A and B and the kid mortality rate was 12.5% and 25% for the group D and C, respectively.

Table 2. Occurrences of diseases or health problems during experimental period in different treatment groups of kids.

Diseases/Health Problems	Treatment groups			
	A	B	C	D
Pneumonia, (no.)	0	0	1.0	1.0
Coccidiosis//Diarrhea, (no.)	1.0	1.0	2.0	2.0
Dermatitis, (no.)	0	0	1.0	1.0
Lameness, (no.)	0	0	0	1.0
Total (no. of kids 8)	1.0	1.0	4.0	5.0
Incidences of diseases/health problems, (%)	12.50	12.50	50.00	62.50
Death (no.)	0	0	1.0	2.0
Kid mortality, %	0	0	12.50	25.00

Finally, the results suggest that weaning age affects badly the post weaning performances of Black Bengal Goat kids. The kids weaned at the age of 90 days performed better and faces less health or disease related problems.

Determination of heavy metals (Pb, Cr, Cd and As) in poultry feed and meat both breast and thigh

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Executive summary

Public health risk has been reported in some literature due to higher concentration of heavy metal exposed through poultry feed and their products including meat. Rashid et al. (2018) stated that non-essential elements such as Pb, Cd, Cr, and As are considered to be toxic and their presence in the body can cause profound biochemical and neurological changes in the body. For the sake of safeguard human health, the World Health Organization (WHO) and Food and Agriculture Organization (FAO) have set standards for acceptable daily intake and maximum residue limits in foods. Heavy metal concentration is estimated in fresh dry weight basis. The absorption wavelengths for the heavy metals were 217.0nm for Pb, 357.87 nm for Cr, 228.8nm for Cd and 217.0nm for Pb. The metal content was calculated by using the formula: Concentration (mg/kg or ppm in dry weight) = Concentration of the element through AAS (ppm) x Volume made up / Sample weight. In this piece of work, we had an objective to make a database of heavy metals presence in poultry feed and chicken meat of different types and several divisions. The values were generated quantitatively using AAS (Shimadzu 7000, Japan) that presence or not in poultry feed, meat in contrast of recommended levels of consumption for human health. Samples of poultry feed and meat were collected from 4 different divisions for lab analysis.

Table 1. Heavy metals analytical result of broiler feed in four divisional feed samples

Feed Type	Location	Pb (ppm)	Cr (ppm)	Cd (ppm)	As (ppm)
Permissible limit		10**	20-30**	0.50*	1.4**
Broiler feed	Dhaka	0.089	0.045	0.005	0.002
	Rajshahi	0.118	0.049	0.006	0.003
	Rangpur	0.143	0.077	0.009	0.001
	Khulna	0.042	0.024	0.002	0.002
Layer feed	Dhaka	0.087	0.039	0.004	0.001
	Rajshahi	0.113	0.055	0.006	0.144
	Rangpur	0.154	0.052	0.009	0.077
	Khulna	0.098	0.090	0.003	0.071
Sonali feed	Dhaka	0.133	0.049	0.006	0.005
	Rajshahi	0.122	0.077	0.006	0.032
	Rangpur	0.190	0.062	0.003	0.002
	Khulna	0.060	0.053	0.004	0.004

** IAEA (International Atomic Energy Authority); Paulien Adamse et al., 2017

It is important to point out that, Chromium, particularly Cr (III) plays an important role in the body function in trace amount but become toxic when it exceeds the tolerance limit (Alam *et al.*, 2011). The analytical values are much lower than permissible limit (Table 1). This trend is also applicable for Pb, Cd and As, hence it can be expressed that poultry feeds of broiler, layer and Sonali from the samples undoubtedly safe from heavy metals. The findings also agreed with the findings of (Sarker, 2014) who got lower Pb content in commercial poultry feed.

Table 2. Heavy metals analytical result of broiler breast and thigh meat in four divisional meat samples

Feed Type	Location	Meat portion	Pb (ppm)	Cr (ppm)	Cd (ppm)	As (ppm)
Permissible limit*			0.100	1.000	0.100	0.100
Broiler meat	Dhaka	Breast	0.123	0.092	0.003	0.021
		Thigh	0.018	0.073	0.001	0.034
	Rajshahi	Breast	0.155	0.074	0.002	0.000
		Thigh	0.115	0.042	0.002	0.004
	Rangpur	Breast	0.050	0.112	0.001	0.039
		Thigh	0.012	0.094	0.001	0.021
	Khulna	Breast	0.011	0.075	0.001	0.046
		Thigh	0.015	0.065	0.001	0.055
Spent Hen meat	Dhaka	Breast	0.181	0.078	0.003	0.035
		Thigh	0.025	0.085	0.001	0.035
	Rajshahi	Breast	0.160	0.073	0.004	0.026
		Thigh	0.125	0.077	0.002	0.019
	Rangpur	Breast	0.170	0.087	0.001	0.038
		Thigh	0.004	0.118	0.001	0.042
	Khulna	Breast	0.005	0.067	0.000	0.008
		Thigh	0.011	0.081	0.001	0.000
Sonali meat	Dhaka	Breast	0.101	0.083	0.006	0.026
		Thigh	0.154	0.076	0.001	0.027
	Rajshahi	Breast	0.130	0.075	0.007	0.026
		Thigh	0.125	0.087	0.006	0.026
	Rangpur	Breast	0.045	0.085	0.001	0.013
		Thigh	0.005	0.090	0.000	0.039
	Khulna	Breast	0.080	0.064	0.001	0.000
		Thigh	0.105	0.067	0.000	0.012

Source: FAO/WHO, 1997; EU, 2002; Chowdhury et al., 2003, *Choi Ya Yin (2012)

According to the USEPA, 2018 (United States Environment Protection Agency), the maximum permissible limit of Cr in chicken meat is 1 mg/kg. Abduljaleel *et al.*, 2012 and Basha *et al*. 2013, who got the Pb content in meat below the permissible limits like our findings for human consumption (Table 2). We have got overall values in meat 0.108, 0.080, 0.002 and 0.025 ppm for Pb, Cr, Cd and As respectively. It can be concluded from the finding both poultry feed and meat are safe from the heavy metals.

Fortification of nutrients (Omega 3 fatty acids) in poultry meat through dietary manipulation

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Executive summary

During the past decade's people became highly aware on functional food for their healthy life. The beneficial effects of n-3 polyunsaturated fatty acids (n-3 PUFA) on human health have been extensively investigated. Worldwide, poultry meat is an important source of proteins and lipids in human nutrition. The production and consumption of chicken meat has become very popular worldwide owing to its desirable nutritional characteristics, such as high protein, low fat and relatively high concentrations of PUFAs compared to beef or pork. Therefore, the objective of the present study was to evaluate the feeding effect of *Moringa oleifera* leaf meal, *Spirulina platensis* and *Trigonella foenum-graecum* (fenugreek) on performance of broiler, oxidative stability and fatty acid profiles of broiler meat.

Total 288-day old mixed sex broiler chicks were purchased from a commercial hatchery. The chicks were weighed and randomly allocated to 20 floor pens containing fresh wood shavings to the depth of 5 cm in an environmentally controlled shed. The experiment was divided into six dietary treatments with four replicates having 48 chicks in each group, T_1-control; T_2, Fenugreek seed (0.5%); T_3, Fenugreek seed (1%); T_4, (*M. oleifera* leaf meal 1% + Fenugreek seed 0.5%); T_5, (*S. platensis* 1.5%+ Fenugreek seed 0.5%); and T_6, (*M. oleifera* 1% + *S. platensis* 1.5%) meal with basal diet.

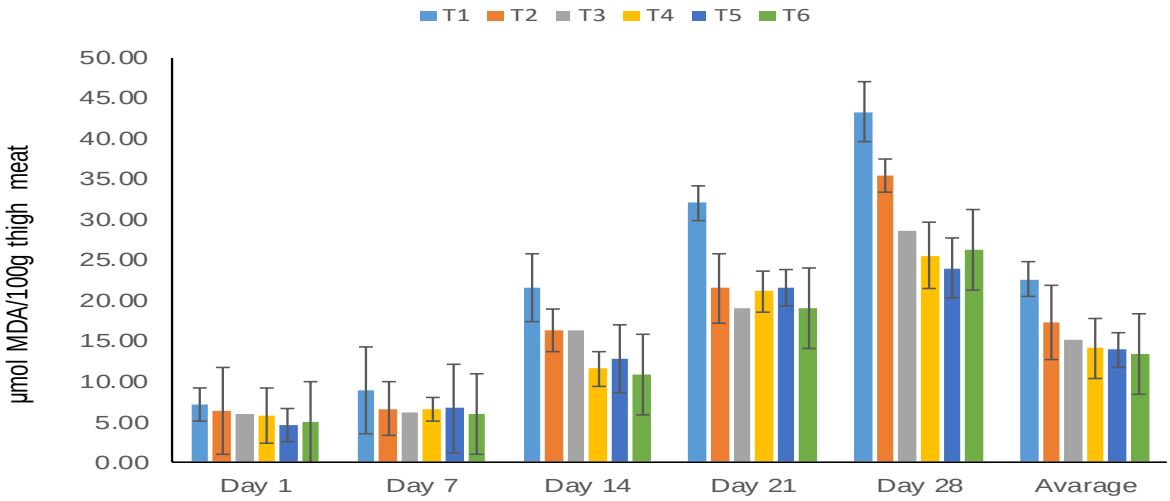

Figure 1. Effects of feeding natural herbs as feed additives on TBARS values of broiler thigh meat during refrigerated storage

Feed and fresh water were offered ad libitum throughout the 35-d rearing period. Feed intake (FI, g) was calculated as feed allocated minus feed refused. In addition, fatty acids profile, oxidative stability and serum cholesterol were evaluated. The final body weight gain was significantly higher ($p < 0.05$) in the T_4 and T_6 groups compared to the T_2, T_3 and T_5 groups and T_1 control group (Table 1). Similarly, birds fed diets with combination fenugreek and *M. oleifera* 1% and *S. platensis* 1.5%, in particular those in T_4 and T_6, had the highest ADG, while those in T_1 and T_2 had the lowest ($p < 0.05$) in ADG. T_4 and T_6 group was also observed decreased feed consumption ratio as compared to control (T_1) group of broilers for the total period. α-Linolenic acid was found significantly ($p < 0.05$) higher in T_3 and T_6 group in broiler meat than control, T_1 group. In Table 1, for the mixed meat, it was observed that linoleic acid was significantly ($p < 0.05$) differs in T_2-T_6 group in contrast of

control group. In addition, serum cholesterol (mg/dL) level was found to be reduced in additives group 116.50±1.70 in T_3 and 120.75±3.66 in T_4 group.

The thiobarbituric acid reactive substances (TBARS) test of broiler breast and thigh meats which determine the amount of malondialdehyde (MDA), a major secondary lipid oxidation byproduct. The addition of feed additives had an effect on the meat's oxidative stability (Figure 1). The lowest ($p < 0.05$) TBARS obtained in thigh meat of T_3 (19.02) and T_6 (19.43) groups, respectively than the control (31.94 µmol MDA[1]/100g) after 4[th] week preservation. Based on these findings, it can be concluded that inclusion of above-mentioned feed at levels that are not detrimental to performance may be a promising method to improve broiler meat quality.

Table 1. Effect of feeding natural herbs as feed additives on body weight, average daily gain, cholesterol and ω-3 fatty acid of broiler chickens.

	T_1	T_2	T_3	T_4	T_5	T_6	SEM	p value
BW(g)	2137^{b}	2253^{ab}	2152^{b}	2384^{a}	2289^{ab}	2371^{a}	39.91	0.115
ADG(g)	2096^{b}	2012^{b}	2012^{b}	2344^{a}	2245^{ab}	2330^{a}	39.91	0.014
Cholesterol (mg/dL)	137.50^{a}	125.50^{ab}	116.50^{b}	120.75^{ab}	133.00^{ab}	122.50^{ab}	3.66	0.192
HDL (mg/dL)	39.75^{b}	43.00^{a}	45.75^{a}	42.25^{ab}	41.00^{b}	40.50^{b}	1.93	0.901
LDL (mg/dL)	56.25^{a}	37.00^{b}	36.50^{b}	33.00^{b}	45.00^{ab}	42.75^{ab}	2.03	0.118
Triglyceride (mg/dL)	75.75^{a}	67.00^{ab}	63.00^{b}	72.25^{a}	62.25^{b}	67.75^{ab}	4.28	0.491
Linoleic acid ω-6, (g/100g)	28.48^{c}	32.81^{b}	39.22^{a}	28.88^{c}	33.74^{b}	29.37^{bc}	1.53	0.279
Linolenic acid ω-3, (g/100g)	0.76^{b}	1.08^{b}	1.43^{a}	1.01^{b}	1.17^{b}	1.41^{a}	0.58	0.160

$^{a, b, c}$Mean with different superscripts within same row are significantly different ($p<0.05$). BW-Body weight (g), ADG- Average Daily Gain. T_1-control; T_2, Fenugreek seed (0.5%); T_3, Fenugreek seed (1%); T_4, (*M. oleifera* leaf meal 1% + Fenugreek seed 0.5%); T_5, (*S. platensis* 1.5%+ Fenugreek seed 0.5%); and T_6, (*M. oleifera* 1% + *S. platensis* 1.5%) meal with basal diet.

Evaluation of biomass production and nutritional quality of different moringa varieties at different densities

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Executive summary

The growing interest in *Moringa oleifera* L., commonly known as "Sajna" in Bangladesh and by several names elsewhere, has resulted in its extensive cultivation worldwide. Moringa can produce green fodder for livestock like any other perennial multi-cut fodder crop. It is fast growing deep rooted plant tolerant to drought conditions. Moringa crop fodder comprises of soft leaves & non-woody stem. It is highly nutritious, palatable and has pleasant aroma. It has potential to produce enormous biomass and promises to be the plant of the future in ensuring year-round green fodder availability for animals. BLRI has been started research on Moringa agronomy and feeding to livestock from 2012-13 fiscal year. In the financial year 2018-19, the technology titled "Cultivation method of Sajna tree and its use as cattle feed" has been handed over to the Department of Livestock. In the year 2018-19, one of the activities was to verify the method of cultivating Moringa as fodder at the farm level. There are two types of native *Moringa oleifera* seeds available in Bangladesh i. Moringa black seed and ii. Moringa white seeds which are available in a certain season. Black moringa seeds are more available and potential for fodder plant production than white seeds. Different varieties of Moringa seed are being imported from India by farmers or entrepreneurs for fodder production as well as human consumption. To expand the hidden potentiality of exotic varieties of Moringa and to make it available to farmers. An experiment was designed to determined germination rate, yield and its nutritional value assessment in different moringa varieties. Another experiment was designed to determine the best density for the highest moringa fodder production. The first experiment was designed in CRD consisting four treatments (Black (control), PKM-1, PKM-2 and Paraynal) with five replications. The plot size was 8×8 square feet and the plant to plant distance was 1.5×1.5 cm from each plant to other. Another experiment was laid out 4 (1.0×1.0; 1.5×1.0; 1.5 ×1.5 and 2.0×2.0) × 4 (Black, PKM-1, PKM-2 and Paraynal) factorial experiment in RCBD design with four replications. Plot size of the experiments was 8×8 square feet. All seeds were one years old. For this purpose, seeds were prepared by soaking and drying method. After germination, seeds were transferred in seed bed to grow upto 30 days. After 30 days the growing seedlings were transferred in well prepared plot. Before transferring of the seedling, the plots were prepared by cultivation, fertilizer application (cow dung and potash) and foradan as an insecticide. After planting the seedlings first cutting was given at 120 days at 60 cm height from land. Subsequent cuttings will be continued in every 40 days interval after first cutting.
The germination rate of Parynal, PKM-1, PKM-2, Black and white was 82.30, 81.08, 80.30, 77.82 and 69.60 respectively. The highest fresh or dry matter (DM) yield (ton/ha/cut) was significantly ($P>0.05$) higher in paraynal and Black variety than PKM-1 and PKM-2 at first cut. The dry matter (DM), crude protein (CP), acid detergent fiber (ADF) and neutral detergent fiber (NDF) percent of parynal, PKM-1, PKM-2 and Black were 18.30, 20.65, 17.42 & 20.03; 17.10, 17.20, 17.25 & 18.38; 40.67, 45.28, 45.15 & 41.03; 56.53, 56.87, 60.91 & 58.18 respectively. It has been shown that no significance different in protein content among the varieties while DM, ADF and NDF content was varied among the varieties due to presence of fiber. The average height and stem diameter of plant was 193.0, 186.0, 172.0 &124.0 cm and 4.28, 4.04, 3.79 & 2.72 for PKM-2, Paraynal, and PKM-1 and Black moringa variety respectively. The average branch number of Parynal, PKM-2, PKM-1 and Black moringa variety was 20.0, 18.0, 17.0 and 9.0 respectively. The highest yield was obtained in Parynal varieties at 1.0 ×1.0 density followed by PKM-2 and PKM-1 and Black.

Table 1. Effect of Moringa variety on yield and nutrient composition.

Parameters	PKM-1	PKM-2	Paraynal	Black
Yield				
Fresh (ton/ha/cut)	18.22 ± 2.19[b]	19.17 ± 4.55[b]	29.92 ± 8.68[a]	28.55 ± 9.34[a]
Fresh (ton/ha/y) Calculated	109.38 ± 13.16[c]	115.91 ± 27.34[c]	179.51 ± 52.10[a]	171.30 ± 56.23[b]
DM (ton/ha/cut)	3.49 ± 0.42[c]	3.34 ± 0.79[c]	6.15 ± 1.78[a]	5.71 ± 1.87[b]
DM (ton/ha/y) Calculated	20.93 ± 2.51[c]	20.03 ± 4.76[c]	36.92 ± 10.72[a]	34.30 ± 11.22[a]
Nutrient Composition (%)				
Dry matter (DM)	20.57	18.30	17.41	20.00
Crude protein (CP)	17.20	17.10	17.26	17.38
Acid detergent fiber (ADF)	45.27	40.67	45.15	40.26
Neutral detergent fiber (NDF)	56.87	56.53	60.90	58.33
Ash	7.53	6.82	6.74	7.10

Identification of candidate gene markers for prediction of RCC sperm quality and fertility

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Executive summary

The present cattle breeding policy of the Government encouraged mass artificial insemination (AI) throughout the country. AI allows the insemination of thousands of cows from one bull semen. Conception rates following AI in dairy cows varied due to bull fertility, cow's reproductive health, efficiency of AI worker and other factors. Thus, bull effects are paramount on herd genetics, dynamics, and production. Use of sperm from a low fertility bull leads to lower pregnancy rates, which results in greater economic costs of housing, feeding and other costs associated with these bulls and non-pregnant cows. Evaluation and early prediction of fertility of breeding bulls before mass AI will results more conception rate as well as more calves and reduces the cost of rearing low fertility bulls in the breeding center. Therefore this study was designed to identify molecular markers associate with the fertility of bulls. During this study period, ten (10) RCC bulls were selected considering their breed characteristics and pedigree record. The selected bulls were trained for semen collection. Semen was collected from each bull using artificial vagina method twice a week. After initial evaluation with computer assisted semen analyzer (CASA), semen sample was diluted with extender to give a sperm concentration of 20 million/dose. Diluted semen was placed in a cold handling cabinet (Minitube, Germany) for 4 hr at 4°C to equilibrate. The semen samples were filled and sealed in 0.250 ml standard printed straws using an automated filling sealing machine. After equilibration, freezing of straws was carried out in liquid nitrogen (LN_2) vapor using a programmable bio-freezer (Minitube, Germany). The straws were then plunged in LN_2 (−196°C) for long term storage. The motility of frozen sperm was evaluated 24 hrs after plunging in LN_2 by CASA system. All fresh semen was cryopreserved with the same protocol described above. Data were analyzed using the microsoft excel programme. Prepared frozen semen straws are using for AI of RCC cows/heifers. Till to date, 193 AI has been conducted in on-farm at Chandanaish, Patia, Anoara, Bashkhali, Satkania, Hathazari and Naikhongchori upazillas of Chattogram division and on-station at BLRI cattle research farm with frozen semen straws from 6 different RCC bulls (Bull numbers 250, 392, 512, 536, 544 and 474). Bull fertility was defined by non-return rate measured 60 days following AI. For molecular characterization total RNA were extracted from frozen semen of 5 bulls following manufacturer protocol (PureLink® RNA Mini Kit, Ambion, Life Science). The cDNA samples were prepared with 50 ng total RNA using AddScript cDNA Synthesis Kit (AddBio Inc, Republic of Korea) following manufacturer's protocol. Primers were tested using conventional PCR and agarose gel electrophoresis (Figure 1). The quantitative real time PCR for quantification of selected mRNA is ongoing. Total 15 mRNA/gene transcripts associated with different biological functions of sperm including sperm motility, membrane integrity, metabolism and oxidative stress among others reported elsewhere were selected for this study.
Results showed that progressive motility of sperm in the studied bull semen varied from 47.5% in bull number 392 to 73.9% in bull number 536. Alternatively, static motility was lower in bull number 536 and higher in bull number 392 (Table 1). Progressive motility of sperm determines non-return rates in dairy cows. The average non-return rate was 58.8% (Table 2). The higher conception rate (75%) was found in case of bull number 536 and the lower conception rate (37.5%) was found in case of bull number 392. The non-return rates of this study are associated with progressive motility of bull sperm. Artificial insemination with other selected bulls is in progress. Non-return rates data of individual bulls will be correlated with expression data of target mRNA/gene transcripts for selecting molecular markers to predict bull fertility in RCC.

Table 1. Fresh semen characteristics of studied Red Chittagong cattle bulls.

RCC Bull ID	Volume (ml/ejaculate)	Concentration (Million/mL)	Total motility (%)	Progressive motility (%)	Static motility (%)
536	4.2±0.58	2310.0±889.5	86.9±11.5	73.9±12.5	13.1±11.5
234	3.88±0.53	1902.6±1038.9	80.9±13.2	62.4±16.2	19.2±13.2
544	4.38±0.33	2107.67±938.9	81.3±11.2	62.1±11.2	18.7±13.2
473	4.67±0.88	1722.6±1123.4	81.9±11.9	61.2±13.9	18.4±11.9
250	4.85±1.01	2072.8±1081.8	78.78±14.2	58.1±16.0	21.2±14.2
474	4.6±0.41	2116.1±1082.2	81.2±13.5	57.3±12.8	18.8±13.5
433	4±0.87	1237.1±701.9	75.2±9.9	56.1±9.3	24.9±10.1
512	3.95±0.83	1387.7±618.4	79.0±9.9	56.7±12.2	20.9±9.9
491	3.55±1.42	1583.2±546.9	71.9±12.3	48.3±13.9	28.1±12.2
392	4.04±1.61	1576.7±851.2	75.5±19.9	47.5±18.4	24.5±19.8

Table 2. Fertility potential measured by non-return rate of RCC breeding bulls.

RCC Bull ID	No of RCC cows inseminated	Non-returned cows after 60 days of AI	Non-return rate (%)
250	154	89	61.4
512	5	3	60.0
536	15	12	75.0
392	8	3	37.5
474*	5	-	-
544*	6	-	-
Total	193	107	58.8**

*Non return rate has not calculated, since AI has not passed 60 days; **Return rate was calculated based on 182 AI.

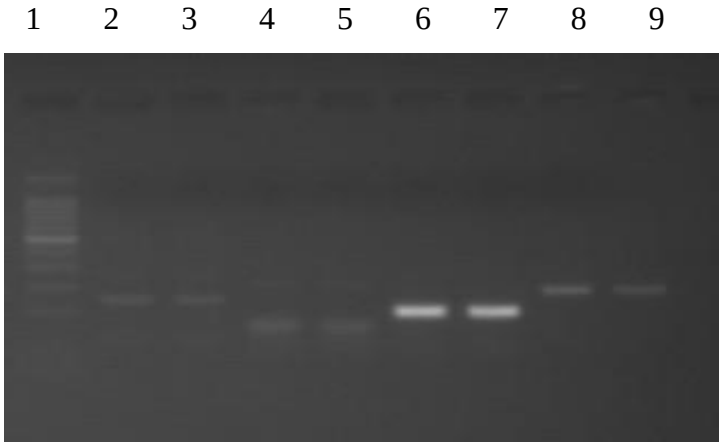

Figure 1. mRNA expression in the Red Chittagong bull's sperms. Column 1: DNA marker, column 2-3: AKAP4 mRNA; column 4-5: AKA1B1 mRNA; column 5-6: GAPDH mRNA and column 8-9: clusterin mRNA transcripts.

Identification of the polymorphisms in low-density-lipoprotein receptor related protein-8 gene and association study with gastrointestinal nematodes infection in goat

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Executive summary

Gastrointestinal nematodes (GINs) are one of the most economically important parasites of small ruminants. The resistance or susceptibility against this parasitic infection are related to the genetic factors and varies between and within breeds. The objective of this study is to identify SNPs in the low-density-lipoprotein receptor related protein-8 (LRP8) gene and investigate their association with GINs infection to know genetic resistance. One hundred and fifty animals are being under monitoring for parasitological (FEC) and hematological parameters (Hgb and PCV). Fecal egg count (FEC) was determined by using modified McMaster technique and blood parameters were determined using Mindray Auto Hematology Analyzer. To construct the evolutionary relationships of LRP8 gene of goat with other species, we also downloaded protein sequences of different species from NCBI. All collected sequences and their corresponding amino acids were aligned and a phylogenetic tree was constructed using MEGA version 6. The genomic DNA was extracted from blood using genomic DNA extraction kit following the manufacturer's guidelines. The DNA concentration and quality were determined by NanoDrop 2000 spectrophotometer and gel electrophoresis. We used goat re-sequencing data to detect possible SNPs in LRP8 gene. Caprine mRNA of LRP8 gene (XM_018044317.1) was downloaded from NCBI and was setup as a "reference genome" using Burrows-Wheeler Alignment (BWA) index. To obtain more sequence variants, we downloaded published re-sequencing data of 33 goat individuals. After quality filtering, the sequence reads of each animal was separately mapped to "reference genome" LRP8 gene using BWA version 0.5.9. The identified SNPs were then genotyped in the 150 goats.

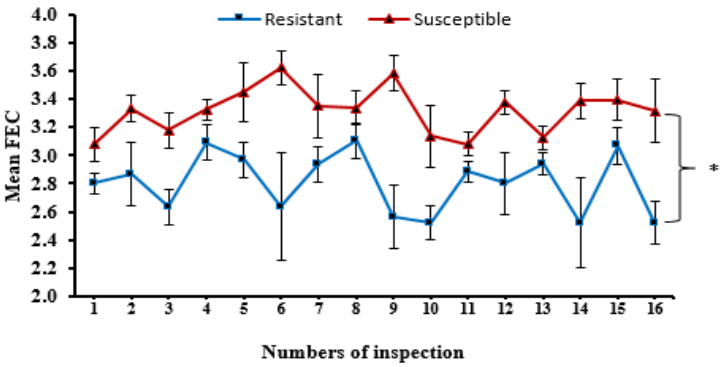

Figure 1. Weekly average fecal egg counts (FEC) of susceptible and resistant Black Bengal Goat (BBG) (N=150). The data were transformed into log10 (n+100), where n is the actual FEC values. The differences were statistically significant at P≤0.01 and errors bar represent standard error of mean (SEM).

The average FEC values from the resistant group were 2.804±0.164, while the susceptible group had average FEC values of 3.315±0.136 at the end of the 16 times inspection in different months considering log-transformed data. This difference was statistically significant (P<0.01). In both goat groups, there was an expected every time fluctuation in FEC (Figure 1) and the susceptible goats consistently demonstrated higher FEC than those of resistant goat groups throughout the period. The maximum likelihood phylogenetic tree showed that the caprine LRP8 gene was closely related to LRP8 gene of cattle and buffalo than that of other studied

species. The protein sequences of LRP8 gene of goats also showed much closer amino acid similarity to the LRP8 gene of cattle (99%) and buffalo (99%) than that of sheep (98%), horse (94%), cat (93%), pig (93%), mouse (89%) and rat (88%). The nine novel polymorphisms were identified in the goat LRP8 gene, in where 5 mutations located in 3´ UTR and 3 synonymous and 1 non-synonymous mutations were located in the exon regions. The non-synonymous mutation were encoded Threonine to Methionine, relative to the start (ATG) codon. Genotypic and allelic frequencies of nine variants were consistent with Hardy-Weinberg equilibrium.

Table 1. Information of nine variants (SNPs) in mRNA sequence of LRP8 gene in goat.

Sl. no.	SNPs & Locations	SNPs & Positions		Code	Encode**	Amino acid substitution
		In genome*	In mRNA			
1	C/T, (Exon 3)	c27865812	C317T	AA[C/T]	Asn = Asn	Synonymous
2	C/T, (Exon 13)	c27840055	C1898T	TC[C/T]	Ser = Ser	Synonymous
3	C/T, (Exon 17)	c27835886	C2452T	A[C/T]G	Thr = Met	Non-synonymous
4	C/T, (Exon 18)	c27833587	C2687T	AT[C/T]	Ile = Ile	Synonymous
5	G/A, (3´ UTR)	c27823399	G3664A	-	-	-
6	G/C, (3´ UTR)	c27823096	G3967C	-	-	-
7	C/T, (3´ UTR)	c27822716	C4347T	-	-	-
8	A/G, (3´ UTR)	c27822419	A4644G	-	-	-
9	A/G, (3´ UTR)	c27821715	A5348G	-	-	-

*Reverse complement mRNA sequence of LRP8 gene (XM_018044317.1), ** Three letters data-base encodes

It's a partial result of our ongoing project but the results indicated that the LRP8 gene could be a good possible candidate gene either as a major gene or as an associated with another major gene in GINs infection in goat. For more clarify, further studies is needed on a large number of goat populations considering different genetic backgrounds.

Development of microbial silage inoculant and evaluation of its efficacy on ensiling roughages

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Executive summary

Fodder ensiling a biochemical process of fodder preservation where naturally occurring epiphytic bacteria under anaerobic conditions ferments soluble sugars in plants to produce lactic acid and thereby reduced pH and preserved nutrients. However, this natural fermentation process can be ensured or boosted up by using selective species of bacteria. There are some species which found to be effective after silage opening as they increase the aerobic stability of silage. Quick fermentation and lowering pH at the initial stage and increased aerobic stability after opening silos together are immensely important for silage commercialization. Therefore, the present study was undertaken to develop different microbial silage inoculants isolated from epiphytic bacteria from fodder crops and from silages. Among different bacterial species isolated and identified previous year, *Lactobacillus fermentum* and *Bacillus subtilis* were selected as potential silage inoculants and this year their performances were tested on maize fodder (*Zea mays*) ensiling in laboratory scale. The bacteria were cultured for mass production of cells, centrifuged followed by repeated washing in saline solution and obtaining the cell pellet. A liquid inoculum was prepared using saline solution containing minimum bacterial cell concentration of 10^8 CFU/ml. Twenty laboratory mini silos of 1 kg capacity were prepared. In each silo, 1 kg of chopped maize fodder was ensiled either having "no inoculant" (Control) or inoculated with *Lactobacillus fermentum* (LF), or *Bacillus subtilis* (BS) or an equal mixture of *Lactobacillus fermentum* and *Bacillus subtilis* (Combo) for 35 days in 4 replications. At silo opening, approximately 200gm of each replicate was collected at different positions of the silo (at the top, in the middle, and in the bottom) and finally mixed together as representative silage samples for each replication, and the rest of the samples were kept at -20^{0}C for further chemical and proximate analyses. Silage was evaluated based on pH, chemical compositions, and microbial enumeration (LAB, Bacillus, yeast, and mold count).

Results showed that (Table 1), the inoculant LF (4.04) and BS (4.09) decreased the final pH ($P<0.01$) of silage compared to the control (4.19) and combo (4.15). The NH_3-N concentration was found highest ($P<0.01$) in the control, followed by LF, BS and combo. However, the loss of DM was found highest ($P<0.01$) in the combo (4.86%) compared to all others (4.56, 4.44, and 4.56% in the control, LF and BS, respectively). Along with the control, LF and BS preserved silage DM better than the combo. Similarly, CP was also well preserved in the control and LF compared to others. The concentration of lactic acid bacteria (LAB) was found highest ($P<0.05$) in LF inoculated silage (8.01 $\log_{10}$ CFU/g silage), while *Bacillus* was found highest ($P<0.01$) in BS inoculated silage. Yeast was found lowest ($P<0.01$) in BS inoculated silage, while mold growth was not detected in any of the inoculated silages.

Table 1. Effects of microbial inoculant on fermentation characteristics and chemical compositions of maize fodder on 35 days of ensiling.

Item	Control (No additive)	*L. fermentum* (LF)	*B. subtilis* (BS)	Combo (LF+BS)	SEM	P-Value
Fermentation indices						
pH of fodder	5.68^{b}	5.71^{ab}	5.69^{b}	5.75^{a}	0.004	<0.01
pH of silage	4.19^{a}	4.04^{b}	4.09^{b}	4.15^{a}	0.005	<0.01
NH_3-N, mg/100g	7.25^{a}	6.80^{a}	5.13^{ab}	4.20^{b}	0.078	<0.01
Microbial enumeration, Log_{10}CFU/g						
LAB	7.83^{b}	8.01^{a}	7.85^{ab}	7.89^{ab}	0.056	<0.05
Bacillus	7.31^{b}	7.30^{b}	8.29^{a}	7.15^{b}	0.153	<0.01
Yeast	6.92^{a}	6.97^{a}	6.58^{b}	6.62^{b}	0.019	<0.01
Mold	2.88	ND	ND	ND	-	-
Chemical composition						
DM of fodder, g/kg	250.20	248.46	248.27	248.76	0.315	>0.05
DM of silage, g/kg	204.62^{a}	204.08^{a}	202.63^{ab}	200.11^{b}	0.319	<0.01
DM loss, %	4.56^{b}	4.44^{b}	4.56^{b}	4.86^{a}	0.010	<0.01
CP of fodder (g/kg)	106.8	106.1	105.7	105.6	0.036	>0.05
CP of silage (g/kg)	85.10^{a}	84.20^{a}	77.67^{b}	77.83^{b}	0.176	<0.01

Control, No additives/microbial inoculants, LF, Maize inoculated with *Lactobacillus fermentum*, BS, Maize inoculated with *Bacillus subtilis*, Combo, Maize inoculated with the equal mixer of LF and BS; SEM, Standard error of mean; LAB, Lactic acid bacteria.

In conclusion, so far studied, inoculant LF and BS both were found effective to lower silage pH, ensure better fermentation and reducing the loss of silage DM.

Efficient management of livestock and poultry manure for value addition and pollution control

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Executive summary

Surface water quality may be contaminated by traditional farm manure and slurry management. Besides, poultry manures (PM) are associated with the release of odorous volatile organic compounds, ammonia (NH_3) and hydrogen sulfide (H_2S). Therefore, the present research was undertaken to estimate the potential water pollution from livestock and poultry farms (Experiment 1) and to study the effectiveness of selected additive application for decreasing odorous gases emission and microbial contamination (Experiment 2). In experiment 1, total 22 cattle farms were selected from Baghabari, Sirajganj, those are adjacent to water bodies and somehow connected or have chance to contaminate water bodies by farm manure. Farm waste water/liquid slurry/water samples were collected from three different points; exit point of waste from farm (S-1), point of mixing waste to water bodies (S-2) and finally from the point where water is used by households (S-3). Laboratory analysis on pH, total dissolved solids (TDS), electrical conductivity (EC), dissolved oxygen (DO), chemical oxygen demand (COD) and microbial load determination concerning public health hazard (*E coli*, *Salmonella*) were performed. In experiment 2, different additives for removing odor from poultry manure in two different doses were used. Poultry manure was incorporated either without any additive (control, T_1) or 10% (T_2) and 20% (T_3) aqueous solution of aluminium sulphate, and 10% (T_4) and 20% (T_5) aqueous extract of *Sapindus mukorossi* (SM) fruit. The gases emission of NH_3, H_2S and CO_2 as well as microbes like *E. coli* and *Salmonella* were studied.

Table 1. Water quality parameters as affected by cattle farm manure.

Sampling point	pH	Physicochemical characteristics				Microbial load (Log_{10}CFU/ml)					
						E. coli			*Salmonella*		
		TDS (ppm)	EC (µS/cm)	DO (mg/L)	COD (mg/L)	% Positive	Count[#]	Over all	% Positive	Count[#]	Over all
S-1	7.4	1107.7[a]	2240.0[a]	0.3[c]	1853.6[a]	100	5.1	5.1[a]	27	3.3	0.9
S-2	7.5	142.3[b]	267.7[b]	4.1[b]	98.5[b]	41	4.1	1.7[b]	18	4.7	0.9
S-3	7.5	56.4[b]	110.9[b]	5.1[a]	17.6[b]	9	3.0	0.3[c]	0	0.0	0.0
SEM	0.05	38.32	74.79	0.08	77.47	-	-	0.19		-	
P-value	NS	<0.01	<0.01	<0.01	<0.01	-	-	<0.01		-	
ECR 1997[*]	6.5-8.5	Max 1000	Max 1200	4.5-8.0	Max 200			1.0-1.7			

[*]ECR, 1997; Environment Conservation Rules, 1997; [#]Mean derived considering only positive cases

Results showed in Experiment 1 (Table 1), that with the travelling distance of waste water, the pH was slightly increased (7.36, 7.51, 7.53 in S-1, S-2 and S-3, respectively; $p>0.05$), TDS (1107.73, 142.30, 56.36 ppm in S-1, S-2 and S-3, respectively; $p<0.01$), EC (2240.00, 267.70, 110.91 µS/cm in S-1, S-2 and S-3, respectively; $p<0.01$) and COD was decreased (1853.64, 98.50 and 17.55 mg/L in S-1, S-2 and S-3, respectively; $p<0.01$), while, DO was also increased (0.30, 4.14, 5.10 mg/L in S-1, S-2 and S-3, respectively; $p<0.01$) in the sample. These findings remained within the permissible limits for the diverse household uses of water according to the Department of Environment (DoE) guideline. Again, *E. coli* was found positive in 100, 41 and 9% of total samples in S-1, S-2 and S-3 with concentrations of 5.13, 4.1 and 3.0 log_{10}CFU/ml, respectively. While *Salmonella* was found positive in 27 and 18% cases in S-1 and S-2 at a rate of 3.3 and 4.7 log_{10}CFU/ml , respectively, but none in S-3. When these results expressed in overall mean considering all 22 farms, microbial counts also remained lower than that allowed

in ECR 1997. In the 2nd experiment (Figure 1), concentrations of NH_3, H_2S and CO_2 gases were significantly ($p<0.05$) reduced in additive treatments irrespective of doses compared to the control. However, from day 1 to 4, results were not persistent, but in the case of NH_3, treatment groups always remained lower compared to the control. Similarly, additive treatments significantly ($p<0.05$) reduced *E. coli* and *Salmonella* compared to the control.

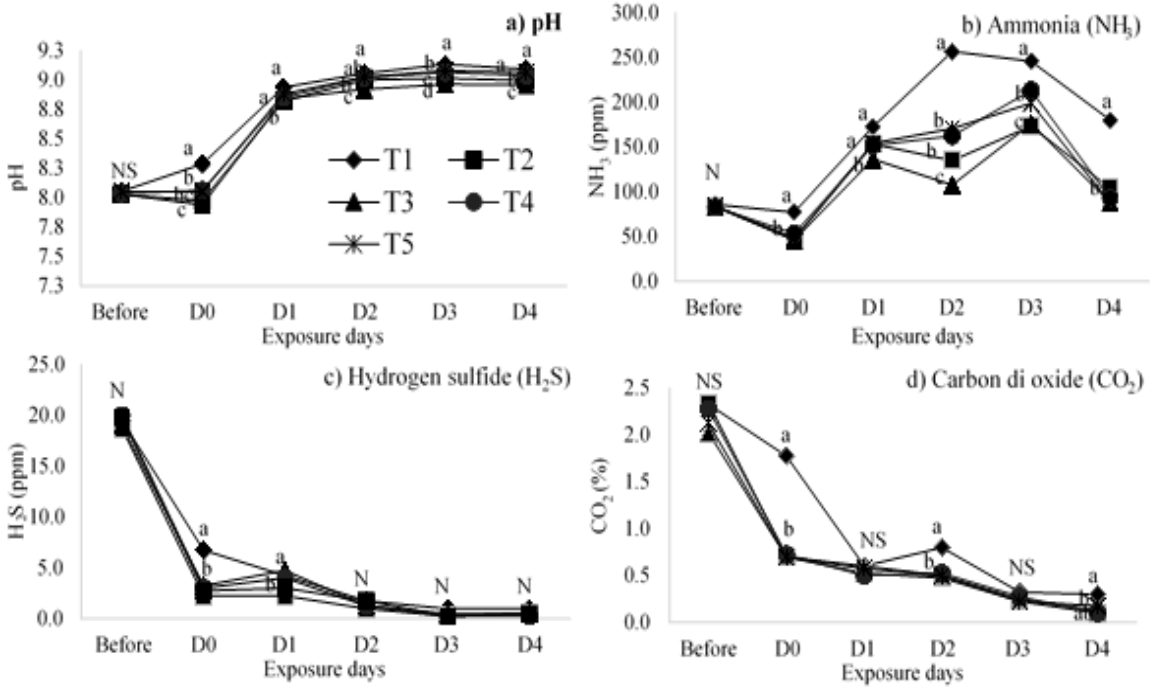

Figure 1 Mean (a) pH and concentration changes of (b) NH_3, (c) H_2S and (d) CO_2 from poultry manure before and after application of different additives from day 0 (D0) up to day 4 (D4).

Based on the current study, it can be concluded that, the livestock farm waste is not directly responsible considering above parameters for household water pollution in those selected farm vicinity. However, expanded study should be conducted covering more regions with high sample size to derive final conclusion. Again, aluminum sulphate and *Sapindus mukorossi* extract at 10-20% dose found effective to reduce gas emission and *E. coli* and *Salmonella* count in layer droppings.

Measurement of noxious greenhouse gases at the poultry shed and their possible remedies

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Executive summary

In Bangladesh, farmers are rearing their chicken in the open housing system and noxious gases are spread in the surrounding areas though the air. So, management of poultry litter and odor emission is a great concern. In 2019-20, two experiments were conducted to determine the effect of feed composition on performance, meat quality and gas emission of slow Multi color Table Chicken (MCTC) and fast growing (broiler) chicken and to isolate, identify and quantify of *Trichoderma spp* and to observe its odor reduction efficacy from poultry litter. Therefore, in exp. 1, a total of 720 day old slow growing MCTC of equal body weight were distributed into 30 pens (5 replicate pens/treatment; 24 birds/pen) and were provided 2 level of CP and 3 level of L-glutamine (Glu) resulting in a 3×2 factorial arrangement of dietary treatments (Starter T_1, 20×0; T_2, 20×0.1; T_3, 20×0.15; T_4, 22×0; T_5, 22×0.1 and T_6, 22×0.15 % CP and glutamine level, respectively). During grower (2-3 weeks) and finisher (4-5 weeks) period dietary CP level was reduced 2% in each treatment. Birds were weighed individually to determine body weight (BW) and weight gain (WG), and feed intake data were recorded for determining feed intake (FI) and feed conversion ratio (FCR). Meat samples were collected to analyze carcass and meat quality. Fresh excreta were collected and gases that formed were measured 5 cm above the excreta samples. In experiment 2, diet was formulated using different levels of glutamine (0, 0.10, 0.15, 0.20, 0.25 and 0.30 %) to optimize growth and reduce gas production. The *Trichoderma Viridae* was isolated from soil sample using potato dextrose agar medium by serial dilution technique and concentration was determined in colony forming unit (CFU)/ml. After determine the concentration, it was diluted with sterile water and was stirred thoroughly and sprayed to poultry litter and gas was measured according to experiment 1. All data were arranged by one and 2-way ANOVA plus interaction mixed procedure of SAS and differences were determined by DMRT. A $P<0.05$ value was considered significant.

Table 1. Effect of dietary protein and glutamine on the performance of slow growing chicks.

Parameter	Treatments						SEM	P value
	T_1	T_2	T_3	T_4	T_5	T_6		CP x Glu
BW (g)	887.55^{b}	948.08^{ab}	983.95^{a}	974.48^{ab}	985.36^{a}	994.66^{a}	8.092	0.024
WG (g)	848.36^{b}	908.85^{ab}	944.73^{a}	935.31^{ab}	946.12^{a}	955.48^{a}	7.948	0.031
FI (g)	2240.01	2228.09	2244.58	2266.14	2254.51	2262.77	14.64	0.326
FCR	2.640	2.452	2.375	2.422	3.383	2.368	0.137	0.078

BW=Body weight, WG=Weight gain, FI= Feed intake, FCR= Feed conversion ratio; Glu=Glutamine Treatment, interaction of dietary protein and glutamine

In exp. 1, there was significant dietary interaction between CP and glutamine on BW, WG and FCR of MCTC chicken (Table 1). With decreasing dietary CP levels and increasing glutamine (reduce 2 % dietary CP and 0.15% glutamine in T_3 treatment) highest BW, WG and lowest FCR were found in T_3 and T_6 group compared to T_1 treatment, while feed intake was not affected by dietary treatments. In meat quality, results showed that muscular pH, color (a*-redness) and cooking loss percentage were significantly improved in T_3 and T_6 treatment as compared to other dietary treatments. However, variation of CP and glutamine did not influence the carcass characteristics of broiler chicks. A significantly lower level of NH_3, H_2S and CH_4S % were found by the T_3 treatment as compared to T_4 treatments (Table 2). However, there were no dietary protein and glutamine interactions regarding CO_2, O_2, CO, NO_2, SO_2 and CH_4 gases production of chicken litter. In similar, growth performance of broiler chicken was significantly higher and gas emission was lower in 0.20 and 0.25 % Glu containing diet was found in experiment 2.

Table 2. Effects of dietary protein and glutamine on noxious gas emission of slow growing chicks.

Treatments	T_1	T_2	T_3	T_4	T_5	T_6	SEM	P value CP x Glu
O_2 (%)	21.43	21.60	23.34	19.50	17.67	19.50	1.75	0.964
CH_4 (%)	13.40	12.83	9.35	14.35	5.80	19.57	2.30	0.669
H_2S (ppm)	30.10^{ab}	30.69^{ab}	22.60^{b}	45.75^{a}	33.56^{ab}	29.93^{ab}	3.25	0.046
CO (ppm)	793.30	695.45	741.60	786.00	763.85	843.75	54.66	0.986
NH_3 (ppm)	72.46^{ab}	71.32^{ab}	59.72^{b}	82.63^{a}	84.68^{a}	79.17^{a}	5.26	0.038
CH_4S (ppm)	52.35^{b}	40.90^{ab}	49.75^{c}	76.97^{a}	54.85^{b}	50.70^{b}	4.23	0.029
NO_2(ppm)	0.14	0.25	0.11	0.21	0.21	0.21	0.02	0.651
CO_2 (%)	4.42	4.55	4.72	3.89	4.47	4.58	0.163	0.792
SO_2 (ppm)	15.93	15.07	16.52	15.09	15.37	17.14	0.775	0.972
pH	6.22	6.10	5.78	6.70	6.46	6.29	0.211	0.901
Temp. (^{0}C)	35.42	34.67	34.75	34.92	35.00	35.17	0.356	0.995

After isolation, *Trichoderma viridae* concentration was found in 19000 CFU/ml. From 1-5 days spray of *Trichoderma* to the litter, no differences were found among the treatments. But after 7 days of fermentation, gas production was reduced significantly by the *Trichoderma* treated litter than that of the control. Therefore, 2% reduction of protein with supplementation of 0.15 % and 0.25 % glutamine in the diet may reduce gas emission without affecting growth performance of slow (MCTC) and fast growing (broiler) chicks. Application of *Trichoderma* to the litter may be effective to reduce odor emission. Further study is needed to isolate and determine *Trichoderma viridae and Trichoderma reesei* concentration and use alone or mixture with other microorganisms to develop a composite product for reducing gas emission in poultry litter.

Low cost and sustainable approaches of bio-slurry management

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Executive summary

Anaerobic digestion of cow dung to produce biogas is getting popular to rural farmers day by day. But the major challenge in this process is bio-slurry management which is the residual by-product of anaerobic digestion feed stock. Concerning this issue, research activities has been going on at BLRI since 2014 to develop a simple and cost-effective way to use bio-slurry. In the present year two different experiments were conducted. The first experiment was conducted to identify the microbial association of bio-slurry water and in second experiment, it was tested whether the vermin conversion of bio-slurry compared to solid cow dung is beneficial or not. For microbial study Potato Dextrose Agar (PDA) media was used for isolating the fungal growth, Nutrient Agar (NA) media and Nutrient Broth (NB) media for bacterial growth and King's B (KB) was used as specific media for isolating the pseudomonas growth in bio-slurry water sample. For vermi conversion, total nine (9) cement made vermi bin was prepared and filled with 20 kg semi-dried bio-slurry. Each bin was then fed to worm (750 nos. in each bin) under controlled condition for 60 days. Same combination was followed for vermiconversion of solid dung as control. After 60 days finally recovered fertilizer amount was calculated and sample was taken for analysing the nitrogen content. Data were analysed using SPSS.20 statistical sofware.

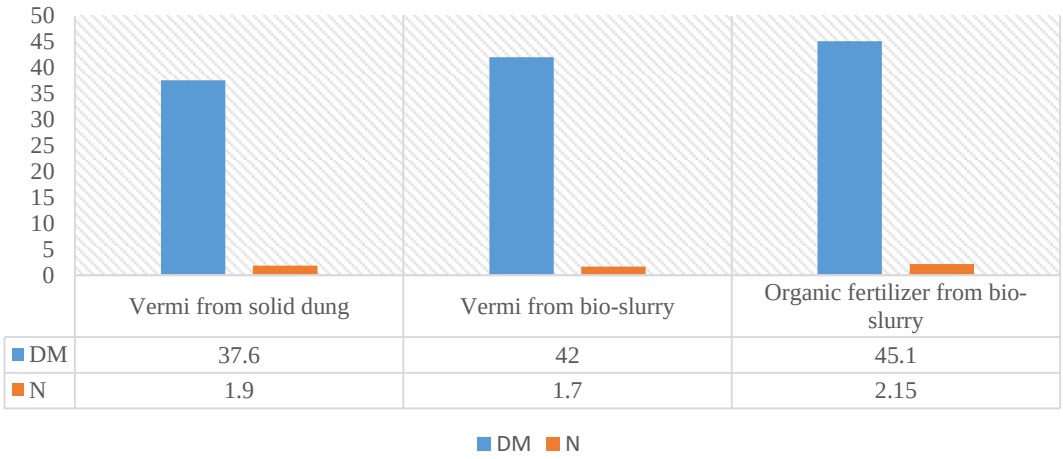

Figure 1. Nitrogen content of organic fertilizer produced from vermi conversion and drying of bio-slurry.

Microbial composition of bio-slurry water was identified also studied under this research. *Pseudomonas fluorescence*, *Bacillus sp and Xanthomonas sp.* of bacteria and *Trichoderma sp.* of fungus was found to be present in bio-slurry water all of which were beneficial to soil health at different extent. But further more studies need to be conducted to make them specific and define their mode of action against different disease and pests. Table -1 represents the recovery rate of organic fertilizer (OF) production through vermin-conversion of solid dung, bio-slurry and sun-drying of fresh bio-slurry from equal amount (20kg) solid dung and bio-slurry. Vermi conversion of solid dung and bio-slurry produced organic fertilizer at almost same rate (31.6 and 30.5%) whereas the return rate was much lower (15%) in OF production from drying bio-slurry. It is a matter of great concern regarding this issue is minimum 60 days is required to get fertilizer using vermin-conversion technique but in case of slurry drying it becomes declined to 3-4 days only. Moreover, this time frame may be reduced to few minutes to hours when simultaneous separation of bio-slurry solid and liquid can be practiced mechanically. The

nitrogen content of organic fertilizer sourced from different origin (vermi composting and sun drying) is presented in figure-1. From the results of figure-1 it is revealed that, maximum amount of nitrogen can be achieved from bio-slurry based organic fertilizer (2.15%) through drying and no difference was observed in vermin fertilizer from both solid dung (1.9%) and bio-slurry (1.7%). From this findings it can be inferred that, OF production from bio-slurry through drying could be much more profitable than it's vermin conversion. Because vermin conversion of bio-slurry requires more time and returns lower nitrogen compared to drying output of it whether this technique could bring optimistic return for the rural or marginal farmers who are not able to manage their animal waste using anaerobic digestion system.

Table 1. Return rate of organic fertilizer from vermi-conversion of solid dung, bio-slurry and dried bio-slurry.

Fertilizer category	Recovered amount (kg)	Return rate (%)	Duration required (Days)
Vermi-conversion of solid dung	6.33	31.6	60
Vermi-conversion of bio-slurry	6.11	30.5	60
Bio-slurry drying	3.00	15	3-4

In conclusion, it can be said that bio-slurry is a supreme fertilizer valued bio-resource is also potent to act as organic pesticide too. But vermin-conversion technique may not be as suitable approach for bio-slurry as for solid dung.

Development of model village through BLRI Technologies at Dhamrai areas

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Executive summary

The aim of the study to disseminate BLRI developed most popular and commonly practiced livestock based information and technology to farmers level for increasing productivity; observe the impact of their interventions on socioeconomic status of farm families; identification of constraints facing during acquaintance with technologies and adaptation. Keeping this mind, one village namely Shorifbag were selected for a model village. Out of 301 farmers 50 farmers were selected for refresher training and 21 technologies demonstration programme were completed this year. A Society/Forum was formulated with holistic approach where 52 members are involved. Mass deworming, vaccination & vitamin supply programme were completed at consistently 2nd year for developing a FMD and PPR control village and poultry biosecurity measures where 1097 animals and 5000 poultry were taken under this programme. Total 60 blood samples were collected randomly before vaccination and after one-month vaccination to detect titer level. Twenty one farmers were selected for adaptation of high yielding fodder (HYF) (Pakchong, Moringa & Maize) cultivation and preservation; Total 25 farmers were selected for improved native chicken rearing and 6 farmers for sheep and goat rearing model at 1st year and consistently 1 year production cycle of this birds/animals were observed at 2nd year; 85 farmers for beef fattening while 17 farmers had at 1st year ; 2 farmers for BLRI improved MCTC (Multi Color Table Chicken) rearing model and one farmer for safe broiler production. At Corana crisis situation, an online cattle sell platform was development for Eid-ul-Azha where 78 cattle were selling out of 166 cattle. The HYF production was increased day by day at model village where 70 decimal lands at 1st year and 775 decimal lands were cultivated at 2st year and used this fodder for their livestock feeding by fresh, silage & hay basis. Six farmers were used **topdressing technique** for application of chemical fertilizer (urea) in the fodder plant where production was about 2 times increased compare to previous state. New 42kids were born and number of farmer's 83.33% increased under sheep and goat rearing model at 2nd year. No clinical outbreaks against FMD, PPR, ND and Duck plague were found during this period and antibody level was protective level in ELISA report. However, antibody titre was 29.33% (n=230), 80% (n=195), and 94% (n=215) in cattle and 33% (n=30), 82% (n=30), and 96% (n=30) in goat and sheep at pre-vaccination, vaccination without anthelmintic and vaccination with anthelmintic respectively. Hence, 14% immunity was increased due to anthelmintic application before 7-14 days of vaccination. There was herd immunity developed against FMD, PPR, strong immunization against LSD was running, and a strong ND titre remained in BLRI model village. It can focus safe animal protein production through controlling circulation of infectious organisms. BLRI newly developed 1400 MCTC were reared on floor and stat management system in rural condition. All birds received the same ration with 2850 Kcal/ kg ME and 22% CP as a starter ration, 2995 Kcal/kg ME and 19 % CP as a finisher ration. The results showed that slat birds had a significantly ($P \leq 0.01$) higher body weight, total and daily weight gain at all ages. The slat birds showed a significantly better growth rate and better economic efficiency by 26% comparing to floor birds. Farmers were earned 30000-38000-Tk by 600 MCTC rearing and also earned 25000-Tk under safe broiler production model at farmer's level. Under validation of "Khamer Guru Apps" innovation technology, 30 farmers were trained and 5 farmers are practicing these mobile Apps for their farm management. In case of native chicken, the age and weight of sexual maturity was 20weeks and 1421gm; Mortality rate in growing and laying period were found 1.6% and 1.2%; the body weight at 12th and 40th weeks of age 813g and 1500g respectively under semi-intensive condition. Annual egg production was 157 and feed intake was 70.00 (g/bird/day) and egg weight varied from 37-44g where scavenging local native birds with an annual average production of 35-49 eggs/hen each weighing 35-39g.The annual egg production and growth rate is 2-3 times higher than the existing village level indigenous flocks. It may be concluded that, BLRI developed technology is being working successfully in community level farming system.

Impact of feeding technology developed by Bangladesh Livestock Research Institute on dairy development in Bangladesh

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Executive summary

The aim of the study was assessing the knowledge of livestock innovations ideas on small-scale farms in selected areas of Bangladesh. The characteristic of dairy cows under smallholder production of the country is performing sub-optimally due to imbalance feeding practiced. In spite of having the same genetic potential of the cow in these areas is expected to produce at least 15 litres of milk per cow per day. The level of milk production from the cows is quite low, ranging from 4 to 5 litres in the dry seasons to 6 to 8 litres in the wet seasons. This situation is presumed to be caused by the poor nutritive values of the locally available feeds and inappropriate feeding, which fail to meet the required nutrients by the cows. Nevertheless, the smallholder dairy farmers in Bangladesh perceived that the low milk yield from their cows is due to low genetic potential of the animals for milk production. The on-farm experiments on recommended mix-ration and silage feeding proved high dairy performance. The BLRI's innovation of such mixed-ration formulae and farm level dissemination of these practices including silage preparation is clamed successful pathway of dairy development in the country. Keeping in mind this the study focused on identifying potential appropriate livestock technology of Total Mixed Rations (TMR) for smallholders and grouped them in innovation areas, defined as a set of well-organized practices with a business purpose under BLRI prescription and advices. Finally, a process management program (PMP) was evaluated according to the livestock innovation level by BLRI and the viability of small-scale farms. Farm management analytical tools and econometric model were used to evaluate the impact of PMP of BLRI on the economic viability of the farm. Information from 600 small-scale livestock farms in Sirajganj, Pabna, Rangpur, Jamalpur, Mymensingh, Kushtia, Sumamganj, Tangail and Kishoregonj was collected and the innovations were grouped in two categories innovation areas and non-innovation areas.

Using simple farm management analytical tools comparative profitability of TMR and non-TMR farms group were identified. Moreover, factors affecting dairy farmers' adoption of TMR were estimated by using logistic econometric model. The resulting innovation level in the system was found at 15.7 percent and heterogeneous among areas. This study showed the usefulness of the methodology described and confirmed that implementing in a farm using TMR allows improving the viability an additional 21 percent performance due to a better integration of processes, resulting in more efficient feeding management.

It was found that TMR using lactating cows under smallholder dairy farmers in area were balance fed for both silage and concentrate diets. The tested feeding practice where cows are fed 4.2 kg of concentrate and 5 kg of forage could increase milk production and profitability of the dairy enterprise. The costs of extra concentrate and forages supplemented to the cows were calculated. The cost of the test concentrate was based on the costs of the ingredients. It included the costs of purchasing the feed ingredients, cost of compounding the concentrate and extra labour cost of supplementation. Likewise, the total milk yield, extra milk yields due to supplementation of TMR. The revenue realized was based on sale of the extra milk obtained due to balance feed and additional forage supplied.

The econometric analysis of the TMR application suggested that the higher response to balance concentrate supplementation by milking cows in study areas had higher potential for milk production. This was supported by the observed increase in milk yield gain of 1.11 lit /kg DM concentrate intake per day by the supplemented cows on. The effect of participating in a farm supporting services by BLRI was found a positive effect on the probability of farmers using TMR. It could be concluded from the findings that advisory services by BLRI help make farmers more aware of the potential benefits of using good feeding practice as a new technique.

In particular, farm advisory services could provide useful advice on the impact of using TMR over other technologies and the most efficient method of using feeding. It must be noted, however, that there is a potential endogeneity problem with the inclusion of this variable in that those who involve themselves with advisory services may be more likely to adopt best management practices irrespective of any advice or help they receive. The existing feeding practices of lactating cows under smallholder zero grazing system in study areas have inadequate nutritional supply, making the animals producing milk below their genetic potential. Therefore, expansion of TMR technology would amicably make solution of low performance of cattle in Bangladesh.

Drawbacks in subsistence goat farming at selected regions of Bangladesh

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Executive summary

Goat farming is growing due to the high demand for goat meat. Raising meat goats is typically easier than raising cow. The most popular breed for goat meat farming is Black Bengal (BB) goat in Bangladesh. The animals are known for quality meat, high reproduction rates and quality skin. BB goats are hardy animals that are well adapted to our environments. BB goats are highly prolific so that flock size increase within very short time. But due to lack of quality buck in farmer's level, social conflict of buck rearing and crossing with different exotic breeds, BB goat are now decreasing day by day. On the other hand, feeding of goat in our country is mostly grazing in the fellow lands where, the goats have to depend only on local grasses, which are insufficiently utilized by goats because of high fiber content, low voluntary intake and deficiency of high soluble carbohydrate and mineral matter as well as poor digestibility of the fibrous fractions by goats. Thus, the productivity of BB goat are not optimum in farmer's level. Conservation of BB goat and for its improvement it is necessary to improve the existing feeding and management system in community level. Considering all these aspects, BB goat producing farmers were surveyed to know the socioeconomic status, goat production systems and to identify the problems of BB goat rearing. Out of 640 BB goat farmers of the selected areas (Bhaluka and Muktagasa of Mymensingh; Khustia Sadar; Meherpur Sadar, Chuadanga Sadar; Jassore Regional Station; Naikhongchari regional station and Rajshahi regional station) 80 were visited, farmers were interviewed and structured questionnaires were filled in to collect data.

The results showed that 70.0% farmers were women and 29.1% were men; among the women, 62.22% are house wife and the other farmers professions are agriculture (17.09%), service (12.99%), business (2.56%), others (5.13%). The education level of the farmers was found illiteracy, below 8th grade and SSC or higher at 42.5%, 41.25% and 16.2%, respectively. Highest family size (no./family) was found in Muktagasa (5.8) and lowest in Rajshahi (4.73). In case of land status, landless to marginal category farmer of studied areas was highest in Muktagasa (68.97%) and lowest was in Meherpur (39.33%). Small to medium category farmer found the highest in Meherpur and Rajshahi (58.62%) with the lowest in Muktagasa (31.04%). There were no large category farmers found in studied areas (Fig.1). The average number of BB goat per farmer found the highest in Chuadanga (14.2) and the lowest in Muktagasa (3.86). PPR, Pneumonia, diarrhea, bloat and parasitic infection were found the main diseases of BB goat amongst all sites. Highest BB goat per farmer was found in Chuadanga (11.73) and lowest in Naikhongchari (2.3), where in others sites followed by Muktagasa (3.97), Meherpur (5.9), Rajshahi (3.86), Jashore(3.5), Kustia (5.4) and Bhaluka (3.2). The feed resources for BB goat in the study areas were almost similar, e.g. green fodder (mostly natural with very few cultivated fodder like Napier, Maize, Oats, matikalai etc.), dry roughage (rice/wheat straw, kalai/soybean hay etc.), rice/wheat bran, khud, rice starch (vater mar) etc. It was observed that no supplementary balance concentrate feed were supplied to their goats in project areas. Lack of marketing facilities, lack or insufficient veterinary services, high price of concentrate feed, lack of pasture, improved buck for services and lack of training and technologies along with dog biting and road accident (mostly in Naikhongchari) were the most faced common problems by BB goat rearing farmers in the surveyed areas (Fig. 2).

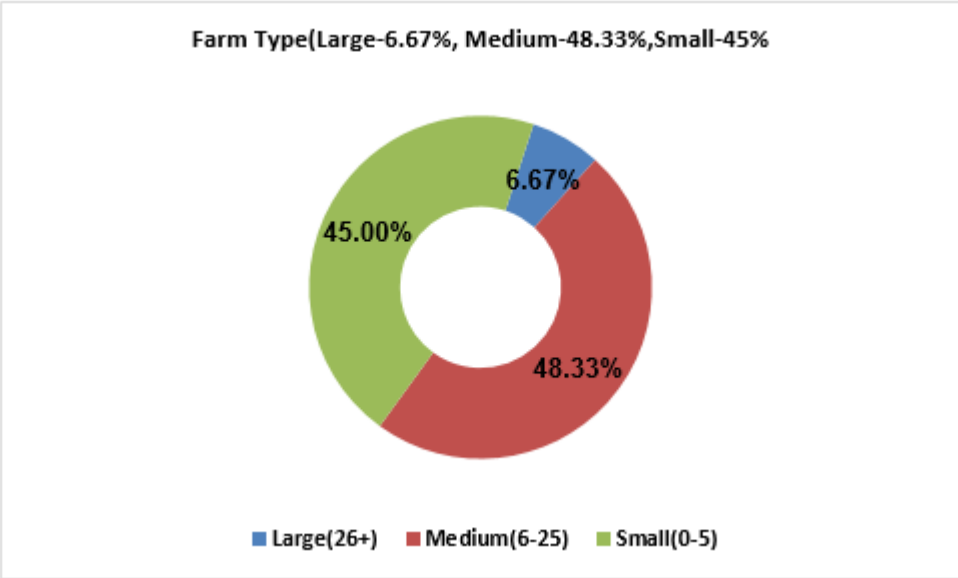

Figure 1. Farm size status on Black Bengal goat rearing in selected areas

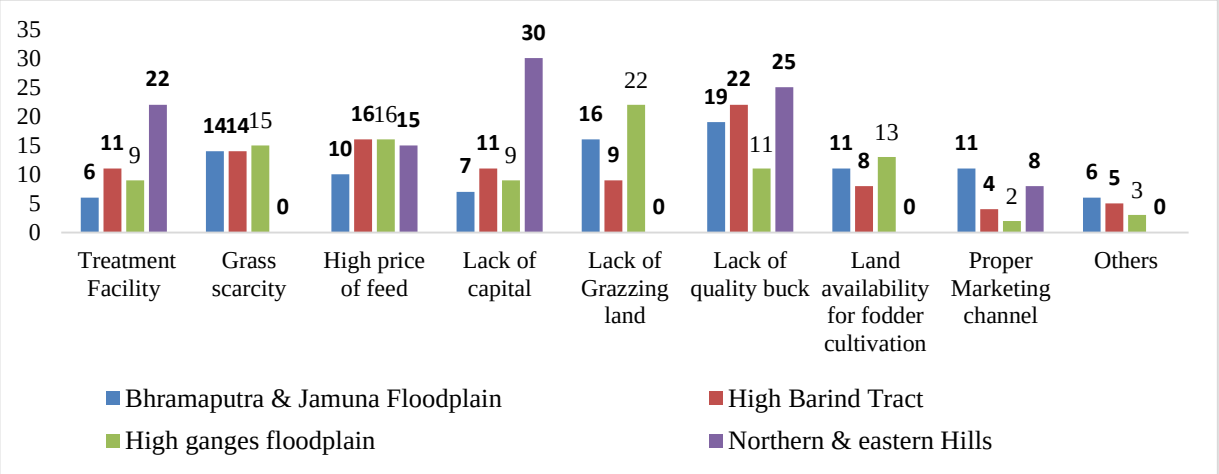

Figure 2. Problems on Black Bengal goat rearing in selected areas.

Based on the results, there are 30 farmers from each site were selected as the research associate farmers. Considering the problems identified in different aspects, the intervention will provide accordingly to improve the livelihood of farmers, feeding system and the productivity of BB goat in the community level.

Studies on the farmers innovative technologies for livestock production in Bangladesh

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Executive summary

As means to eke out poverty and generate income and employment in rural Bangladesh, numerous livestock and poultry production programs are being introduced in the rural areas through farmers, different government and non-government organizations. Now a days, farmers and rural youth are engaged in dairy farming, poultry farming, and beef fattening programs for their economic and social upliftment. In most of these farmers/enterprises, it is understood that entrepreneurs apply some indigenous techniques for feeding, management and even disease control of the species. Upon these views, last year (2019-20) a field survey was completed on farmer's innovative techniques on livestock in Sirajganj, Jashore and Bandarban districts. A total of 220 farmers who's used their own innovative techniques for livestock production were selected for this study. Field survey method was followed to collect data. Mostly descriptive analysis was used.

The general information of the farmers and the innovative technologies used by them are described here. The education levels of the farmers (%) were 20±3.5, 40±4.2 and 30±2.3 primary level, 50±5.2, 25±2.2 and 45±1.9 SSC, 20±1.1, 10±0.91 and 15±2.1 HSC and 8±0.85,1±0.10 and 5±0.09 graduates/masters level respectively, Jashore, Bandarban and Sirajgonj. The family members of male were below 18 years 2.7±0.08, 2.2±0.07 and 2.9±0.06, and over 18 years 3.5±0.1, 2.6±0.1 and 2.9±0.1 numbers per family respectively, Jashore, Bandarban and Sirajgonj. The females below 18 years accounted for 2.3±0.96, 1.8±0.13 and 1.9±0.11 respectively, Jashore, Bandarban and Sirajgonj and over 18 years 2.50±0.11, 2.81±0.32and 2.43±0.15 numbers per family respectively, Jashore, Bandarban and Sirajgonj. The Agriculture was the highest 67±4.11%, 60±3.21% and 70±2.12% occupation followed by business 23±3.23%, 30±2.54% and 20±3.23%; services 6±1.11%, 5±0.98% and 4±0.68% ; and others 4±0.78%, 5±0.67% and 6±0.87% respectively, Jashore, Bandarban and Sirajgonj. The possessions of cattle were 5.30±1.10, 3.20±0.97 and 11.96±2.11 no./family respectively, Jashore, Bandarban and Sirajgonj. In case of small ruminants, average no. of goat and sheep were 11.20±3.11, 6.32±1.10 and 5.76±1.30 and 3.84±0.68, 3.21±0.97 and 1.77±0.56 no./family, respectively, Jashore, Bandarban and Sirajgonj. About 46 innovative techniques have been identified which farmers used in feeding, breeding, management and disease control of livestock in Sirajganj, Jashore and Bandarban districts. Surveyed data shows that some identified innovative technologies are playing an important role in increasing milk, meat and egg production and controlling diseases. Location wise important innovative technologies were given in Table 1.

The general information of the farmers represents small scale livestock production. The study tries to highlight the list of farmer's innovative technologies those were used for livestock production in Jashore, Bandarban and Sirajgonj. However, farmer's opinion that, farms were benefited by using the above mentioned innovative technologies. In future field trial will be needed to know the benefit cost ratio of these technologies. The research project is on-going, it be possible to make a final conclusion or recommendation after completion of the field trial.

Table 1. Important innovative technologies adopted by farmers in different locations.

S.N	Farmers innovative technology	Location
1.	Use of Fenugreek (*Trigonella foenum-graecum)* for reducing abdominal fat and increasing egg production of commercial layer.	Jashore
2.	Use of bael (*Aegle marmelos*) leaves for reducing libido and increasing growth of bull.	Jashore
3.	Feeding cooked sabu grain with salt for cattle/goat fattening.	Bandarban
4.	Use of boiled Spiny amarnath (*Amaranthus spinosus*) and broken rice for increasing milk production of cow.	Jashore
5.	Use of German creeper for increasing digestibility and deworming of cattle.	Jashore
6.	Use of Fig (*Ficus hispida*) and Gugo **(***Entada phaseoloides*) fruits for the fast removal of cow placenta after parturition.	Jashore
7.	Use of Azolla for increasing growth and milk production performance of cattle/goat.	Jashore
8.	Feeding chickpea with salt for cattle/goat fattening.	Bandarban
9.	Feeding bottle gourd for cattle/goat fattening.	Bandarban
10.	Feeding brinjal for cattle/goat fattening.	Bandarban
11.	Uses sugarcane leaves for rapid discharge of placenta of cattle, goat and sheep.	Bandarban
12.	Use of Sweet potato (*Ipomoea batatas*) leaves for increasing the milk production of goat/sheep.	Jashore
13.	Feeding giant crape-myrtle (Jarul) extract for diarrhea and bloat	Bandarban
14.	Feeding pineapple leaves for deworming of cattle.	Bandarban
15.	Use of Papaya (*Carica papaya*) leaves extract for the treatment of coccidiosis.	Jashore
16.	Use of Stone Chip (*Kalanchoe pinnata*) leaves extract and salt for the treatment of bloat of goat/cattle.	Jashore
17.	Use of green Sapodilla (*Manilkara zapota*) fruit for the remedy of goat diarrhoea.	Jashore
18.	Use of Neem (*Azadirachta indica*) for deworming of cattle/goat.	Jashore
19.	Use of Basok (*Adhatoda vasica*) leaves for the treatment of cold-cough of cattle/goat.	Jashore
20.	Use of Black dhutras (*Datura mete*) fruits for the remedy of cattle/goat diarrhoea.	Jashore
21.	Use of Turmeric powder and mustard oil for treatment of chicken pox	Bandarban/Sirajgonj
22.	Use of Vermi shak for the remedy of allergy and deworming of cattle/goat.	Jashore
23.	Use of Goldilocks and Sara tree leaves for the treatment of cattle/goat diarrhea.	Jashore
24.	Use of mustard oil and salt solution for the remedy of Eye stickiness of poultry.	Jashore
25.	Use of Tulsi (*Ocimum sanctum*) leaves and roots extract for deworming of calf	Jashore/ Sirajgonj
26.	Use of Neem ((*Azadirachta indica*) and Nishinda (*Vitex negundo*) leaves for the remedy of fever and deworming of cattle/goat.	Jashore
27.	Use of young guava leaves and salt for the remedy of acidity of cattle/goat.	Jashore
28.	Use of Ashwagandha (*Withania somnifera*) leaves extract in urinary incontinence of goat.	Jashore
29.	Uses Salt+water+ turmeric powder to eliminate fowl pox	Bandarban/Sirajgonj
30.	Uses honey+ turmeric powder uses for FMD treatment	Bandarban/Sirajgonj
31.	Use of Babul (*Acacia nilotica*) friuts for the remedy of allergy and cow pox.	Jashore

Impact of training on adoption of BLRI developed technologies for last ten years

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Executive summary

Training plays an important role in the advancement of human performance by providing a systematic improvement of knowledge and skills which successively helps the trainees to perform their task effectively. It is a process of acquiring new skills, attitude and knowledge. Bangladesh Livestock Research Institute (BLRI) has developed 75 packages/technologies on livestock and poultry production. A good number of technologies are now available through which the farmers can increase their income to a great extent. BLRI is also taking initiatives to provide farmers training on different livestock technology in different areas of Bangladesh. Keeping this mind after training, the objectives of this study are: to identify the socioeconomic condition and identify the adoption status of BLRI technologies by the farmers. Trainings were held in different technologies on poultry, goat, beef fattening and dairy farming. Among all farmers, a significant number of farmers are graduate (21%), followed by JSC (21%), SSC (21%), HSC (17%), PSC (12%) and illiterate (7.6%). Beef fattening farmers are more educated than other types of farmers (followed by dairy farmers). About 55% farmers are marginal in terms of crop land with 3% large farmers. Most of their lands are under double cropping pattern (41%) followed by single (26%) and triple cropped area (25%). After training, beef fattening has increased by more than 20%, so the training is a very successful one to increase meat production. Almost all the farmers who received training in Savar, they use almost all technologies, followed by participants from Sirajganj, but very few farmers from Jessore, Bogura and Bandarban used technology. They use all types of vaccine regularly and medicine against worm, while in other areas; they are not regular users of these inputs. Different diseases affected livestock as well as farmers. But due to participation in training, they can cope with the situation. Among them, most of the farmers didn't go for treatment.

In this study, we have calculated income from job, business, agriculture, crop, fish, poultry, beef fattening, and dairy farming. In case of poultry farmers, most of the farmers' income from poultry has increased after training. In case of goat rearing trainees, most of their income has increased from goat and sheep selling after training on an average by Tk. 5000). In beef fattening trainees, the income change has been occurred for the respondents who have a primary occupation of fattening by Tk. 10000 - 20000. In case of dairy farmers, income from business, agriculture, fattening, dairy has increased whereas it has decreased from official job and fish farming. The overall average income has been increased for dairy farming after training by more than Taka 10000. But for Jessore and Sirajganj batch, overall increase in income is Taka 7143 and Taka 714 respectively. Most of the farmers' income has increased from the selling of livestock and poultry products.

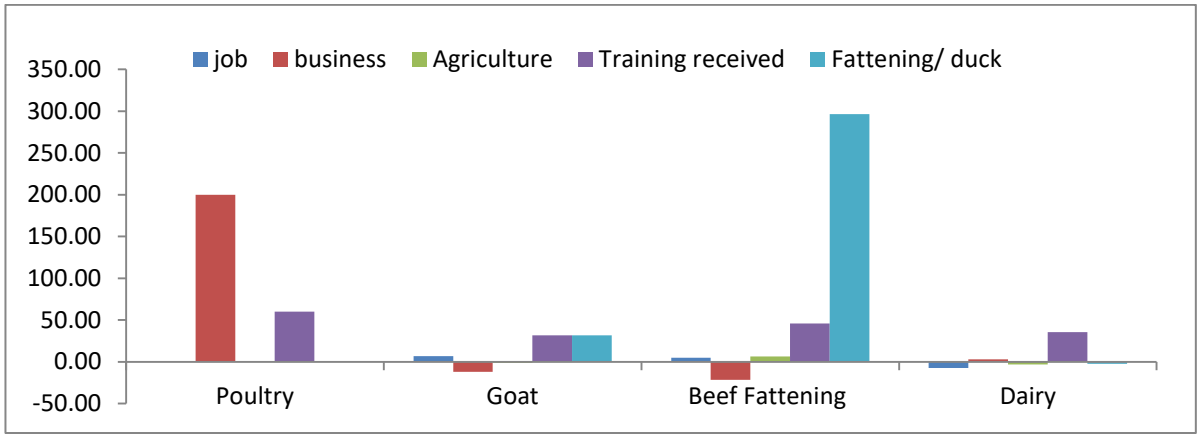

Figure 1. Change in incomes before and after training

Table 1. Change in average household consumption (in gram) before and after training.

Trainees	Rice	Dal	Ata	Fish	Meat	Milk	Egg	Vegetables
Poultry farming	0.0	0.0	0.0	0.0	-11.0	0.4	0.0	0.0
Goat	37.0	7.8	0.0	21.4	23.7	67.7	0.0	6.7
Beef Fattening	15.6	3.8	0.0	22.4	42.0	100.5	0.1	7.5
Dairy	66.8	1.9	-56.2	99.8	-27.4	158.2	0.0	77.5

In this study, we have calculated consumption of rice, dal, wheat flour, fish, meat, milk, egg and vegetables. In case of poultry trainees, rice, dal, fish, meat and milk consumption have increased by 50 gm, 8.8 gm, 6.6 gm, 18 gm and 2.8 gm respectively. In case of goat rearing trainees, rice, dal, fish, meat and milk consumption have increased by 18 gm, 4.4 gm, 6.6 gm, 19 gm, 17 gm and 67 gm respectively. In case of Bandarban trainees, their consumption has significantly increased in rice consumption. Similar results have also been found for dairy and beef fattening. Almost all the food items, specially fish, milk, meat and egg is showing an increase in consumption. It could be mentioned here that after training, protein consumption has increased for about 40% trainees.

So, this research clearly shows that most of the farmers adopted technology, increased their income, increased consumption and their livelihood status. Therefore, training played a significant role in improving their socioeconomic condition.

Evaluation of Goatpox vaccine produced in Livestock Research Institute, Department of Livestock Services

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Executive summary

Goatpox is a contagious viral disease of a goat. This disease may be mild in indigenous breeds in endemic areas, but it is often fatal in newly introduced exotic breeds as well as crossbred and hybrids. Economic losses result from decreased milk production, damage skin quality, abortion of a fetus, weight loss, and other production losses. It also can limit trade and inhibit the development of intensive goat farming and prevent the rearing of the new exotic breeds in endemic countries. Clinical signs of goatpox affected animals, typically included fever, enlargement of superficial lymph nodes, oculo-nasal discharge, and poxvirus lesions that may affect the skin, mucous membranes, or internal organs. The current research was conducted under a specific objective-to evaluate the present status of the goatpox vaccine of LRI, DLS. The research activity was the detection of goatpox virus from LRI supplied goatpox vaccine and its isolation through culture into Vero cells and reconfirmed the virus by PCR test from cultured fluids.We have collected the goatpox vaccine from LRI. Followed by, viral DNA was extracted from the vaccine virus by Monarch® Genomic DNA extraction kit according to manufacturer protocols. Polymerase chain reaction (PCR) was performed for the amplification of the RPO40 gene of the goatpox virus. The primers used in PCR reactions were- E10R-f CCGCTCGAGGCCACCA TGAATCCTAAACACTGGGGAAGAGC and E10R-r-CGCGGATCCCGAAGCGGT AATACCTTATTTAAATTG (Zhao et al., 2017). PCR positive sample was inoculated into Vero cells to observe the cytopathic effect (CPE). In PCR reactions, the vaccine virus showed a specific size of the band (285bp) as positive for goatpox virus (Figure 1). In Vero cells, the goatpox virus produced a cytopathic (CPE) effect at eight days of post infection (dpi), characterized by rounding of the infected cell and aggregation of nuclear and cytoplasmic inclusion bodies. Finally, the DNA of the goatpox virus reconfirmed in the cell-cultured fluid by PCR test. In conclusion, it could be said that the supplied goatpox vaccine from LRI containing goatpox virus and it can grow well in Vero cells

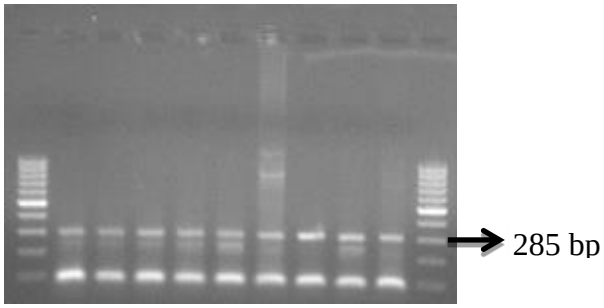

Figure 1. Amplification of the portion of RPO40 gene (285 bp) of goatpox virus in agarose gel.

Conservation and improvement of Munshiganj cattle

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Executive summary

Munshiganj cattle (MC) are predominantly found in Munshignaj district and its adjacent periphery areas. Despite having good quantity of milk production farmers are yet intend to inseminate their pure MC with foreign germplasm in order to get more milk. As a result population of MC is rapidly declining in their breeding tract. Hence, conservation and subsequent improvement of production performance of the variety is necessary. Considering the above facts, steps has been taken by BLRI for conservation, characterization and subsequent improvement of this valuable germplasm at their own habitat and BLRI cattle research farm. For *in situ* conservation, a Munsiganj cattle rearing community was established in Munshiganj district. A nucleus herd was established in BLRI and this herd has been enlarged with a total population of 36 animals including 11 cows, 13 breeding bulls, 6 heifer calves and 6 bull calves. Different productive and reproductive performance was recorded in the nucleus herd. For conservation of this verity to regain its purity in the farmer's house artificial insemination is ongoing in their original breeding tract with pure Munshiganj frozen semen. Till date 240 AI has been performed in both MC and indigenous cattle with an average conception rate of 51.67%. Following AI, 52 calves (30 female and 22 male) has been born so far. Some non-descript indigenous cattle are also selected for AI to increase the population of MC.

Table 1. Artificial insemination statistics of MC in Munshiganj community.

Parameter	No of AI performed	Non-return after 60 days of AI	Non-return rate (%)	No of calf born	Calf sex	
					Male	Female
Munshiganj cattle	210	108	51.43	44	18	26
Indigenous cattle	30	16	53.33	8	4	4
Total	240	124	51.67	52	22	30

The colour of body-coat was mostly creamy to dull pinkish and looked different from other indigenous varieties of Bangladesh. The average birth weights of male calves and female calves were found (19.47±0.79 kg) and (16.14±0.52 kg) in on station. On farm male and female calf birth weight were found (16.94±1.23 kg) and (14.44± 0.78kg), respectively (Table 2).Average lactation length, daily milk yield, postpartum heat period (PPH) and number of services for each conception (NSPC) was found (222.82±16.58) days, (4.15±0.41) L, (279.39± 3.79) days, (64.52± 23.09) days and (1.57± 0.82) for on station and (209.37±13.21), (3.01±0.43), (279.09±1.29), (72.33±9.11) and (1.62± 0.61) for on farm, respectively.

Table 2. Comparative productive and reproductive performance of Munshiganj cattle in on-station and on-farm (Mean±SD).

Parameter	On-station	On-farm
Body weight of male calf (kg)	19.47±0.79 (n=8)	16.94±1.23 (n=18)
Body weight of female calf (kg)	16.14±0.52 (n=8)	14.44± 0.78 (n=26)
Lactation length (Days)	222.82±16.58 (n=11)	209.37±13.21 (n=52)
Daily milk yield (L)	4.15±0.41 (n=11)	3.03±0.43 (n=86)
Gestation period (days)	279.39± 3.79 (n=11)	279.09±1.29 (n=56)
Post-partum heat period (days)	64.52± 23.09 (n=11)	72.33±9.11 (n=87)
Number of service per conception	1.57± 0.82 (n=11)	1.62± 0.61(n=87)

Along with steps has been taken to increase mass awareness and concern regarding its conservation and maintaining purity through cattle fair, seminar, farmers training and door to door personal communication. The current ongoing AI programme in the community will ensure availability of potential Munshiganj cattle conforming pure characteristics ready in hand for sustaining their unique features, so that it can be disseminated in their original breeding tract.

Collection, conservation and improvement of specialized fowl (Turkey, Guinea fowl and Pigeon) production at BLRI

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Executive summary

In Bangladesh, the poultry population consists of 90% chicken, followed by 8% duck and remaining 2% include other species of specialized fowl such as quails, geese, pigeons, guinea fowls etc. (Das *et al.*, 2008). Due to various reasons the demand of specialized fowls (Turkey, Guinea fowl and Pigeon) are increasing day by day and thus farming of specialized fowls has a lot of opportunity in our country. In order to maximize food production and meet protein requirements in developing countries, variable options need to be explored and evaluated (Owen *et al.*, 2008). Therefore, the study was conducted to evaluate the performances of specialized fowls and to introduce new turkey, guinea fowl and pigeon varieties with the existing stock at BLRI research farm for improving their performance. Hatching eggs of Turkey, Guinea fowl and pigeon germplasm were collected. The collected eggs were hatched at the hatchery of BLRI and their performances were studied. The chicks of turkey and guinea fowls were brooded up to 4 weeks of age. The formulated feed with required nutrient according to age were supplied to the birds at all ages. Prescheduled vaccination was followed. Standard management practices and biosecurity measures were followed. Record of reproductive and productive parameters were kept. The live weight of five varieties of Turkey at all ages were found highly significant. The maximum live weight of male and female birds at 20 weeks was found 3770 and 3346 g/bird for Bronze and Mixed variety, respectively. The average feed intake at 20 weeks of age was 217g/bird/day. The mortality up to 20 weeks of age was 5.5%.

Table1. Performance of Turkey up to 20 weeks of age.

Age (week)	Sex	Live weight (g/bird) (Mean±SE) of different varieties					p		Average feed intake (g/bird/day)	Mortality up to 20 weeks (%)
		Black	Bronze	Mixed	White	Bourbon Red	Variety	Sex		
12th	M	2074.8±55.6	2011.6±37.5	1478.4±101.7	2002.0±65.9	1930.6±39.1	***	***	146	5.5
	F	1761.6±13.6	1731.0±30.3	1377.2±98.2	1704.8±23.6	1528.4±39.3				
15th	M	2668.8 ± 54.7	2632.6±74.4	2848.6 ±58.2	2416.8±52.9	2500.2 ±47.3	***	***	151	
	F	2097.6 ± 63.3	1968.8±46.7	2317.8±128.5	2016.4±36.4	1950.4 ±49.5				
20th	M	3289.6±130.6	3770.4±94.3	3524.4±157.1	3537.2±159.4	3598.4±114.9	**	***	217	
	F	2481.2 ± 53.9	3000.0±79.6	3346.0±140.5	2756.2±78.6	2958.4± 67.6				

*** = p< 0.001; ** =p< 0.01; M=Male; F=Female

A total of 590 guinea fowl eggs of 4 varieties were hatched. The average fertility and hatchability were 55 and 67%, respectively. The highest fertility and hatchability were found in White and Lavender variety of Guinea fowl to be 72 and 79%, respectively.

The live weight of Guinea fowl was found significant at all ages except at 5 weeks. The highest live weight of male and female birds at 20 weeks was found 1408 and 1186 for Lavender and White variety, respectively. The highest average hen day egg production found for Pearl variety. The overall mortality found 7.5% up to 45 weeks.

Table 2. Performances of Guinea fowl up to 45 weeks of age.

Age (Week)	Sex	Live weight (g/bird) (Mean±SE) of different varieties				p
		Pearl	Mixed	White	Lavender	
5	Both	359.00±9.05	373.10±8.14	346.50±9.87	361.70±6.54	NS
10	Both	1032.80±6.80	1042.40±8.66	1015.20±7.38	1074.60±10.42	***
15	Male	1413.00± 13.86	1383.80±89.42	1378.20± 33.64	1343.20±25.80	**
	Female	1266.80± 23.15	1318.60± 21.90	1194.40±62.29	1204.00± 65.47	
20	Male	1305.80± 16.57	1267.60±15.66	1337.00± 25.71	1407.80±19.89	***
	Female	1177.40± 28.68	1103.40± 22.60	1186.40±25.85	1131.20± 13.06	
AFI (g/bird/day)						
10	Both	68	62	72	74	-
20	Both	97	95	97	103	-
AHDEP (%)	-	27	14	26	14	-
Mortality % (up to 45 weeks)	Both		7.5			-

*** = p< 0.001; ** =p< 0.01; NS= p> 0.05; AHDEP= Average hen day egg production up to 45 weeks of age. AFI= Average Feed Intake.

One pair of Moyurponkhi and four pair of Golla variety of pigeon were introduced and studied. The highest adult weight was found for King variety of both sexes.

Table 3. Performance of different pigeon varieties.

Name of variety	Adult live weight (g)		Average feed intake (g/bird/day)
	Male	Female	
Moyurponkhi	415	386	30
King	973	633	32
Golla (Brown)	236	232	27
Golla (White)	273	255	20
Golla (Black-white)	279	255	24
Golla (Red-white)	266	253	25
Squab weight at 21 days (g)	134		---

A good number of specialized fowl varieties were introduced and the evaluation of their performances through planned breeding will be continued for improving productivity.

Conservation and improvement of Quail: Performance of ninth generation

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Executive summary

Four genotypes of quail like Dhakai (D), White (W), Brown (Br) and Black (Bl) quail are being maintained at BLRI with the objective i) To increase the 6th week body weight of Dhakai and BB-white quail through selective breeding ii) To select parental birds (males and females) and breed them in an assortative plan for the production of 9th generation birds. The parent males and females were being maintained in cages for single pair mating through selective breeding system for producing each generation. Pedigree records are being kept by using commercially available leg bands to identify quail of all ages. For producing ninth generation (G_9), parent quails of each genotype were selected on the basis of breeding value according to their 6th week body weight. Hatching eggs were collected from every single pen of the selected parent quails. A total of 2111-day-old quail chicks comprising of 4 types of quail namely White (W-1365), Black (Bl-280), Brown (Br-146), Dhakai (D-320) were hatched to produce ninth generation (G_9**)**. Ten quails from each genotype were randomly selected after feed withdrawal for 12 hr. The selected birds were weighed individually to obtain body weight. Calculations of dressed percentage were estimated according to method of Alkan *et al.* (2010). Expected genetic progress due to selection for 6th week body weight was estimated for ninth generation (G_9) using the following equation (Falconer, 1981).$R = h^2 \times S$where, R = Expected response, h^2 = heritability for 6th week body weight and S = Selection differential for the selected males and females. Recorded data were analysed by one-way analysis of variance using the PROC GLM procedure in SAS and differences were determined by DMRT.

The genotype had significant ($p<0.0001$) effect on the body weight of quails at 2nd and 3rdweek of age (Table 1). Body weights at 2thand 3rd week were78.44, 67.23, 70.25, 60.51 and 131.38, 111.41, 116.83 and 108.96g; respectively for D, Br,W and Bl genotypes. The egg production (%) up to 22th weeks of age was 72.70, 68.25, 77.28 and 68.65, respectively for D, Br, W and Bl, and significantly ($p<0.01$) differed among all genotypes.

Table 1. Body weight, egg production and carcass characteristics of different genotypes of quail.

Parameters	Dhakai	Brown	White	Black	SEM	P-Value
2nd week body weight (g)	78.44[a]	67.23[b]	70.25[b]	60.51[c]	1.736	<.0001
3rd week body weight (g)	131.38[a]	111.41[bc]	116.83[b]	108.96[c]	2.398	<.0001
Egg production (%) (6-22 weeks)	72.70 [ab]	68.25[b]	77.28[a]	68.65[b]	1.18	p<0.01
Live weight (g)	178.18	164.18	152.72	161.14	3.56	NS
Carcass weight (g)	101.75[a]	98.26[a]	84.78[b]	86.52[b]	1.93	p<0.01
Dressing %	68.62	70.95	68.79	65.56	0.967	NS
Abdominal fat weight (g)	1.20	1.39	1.47	1.43	0.25	NS
Thigh meat weight (g)	25.14[a]	23.95[a]	20.27[b]	20.65[b]	0.54	NS
Breast meat weight (g)	29.34[a]	28.63[a]	24.98[b]	24.50[b]	0.62	p<0.01

Least squares means without a common superscript along the row within a factor differed significantly ($p<0.001$), NS=Non-significance; g= gram; %= percentage

The average carcass weight of Dhakai was significantly ($p<0.01$) higher than Br, W and Bl quails. Dressing percentage, abdominal fat weight and thigh meat weight were not affected by genotype but genotype had significant effect on breast meat weight ($p<0.01$). Table 2 showed that 6th week body weight of malequails of D, W, Br and Bl were expected to increase by 3.11, 4.24, 1.26 and 2.36 g; respectively. While in femalequails of D, W, Br and Bl, the expected responses were 3.71, 3.14, 3.58 and 4.41g; respectively.

Table 2. Selection response for 6 weeks body weight (g) in ninth generation (G9) of quail genotype.

Genotype	Sex	Before selection		After selection		Selection Differential (S) (g)	Heritability (h^2)	Expected response to selection (R)
		No.	Aver.	No.	Aver.			
Dhakai	M	105	165.3	80	172.5	7.2	0.432	3.11
	F	125	183.1	80	192.6	9.5	0.391	3.71
White	M	168	150.2	80	159.0	8.8	0.482	4.24
	F	182	163.5	80	170.1	6.6	0.476	3.14
Brown	M	45	132.8	30	135.6	2.8	0.451	1.26
	F	52	145.3	30	153.2	7.9	0.454	3.58
Black	M	123	133.4	80	139.3	5.9	0.401	2.36
	F	126	142.7	80	152.4	9.7	0.455	4.41

M = male, F = female, No. = number, Aver.= average

Based on the performance Dhakai quail was superior for body weight and white quail for egg production. Since the dressing percentage of Brown quail was of good percentage than Dhakai, White and Black quails; Brown quail needs to be genetically improved for carcass yield.

Effect of timing of artificial insemination on fertility and hatchability of native chicken

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Executive summary

Artificial insemination (AI) in avian species has relative advantages compared with natural mating. However, timing of AI is very important to secure high fertility. Considering this facts, the present study was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka to determine the optimum timing of artificial insemination in three native chickens (Non-descript Deshi, Hilly, Naked Neck) for maximum fertility. A total of 420 breeder hens, consisting of one hundred forty hens each of Non-descript Deshi (ND), Hilly (H) and Naked Neck (NN) were used for this experiment. The breeder hens were about 45 weeks old with body weight of around 1.5 kg of each group except Hilly hen (1.8 kg). The three genotypes of breeder hens were equally subdivided into groups I and II, with each group having 70 ND, H and NN. Hens were individually caged and properly identified by their cage and wing band numbers. The body weights of ND, H and NN cocks were 2.7-3.0 kg, 3.0-3.8 kg and 2.0-2.6 kg; respectively at 45 weeks of age. Semen was collected from 84 cocks every alternate day by manual massage technique. Groups I and II breeder hens were inseminated at 10:00 hr and 15:00 hr, respectively for two days in a week each, with 0.05ml of pooled semen from ND, H and NN breeder cocks, using graduated tuberculin syringe. Eggs collected from hens were properly identified two days after the first insemination for ten consecutive days. Each day fertile eggs collection were transported to the incubation and hatching facilities of Poultry Production Research Division and stored at 16^0C for ten days and then incubated in a petersime incubator. Percent fertility and hatchability were determined following candling at day 10 of incubation and at hatching on day 21, respectively.

Hatching egg weights and chick weights of ND, H and NN were 46.52±0.41, 46.93±0.28, 45.85±±0.13 and 31.67±0.31, 32.10±0.15, 31.05±0.16g; respectively (Table 1). The body weights of cocks during semen collection were 2872.96, 3401.40 and 2382.56g; respectively for ND, H and NN genotypes. Body weights of hens during artificial insemination were significantly ($p<0.001$) influenced by genotypes. The average age at first egg of Naked Neck (149.67 days) was 7.56 days earlier than that of Hilly (157.23 days). Egg production (20-40 weeks) number was significantly ($p<0.001$) affected by genotype (Table 1). The egg production number of ND, H and NN were 78.13, 68.03 and 73.67, respectively. Hen-day egg production (HDEP %) was affected ($p<0.001$) by genotype. The percent fertility of eggs obtained from Hilly and Naked Neck hens was higher in hens inseminated at 10:00 hr than those inseminated at 15:00 hr with the values of 84.82%, 84.28% and 82.80%, 83.06%; respectively. On the other hand, the percent fertility of eggs obtained from Non-descript Deshi hens was higher in hens inseminated at 15:00 hr than those inseminated at 10:00 hr with the values of 81.76% and 80.01%; respectively (Figure 1). The percent hatchability of eggs obtained from Hilly and Naked Neck hens inseminated at 10:00 hr had a hatchability of 82.45% and 79.40%, while those inseminated at 15:00 hr had a hatchability of 73.37% and 78.16% for the same genotypes Hilly and Naked Neck. The result of the present study also showed that Non-descript Deshi hens inseminated at 15:00 hr had a higher hatchability of 83.64%, while those inseminated at 10:00 hr had a hatchability of 75.07% for the same genotype (Figure 2). The higher fertility and hatchability were obtained from Hilly and Naked Neck hens inseminated in the morning hours (10:00 hr), indicating that artificial insemination should be carried out in the morning hours for optimum insemination results.

Table 1. Performances of three native chicken genotypes (Mean ±SE).

Parameter	Genotype			Level of significance
	ND	H	NN	
Hatching egg wt (g)	46.52±0.41	46.93±0.28	45.85±±0.13	NS
Chick wt (g)	31.67±0.31	32.10±0.15	31.05±0.16	NS
Body weight (g) of cock during semen collection at 45 weeks of age	2872.96^{b}±13.15	3401.40^{a}±11.30	2382.56^{c}±16.47	p<0.001
Body weight (g) of hen during artificial insemination at 45 weeks of age	1558.54^{b}±12.37	1864.90^{a}±9.62	1542.01^{b}±11.57	p<0.001
Age at first egg (days)	150.86^{b}±7.35	157.23^{a}±7.97	$149..67^{b}$±8.21	p<0.001
Egg production (no.) (20-40 wks)	78.13^{a}±1.11	68.03^{c}±1.21	73.67^{b}±1.19	p<0.001
HDEP (%) (20-40 wks)	57.32^{a}±0.43	49.75^{c}±0.45	52.51^{b}±0.81	p<0.001

ND=Non-descript Deshi; H=Hilly; NN=Naked Neck; HDEP=Hen day egg production; least squares means without common superscript along the row within a factor differed significantly (p<0.001). NS=Non-significant.

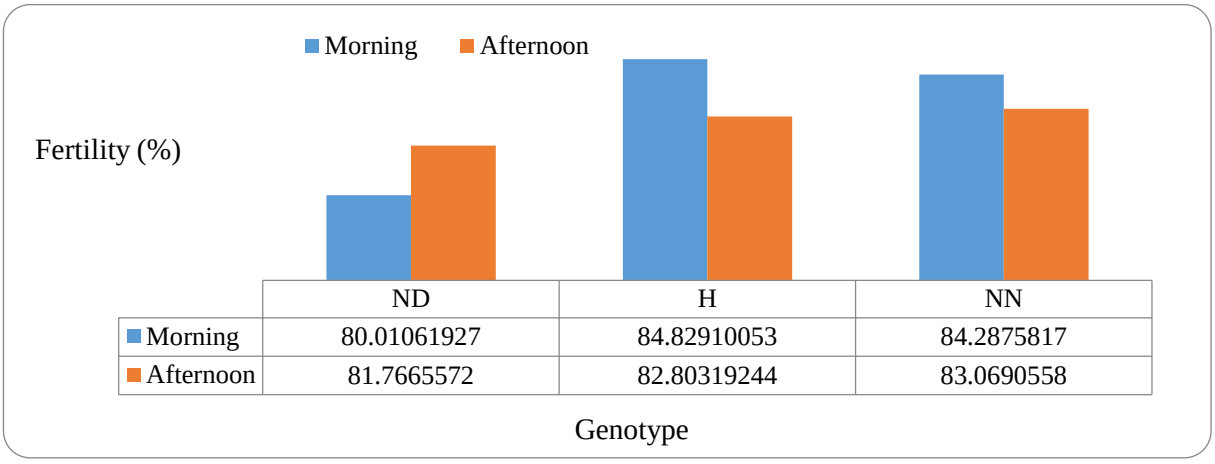

Figure 1. The effect of timing of artificial insemination on fertility of native chicken eggs.

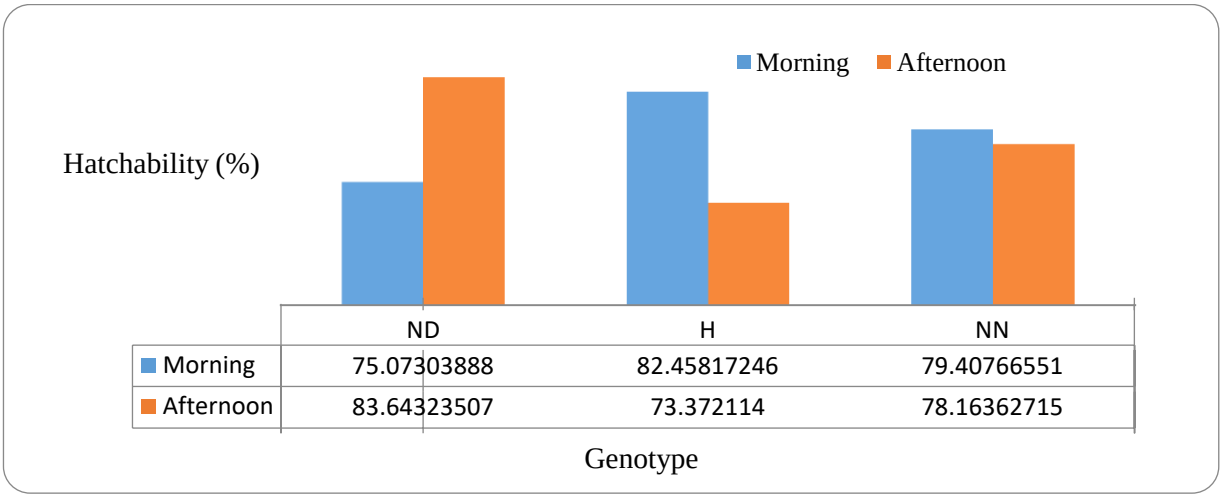

Figure 2. The effect of timing of artificial insemination on hatchability of native chicken eggs.

Production and performance study of mule duck

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Executive summary

Poultry species have contributed immensely as a source of animal protein. Duck occupies second position for the production of poultry meat after chicken in Bangladesh. The mule ducks are sterile intergeneric hybrids which are produced by crossing F_1 (Breed A ♂ × breed B ♀) female ducks with Muscovy drakes (*Cairina moschata*). Crossbreeding is an important tool in ducks to exploit heterosis. Although the crossbred of different ducks are used in the country in different farming systems, but unfortunately no information was recorded/available in this cross-breeding program. Presently, some cross-breeding program is running by Department of Livestock Services (DLS), Bangladesh Agricultural University (BAU) and Bangladesh Livestock Research Institute (BLRI). Some investigators opined that crossbreeding of duck can reduce harmful fat in duck meat. So the present study was undertaken to collection, multiplication of parental ducks of mule and production of F_1 generation. A total of 50 Breed B (desi) female ducks were reared in a house, having rearing pens, under appropriate light. They had free access to water. Ducks were reared in a natural-ventilated duck house. Breed A male and breed B female were mated at the ratio of 1: 5 using natural mating. Diet containing 17.5% CP and 2750 Kcal ME/kg. Individual egg production was recorded from each duck. A total of 210 hatching eggs were collected for production of F_1 and 135 F_1 ducklings were produced. Ducks were vaccinated against duck plague and duck cholera as per schedule. At different production periods all ducks received the same diets. All productive and hatching data were recorded. Collected data were analyzed by SAS program.

Table 1. Performance of parental ducks for the production of F_1 **.**

Parameters	Breed A (♂) (Mean ± SE)		Breed B (♀) (Mean ± SE	
	Male line	Female line	Male line	Female line
Average body weight, g	2046 ± 99.49	1945 ± 107.49	1673.09±55.27	1507.07±63.74
Feed intake, g	137.48±7.28	135.83±5.28	135.50±4.20	130.91±4.51
FCR	4.81±1.79	4.38±1.65	3.32±2.08	3.33±2.94
Egg production %	-	47.39±9.69	-	62.26±12.43
Egg weight, g	-	65.53±4.72	-	63.23±1.49
Fertility %	73.05±10.52	-	65.98±10.36	-
Hatchability %	-	76.58 ±4.30	-	72.94±4.15
Livability %	98.50±1.20	98.50±1.20	95.09±4.98	95.09±4.98

Table 1 shows the performance of parental ducks for the production of F_1. In the male lines, the main focus of selection is on growth rate, feed efficiency, carcass yield and meat quality, while the female lines are also selected for egg production and hatchability.

Table 2. The carcass characteristics of Breed A and F_1 Ducks at different ages.

Parameter	Age (week)	Breed A	F_1 duck	SEM	Level of significance
Live weight	10	2000.33	1760.00	33.50	NS
	12	2206.60	1843.23	90.95	NS
Dressing yield, %	10	66.05	65.65	0.38	NS
	12	70.18^a	64.21^b	1.68	*
Breast muscle, %	10	10.07	9.36	0.75	NS
	12	10.10	10.54	0.60	NS
Abdominal fat, %	10	0.87	0.71	0.09	NS
	12	1.26^a	1.02^b	0.22	*

Carcass characteristics of breed A and F_1 Ducks at different ages are shown in Table 2. There was no significant difference found for live weight and breast muscle weight at different ages. But found significant difference ($p<0.05$) in dressing yield and abdominal fat at 12 weeks of age. Based on the result it is concluded that F_1 generation contained lower percentage of abdominal fat and it is very important for production of mule duck.

Adaptation of high yielding exotic sheep breeds and production of upgraded crossbreds

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Executive summary

In 2016, BLRI imported three different pure exotic sheep breed (Suffolk, Dorper and Parendale) from Australia for high genetic value like body weight growth (70-110 kg), fine & elastic wool production and good litter size (2-3 lamb/parity). In early period, the survivability of the high yielding sheep in our climatic, farming and management condition was quite difficult. But gradually these sheep breeds are adapted to our environment, feeding and farming system and getting 2nd generation. For proper adaptation of these breeds, it is important to observe closely at least up to 7th generation. Moreover, this pure exotic sheep breed was used for the upgradation of native sheep through crossbreeding. However, composites breed are derived from crossbred foundations and considered as new breeds. The composite breed is used as one breed in commercial breeding farm and usually required to 3rd generation of intense mating among the line of cross breeding & designed to benefit from hybrid vigor. Thereafter, maintenance and adaptation of exotic pure sheep breed germplasm and upgradation of cross breed. Therefore, this research work was undertaken to adapt high yielding exotic sheep breed and produce cross breed suitable for hot and humid climatic condition and to measure the productive and reproductive performance of pure and synthetic cross breed sheep. However, for health management routine vaccination against common infectious diseases like Peste Des Petits Ruminants (PPR), Foot and Mouth Disease (FMD), Hemorrhagic septicemia (HS) and enterotoxaemia were done according to Standard Operating Protocol and Manufacturer's guidelines. However, pre and post vaccination blood serum samples were collected to measure the protecting antibodies against the mentioned infectious diseases through c-ELISA. However blood profile also in consideration & anthelmintic and fecal examination was done before vaccination. In feeding management 10kg green grass (zamboo, oats, maize and natural grass) per 100kg body weight with 250 gm concentrate mixture were supplied. In breeding management, pure exotic breed was mated with their same pure line. For making composites breed following breeding policy was maintainedby Suffolk sheep (male) × Coastal sheep (female)= Genotype 1(Suffolk 50% –Coastal sheep 50%) , Dorper (male) × Coastal (female) = Genotype 2 (Dorper 50% –Coastal sheep 50%), Parendale (male) × Coastal (female) = Genotype 3 (Parendale50% –Coastal sheep 50%), in all cases the female lamb was selected based on three, six, nine and twelve months body weight Subsequently, data on productive and reproductive performances was recorded properly.

For research output, a total 37 of pure exotic sheep was remained with where 6 were parent stock and 32 in1st and 2nd generation of sheep breed that are shown in Table 1. They were habituated to our local feeding management. Semen collected from exotic ram and artificial insemination (AI) was performed in our local ewes. A total 98 cross breed (Exotic × Local) sheep were borne where 7 from artificial insemination that are shown in Table 2. A total number of 810 dose semen was collected and stored in liquid nitrogen for AI purpose. A total number of 37 serum samples were designed for c-ELISA and the antibody titre was 90% against PPR and 87% against FMD vaccination in exotic sheep. However, a total 54 representative blood samples were collected from cross breed after vaccination against PPR and FMD. The vaccination titre was 93% against PPR and 90% against FMD. Meanwhile, blood profile (RBC, WBC, PCV. TLC etc.) were monitored after 3 month of interval and BAT (Babesiosis, Anaplasmosis and Theileriosis) were checked when necessary. The BAT infection rate (15-18% RBC) and blood profile found in normal level in the exotic sheep and hard immunity developed against PPR and FMD both in exotic and cross bred sheep. In addition, the average body weight gained within two year of the exotic and cross breed (Pure exotic x Local) sheep was 80-90 kg that was almost similar to Australian origin and 35 kg, respectively. It was interesting that, average 15 kg body weight higher (35%) in cross bred than the local ones (20 kg).

Table 1. Number of Pure Exotic Sheep (N=37) in BLRI.

SL No	Name of Pure Exotic Sheep Breed	Parent Stalk		$G_1$and G_2 Generation		Total Number of Sheep (N)
		Ram	Ewe	Ram	Ewe	
01	Suffolk	1	0	1	4	6
02	Dorper	2	0	0	5	7
03	Parendale	0	2	10	12	24
Grand Total		3	2	11	21	37

Table 2. Number of Cross breed (Exotic × Local) Sheep (N= 98) in BLRI.

SL No	Breeding policy ((Exotic × Local)	Natural Breeding (F_1)	Artificial Insemination (F_1)
01	Suffolk × Coastal sheep	8	1
02	Parendale × Coastal sheep	43	3
03	Dorper × Coastal sheep	40	3
	Total	91	7
	Grand Total (N)	98	

Moreover, in local sheep wool characteristics were phenotypically greasy, fragile, cracked but in case of the cross bred it was fine, long and elastic. In conclusion, it could be said that the pure line exotic and cross sheep breed were adapted in hot humid climatic condition withdesired productive and reproductive performance but required to further research up to seven generation with protective biosecurity and medication.

Conservation and improvement of Jamunapari Goat at Bangladesh Livestock Research Institute

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Executive summary

Goat is a multi-functional animal and plays a significant role in the economy and nutrition of landless, small and marginal farmers in the country. Mostly Black Bengal goat breed along with some Jamunapari and their crosses with Black Bengal constitutes the goat population in Bangladesh. The Jamunapari is known as the best dairy goat in India. The number of this breed in Bangladesh is not known but the breed is preferred by local farmers in some areas of the country. Therefore, the objectives of this project were to conserve and improve Jamunapari goat through selective breeding and to study the productive and reproductive performance of Jamunapari goat. The study was conducted in Goat and Sheep Research Farm of Bangladesh Livestock Research Institute, Savar, Dhaka. The breeding program was conducted through Open Nucleus Breeding System (ONBS) avoiding inbreeding in order to improve the genetic and phenotypic traits of existing breeding goat stock. The selection objectives of the study were to improve the prolificacy, milk production and growth rate of the breed. The selection targets were minimum 2 kids per kidding, 1.0 litter/day milk and 16 kg body weight at 6 months. The selection index was calculated by the following equation, $I_B = b_1x_1 + b_2x_2 +.. + b_nx_n$. Where, b_1, b_2,..,b_n were phenotypic values for the traits and x_1, x_2.., x_n were relative economic values given to each of the traits. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0.

Table 1. Reproductive performance of Jamunapari Goat (Mean±SE).

Generation	Average prolificacy	Dam kidding interval (day)	Age at sexual maturity (day)
1	2.19±0.09 (8)	316[a] (4)	230±42.0 (4)
2	1.84±0.10 (26)	234.11±6.99[b] (18)	238±7.97 (14)
3	1.30±0.07 (13)	329±19.57[a] (6)	275±7.8 (8)
4	2.00±0.12 (10)	250±12.45[b] (7)	253±24.13 (4)
5	1.80±0.06 (10)	317±21.80[a] (10)	275±6.44 (4)
6	1.67±0.33 (3)	-	291±3.5 (2)
Sig. level	NS	***	NS

Figure in the parenthesis indicate the number of observations. ***= highly significant (p=0-0.001), NS= Non significance (p>0.05)

Table 2. Productive performance of Jamunapari Goat (Mean±SE).

Generation	Dam milk production (lt/d)	Birth weight (kg)	3 months body weight (kg)	6 months body weight (kg)
1	-	1.52±0.09 (8)	8.44±0.83 (5)	11.92±1.57 (5)
2	0.40±0.06 (15)	1.97±0.09 (26)	9.28±0.45 (19)	13.55±0.56 (17)
3	0.41±0.04 (9)	2.35±0.17 (13)	6.70±0.46 (11)	11.43±0.62 (8)
4	0.45±0.04 (10)	2.06±0.14 (10)	8.31±0.86 (7)	13.30±2.77 (4)
5	0.38±0.01 (5)	2.12±0.22 (10)	8.01±0.99 (7)	12.45±0.83 (4)
6	0.43 (2)	1.70±0.26 (3)	6.60±0.70 (2)	11.40±0.10 (2)
Sig. level	NS	NS	NS	NS

Figure in the parenthesis indicate the number of observations. NS= Non significance (p>0.05)

The average prolificacy, dam milk production and 6 months body weight were 1.79±0.05, 0.45±0.32 litter and 12.60±0.47 kg, respectively. Higher prolificacy was found in generation 1 (2.19) whereas, higher 6 months body weight in generation 2 (13.55 kg). Higher dam milk production was found in

generation 4 (0.45). There was no significant difference between generation and prolificacy, dam milk production, body weight at birth, 3 months, 6 months and age at sexual maturity. Significance difference was found in dam kidding interval at different generation. In conclusion, superior bucks and does will be selected by the individual performance score. The findings suggested for further research until a significant level of achievement to improve the Jamunapari goat at BLRI.

Conservation and improvement of native sheep at Bangladesh Livestock Research Institute

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Executive summary

Sheep is a potential livestock species to address the food insecurity and reduce poverty among smallholder farmers in the developing countries like Bangladesh. Having the unique ability to adapt in marginal environments with low level of input, high prolific nature and multiple birth in each lambing, sheep contributes much for sustaining rural livelihoods. Continuous improvement by genetic selection, feeding and other management system may contribute to improve sheep genetic resources. The project has designed to develop superior native sheep germplasm and their improvement at BLRI and to study the productive and reproductive performance of native sheep and to utilize candidate genes polymorphisms associated with prolificacy trait in native sheep. The breeding program was conducted at goat and sheep research farm, BLRI, Savar, Dhaka. Research was conducted with three different types of sheep viz. Coastal, Barind and Jamuna river besin. All the sheep were housed in slated floor permanent house raise above the ground level with sufficient space to keep them comfortable. Green grass (*ad-libitum)* and concentrate (17% CP, 11MJ/kg DM) were supplied twice daily (morning and evening) at the rate of 300g per head per day. Open Nucleus Breeding System was adopted in order to improve the genetic and phenotypic traits of existing breeding sheep stock avoiding inbreeding. The selection targets of the study were to improve litter size, birth weight and 6 month body weight. The targeted litter size, birth weight and 6 month body weight were minimum 2 kids per lambing, 1 kg and 12 kg. Data on productive and reproductive performances were recorded regularly. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0.

Table 1 shows the productive and reproductive performance of different sheep genotypes. The average litter size, birth weight and 6 month body weight of coastal sheep were 1.55±0.04, 1.59±0.03 and 9.51±0.29 kg, respectively. In case of jamuna river besin sheep, average litter size, birth weight and 6 month body weight of coastal sheep were 1.69±0.06, 1.49±0.03 and 9.48±0.23 kg, respectively. The average litter size, birth weight and 6 month body weight of barind sheep were 1.41±0.05, 1.40±0.03 and 8.35±0.29 kg, respectively. Highest birth weight and 6 months body weight was found in coastal sheep while the highest litter size was found in jamuna river basin sheep.

Table 1. Productive and reproductive traits of different types of indigenous sheep at BLRI.

Parameters	Native sheep genotype			Significance level
	Coastal sheep	Jamuna river basin sheep	Barind sheep	
Litter size (no)	1.55±0.04 (183)	1.69±0.06 (110)	1.41±0.05 (109)	NS
Birth weight (kg)	1.59±0.03 (183)	1.49±0.03 (110)	1.40±0.03 (109)	NS
3 months body weight (kg)	6.68±0.17 (110)	6.45±0.33 (73)	5.13±0.23 (70)	NS
6 months body weight (kg)	9.51±0.29 (60)	9.48±0.23 (38)	8.35±0.29 (30)	NS

It can be concluded that, superior rams and ewes will be selected for breeding purpose according to their individual performance score. The findings suggested for further research until a significant level of achievement to improve the native sheep at BLRI.

Conservation and improvement of Black Bengal Goat in rural areas of Bangladesh

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Executive summary

Bangladesh Livestock Research Institute (BLRI) has been attempted to improve Black Bengal Goat (BBG) through selective breeding since 1988. Considering these facts, BLRI improved BB goat was distributed among the farmers of the three villages of three different district named, Bhaluka and Muktagasa of Mymensingh; Naikhongchari of Bandarban district; and Goat &Sheep research farm of Bangladesh Livestock Research Institute (BLRI), Savar (control group), based on community breeding approach to improve indigenous goat. The objectives of this study were to improve the BB goat at farmer level, to improve livelihood of community farmer through rearing BB goat and to operate community based Buck Park at farmer's level. A base line survey was carried out in the selected areas with a structured questionnaire. The selected areas and farmers were considered on the basis of their experience and interest of BBG rearing. The questionnaire was set out to know the goat population, breeds, existing feeds and feeding systems, general husbandry practices, production, reproduction, prevention and control of diseases and socio-economic condition of the farmers. Through this survey, 50 farmers were selected randomly and finally 30 farmers were selected from each site considering the survey data. Among selected farmers, twenty (20) maiden does from Goat and Sheep Research farm, BLRI were given to 10 selected farmers and 6 superior bucks were also given to the 3 buck rearing farmers in each site. A well-organized data recording card was given for recording data of the goat in the each farmer's house.

A total of 90 BB goat farmers of the selected areas (Bhaluka and Muktagasa of Mymensingh district; Naikhongchari regional station) having 50 of each were interviewed through structured questioniarry and finally 30 BB goat farmers were selected to carry on the project. It was observed that 74.6% were women and 35.4% were men, where house wife (56.32%), agriculture (13.2%), service (18.3%), business (3.6%), others (8.58%) amongst the beneficiaries. The education level of the farmers was found illiteracy (47.23%), below 8th (38.22%) and SSC or higher (14.55%), respectively. In case of land status, landless to marginal category farmer of studied areas was highest in Muktagasa (68.97%) and lowest was in Bhaluka (43.73%). Small to medium category farmer found Bhaluka (48.62%) and found lowest in Muktagasa (31.04%). There were no large category farmers found in studied areas. The average no. of BB goat per farmer found highest in Bhaluka (3.2) and lowest in Naikhongchari (1.86). As type of farming 32.83% were categorized as medium type (6 to 25 no.) followed by 65.45% small type (0 to 5 no.) and 1.72% big (26 to 50 no). As this project was newly started in Naikhongchari and Muktagasa district, in Bhaluka the partial activity was going on, so the performance data of Bhaluka was shown in Table 2.

Table 1. Results on selected farmer's opinion about Buck parks in the study areas.

Project Area	Initial survey data regarding buck parks (Total goat keepers:30 in each site)					Interested goat keepers for Buck Park (No.)
	Knowledge on quality buck selection (%)	Uncontrolled breeding (%)	Paymentservice (%)	'Does'/'buck' breeding record (%)	Use of rotated buck	
Bhaluka	40	70	60	60	30	03
Muktagacha	15	100	0	0	0	01
Naikhongchari	10	100	0	0	0	03

From the result, it was found that, the buck park activity have been reducing the crisis of quality bucks in the working places. Goat farmers have already awarded of quality bucks, regular buck rotation program and breeding their 'does' using parked bucks with service charges. Superior bucks

in the park might increase the productive and reproductive performances of their progeny. Data based on socio-economic status of farmers and productive & reproductive performance of BB goats during this study might help in decision making on the evaluation of performance of BLRI improved BB goats at farmer's community. Therefore, the study should be continued until significant change to build up a model for community based goat production.

Table 2. Performances of BBG at farmer's level (Bhaluka).

Parameters	Progeny of BLRI doe	Progeny of BLRI buck	Level of significant (F- value)
	Mean±SE	Mean±SE	
Birth weight (kg)	1.50±0.04^{b} (23)	1.67±0.04^{a} (27)	* (5.27)
Weaning weight (kg)	6.10±0.40^{b} (13)	7.59±0.28^{a} (23)	* (5.88)
Weaning Age (days)	97.45±1.17^{a} (13)	101.36±2.05^{b} (11)	* (5.39)
6 month weight (kg)	9.31±0.51^{b} (8)	10.97±0.43^{a} (7)	*(8.25)
12 month weight (kg)	12.4±0.48^{b} (5)	19.14±0.94^{a} (9)	*(7.21)
Litter size (no)	1.53±0.12^{b} (17)	2.33±0.14^{a} (12)	** (17.79)
Gestation length (days)	145.82±0.77^{a}(11)	146.36±1.14^{b}(11)	NS (0.11)
Kidding interval (days)	257.25±37.32 (4)	-	-

Means with uncommon superscripts differ significantly. Figures in the parenthesis indicate the number of observation.*=Significant at 5% level of probability ($p<0.05$). **= Significant at 0.1% level of probability ($p<0.001$). NS= Not significant ($p>0.05$).

Development of animal ID and recording system of RCC and their graded cattle through computer and mobile application technology

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Executive summary

The present study was conducted to develop a smart animal recording system through a combination of mobile and computer applications. Animal population, breeding and reproductive condition, phenotypic feature, growth and milk production, health condition, feeding practice can be accurately recorded with the application of developed recording systems. Previously, a baseline survey was conducted to evaluate the existing condition of RCC cattle in the field. After that, 450 farmers were selected and 917 animals were numbered on ear using a tattoo machine. Along with, data recording system using mobile and computer applications was developed by outsourcing the IT farm. In this year additional 450 farmers were selected and 844 animals were numbered. After that field testing of the application was conducted. Moreover, productive and reproductive data of selected cattle that were recorded in the system were collected and analyzed using SPSS software 20.0 with pair sample t-test. For data collection, a total of 1761 cattle were selected. Among them, the highest numbers of cattle were selected from Godagari Upazila (450) followed by Sandwip (232) and Hathazari (201) Upazilas. Among the selected animals RCC was found in all selected areas except Godagari and Jaintapur Upazilas. For increasing of RCC population and get RCC graded cattle total of 685 artificial inseminations (AI) were conducted. Among them, the highest percentage of AI had conducted in Satkania (75%) Upazila followed by Anowara (67%) and Chandanaish (53%) Upazilas. The average service per conception rate was worthy (1.20). After conducting AI total 170 calves were born the average birth weight was 14.80±0.48 kg. Considering reproductive traits age at puberty (months), age at first calving (months), and post-partum heat period (PPHP) (days) were significantly lower than indigenous cattle. However, dairy productive traits, lactation length (days), and total lactation milk yield (liters) were found significantly higher than indigenous cattle.
This is an ongoing project. After completion of the project animals' records by using the smart cell phone and thus enabling the accumulation of all records in a central RCC recording server may be possible. Finally, the selection of superior sires and dams with high genetic merit and controlling breeding road map will be established.

Table 1. Numbered cattle, breeding and newborn calves in the selected areas.

Upazila	Numbered cattle (%)	Total AI (%)	Service/conception rate	Newborn calf	
				Total (%)	Birth weight (kg) (Mean±SE)
Anowara	7.72 (136)	67.64 (92)	1.19	17.64 (30)	14.42±0.29
Patiya	10.90 (192)	46.35(89)	1.18	16.47 (28)	15.31±0.72
Jaintapur	9.76 (172)	35.47 (61)	1.37	4.70 (8)	13.58±0.48
Satkania	5.68 (100)	75.00 (75)	1.16	15.82 (27)	16.29±0.38
Hathazari	11.41 (201)	36.32 (73)	1.26	9.41 (16)	16.50±0.57
Chandanaish	7.78 (137)	53.28 (73)	1.20	15.88 (27)	15.79±0.61
Sandwip	13.17 (232)	26.72(62)	1.14	8.24 (14)	12.80±0.41
Banskhali	8.01 (141)	42.55(60)	1.16	8.24 (14)	15.74±0.75
Godagari	25.55 (450)	22.22(100)	1.21	3.53(6)	12.79±0.49
Overall	100.00 (1761)	38.89 (685)	1.20	100.00 (170)	14.80±0.48

Number in the parentheses indicate cattle/calf number

Table 2. Reproductive and dairy traits of RCC in the selected areas (Mean±SD).

Parameters	Traits	RCC	Indigenous	Level of significance
Reproductive traits	Age at puberty (months)	27.28±7.44	33.31±8.03	**
	Age at first calving (months)	38.15±7.66	44.45±8.50	**
	Post-partum heat period (PPHP) (days)	59.37±28.77	88.46±56.94	**
	Calving interval (months)	12.18±1.65	12.66±1.73	NS
Dairy productive traits	Lactation length (days)	204.54±4.70	186.76±2.05	**
	Total lactation milk yield (liters)	572.48±59.13	420.16±25.75	**
	Daily average milk yield (liters)	2.77±0.22	2.26±0.10	NS

Significant at 5% level of significance **=$p<0.05$

Development of community breeding model for Red Chittagong Cattle

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Executive summary

Red Chittagong Cattle (RCC) is one of the promising variety of cattle in Bangladesh. The habitats of these cattle are greater Chattagram and hill tracts region. This variety evolved in the locality by natural selection and breeding among themselves for a long historic period. Purity of this variety are declining due to indiscriminate breeding within the native stock and crossbreeding with exotic breeds. In order to maintain the purity of Red Chittagong Cattle, it is important to maintain the purity during breeding with either natural mating or artificial insemination. Bangladesh Livestock Research Institute (BLRI) had been taken initiative for conservation and further improvement of RCC through selective breeding and applying biotechnological tools since 2001. Community based breeding program have been considered as a sustainable option to conserve and to improve RCC production under smallholder conditions and in low-input system. Local communities have a vested interest in all the natural resources on which their livelihoods depend. As a result, communities are the best places of conserving local farm animal genetic resources. Thus, the present study was designed with the objectives to develop a sustainable community led pure breeding program for Red Chittagong Cattle. For the formation of model RCC community, farmers having at least one RCC cow or heifer preferably nearest peripheral circle was selected and registered under the project in the selected upazilla of Chattogram division. Other than Chattogram division, farmers having at least one pure indigenous cow or heifer preferably nearest peripheral circle was selected and registered under the project. A total 1500 farmers were selected in 15 project area and their animals (RCC and pure indigenous) were registered with permanent marking. Among the registered animals 58% are RCC and rest of them are pure indigenous cattle. To ensure semen of pure meritorious RCC bull for the community members, semen collection, evaluation and cryopreservation was done at BLRI. Six (6) pedigree tested pure meritorious RCC bull was supplied to DLS for production of frozen semen. Both BLRI and DLS ensure the supply of RCC frozen semen to the community on regular basis for artificial insemination to maintain purity of Red Chittagong cattle. Till date 15000 doses of frozen semen has been prepared and distributed and 1528 AI were done so far in the project area (Table 1) with an average conception rate of 64.33%. Till date 242 calves has born where 116 were male calf and 108 were female calf (Table 1).

Table 1. Community breeding statistics of Red Chittagong Cattle.

Project area	No of AI performed	Non-return after 60 days of AI	Non -return rate (%)	No of calf born	Calf sex	
					Male	Female
Patia	72	60	83.33	31	22	9
Chandonaish	82	59	71.95	41	16	25
Anowara	96	71	73.96	30	9	21
Satkania	46	33	71.74	19	13	6
Hathazari	73	48	65.75	16	8	8
Bashkhali	63	44	69.84	15	7	8
Swandip	64	42	65.63	13	7	6
Jaintapur	65	39	60.00	8	5	3
Keshobpur	48	21	43.75	8	5	3
Naikhongchori	13	9	69.23	--		
Rajshahi	780	483	61.92	30	16	14
Sakhipur	126	74	58.73	13	8	5
Total	1528	983	64.33	224	116	108

Table 2. Productive and Reproductive Characteristics of RCC at Community level.

Parameter	Mean±SD
Male calf body weight (kg)	14.39 ±0.87
Female calf body weight (kg)	12.22 ± 0.81
Service per conception (no.)	1.59±0.16
Postpartum heat period (days)	74.61± 9.14

Different reproductive data of the animals are being recorded in a herd book maintained by community farmers (Table 2). The ongoing artificial insemination programme may results more number of graded RCC cattle in the community that will eventually results conservation of this germplasm in the community.

Development of a system generated database at BLRI cattle and Buffalo Research Farm

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Executive summary

Animal recording is a generic term that integrates animal identification and registration, animal traceability, animal health information and animal performance recording. Animal identification is a top priority for any genetic improvement program. Errors in identification can lower estimates of genetic variability and can result in biased genetic evaluations. Animal recording and registrations are needed to improve the breed or population. So, successful animal breeding requires collection and storage of data on individually identified animals; complete pedigree information and appropriate statistical methods and computing hardware. Without these pieces of information little genetic change can be made in a population. Records need to be stored electronically for computer manipulation and data analyses. On-farm computer database systems help for collection and storage of data. A good farm management keeps lots of register to run their farm more precisely like livestock register, breeding register, milk register, calf register, feed register, health and disease register etc. Bangladesh Livestock Research institute (BLRI) also maintains such type of records, since its inception and a lot of data had been generated to date. These data are mainly being kept in paper book. However, it is very difficult to pick up all data in a summarized form from this paper book for genetic evaluation of all individuals in the herd. It is a routine activity of a farm manager to select best dams and sires for producing next generation and to cull inferior animals for selling regularly. But, selection or culling decision is taken based on the estimated breeding values (EBVs) of all individuals in the herd. It is a best practice for an animal breeder to analyze data in a population applying different models using computer based programming for estimation of breeding values of all individuals. Animals are ranked on the basis of their EBVs, and then superior animals are selected for mating and inferiors are culled (i.e. not allowed to mate).Animals are usually evaluated for several traits and these are weighted by their relative economic values allowing for the heritability of each trait and the genetic correlations among the traits. Computer aided analytical programs (CAAP) are now very much convenient ways to make it ease of such type of complex task. To do so, a system generated computer based database is essentially needed for BLRI animal research farm. Therefore, to digitalize farm database, this work was designed with a view to develop up-to-date system generated database software that could be useable both in PC and mobile phone.

The online digital database software is developed (Figure 1) by a team composed of a software developer, animal breeder, animal nutritionist and veterinarian. In the software, input facility of economic important biological information of all individuals exposed from birth up to end of productive life is created with systematic arrangements. Based on the imputed data, output will be obtained within a moment. The software will facilitate to filter data of an individual from large data set very easily. Besides, population data of any trait of interest will be obtained for extraction from the whole dataset followed by transporting into spreadsheet for statistical analyses. The software is securely stored in cloud hosted by Microsoft Corporation with monthly payment system. It is lifelong protected, not publicly open and authorized users may visit this site with their user password. Some users are allowed only to access farm report but cannot interfere data handling. Data recording, editing or deleting will be managed only by farm manager or his authorized representative. In the software; vaccination, calving and weighing schedule along with breeding plan is incorporated for smart farm management and operation. Besides, database users can easily find the updated information regarding pedigree, categorized animal population statistics, in-breeding status, and herd mortality, culling and abortion rate and disease prevalence of the farm. Age and calving calculator has also been incorporated in the database (Figure 2).

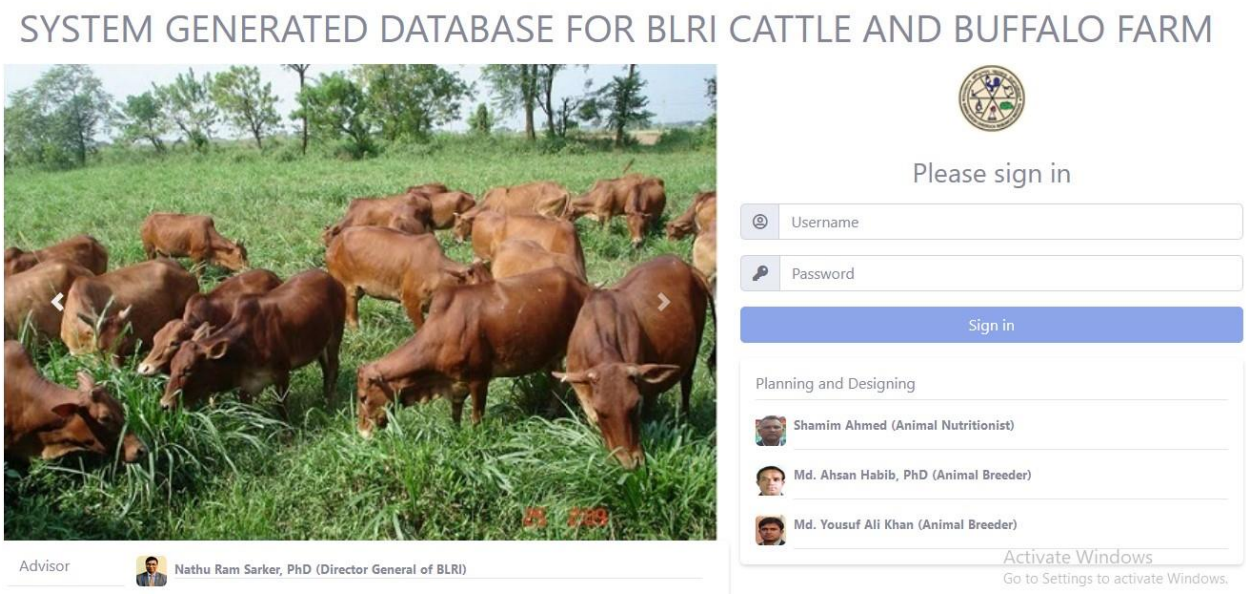

Figure 1 Database homepage.

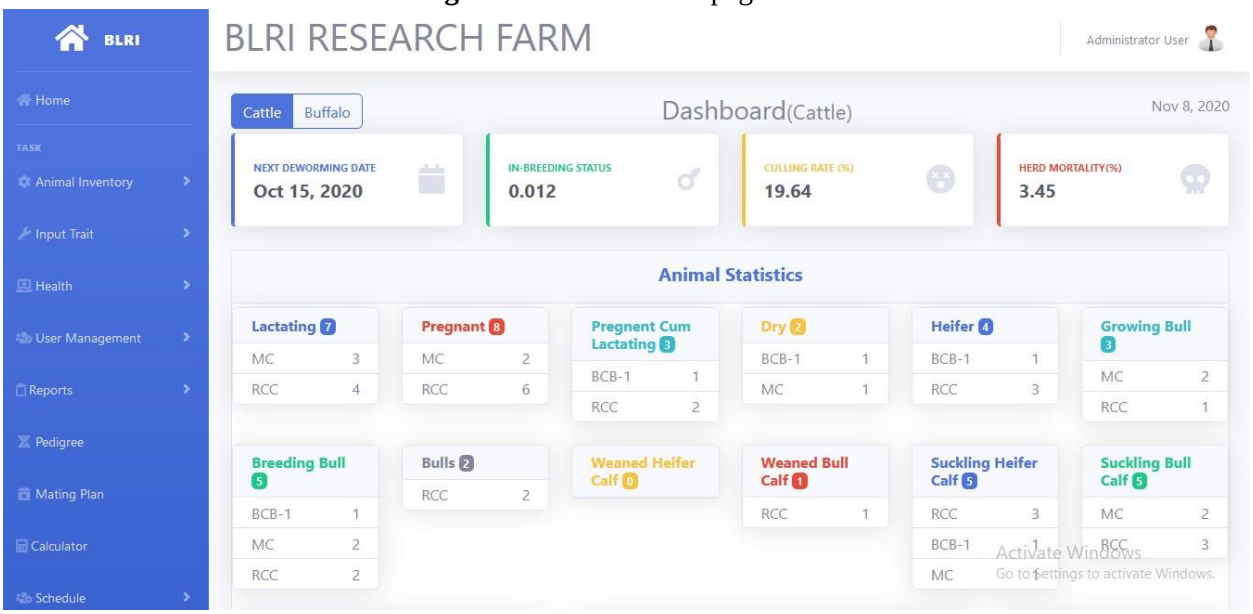

Figure 2. Database dashboard.

Finally, it may be concluded that the developed database software will help in storing data permanently and hence, overall farm management and decision for selection and culling of animals based on the genetic merit analyzed by taking data from the software will be very convenient for a farm manager. Finally, authority of this institute can take any initiative for future planning to acquaint the history of this research farm.

Feeds and nutrition of dairy cattle at Sahzadpur, Sirajganj

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Executive summary

Studying on-farm dairy cattle production may help to gain knowledge about present management practices and to identify the needs for increasing productivity. The study was undertaken to investigate feeds and feeding of dairy cattle, and their farm and manure management at Shahazadpur, Sirajgonj, Bangladesh. To investigate, 102 beef cattle farms were visited, and questionnaires were filled in by interviewing farmers, family members and farm-workers regarding farm animal composition, feeds and feeding, management activities and productivity of cows during winter 2019 (November-December). The data were inserted in the Microsoft Excel, analyzed for their mean, standard deviations (SD), and range, and presented accordingly. Five representative samples of each feedstuff and concentrate mixtures from different farms were collected and preserved until being analyzed for their chemical composition, as presented in the Table 1.

The results of the study indicated that farms had 33 total crossbred cattle on an average, ranging from 4 to165 animals. The number of milking cows, calves, yearlings, pregnant cows, dry cows, heifers, and bulls were 10, 5, 6, 4, 2, 4 and 3, respectively. The average diet of a dairy cow (343±185 kg live weight), producing 12.1 (±4.94) kg/day milk, was consisted of Napier grass, rice straw and concentrate mixtures, amounting 15.6 (±9.34), 5.5 (±4.86) and 5.3 (±2.64) kg/day, respectively. The total DM intake (11.6 kg/d) represented 3.38% of live weight of cows producing 12 L/day milk. Regarding manure management of the farms, the higher proportion was used as fuel (30.1%), followed by biogas digester, dry lot, solid storage, daily spread and use in pastures, representing about 21.5%, 17.5%, 11.5%, and 8.7%, respectively. The farms were run by employing 3.8 (±1.6) man-day worker and 2.4 (±1.2) milk-man on a daily basis consuming 523 (±933) kW-h electricity per month.

Table 1. Chemical composition of feedstuff.

Feedstuff	DM	OM	CP	NDF	ADF	GE
Napier grass	20.7	89	10.3	68	38	17.4
Rice straw	92	84	4.5	74	44	15.5
Concentrate mixture	89	86	18.9	45	24	19.4

DM, dry matter; OM, organic matter; CP, crude protein; NDF, neutral detergent fiber; ADF, acid detergent fiber; GE, gross energy intake.

Table 2. Feeds and nutrition of dairy cows.

Parameters	Mean	SD	Minimum	Maximum
Live weight, kg	342.9	185.34	160	855
Milk yield, L/day	12.1	4.94	2	30
Ingredient composition of diet (% fresh)				
Napier grass, kg/day	15.6	9.34	2	35
Rice straw, kg/day	5.5	4.86	2	33
Concentrate, kg/d, fresh	5.3	2.64	1.8	10
Intake of nutrients				
Total DM intake, kg/day	11.6	4.26	4.92	20.75
OM intake, kg/day	9.9	3.68	4.21	17.97
CP intake, g/day	1280	589	566	2635
NDF intake, kg/day	7.20	2.56	2.84	12.34
ADF intake, kg/day	4.09	1.45	1.61	6.91
GE intake, MJ/day	200.69	76.27	87.52	370.02

SD, standard deviation; DM, dry matter; OM, organic matter; CP, crude protein; NDF, neutral detergent fiber; ADF, acid detergent fiber; GE, gross energy intake.

In conclusion, dairy cattle farms in the studied areas were found to rear only Holstein crossbred cow (343 kg LW) which may produce about 12 L/day milk by consuming 11.6 kg dietary DM. More study is needed to understand their metabolism of nutrients and environmental suitability.

Effect of plant density on biomass yield, quality and morphological characteristics of Napier grass (*Pennisetum purpureum*) under on-station conditions

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Executive summary

The development of the livestock sub sector in Bangladesh is hindered by a numbers of constraints. Unavailability of both high quantity and quality feed is considered one of major factor. However, the problems associated with shortage supply and low nutritive qualities of tropical forages have been frequently reported and these are major constraints limiting animal performance. Napier (*Pennisatum purpureum* L.) is a perennial grass widely used for ruminants in most of the tropical and sub-tropical countries including dairy & beef production in Bangladesh. This grass comprises up to 80% of the animal diet in many regions, Despite higher biomass yield, animal productivity from this grass is low (Islam *et al.*, 2019). One of the reasons for this lower productivity is due to lower nutritive value under existing management practice. With appropriate or best management practices (intervention of defoliation or severity height, plant density etc.), Napier grass could play an important role in providing a significant amount of quality forage, both for the smallholder farmers as well as intensive livestock production systems (Tessema and Halima, 1998; Alemayehu, 2004). The present study was therefore designed to assess the effect of different plant densities on yield, nutritive value and morphological characteristics of Napier grass under on-station condition. This experiment was conducted from December, 2019 to June 2020 at Fodder Research Plot of Bangladesh Livestock Research Institute, Savar, Dhaka. The experiment incorporated 2 Napier cultivars such as BLRI Napier-3 and Napier Pakchong, 3 row spacing of 25, 50 & 100 cm and 3 plant spacing of 25, 50 and 100 cm. Thus, the design was a 2×3×3 factorial arrangement in a randomized complete block design (RCBD) with 3 replications-giving a total of 54 plot each 4×4 m^2. The grasses were grown from stem cuttings having 2 nodes. Harvests were made 5 and 6 times for BLRI Napier-3 and Pakchong, respectively when the plant height reached 50 cm. However, for all treatments the severity or cutting height was considered 10 cm above the ground. The basal fertilizer viz. Urea, TSP, MoP and Zipsam were given at a rate of 292, 214, 56 and 90 kg ha^{-1}, respectively for all plots based on soil testing result. Each plot was applied urea at a rate of 312 kg ha^{-1}at fortnightly basis during the whole experimental period. According to necessity, all plots were watered by sprinkler irrigation to ensure adequate soil moisture for plant growth. Plant height, survivability, green leaf number, tiller number, node number, leaf- stem ratio and biomass yield were recorded during harvesting time. Analysis of variance was carried out using the SPSS (2020) with General Linear Models (GLM) following randomized complete block design and mean separation was tested by least significant difference (LSD).

The Effect of variety and plant density on biomass yield, DM content and morphological characteristics of Napier grass have been presented in Table 1, which shows that, irrespective of plant density, BLRI Napier-3 had significantly ($p<0.001$) higher fresh biomass (27.3 $ton^{-1}ha^{-1}cut^{-1}$) and dry matter (3.58 $ton^{-1}ha^{-1}cut^{-1}$) than that of Pakchong grass (17.8$^{-1}ha^{-1}cut^{-1}$ and 2.19$ton^{-1}ha^{-1}cut^{-1}$, respectively). Irrespective of variety, there were significant ($p<0.001$) differences among plant densities for both fresh and DM yield (Table 1) and DM yield increased as plant density increased. The highest DM yield of 3.63 t ha^{-1} cut^{-1} was obtained from 25×25 planting density and this was significantly higher than that from other planting densities. In 100×100 space, dry matter yield (2.45 t ha^{-1} cut^{-1}) was significantly ($p<0.001$) lower than other planting spaces. Leaf number determines the photosynthesis capacity of the plants, which was significantly ($p<0.01$) affected by Napier variety, while plant density or spacing had no effect on this parameter ($p>0.05$; Table 1). The number of leaf per plant was higher ($p<0.01$) in BLRI Napier-3 (6.10) than that of Pakchong grass (5.91). Both variety and plant density had significant ($p<0.001$) effects on tiller numbers (Table 1). Mean tiller number per hill was higher in BLRI Napier-3 (38.7) than that of Pakchong (28.4), while minimum plant density being 100×100 cm had the highest average number of tiller (48.6 tiller/hill),

whereas maximum plant density being 25×25 cm was the lowest (20.7 tiller/hill). Similarly, mean length of leaves (43.8 cm) and leaf proportions (63.2%) was significantly ($p<0.001$) greater in BLRI Napier-3 than that of Pakchong (40.1 cm & 57.2%, respectively). On the other hand, Pakchong had significantly ($p<0.001$) higher stem proportion (42.8%) than that of BLRI Napier-3 (36.8 %). Irrespective of Napier variety, the plant density had no significant ($p>0.05$) effect on leaf length, leaf and stem ratio. The days required between harvest was significantly lower ($p<0.001$) in Pakchong (21.0 days) to achieve 50 cm plant height than that of BLRI Napier-3 (22.4 days) while plant density or spacing had no effect on this parameter ($p>0.05$; Table 1).The dry matter ($p<0.001$) and crude protein ($p<0.05$) concentration was significantly affected by variety of Napier. Irrespective of plant density, BLRI Napier-3 had ($p<0.001$) higher DM (13.1%) content than Pakchong (12.3%). Pakchong (CP 18.3%), on the other hand had the highest ($p<0.05$) concentration of crude protein than BLRI Napier-3 (CP 17.1%). However, plant density did not show any significant ($p>0.05$) effect on the chemical composition of Napier grass in the study.

Table 1. Effect of variety and plant density on biomass yield, DM content and morphological characteristics of Napier grass

Variety, plant density level & their interactions		Yield (t ha^{-1}/cut)		% DM, fresh basis	Morphological characteristics					Harvest interval (d)
		DM	Fresh		No. of leafs /plant	No. of tiller /hill	Leaf length (cm)	Leaf %	Stem %	
Variety	BLRI Napier-3	3.58	27.3	13.1	6.10	38.7	43.8	63.2	36.8	22.4
	Pakchong	2.19	17.8	12.3	5.91	28.4	40.1	57.2	42.8	21.0
Plant density	25*25	3.63^{a}	27.2^{a}	13.2	5.78	20.7^{b}	42.4	60.0	40.0	21.7
	25*50	3.09^{b}	24.0^{b}	12.8	5.76	23.6^{bc}	41.7	60.0	40.0	21.7
	25*100	2.87^{bd}	22.7^{b}	12.5	5.93	27.3^{ac}	42.2	59.1	40.9	21.7
	50*25	2.96^{b}	23.9^{b}	12.3	5.86	29.9^{ac}	41.3	60.6	39.4	21.7
	50*50	2.88^{be}	22.3^{bd}	12.7	5.84	34.8^{e}	41.1	58.5	41.5	21.7
	50*100	2.88^{be}	23.1^{b}	12.4	5.86	40.7^{d}	41.8	60.4	39.6	21.7
	100*25	2.62^{cde}	20.3^{cd}	12.9	5.79	38.6^{de}	41.5	61.2	38.8	21.7
	100*50	2.57^{cde}	20.3^{cd}	12.6	5.74	37.6^{de}	41.0	60.9	39.1	21.7
	100*100	2.45^{c}	19.0^{c}	13.0	5.87	48.6^{f}	44.3	61.1	38.9	21.7
SED		0.06	0.37	0.12	0.04	0.82	0.67	0.44	0.44	0.16
Sig. lev.	Variety	***	***	***	**	***	***	***	***	***
	Density	***	***	NS	NS	***	NS	NS	NS	NS
	v×d	*	**	NS	NS	*	NS	NS	NS	NS

In conclusion, there was no significant effect except tiller number on the morphological characteristics of Napier grass due to plant density during the experimental period. Irrespective of plant density, BLRI Napier-3 yielded higher dry matter per hectare land per cut than that of Pakchong grass. Pakchong had higher crude protein content than that of BLRI Napier-3. Irrespective of variety, Napier grass using planting space of 25cm x 25cm would be advantageous to the smallholder farmers as well as commercial producers in the country. Moreover, at least a year round field experimental data will be required to final conclusion.

Implementation of HACCP system at BLRI Research farm-effect on herd health and milk quality

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Executive summary

Overuse of drugs in the livestock industry, especially the dairy sector has become a major food safety issue in Bangladesh. Indiscriminate use of antibiotics (most notably tetracycline and oxytetracycline) and lack of awareness regarding the withdrawal period has resulted in a higher content of antibiotic drug residues in market milk. Hazard analysis and critical control point (HACCP) system could be a possible solution to this problem. HACCP is an effective management tool that deals with all hazards that could affect the dairy production and processing including, and should be applied to all stages of dairy operation – right from the dairy farms to the retail stores.
The research project aimed at developing the guideline of this milk safety system for implementation at the BLRI farm, and then at other dairy farms in the country. The research was designed in three parts. For the first part, a survey was carried out among the dairy farms/farmers in three separate locations – Savar, Mymensingh and Baghabarighat – using a standard survey questionnaire. From each of these locations one large farm, six medium farms, and nine small farms were randomly selected for the survey. The second part involved the collection of milk samples from the farms that participated in the survey for testing of antibiotics (tetracycline and oxytetracycline). All the samples were analysed for proximate composition at the Department of Dairy Science, while antibiotic content at the Interdisciplinary Institute for Food Security (IIFS) of the Bangladesh Agricultural University, Mymensingh. The third part involved the preparation of a HACCP guideline to minimize and control the presence of antibiotic as drug residue in milk.

Table 1. Survey result for the knowledge of HACCP and the use of antibiotics in three different regions of Bangladesh in aspect of different farm category

Parameter	Small Farm (<5 cows) n = 27	Medium Farm (5-20 cows) n = 18	Large Farm (>20 cows) n = 3
Knowledge of HACCP	0%	11.1%	100%
Implementation of HACCP	0%	0%	0%
Intention to implement HACCP	100%	100%	100%
Keeping of Health Record	3.7%	16.7%	100%
Use of Antibiotic	100%	100%	100%
Knowledge of the withdrawal period	22.2%	72.2%	100%
Knowledge of tolerance limit	0%	16.7%	66.7%
Maintenance of the withdrawal period	0%	16.7%	100%
Testing of milk for antibiotic	0%	0%	33.3%

It was found that larger farm authorities were more aware than about the HACCP protocol, though they did not have sufficient knowledge. All of the farms were interested to implement the HACCP protocol once the knowledge becomes available to them. There was a deficiency of keeping of proper health record, most among the small and medium farms. All of the farmers regularly use antibiotics to treat their cows, either prescribed by a veterinarian or as per instruction from a quack. Testing of milk for antibiotic residues was totally absent among all types of dairy farms, but with one exception.

Table 2. Composition and antibiotic (tetracycline) content (Mean±SD) of raw milk collected from three different categories of farm from selected areas of Bangladesh.

Parameter	Small Farm (<5 cows) n = 27	Medium Farm (5-20 cows) n = 18	Large Farm (>20 cows) n = 3	Level of Significance
Total Solids (%)	$11.95^{ab} \pm 0.068$	$11.78^{b} \pm 0.043$	$11.98^{a} \pm 0.036$	*
Fat (%)	$3.52^{b} \pm 0.032$	$3.57^{ab} \pm 0.047$	$3.60^{a} \pm 0.010$	**
Protein (%)	$3.02^{ab} \pm 0.021$	$3.01^{b} \pm 0.029$	$3.09^{a} \pm 0.053$	**
Lactose (%)	4.61 ± 0.012	4.60 ± 0.028	4.59 ± 0.036	NS
Ash (%)	$0.80^{a} \pm 0.03$	$0.60^{c} \pm 0.1$	$0.70^{b} \pm 0.05$	**
pH	6.5 ± 0.2	6.6 ± 0.1	6.6 ± 0.05	NS
Tetracycline (ppm)	Trace	Not detectable	Not detectable	NS
Oxytetracycline (ppm)	Trace	Not detectable	Not detectable	NS

^{a,b,c} Means with a different superscript in the same row differ significantly: **significant at 1% level (P<0.01); *significant at 5% level (P<0.05); NS = not significant.

It was observed that raw milk quality varied depending on the scale of production. Milk from large farms was found to be significantly better in terms of total solids content (P<0.01), fat content (P<0.05) and protein content (P<0.05), while ash content was the lowest (P<0.05). Lactose content and pH were found to have an insignificant difference. The content for tetracycline was a trace in the milk from some of the smaller producers, while milk samples from medium and large producers contained antibiotic (tetracycline) almost undetectable. Health record was available in cases of medium and large farms. It was observed that tetracycline/oxytetracycline was widely used as a broad- spectrum antibiotic. In both cases, the withdrawal period was moderately maintained. However, smaller farmers were either ignorant or careless about the antibiotic used, which was often administered by unregistered quacks; no record was found either. Milk from one of the small farmers at Baghabarighat region contained tetracycline/oxytetracycline more than the maximum tolerance limit (0.2 ppm) set by the Bangladesh Food Safety Authority. Nonetheless, when milk is pooled from various sources for the sale as bulk milk, the antibiotic concentration inevitably dilutes. Based on the above findings, the BLRI research team has developed a booklet regarding HACCAP protocol for dairy farms in Bangladesh to produce milk free from antibiotics.

Study on available meat products and quality assessment of canned meat

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Executive summary

Now value added meat and meat products are getting popularized to Bangladeshi people. People are moving forward to processed product due to increasing trend of work pressure outside the home irrespective of gender. School going children, teenagers and even elderly people are always seen to make crowd in fast food outlets for purchasing this products. But the scenario of processed raw meat market is not potentially visible compared to product. But processed raw meat demand is also increasing in today's world and Bangladesh is far behind in this aspect. Regarding this issue, this study was undertaken to get introduced with the market available meat products and assess the quality of canned meat developed at BLRI. For this purpose, a survey was conducted to identify the market available meat and meat products where the outlets of nationally recognized company (AG Food, Shwapno, Agora, Golden Harvest, Kazi Farm, KFK) was targeted. Personal interview with shop keepers to fill up the questionnaire was followed method there. For canning purpose fresh raw meat (beef) was purchased from local market immediate after slaughter and brought at meat processing laboratory of BLRI. The pH of both raw & canned meat was recorded immediately with a digital pH meter following the method of University of Nebraska-Lincoln (2005). The drip loss (%) and cook loss (%) of fresh raw meat was measured following the method described by Joo et al. (1995) and Yang et al. (2006). Then fresh meat was sliced in standard size for filling the canning jar. Masson jar of half kilogram size was used and each jar was filled with about 470 gm fresh raw beef where common salt (NaCl), Na-nitrite and Kalojira oil (*Nigella sativa*) were added as preservative. Number of replication of each preservative was three. One jar was kept as control. Sample of fresh and canned meat was analyzed for physical and chemical study and the recovery rate of canned product was also calculated as well. Data were analyzed with 17th SPSS programme.

Table-1 shows the available meat and meat products with price in our country where the processed meat products are being sold at such a high price that is not affordable for all cluster of people. The physical and chemical properties of fresh meat used for canning purpose which is presented in Table-2 where represents the quality of fresh meat used in this study satisfied the standard value of quality for human consumption. Though the slaughtering system of our country stands below the scientific standard and raw meat used in this study were collected from local market, so this could be the reason behind certain fluctuation from standard value. Table-3 represents the effect of preservatives on physico-chemical qualities of canned meat and losses and recovery rate of canned beef. Results shows that, significant difference was observed in P^{H}, organic matter and total mineral content of canned meat and Kalojira oil performed as impressive

Table 1. Meat product available in Dhaka city and their Market price (BDT).

Meat products	Price/kg (Tk.)
Meat Ball	630
Chicken nuggets	720
Chicken lolipop	766
Chicken Sausages	630
Chicken Teason	720
Chicken popcorn	360
Chicken burgor	900
Chicken Samusa	600
Chicken Strips	800
Chicken Paratha	360
Chicken drumstic	360
Chicken breast with bone	360
Beef minced	880
Beef Boneless	850
Beef Samusa	700

Table 2. Physico- chemical quality of fresh beef meat used for can meat preparation.

Physical quality	
Meat p^{H}	6.35
Drip loss (%)	5.61
Cook loss (%)	27.44
Chemical quality	
Moisture, %	73.81
Dry matter, % fresh	26.18
Crude protein, % fresh	19.28
Organic matter, %	96.2
Ash	3.80

preservative compared to others. Maximum dry matter was found in Kalojira which becomes proven in having maximum recovery rate (63.80%) and lowest loosing rate during canning (3.82%). Although there was no significant difference in moisture, dry matter and crude protein content but visibly maximum protein content (29.15%) was found in Kalojira oil group. The highest mineral content (3.6%) was common salt group as because common salt itself is a mineral so it decreased the total organic matter (96.4%) and increased the total mineral content as well. In a broad sense, no significant difference was observed in all concerned parameters among the preservatives and control but still Kalojira oil could be considered as a suitable preservative than other two for red meat canning for its own herbal or medicinal properties.

Table 3. Effect of preservatives on physico-chemical qualities and loss or recovery rate of canned beef.

Parameters	Preservatives				SED	Sig.
	Control	Klj. oil	$NaNO_3$	NaCl		
Physico-chemical quality						
P^H	6.47^{ab}	6.44^{ab}	6.54^{a}	6.37^{b}	0.02	*
Moisture, %	63.97	61.48	64.67	62.58	0.70	NS
DM, %	36.02	38.51	35.32	37.41	0.70	NS
CP, %	28.72	29.15	28.29	28.37	0.21	NS
OM, %	96.88	97.11	97.10	96.40	0.16	NS
Ash, %	3.12	2.89	2.90	3.60	0.16	NS
Loss or recovery rate						
Losses during canning process, %	4.68	3.82	4.57	4.14	0.72	NS
Water in canned jar, %	31.38^{a}	28.72^{b}	28.19^{b}	28.08^{b}	0.62	*
Meat in canned jar, %	60.74	63.80	62.76	62.12	1.52	NS
Raw beef used, g	470	470	470	470	-	-

Finally it could be said that, so many meat products are available now in our market but price is too high. So, proper research should be conducted to make it affordable for common people. At the same time canning with Kalojira oil (*Nigella sativa*) could be a suitable value added fresh meat preservation technology in perspective of our country.

Design and development of products from native sheep skin

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Executive summary

Leather is animal skin that has been chemically modified to produce a strong, flexible material that resists decay. Driven by its wide applications in everyday life, the demand for leather products has become increasing from time to time. Sheep have been a key animal in the history of farming and have a deeply entrenched place in human culture. They were one of the first animals to be domesticated along with man's best friend the dogs they were easily trained and formed an animal companion and sheep as they have a natural herding instinct and could be easily managed in groups. Sheep skin is used to produce sheep skin leather products and soft wool-lined clothing or coverings, including gloves, hats, slippers, footstools, automotive seat covers, baby and invalid rugs and pelts. At present, more than 50 percent of bovine hides and approximately 40 percent of sheep and goat skins are processed into footwear, with the remainder being used for the production of garments, furniture and travel goods. So, the development of local sheep skin and value added products may enable to unlock the enormous potential of this skin and provide very good scope for sheep farmer to generate income. A research was conducted for commercial use of sheep skin in Bangladesh through leather production with the joint collaboration of Bangladesh Livestock Research Institute and Leather Research Institute of Bangladesh Council for Scientific and Industrial Research (BCSIR). The aims of the research work are to assess the properties (physicals and chemicals) of sheep skin and produce leather products from native sheep skin.

Forty five (45) raw sheep skin was collected from local market and bring it to Leather Research Institute for processing. The processing of leather, starting from preserved raw sheep skins, as follows. Once cured, the skins were then soaked in water for several hours to several days. The water and surfactants helps in the removal of salt, dirt, debris, blood and excess animal fats. Rehydration was also reintroduced. Subcutaneous material and majority of hair was removed. This was used to loosen the fibers allowing the skin to absorb chemicals that was used later in the tanning processes. Limed hides appear swollen and with an increased thickness, therefore can be easily split into two or more layers. This process brings to removal of alkali from the pelt with the consequent dispelling of the fibers and helps lowering of the pH to the values used in the bating process. It was carried out with slightly acidic chemicals. This was an operation to complete the deliming process, by eliminating residues of other substances and loosen the fibers of the skin, in order to smooth the grain and achieve soft and flexible leather. Pelts were soaked in a solution of water, salt and hydrochloric or sulphuric acid. This was the process which converts the protein of the raw hide or skin into a stable material which was not putrefy and it was suitable for a wide variety of end applications of the leather. There were several types of tanning: chrome tanning was the most widespread. At the end of the tanning the hides or skins appear blue-green. This is called wet-blue and temporary preserved. The vegetable tanning was the oldest, made with the use of tannins which gave the vegetable tanned leather shades of brown, more or less intense. The tanned leather was not yet usable to produce goods. To turn it into a marketable product the leather must be further treated with syntan, fatliquor, filler and mechanical processes in the drums. It was the final stage and the most complex process, which includes all operations to be, carried out on dried skins, to change the surface effect, both for aesthetic and functional aims. Finishing can be mechanical or chemical. During manufacturing a product, the following important steps were involved as select target groups, gather ideas, select ideas, design development, pattern development, assorting the materials, cutting, sub-assembling processes, assembling and stitching, finishing. Manufacturing of some leather products such as ladies bag and purse were completed and such products are going on. If products is available with the help of supporting company, it is demandable so no problem in marketing.

Sheep leather made ladies bag

Sheep leather made ladies purse

Status of Gayal (*Bos frontalis)* farming in Chottogram Hill Tracts and exploring the mitochondrial genome sequencing of this unique genetic resource

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Executive summary

The gayal is a large-sized endangered semi-domesticated bovine species belonging to the family Bovidae, genus Bos, and species Bos frontalis. It is also called as the mithan or mithun. Bangladesh Livestock Research Institute (BLRI) has been conserving gayal at its regional station located in Naikhongchori, Bandarban. We have conduct a field survey for evaluation of the present scenario of gayal in the Hill tracts and attempted to study on mitochondrial genome of gayal. Field survey of gayal was conducted at Ruma, Thanchi and Bilaichari upazila of Chittagong Hill tract region with the help of respective local Livestock Offices and tribal people using a pre-tested questionnaire. The preliminary survey results showed that among the gayal rearing selected households, about 18% of them reared deshi cattle and 38% reared deshi chicken together with gayal. The average age of the responded goyal rearing farmers was 46.38 years with 6 family members per household. The average annual income of the farmers was found 18890.65 taka. Agriculture was found as the most frequent primary occupation (64%) of respondents followed by service (16%). The gayal population at Ruma, Thanchi and Bilaichari upazilla were 300 (60), 360 (65) and 185 (40), respectively and the average number of gayal of the household was 5.12. Nearly 95% of farmers do not provide concentrate feed to their gayal. The gayal was reared in the separate house. About 44% of farmers provided anthelmintics and no vaccine was administered to their gayal. Among infectious diseases, Foot and mouth disease (FMD) was highly prevalent in gayal (about 72%).

The mitochondrial genome of a gayal from Bangladesh was sequenced using state-of-the-artnext generation sequencing (NGS) tool employing illumina Novaseq 6000 sequencing approach. The computational framework to explore gayal mitogenome as followed for this study is represented in Figure 1. Blood sample of adult male *Bos frontalis* was collected and transported to the laboratory for subsequent DNA extraction. The NGS data analyses revealed that the mitogenome of *B. frontalis* is 16,347 bp in length and contains 37 genes including 13 protein-coding genes, 22 tRNA genes, 2 rRNA genes and a control region (Figure 2). The AT and GC content of the mitochondrial genome is observed to be 60.21% and 39.79% respectively, which indicates that the nucleotide composition is overall biased towards adenine and thymine. All tRNA sequences and structures were determined where most of the tRNA genes displayed the typical cloverleaf secondary structure except trnS1 and trnK lacking a stable dihydrouridine arm loop. Phylogenetic analysis revealed that Bangladeshi gayal (*B. frontalis*) clustered with *mithun* and Indian gaur. This signifies a very close genetic relationship between *mithun* and gaur. This finding strongly supports the concept of the *mithun* being a direct descendent of gaur. The data will help explore evolutionary relationships with closely related species.

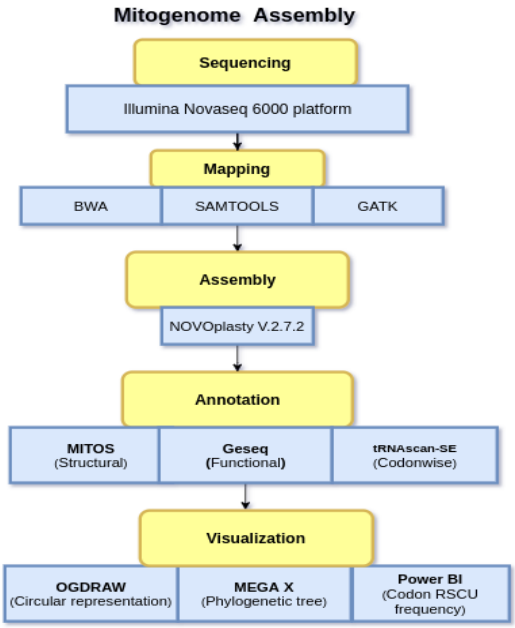

Figure 1. The flowchart of the bioinformatic tool pipelines used for mitogenome data exploration of *Bos frontalis*.

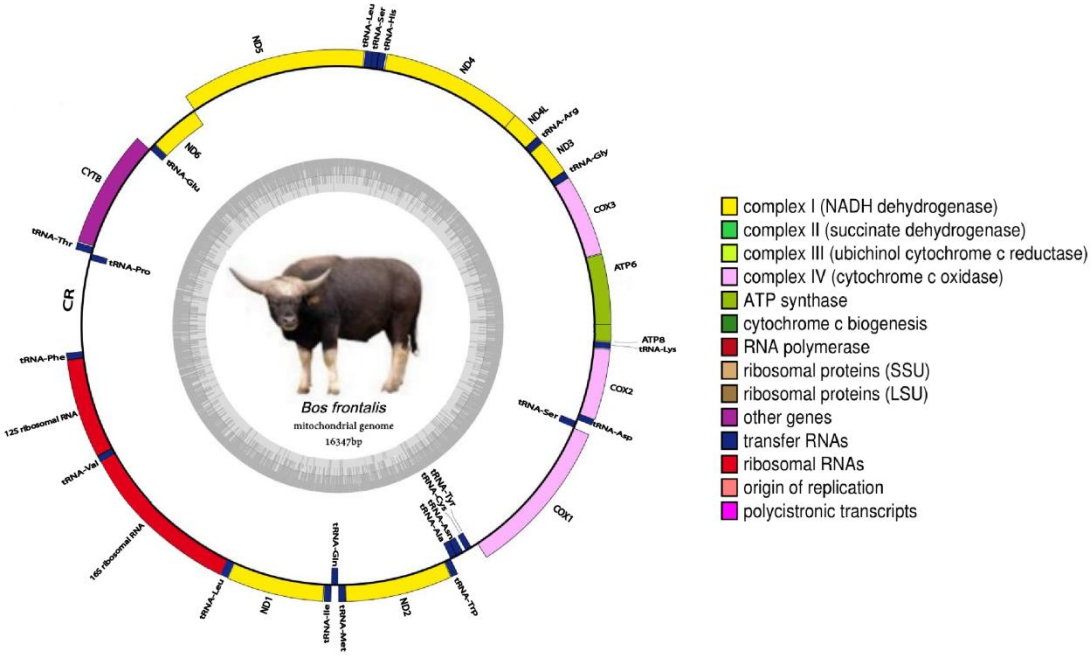

Figure 2. Circular map of the complete mitochondrial genome of the *Bos frontalis*. The colored blocks outside the circle denoted 28 genes encoded on the H- strand whereas the colored blocks inside the circle denote the remaining 9 genes encoded on the L-strand. The total GC content of the mitochondrial genome is represented by an inner ring (grey color). The mitogenome map is generated by the webserver OGDRAW [https://doi.org/10.1093/nar/gkz238].

Adaptation of somatic cell nuclear transfer (SCNT) technologies for cattle in Bangladesh

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Executive summary

Somatic cell nuclear transfer (SCNT) technology is applying to multiply genetically elite farm animals for producing transgenic animals with desired trait and for conservation of endangered species among others. It is an approach for introducing new, specific, genetic information into genome of an animal. Inbreeding programs, cloning can be used to increase the accuracy of selection and the rate of genetic progress to speed up the dissemination of genes from animals of exceptionally high genetic merit to the commercial population and to reproduce transgenic animals. SCNT requires a combination of technologies including oocyte aspiration, *in vitro* maturation, *in vitro* embryo culture and embryo transfer and nuclear transfer among others. The oocyte aspiration, donor cell culture, *in vitro* maturation, *in vitro* embryo culture and embryo transfer protocols have already been adopted at Bangladesh Livestock Research Institute (BLRI). In the previous year, primary fibroblast cell line was developed using cattle ear tissue. For successful SCNT embryo production, starvation is an important step for regulating cell growth. Serum starvation is commonly used in SCNT programme to arrest *in vitro* cultured somatic cells at G0/G1 phase.Therefore, the objective of current year research programme was to develop suitable protocol for arresting donor cell at G0/G1 phase. For this study, *in vitro* cultured cattle ear fibroblast cells were divided into four groups: (1) cultured to 70–80% confluency (control group), (2) cultured to 100% confluency, (3) cell at 70–80% confluency were starved in low serum medium for 4d and (4) cells at 100% confluency were serum starvation for 4 d. Cell counting was used to assay the viability of the fibroblasts. For this purpose, the ear tissue was cleaned and washed three times with Dulbecco's phosphate-buffered saline (D-PBS; Invitrogen, Carlsbad, CA), finely cut into 1-2 mm pieces, and digested in 0.25% (v/v) Trypsin-ethylene diamine tetra acetic acid solution (EDTA) at 37^0C for 1 hour. Thereafter, cells were washed three times with donor cell culture medium (Dulbecco's modified Eagle's medium [DMEM; Gibco] supplemented with15% bovine serum albumin, 1% [v/v] penicillin–streptomycin [P/S], centrifuged at 1000 rpm for 2 minutes, and seeded into a 100 mm plastic dish (Becton Dickinson, Franklin Lakes, NJ). Seeded cells were subsequently cultured in donor cell culture medium at 37C in a humidified atmosphere of air containing 5% CO_2. When the cells from the explants reached 80% confluency, they were removed with 0.25% (m/v) trypsin-0.05% (m/v) EDTA treatment, washed 2–3 times in PBS, counted, frozen into aliquots in 10% (v/v) DMSO, 20% (v/v) FBS and 70% (v/v) DMEM, and stored in liquid nitrogen. Thawed fibroblasts were plated in 12-well plates and cultured in normal DMEM using the conditions described above. When the fibroblasts reached 70–80% confluency (control group), every 1–2 plates of fibroblasts were subjected to one of the following culture methods: low serum starvation (0.5% (v/v) FBS in DMEM) for 4 d or cultured to full confluency in normal DMEM with or without further starvation for 4 d. Three wells of fibroblasts from each treatment (70–80% confluency, 100% confluency, serum starvation and full confluency followed by serum starvation) were removed from the plates. All fibroblasts in one well from each culture method were harvested, washed 1–2 times in PBS. After dyed with 0.4% (m/v) trypan blue (dissolved in PBS) for 3 min, the viability (No. of viable cells/No. of total cells)×100%) of the fibroblasts was assayed by cell counting. Moreover,the cell cycle of the fibroblasts was assayed with flow cytometry. Results showed that cell viability was higher during 70–80% confluency followed by 100% confluency,serum starvation at 70–80% confluency and 100% confluency followed by serum starvation (Table 1, Figure 1). However, expected G0/G1 phase cells were highest at 100% confluency followed by serum starvation. In conclusion, serum starvation after 100% confluency may be adopted for harvesting higher percentage of Go/G1 cells for nuclear transfer experiment.

Table 1. Effect of cell culture method on cell viability and cell arrest at Go/G1 phase.

Cell culture method	% Viability	Go/G1 phase
Cell during 70–80% confluency	92.47±3.07	58.77
Cell during 100% confluency	90.30±2.66	66.82
Serum starvation during70–80% confluency	78.87±3.40	71.24
Serum starvation after100% confluency	76.30±3.09	80.70

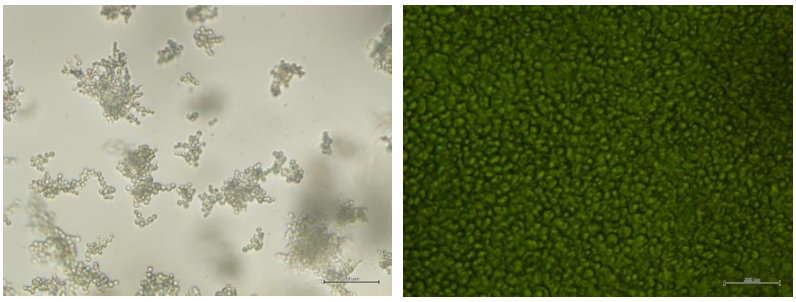

Figure 1. Cultured donor cell at different

Developing starter culture for Yoghurt

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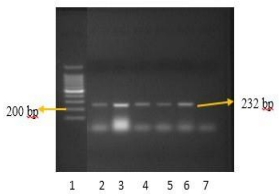
Executive summary

Yoghurt is a fermented dairy product, obtain from control fermentation of milk by a selective culture of lactic acid bacteria (LAB) produced a flavor and typical aroma. To produce a good quality yoghurt, starter culture containing desirable live viable food grade LAB is prerequisite. However, unlike developed countries, packed starter culture in sachet is not available in the local market in Bangladesh. Consumers are dependent mostly on marketed yoghurt, bacterial type and contents of which are non-descriptive and often not viable for further use as starter culture and not cost-effective. Considering these facts, the present study was undertaken to develop a suitable starter culture for yoghurt/dahi preparation at commercial use as well as the consumer's home. In the previous year *Lactobacillus acidophilus* and *Streptococcus thermophilus*, bacteria were identifiedusing biochemical,genus and molecular from yoghurt sample collected from Dhaka. However, in this year fourteen yoghurt samples were collected from the local market of Rajshahi, Bogra, Khulna and Bhola. Consequently, serial dilution and cultured on MRS and M17 selective agar culture media were conducted. Colony-forming unit (CFU) on selective culture media were calculated and Lactic acid bacteria was initially identified by performing catalase and gram's staining test. Catalase negative, gram's staining positive bacteria were isolated and purified through sequential sub-culture for further identification. DNA was extracted from isolated bacteria by hot-cold method, quantified by Nanodrop 2000c specto-photometer and identified by PCR using genus and species-specific 16S rDNA primer sequences. After molecular identification acid production test of identified bacteria was conducted using skim milk. Finally, yoghurt was prepared and quality was evaluated using the scorecard.

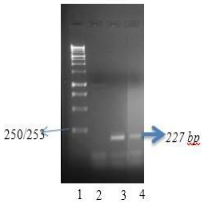
During serial dilution, viable bacteria were observed for all yoghurt samples. Viable bacterial colony number on culture plate ranged from 14 $x10^{-6}$ to $224x10^{-6}$CFU/ml on MRS culture media and $60x10^{-6}$ to $278x10^{-6}$CFU/ml on M17 culture media. Based on catalase and gram's staining test, twenty bacterial colonies were isolated.Among them, 14 colonies were rod shape and the rest of them were cocci shape. Among rod shape bacteria nine isolated bacterial colonies belonged to *Lactobacillus* genus whereas five of them belonged to *Bifidobacterium* genus. Among lactobacillus genus bacteria four colonies showed positive amplification for *Lactobacillus acidophilus* and five bacteria showed positive amplification for *Lactobacillus delbrueckii subsp. bulgaricus.* Among cocci shape bacteria four colonies belonged to *Streptococcus* genus. From acid production test, it was observed that the average pH of isolated bacteria ware 5.43±0.056 where the highest pH was5.85 and the lowest pH was4.5. After yoghurt preparation, it was observed that *Lactobacillus acidophilus*, *Lactobacillus delbrueckii subsp. Bulgaricus*, *streptococcus thermophilus* in a ratio of 2:1:1 showed the best yoghurtfor texture and test.

It is an ongoing project. Yoghurt was prepared from isolated bacteria and the sensory quality was tested by the expert panel. In the next year, easy preparation of good quality yoghurt and production of packed starter culture will be conducted.



1= 100 lb ladder, 2= R2, 3= V1, 4= V4, 5= K1, 6= B5, 7=Negative control.

Figure 1: DNA amplification by *Lactobacillus bulgaricus* species Specific primer



1= 1000 lb ladder, 2= Negative control, 3= K2, 4=. R1

Figure 2: DNA amplification by *Lactobacillus acidophilus* species Specific primer

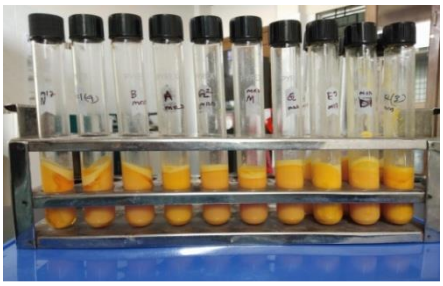


Figure 3. Acid production test.

Screening for causative mutations of major prolificacy genes in Black Bengal Goat

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Executive summary

Improvement of prolificacy has a vital importance for the goat industry and has received much more consideration now a days. However, litter size is a trait with low heritability; therefore, traditional direct selection and breeding program is ineffective and time consuming. At present, marker-assisted selection (MAS), based on relevant genetic variants, is used extensively to improve traits with low heritability. Molecular genetics has led to discover the candidate genes with substantial effects on phenotypic traits. These advances in molecular genetics has provided an opportunity to identify different candidate genes and variants associated with different production, reproduction and diseases related traits. Considering these opportunities, the present study was undertaken to explore the candidate genes and to screen the prolificacy markers in Black Bengal Goats (BBGs). Natural mutations in prolific sheep breeds have shown that the transforming growth factor beta (TGF-β) super family ligands such as growth differentiation factor 9 (GDF9), bone morphogenetic protein 15 (BMP15) and their type I receptor (bone morphogenetic protein receptor, BMPR1B) are crucial for ovulation and as well as for increasing litter size. Mutations in any of these genes increased prolificacy in sheep. Based on the known mutation information in sheep, the PCR primers were designed to amplify complete CDs sequences based on the reference sequence of the ovine genes to screen the mutations in BBGs. The NCBI primer blast were used for designed the primers and OLIGO7 software (Molecular Biology Insights) were used for checking the right primers in accordance with the gene sequences. The genomic DNA was extracted from blood of each goat using genomic DNA kit (TianGen, Beijing, China) following the manufacturer's guidelines. The DNA concentration and quality were determined by NanoDrop 2000 (Thermo Fisher Scientific, Waltham, MA, USA) spectrophotometer and gel electrophoresis.

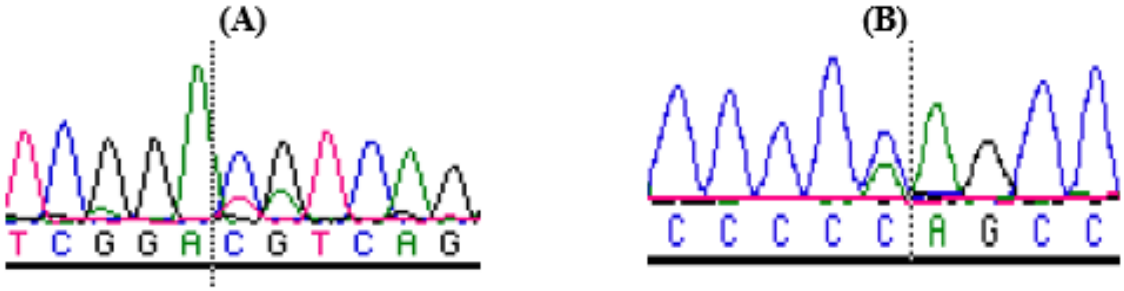

Figure 1. Sequence analysis, mutations detection and genotyping based on individual polymorphisms of BMPR1B gene in Black Bengal Goat breeds; (A) detected two mutations after the dotted line, C/T and G/A; (B), detected one mutation before the dotted line, C/A.

A pooled DNA samples (50ng/µL/goat) was made from the DNA of all selected animals. For PCR amplifications, pooled DNA samples were performed in a final reaction volume of 50µl consisting of 1.5µl of each primer, 50ng genomic DNA of 2µl, and 25µl premix (TaKaRa, Dalian, China). The amplifications environment of PCR was 5 min at 95ºC for initial denaturing followed by 30 cycles at 95ºC for 30s; annealing temperature at 59ºC for 30s; 72ºC for 40s; and a final extension at 72ºC for 5 min. From the each PCR product 40µl of was sequenced using the ABI3730XL (Applied Bio-systems, Foster City, CA). The sequences were aligned with mega 6.0 program to determine the presence of any mutations. A total of three mutations (C/A, C/T and G/A) were detected by sequences analysis of BMPR1B gene in Black Bengal Goat breed. Then the identification of SNPs were genotyped in the tested BBGs following restriction fragment length polymorphism (RFLP). The result showed that only the BMPR1B gene was polymorphic. Three genotypes of animals were

detected in tested animals. All known point mutations of BMP15 and GDF9 genes were monomorphic in the tested animals. These results preliminarily showed that the BMPR1B gene might be a major gene that influences prolificacy of Black Bengal Goats.

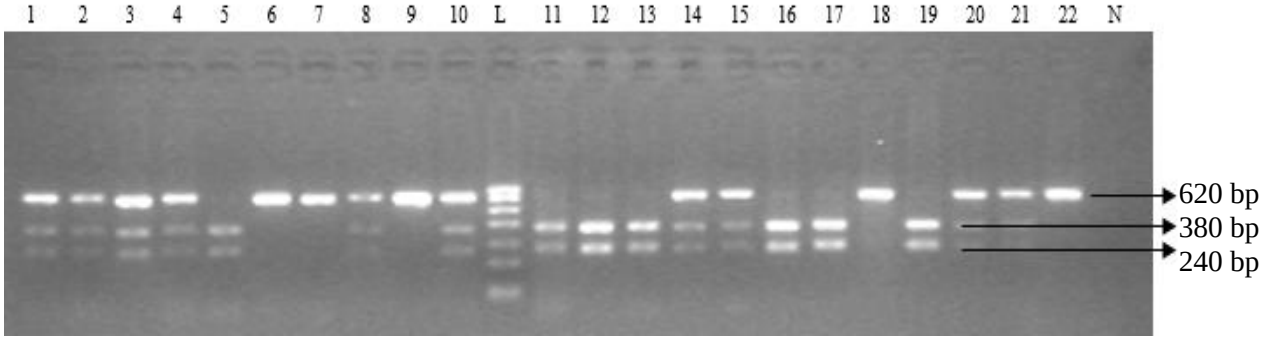

Figure 2. The agarose gel electrophoresis (2%) result of PCR-RFLP band patterns at C/A variant in BMPR1B gene. DNA was digested with the restriction enzyme Xho I and three types of genotype CC (620bp), CA (620bp/380bp/240bp) and AA (380bp/240bp) were found in the band patterns (Lane 1-22), L: Ladder and N: PCR without genomic DNA (negative control template).

It's a first year's partial findings of our ongoing project but the results indicated that the BMPR1B gene could be a good possible candidate gene for prolificacy either as a major gene or as an associated with other major genes. For more clarify, further studies is needed with a large number of Black Bengal goat populations considering different genetic backgrounds of Bangladesh.

Genetic variants of beta-casein in native and crossbred cattle and buffaloes of Bangladesh

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Executive summary

The most frequently observed forms of ß-casein gene (CSN2) in dairy cattle breeds are A1 and A2. This difference in structure results in A1-ß-casein preferentially releasing an opioid peptide called ß--casomorphin-7 (BCM-7) upon digestion, which may lead to adverse physiological effects like gastrointestinal inflammation, worsening of post-dairy digestive discomfort symptoms, triggers lactose intolerance, ischemic heart diseases, insulin-dependent diabetes, atherosclerosis, sudden infant death syndrome, autism and schizophrenia. However, screening of available cattle and buffalo genotypes in Bangladesh has not yet been undertaken for CSN2 polymorphism. Considering the healthfulness of A2 milk as well as positive relationship of A2 allelic variant with milk performance traits in different cattle and buffalo breeds, the present study was undertaken with the objectives to (i) identify genetic variability (A1/A2) of beta-casein in existing cattle and buffalo genotypes of Bangladesh. To achieve the objective, cattle and buffalo genotypes i.e. Red Chittagong (RCC), BLRI Cattle Breed-1 (BCB-1), Munshiganj (MC), North Bengal Grey (NBG), non-descriptive native cattle and their crosses with Holstein-Friesian (HF), Sahiwal (SL), Jersey, Brahman, exotic cattle breeds, native and crossbred buffaloes were selected for the genetic variability study of A1 and A2 beta-casein. In the financial year of 2019-20, a total of 339 blood samples were collected from four native, two exotic cattle breeds and their crosses, native and crossbred buffalo of which 47, 61, 69, 50,16, 3,51, 30 and 12 samples were from RCC, BCB-1, MC, NBG, HF, SL, crossbred cattle, native and crossbred buffaloes, respectively. The blood samples were taken from jugular vein using Venoject tubes coated with EDTA. The date and place of collection, sample number/ID and sex of animals were recorded. The collected blood samples were carried in cooling box and preserved at -20 ºC until DNA extraction. The DNA was extracted from blood samples using a commercial kit (Promega Wizard® Genomic DNA Purifcation Kit) following manufacturer instruction. The extracted DNA samples were quantified by agarose gel electrophoresis. The primers used in this study from the bovine CSN2 gene (Gene Bank Accession No. M55158.1). The allele specific-PCR was carried out using a forward primer carrying either A (IGBhF: 5'CTTCCCTGGGCCCATCCA 3') or C (IGBpF: 5'CTTCCCTGGGCCCATCCC 3') and at the 3' end a common reverse primer (IGBR: 5'AGACTGGAGCAGAGGCAGAG 3') to amplify a 244 bp fragment. The primer pairs IGBhF-IGBR and IGBpF-IGBR were intended to pick histidine (A1) and proline (A2) specific amplicon, respectively. The PCR amplifications were performed in a total volume of 25 µl using commercial master mix (Promega- GoTaq® G2 Green Master Mix) following manufacturer instruction, which contain 100-180 ng of genomic DNA, 15 pmol of each primer, 200 µM of each dNTP, 1× buffers with 1.5 mM MgCl2 and 1 U Taq DNA polymerase in final concentration. The PCR amplifications were performed using thermal cycler (GTQ Cycler 96, of HAIN Life-science) in a condition of initial denaturation at 95 °C for 5 min followed by 30 cycles of 95 °C for 60 s, annealing temperature (58 °C) for 45 s and 72 °C for 60 s followed by final extension at 72 °C for 10 min. The amplified products were analyzed by electrophoresis on 1% agarose gel at 80 V for 40 min with golden view staining and alleles were identified using UV-trans-illuminator (Figure 1).

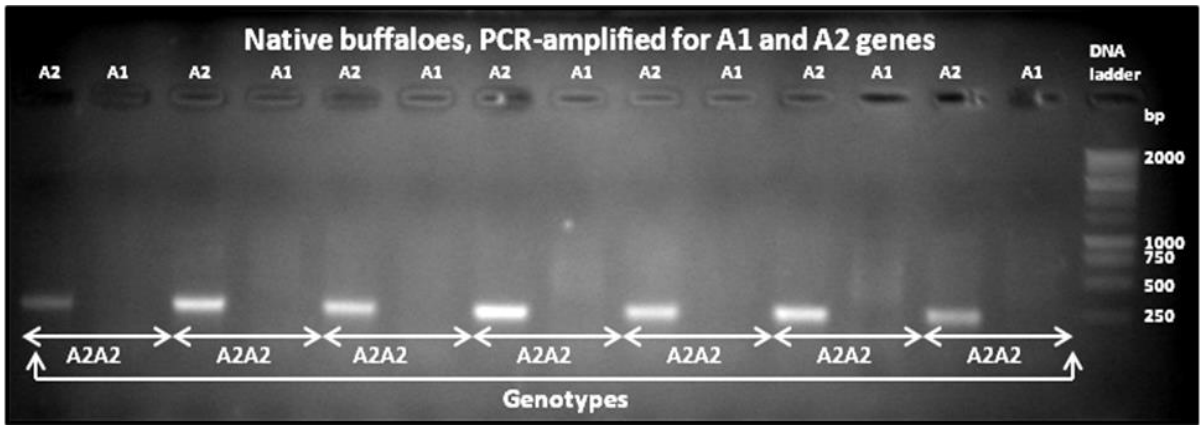

Figure 1. Identification of A1 and A2 alleles in native buffaloes through AS-PCR and agarose gel electrophoresis.

Electrophoresis analysis of the AS-PCR products revealed that three genotypes A1A1, A1A2 and A2A2 of beta-casein gene are prevalent among the tested animals (Table-1). Of the tested samples, 78.47% (266/339) were found homozygous A2A2 (A2 milk producer), 19.47 % (66/339) heterozygous A1A2 (Mixed A1A2 milk producer) and 2.06 % (7/339) homozygous A1A1 allelic (A1 milk producer). Homozygous A1A1 genotype was found in both native, HF and crossbred cattle but not in buffaloes and SL. From the study it is evident that A1 and A2 allele of beta-casein gene is existed in dairy animals of Bangladesh.

Table 1. Genotype frequencies of beta-casein in RCC, BCB-1, MC, NBG and crossbred cattle.

Breeds	No. of Sample	Genotype frequency% (n= number of samples)		
		A2A2	A1A2	A1A1
RCC	47	89.4 (n=42)	10.6 (n=5)	0 (n=0)
BCB-1	61	85.25 (n=52)	13.11 (n=8)	1.64 (n=1)
MC	69	79.70 (n=55)	18.88 (n=13)	1.40 (n=1)
NBG	50	72.00(n=36)	28.00(n=14)	0.00(n=0)
HF	16	31.25 (n=5)	56.25(n=9)	12.5 (n=2)
SL	03	33.33 (n=1)	66.66(n=2)	0.00(n=0)
Crossbred cattle	51	64.71 (n=33)	29.41(n=15)	5.88(n=3)
Native buffalo	30	100(n=30)	0.00(n=0)	0.00(n=0)
Crossbred buffalo	12	100(n=12)	0.00(n=0)	0.00(n=0)

In conclusion, so far data obtained, it may be stated that, most of the native cattle, buffalo and crossbreds have A2A2 genotype. Compare to native, crossbred cattle have higher A1A2. No A1A1 was observed in RCC, NBG, SL and buffalo population. The present investigation offers a plenty of scope for changing gene frequency through using A2A2 genotyped bulls in artificial insemination program.

Ovum pick up based technique for production of Red Chittagong calves

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Executive summary

Ovum pick up based *in vitro* embryo production system (OPU-IVP) is recently using for multiplication of dairy and beef cows in different countries. This technology allows production of large number of calves from a genetically high merit cow in short period. Therefore, the chances of enhancing genetic gain in breeding programme might be much higher. The OPU-IVP technique accelerate genetic gain through increasing selection intensity and reducing generation interval. Considering above facts, BLRI has adopted IVP protocol and produced first IVP calves in Bangladesh in 2016. Moreover, researches have beed taken to adopt OPU technology for faster multiplication of Red Chittagong cows at BLRI. Follicular dynamics and hormonal levels during the estrus cycle was studied in RCC cows and heifers. Hence, the objectives of this year experiment was to adopt ultrasound-guided transvaginal ovum pick-up (OPU) protocol at BLRI. For this purpose, oocytes were collected throughout the experimental period from four regular breeder Red Chittagong cows, without subjecting the cows to hormonal stimulation. Follicles were visualized using an ultrasound scanner (Honda Electronics, Japan) equipped with a sectorial probe fitted in a custom made intra-vaginal OPU probe-holder. Follicles number was recorded using ultrasonography. An 18 gauge disposable hypodermic needle connected to a 50 mL conical tube by Teflon tubing was used for follicular puncture. The COC collection tube and aspiration medium was kept at 38°C in a water bath. Oocytes were collected in Tyrodes lactate (TL)-HEPES medium enriched with 2% (v/v) fetal calf serum, 100 iu/mL penicillin, 0.1 mg/mL streptomycin and 5 iu/mL heparin. To minimize abdominal straining during OPU, epidural anesthesia was performed with 5 mL of lidocaine. Twice a week OPU schedule was used for collection of oocytes from donor cows. During this experimental period thirty OPU sessions were conducted. Oocyte were recovered from 15 sessions and subjected to *in vitro* maturation (TCM199 + 10% FBS, 1 µg/mL β-estradiol, 10 µg/mL FSH, 0.6-mM cystein, and 0.2-mM sodium pyruvate). The maturation rates were evaluated by expansion of cumulus cell. The matured oocytes were fertilized with frozen semen *in vitro*. One straw (0.25ml) of frozen semen was thawed (10 sec) and placed in a 15-mL conical tube containing 10 mL D-PBS and pelleted by centrifugation at 750 × g for 5 min. The supernatant was removed carefully and 10 mL D-PBS was added in the tube. The sperm were washed for 2 times accordingly. Then spermatozoa was capacitated through incubation with 500 µL IVF medium (Tyrode's lactate solution supplemented with 6 mg/mL BSA, 22 µg/mL sodium pyruvate, 100 IU/mL penicillin, and 0.1 mg/mL streptomycin) containing heparin sodium salt (20 µg/mL) for 15 min. After capacitation, the spermatozoa were diluted at approximately 1×10^6 spermatozoa/mL with IVF medium. The matured COCs were co-cultured with capacitated spermatozoa for 18 to 20 hr. After IVF, the cumulus cells were removed by gentle pipetting into TL-HEPES and the denuded presumed zygotes were placed in 120 µL CR1-aa medium supplemented with 44 µg/mL Na-pyruvate, 14.6 µg/mL glutamine, 10 µL/mL penicillin/streptomycin, 3 mg/mL BSA and 310 µg/mL glutathione for 3 days (IVC-I). These were then cultured until day 8 of embryonic development in a medium of the same composition, except that the BSA was replaced with 10% (v/v) FBS (IVC II). The incubation conditions during IVM, IVF and IVC were 5% CO_2 in air at 38.5°C with maximum humidity. The media (IVM, IVF and IVC) were pre-incubated for minimum two hours under culture condition. Total 255 follicles were punctured and 118 cumulus-oocyte-complexes were recovered during 15 OPU sessions. The oocyte recovery rate was 46.27%. The *in vitro* maturation rate was 64.41% (76 out of 118). Cleavage rate was 60.53% (46 out of 76). However, no oocyte was developed into blastocyst stage. This experiment is continuing to develop culture system for blastocyst development and embryo transfer.

Adaptation of Bio-char for sustainable improvement of soil fertility in sandy soil and establishment of fodder germplasms at BLRI regional stations

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Executive summary

Bio-char is made by pyrolysis, the thermochemical decomposition of organic materials at elevated temperatures (300-500 ^{0}C) under anaerobic conditions which can produced from animal manure, crop residue, bio-solids, paper mill waste and many other types of feed stocks. The objectives of this research was to quantify the combined effect of biochar and mineral fertilizer on soil fertility, soil quality and soil organic carbon in char lands and another to establish a fodder germplasm bank of two Regional Station (RS) at BLRI. Keeping this in mind, after land selection at Baghabari RS, bio-chulli was constructed with the technical help of Bangladesh Agriculture Research Institute (BARI) and the temperature measuring system was established with help of BUET. The capacity of bio-chulli was 50 kg and prepared biochar from Rice husk and applied it to experimental plot. There were four treatments (T_1 =control, T_2=Mineral fertilizer, T_3=Biochar with mineral Fertilizer, T_4=Cow dung with mineral fertilizer) with three replications and each of the plot was 150m^2.The production parameter of high yielding fodder variety of Napier at 45 and 65 days of cutting were recorded. On the other hand, HYF variety germplasm were established at Baghabari (19) and Jashore (9) RS and the production potentiality, biomass yield and chemical analysis of Napier fodder were also evaluated through this project. The data were analyzed using SPSS 20.0 statistical program.

Results revealed that there was no significant (P>0.05) different of leaf length, plant height, number of leaf/plant, tiller/hiller number and biomass yield of HYF among the treatments at 45 and 65 days of cutting (Table 1). In the second study, data on biomass yield, number of hill/ha, number of tiller/hill, plant height, leaf length, and leaf width and the Biomass yield ratio of botanical fraction for different Napier cultivars were presented on Table 2. Out of five Napier varieties, Napier-3 have highest biomass yield (71.55 ton/ha) and better morphological characteristics followed by other cultivars of Napier. The plant height, leaf length and leaf width was also higher in Napier-3 followed by others cultivars. According to biomass yield ratio of botanical fraction, Napier-2 showed the higher leaf weight but Napier-3 showed higher stem weight and stem and leaf ratio compared to other cultivars.

Table 1. Production performance of HYF variety (Napier) of different treatment at 45 days and 65 days of cutting.

Parameter	Treatment group				SEM	p-value
	T_1	T_2	T_3	T_4		
45 days of cutting						
Leaf length(inch)	10.0	10.00	9.0	10.00	0.39	0.99
Plant height (inch)	11.0	12.33	12.33	11.66	0.27	0.25
No.of leaf/plant	6.66	7.33	8.33	6.00	0.37	0.14
Tiller/hiller no.	3.0	3.66	3.33	3.33	0.25	0.87
Biomass yield (Kg)	7.33	8.50	7.56	9.26	0.85	0.91
65 days of cutting						
Leaf length (inch)	15.33^b	13.33^a	12.0^{ac}	11.33^c	0.57	0.036
Plant height (inch)	12.66	13.66	13.0	13.0	0.22	0.53
No.of leaf/plant	6.33	7.00	8.66	6.0	0.42	0.96
Tiller/hiller no.	3.0	3.33	4.0	4.0	0.33	0.70
Biomass yield (Kg)	8.50	12.33	10.85	11.0	1.5	0.88

^{a,b,c}Means within a row with different superscripts differ at P<0.05; SEM=Standard Error of Mean

Table 2. Biomass yield, morphological characteristics and biomass yield ratio of botanical fraction of different Napier cultivars.

Parameters	BLRI Napier-1	BLRI Napier-2	BLRI Napier-3	BLRI Napier-4	Napier Pakchong	Sig Level
Biomass(ton/ha)	24.57^{d}±2.07	43.38^{b}±2.19	71.55^{a}±0.87	38.78^{c}±0.93	42.57^{b}±0.65	**
No. of hill/ha (thousand)	41.75^{c}±1.20	47.63^{a}±0.85	48.43^{a}±1.20	48.00^{a}±1.00	44.37^{b}±1.07	**
No. of tiller/hill	10.00^{b}±1.00	21.00^{a}±2.65	9.67^{b}±2.08	11.33^{b}±1.53	9.80^{b}±0.20	**
Plant Hight (feet)	6.00^{b}±0.43	5.90^{b}±0.10	8.37^{a}±0.32	5.83^{b}±0.76	6.33^{b}±0.15	**
Leaf Length (cm)	66.67^{b}±0.58	80.33^{b}±13.05	98.33^{a}±10.02	72.67^{b}±2.08	96.00^{a}±3.46	**
Leaf Width (cm)	2.13^{b}±0.59	2.33^{b}±0.31	3.80^{a}±0.20	2.67^{b}±0.15	3.70^{a}±0.10	**

Biomass yield ratio of botanical fraction for different Napier cultivars

Variety	Stem wt./kg	Sheath wt./kg	Leaf wt./kg	Stem: Leaf
BLRI Napier-1	505	129	366	5.05:3.66
BLRI Napier-2	381	217	402	3.81:4.02
BLRI Napier-3	650	105	245	6.5:2.45
BLRI Napier-4	532	142	326	5.32:3.26
Napier Pakchong	552	115	333	5.52:3.33

^{a,b,c,d,} means bearing uncommon superscripts in a row differ significantly. **= P<0.01 and value indicate-Mean ± Standard Deviation (SD)

In case of biomass yield and production performance of Napier fodder, at 45 and 65 days of cutting, the effect of combined mineral fertilizer and biochar treatment group in char land showed better result compared with control group. On the other hand, biomass yield, morphological characteristics and biomass yield ratio of botanical fraction of different Napier cultivars were significantly ($p<0.05$) differed among treatment group.

A baseline survey on socioeconomic status of selected sheep farmers at community level

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Executive summary

Bangladesh had no practice to rear sheep at forest region there are a lot of feed resources such as fodder and tree leaves for sheep rearing. Most of the people of hilly region they are income under the below of poverty level. Scavenging system rearing is lot of scope at hilly region. Environments are very friendly for sheep rearing at hilly areas. On the other hand, plain land day by day decreasing trends to grown in different crops and housing, road, industrial development and scope is very limited and decreasing day by day to rearing the sheep. So, this study was conducted at sadar upazilla of Khagrachari, Muktagacha of Mymensingh District and Naikhongchari of Bandarban district to evaluate the productive and reproductive performances of BLRI improved native sheep at farms and farmers level as to improve their genetic potentiality along with improving the livelihood pattern of community farmers of the selected areas through rearing BLRI improved native sheep.
There were10 farmers who were selected randomly from 3 study sites. A total of three sheep (two ewes and one ram) were supplied to each selected farmer in each site. There was a control group (10 nos.) at Goat and Sheep Research farm at BLRI. Sheep of each farmer were identified giving identification number. The logistic support of the ewe and ram with different activities (regular vaccination, deworming, shearing, dipping, medication, fodder cutting distribution etc) at project sites were continued but wasn't smoothly done due to Covid-19 pandemic situation. A well-organized recording card was given for recording the productive and reproductive performances of each of the sheep in each farmer's house. The interview schedule was pre-tested with 10 sheep farmers prior to final data collection conducted from June'19 to July'19. From the initial data, it was found that, 51% respondents were engaged with native sheep rearing for below 5 years, 27% were 6-8 years and 22% were above 10 years in sadar upazilla of Muktagacha and as the sheep rearing was new in hills, so the respondents of Naikhongchari and Khagrachari district have only 3-4 years of sheep rearing experience. The farmer's family having the highest proportion low income constituted 56% in sadar upazilla of Muktagacha, 76% Naikhongchari and 69% Khagrachari district, respectively. The average land holdings of the households were found 234.13 decimal in Khagrachori, 276.45 decimal in Muktagacha and 316 decimals in Naikhongchori. Among all the respondents 13% of Muktagacha, 81% of Naikhongchari and 67% of Khagrachari had received training on different management on sheep rearing. Pneumonia, diarrhoea, bloat and parasitic infestation were found as the main diseases of sheep amongst all three sites. Some other problems like, dog biting, sheep marketing, improved ram, housing, lack of finance, low milk production were commonly found in each site. Higher feed price and quality ram for insemination service were major problems existing in each site, where grazing land problem found the lethal problem in Muktagacha site. Furthermore, dog bite, sheep marketing, improved ram, housing, social obstacle, low milk production problems were also found in each site. Most of the sheep farmers reported that sheep rearing was helping them to generate their income, reducing poverty, providing ready cash in hand and empowering rural women.

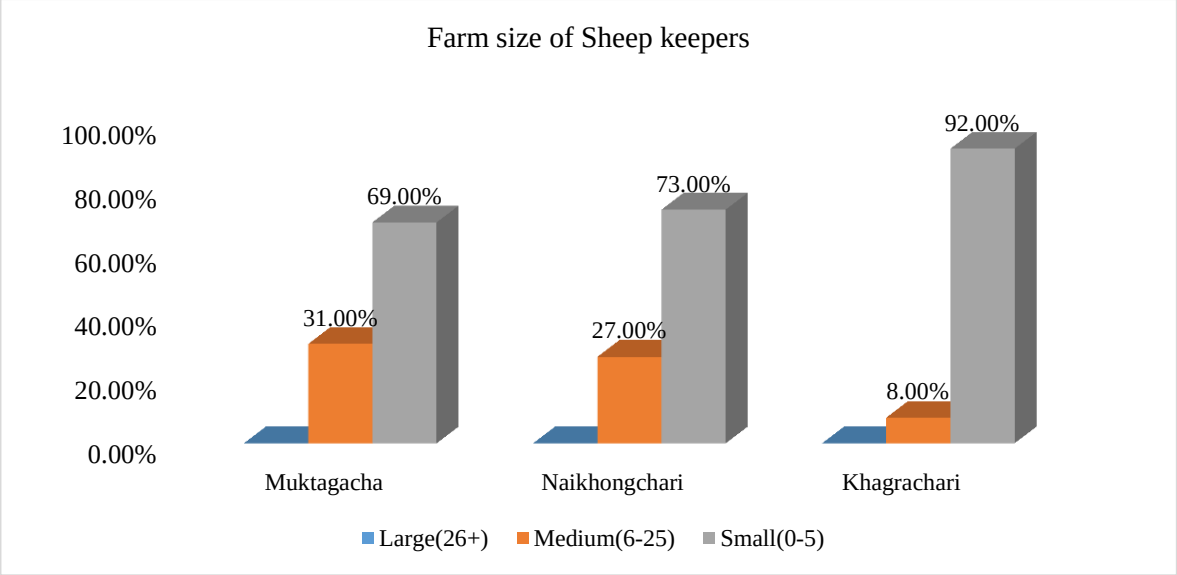

Figure 1. Different farm size of the beneficiaries of project sites.

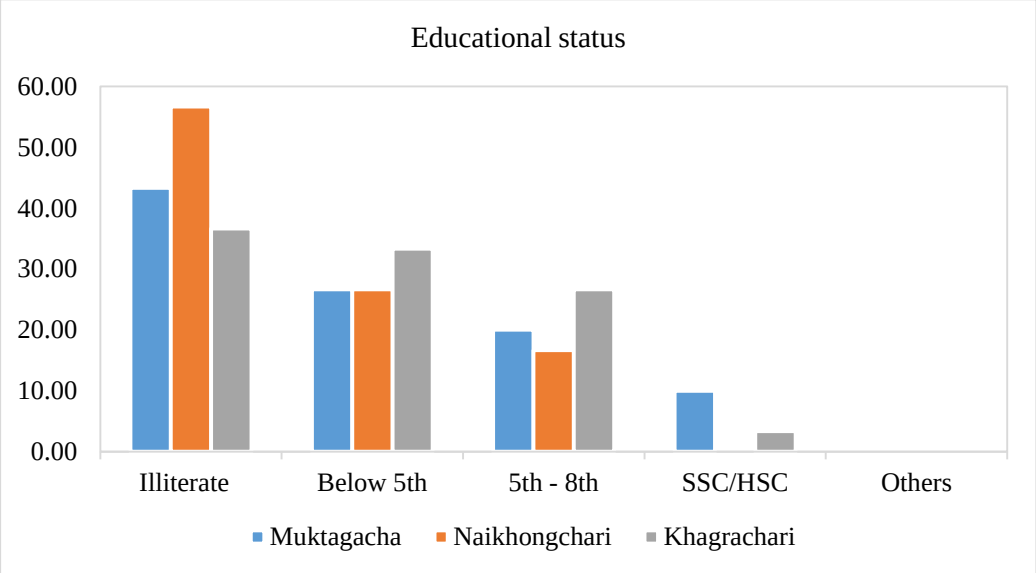

Figure 2. Educational status of the beneficiaries of project sites.

It is recommended that further improvement is needed to develop technologies related to sheep breeding, nutrition, health management and socioeconomic problems. There is scope for increasing access in the lamb supply chain to improve linkages through national and international meat supply agencies. This study might help in decision making on evaluation of performance of BLRI improved sheep at farmer's rural community level. This study needs to be continued until a significant improvement of native sheep stock at farm and farmer's level.

Developing a model for up-scaling livelihood of the rural poor farmers by rearing Red Chittagong Cattle

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Executive summary

The present research work was designed to develop a model for the up-scaling livelihood of the rural poor people by keeping and conserve RCC in the farmers' house (*in-situ*). In this connection 400 farmers from four Upazilas (Anowara, Patiya, Sakhipur, and Godagari) of 3 Districts (Chattogram, Rajshahi, and Tangail) under the project area were selected. For up-scaling livelihood, three days hands on training on modern cattle rearing was given to the farmers. Semen of meritorious RCC bull, vaccine, medication and treatment are being provided to the RCC community. Impact of the project interventions will be assessed before the end of the project comparing baseline and end-line data. For this purpose, a baseline survey was conducted in the selected areas and data on economic status in details including their occupation, primary and other sources of income, savings and expenditures, etc. were collected through a pre-tested questionnaire.
In this year, a total of 4 training programs were conducted in 4 selected Upazillas, and a total of 400 farmers participated in the training program. In the selected areas, a total of 907 cattle were registered using ear tagging. The highest cattle were registered in Godagari Upazila 49.61% (450) of Rajshahi District. Among registered cattle, 87.98% (798) cattle were dewormed and the highest cattle were dewormed in Godagari Upazila 95.55% (430). Moreover, a total of 56.67% (514) cattle were vaccinated in this year and the highest number of cattle vaccinated in Sakhipur Upazila 73.64% (95). However, the highest (26.35%) 34 treatment cases was found in Satkhira with an average of (15.25%) 140 for all the selected Upazilas. A total of 77 calves were born from the RCC semen supplied from BLRI and the highest 38.96%) calves were born in Anowara Upazila. Among newborn calves, 46.75% (36) were male and 53.25% (41) were female. The overall daily milk yield of registered RCC cows was 2.95±0.20 litters , while the peak milk yield in a day was 4.75±0.31 litters.
This is an ongoing research and data on household income-expenditure, cost-benefit analysis, productive and reproductive parameters will be collected and final impacts of the project intervention will be assessed based on the overall changes over time.

Table 1. Status of the project intervention at registered RCC community.

Upazila	No of registered cattle (%)	Newborn calf			Deworming (%)	Vaccination (%)	Treatment (%)
		Total (%)	Male (%)	Female (%)			
Anowara	14.99 (136)	38.96 (30)	30.00 (9)	70.00 (21)	78.67 (107)	48.53 (66)	15.44 (21)
Patiya	21.17 (192)	36.36 (28)	60.71 (17)	39.29 (11)	83.33 (160)	53.64 (103)	13.02 (25)
Sakhipur	14.22 (129)	16.88 (13)	61.53 (8)	38.47 (5)	78.29 (101)	73.64 (95)	26.35 (34)
Godagari	49.61 (450)	7.79 (6)	58.33 (35)	41.67 (25)	95.55 (430)	55.55 (250)	13.33 (60)
Overall	100.00 (907)	100.00 (77)	46.75 (36)	53.25 (41)	87.98 (798)	56.67 (514)	15.43 (140)

Number in the parentheses indicates cattle/calf number

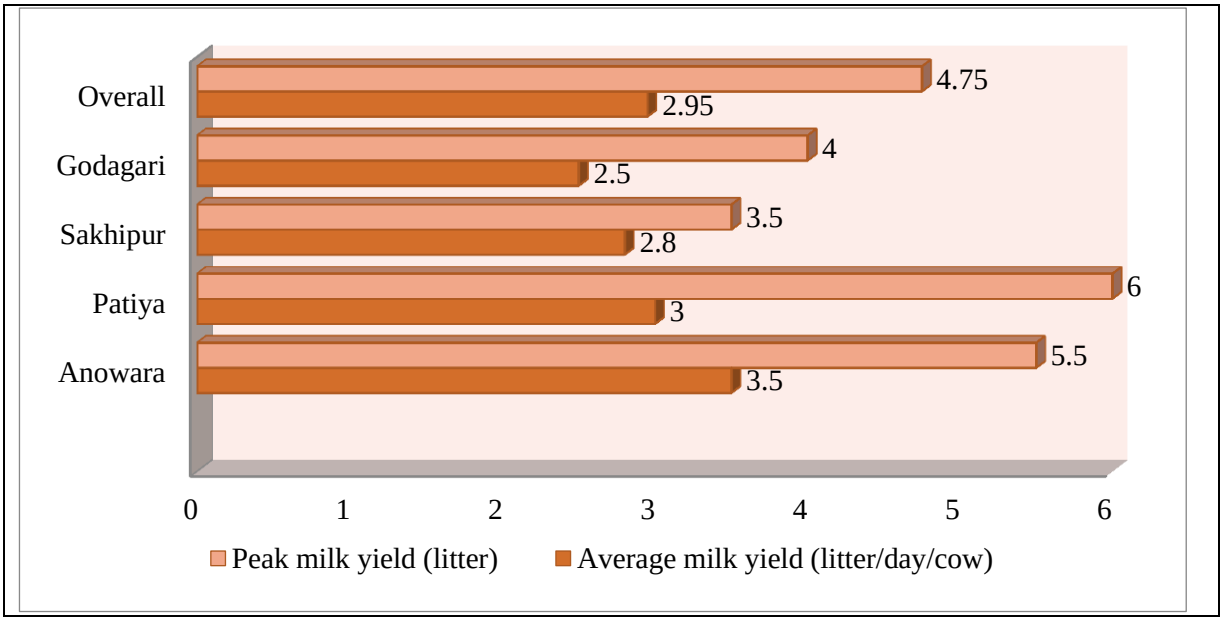

Figure 1. Milk yield of RCC cow irrespective of the selected areas.

Impact of dairy initiatives taken at post-2000 in northern Bangladesh on production and consumption status of dairy products

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Executive summary

Dairy sector has been changing gradually since 2000 that includes from local bred to cross bred, from semi-subsistence to commercial, from poor farmers' resource to rich farmers' profession, from manual farming system to highly technology-based farming and many others. The study was conducted to know the impact of dairy initiatives taken at post-2000 in northern Bangladesh on production and consumption status of dairy products considering of nine districts of northern Bangladesh. Key informant interviews were conducted with DLS officers and personnel's from private sector dairy initiatives (Aarong, MilkVita, Khamari etc.). Data had been collected from a total of 262 farmers during March to June, 2020. Farmers were asked about farm management, feeding, vaccination, selection of fodder, disease control, treatment etc. According to the DLS, milk production in the northern Bangladesh has increased due to BDT 200 core loan in 5% interest in livestock farming, NATP and LDDP project, introduce modern technology-based farming by training, AI services, feed management, farm management, fattening, animal disease etc. It has also been found that the private dairy initiative have done a lot to increase milk production including supporting marketing channel, establishment of chilling centers etc.

The study found that after 2000, the number of farmers has increased significantly, as farmers' average level of experience is 8 years. More than 80% of the farms are based on family labour. Most of the farmers use rice straw (85%), urea molasses (63%), and Napier grass (46%), as fodder. Large farmers mainly use mixed ready feed. As the farmers are mostly following the traditional management method, they do not receive expected amount of milk. Most of the cross bred are Holstein Frisian and the average milk production is 6-12 liters. As there is less manpower of DLS in the field, 43% of the sampled farmers take treatment from the quack, among which 40% respondents aren't satisfied with their veterinary services. Farmers are sometimes suggested unnecessary medicines, and pay higher prices to the companies who provide semen; rarely do they consider the quality. If the bred, and management could go in a proper way, the milk production would increase.

More than 70% farmers do practice routine vaccination regularly with a big percentage (64%) of only FMD. Though farmers are facing several animal diseases, but this year, Lumpy skin disease (LSD) has made 36% of farmers' life very critical. Some 39% farmers are not involved in vaccination. In the large farms, vaccination programme is arranged routinely. All the farmers mentioned that they do not receive fair price of milk. About 37% of respondents sell their milk directly to milk collector, whereas 32% sell at house or in own village on a daily basis, 21% sell at hat/bazaar and 12% have formed milk producer group. From selling milk at hat/bazar and neighbours, respondents get about Tk. 48 and selling at direct to milk collector they receive Tk. 40. But feed price has been increased many times in these years.

Still now, very less number of households regularly consumes milk across rural and urban area. People' perception is: milk is the food for child and sick. It has been found that milk producers' families consume 1-1.5 liter of milk per day, while the non-producers consume 250 -500 ml of milk. It has been found that in the rural sweetshops, sweets, curd, etc. are produced with 40-50 liters/day of milk, where in urban areas the amount is 200-250 liters/ day. It is great that though people do not consume milk, they sometimes buy and consume sweets. In the rainy days and other unusual days, milk consumption decreased, the products remain unsold. So if we would like to improve dairy sector, we must go for chilling centers. The problems regarding dairy farming are: lack of veterinarians, lack of getting loan with low interest, lack of electricity supply, lack of storage facility, low quality and high prices of feed, disease, lack of availability of quality bred, lack of knowledge, treatment by quack, etc. The dairy farmers expect policy support from government to remove the obstacles those they face. The policy level stakeholder needs to seriously think about milk pricing and need to reduce importing milk to improve the development of this sector.

A pilot program for the validation of newly developed android apps entitled "KhamarGuru"

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Executive summary

The Government of People's Republic of Bangladesh is highly committed to create opportunities for increasing livestock production and highest emphasis drawn in the SDGs' to double the agricultural productivity by innovating sustainable technologies or by improving existing farming practices. So, this is the time to interventions of scientific innovation for strategic development ensuring conservation of genetic resources and safe food production. "KhamarGuru" android apps has developed keeping all the above concern and then this pilot program was undertaken to validate the "KhamarGuru" Android Apps at farmers' field. Validation program for the packages of Cattle fattening, Buffalo farming was conducted in Savar Upazilla and Vola District, respectively. Validation for Goat rearing and dairy farming in Jessore and Shirajgong are on-going. A one way ANOVA experiment of CRD design was settled down to accomplished the program for both the cases. Farmers were selected based on a baseline survey who have at least five growing cattle or buffalo bulls previously for conducting the validation trial and trained them accordingly. Day long training with twenty participants was performed in each of the study area, regarding the respective package of "KhamarGuru" apps. In case of cattle fattening, eighty bulls of 2-3 years of ages were taken into consideration and divided into two groups randomly. Sixty animals were reared following the cattle fattening package of "KhamarGuru" android apps, treatment denoted as T_1 and rest of the 20 animals were reared under the existing management practices as control treatment, denoted as T_0. Feed intake and growth of all the animals were recorded consecutively during the whole experimental period. Same procedure was followed for buffalo fattening but the sample size of growth trial of buffalo was little than cattle. Thirty buffalo bulls were taken and grouped randomly keeping twenty bulls as experimental treatments denoted as T_1 and ten bulls as control denoted as T_0. All the cattle and buffalo bulls were dewormed with anthelmintics prior to the feeding trial. All the experimental animals were housed in individual tie stalls and ensure the clean water for all the time period of trial. Due to the pandemic of Covid-19, there was some restriction. However, feeding trial of cattle fattening was continued for 72 days and buffalo bull fattening for 90 days. All the animals of cattle fattening trial weighed at an interval of 12 days. All the buffalo bulls weighed at an interval of 15 days and till the end of the both trial it was continued successfully. The growth performance, feed intake as well as dry matter and crude protein intake were analyzed statistically in an ANOVA of a completely randomized design (CRD) using the "R" computer software packages.

Table 1. Performance of local bulls following the cattle fattening package of "KhamarGuru" apps

Parameters	Control (kg)	Treatment (kg)	F value	CV	Sig.
ILW	212.35±19.42 [a]	226.64±66.93 [a]	0.88	26.40	NS
FLW	228.75±14.68 [b]	276.37±64.88 [a]	10.51	21.48	**
ADG	0.16±0.20 [b]	0.50± 0.08 [a]	54.23	42.36	***
DMI	530.19±69.15 [b]	633.80±182 [a]	6.13	26.63	*
CPI	133.55±17.41 [b]	219.31±78.46 [a]	23.31	34.74	***

ILW=Initial live weight, FLW=Final live weight, ADG=Average daily gain, DMI=Dry matter intake, CPI=Crude protein intake, *=p<0.05; ** = p<0.01; ***=p<0.001; p>0.05=Non-significant (NS)

Results of cattle fattening trial are presented in Table 1. To conduct the trial logically, the initial live weight of both the groups remains similar with non-significant variations. From the final live weight (ILW) of cattle, it was observed that, the final live weights (FLW) of bulls of treatment groups, who were reared following the apps were significantly differed (p<0.01) from the control group (276.37± 64.88 and 228.75±14.68 kg, respectively). The F value of growth increased from 0.88 to 10.51 within 72 days only. Considering the whole experimental period, average daily gain was measured

and it was observed that, average live weight gain (ADG) of treatment group was quite higher than control group (0.50±0.08 and 0.16± 0.20 kg/d, respectively) and difference between the groups were highly significant ($p<0.001$). The F value of ADG (54.23) indicates the strong variations between the groups. The dry matter intake (DMI) and crude protein intake (CPI) also showed significant difference between the groups. The DMI found significantly higher ($p<0.01$) in treatment group than control group (633.80 ± 182 and 530.19 ± 69.15, respectively) and again CPI found significantly higher ($p<0.001$) in treatment group than control group (219.31±78.46 and 133.55±17.41, respectively), shown in Table 1. Growth variants of cattle showed that, over the period of time F value was increased and just after one month of trial great variations were observed between the groups, which also indicates the compensatory growth of bulls. From the 2nd stage to final stage (1.08, 2.87, 4.33, 6.59 and 10.51, respectively) the variations turned around double than previous value (Figure 1).

Figure 1. Growth variants of cattle.

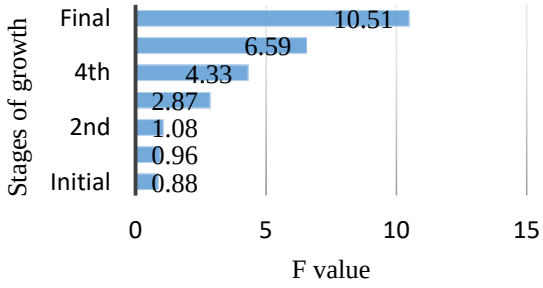

Figure 2. Growth variants of buffalo.

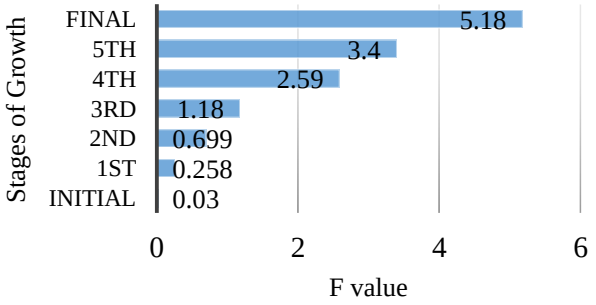

Table 2. Performance of buffalo bulls following the buffalo rearing package of "KhamarGuru"apps.

Variables	Control	Treatment	F value	CV	Sig.
ILW	245.00±21.21 [a]	247.15±30.71 [a]	0.03	11.36	NS
FLW	253.00±19.33 [b]	278.55±32.56 [a]	5.18	10.73	*
ADG	0.11±0.04 [b]	0.47±0.08 [a]	132.3	22.26	***
DMI	387.53±36.47 [b]	458.33±227.33 [a]	0.94	43.33	NS
CPI	23.65±1.75 [b]	118.00±29.93 [a]	97.44	28.51	***

ILW= Initial live weight, FLW= Final live weight, ADG= Average daily gain, DMI=Dry matter intake, CPI=Crude protein intake, *=p<0.05; **= p<0.01; ***=p<0.001; p>0.05 = Non-significant (NS)

Results of buffalo fattening growth trial with different performance parameters are presented in Table 2. ILW of two experimental groups of buffalo was similar with no significant difference. After the finish of growth trial period, it was observed that, FLW of T_1 was significantly ($p<0.01$) differed with control group (278.55±32.56 and 253.00±19.33 kg, respectively). Actual variation was observed in the result of ADG. ADG was differed very significantly ($p<0.001$) between the groups and treated group (T_1: which group was reared following the apps) performed better than control group (0.47±0.08 and 0.11±0.04 kg/d, respectively). The resulted F value of ADG (132.3) reflects the large variations between the groups. The DMI was showed non-significant difference between the groups but CPI of treated group (T_1) was significantly ($p<0.001$) very higher than control group (118.00±29.93 and 23.65±1.75 kg, respectively). From this result, it may assume that, concentrate feeding might be influenced the growth of buffalo bulls (Table 2).

Growth variants of buffalo also increased like cattle over the period of time but in a slow rate. Not much variation was observed from their growth but the compensatory growth viewed after the 1st stage of growth period. From the 1st stage of growth, it was increased slowly (0.25, 0.69, 1.18, 2.56, 3.4 and 5.18, respectively) but made the clear difference for assuming the variations of groups (Figure 2).

Annual Research Review Workshop 2020

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মুজিববর্ষে বাংলাদেশ

Bangladesh Livestock Research Institute

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SESSION II

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SESSION III

FEEDS, FODDER AND NUTRITION

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SESSION V

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