Annual Research Review Workshop 2019

Date: 26-27 January 2020

BLRI Conference Hall

3rd floor, Building 3

PROGRAMME

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

TECHNICAL SESSIONS

Day 1: Sunday, 26 January, 2020

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

Chairperson : **Professor Dr. Nitish Chandra Debnath**
Director, Teaching & Training Pet Hospital and Research Centre and Ex VC, CVASU, Chittagong

Co-Chairperson : **Dr. MJFA Taimur**
CSO (Rtd) and Ex Head
Animal Health Research Division, BLRI

Rapporteurs : DR. Md. Abu Yousuf , SO, BLRI
DR. Sonia Akther, SO, BLRI

09:30-09:40	Prevalence of sub-clinical mastitis in Pabna cows and high yielding crossbreeds and its control strategies	SM Rahman SSO
09:40-09:50	Surveillance and molecular evolution of highly pathogenic avian influenza virus (HPAIV) in Bangladesh	MZ Ali SO
09:50-10:00	Monitoring of Peste des Petits Ruminants (PPR) virus and Peste des Petits Ruminants (PPR) like disease in Bangladesh	MA Yousuf SO
10:00-10:10	Seroprevalence of tick borne blood protozoan diseases of cattle and sheep and standardization of BLRI developed TBDs autogenous killed vaccine	MZ Hassan SO
10:10-10:20	Prevalence of different dairy cattle diseases in selected dairy areas and farms of Bangladesh	MAH Miah SO
10:20-10.45	**Discussion**	
10:45-12:10	**Inauguration**	
12:10-12:30	**Refreshment**	
12:30-01:00	**Poster Presentation**	
01:00-02:00	**Lunch and Prayer**	

Day 1: Sunday, 26 January, 2020

Technical Session II : ANIMAL AND POULTRY BREEDING AND GENETICS

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

Co-Chairperson : Md. Lutfor Rahman Khan
Director (Extension)
Department of Livestock Services, Farmgate, Dhaka

Rapporteurs : Dr. Mst. Parvin Mostari, SSO, BLRI
Nure Hasni Desha, SO, BLRI

02:00-02:10	Test-day and adjusted full lactation yield of local Pabna cows in Bangladesh	MAI Talukder CSO
02:10-02:20	Development of mobile and web based data recording application for Dairy Development Research Project (DDRP)	M Shahjahan SSO
02:20-02:30	Conservation and improvement of native chicken: laying performance of seventh generation	S Faruque SSO
02:30-02:40	Conservation and improvement of exotic germplasms and development of egg and meat type chicken	MR Hassan SSO
02:40-02:50	Conservation and improvement of Quail: Performance of eighth generation	S Faruque SSO
02:50-03.00	Conservation and improvement of native duck and geese genotypes: Laying performances of 5th generation of BLRI improved duck genotypes	H Khatun SSO
03:00-03:10	Conservation and improvement of Black Bengal goat at Bangladesh Livestock Research Institute (BLRI)	NH Desha SO
03:10-03:20	Performance evaluation of F1 progeny of different beef breeds with native cattle	MP Mostari SSO
03:20-03:30	Characterization and screening of different coat color variants goat stock at BLRI	MF Afroz SSO
03:30-03:40	Red Chittagong cattle breeding and revealing their genetic architecture using High Density Single Nucleotide Polymorphism Array	AKFH Bhuiyan Professor, BAU
03:40-04:00	**Discussion**	
04:00-04:10	**Tea and Snacks**	
04.10-05:00	**Poster Presentation**	

Day 2: Monday, 27 January, 2020

Technical Session III : FEEDS, FODDER AND NUTRITION

Chairperson : **Professor Dr. Md. Jasimuddin Khan**
Pro-Vice Chancellor
Bangladesh Agricultural University
Mymensingh 2202

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

Rapporteurs : Dr. Ali Akbar Bhuiyan, SSO, BLRI
Mr. Md. Ashadul Alam, SSO, BLRI

09:30-09:40	Development of feeds and feed additives for producing value added poultry meat and eggs emphasizing lipid profile and antioxidant	F Sharmin Post-Doc. Fellow
09:40-09:50	Study on production, nutritive value and land use efficiency of fodder maize (Zea mays) intercropped with alfalfa (*Medicago sativa*)	S Ahmed SSO
09:50-10:00	Strategic development of feeding and management techniques to improve the performance of egg and meat type chicken and their qualities	MAG Rabbani SO
10:00-10:10	Evaluation of the weaning stress and estimation of weaning age of Black Bengal kids at different weaning condition	S Ahmed SSO
10:10-10:20	On-farm validation of TMR technology for fattening cattle	MA Alam SSO
10:20-10.30	Conservation, multiplication and adaptation of High Yielding Fodder (HYF) variety at BLRI Regional Station	US Alam SO
10:30-10:40	Development of feeding system for growing buffalo in coastal area of Bangladesh	BK Roy SSO
10.40-10.50	Determination of best practice management for Napier grass: Defoliation height and severity to optimize nutritive value and regrowth	BK Roy SSO
10.50-11.00	Study on production potentiality and preservation technique of Moringa fodder and assessment of it's nutritional quality	N Sultana PSO
11:00-11:20	**Discussion**	
11:20-11:30	**Tea and Snacks**	

Day 2: Monday, 27 January, 2020

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

Chairperson : **Professor Dr. MAM Yahia Khandoker**
Department of Animal Breeding and Genetics
Bangladesh Agricultural University
Mymensingh 2202

Co-Chairperson : **Md. Abdul Gofran**
Chairman
Bangladesh Biogas Development Foundation

Rapporteurs : Dr. Shakila Faruque, SSO, BLRI
Dr. Shabiha Sultana, SO, BLRI

11:30-11:40	Screening of heavy metal residue in animal food chain system	MA Islam MS Student
11:40-11:50	Adaptation of ovum pick up technology for the production of Red Chittagong calves	GK Deb SSO
11:50-12:00	Isolation and identification of lactic acid bacteria for the development of microbial silage inoculant	SM Amanullah SSO
12:00-12:10	Efficient management of poultry manure: anaerobic co-digestion for biogas production and application of additives for odor reduction	MM Rahman SO
12:10-12:20	Carbon footprint of beef cattle production at Khulna division of Bangladesh	NG Das SSO
12:20-12.30	Study on the improvement of existing manure management system of Bangladesh	JS Khanam SO
12:30-12:50	**Discussion**	
12:50-02:00	**Lunch and Prayer**	

Day 2: Monday, 27 January, 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. Md. Shahjahan Ali Khandaker**
Joint Chief
Agriculture, Water Resource and Rural Institutions
Planning Division, Ministry of Planning

Rapporteurs : Dr. Zillur Rahman, SSO, BLRI
Sabina Yasmin, SO, BLRI

02:00-02:10	Baseline study on available Horse genetic resources in Bangladesh	MFH Miraz SO
02:10-02:20	Determination of income elasticity of demand and forecasting demand for milk, meat and egg in Bangladesh in 2025 and 2030	S Yasmin SO
02:20-02:30	Determinants of profitability of cattle fattening: A technical and allocative efficiency analysis of fattening enterprise in Bangladesh	M Khatun SO
02:30-02:40	Development of model village through BLRI technologies at Dhamrai areas	R Khatun SSO
02:40-02:50	Impact of farmers training on adoption of BLRI developed technologies	MZ Rahman SSO
02:50-03:10	**Discussion**	
03:10-04.00	**Poster Presentation**	
04:00-05:10	**Closing session**	
05:10-05:30	**Tea and Snacks**	

POSTER SESSION

Day 1: 12:30-01:00 pm & 04:10-05:00 pm
Day 2: 03:10-0400 pm

Rapporteurs Mr. Md. Ataul Goni Rabbani, SO, BLRI
DR. Habibur Rahman, SO, BLRI

SL No.	Title	Presenter
1.	Comparison on different morphological parameter, biomass production and nutritive value of three fodder germplasms	MM Billah SO
2.	Collection, conservation and improvement of specialized fowl (Turkey, Guinea fowl and Pigeon) production at BLRI	MA Rashid SSO
3.	Substitution of soybean meal by cotton seed meal as a source of protein supplement in the diet of broiler chicken	MRA Sumon SO
4.	Improvement of Black Bengal goat in rural areas	NH Desha SO
5.	Conservation and improvement of native sheep at BLRI	NH Desha SO
6.	Production and evaluation of crossbred sheep of Coastal with Damara, Dorper and Parendale	NH Desha SO
7.	Evaluation of new developed lines from BLRI Napier-3 cultivar under saline condition in coastal region of Bangladesh	MK Alam SSO
8.	Feeding of vegetable waste silage to beef cattle at farm level	NG Das SSO
9.	Field testing of BLRI Feed Master mobile application in selective locations of Bangladesh	MA Kabir SO
10.	Adaptation of somatic cell nuclear transfer (SCNT) technologies for cattle in Bangladesh	GK Deb SSO
11.	Developing a model for up-scaling livelihood of the rural poor farmers by rearing Red Chittagong cattle	MR Amin SO
12.	Development of animal ID and recording system of RCC and their graded cattle through computer and mobile application technology	SMJ Hossain PSO
13.	Development of herd book based RCC recording system at the community level	H Rahman SO
14.	Development of starter culture for Yoghurt	MA Kabir SO
15.	Conservation and improvement of Munshiganj cattle	MFH Miraz SO
16.	Development of low input community breeding model for Red Chittagong cattle	MFH Miraz, SO

17.	Empowerment factors of rural women through homestead native sheep rearing in Hilly area at Naikhongchari	MA Hemayet SO
18.	Cryopreservation of exotic ram semen for conservation and multiplication of sheep germplasm of BLRI	MKH Mazumder SSO
19.	Design and development of products from native sheep skin	MKH Mazumder SSO
20.	Development of blended yarns and fabrics from jute, cotton and native sheep wool	MKH Mazumder SSO
21.	Phenotypic and genotypic profiling of antimicrobial resistance (AMR) in enteric bacterial communities in finisher livestock and poultry in Bangladesh	MR Begum
22.	Canned meat production and its preservation quality assessment	JS Khanam SO
23.	Morphological features and growth traits of half-sib local Pabna calves up to yearling stages	S Munira SO
24.	Improving production performance of local buffalo through crossbreeding	GK Deb SSO
25.	Study on follicular physiology of repeat breeder cows in Baghabari milk shed areas	R Khatun SSO
26.	Identification of candidate gene markers for prediction of RCC sperm quality and fertility	MFH Miraz SO
27.	Effect of nitrogen fertilizer on morphological parameter, biomass yield and nutritive value of Napier fodder	MM Billah SO
28.	Development of a mini processing plant for safe poultry meat production	MSK Sarker SSO
29.	Impact of sheep project on socioeconomic conditions and sheep management practices in selected areas of Bangladesh	MR Amin SO
30	Development of system generated database at BLRI research farm for genetic evaluation in progressive generations	S Ahmed SSO
31	Genetic variants of beta-casein in native and crossbred cattle of Bangladesh	MP Mostari SSO
32	Conservation and improvement of farm animal genetic resources (FAnGR) at Hilly region at Naikhongchari	MA Alam SSO

INAUGURAL SESSION

(26 January, 2020)

Chief Guest : **Mr. Md. Ashraf Ali Khan Khasru, MP**
Hon'ble State Minister
Ministry of Fisheries and Livestock

Special Guest : **Dr. Md. Enamur Rahman, MP**
Hon'ble State Minister
Ministry of Digester Management and Relief

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

Special Guest :
Mr. Md. Zakir Hossain Akanda
Member (Secretary)
Agriculture, Water Resources and Rural Institutions,
Ministry of Planning

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

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

10:45 am	Guests take their seats
11:00 am	Recitation from the Holy Qurán and Holy Gita
11:05 am	Welcome Address by **Md. Azharul Amin** Additional Director & Convener, Annual Research Review Workshop-2019
11:10 am	Address by the Guest of Honor **Dr. Abdul Jabbar Sikder** Director General, Department of Livestock Services
11:15 am	Address by the Special Guest **Mr. Rawnak Mahmud** Secretary, Ministry of Fisheries and Livestock
11:25 am	Address by the Special Guest **Mr. Md. Zakir Hossain Akanda** Member (Secretary), Agriculture, Water Resources and Rural Institutions, Ministry of Planning
11:35 am	Address by the Special Guest **Dr. Md. Enamur Rahman, MP** Hon'ble State Minister, Ministry of Digester Management and Relief
11:50 am	Address by the Chief Guest **Mr. Md. Ashraf Ali Khan Khasru, MP** Hon'ble State Minister, Ministry of Fisheries and Livestock
12:05 pm	Address by the Chairperson **Dr. Nathu Ram Sarker** Director General, Bangladesh Livestock Research Institute
12:10 pm	Refreshment

CLOSING SESSION

(27 January, 2020)

Chief 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

04:00 pm	Recitation from the Holy Qurán and Holy Gita
04:05 pm	Presentation of Workshop Recommendation **by Dr. Md. Giasuddin** Head, Animal Health Research Division, BLRI
04:20 pm	Open Discussion
04:40 pm	Address by the Special Guest **Dr. Abdul Jabbar Sikder** Director General, Department of Livestock Services
04:50 pm	Address by the Chief Guest **Mr. Rawnak Mahmud** Secretary, Ministry of Fisheries and Livestock
05:00 pm	Concluding remarks by the Chairperson **Dr. Nathu Ram Sarker** Director General, Bangladesh Livestock Research Institute
05:10 pm	Refreshment

CONTENTS

Prevalence of sub-clinical mastitis in Pabna cows and high yielding crossbreeds and its control strategies

MAI Talukder[1], SM Rahman [2]*, MAH Miah[2], M Shahjahan[2], MY Ali[2] and MM Billah[2]

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[2]Bangladesh Livestock Research Institute Regional Station, Baghabari, Sirajganj-6770
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Executive summary

Bovine mastitis is the most costly disease of dairy cattle due to economic losses from reduced milk production, treatment costs, increased labour, milk withheld following treatment, death and premature culling. There are three forms of mastitis namely clinical, sub-clinical and chronic. It is now a well known fact that the sub clinical mastitis (SCM) is more serious and is responsible for greater loss to the dairy industry in Bangladesh. Though the indigenous cattle are believed to be less susceptible to any forms of mastitis its prevalence in different grads of dairy cattle is not studied. Good management practices are believed to play a great role in controlling SCM but the practice is not standardized. Considering all these matters the present study was taken the prevalence of SCM in selected dairy areas and to develop prophylactic treatment and management practices. The study areas were the NBH and the community of the Dairy Development Research Project. NBH is located in the BLRI-RS, Baghabari and the community consists of three villages of Bera upazilla of Pubna district namely Kharbagan, Hatalaralia and Charsabolla. A preformed questioner was developed to study the prevalence and farming practices shown in Table 1. California Mastitis Test (CMT) was performed in three parameters (weak, distinct and strong) healthy cows to study the prevalence. Commercial anti-mastitis preparation, vit-E and selenium supplementation was given to CMT positive cows (Data not shown). The survey and drug trial data was analyzed by SPSS 20.0 statistical package program.

Table1. Farming practice in the study area

Parameter	Homestead	Farm	Bathan	% adoption of the good practice
No. of cows	42 (18 farms)	45 (6 farms)	34 (3 farms)	-
Barn type Free	Open stall-tethered	In house-tethered	Open stall-natural Free	-
Floor type	Muddy & unclean	Watery & unclean	Muddy & unclean	0
Milking	At the barn	At the barn	At the barn	0
Milking machine	Not used	Not used	Not used	0
Feeding	Before milking	Before milking	Before milking	0
Post milking teat-dipping	No	No	No	0
Dry cow therapy	No	No	No	0
Periodic use of CMT	No	No	No	0
Post-milking udder massage	No	No	No	0
Milking interval (hours)	Not fixed, 9-12	Not fixed, 11-13	Not fixed, 9-12	-

The study shows that prevalence of different types of SCM varied significantly ($p < 0.001$) within the two genotypes of cattle and in their quarter (Table 2) while the difference was non-significant ($p > 0.05$) between the two genotypes (59.61% in Pabna and 53.96% in crossbreds). Although clinical mastitis was absent in Pabna cattle but SCM was present in higher percentage. Many researchers shows the beneficial effect of vitE (E-sel gold) in treating subclinical mastitis. So we use a combination of the both to treat the condition and found them to be satisfactorily positive.

Table 2. Prevalence and severity of subclinical mastitis in lactating cows

Genotype	Types	No. tested	Positive No. (%)				Negative No. (%)	Level of sig.
			Weak	Distinct	Strong	Total		
Pabna	Cows	52	14 (26.9)	4 (7.7)	13 (25)	31 (59.6)	21 (40.4)	***
	Quarters	208	48 (23.1)	20 (9.6)	19 (9.13)	87 (41.8)	121(58.2)	***
Cross	Cows	63	6 (9.5)	10 (15.9)	18 (28.57)	34 (53.9)	29 (46.0)	***
	Quarters	252	36 (14.3)	30 (11.9)	28 (11.11)	94 (37.3)	158 (62.7)	***
Overall	Pabna	52	14 (26.9)	4 (7.7)	13 (25)	31 (59.6)	21 (40.4)	NS
	Cross	63	6 (9.5)	10 (15.9)	18 (28.57)	34 (53.9)	29 (46.0)	

Anti-mastitic drugs can successfully reduce the severity of SCM in lactating cows. In 11 identified cows with different severity of SCM we used a commercial anti-mastitic drug (Masticare^{R}, Square, Dhaka, Bangladesh). The recommended dose (30 gm/cow/day) for 7 days was effective and 9 days treatment made all the cows negative for CMT. All the animals were negative for CMT for the next three months. In the community we conduct campaign and training for hygienic milking, udder health management and general healthcare to reduce the SCM. But after one year we found 57.65% CMT positive cows in the community.

In this study period, clinical mastitis was absent in the NBH and scanty in the community which should be investigated further.

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

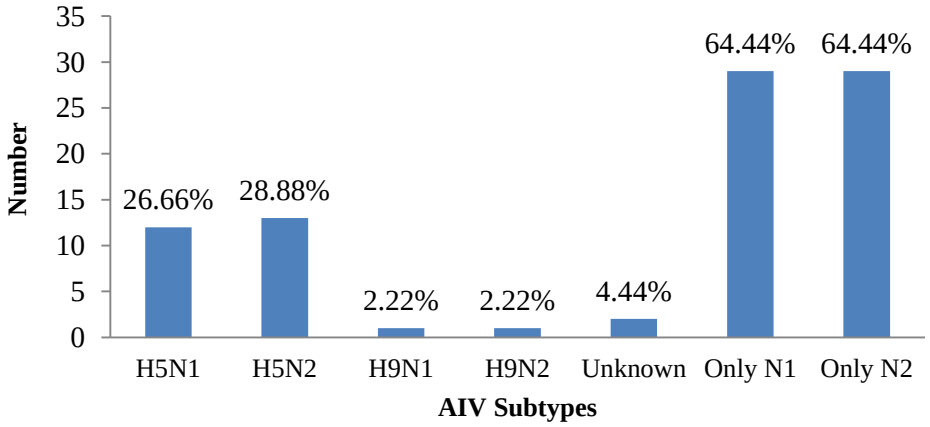
M Giasuddin, MA Samad, MZ Ali, MR Karim and M Hasan

National Reference Laboratory for Avian Influenza, Animal Health Research Division, Bangladesh Livestock Research Division, Savar, Dhaka 1341, Bangladesh.

Executive summary

Influenza A viruses, belonging to the orthomyxoviridae family, are negative single-stranded RNA viruses with an eightfold segmented genome. Among at least eleven proteins encoded by this genome, the Haemagglutinin (HA) and Neuraminidase (NA) are of utmost importance in terms of immunogenicity and induction of protective immunity following vaccination. There exist 16 different types of HA and 9 of NA, antigenically distinguishable protein subtype, thus theoretically giving rise to 144 combinations. Influenza viruses are known to undergo a process called antigenic drift, whereby they continuously change their antigenic properties by accumulating non-synonymous point mutations in the HA and NA encoding gene segments. The absence of proof-reading and post-replicative repair mechanisms characteristic of the RNA polymerase complex of these viruses is, in addition to external selection pressure, an important factor of antigenic drift. The most important outcomes of antigenic drift may be an increased ability of the virus to avoid naturally acquired or vaccine induced host immunity, as well as a possibility of breaching host-range barriers. Both the HA and the NA proteins are involved in the process of antigenic drift with the HA implicated much more, since it is the main target of neutralizing antibodies and is known to accumulate many point mutations in its epitopes or antibody binding regions.

The main objectives of this study were to detect and isolate the highly pathogenic serotypes (H5N1, H5N6, H5N2, H5N8, and H9N2) at farm level. A total of 582 samples including 562 (swab), 20 (trachea) were collected from different small and medium poultry farms in different areas of Gazipur and Dhamrai. Immediately after collection, the samples was transferred to the National Reference Laboratory for Avian Influenza (NRL-AI) and all the samples were processed for genome extraction by using MagMax AIV/ND RNA extraction kit according to manufacturer protocol and tested for M (matrix) gene to confirm influenza A. Then the positive samples were undertaken for further screening for H5, H9, N1, N2, N6 and N8 subtypes using the Australian Animal Health laboratories (AAHL) protocols which is an OIE reference laboratory. Among the 582 samples, 45 samples (7.73%) were positive for AIV type A. Out of 45 AIV type A positive samples H5N1, H5N2, H9N1, and H9N2 were found 26.66% (12/45), 28.88% (13/45), 2.22% (1/45), 2.22% (1/45) respectively. Considering subtypes only N1 and N2 was 64.44% (29/45) and 64.44% (29/45) respectively. The unknown subtypes were 4.44% (2/45). All positive samples were stored for further molecular characterization which will be done in coming financial year. From the above observation we could concluded avian influenza are still circulating in the poultry of selected areas and this study will contribute to control and eradicate avian influenza to achieve SDG goal 2.



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

MA Samad[1], MA Yousuf[1], M Nazia[2], ME Chowdhury[3] and M Giasuddin[2]

[1]SAARC Regional Leading Diagnostic Laboratory for PPR, [2]Animal Health Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka, [2] Professor, Department of Pathology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh2202, Bangladesh.

Executive summary

Peste des Petits Ruminants (PPR) is a highly fatal viral disease of goats and sheep which is characterized by high fever, depression, oro-nasal secretion, respiratory distress, diarrhea, high morbidity and mortality in small ruminants. In Bangladesh, this disease was first identified in the year 1993. Since then, PPR is endemic all over the country causing huge economic loss. To control PPR in Bangladesh, a live attenuated conventional PPR vaccine was developed by Animal Health Research Division of Bangladesh Livestock Research Institute (BLRI) in 2000 and successfully used in the country. Control of economic diseases such as PPR will increase the national productivity of the small ruminants and reduce poverty among poor farmers. Although sporadic vaccination against PPR has been practiced all over the country for a long period, no specific strategic plan was followed. The OIE and FAO developed a strategic plan under the title "Global strategy for the control and eradication of PPR", targeting to eradicate PPR from the globe at 2030. To control this disease, proper monitoring of this virus is necessary. To ensure the efficacy of mass vaccination against PPR, a current project was undertaken with the aim of monitoring the PPR control strategy in Bangladesh through determining the level of conferred immunity in vaccinated flocks and conducting surveillance of PPR and PPR like diseases to reduce the misperception concerning PPR.

Sero-surveillance was conducted throughout the region of PPR mass vaccination. A total of 185 villages were surveyed under four Upazila of the southern part of the country where mass vaccination was done. The geographic locations of sampling household were recorded by GPS method during sampling. Blood sera was collected randomly from vaccinated goat/sheep flocks and tested with cELISA kit to assess the titer levels. A total of 1794 sera were collected and tested by cELISA method to assess the antibody levels. Among them, 83.70% immunity at 48 months of post vaccination in Jichergacha upazilla of Jossore district. Whereas, at 3 months of post vaccination the immunity level was 93.70% in Jibannagar, 64% in Debhata, 78% in Damurhuda and 75% in Meherpur Sadar upazilla. The overall herd immunity level in vaccinated animal was 80%, nonetheless 28% of positive antibody found in control villages. The duration of immunity level in Jikorgacha Upazila of Jessore district was revealed to be lifelong even at 48 months of post vaccination against the PPR virus.

During outbreak investigation, a total of 25 nasal swabs samples were collected along with related epidemiological and economic impacts information using pretested questionnaire. In molecular diagnosis, 80% (25/20) samples were found positive for PPR in RT-PCR. Epidemiologically, PPR and some other non-specific diseases were recorded in the selected areas. New entry of goats into the household or village is one of the most important risk factors for PPR virus circulation and several outbreaks were recorded in control villages. Morbidity and case fatality rates were 14% and 70.55% respectively during outbreaks. There was no outbreak of PPR in the mass vaccinated villages, and only one goat died that was purchased from local market and new entry. As for sick goats, about 82% received treatment, 13% were sold and 5% were slaughtered. The 93% of dead goats were buried under soil. To sum, it can be concluded that this study will be helpful for the PPR eradication program aiming at 2030, to achieve the SDG goal 2.

Seroprevalence of Tick Borne Blood Protozoan Diseases of Cattle and sheep and Standardization of BLRI Developed TBDs Autogenous Killed Vaccine

MZ Hassan[*1], M Giasuddin[1], M Hasan[1], MM Rahman[3], MA Yousuf[1], M Z Ali[1], S Akhter[2], MH Rahman[2], M Ershaduzzaman[3] and MAHNA Khan[4]

[1]Animal Health Research Division, [2]Goat and Sheep Production Research Division, [3]Sheep Development Project, BLRI, Savar, Dhaka, [4]Dept. of Pathology, Bangladesh Agricultural University, Mymensingh 2202. Bangladesh. [*]Correspondence at zakir.vet@blri.gov.bd

Executive summary

Babesiosis, Anaplasmosis, and Theileriosis (TBDs) are the silent killer intra cellular (RBC) blood protozoan diseases in the animal. It is usually known as tick borne blood protozoan diseases (TBDs). The TBDs are life-threatening disease in the exotic and high yielding animal in tropical and subtropical countries including Bangladesh. They are transmitted through tick bites usually Ixodes. In 2018, there were 10 exotic sheep were died within a week in BLRI main sheep farm. During the outbreaks the sheep was showing the clinical signs like TBDs, notably high fever (105-107^{0}F), complete off feeding, respiratory distress, continual panting, rapid breathing, diarrhea, sometimes bloody diarrhea and coffee color urine and could not show positive response to practice line of treatment. To check this crisis period an experimental autogenous killed blood protozoan vaccine (BPV) was prepared for the purpose of seroprevalence and efficacy trial of experimental autogenous blood protozoan killed vaccine (BPV) in exotic sheep.

However, a total number of 525 blood samples were collected from cattle (480) and sheep (45) for Giemsa's stain blood smear microscopy in Parasitology laboratory, BLRI. The selected exotic sheep breed was Dhamara, Dorper, Parendale at different age and sex. Molecular detection of blood protozoa was done by multiplex PCR in the blood of suspected sheep breed. The primer sequences and PCR conditions were designed according to Bilgic *et al.* (2017) and Bilgic *et al.* (2013) for *Babesia ovis*, *Babesia motasi*, *Anaplasma marginale* and *Theileria annulata* (Table 1). After that, the PCR confirmed blood samples were selected for experimental autogenous BPV preparation. The isolation of blood protozoa were done through lysis of RBC by ammonium chloride and killing the protozoan fragment through heat treatment. The TBDs killed vaccine was containing blood protozoan fragment @ 1×10^6 per ml of vaccine seed. This vaccine seed was mixed with oil adjuvant at the ratio of 1:1000 and selected for vaccination in the exotic sheep. During the experimental period, the vaccine was introduced @3ml containing 3×10^3 fragments of antigen subcutaneously in the infected sheep. After vaccination, randomly selected serum samples were collected at 30 days interval six times. However, the antibody titer was detected and monitored by using commercially available c-ELISA, kit (VMRD, USA) against *Babesia ovis* and *Anaplasma margenale*.

Table1. Primer sequence of *Babesia*, *Anaplasma* and *Theileria* spp in sheep for multiplex PCR

SL No.	Primers Name	Sequence (5'-3')	Amplicon size	References
01	B. Ovis F1	[CCTGGGTAATGGTTAATAGGAACGG]	422bp	Bilgic et al., 2017
02	B. Ovis R1	[GCAGGTTAAGGTCTCGTTCGTTAAC]	422 bp	
03	B. Motasi F1	[CTCTGGTACAATATGCATTGC]	518 bp	
04	B. Motasi R1	[CTGGTTCCCAGATATGGTAGC]	518bp	
05	A. Ovis F1	[CAGCCAGGCACTCTGCACCAC]	265bp	
06	A. Ovis R1	[CAACAATTGATGTGAGTGCGC]	265bp	
07	A. Margin F1	[GCTCTAGCAGGTTATGCGTC]	265bp	Bilgic et al., 2013
08	A. Margin R1	[CTGCTTGGGAGAATGCACCT]	265 bp	
09	T. Anulata F	[ACTTTGGCCGTAATGTTAAAC]	312 bp	
10	T. Anulata R	[CTCTGGACCAACTGTTTGG]	312 bp	

In blood smear microscopy, the overall prevalence of TBDs was 68% (n=357) in cattle and 100% (n=45) in sheep. Among the positive sample in sheep, the prevalence of *Anaplasma* spp. was 33%, *Babesia* spp. 24%, *Anaplasma* + *Babesia* spp. 29%, *Theileria* spp 11%, and *Anaplasma* + *Babesia* + *Theileria* spp were detected 4%. In multiplex PCR, among 15 blood sample (sheep), the prevalence of *Anaplasma marginale*, *Anaplasma ovis*, *Babesia motasi*, *Babesia ovis* and *Theileria annulata* were

33.33% (n=5), 13.33% , 26.67% (n=4), 13.33% (n=2), 13.33% (n=2) respectively. During this experimental period, no clinical outbreaks were found and animal deaths were checked. Moreover, routine blood microscopy was done every month where the prevalence of blood protozoa reduced significantly. In conclusion, it can be stated that the exotic sheep was highly susceptible to TBDs. The developed blood protozoan autogenous killed vaccine (BPV) can give the protection of exotic sheep, even during clinical outbreaks. However, the efficacy of the vaccine was monitored properly and standardization of vaccine required further study.

Prevalence of different dairy cattle diseases in selected dairy areas and farms of Bangladesh

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Executive summary

The present study was designed to have a comprehensive epidemiological data of the circulating diseases in the Nucleus breeding herd (NBH) and the community of Dairy Development Project of BLRI. The NBH is located in the BLRI-RS, Baghabari and the community consists of three villages of Bera upazila of Pabna district namely Kharbagan, Hatalaralia and Charsabolla. The cattle population was 546 (441 in the community and 105 in the NBH). A total of 1250 clinical cases of cattle of different breed and sex were diagnosed during the period from July 2018 to June 2019. The handling of animals in the study was performed in accordance with current Bangladesh legislation (Cruelty to Animals Act 1920, Act No. I of 1920 of the Government of the People's Republic of Bangladesh). Diagnosis of diseases was made by general physical examination of animals, clinical signs, gross pathology and laboratory procedures. In some cases, confirmatory diagnosis was made by cultural and biochemical test of causative organisms following standard procedure. Parasitic infestations were diagnosed by faeces examination under microscope (Soulsby, 1986). Blood smears were prepared and examined under microscope after Giemsa's staining.

The prevalence of endo-parasites, bovine ephemeral, foot rot, nonspecific diarrhea and postpartum anoestrus were higher among the parasitic, viral, bacterial, digestive disorder, reproductive disorder respectively. In case of other diseases, there were not any significant difference between on station and community. Nonetheless, in paired t-test, there is no significant difference in the pattern of diseases. The descriptive statistics suggested that Endo-parasites (10.56 %), Bovine Ephemeral Fever (10.97%), Non-specific Diarrhea (10.51 %) and Post-partum anoestrus (8.43 %) are the most prevailing diseases in the community and Foot-rot (26.82%), Maggot infestation (14.06%), Endo-parasites (9.38%), UTIs (9.12%) and Hump sore (3.65%) are the most prevailing diseases in the NBH.

Table 1. Comparative prevalence of different dairy cattle diseases between community and the Nucleus breeding herd

Disease category	Name of the disease	No. of identified cases		Prevalence% by cases		t- test	prevalence % by population		t-test
		Community	On station	Community	On station		Community	On station	
Parasitic	Blood protozoa	11	2	1.27	0.52	0.76	2.49	1.90	0.39
	End-parasite	116	36	10.56	9.38		20.73	34.29	
	Hump sore	2	14	0.23	3.65		0.45	13.33	
	Ectoparasite	27	4	3.12	1.04		6.12	3.81	
	Maggot	25	54	2.89	14.06		5.67	51.43	
Viral	FMD	16	0	1.85	0	0.23	3.63	0	0.49
	Ephemeral fever	85	6	10.97	1.56		21.59	5.71	
	Wart	7	1	0.81	0.26		1.59	0.95	
	Rabies	1	0	0.12	0		0.23	0	
Bacterial	Anthrax	1	0	0.12	0	0.47	0.23	0	0.35
	HS	33	0	3.81	0		7.48	0	
	Dermatophilosis	12	9	1.39	2.34		2.72	8.57	
	Conjunctivitis	14	8	1.62	2.08		3.17	7.62	
	Pneumonia	13	0	1.50	0		2.95	0	
	Mastitis	17	2	1.96	0.52		3.85	1.90	
	BQ	4	0	0.46	0		0.91	0	
	Tetanus	1	0	0.12	0		0.23	0	
	Foot rot	5	103	0.58	26.82		1.13	98.10	
	Arthritis	6	1	0.69	0.26		1.36	0.95	
	Anorexia	25	3	2.89	0.78	0.10	5.67	2.86	0.17
	Ruminal acidosis	20	0	2.31	0		4.54	0	
Digestive	Constipation	3	3	0.35	0.78		0.68	2.86	
	Simple indigestion	5	0	0.58	0		1.13	0	
	Non specific Diarrhea	91	5	10.51	1.30		20.63	4.76	
	Blot	25	0	2.89	0		5.67	0	
Metabolic	Milk fever	10	0	1.15	0	0.34	2.27	0	0.78
	Grass tetany	3	0	0.35	0		0.68	0	
	Weak calf syndrome	15	5	1.73	1.30		3.40	4.76	
Reproductive	Retained Placenta	1	9	0.12	2.34	0.95	0.23	8.57	0.53
	UTIs	3	35	0.35	9.12		0.68	33.33	
	Repeat breeding	23	1	2.66	0.26		5.22	0.95	
	Post-partum anoestrus	73	2	8.43	0.52		16.55	1.90	
	Prolapse	1	1	0.12	0.26		0.23	0.95	
Surgical	Abscess	2	1	0.23	0.26	0.47	0.45	0.95	0.22
	Naval-ill	5	2	0.58	0.52		1.13	1.90	
	UPF	0	4	0.00	1.04		0.00	3.81	
	Hernia	2	0	0.23	0		0.45	0	

Test-day and adjusted full lactation yield of local Pabna cows in Bangladesh

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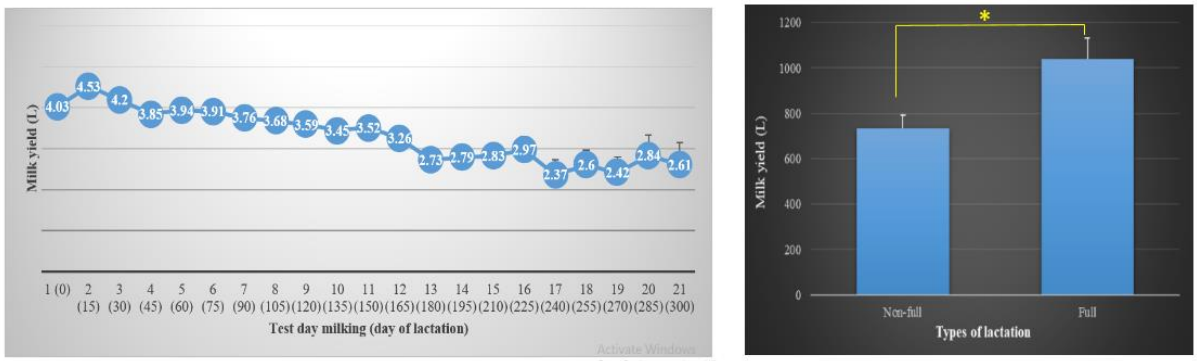
Executive summary

The local Pabna cows are more promising among the native cattle varieties in Bangladesh. The study was designed to reveal the test-day milk yield and identify the adjusted factors to convert morning to evening milking for calculating full lactation yield. Data of 320 test-day milking (15 days' interval started from 6th day after parturition) were collected from 21 local Pabna cows having 1-3 parity number during January, 2018 to June, 2019 (DDRP-BLRI solution, SourceTrace System, Massachusetts, USA). All the cows were kept under similar management system with dry matter basis feeding regime (2.50% of body weight using concentrate, straw and/or green grass). Morning milking was registered for all cows but evening milking was performed 15 days' interval. Out of 21 cows, 14 cows completed their lactation period from which data of lactation period and total milk yield were collected. Adjustment factors (morning to evening) were calculated based on percentage from the 1st to 21st test days' milking and these factors were used to calculate the missing evening milking (out of test day) for 305 days full lactation yield. The average adjustment factor between two consecutive test days was multiplied within the morning milking of those respective two test days to obtain the values of evening milking. However, to assess the last five days of lactation after 300 days the adjustment factor of 21st test day was multiplied with morning milking of those days for getting the values of evening milking. Multivariate analysis using GLM under Randomized Complete Block Design (RCBD) was applied including Bonferroni *post hoc* mean separation test. One-way ANOVA of Completely Randomized Design (CRD) was also followed using Tukey'S HSD *post hoc* mean separation test to analyze the lactation length and lactation yield.

The effect of dam parity, calving season and lactation stages showed significant differences (p<0.05) on test-day milking (Figure 1) after fifth day of calving (Table 1). It was observed that cows of third parity (4.06±0.33 L), calving in Summer (3.74±0.16 L) and first stage of lactation during 0-105 days of lactation (4.00±0.13 L) produced more milk than others. However, calves having birth weight above 22 kg (4.17±0.17 L) and dams' body weight above 275 kg (3.93±0.15 L) had significant effect (p<0.05) on higher milk yield. These data suggested the selection criteria to identify elite local cows based on parity and weight of dam, lactation stage, calving season and calves' birth weight. Adjustment factors for morning to evening milking revealed that higher and lower values observed at first (0.51) and 21st (0.39) test day milking, respectively. The second parity of dam (3.22±0.02 L), calving at Summer (3.17±0.02 L) and 0-105th days of milking stage (3.53±0.03 L) also indicated higher milk production (p<0.05) based on adjusted overall lactation period. The average lactation length and milk yield of Pabna cows in full lactation observed 252 days and 800 L, respectively. Based on 305 days of lactation (Figure 1), the cows covered full lactation provided statistically (p<0.05) higher milk (1037.67±94.68 L) than those cows (734.91±57.95 L) having lower lactating days. The cows had lengthy lactation period and higher average production would be suitable for nucleus breeding herd.



a b

Figure 1. Milk yield up to 300 days of lactation (a) including types (b) in local Pabna cows

Table 1. Effect of dam parity, calving season and lactation stages on milk yield of local Pabna cows

Variable	n	Milk yield (L)		Minimum	Maximum	P value
		LSM	SE			
Parity						
1st	50	2.72[b]	0.18	0.64	7.40	0.000
2nd	258	3.54[a]	0.08	0.78	9.10	
3rd	12	4.06[a]	0.33	2.60	6.60	
Calving season						
Summer	68	3.74[a]	0.16	1.76	6.20	0.001
Rainy	56	3.39[abc]	0.25	1.44	5.51	
Autumn	51	3.08[abc]	0.18	1.27	4.77	
Late autumn	42	2.50[c]	0.25	0.64	7.84	
Winter	51	3.55[ab]	0.19	0.78	9.10	
Spring	52	3.63[ab]	0.16	1.42	7.40	
Lactation stage						
0-105th day	147	4.00[a]	0.13	1.41	9.10	0.000
106th -210th day	116	3.09[b]	0.14	1.40	5.78	
211th -305th day	57	2.48[c]	0.19	0.64	4.50	
Interactions						
Parity*Season						0.008
Season*Lactation stage						0.053
Parity*Lactation stage						0.679
Parity*Season*Lactation stage						0.071

The parity number and body weight of dam, calving season and calves' birth weight, lactation stage, and lactation length could be considered as section parameters for local Pabna cows considering total milk yield.

Development of mobile and web based data recording applications for Dairy Development Research Project

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Executive summary

Data recording is utmost important for farm management and conducting research. Except few research station or farms, data recording is not available in the dairy sector of Bangladesh, while it can be done well with the utilization of digital data recording. The key utility of such digital innovations lies in strengthening the management information system (MIS) by enabling online real-time data collection. As digitalization is one of the prime visions of the Government of Bangladesh, it can use for documentation and processing of research activities across scattered locations ranging from research stations to community villages through digital devices to bring about ease and efficiency in its operational systems. The Dairy Development Research Project (DDRP) of Bangladesh Livestock Research Institute (BLRI) looked for database software to establish a digital data recording system leading its smart dairy research initiatives. The software has been executed to input farm and community based research data via mobile (online and offline) and web.

The data recording system of DDRP-BLRI applications includes genotype based pedigree history of individual cattle with climate changing parameters (Figure 1).This software incorporated cattle and calf enrollment with cattle herd book, characterization, growth, breeding and reproduction, milking cows, dairy characteristics, semen characteristics, daily feeding, body condition and health modules (Figure 2). There are few supporting modules (weather, transaction summary, cattle list, settings, exit etc.) added with mobile's applications for facilitating enumerator works. This software enables to capture farm pictures with GPS coordinates and physical positioning on maps, in addition, input (feeding, vaccinations, deworming etc.) and output (milk yield, physio-chemical parameters of milk and semen, growth etc.) tracking. Additionally, it has been using for breed history tracking that would contribute to develop a digital cattle herd book for individual animal considering a lifetime certificate. After inputting primary data in that software, all those data can be downloaded either by excel or pdf format from report section of that applications to analyze in future.

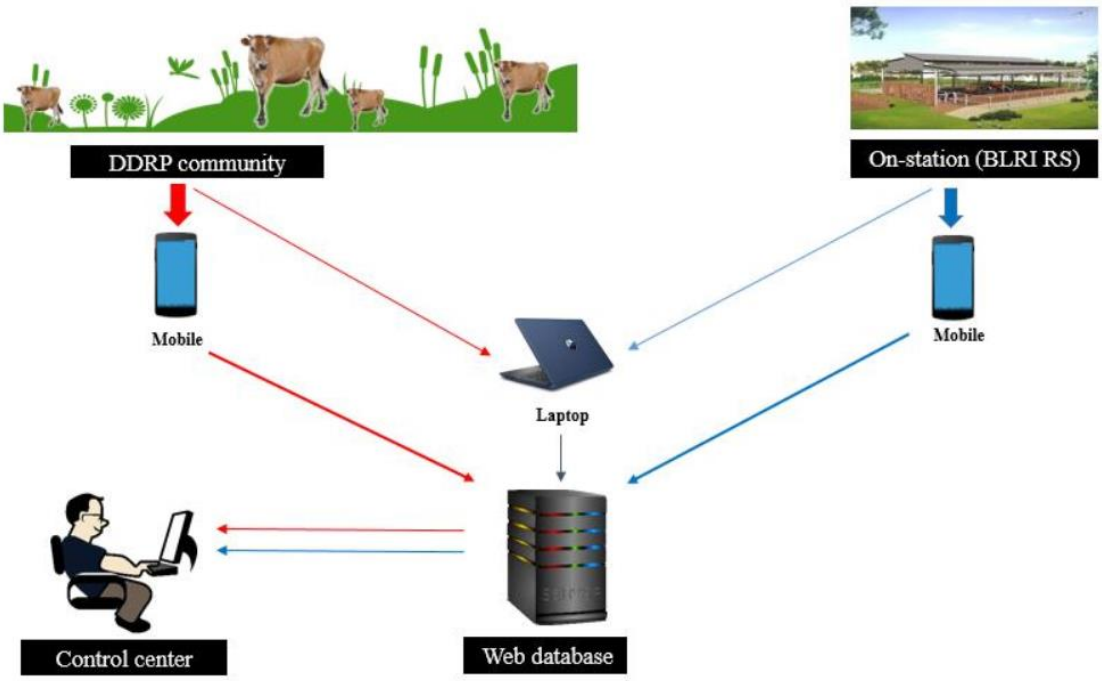
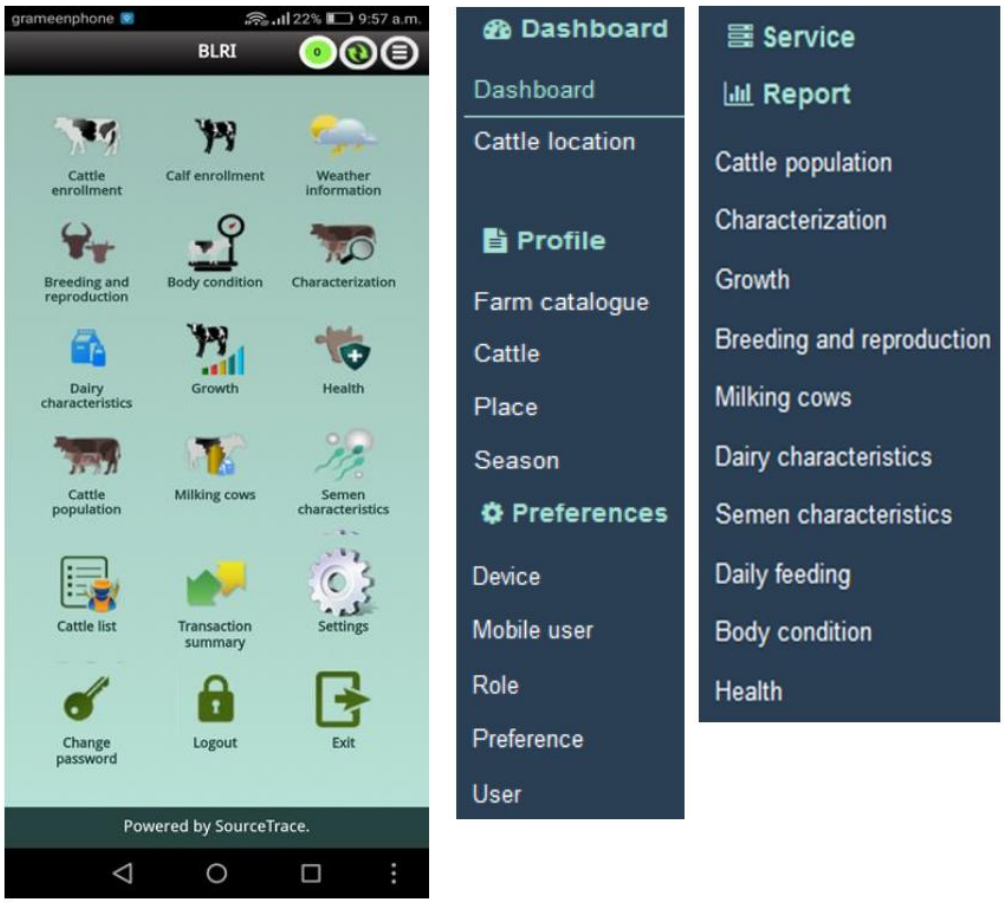


Figure 1. Data recording system using DDRP-BLRI mobile applications



a. Mobile modules b. Web modules

Figure 2. Modules of DDRP-BLRI applications

Therefore, the DDRP-BLRI applications might be considered as an ideal digitalized farming data recording software towards breed development and conservation having user friendly characteristics for simultaneous data inputting and reporting.

Conservation and improvement of native chicken: laying performance of seventh 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 laying performances of three native chicken (Non-descript Deshi, Hilly, Naked Neck) genotypes under intensive management, ii) to study the comparative performances among native and Kadaknath chickens. The selection objectives of the study were to improve the egg production and / or growth rate of Indigenous Chicken depending on the genotype (ND, H and NN) of birds. At 40-week of age, on the basis of an index comprising the age at first egg laid (AFE), body weight (BW) at 40 week, egg production (EP) up to 280 days and egg weight (EW) at 40 weeks. Egg production was recorded on 280 days. For Kadaknath (K), a total of 500 pedigree hatched day old chicks were identified individually by wing band. Egg quality was observed at 40 weeks of bird's age and blood profile was analysed. At 10 weeks of age, a total of 24 birds **(**Naked Neck, Hilly, Non-descript Deshi and Kadaknath chicken) (6 birds in each genetic group, 3 males and 3 females) were randomly selected and peripheral blood samples (2-3 ml) were obtained by wing vein puncture. Glucose, Haemoglobin, Iron content were measured on a Humalyzer 2000 chemistry (Germany) using a turbidimetric method as described by the manufacturer. The data were analyzed in CRD by General Linear Model (GLM) Univariate Procedure in SPSS Computer Program.

Hatching egg weights of ND, H and NN were 46.29, 46.68 and 46.52g; respectively. Chick weight was not affected ($p>0.05$) by genotype (Table 1). Fertility of ND, H and NN were 88.96, 87.03 and 86.67%, respectively. The highest hatchability (90.85%) was found in ND ($p<0.001$) compared to H (89.25%) and NN (83.94%) (Table 1). Egg production (20-40 weeks) number was significantly ($p<0.001$) affected by genotype. The highest egg production number of ND, H and NN were 79.08, 69.33 and 74.86, respectively. The hen-day egg production (HDEP %) of native chicken genotypes are presented in Table 1. Hen-day egg production (HDEP %) was affected ($p<0.001$) by genotype. Significantly ($p<0.05$) the lowest glucose content was found in K chicken (4.34 mMol/L) compared to H (7.34 mMol/L)), NN (5.88 mMol/L) and ND (5.76 mMol/L) (Table 2). Iron content of blood was non-significantly highest in K chicken compared to other three native chickens. Haemoglobin content of blood was non-significantly highest in H chicken. Significantly ($p<0.05$) the highest dressing yield (76.47 %) and breast meat weight (10.37 %) were observed in H genotype followed by other three genotypes.

Table 1. Performances of non-descript, naked neck and Hilly chicken genotypes under intensive rearing condition

Parameter	Genotype			Level of significance
	ND (Mean ±SE)	H (Mean ±SE)	NN (Mean ±SE)	
Hatching egg wt (g)	46.29±0.39	46.68±0.39	46.52±±0.35	NS
Chick wt (g)	31.48±0.22	31.60±0.22	30.96±0.20	NS
Fertility (%)	88.96±1.35	87.03±1.35	86.67±1.21	NS
Hatchability (%) of fertile eggs	90.85^{a}±1.32	89.25^{a}±1.32	83.94^{b}±1.19	p<0.001
EP (no.) (20-40 wks)	79.08^{a}±1.19	69.33^{c}±1.31	74.86^{b}±1.17	p<0.001
HDEP (%) (20-40 wks)	56.48^{a}±0.85	49.52^{c}±0.93	53.47^{b}±0.83	p<0.001

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

Table 2. Comparative Performances of three native and Kadaknath chicken genotypes

Parameter	Genotype				Level of significance
	K	H	NN	ND	
Glucose (mMol/L)	4.34[b]	7.34[a]	5.88[ab]	5.76[ab]	p<0.05
Iron (µg/dl)	138.00	128.20	129.80	129.80	NS
Haemoglobin (g/dl)	11.98	12.88	11.70	11.56	NS
Dressing (%)	69.40	76.47	75.19	74.67	p<0.05
Drumstick wt (g)	9.09	10.45	10.49	9.57	P<0.01
Breast meat (%)	7.84	10.37	9.55	9.08	p<0.05
.Shape Index	76.05	75.40	76.54	77.44	NS
Albumen Index	9.75[b]	11.08[ab]	11.89[a]	12.36[a]	p<0.05
Yolk Index	45.03[b]	48.09[a]	48.97[a]	48.59[a]	p<0.001
ESBS (kg/cm^2)	3.87	3.63	4.21	3.35	NS
Haugh Unit	84.83[b]	89.71[a]	91.03[a]	92.91[a]	p<0.01

K=Kadaknath, ND=Non-descript Deshi; H=Hilly; NN=Naked Neck; ESBS=Egg Shell Breaking Strength; least squares means without a common superscript along the row within a factor differed significantly (p<0.05), NS=Non-significance

The qualities of the eggs collected from different chickens genotypes kept under intensive rearing system are presented in Table 2. There were non-significant (p>0.05) differences in shape index among the genotypes. Non-significant (p>0.05) variation was found in breaking strength. The internal quality trait such as Haugh unit was significantly (p<0.01) affected by genotype. Non-descript Deshi was superior for egg production, fertility and hatchability traits. No extra ordinary result was found in case of Kadaknath chicken.

Conservation and improvement of exotic germplasms and development of egg and meat type chicken

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Executive summary

In recent years, climates are changing in Bangladesh. Therefore, summers becoming hotter; monsoon irregular, untimely rainfall directly affects bird performance. Keeping those issues in mind, BLRI has developed multi color table chicken (MCTC) for meat production using native germplasms which has mixed feather color like native chicken. Therefore, to know the performance and adaptabilities of MCTC, several experiments were conducted from 2016-2019. In consecutive four on station trials results, day old chick's weight ranges from 37-40 g, body weight at 8 wks: 950-1000 g, feed intake: 2200-2300 g, FCR: 2.2-2.3 and mortality was found 1-1.5 %. Therefore, the present research program was undertaken to address two activities. Activity 1: a total of 600 day old chicks were allotted in 30 pens (20 chicks per pen) to know the performance and carcass characteristics. The birds were feed with the starter (1-21 d), grower (22-35 d) and finisher (36-56 d) diet. Body weight (BW), weight gain (WG), feed intakes (FI) and feed conversion ratio (FCR) were measured weekly. In results, the average day-old weight was found 39.46 grams. During 0-56 days, average BW, WG, FI and FCR were found 985.65 g, 945.35 g, 2199.23 g and 2.326 respectively. Average mortality was found 1.36 %. Activity 2: a total of 12000 day old chicks of MCTC were distributed to 12 different district of the country to validate the growth performance, adaptability and benefit cost ratio under farmer's existing condition. All data were analyzed by SAS and differences were determined by Duncan Multiple Range Test.

Table 1. Performance of MCTC under on station condition

Parameter	On station trial				Average	SEM	P value
	Exp 1	Exp 2	Exp 3	Exp 4			
Day old chicks weight (g)	38.83	37.76	39.43	38.436	38.61	0.512	0.718
Body weight (g) at 8 weeks	985.12	930.60	980.50	960.35	964.15	32.17	0.125
Weight gain (g)	946.29	892.84	941.07	921.91	925.53	31.45	0.148
Feed intake (g)	2338.28	2190.30	2234.27	2223.64	2221.63	56.90	0.423
FCR	2.471	2.453	2.374	2.412	2.427	0.094	0.294
Mortality (%)	1.50	2.10	1.90	2.20	1.93	0.002	0.872
Dressing % (with viscera)	71.22	73.58	72.99	71.86	72.41	0.743	0.736
Cooking loss (%) of meat	15.17	15.32	14.63	14.82	14.98	1.867	0.324
Meat pH	5.74	5.88	5.86	5.84	5.83	0.041	0.997

During on station trials no differences ($P>0.05$) were observed for studied parameters (Table 1). Day old chick's weight was varied from 37 to 39 gram. At 8 weeks of age, average body weight was found 900-1050 g (male 1050-1200g and female 800-950 g). At 7 weeks of age, average body weight was found 750-820 g by feeding of 1600-1700 g per bird. During 0-8 weeks rearing, average mortality was found 1-2 % among the experiment.

During on farm experiments, growth performance was found significantly higher in Rajbari and lower in Rangpur region (Table 2). Therefore, better FCR was found in Rajbari which might be due to the variations in season, housing and management system. In economic evaluation, the average total cost and gross return were found 145935.97 and 185744.10 taka respectively. Therefore, the average net returns were found 39809.04 taka within 8 weeks rearing of 1000 MCTC chicken. So, the input output ratio was found 1:1.274.

Table 2. Comparative performances of MCTC chicken under on farm condition (0-56 d)

Location	Bird no.	Parameters					
		DOC weight (g)	Body weight (g)	Weight gain (g)	Feed intake (g)	FCR	Mortality (%)
Khulna	1000	37.49	950.31^{ab}	912.82^{ab}	2250.21	2.464^{a}	1.69
Barisal	1100	38.15	1020.54^{a}	982.39^{a}	2190.54	2.229^{ab}	1.38
Pabna	500	37.08	920.18^{ab}	883.10^{ab}	2210.63	2.503^{a}	2.10
Rajbari	900	41.01	1040.00^{a}	998.99^{a}	2027.52	2.029^{b}	0.96
Manikgonj	1500	37.91	963.00^{ab}	925.09^{ab}	2280.68	2.465^{a}	3.68
Comilla	1000	37.68	972.58^{ab}	934.90^{ab}	2310.05	2.471^{a}	2.94
Rangpur	940	36.92	895.63^{b}	858.71^{b}	2190.29	2.551^{a}	4.21
Gazipur	980	38.36	940.50^{ab}	902.14^{ab}	2240.61	2.483^{a}	1.72
Dhaka	1500	37.21	965.02^{ab}	927.81^{ab}	2160.73	2.328^{ab}	2.64
Norsingdi	1250	38.00	925.00^{ab}	887.02^{ab}	2210.81	2.492^{a}	3.23
Narayangonj	800	38.54	958.00^{ab}	919.46^{ab}	2170.28	2.360^{a}	1.89
Noakhali	540	37.84	960.30^{ab}	922.46^{ab}	2315.34	2.509^{a}	3.49
SEM		0.482	38.29	37.43	63.84	0.073	0.271
P value		0.137	0.023	0.027	0.384	0.032	0.078

The performance of chicks at different locations signifies its acclimatization in local environment. Based on the on station and on farm trials, results indicated that production performance of MCTC is consistent, adaptable and profitable under farmer's condition.

Conservation and improvement of Quail: Performance of eighth 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 objectives i) to increase the sixth week body weight of Dhakai and BB (BLRI, BAU) white quail through selective breeding, ii) to select parental birds (males and females) and breed them in an assortative plan for the production of 8th generation birds. The parent males and females were maintained in cages for single pair mating through selective breeding systems produce successive generation. Pedigree records are being kept by using commercially available leg bands to identify quail of all ages. For producing eighth generation (G_8), parent quails of each genotype were selected from the seventh generation (G_7) 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 1118-day-old quail chicks comprising of 4 types of quail namely White (W-681), Black (Bl-193), Brown (Br-84), Dhakai (D-160) were hatched in one batch to produce eighth generation (G_8)**.**The diet containing 24% crude protein and 3000kcal ME/kg were provided to the birds at laying period. Data on egg weight, hatchability, body weight of chick at first day, 2nd week, 4th week, 5th week and 6th week of age, feed intake, mortality and egg production were recorded to study their productive and reproductive performance. Collected data were analyzed in a CRD by General Linear Model Univariate Procedure using SPSS Software version 11.5. The expected genetic progress due to selection for 5thweek body weight was estimated for G_8 using the following equation;$R = h^2 \times S$; where, R = Expected response, h^2 = heritability for 6th week body weight and S = selection differential for the selected males and females.

The genotype had significant ($p<0.001$) effect on the body weight of quails at 5th week of age (Table 1). Body weights at5th week were132.34±0.8, 123.91±0.5, 104.29±0.7 and 105.36±0.6g, respectively for D, W, Br and Bl genotypes. The hatchability rate was significantly ($p<0.001$) higher in D (78.47%) compared to other three genotypes of quail (Table 1). The eggs production (%) up to 24th week of age was 85.27±1.0, 80.22±1.61, 81.07±1.2 and 96.12±1.1, respectively for D, W, Br and Bl and significantly ($p<0.001$) differed among all genotypes. Mortality among 4 genotypes did not differ ($p>0.05$).

Table 1. Productive and reproductive performance of four quail genotypes

Parameter	Genotype (Mean±SE)				Level of sig.
	Dhakai	White	Brown	Black	
5th week body weight (g)	132.34^{a}±0.8	123.91^{b}±0.5	104.29^{c}±0.7	105.36^{c}±0.6	p<0.001
Hatchability on setting eggs (%)	78.47^{a}±1.3	77.32^{a}±1.0	69.21^{b}±1.3	75.15^{a}±1.2	p<0.001
Feed intake(g/b/d) (6-24 wks)	19.11±1.05	18.54±1.1.0	17.31±1.04	18.05±1.11	NS
Egg production (%) (6-24 wks)	85.27^{b}±1.0	80.22^{c}±1.61	81.07^{c}±1.2	96.12^{a}±1.1	p<0.001
Mortality (%)	3.28±0.16	2.58±0.23	3.11±0.11	2.41±0.13	NS

Least squares means without a common superscript along the row within a factor differed significantly ($p<0.001$), NS=Non-significance; wks: weeks

Table 2 showed that 6th week body weight of males of D, W, Br and Bl quails were expected to increase by 4.06, 6.36, 2.39 and 3.12 g, respectively. While in females of D, W, Br and Bl quails, the expected responses were 5.60, 3.61, 4.17 and 3.91g, respectively. Based on the performance Dhakai quail was superior for body weight and Black quail for egg production. These findings suggested for continuing the quail breeding research for producing a suitable meat type quail genotype in our country.

Table 2. Selection response for 6 weeks body weight (g) in eighth generation (G8)

Genotype	Sex	Before selection		After selection		Selection Differential (S) (g)	Heritability (h^2)	Expected response to selection (R)
		No.	Aver.	No.	Aver.			
Dhakai	M	95	152.9	40	162.3	9.40	0.432	4.06
	F	100	165.98	40	180.3	14.32	0.391	5.60
White	M	200	135.6	120	148.8	13.20	0.482	6.36
	F	201	152.9	120	160.5	7.60	0.476	3.61
Brown	M	175	130.5	120	135.8	5.30	0.451	2.39
	F	180	135.7	120	144.9	9.2	0.454	4.17
Black	M	102	128.9	40	136.7	7.8	0.401	3.12
	F	92	136.8	40	145.4	8.6	0.455	3.91

Conservation and improvement of native duck and geese genotypes; Laying performances of 5th generation of BLRI improved duck genotypes

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Executive summary

Improving the performance characteristics of Rupali and Nageswari duck genotypes, an individual selection program has been taken at BLRI since 2012. After improvement of fourth generations of Rupali and Nageswari ducks, laying performance of fifth generation (G_5) were studied in this year. The selection Index was used for the selection of ducks. The individuals with higher score were selected for breeding purposes. In each generation selection were practiced on the basis of age at first lay (day), body weight at first lay (g), egg production % (168-336 days) and egg weight (g). Selected male and female were mated at the maximum ratio of 1: 5 using natural mating. Adult ducks were housed in an open sided shed and diet contains 17.5% CP and 2750 Kcal ME/kg DM. The drinking water was provided *adlibitum* throughout the day. Egg production egg weight, feed intake, egg mass and FCR data were calculated. Two eggs from each duck genotypes were randomly collected at the age of 40 weeks and egg quality characteristics were evaluated. The selection intensity and 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. Selection differential, selection intensity and selection responses of Rupali and Nageswari Ducks in fifth generation (G_5)

Genotype	Traits	Before selection	After selection	Selection differential (S)	Selection intensity (i)	Heritability (h^2)	Selection responses ®
Rupali	ASM (d)	157.23	155.66	-1.57	-0.12	0.4	-1.63
	EW(g)	57.96	59.16	1.20	0.32	0.5	0.60
	BW(g)	1412.60	1452.58	39.98	0.46	0.5	19.99
	EP (%)	44.60	51.36	6.76	1.23	0.15	1.01
Nageswari	ASM (d)	152.63	150.50	-2.13	-0.13	0.4	-0.85
	EW(g)	54.28	55.06	0.78	0.23	0.5	0.39
	BW(g)	1346.58	1345.78	-0.80	-0.01	0.5	-0.40
	EP (%)	41.75	44.86	3.11	0.45	0.15	0.47

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

Table1 shows the selection criteria of fifth generation (G_5) of both duck genotypes. Selection differential of age at sexual maturity, egg weight and egg production for Rupali and Nageswari were -1.57 and -2.13; 1.2 and 0.78; 6.76 and 3.11, respectively. The intensity of selection for ASM, egg weight and egg production were -0.12 and -0.13; 0.32 and 0.23; 1.23 and 0.45 for Rupali and Nageswari duck, respectively. As a result of selection, age at sexual maturity, egg weight, and egg production were expected to improve by -1.63, 0.60, 1.01 and -0.85, 0.39, 0.47 for Rupali and Nageswari ducks, respectively. The laying and egg quality performance data of Rupali and Nageswari ducks are presented in Table2 and found that,egg mass was significantly($P<0.05$)higher in Rupali (40.24g) thanNageswari (37.55g) duck whereas, egg weight was not significantly ($p>0.05$) differ in both genotypes. Egg production in Rupali and Nagesswari duck was 59.93% and 57.46%, respectively. Rupali ducks were significantly ($p<0.05$) consumed more feed (134.54 g) than Nagesswari ducks (126.23 g). The FCR was significantly ($p<0.05$) better in Rupali (3.34) than Nageswari (3.61) ducks.The egg quality results showed that egg shell thickness of Rupal iduck was significantly ($p<0.05$) higher than Nageswari. Higher values for albumen width (65.03) was also found in Rupali than Nageswari($P<0.05$) duck.On the other hand shape index, albumen index, yolk index and haugh unit were not found significantly different in both genotypes.

Table 2. Production and egg quality performanceof Rupali and Nageswari ducks in fifth generation (G_5)

Parameters	Rupali	Nageswari	SEM	P value
EP%	59.93	57.46	0.918	0.117
EW (g)	67.12	65.40	0.572	0.103
EM (g/d)	40.24	37.55	0.363	0.042
FI(g/d)	134.54	126.23	0.398	0.039
FCR	3.34	3.61	0.384	0.043
Egg weight (g)	66.93	63.68	1.227	0.216
Albumen length (mm)	88.44	86.28	1.200	0.429
Albumen width (mm)	65.03	59.11	1.572	0.035
Shell thickness (mm)	0.51	0.44	0.015	0.0001
Shape index (%)	78.36	75.56	0.833	0.085
Albumen index (%)	11.05	11.76	0.351	0.369
Yolk index (%)	38.89	39.93	0.339	0.136
Haugh unit	90.17	90.85	0.587	0.620

EP= Egg Production, EM= Egg mass, EW= Egg weight, FI= Feed intake, FCR= Feed conversion ratio

These findings revealed that among the native duck genotypes Rupal duck was better in terms of egg weight, egg mass and egg production. But Nageswari genotype was also found reaching maturity earlier than Rupali genotype and this findings give us more attention for continuing the duck breeding research for developing suitable egg type native duck genotypes in Bangladesh.

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

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Executive summary

Goat is one of the potential livestock species which 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, improve and evaluate the performance of Black Bengal goat through selective breeding and ii) To reveal the factors affecting kid mortality. 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. Kid mortality rate was calculated by data recorded from the period of September, 2017 to August, 2019. The following general linear model was used to estimate the effect of different factors on mortality rate of kid, $Yijklmn = \mu + B_i + G_j + T_k + S_l + V_m + e_{ijklmn}$. Where, μ = Overall population mean for any of the said traits, B_i = Effect of i'th parity, G_j = Effect of j'th birth type, T_k = Effect of k'th sex, S_l = Effect of l'th birth weight,V_m = Effect of m'th birth season and e_{ijklm} = Random residual error associated with Y_{ijklmn} observation.

The average prolificacy birth weight, 3 months body weight and 6 months body weight were 2.12±0.03, 0.28±0.02 litter, 1.15±0.02 kg, 5.73±0.10 kg and 8.59±0.18 kg, respectively. Table 1 shows higher prolificacy in generation 1 (2.29±0.06) whereas, higher 6 months body weight in generation 2 (9.32±0.58). The average kid mortality was 29.8% whereas, the kid mortality of selected Black Bengal goat was 10.33% and also affected by sex, birth weight, season, birth type and parity (table 2).

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

Generation	Average prolificacy	Birth weight (kg)	3 months body weight (kg)	6 months body weight (kg)
1	2.29±0.06 (53)	1.11±0.03 (53)	5.77±0.19 (45)	8.47±0.3 (29)
2	2.006±0.02 (25)	1.17±0.05 (25)	6.01±0.32 (24)	9.32±0.58 (20)
3	2.24±0.09 (23)	1.05±0.04 (23)	5.47±0.15 (23)	8.16±0.34 (16)
4	1.83±0.08 (13)	1.24±0.06 (13)	5.71±0.40 (9)	7.92±0.45 (8)
5	1.74±0.06 (12)	1.15±0.05 (12)	5.80±0.29 (10)	8.57±0.30 (9)
6	2.19±0.10 (14)	1.27±0.06 (14)	5.69±0.26 (14)	9.01±0.44 (7)
7	2.00 (3)	1.13±0.03 (3)	4.75±1.45 (2)	7.45±1.65 (2)
Sig. level	NS	NS	NS	NS

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

Table 2. Kid mortality in Black Bengal Goat (%)

Total kid mortality (%)			29.8%				
Kid mortality in Selected BBG (%)			10.33%				
Kid mortality in Non-Selected BBG (%)			19.47%				
Sex	Male	Female					
Kid mortality (%)	41.91	58.8					
Birth weight (kg)	≤1 kg BW	>1kg BW					
Kid mortality (%)	32.88	66.91					
Season	Summer	Rainy	Winter				
Kid mortality (%)	23.33	44.89	27.54				
Birth type	Single	Twin	Triplet	Quadruplet			
Kid mortality (%)	22.06	56.62	14.7	4.41			
Parity	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	$7^{th} – 9^{th}$
Kid mortality (%)	16.18	22.06	21.32	14.70	8.82	5.15	4.41

In conclusion, superior bucks and does will be selected by the individual performance score. On the other hand, the initial findings of kid mortality suggested for further research to minimize the effect of factors affecting kid mortality. Therefore, the research program should continue for the coming years to achieve the targeted goal.

Performance evaluation of F_1 progeny of different beef breeds with native cattle

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Executive summary

Bangladesh has a high dense of cattle population but low carcass yield of native cattle and to meet up the growing demand of beef in the upcoming years, crossbreeding of native cattle with suitable high yielding exotic beef sire (s) is prerequisite. Aiming at developing breeding bulls for crossing, the cows of BLRI Cattle Breed 1 (BCB-1) were inseminated with the imported frozen semen of Brahman, Simmental, Charolais or Limousine. The crossbred bulls of different assorted F_1 genotypes are being selected and their production and breeding performance are being recorded, evaluated and compared with native BCB-1. All calves were raised in an identical care and management. The supplied concentrate mixture contained 18% CP. The recorded economic traits were compared statistically in an ANOVA of a Completely Randomized Design using General Linear Model of "agricolae" package of R software (version 3.5.1). A total number of 53 F_1 crossbred progeny were produced and out of that 15 were Limousine, 14 were Simmental, 12 were Charolais and 12 were Brahman crosses.

Table 1. Effects of genotypes on live weight of F_1 progeny at different ages

Live weight (kg)	Genotype (Mean±SD)					Sig. Lev.
	Purebred BCB-1	Brahman cross	Charolais cross	Limousine cross	Simmental cross	
			Male			
At birth	18.84^{b}±3.40(5)	24.90^{a}±2.48(7)	25.70^{a}±6.09(9)	22.43^{ab}±4.77(9)	23.08^{ab}±2.10(6)	*
At 1 yr	202.20±9.75(5)	250.14±19.75(7)	246.14±74.19(7)	231.62±41.41(8)	235.60±60.32(5)	NS
At 2 yrs	348.00^{d}±20.0(5)	407.14^{c}±15.23(7)	495.00^{ab}±40.92(4)	472.66^{b}±38.(6)	543.50^{a}±105.35(2)	***
At 3 yrs	460.20^{b}±67.12(5)	583.50^{a}±36.84(4)	633.50^{a}±51.62(4)	602.80^{a}±32.58(5)	658.00^{a}±70.71(2)	***
			Female			
At birth	16.84^{b}±4.13(5)	22.54^{a}±2.01(5)	25.55^{a}±4.16(6)	22.58^{a}±6.13(7)	22.79^{a}±2.87(13)	*
At 1 yr	173.6^{b}±9.31(5)	210.6^{ab}±26.43(5)	225.83^{a}±43.7(6)	205.57^{ab}±37.13(7)	229.72^{a}±45.49(11)	NS
At 2 yrs	290.8^{c}±11.79(5)	323.6b^{c}±14.32(5)	382.2^{ab}±47.83(5)	385.25^{ab}±69.73(4)	413.87^{ab}±75.88(8)	**

***Highly significant ($p<0.001$);**Significant ($p<0.01$); *Significant ($p<0.05$); SD= standard deviation; NS= not significant; value in the parenthesis indicate the number of observation

Table1 revealed that all crossbred F_1 progeny performed better than BCB-1 in terms of live weight at different ages and they differ significantly among the groups except at the yearling age of both sexes. At birth both male and female calves of Charolais showed the highest live weight but at 2 years (Market age) of age male of Simmental cross showed the highest live weight followed by Charolais, Limousine, Brahman crosses and BCB-1. Interestingly, at 3 years of age males of all crosses did not differ statistically among them. Similarly to male, Simmental female also attained higher live weight compared to other crosses and BCB-1 at market age.

Table 2. Effects of genotypes on intake, growth and FCR at 24 months of age

Parameters	Genotypes					Sig .lev.
	PurebredBCB-1 (5)	Brahman cross (6)	Charolais cross (5)	Limousine cross (3)	Simmental cross (3)	
Total DMI (Kg/d)	6.02 [b]±1.57	7.44 [ab]±1.12	8.53[a]±1.23	8.40 [a]±1.20	8.01 [ab]±1.89	NS
Total Gain (Kg)	53.40±5.68	44.00±12.47	53.80±13.10	48.00±6.56	49.33±10.07	NS
ADG (Kg)	0.78±0.08	0.65±0.18	0.79±0.19	0.71±0.10	0.72±0.15	NS
FCR	7.79 [b]±2.46	12.16 [a]±3.22	11.33 [ab]±3.39	11.90 [ab]±0.15	11.22 [ab]±2.47	NS

NS= not significant; value in the parenthesis indicate the number of observation

During birth to market age and above, all crossbred males gained more than BCB-1 and Simmental cross gained the highest daily live weight (0.74±0.16 kg) followed by Charolais (0.67±0.03kg), Limousine (0.65±0.04kg), Brahman (0.57±0.05kg) crosses and BCB-1 (0.46±0.03kg).Table 2 revealed that genotypes had no significant ($p>0.05$) effects on total dry matter (DM), total live weight gain, average daily gain (ADG) and feed conversion ratio (FCR) at 24 and >24 months of age for 68 days of feeding trial. This Table indicated that purebred BCB-1 took the lowest DM and showed the highest feed conversion efficiency compare to other crosses. It means crossbreds showed the higher extend of beef production but BCB-1 is more efficient in feed utilization and profitable farming. Here, initially the control BCB-1group had some compensatory growth effect but the crosses were better in body condition scores.

It may be stated that among the four crosses Simmental×BCB-1 performed best based on growth but purebred native BCB-1 also has production potentials. More F_1 progeny is yet to be produced and required to evaluate the production and breeding performance of crossbreds. Carcass characteristics and meat quality of different beef breeds at different ages will be determined in the upcoming fiscal year. Semen collection, evaluation and preservation of selected bulls, field testing, *inter-se* mating in F_1 generation of the best performing genotype(s), back crosses, three-breed terminal cross, and synthetic beef breeds will be produced under the program. For these, this breeding program should be continued to achieve its goal.

Characterizing and screening of different coat color variants goat stock at BLRI

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Executive summary

In Bangladesh, the goat ranks second in position among the ruminant species with high prolificacy rate. Goats have great variation in color and the genetic control can be tricky. Although, lots of solid and mixed colored goats are available in our country but the studies on coat color inheritance are very scanty in our country. The present study were taken to develop pure-line goat genotypes based on coat color variant and phenotypic characterization of different coat color goat. The research conducted at BLRI goat research farm. To develop different color variants' goat stock, having three distinguished colors viz. solid white, Dutch belted and Toggenburg pattern. Within color pure breeding was followed for designing mating plan. Progeny was screened based on their color inheritance. Semi-intensive management was followed for animals of each flock. Genetic and phenotypic data were recorded. The collected data were analyzed statistically with IBM SPSS 20.0. Mean comparison were estimated by DMRT method.

Table 1. Body weight of kid at different ages

Factor	Mean±SE				
	BWT (Kg)	3MWT (kg)	6MWT (kg)	GR_{0-3} (g/d)	GR_{3-6} (g/d)
Sex	NS	NS	NS	NS	NS
Male	1.18±0.02 (107)	7.48±0.23 (71)	11.79±0.39 (56)	69.68±2.41 (71)	49.11±2.79 (55)
Female	1.15±0.02 (90)	7.39±0.23 (62)	11.70±0.40 (49)	69.19±2.52 (62)	46.94±2.35 (48)
Genotype	NS	NS	NS	NS	NS
SW	1.16±0.02 (87)	7.21±0.22 (58)	11.53±0.44 (46)	66.72±2.41(58)	49.26±2.78(45)
DB	1.15±0.04(57)	7.90±0.37(34)	12.12±0.59(23)	74.19±3.84(34)	46.04±4.36(23)
TB	1.16±0.01(49)	7.25±0.28(34)	11.55±0.42(28)	68.61±3.05(34)	46.75±2.72(27)
Parity	NS	*	NS	NS	NS
1st	1.13±0.03(71)	7.01^{ab}±0.23(53)	11.12^{ab}±0.42(42)	64.91±2.43(53)	47.34±2.77(41)
2nd	1.19±0.04(55)	7.90^{a}±0.32(29)	11.61^{a}±0.38(27)	73.16±3.29(29)	42.22±2.89(27)
3rd	1.15±0.02(36)	6.98^{ab}±0.27(25)	10.92^{ab}±0.35(19)	64.80±2.89(25)	45.20±3.68(19)
4th	1.06±0.08(12)	6.52^{b}±0.38(10)	8.97^{b}±1.29(3)	63.11±4.78(10)	35.55±5.55(2)
5th	1.23±0.09 (6)	-	-	-	-
Litter type	***	NS	NS	NS	NS
Single	1.37^{a}±0.09(19)	7.32±0.76(13)	11.30±1.03(8)	66.01±7.24(13)	45.0±5.17(8)
Twin	1.14^{b}±0.03(57)	7.17±0.25(35)	11.61±0.51(30)	66.22±2.71(35)	49.08±3.51(29)
Triplet	1.15^{b}±0.03(68)	7.25±0.24(43)	10.70±0.33(37)	67.84±2.45(46)	42.19±2.50(36)
Quadruplet	1.15^{b}±0.03(24)	6.78±0.37(13)	10.75±0.29(12)	62.29±4.04(13)	43.33±4.41(12)
Five fold	1.03^{b}±0.04(15)	7.03±0.33(11)	11.50±0.25(5)	65.86±1.55(11)	44.44±4.96(5)
Overall	1.17^{b}±0.01(197)	7.43±0.16(133)	11.75±0.28(105)	69.45±1.73(133)	48.10±1.84(103)

(Figures in the parenthesis indicate number of observation; NS-Non-significant, ($p>0.05$), *($p<.05$) and *** ($p<0.001$).BWT= Birth weight, 3MWT=Three month body weight, 6MWT=Six month body weight,GR=Growth rate)

Table 1 shows the body weight and growth performances of kids at different ages. Irrespective of different genetic factors, the overall mean birth weight (BWT), three month body weight (3MWT), six month body weight (6MWT), growth rate at 0 to 3 month (GR_{0-3}) and growth rate at 3 to 6 month (GR_{3-6}) were 1.17±0.01kg, 7.43±0.16kg, 11.75±0.28kg, 69.45±1.73g/d and 48.10±1.84g/d, respectively. Three month body weight (3MWT) of kids were significantly ($p<0.05$) higher than those of parity. Birth weight of kids were highly significant ($p<0.001$) than those of litter type. However, sex and genotype had no significant effect on BWT, 3MWT, 6MWT, GR_{0-3} and GR_{0-6}. Table 2 shows the reproductive performances for different color genotypes of goat. The overall gestation length,

litter size, post-partum heat period and kidding interval obtained in this study were 159±2.14 d, 2.21±0.09, 50.79±9.06 d, and 214.44±16.66 d, respectively. Color genotype, had no significant effect on gestation length, litter size, post-partum heat period and kidding interval. On the other hand, Parity had significantly effect on gestation length ($p<.05$) and litter size ($p<.01$) but had no significant effect on post-partum heat period and kidding interval.

Table 2. Reproductive performance for different genotype

Factor	(Mean±SE)			
	Gestation length (days)	Litter size (no.)	Post-partum heat period(days)	Kidding Interval (days)
Genotype	NS	NS	NS	NS
SW	157. 17±4.07 (35)	2.39±0.15(43)	43.13±12.26 (15)	211.58±33.00 (12)
DB	161.57±2.95 (38)	2.10±0.16 (39)	51.88±12.99 (18)	217.14±16.70 (14)
TB	157.84±4.25 (19)	2.00±0.13 (19)	66.67±84.73 (6)	208.0±21.08 (12)
Parity	*	**	NS	NS
1st	168.21^{b}±4.19 (28)	1.81^{b}±0.13 (36)	-	-
2nd	158.81^{ab}±3.44 (27)	2.13^{b}±0.15 (30)	59.88±15.33(17)	230.20±28.62 (15)
3rd	156.26^{ab}±4.34 (19)	2.63^{ab}±0.23 (19)	35.55±8.05 (11)	195.40±10.75 (7)
4th	152.15^{a}±3.22 (13)	2.55^{ab}±0.36(11)	35.60±19.96(5)	193.40±21.76(5)
5th	-	3.50^{a}±0.50(2)	-	-
Overall	159.13±2. 14 (92)	2.21±0.09 (101)	50.79±9.06 (39)	214.44±16.65 (27)

*Figures in the parenthesis indicate number of observation; *-$p<0.05$; **-$p<0.01$); NS-Non-significant ($p>0.05$).

This study reveals that phenotypic performances among three coat color goat genotypes showed almost similar and they are very prolific in term of growth rate and litter size. From above research work it can be said that all three coat color goat genotypes needs to be conserved which may lead to establish pure line indigenous goat population based on coat color phenotype.

Red Chittagong Cattle breeding and revealing their genetic architecture using High Density Single Nucleotide Polymorphism Array

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Executive summary

The Red Chittagong Cattle (RCC) is a valuable cattle genetic resource of Bangladesh. The objectives of this project were: (1) to assess the performance of pure and graded RCC with a view to make available young bulls to national breeding service providers and (2) to investigate the genetic diversity and genomic architecture of RCC using high density Single Nucleotide Polymorphism (SNP) markers. Data on a total of 822 pure RCC of different ages and sexes available in BAU, BLRI, DLS, BRAC, ADL etc. except rural farmers of greater Chattogram district and elsewhere have so far been collected, a standard database developed and uploaded in National RCC website. Alongside, a total of 162 Local Non-descript cows have been bred with pure RCC semen produced at the BAU AI Centre to produce graded RCC in Mymensingh district which are also being tracked. Standard RCC Herd Book has been developed and data on pedigree and traits of economic are being kept on all identified RCCs and graded RCC. For molecular study, 114 blood samples from pure and unrelated RCC have already been collected from BLRI, ADL, Chattogram and Mymensingh. Besides, 167 blood samples were collected from Pabna, North Bengal Grey, Munshiganj, Sahiwal and Indigenous cattle. The concentration of extracted DNA samples ranged between 32.6 to 279.8 ng/µl whereas purity of those samples varied between 1.67 to 2.00. In total, 210 samples have already been sent to commercial sequencing service company for genotyping by Illumina 50K SNP bead chip and are waiting for genotyping results. On the other hand, 8 ear tissue samples were collected from pure and unrelated RC cows and bulls. The extracted DNA samples are ready for whole genome sequence using Illumina NGS technology. Twelve potential pure young RCC bulls with known pedigree records have been screened and their fortnightly body weight, growth and andrological data are being recorded at the BAU AI Centre for making meritorious yearling RCC bulls available to the breeding service providers of the country.

Development of feeds and feed additives for producing value added poultry meat and eggs emphasizing lipid profile and antioxidant

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Executive summary

Now-a-days, consumers demand are increasing on natural, safe and eco-friendly products that can promote health benefits beyond their nutritional value, improve well-being and limit the risk of some chronic diseases. These foods are named as functional foods or nutraceuticals. This consumers' attitude applies for the poultry products also. Various nutritional manipulations to the chicken diet can be done to produce different types of value added meat and egg products. Two different experiments were performed to fulfill these objectives. At first experiment was carried out to investigate the effects of *Moringa oleifera* and *Spirulina platensis* on lipid profile, oxidative stability and fatty acid profile in broiler meat. Two hundred forty day old Cobb 500 broiler chicks were assigned to five dietary treatments for 5 weeks with four replications having 12 chicks per replication. The dietary treatments were: positive control (T_1), *M. oleifera* leaf meal 1% (T_2); 1.5%, (T_3) and *S. platensis* 1% (T_4); 1.5% (T_5). Final body weight gain was significantly ($p<0.05$) higher in T_2 and T_5 group and feed conversion ratio improved in T_2 group (1.68). The lowest ($p<0.05$) thiobarbituric acid reactive substances values (TBARS) obtained in breast meat T_3 (10.38) and T_4 (14.52) groups, respectively than the control (27.11 µmol MDA[1]/100g) after 3rd week preservation. In addition serum cholesterol (mg/dl) level was significantly reduced in additives group 124.11 ± 3.56^{c} in T_2 and 100.93 ± 1.79^{e} in T_5 group. It was interesting that T_2 (93.52 mg/100g) and T_5 (76.56 mg/100g) had lower total cholesterol compared to control group (269.42 mg/100g). The fatty acids profiles both breast and thigh meat showed that total ω-3, have the highest concentration in additives group (T_2-T_5) compared to control (Table 1).

Table 1. Effect of diets added with *M. oleifera* leaf meal and *S. platensis* on body weight, feed conversion ratio (feed:gain), cholesterol and ω-3 fatty acid of broiler chickens

Parameter	Dietary Treatments				
	T_1	T_2	T_3	T_4	T_5
BW(g)					
0d	46.42±0.34	46.38± 0.43	47.54±0.88	47.06±0.15	48.46±1.4
21d	779.50 ± 11.97^{a}	786.25 ± 5.06^{a}	751.75 ± 6.61^{b}	768.50 ± 11.25^{b}	778.75 ± 75^{a}
35d	1512.65 ± 29.47^{b}	1612.28 ± 25.66^{a}	1521.71 ± 23.96^{b}	1518.31 ± 30.07^{b}	$1629.47\pm.29.01^{a}$
F:G (g:g)					
21d	1.66±0.09	1.62±0.09	1.63±0.07	1.61±0.08	1.64±0.09
35d	1.79 ± 0.02^{b}	1.68 ± 0.03^{a}	1.75 ± 0.04^{b}	1.77 ± 0.02^{b}	1.72 ± 0.11^{ab}
Serum cholesterol	140.33 ± 2.68^{a}	124.11 ± 3.56^{c}	134.33 ± 4.05^{b}	113.42 ± 3.52^{d}	100.93 ± 1.79^{e}
Total cholesterol	269.42±4.31	93.52±2.37	105.60±2.98	137.61±3.81	76.57±3.50
Σω-3 (breast meat)	0.43±0.17	1.45±0.31	0.64±0.26	1.22±0.21	2.29±0.41
Σω-3 (thigh meat)	0.60±0.32	1.07±0.09	1.00±0.03	0.80±0.02	1.27±0.11

[a, b, c]Mean with different superscripts within same raw are significantly different ($p<0.05$). BW-Body weight (g), FG- Feed:gain (g:g), Σω-Total omega -3

In the second experiments, two hundred native chickens at the age of 26 weeks were selected and fed treatment diets as in first experiment for 42 weeks. The birds were housed in a close, ventilated caged-layer house and were distributed in five dietary groups having 40 birds in each group with 5 replications having 8 birds per replication. The average egg weight was found to be increased in additives groups. Serum cholesterol levels were significantly reduced ($P<0.05$) in all additive groups. In contrast, total egg cholesterol content in T_2 and T_5 was the lowest with the value of 173.95 and 226.21 mg/100g compared to control group, 283.86 mg/100g (Fig. 1). Omega 3 fatty acids in egg (g/100g) of the said dietary treatments were increased in T_2 group with the value of 1.57 and 1.55 in

T4 group. However, higher omega 3 fatty acid was found in commercial egg 1(CE1) with the value of 2.03 g/100g. Similar trends were found in total PUFA compared to control diet fed chicken egg.

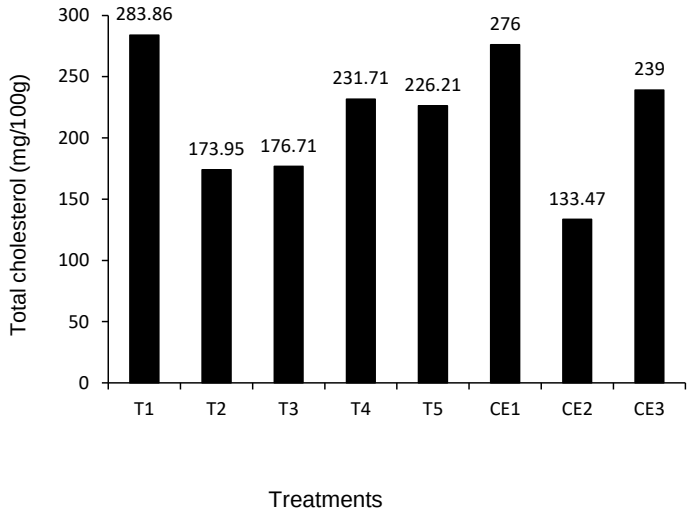

Figure 1. Effect of *M. oleifera* and *S. platensis* as natural feed additives on total cholesterol (mg/100g) of egg

Based on this study, it may be concluded that functional meat and egg, rich in n-3 PUFA and antioxidant can be produced by feeding hens with functional feed additives (*M. oleifera* and *S. platensis*) containing bioactive ingredients. This functional feeds, not only improved the general health the hens (broiler and layer), but also incorporated these health-promoting ingredients into the meat and egg. Consumption of such functional meat and eggs by humans may significantly improve their health. Further trails may be required to produce designer or value added egg production as well as commercialization.

Study on production, nutritive value and land use efficiency of fodder maize (*Zea mays*) intercropped with alfalfa (*Medicago sativa*)

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Executive summary

Intercropping is mostly used for higher yields per unit area than sole cropping. The present research work was conducted to study the yield, quality and land use efficiency of fodder maize intercropped with alfalfa. For this purpose 40 plots each with (5m×5m) areas of land at Pachutia Research Farm, Bangladesh Livestock Research Institute (BLRI) were laid out in a randomized block design (RBD) with 8 treatments (described in Table 1) in five blocks. The field was prepared properly by removing stubbles, ploughing, manuring and leveling. The maize and alfalfa seeds were planted both in broadcasting and line sowing at the same rate of 40 and 15 Kg ha^{-1}, respectively with a line spacing of 30cm. The experiment was started at 25th December and data were collected up to July, and was analyzed statistically by SPSS.

The results revealed that highest yields both for green herbage (170.64 tones ha^{-1} from 3 harvests) and dry matter (20.65 tones ha^{-1} from 3 harvests) were obtained from fodder maize cultivated as monoculture. On the other hand, lowest yields both for green herbage (30.21 tones ha^{-1} from 3 harvests) and dry matter (5.96 tones ha^{-1} from 3 harvests) were obtained from alfalfa cultivated as monoculture.

Table 1. Crude protein (CP) yields of alfalfa and fodder maize intercrop

Treatments	CP yields (MT ha^{-1}) at different harvest (H)									
	Alfalfa					Fodder Maize				Grand
	H-1	H-2	H-3	H-4	Total	H-1	H-2	H-3	Total	Total
T_1 (M_b)	-	-	-	-	-	0.763^{a}	0.805^{a}	0.546^{ab}	2.114^{ab}	2.114^{d}
T_2 (M_s)	-	-	-	-	-	0.749^{a}	0.818^{a}	0.597^{a}	2.164^{a}	2.164^{cd}
T_3 (A_b)	0.328^{a}	0.439	0.197^{a}	0.141	1.106^{a}	-	-	-	-	1.106^{e}
T_4 (A_s)	0.301^{a}	0.410	0.178^{ab}	0.134	1.023^{ab}	-	-	-	-	1.023^{e}
T_5 (M_bA_b)	0.178^{b}	0.412	0.126^{b}	0.120	0.837^{d}	0.767^{a}	0.613^{bc}	0.549^{ab}	1.929^{b}	2.766^{a}
T_6 (M_sA_s)	0.185^{b}	0.397	0.126^{b}	0.133	0.842^{cd}	0.596^{b}	0.523^{c}	0.402^{c}	1.521^{c}	2.363^{bc}
T_7 (M_sA_b)	0.199^{b}	0.477	0.176^{b}	0.120	0.973^{bc}	0.734^{a}	0.694^{b}	0.503^{abc}	1.931^{b}	2.904^{a}
T_8 (M_bA_s)	0.197^{b}	0.386	0.129^{b}	0.132	0.844^{cd}	0.593^{b}	0.549^{c}	0.432^{bc}	1.573^{c}	2.417^{b}
SEM	0.03	0.01	0.01	0.01	0.05	0.03	0.05	0.03	0.11	0.25
Sig. level	***	NS	**	NS	***	***	***	*	***	***

*p<0.05; **p<0.01; ***p<0.001; NS-p>0.05; uncommon superscript of mean values within same column differed significantly; SEM-standard error of means; M_b-maize broadcasted; M_S-maize line-sowed; A_b-alfalfa broadcasted; A_s-alfalfa line-sowed.

Table 2. Nutrient composition of alfalfa and maize fodder as affected by intercropping pattern

#Treatments	DM (%)		CP (%)		Ash (%)		ADF (%)		NDF (%)	
	Alfalfa	Maize	Alfalfa	Maize	Alfalfa	Maize	Alfalfa	Maize	Alfalfa	Maize
T_1 (M_b)	-	12.22	-	10.54^{b}	-	09.34^{ab}	-	49.47^{c}	-	77.17^{b}
T_2 (M_s)	-	12.10	-	10.48^{b}	-	14.10^{a}	-	48.05^{bc}	-	76.38^{b}
T_3 (A_b)	19.73	-	18.55	-	13.31	-	43.87	-	63.43^{a}	-
T_4 (A_s)	19.54	-	17.04	-	12.40	-	45.68	-	65.98^{a}	-
T_5 (M_bA_b)	19.88	15.09	16.39	17.47^{a}	12.11	08.97^{ab}	47.08	46.42^{b}	74.00^{b}	70.15^{ab}
T_6 (M_sA_s)	18.30	13.06	17.81	17.22^{a}	14.87	11.48^{ab}	45.12	47.26^{bc}	65.24^{a}	64.70^{a}
T_7 (M_sA_b)	20.73	14.40	16.87	17.62^{a}	12.59	08.24^{ab}	45.57	42.85^{a}	75.24^{bc}	69.27^{ab}
T_8 (M_bA_s)	20.88	13.35	15.85	17.98^{a}	13.10	07.89^{b}	45.65	45.40^{ab}	78.81^{c}	74.81^{b}
SEM	0.38	0.48	0.40	1.49	0.40	0.54	0.42	0.94	2.59	1.98
Sig. level	NS	NS	NS	***	NS	NS	NS	**	***	*

*p<0.05; **p<0.01; ***p<0.001; NS-p>0.05; uncommon superscript of mean values within same column differed significantly; SEM-standard error of means; #described in Table 1.

The yields in intercropped treatments were moderate ranging from 91.05 to 103.92 tones ha^{-1} for green herbage and 13.56 to 16.73 tones ha^{-1} for dry matter yields. CP yields were significantly higher in intercrop than sole crop (Table 1). The nutrient compositions of fodder maize and alfalfa for different treatment combinations (Table 2). N-uptake differed significantly among treatments. Lowest N-uptake was observed in fodder maize monoculture (10.29 kg ha^{-1}), highest in alfalfa monoculture (38.42 kg ha^{-1}) and intermediate (ranging from 20.80 to 33.69 kg ha^{-1}) in intercrop treatments. To assess the profitability of intercrop, competition index (CI) was estimated and found to be less than 1 that intercropping is more profitable than monoculture yields.

Finally, it may be concluded that yields of maize fodder intercropped with alfalfa was better than mono culture for both fodders in terms of CP yields. Further, intercropping of alfalfa enhanced the nutrient quality of fodder maize.

Strategic development of feeding and management techniques to improve the performance of egg and meat type chicken and their qualities

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Executive summary

An optimum amino acid concentration in broiler diet is a strategy to maximize the performance and minimize noxious gas emission in broiler litter. Therefore, the present experiment was undertaken to investigate the effects of low protein diets with glutamine supplementation on growth performance, meat quality, gut morphology and noxious gas emission of broiler chicken. A total of 600 day old Lohman broiler chicks were purchased from Ag Agro Hatchery and body weight were equalized and distributed into 30 pens (5 replicate pens/treatment; 20 birds/pen) and were provided 2 level of CP and 3 level of L-Glutamine resulting in a 3×2 factorial arrangement of dietary treatments (Starter T_1, 23×0; T_2, 23×0.2; T_3, 23×0.3; T_4, 21×0; T5, 21×0.2 and T_6, 21×0.3 % 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. Feed intake (FI) was recorded daily. Body weights (BW), weight gain (WG) and feed conversion ratio (FCR) were measured weekly. At 5th weeks of age, 6 birds per treatment were sacrificed and samples were collected to analyze met and carcass characteristics. In addition, intestinal segments (jejunum, Meckel's diverticulum) were collected and fixed in 4% paraformaldehyde in 0.1 M phosphate buffer for 48 h, and paraffin sections (5 µm thick) were made and stained with hematoxylin and eosin. Villus height and crypt depth were measured from 5 vertically oriented crypts and villi structures of each section by using image analysis software. Excreta (1000 g) were collected in each treatment and allowed to ferment for 1 day at room temperature and gases were measured using a Geotech (Biogas 5000,UK). All data were arranged by 2-way ANOVA plus interaction mixed procedure of SAS and differences were determined by DMRT.

In the present results, there was significant dietary interaction between CP and glutamine on BW, WG and FCR of broiler chicken (Table 1). With decreasing dietary CP levels and increasing glutamine (reduce 2 % dietary CP and 0.30% glutamine in T_6 treatment) highest BW, WG and lowest FCR were found in T_6 group compared to T_4 treatment which contains low CP without supplementation of glutamine in the diet. While feed intake was not significantly affected by the dietary treatment, it was numerically increased by the T_4 treatment.

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

Parameters	Treatments						SEM	P value CP x Glu
	T_1	T_2	T_3	T_4	T_5	T_6		
BW (g)	1795.94^{b}	1817.72a^{b}	1800.47^{ab}	1704.58^{c}	1763.68^{b}	1858.50^{a}	9.084	0.002
WG (g)	1752.43^{b}	1774.22a^{b}	1756.96^{ab}	1661.08^{c}	1720.18^{b}	1815.00^{a}	8.987	0.006
FI (g)	3150.56	3128.33	3016.76	3173.83	3171.78	3154.92	15.69	0.234
FCR	1.795^{ab}	1.764^{ab}	1.717^{b}	1.911^{a}	1.843^{ab}	1.738^{b}	0.142	0.031

Treatment, interaction of dietary protein and glutamine T_1, (23x0); T_2, (23x0.20); T_3 (23x0.30); T_4 (21x0); T_5 (21x0.20); T_6 (21x0.30); 2% CP was reduced in grower & finisher phase in each treatment group

In meat quality, the present results showed that muscular pH, color and cooking loss % were significantly improved in T_6 treatment as compared to other dietary treatments. However, variation of CP and glutamine did not influence the carcass characteristics of broiler chicks. On the other hand, T_6 treatment was showed higher ($P<0.05$) villus height and villus height:crypt depth ratio in compare to T_4 group (Table 2). However no significant differences were found among the T_1, T_2, T_3 and T_5 treatments.

Table 2. Effect of different level of protein and glutamine on gut morphology of broiler chicks

Parameters	Treatments						SEM	P value CP x Glu
	T_1	T_2	T_3	T_4	T_5	T_6		
Villus height (µm)	67.21^{a}	65.43^{ab}	68.56^{a}	61.92^{b}	63.48^{ab}	69.23^{a}	4.09	0.036
Crypt depth (µm)	17.36	15.90	15.33	16.43	15.96	14.58	2.11	0.513
Villus height-to-crypt depth ratio	3.872^{b}	4.151^{a}	4.472^{a}	3.76^{b}	3.98^{ab}	4.746^{a}	0.29	0.043

In addition, significantly higher level of NH_3 and H_2S gases were produced in T_1 treatment as compared to other dietary treatments (Table 2). However, there were no dietary protein and glutamine interactions regarding CO_2 and O_2 gases production of broiler litter. Therefore, starter (21x 0.30 %), grower (19 x 0.30 %) and finisher (17 x 0.30 %) level of dietary protein and glutamine may enhanced growth performance, gut morphology and meat quality characteristics of broiler chicken.

Evaluation of the weaning stress and estimation of weaning age of Black Bengal kids at different weaning condition

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Executive summary

The objective of the present study was to evaluate the weaning stress and estimation of appropriate weaning age of Black Bengal kids. A total of twenty four (24) lactating does (2 to 4 parity and average live weight of 19 ±2.80 kg) with kids were selected and divided into four treatment groups having six (6) doe in each treatment group. Kids of different treatment groups were weaned at different ages after kidding i.e. 45, 60, 75 and 90 days and denoted as 'A', 'B', 'C' and 'D', respectively. The group 'D' was considered as control group. The BPM (no. of heart beat/minutes) of the kids were measured 03 days before (-3), days at weaned (0) and 03 days after (+3) of respective weaning schedule of different treatment groups. Similarly -3 and +3 days, blood samples were also collected from the kids to analysed T_3 (triiodothyronine), T_4 (thyroxine) and cortisol hormones. Besides these, kid's birth weight, weight changes and weaning weight were also recorded. Data were analysed the GLM procedure of SPSS with 4x3 and 4 x2 factorial design and Duncan's test was used to test the differences between means.

Table 1. Changes of blood hormone levels in different treatment groups at different sampling date (mean±SE)

Treatment	Sampling day	T3, ng/ml	T4, ug/dl	Cortisol, ug/dl
A	-3	26.63±4.54	23.80±2.29	0.28±0.43
	+3	31.33±4.54	27.90±2.29	0.31±0.43
B	-3	37.34±4.98	28.76±2.50	0.67±0.47
	+3	26.20±4.98	23.80±2.29	0.66±0.43
C	-3	35.80±4.54	26.78±2.29	0.82±0.43
	+3	23.82±4.54	27.80±2.29	1.63±0.43
D	-3	34.75±4.54	27.33±2.29	0.58±0.43
	+3	21.75±4.54	24.55±2.29	2.26±0.43
Treatment (T)	A	28.98±3.21	25.85±1.62	0.29^{a}±0.31
	B	31.26±3.37	26.05±1.70	$0.67a^{b}$±0.32
	C	29.81±3.21	27.29±1.62	1.22^{b}±0.31
	D	28.25±3.21	25.94±1.62	1.42^{b}±0.31
Day (d)	-3	33.47±2.33	26.58±1.17	0.79±0.22
	+3	25.78±2.27	26.01±1.14	1.21±0.22
Sig. level	T	NS	NS	*
	d	*	NS	*
	T x d	NS	NS	*

T3 (triiodothyronine), T4 (thyroxine), different superscript in same column differ significantly, *p<0.05.

In the growth performance data of kids, only weaning weight were significantly (p<0.05) differ among treatment groups as the weaning age were different. The T_3, T_4 and cortisol hormones were monitored to assess the stress level of kids at different weaning age (Table 1). The serum concentration of T_3 and T_4 hormones decrease significantly (p<0.05) at +3 days after weaning compare to -3 days before weaning except A group of kids. During the stressful condition the thyroid hormone secretion is suppressed. The results suggest that the kids under B, C and D groups were felt more stress due to weaning compare to group A. On the other hand, cortisol concentration increased (p<0.05) about 2 and 4 fold at +3 sampling date for C and D groups, respectively and their interaction also significant (p<0.05). Normally, in stressful condition cortisol concentration increases. Hence, results suggest that kids in C and D groups were more stressful condition due to weaning compare to

kids under A and B groups. The BPM value of kids increased significantly ($p<0.05$) due to weaning stress (Table-2). In group A and B, both BPM_max and BPM_av was highest in 0 (zero) sampling day and then decline (+3). But for group C and D, increment ($p<0.01$) started at 0 (zero) sampling day and highest value observed at +3 day. Results suggest that the kids of C and D groups were in more stressful condition due to separation from their mother.

Table 2. The BPM of different weaning group of kids at different sampling date (mean±SE)

Treatment	BPM_max			BPM_av		
	Sampling Day			Sampling Day		
	-3	0	+3	-3	0	+3
A	155.43±7.60	172.00±7.60	156.19±7.60	130.29±6.26	139.86±6.26	138.90±6.26
B	153.10±7.11	166.10±7.60	160.08±7.60	134.48±5.86	152.10±6.26	142.13±6.26
C	113.26±6.70	130.37±6.70	145.67±6.70	96.67±5.52	121.11±5.52	131.41±5.52
D	80.80±6.36	91.06±5.89	133.92±6.98	74.70±5.24	80.46±4.86	115.36±5.74

		BPM_max	BPM_av
T	A	161.21^{a}±4.39	136.35^{a}±3.62
	B	159.77^{a}±4.30	142.86^{a}±3.54
	C	129.77^{b}±3.87	116.40^{b}±3.19
	D	99.54^{c}±3.71	88.23^{c}±3.10
d	-3	123.41^{a}±3.48	107.82^{a}±2.87
	0	130.13^{a}±3.49	113.91^{a}±2.88
	+3	149.46^{a}±3.62	133.44^{b}±2.99
Sig.	T	**	**
	d	**	**
	Tx d	**	**

BPM_max= height no. of heart beat/minute, BPM_Av= average no. of heart beat/minute, different superscript in same column differ significantly, * *$p<0.01$, T=treatment, d=sampling day

Thus, weaning of Black Bengal Goat kids before 75 days of age was more stressful that may affect post weaning growth and production. Finally, it can be concluded that weaning age should not be less than 75 days for Black Bengal Kids.

On-farm validation of TMR technology for fattening cow

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Executive summary

This study depicts the effect of feeding maize stover based complete ration on feed intake and efficiency, growth and economic outcome in fattening bulls. This field trial was carried out for a period of 53 days on 15 bulls belonging to the farmers of Sharif Bagh at Dhamrai upazila, a model village developed by Bangladesh Livestock Research Institute (BLRI) for disseminating it's developed technologies among farmers inhabited in the said village. Three farmers were selected having their own animals for fattening. Five (05) animals from each farmer were taken under experimental trial and three (03) of them were selected for TMR feeding and two (02) of them were let to feed traditional feeding commonly farmers do practice. Thus, a total of 15 animals were grouped into two; six (06) animals were in control group (T_0) and nine (09) were in treatment group (T_1). All the animals were bull cows within 2-3 years old. The control group (T_0) may be defined as the group of animals provided conventional feeding and in treatment group (T_1), animals were provided TMR *adlib*. In control group (T_0), animals were provided conventional feeds comprising of 15-25.0 kg Napier grass and 4-7 kg concentrate feeds, while animals in other group (T_1) were fed with a complete ration comprising of chopped maize stover and concentrate with 50:50 proportions according to their nutrient requirements. The dry matter (DM), crude protein (CP) and ME in TMR were around 60%, 15% and 9.70 MJ/kg DM. The animals in both groups were housed in conventional stalls with individual feeding and watering arrangements. Prior to starting the experiment, all the animals were de-wormed followed by a 7 days adjustment period as for acquainted with TMR feeds. TMR was prepared every day and supplied to animals along with clean drinking water *adlib*. Daily feed intake was calculated by total feed supplied in a day deducted by feeds refused in a day. In control group feed supplied and intake was also recorded. The chemical composition of TMR and conventional feeds were analyzed at Animal Nutrition Laboratory at BLRI. Initial body weight followed by body weights at 15 days intervals were also recorded. All the data were analyzed by "IBM SPSS 20.0" statistical program in a completely randomized design (CRD).

The feed and nutrient intakes, feed utilization efficiency and growth performance of animals in two dietary groups are shown in Table 1. Fresh feed, DM and ME intake in T_0 group was significantly higher than T_1 group, but CP intake did not differ between groups. Feed utilization efficiency of T_1 group was better than T_0. Table 1 however, shows that although, initial and final body weight did not differ between groups, but weight gain of animals in T_1 was significantly higher than animals in T_0 group.

Table 1. Feed and nutrient intake, efficiency and growth performance of animals in two dietary groups

Parameter	Control (T_0)	TMR (T_1)	Level of Significance
Fresh feed intake (kg/day)	23.81±0.54	10.78±0.70	***
DM intake (kg/day)	8.93±0.46	6.37±0.43	**
CP intake (kg/day)	1.06±0.07	0.97±0.06	NS
ME intake (MJ/day)	87.73±5.48	61.76±4.15	**
Feed Conversion Ratio (FCR)	13.35	6.67	-
Initial body weight (kg)	192.82±30.81	201.11±21.93	NS
Final body weight (kg)	225.61±30.78	247.92±21.36	NS
Body weight gain (kg)	32.79±0.43	46.81±1.24	***
Rate of weight gain (kg/d)	0.669±0.01	0.955±0.03	***

-p<0.01; *-p<0.001; NS-p>0.05

At the end of the whole experiment, economic analysis was conducted based on variable cost and income from animals sold of two treatment groups. In this experiment maximum profit from fattening bulls was obtained in T_1 group (Table 2).

Table 2. Economic analysis for two dietary groups

Parameter	Control (T_0)	TMR (T_1)
Cost (BDT) of animal purchased for fattening	50205.00	50278.00
Total feed cost (BDT) during experiment	9460.00	12616.00
Labor cost (considering 1 labor for managing 25 animals)	880.00	880.00
Other cost (electricity, equipment, medication, miscellaneous)	100.00	100.00
Total cost (BDT)	60645.00	63874.00
Return from animals sold (BDT/animal)	74400.00	79444.00
Net return (BDT/animal)	13755.00	15570.00
Benefit-cost ratio (BCR)	1.23	1.24

Based on the results, it may be concluded that feeding of maize stover based complete ration (TMR) improved body weight and feed utilization efficiency, with concurrent higher profit margin from fattening bulls.

Conservation, multiplication and adaptation of high yielding fodder (HYF) variety at BLRI regional station

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Executive summary

The experiments were conducted at Bangladesh Livestock Research Institute, Regional Station, Baghabari, Shahjadpur; Sirajgonj and on-farm at farmer's community at the village of Tiar Bond during the financial year 2018-19. These experiments were implemented to fulfill the following objectives to conserve and multiply of high yielding fodder crops for the distribution of cuttings/seeds among the farmers, determine the biomass yield & nutritive value of different high yielding fodder, adapt HYF at farmers level, evaluate the variation of nutrient content according to season and cutting interval with their botanical fraction, calculate economic analysis of fodder production and maintain an ideal fodder germplasm bank at the regional station. The experimental design was split-plot in (CRD) with three replications.

For this study we selected 6 farmers from 3 villages of Shahjadpur Upzila for on farm fodder cultivation and each plot were 20 decimal. At the same time we also maintained the same amount of land at BLRI regional station for trial of Napier and Sugar beet. The land was prepared in both on farm and on station according to the guideline of BLRI developed fodder cultivation techniques/guidelines. Sugar beet (*Beta Vulgaris*) as another HYF fodder variety was collected adapted and evaluated the production potentiality at BLRI regional station. All collected data were statistically analyzed by the SPSS 17.0 computer software program. Results revealed that, comparatively highest fresh biomass yield of Napier fodder (57.66±4.68) t/ha was observed in on-station than farmers community level but they were not significantly ($P>0.05$) differed. In case of leaf length of Napier fodder (3.59±0.04) ft. and plant height (6.36±0.20) ft. were significantly ($P<0.05$) differed and maximum values were observed in on-station than farmers community level 3.37±0.02 ft. and 6.00±0.03ft respectively. Tiller number (no/hill) and stem perimeter (cm) of Napier fodder highly significant ($P<0.001$) differences were observed and maximum values (30.72±4.27 and 6.68±0.06) obtained in on-station compared to farmer's community (18.21±0.65 and 6.14±0.02) level respectively. Leaf and Hillar number were did not differed significantly ($P>0.05$) though the parameter of on-station comparatively higher than farmers community level respectively. The production performance of sugar beet (*Beta Vulgaris*) the weight of fresh root with leaf (g/plant), fresh root weight without leaf (g/plant), Leaf weight (g/plant), Existing plant no(thousand/ha) and Survivability percentage (%) were not significantly ($P>0.05$) differed among the plots (treatments) at on-station. Maximum fresh root weight with leaf (g/plant) was observed in treatment 1 compared to others treatments.

Table 1. Production performance of high yielding fodder variety (Napier) at 40 days of cutting (Mean±SE)

Parameter	On-station	Farmers community	P value	Level of significance
Biomass(t/ha)	57.66±4.68	54.89±1.20	0.568	NS
Leaf length(ft.)	3.59±0.04	3.37±0.02	0.010	*
Leaf number (Leaf No/Plant)	16.24±0.79	17.13±0.18	0.231	NS
Plant height(ft.)	6.36±0.20	6.00±0.03	0.011	*
Tiller number (No/Hill)	30.72±4.27	18.21±0.65	0.000	**
Hillar number (thousand/ha)	58.66±5.15	55.20±1.06	0.425	NS
Stem perimeter (cm)	6.68±0.06	6.14±0.02	0.000	**

NS= Non significant ($P>0.05$), * stands for significant differed and ** stands for highly significant

Table2. Production performance of *Beeta vulgaris* (Sugar beet)

Parameter	Plot(Mean±SE)					P Value	Level of significance
	1	2	3	4	5		
Fresh root weight with leaf(g/plant)	478.0±70.6^{a}	248.4±70.6^{ab}	224.4±70.6^{b}	266.0±70.6^{b}	229.2±70.6^{c}	0.70	NS
Fresh root weight without leaf (g/plant)	393.6±57.7^{a}	210.4±57.7^{ab}	178.8±57.7^{b}	219.2±57.7^{b}	189.6±57.7^{c}	0.65	NS
Leaf weight (g/plant)	84.4±19.6^{a}	38.0±19.6^{c}	45.6±19.6^{ab}	46.8±19.6^{b}	39.6±19.6^{bc}	0.14	NS
Existing plant no(thousand/ha)	54.0±0.97^{a}	44.0±0.9^{a}	42.0±0.9^{bc}	50.0±0.9^{b}	40.0±0.9^{c}	0.12	NS
Survivability%	51.8±4.4^{b}	43.8±4.4^{c}	47.9±4.4^{ab}	54.0±4.4^{a}	44.9±4.4^{bc}	0.15	NS

NS= Non significant (P>0.05)

Development of feeding system for growing buffalo in coastal area of Bangladesh

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Executive summary

Buffaloes, are being distributed @ 3.77±2.63 heads per Km^2 (Huque & Khan, 2017), mostly concentrated in the north-western and south deltas. The production potentials of conventional pastoral buffaloes of the south delta is yet to be unearthed through good practice interventions and the capacity enhancement of farmers and entrepreneurs. The salinity rich pastures and the seasonal loss of green vegetation especially, during hot & dry period in maritime belts along with conventional herd management often affect the production and productivity of buffaloes and the socioeconomic contributions to farmers and the paid labors get their livelihood support out of the age-old pastoral buffalo raising system in the south. Scarcity of feeds and absent of specific feeding system are the two major problems faced by the buffalo farmers in the country. Thus, an investigation was made with the objectives: i) to increase production and productivity of buffalo through improving the existing feed resources in the southern deltas of Bangladesh & ii) to develop a sustainable and cost effective roughage based feeding system for buffalo fattening under on-station and on-farm conditions. To achieve the above objectives, BLRI head quarter and coastal region like Bhola Sadar Upazila were selected as the on-station and on-farm experimental site, respectively for this study. Under on-station condition, fifteen (15) local growing buffalo bulls were put on feeding trial in three different diets such as UMS based diet, Silage based diet and Fermented Corn Mixture (FCM) based diet as denoted by T_1, T_2 and T_3, respectively and each dietary group having 5 animals. The bulls used in each group were of almost the same weight and their age ranged between 2 and 3 years. In case of T_1 and T_2 dietary treatment groups, the total DM intake during the feeding trial of animals were fulfilled approx. 40 percent from concentrate mixture and the rest 60 % were provided from roughage sources (*adlib*) on DM basis. However, animals under T_3 treatment were provided FCM and protein supplement/protein mixture at a rate of 1.25% and 0.25%, respectively in addition to supply *adlib* roughages on their live weight. In on-farm condition, a total of 12 local buffalo bulls of age ranges from 2-3 years were fed only UMS based diet. The animals both on-station and on-farm conditions were housed individually in separate pens and offered daily ration in two equal meals at 9:00 and 16:00 h. At the onset of feeding trial, animals both under on-station and on-farm condition were dewormed properly with anthelmentics (Levamesol BP 600 mg per bolus). The feeding trial was continued for a period of 90 days including 7 days conventional digestion trial was conducted only for animals reared under the on-station condition. The animals were weighed at an interval of 10 days, and their feed intake, digestibility of nutrients, FCR, growth performance and cost-net profit calculation were analyzed statistically in an ANOVA of a completely randomized design (CRD) using the compare means with SPSS, 20 computer software packages.

Table 1. Chemical composition of diets used in on-station & on-farm experiment their cost

Items	DM, % fresh	Chemical composition (% DM)				GE (MJ/kg, DM)	Cost (Kg, DM; BDT)
		OM	CP	ADF	NDF		
On-station							
Napier silage	18.46	93.00	7.98	59.06	86.92	16.00	6.50
Fermented Corn mix.	61.79	91.51	15.91	15.18	49.54	24.13	14.71
Protein mix.	89.18	83.34	22.92	10.65	30.18	24.26	33.42
UMS	57.80	85.50	9.47	42.82	67.24	20.63	11.60
Concentrate mix.	87.73	92.25	18.21	14.53	31.34	16.48	36.00
On-farm							
UMS	56.23	82.40	9.11	45.15	67.69	-	9.80
Concentrate mix	87.95	92.13	17.53	13.40	35.00	-	36.00

The chemical composition of diets used in on-station and on-farm experiment and their cost of production are presented in Table 1. In on-station trial, the production cost per Kg DM silage, FCM,

protein mixture, UMS and concentrate mixture were TK. 6.50, 14.71, 33.42, 11.60 and Tk. 36.00, respectively. Similarly, the production cost of UMS and concentrate mixture in on-farm trial were Tk. 9.80 and Tk. 36.00, respectively (Table 1). The total per head daily DM, OM, ADF and NDF intake of buffalo bulls did not vary significantly ($p>0.05$) among the three different dietary treatment groups. However, the DM intake of bulls based on percent live weight was significantly ($p<0.001$) higher in UMS based dietary groups (2.65% LW) than that of Napier silage (2.34% LW) and FCM (2.00% LW) based dietary groups. Similarly, per day CP intake of bulls fed UMS based diet (1.03 Kg/d) was significantly higher ($p<0.05$) followed by bulls those fed Napier silage (0.89 Kg/d) and FCM based diet (0.75 Kg/d). The DM, OM and CP digestibility did not vary significantly ($p>0.05$) among the three dietary treatment groups. However, the ADF ($p<0.001$) and NDF ($p<0.05$) digestibility appear to be greatest for FCM based diet (65.97 & 70.35%, respectively, intermediate for Napier silage based diet (58.73 & 64.78%, respectively) and the lowest for UMS based diet (54.44 & 60.97%, respectively). Similarly, bulls fed UMS based diet had the highest ($p<0.05$) intake of digestible DM and digestible CP followed by DDM and DCP intake of Napier silage and FCM based diets. However, the intake of DOM did not vary significantly ($p>0.05$) among the dietary treatment groups. Feeding Napier silage based diet had higher ($p>0.05$) average daily gain of 1.00 Kg compared to 0.97 Kg of UMS or 0.84 Kg of FCM based diet with an average feed conversion efficiency of 7.10, 8.35 and 7.24, respectively ($p<0.05$; Table 2) indicating that the FCR of bulls fed Napier silage and FCM based diet found better (<0.05) than bulls those fed UMS based diets. The results on validation of UMS based feeding system under on-farm condition and its comparison with the results obtained from on-station trial revealed that except OM and CP intake, the daily DM, ADF and NDF intake of bulls did not vary significantly ($p>0.05$) in between groups. However, daily OM and CP intake was significantly ($p<0.05$) higher in bulls those fed UMS based diet under on-station condition (7.11 Kg/d &1.03 Kg/d, respectively) than bulls fed UMS diet in on-farm condition (6.16 Kg/d & 0.88 Kg/d, respectively).

Table 2. Intake, nutrient digestibility, growth, feed conversion efficiency & cost-benefit of buffalo bulls fed different diets under on-station conditions

Parameters	Experimental diets			SED	Sig.
	T_1 (UMS)	T_2 (Silage)	T_3 (FCM)		
DMI (Kg/d)	8.07	7.12	6.15	0.50	NS
DMI (Kg; % LW)	2.65^{a}	2.34^{b}	2.00^{c}	0.03	***
OMI (Kg/d)	7.11	6.60	5.62	0.42	NS
CPI (Kg/d)	1.03^{a}	0.89^{ac}	0.75^{bc}	0.06	*
DM dig.	64.07	64.19	65.08	0.61	NS
OM dig.	67.72	66.49	66.96	0.59	NS
CP dig.	66.62	66.87	67.79	0.64	NS
ADF dig.	54.44^{b}	58.73^{b}	65.97^{a}	1.29	***
NDF dig.	60.97^{b}	64.78^{bc}	70.35^{ac}	1.54	*
Initial LW(Kg)	259.2	256.6	257.8	20.8	NS
Final LW (Kg)	346.8	346.8	333.2	24.4	NS
ADG (Kg)	0.97	1.00	0.84	0.05	NS
FCR	8.35^{a}	7.10^{bc}	7.24^{ac}	0.32	*
Total cost/Kg gain	216.4^{a}	176.5^{b}	126.3^{c}	6.20	***
Net profit	11265^{b}	15175^{a}	15877^{a}	1215	*

The ADG and FCR of bulls fed UMS based diet however did not differ significantly ($p>0.05$) between on-station and on-farm conditions. The total cost including feed, refusal and management cost and net benefit analysis of buffalo fattening under on-station feeding condition revealed that the total cost involved per Kg gain was significantly ($p<0.001$) higher in bulls fed UMS based diet (Tk. 216.00) followed by bulls fed Napier silage (Tk. 176.00) and FCM based diets (Tk. 126.00). Considering the total cost involved for 90 days fattening of a bull, the net profit on the other hand were significantly ($p<0.05$) higher in bulls fed both FCM and Napier silage based diet than bulls those fed with UMS based diet. Though, the profit margin was less but still feeding UMS to buffalo bulls showed an efficient and cost effective diets (Table 2). The total cost per Kg gain and net profit of a

bull fattening with feeding of UMS based diet however, did not vary significantly ($p>0.05$) when comparing both on-station and on-farm conditions.

Therefore, it may be concluded that, considering the results of FCR and cost-benefit analysis, the bulls fed both FCM and silage based diet performed better than that of UMS based diet under on-station condition. Though, the FCR and profit margin was relatively less but still feeding UMS to buffalo bulls showed an efficient and cost effective dietary system both on-station and on farm conditions. Based on the availability of feed resource, farmers in different locality including coastal regions my use either FCM, silage or UMS based feeding system for sustainable and profitable buffalo fattening enterprise.

Determination of best practice management for Napier Grass: Defoliation height and severity to optimize nutritive value and regrowth

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Executive summary

Development and growth of livestock are conditioned by the availability of fodder both qualitatively and quantitatively from arable land (Bhende et al., 2004). Roughage feed plays an important role in the development of diets for dairy or beef cattle, as it directly or indirectly determines the diet cost and influence animal performance. Napier (*Pennisatum purpureum*) is a perennial grass widely used for ruminants particularly for dairy production in Bangladesh. Generally, this grass is used to feed the livestock as cut and carry system when it reaches~200-300 cm height and harvested at a severity of 5-6 cm above ground mainly to achieve greater biomass. However, protein and energy content of Napier grass harvested at this stage/height is low. Little or no information is available on the impact of Napier grass harvest/cut height and severity on yield and nutritive value to guide management decisions for small-holder farmers. Therefore, the present study was undertaken to determine best practice of cut and carry management principles for Napier grass to optimize the performance of small-holder dairy production system in Bangladesh.

The materials used were two cultivars of Napier grass viz BLRI Napier hybrid (BLRI Napier-3) and Napier Pakchong grass under this study. The experiment incorporated 3 defoliation heights of 50, 100 and 200 cm, and 3 cutting/severity heights of 5, 10 and 20 cm. from ground level. The design was a 3×3 factorial arrangement in a randomized complete block with 3 replications-giving a total of 54 plot each 4×4 m2. Before planting, soil samples were taken from depths of 0-30 cm as composites of 3 samples from three random locations. Limestone was applied at 1976 kg/ha based on the soil analysis, before planting 14 days. The basal fertilizer viz. Urea, TSP, MoP and Zipsam were given at a rate of 292 kg/ha, 214 kg/ha, 56 kg/ha and 90 kg/ha, respectively to all plots. Planting both Napier hybrid and Napier Pakchong grass by stem cutting with 2 nodes of a piece and placed 45o with 2 pieces a hole with plant spacing of 70 x 100 cm for Napier hybrid (No. of hills-30) and 50 x 50 cm for Napier Pakchong (No. of hills-64) in 4 x 4 m plot size. Each plot was applied urea fertilizer at a rate of 312 kg/ha at fortnightly basis during the whole experimental period. According to necessity, all plots were watered by hosepipe to ensure adequate soil moisture for plant growth. Morphological characteristic measurements like normal and raised plant height, dead and green leaf number, number tillers, node number, leaf- stem ratio etc. and biomass yield were recorded during harvesting time.

Defoliation height had a significant effect on the percentage content of dry matter and organic matter in both Napier hybrid ($p<0.001$) and Napier Pakchong ($p<0.001$) grass, with DM percent and OM percent increasing as the defoliation height increased from 50 to 200 cm. By comparison, crude protein showed a decrease as the defoliation height increased for both the Napier hybrid (Table 1) and Napier Pakchong (Table 2). The effect of severity/cutting height on the percentage content of DM, OM and CP in Napier hybrid did not vary significantly ($p>0.05$). For Napier Pakchong grass, severity/cutting height had a significant effect on DM and OM content, with DM and OM content increasing as the severity/cutting height increased. However, the cutting height had no effect on CP content in Napier Pakchung grass (Table 2). Dry matter & crude protein yield is an important indicator of forage production. Both the defoliation height and cutting height had a significant effect on fresh biomass and dry mater yield per cut of Napier hybrid and Napier Pakchong grass. As the defoliation height increasing, the fresh biomass and dry matter yield per cut for both Napier hybrid ($p<0.001$) and Napier Pakchong ($p<0.001$) were increased linearly and significantly. Similarly, the cutting height had also a significant effect on dry matter and crude protein yield per cut of both Napier hybrid and Napier Pakchong. The crude protein yield per cut were higher at 10 cm cutting height when cut both the Napier hybrid ($p>0.05$) and Napier Pakchong ($p<0.001$) from ground level (table 1 & 2). Both defoliation and severity height had a significant effect on harvesting interval. The average days between harvesting or harvesting interval increasing as the defoliation height increased from 50-

200 cm for both the cultivars. The harvesting interval however, was decreasing as the increased of severity height for both Napier hybrid and Pakchong grass. The average number of green leaf increasing as the increased of defoliation height of both the Napier cultivars. The regrown tiller number for both Napier hybrid and Napier Pakchong grass was higher in the plants cuts from 50-100 cm defoliation height than in those cut at a 200 cm defoliation height.

Table 1. Chemical composition, biomass yield and morphological characteristics of BLRI Napier hybrid (BLRI Napier-3) grass cutting at different defoliation heights and different severity heights.

Parameters	Defoliation height (cm)			Severity height (cm)			SED	Sig. level		
	50	100	200	5	10	20		P	S	PxS
Chemical composition (%)										
DM content	13.25^{b}	15.96^{a}	16.00^{a}	14.97	14.87	15.37	0.25	***	NS	NS
OM content	88.54^{c}	89.95^{b}	91.29^{a}	90.10	89.74	89.93	0.26	***	NS	NS
CP content	19.22^{a}	15.48^{b}	11.44^{c}	15.19	15.24	15.70	0.29	***	NS	NS
Biomass yield (t/ha/cut)										
Fresh yield	16.34^{c}	28.37^{b}	66.86^{a}	38.47^{bc}	38.59^{ac}	34.50^{b}	1.00	***	*	NS
DM yield	2.08^{c}	4.36^{b}	10.70^{a}	5.92^{a}	5.83^{ac}	5.38^{bc}	0.12	***	*	NS
CP yield	0.39^{c}	0.65^{b}	1.22^{a}	0.76	0.77	0.72	0.02	***	NS	NS
Ave. days between harvest	21.75^{c}	38.42^{b}	72.00^{a}	44.94^{a}	44.56^{b}	42.67^{c}	0.40	***	*	NS
Morphological characters										
No. of green leaf per plant	5.48^{c}	8.30^{b}	10.72^{a}	8.36	8.03	8.11	0.09	***	NS	NS
No. of dead leaf per plant	0.00^{c}	2.04^{b}	3.31^{a}	1.77	1.78	1.81	0.07	***	NS	NS
No. of tillers per hill	85.38^{a}	80.50^{a}	68.93^{b}	72.44	82.58	79.79	2.43	**	NS	NS

Table 2. Chemical composition, biomass yield and morphological characteristics of Napier Pakchong grass cutting at different defoliation heights and different severity heights

Parameters	Defoliation height (cm)			Severity height (cm)			SED	Sig. level		
	50	100	200	5	10	20		P	S	PxS
Chemical composition (%)										
DM content	11.84^{c}	12.45^{b}	13.70^{a}	11.77^{bc}	12.89^{ac}	13.31^{a}	0.17	***	***	NS
OM content	83.67^{c}	88.34^{b}	92.29^{a}	87.33^{b}	88.13^{bc}	88.85^{ac}	0.34	***	*	NS
CP content	20.58^{a}	20.40^{a}	12.61^{b}	18.42	17.78	17.39	0.28	***	NS	*
Biomass yield (t/ha/cut)										
Fresh yield	3.36^{c}	10.41^{b}	44.18^{a}	20.72^{a}	20.66^{a}	16.57^{b}	0.45	***	***	***
DM yield	0.39^{c}	1.29^{b}	6.04^{a}	2.61^{a}	2.81^{a}	2.30^{b}	0.07	***	**	*
CP yield	0.08^{c}	0.26^{b}	0.79^{a}	0.38^{a}	0.44^{a}	0.30^{b}	0.01	***	***	***
Ave. days between harvest	14.27^{c}	26.78^{b}	54.50^{a}	34.43^{b}	32.17^{b}	28.85^{a}	0.68	***	***	NS
Morphological characters										
No. of green leaf per plant	6.00^{c}	9.03^{b}	13.14^{a}	9.69	9.27	9.25	0.29	***	NS	NS
No. of dead leaf per plant	0.00^{c}	1.70^{b}	3.01^{a}	1.98^{a}	1.54^{b}	1.20^{c}	0.07	***	***	***
No. of Node per plant	0.00^{c}	0.76^{b}	10.43^{a}	3.99	3.65	3.54	0.14	***	NS	NS
No. of tillers per hill	20.00^{b}	24.29^{a}	10.50^{c}	16.75	18.45	19.59	1.01	***	NS	NS

The results so far obtained, it may be concluded that the crude protein content in both the Napier hybrid and Napier Pakchong grass were higher in the plants cuts at a 50 cm defoliation height than in those cut at 100 or 200 cm defoliation height. The crude protein yield per cut were higher at 10 cm severity height when cut both the Napier cultivars from ground level. Napier hybrid (BLRI Napier-3), irrespective of their defoliation and severity height, being yielded more than double DM and CP yield than Napier Pakchong even though the plant density of Napier hybrid was lower than Napier Pakchong.

Study on Production Potentiality and Preservation Technique of Moringa Fodder and Assessment of it's Nutritional Quality

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Executive summary

Moringa is an exclusive animal feed compared to any other fibrous feed, fodders and by-products of cereal or agro-industrial products which are available in our country. It plays a significant impact on the production and productivity of dairy, fattened or small ruminant animals and even poultry too. So, exploring the new approaches of moringa cultivation and its suitable preservation technique could play a promising role on reducing feed demand and cost besides of enhancing the farm economy in terms of qualitative and quantitative production. In this regard, BLRI started research work on exploring the potentiality of Moringa as livestock feed. BLRI developed agronomy of moringa fodder cultivation which was practiced in Dinajpur, Khustia and Chuadanga to validate the findings as obtained in BLRI. Based on the results of continuous research and validation program, in the current fiscal year the expectancy of moringa as livestock feed and its agronomical practice is already been handed over as technology to Department of Livestock Services (DLS). To expand the hidden potentiality of Moringa and to make it available to farmers. Some exotic variety (PKM-1, PKM-2 and Parynal) of Moringa have been imported and cultivated at BLRI farm following previously developed agronomical practice and an experiment was designed to study the germination rate, yield and its nutritional value assessment. At the same time, another experiment was designed to develop a simple and cost-effective fresh biomass preservation technique keeping with its nutritional quality and impact on dairy production. The study of biomass production of three imported variety was conducted at BLRI research field designed in CRD consisting of three treatment and four replications of each. 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. The plot size was 6×6 square meter and the plant distance was 1.5×1.5 cm from each plant to other. Before transferring of the seedling, the plots were prepared by cultivation, fertilizer application (cow dung and potash) and foradan as aninsecticide. After planting the seedlings first cutting was given at 120 days at 60 cm height from land.Subsequent cuttings was continued after first cutting in every40 days interval. Fresh Moringa (Black seed, local variety) was chopped in 1.5 to 2.0 cm length. Fresh chopped moringa was packed in small air tight plastic container. A total45containers were filled with chopped fresh moringa and another 45 containers were filled with fresh moringa including 5% straw in small (6 kg capacity) air tight plastic container. Each group had 9 treatments (7, 14, 21, 28, 35, 42, 49, 56 and 63th day) with 5 replications. Filled moringa container were opened at each 7 days interval upto 63 days. All samples were taken and analyzed at animal nutrition laboratory of BLRI for proximate component and fiber analysis. Feeding trial was conducted to study the impact of moringa silage on milk production and its quality of dairy cow, the experiment was arranged with 10 (ten) lactating RCC cows of which 5 (five) RCC cows were considered as control group (supplied feed in accordance to common farm practice) and 5 (five) RCC cows were supplied moringa silage as complete feed. Daily milk production was recorded and milk quality in terms of milk fat, protein, SNF, fatty acid profile, calcium, phosphorus and cholesterol was analyzed. Blood glucose, cholesterol and lipid profile were also analyzed. Statistical analyses were performed using SPSS statistical software program 17.0 (SPSS Inc., Chicago, IL, USA). Fresh biomass and dry matter yield were significantly higher in Paraynal variety compared to PKM1 and PKM2, respectively. Nutrient composition interms of dry matter (DM), crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF) and ash were nearly similar in all varieties of fresh moringa (Table-1). DM, CP, ADF, NDF and ash of preserved fresh moringa foliage and added 5.0% straw in fresh moringa foliage were similar, except ADF and NDF at 7, 14, 21, 28, 35, 42, 49 56 and 63th days. ADF and NDF were reduced after preservation.

Table 1. Biomass yield and their nutritional composition of different moringa varieties

Parameter	Paraynal	PKM-1	PKM-2	Sign
Fresh biomass yield (ton/ha/cut)	3.13±0.35[a]	1.91±0.17[b]	1.83±0.14[b]	***
Dry matter (DM) yield	0.65±0.07[a]	0.35±0.03[b]	0.31±0.02[b]	***
Dry matter (DM)	18.07±0.46	18.54±0.23	17.66±0.81	NS
Crude protein (CP)	17.11±0.30	17.66±0.32	18.17±0.09	NS
Acid detergent fiber (ADF)	57.13±0.45	56.18±0.73	56.820.43	NS
Neutral detergent fiber (NDF)	64.33±0.58	61.38±0.45	63.96±0.50	NS
Ash	8.02±0.35	7.83±0.14	7.81±0.41	NS

Moringa silage increased milk yield by about 14.17%. Milk composition (Fat, protein, lactose and SNF) was not significantly (P>0.05) different between two treatments, while milk fat was a bit higher (5.52%) in Moringa supplemented RCC cows compared to control (5.06%) which increased about 9.07% in milk. Moringa silage increases polyunsaturated fatty acids (PUFA), linoleic acid (C18:2), linolenic acid (C18:3), arachidonic acid (C20:0) ecosopantanoic acids (C20:1) and decreased saturated fatty acid (SFA) and mono unsaturated fatty acids (MUFA) in milk.Milk cholesterol was found lower (0.092 mg/kg) in moringa supplemented milk compared to control (0.142 mg/kg). Calcium, phosphorus and lead (40.96, 83.50 and 0.04 vs 38.54, 80.06 and 0.043) were not significantly (P>0.05) different between treatment and control group. Cadmium (Cd)and Chromium (Cr) level was found to be below detected level in both groups. Moringa silage had no significant effect on the concentration of serum cholesterol, HDL, LDL, triglyceride and glucose.The study shows that parynal variety of moringa produced higher fresh yield of moringa biomass. Therefore, paraynal variety may be cultivated as livestock feed. Fresh moringa fodder can possibly to be preserved as silage. Feeding moringa silage to RCC cow was increased milk production and its quality. Furthermore, research need to be arranged to draw a specific conclusion regarding impact of preserved moringa fodder on production.

Table 2. Effect of moringa silage (Black Moringa Native) on milk production and quality (Mean±SEM)

Parameter	Treatment	Control	Sign
Milk production (kg/day)	5.16±0.31	4.76±0.28	NS
Milk composition (%)			
Fat	5.52±0.09	5.06±0.11	***
SNF	9.37±0.20	9.31±0.10	NS
Protein	3.43±0.06	3.41±0.4	NS
Lactose	5.07±0.02	5.1±0.05	NS
Mineral (mg/kg)			
Calcium	40.95±2.3	38.53±1.3	NS
Phosphorus	83.5±1.3	80.05±1.8	NS
Cholesterol	0.9±0.03	0.14±0.08	NS
Heavy metal (mg/kg)			
Lead (Pb)	0.04±0.0	0.04±0.0	NS
Cadmium (Cd)	BDL	BDL	-
Chromium (Cr)	BDL	BDL	-
Fatty acid profile			
Saturated Fatty Acids	62.07±o.25	65.95±0.72	*
MUFA	33.06±0.80	36.19±0.66	*
PUFA	3.82±0.28	2.05±0.53	*
Linoleic acid	3.61±0.28	1.18±0.38	**
Linolenic acid	0.92±0.13	0.60±0.16	NS

Screening of heavy metal residue in animal food chain system

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Executive summary

Heavy metals are those metals with relatively high densities or atomic weights. Some heavy metals are essential as nutrients which are harmless, but some of them are highly poisonous. Most of the heavy metals are highly poisonous in human at a certain dosage. Poisonous heavy metals have a great negative impact on almost every living organism. In recent years, there has been an increasing ecological and global public health concern due to heavy metal contamination in our environment. An exponential increase of usage of heavy metals in several industrial, agricultural, domestic and technological applications has been occurred in recent years. Animal may get exposure of heavy meatal through animal food chain system. Human and livestock are inextricably related. It causes various diseases including cancer in human. To determine the concentration of heavy metals, nine different samples; soil (rice field), soil (fodder field), water (home), water (field), rice straw, fodder, cow dung, blood and milk were collected from five different arsenic prone districts (Faridpur, Jashore, Narayanganj, Chadpur and Sirjganj) of Bangladesh which covered most of the agro-geological regions of Bangladesh. The sampling area were selected by evaluating the arsenic polluted area map of Bangladesh developed by Sustainable Development Networking Program (SNDP) under United Nations Development Program (UNDP). Samples were collected from six to seven farmers who had milking cows and cultivated fodders in each study areas. Collected samples were digested by Aqua regia-Perchloric acid digestion method and analyzed by Atomic Absorption Spectroscopy (AAS).

Average concentrations of cadmium (Cd) and chromium (Cr) in different samples of all studied locations in Bangladesh have been presented in Figure 1 and Figure 2. Cd was found in most of the samples in all the studied locations (Fig. 1), but the concentrations were less than the WHO standard (0.8 ppm) in soil. Water samples in Faridpur contained higher concentration of Cd (0.014 ± 0.005 ppm) compared to other locations and the concentration was higher than the Bangladesh Food Safety Authority (BFSA) standard limit (0.003 ppm) for drinking water in Bangladesh. Fodder samples in all studied locations contained lower concentration of Cd than the WHO standard limit (0.02 ppm) in plant.

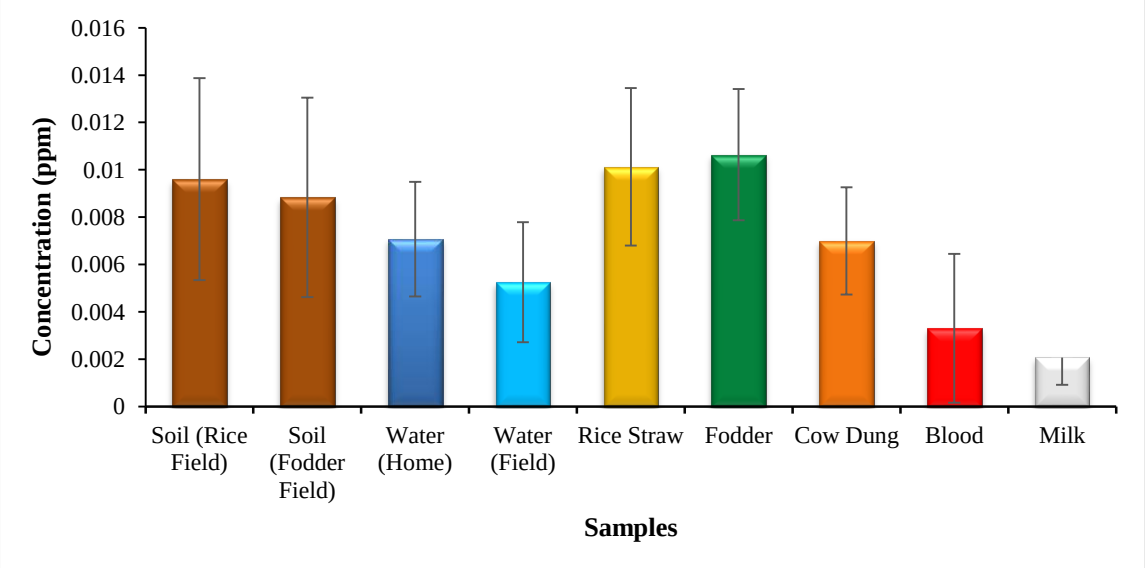

Figure 1. Average concentration of Cd in different samples from five studied locations of Bangladesh

Chromium (Cr) was found in most of the samples in all the studied locations (Fig. 2). Soil (rice field) samples in Faridpur contained higher (0.7 ± 0.123 ppm) concentration of Cr than the other studied locations and the concentration was lower than the WHO standard in soil (100 ppm). Water, except in Sirajganj, other studied locations contained higher concentration of Cr than the United States Environmental Protection Agency (US EPA) standard (0.1 ppm) for drinking water.

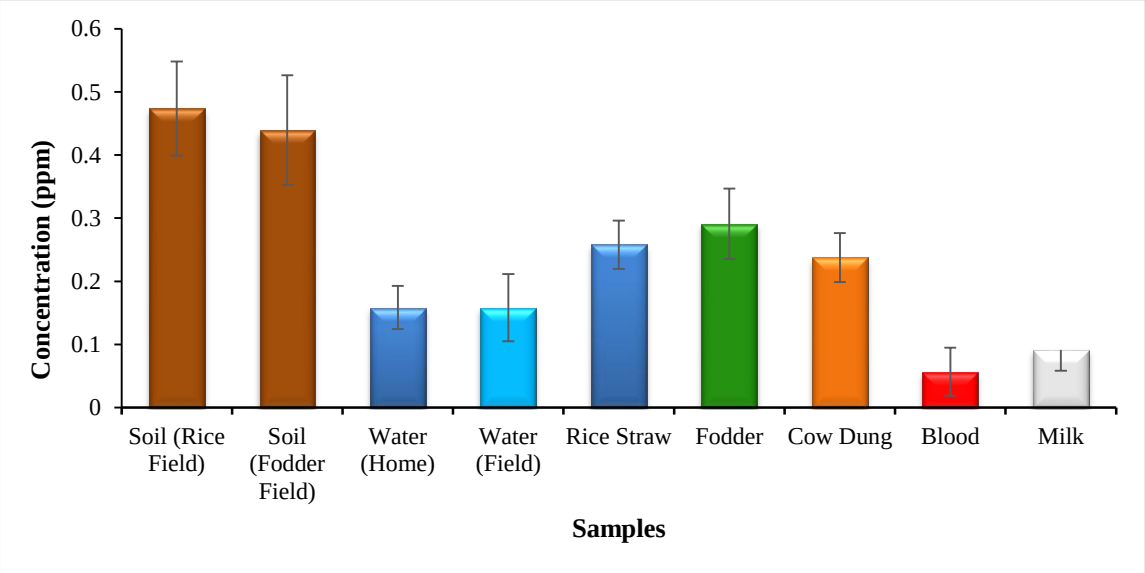

Figure 2. Average concentration of Cr in different samples from five studied locations of Bangladesh

In the summing up, the study clearly showed that all the studied samples contained Cd and Cr. Therefore, steps should be taken so that the concentrations of these two heavy metals may not exceed the existing concentration which may cause harmful for animals and human beings.

Adaptation of ovum pick up technology for the production of Red Chittagong calves

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Executive summary

The present study was designed to characterize the follicular dynamics of Red Chittagong Cattle (RCC) during natural estrous cycle. For this purpose, 5 RCC cows and 5 RCC heifers were selected for studying follicular dynamics measured by follicular growth pattern and circulating concentration of progesterone (P4), follicle stimulating hormone (FSH) and luteinizing hormone (LH). From the detection of estrus onward, ovary of studied cattle were scanned using ultrasonography system (HS-2200V Honda Electronics Co., LTD) equipped with a vaginal probe (7.5MHz) twice daily in two consecutive estrous cycles. Blood samples were collected daily for separation of serum used for determination of concentration of studied hormones using standard ELISA procedure. Data were analyzed using Microsoft excel programme. The length of estrus cycle were differed ($p<0.01$) between RCC cows (21.00±1.50 days) and heifers (20.00±1.10 days). The follicular growth patterns were occurred in two waves in all experimental cattle (Figure 1). It was found that the interval since the emergence of the wave to the deviation of the dominant follicle was 4.29±1.89, 3.29±2.17 days for the first and second wave, respectively; likewise, the number of follicles was 9.11±2.47 and 8.18±1.86. Finally, the dominant follicle diameter was 9.56±1.58 mm for first and 9.75±1.67 mm for second wave. The maximum luteal diameter was 17.58±4.16 mm for RCC cows and 18.74±3.32 mm in heifers. Luteal regression took place at 15.22±5.26 and 17.62±1.68 days of the oestrous cycle in RCC cows and heifers, respectively. The number of follicular waves did not affect the maximum size and volume reached by the CL during its development in luteal phase of cycle because the maximum diameter of the ovulatory follicle was similar between two follicular waves. The first dominant follicular diameter of first wave was 11.5 mm in cows and 10.5 mm in heifers, respectively.

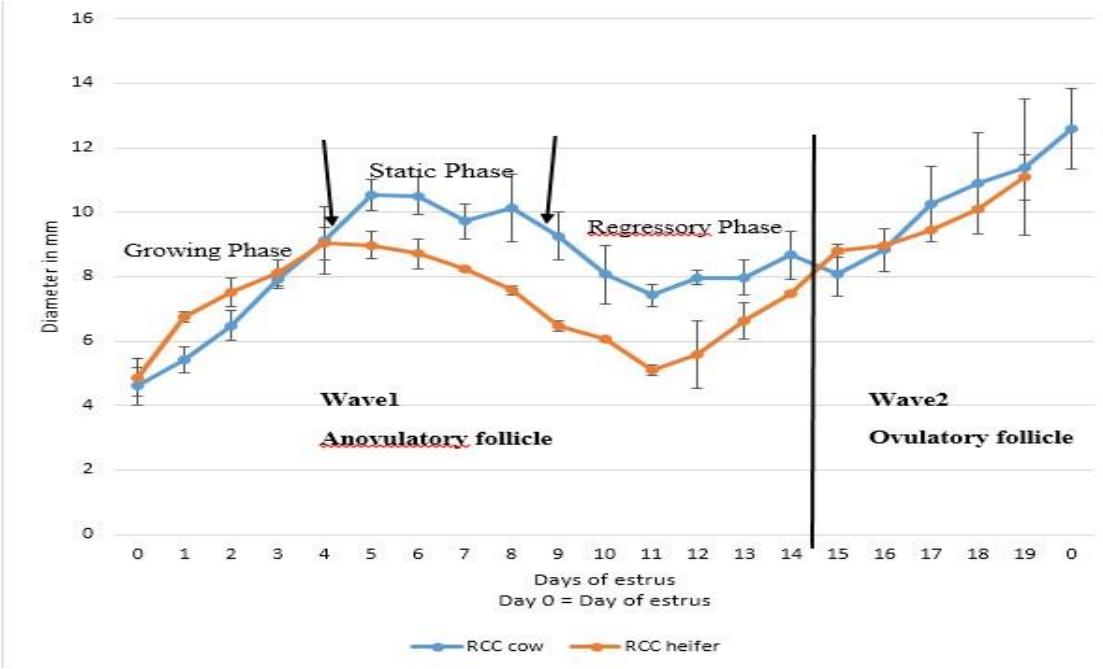

Figure 1. Follicular growth pattern of Red Chittagong cattle at BLRI Research herd

The concentrations of FSH during the estrus cycle in two follicular wave cycles of RCC heifers were 0.96 to 2.25 mIU/mL and 1.13-2.32 mIU/ml in RCC cows. The mean plasma levels of

FSH followed a constant pattern and FSH-peaks ($p< 0.05$) occurred around days 2, 3, 4 and 13, 14, 15 in RCC cows and heifers showing a wavelike pattern. The P4 concentration progressively increased from <1 ng/mL in 1–2 days post-ovulation to approximately ≥27 ng/mL at days 4–6, at the same time as follicular deviation in the first follicular wave; after that they were maintained and declined <1 ng/mL during ovulation time. The concentrations determined two days before and three days after ovulation are constantly low between 0.2 and 17.55 ng/ml plasma in blood serum. From day 4, a gradual increment was observed and progesterone levels reached in a plateau around day 10 after ovulation. There is a sharp and significant ($p<0.005$) fall in the progesterone levels on day 17 which was lasting for about 18 hours. The mean concentrations of LH calculated from plasma of 2 cycles basal values are fairly constant. Concentrations decrease below the calculated mean levels on days 11-13 and thereafter increased again. A further gradual increment ($p<0.05$) that exceeded the basal levels beginning from day 17 until the preovulatory LH-peak on day 20. Immediately before ovulation LH values again decrease to the basal concentrations.

Considering follicular dynamics of RCC research is conducting to adopt the ovum pick up technology at BLRI. Follicular dynamics in RCC were characterized by the predominance of two follicular waves. The concentration of P4, FSH and LH hormone corresponded with follicular developmental stages in RCC cow and heifer.

Table 1. Follicular dynamics in Red Chittagong Cattle (RCC) during estrous cycle (Mean±SD)

Parameter	Cow	Heifer	p-value
Duration of the estrous cycle (days)	21.00±1.50	20.00±1.10	0.01
Number of waves	2	2	NA
Emergence of wave 1 (day of the estrous cycle)	2.00±1.50	1.00±1.84	0.02
Number of follicles in wave 1	8.00±1.50	5.00±1.70	0.01
Deviation of wave 1 (day of the estrous cycle)	4.00±1.10	4.00±1.44	0.04
Diameter of the deviation of wave 1 (mm)	8.00±1.70	8.00±1.17	0.01
Emergence of wave 2 (day of the estrous cycle)	12.00±2.10	12.00±1.50	0.03
Number of follicles in wave 2	6.50±1.70	6.00±1.90	0.02
Deviation of wave 2 (day of the estrous cycle)	14.00±2.10	15.00±1.10	0.01
Diameter of the deviation of wave 2 (mm)	8.00±1.16	8.80±0.50	0.04
Diameter of the preovulatory follicle (mm)	12.00±1.70	11.00±1.50	0.02

Isolation and identification of lactic acid bacteria for the development of microbial silage inoculant

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Executive summary

Forage ensiling for feeding dairy cattle as well as selling silage in the market are getting momentum, coupling with dairy development in recent years in Bangladesh. Although silage fermentation occurs naturally under anaerobic conditions due to the native epiphytic bacteria, the speed and efficiency of fermentation are variable, depending on the numbers and types of lactic acid bacteria (LAB) on the crop. Bacterial inoculant of selective species was found effective to ensure quick fermentation with minimum nutrient losses and increased aerobic stability of silage after opening silo. These reactions are very much important to achieve during ensiling, especially for large/commercial scale silage production. Therefore, identification and use of such bacteria for ensiling fodder were included as one of the priority tasks in the Action Plan under The National Biotechnology Policy 2012. The current study was undertaken to isolate and identify suitable phytic bacteria for the developmrnt of microbial silage inoculant. For this purpose, 33 samples (Napier: 12 fodder, 3 silage; Maize: 15 fodder, 3 silage) from Napier and Maize fodder and silages were collected. Bacteria were isolated using MRS Agar media. Based on colony morphology and size, Gram's staining and biochemical properties, 21 colonies were selected and isolated following purification through culturing in MRS agar and MRS broth sequentially. In addition to above tests, biochemical characterization also included growth at different temperatures (5,10,15, 30, 40, 43,45 and 50ºC), different NaCl concentrations (2, 3, 4,6.5, 7, 8 and 10% NaCl), different pH (3.0, 3.5, 4.0, 4.5, 5.0, 6.5, 7.0, 8.0, 8.5, 9.0 and 9.5) and carbohydrate fermentation profile (glucose, sucrose, arabinose, ribose, melibiose, cellobiose, sorbitol and raffinose etc.). Molecular confirmation of isolates was done by using 16s rRNA gene sequencing, where PCR products were determined directly with a sequencing kit using the prokaryotic 16S ribosomal DNA universal primers (27F: 5´- AGA GTT TGA TCM TGG CTC AG -3´ and 1492R:3´- CGG TTA CCT TGT TAC GAC TT -5´). Sequence similarity searches were performed using the Basic Local Alignment Search Tool (BLAST) in NCBI database. The sequence information was imported into the CLUSTAL X software program for assembly and alignment. Then the phylogenetic trees were constructed using the neighbor-joining method. The topologies of trees were evaluated using bootstrap analysis of the sequence data with Molecular Evolutionary Genetics Analysis (MEGA) 4 software, based on 100 random re-samplings.

All 21 isolates were found Gram positive and heterofermentative. Of the 21 isolates, only one isolate was coccus in shape, while two found cocco-bacillus and the rest 18 were bacilli. Seven strains were found catalase negative, while 14 were catalase positive. Based on these characteristics 6 isolates were identified as *Lactobacillus*, 14 as *Bacillus* and 1 as *Staphylococcus* genus. Together with the results of biochemical characterization (growth at different temperature, NaCl concentrations, and at different pH and sugar fermentation profile; data are not shown), sequence data revealed that 6 isolates were *Lactobacillus fermentum*, 4 were *Bacillus spp.* 7 were *Bacillus subtilis*, 1 was *Lysinibacillus sphaericus*, 2 were *Bacillus megaterium and* 1 was *Staphylococcus spp.* Among these, *L. fermentum*and *B. subtilis* are being used as silage inoculant and therefore, will be tested for their potential as silage inoculant under this study. Besides, isolation and identification of other suitable bacteria will be continued.

Efficient management of poultry manure: anaerobic co-digestion for biogas production and application of additives for odor reduction

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Executive summary

Major uses of poultry manure (layer droppings) under traditional management system are in aquaculture and organic fertilizer production. Considerable portions are being wasted and very few farmers use it for biogas production. However, poultry manure (PM) could be an efficient biomass for biogas production, especially when it is co-digested with other carbon rich, but nitrogen deficient biomass. Again, whatever the management system is, temporary pilling of manure in farm is liable for noxious odor in vicinity. Therefore, this study was conducted to know the efficacy of PM for biogas production and composition in co-digestion with slaughter-house rumen digesta (SHRD) and effects of additives for odor reduction during temporary storage. In the first experiment, PM was mixed with SHRD at 100:0(RD_0), 75:25(RD_{25}), 50:50 (RD_{50}), 25:75(RD_{75}) and 0:100 (RD_{100}) on total solid (TS) basis and anaerobically digested in laboratory simulated biogas digester at 35^0C for 54 days. Gas production was measured daily, gas composition was analyzed weekly, pH and microbial load was determined at beginning in fresh substrate and bio-slurry at the end. In the second experiment, 1 kg of PM was surface applied with either "no additives" (control) or aqueous solution (5%) of different chemicals e.g., aluminium sulfate (AS), calcium chloride (CC), hydrogen peroxide (HP) or aqueous extract (10%) of different plant sources e.g., *Sapindus mukorossi* (SM) fruit, *Azadirachta indica* (AI) leaf and *Yucca schidigera* (YS) plant for 4 consecutive days. The pH and concentration of NH_3 and H_2S were analyzed before and immediately after (0 hours) additive application and then daily up to day 4. The *E. coli* and *Salmonella spp.* were counted at the beginning and at the end of the experiment. Gas composition data were analyzed using repeated measures in General Linear Model (GLM), while other data were subjected to Analysis of Variance (ANOVA) in complete randomized design (CRD) in SPSS 20.

In experiment 1 (Table 1), biogas production was observed highest (P<0.01) in RD_{25} and RD_{50} than that in other treatments, which was almost double compared to the control. Moreover, CH_4 concentration was found triple time higher (P<0.01) in $RD_{25,}$ RD_{50} and RD_{75}, compared to the control and RD_{100} treatment. Though the fresh substrates contained *E. coli* (Average 5.9±0.02 $\log_{10}$ CFU/g) and *Salmonella spp.* (Average 5.2±0.02 $\log_{10}$ CFU/g) but none of the slurries contained any of these microorganism after anaerobic digestion.

Table 1. Biogas production from anaerobic co-digestion of PM with SHRD in different ratios

Biogas production	Treatments					SEM	*Sig*
	RD_0	RD_{25}	RD_{50}	RD_{75}	RD_{100}		
Biogas production							
Total gas, L	7.0^{c}	13.4^{a}	13.9^{a}	11.0^{b}	5.4^{c}	0.14	<0.01
L/kg of FM	18.9^{b}	32.2^{a}	27.8^{a}	20.9^{b}	8.1^{c}	0.31	<0.01
L/kg of TS	66.6^{b}	113.4^{a}	107.6^{a}	83.0^{b}	38.8^{c}	1.44	<0.01
L/kg of VS	80.1^{b}	148.9^{a}	147.7^{a}	124.3^{a}	63.6^{b}	2.08	<0.01
Daily gas, ml/ day	128.6^{c}	248.5^{a}	257.5^{a}	204.3^{b}	100.6^{c}	2.67	<0.01
Biogas composition							
CH_4, %	10.1^{c}	30.6^{b}	33.1^{a}	31.9^{ab}	8.5^{c}	0.58	<0.01
CO_2, %	29.7^{a}	26.8^{a}	22.6^{b}	21.5^{b}	14.6^{c}	1.02	<0.01
NH_3, ppm	478.5^{a}	292.8^{b}	209.6^{c}	202.6^{c}	32.4^{d}	9.22	<0.01
H_2S, ppm	2770.5^{a}	1597.5^{b}	946.8^{c}	1016.5^{c}	43.2^{d}	39.46	<0.01

TS, Total solids; VS, volatile solids; FM, fresh manure; SEM, Standard error of mean; $^{a-e}$Means having different superscripts differ significantly (P<0.05).

In experiment 2 (Figure 1), NH_3 and H_2S concentrations were reduced ($p<0.01$) in all additives compared to the control after 24h, while they were similar ($P>0.05$) at the beginning. However, extent of gas reduction was varied among treatments. The highest reduction of NH_3 was found in AS (95.9%) followed by CC (64.4%) and SM (50.8%), while for H_2S, reduction was highest in AS (93.7%) followed by CC (85.5%) and SM or HP (79.0%) from initial concentration (data not shown). All additives reduced *E. coli* and *Salmonella* count, but plant extracts showed more antimicrobial activity (data not shown).

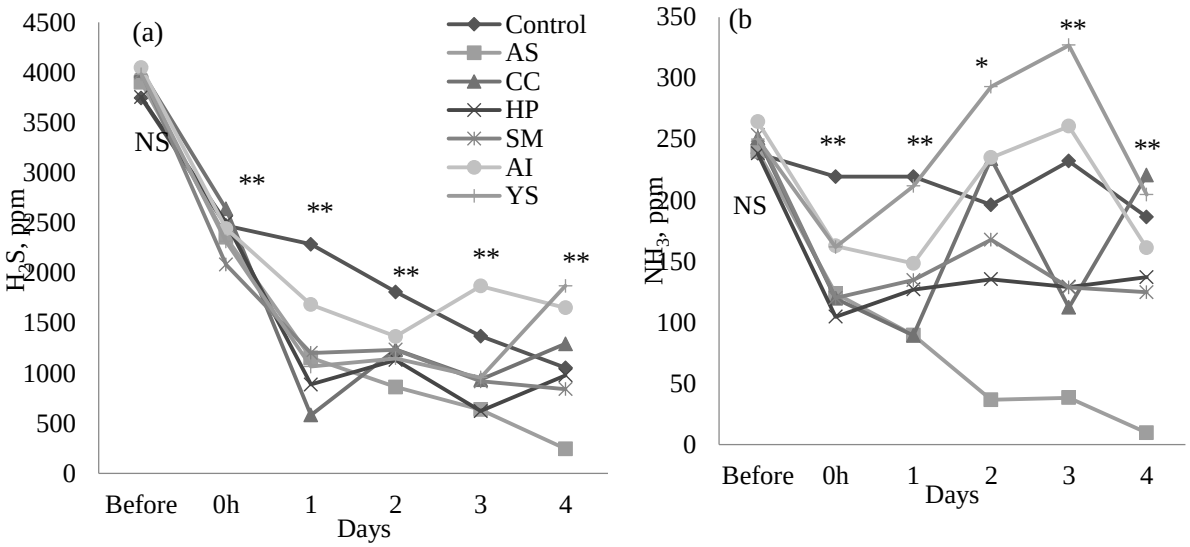

Figure 1.Changes of concentration of (a) hydrogen sulfide and (b) ammonia in different treatments at different time periods. AS, aluminum sulfide; CC, calcium chloride; HP, hydrogen peroxide SM,*Sapindusmukorossi*; AI,*Azadirachtaindica* and YS,*Yucca schidigera*; **, P<0.01; NS, Non-significant.

In conclusion, PM can be co-digested with SHRD from 25-50% for doubling biogas production with increased (triple time) CH_4 concentration. Again, aqueous solution of chemical additives, especially AS and CC and plant origin extract, especially SM can be applied on the surface of PM for reducing odorous gases like NH_3 and H_2S as well as microbes (*E. coli* and *Salmonella*) of public health concern.

Carbon footprint of beef cattle production at Khulna division of Bangladesh

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Executive summary

The beef cattle farming enterprise contributes to greenhouse gas (GHG) emission. This GHG emission is associated with the production or purchase of farm feed recourses, enteric fermentation of feedstuffs in the rumen, manure management system and farm operation activities. The exploration of carbon footprint of beef cattle production is of importance in order to identify major sources of GHG emission from their farming and to take appropriate mitigation measures.

In order to study this, a survey was conducted in 202 beef cattle farms at Khulna division, Bangladesh. The partial tier 2 approach of IPCC was followed to estimate the greenhouse gas emission factors for enteric fermentation, manure management, farm operation and farm feedstuffs under a gate to gate system boundary where the quantification was done during the period from the animals being housed to being sold. During the survey, 10 representative samples of each feedstuff from different farms (about 500 g) (different fodders, local grasses, rice straw, and concentrate mixtures) were collected and analyzed in the laboratory to calculate energy and nitrogen intake of animals. Nitrogen excretion rate which determines nitrous oxide emission was estimated by using appropriate mathematical model. The difference in emission factor between small (1-5 cattle) and large farms (>5 cattle) was calculated. The carbon footprint of farm feedstuffs of the study area are presented in the Table 1. It showed that the carbon footprint of Napier, Jumbo and maize grass was 12.72, 11.44 and 21.48 CO_2e kg/t fresh biomass. All the farms had to purchase feedstuffs to meet their requirements, and its average share was 0.77. Considering the distance between farm and market (2.58 km), the carbon footprint of purchased feedstuffs was estimated as 0.97 CO_2e kg/t fresh biomass. Considering the share of purchased and cultivated feedstuffs, the resultant carbon footprint of farm feedstuffs was quantified as 2.55 CO_2e kg/t fresh biomass.

Table 1. Carbon footprint of farm feedstuffs (fresh basis)

Parameters	Carbon footprint		
	Mean	SD	Replication
Carbon footprint of Napier grass, kg CO_2e/t fresh	12.72	1.25	100
Carbon footprint of Jumbo, kg CO_2e/t fresh	11.44	1.64	12
Carbon footprint of Maize, kg CO_2e/t fresh	21.48	3.24	7
Share of purchased feedstuffs in the total farm feedstuffs	0.77	0.25	202
Distance between market and farm, km	2.58	1.97	202
Carbon footprint of purchased feedstuffs, kg CO_2e/t fresh	0.97	0.70	202
Carbon footprint of farm feedstuffs, kg CO_2e/t fresh	2.55	2.57	202

SD, standard deviation.

The emission factor of different GHG and the carbon footprint of beef cattle production are presented in the Table 2. The study found that the emission factors of enteric methane, direct and indirect nitrous oxide, carbon dioxide from farm operation and feedstuffs were different between small and large farms ($P<0.05$). However, manure methane emission was not different between them. Considering the emission factors, the cumulative GHG emission from different sources of farming enterprise resulted in the carbon footprint of 11.12 CO_2e kg /kg LW of beef cattle (7.57-19.42), which was similar between small and large farms ($P>0.05$).

Table 2. Greenhouse gas emission factor and carbon footprint of beef cattle production

Parameters	Farm size				All farms	
	Small	Large	SEM	P-values	Mean	Range
Emission factors						
Enteric CH_4 emission, kg/year CH_4	38.02	47.10	12.08	0.000	42.47	21.70-75.50
Manure CH_4 emission, kg/year CH_4	6.48	9.54	11.35	0.057	7.98	0.35-73.00
Direct N_2O emission, kg/year N_2O	1.93	2.37	0.58	0.000	2.15	1.18-3.77
Indirect N_2O emission, kg/year N_2O	0.06	0.10	0.07	0.000	0.08	0.00-0.29
Farm operation, kg/year CO_2e	193.00	140.00	64.81	0.000	167.00	17.10-411.00
Farm feedstuffs, kg/year CO_2e	2.63	5.04	3.30	0.000	3.81	0.11-22.97
Carbon footprint, kg CO_2e/kg LW						
CH_4 from enteric fermentation	5.54	5.54	0.79	0.997	5.54	4.00-7.59
CH_4 from manure management	0.95	1.15	1.42	0.305	1.05	0.04-7.35
Direct N_2O emission	3.38	3.32	0.48	0.435	3.35	2.37-4.91
Indirect N_2O emission	0.11	0.13	0.09	0.037	0.12	0.00-0.39
CO_2 emission from farm operation	1.19	0.74	0.47	0.000	0.97	0.08-2.64
CO_2 emission from farm feedstuffs	0.07	0.13	0.08	0.000	0.10	0.002-0.50
Total carbon footprint	11.23	11.02	2.20	0.498	11.12	7.59-19.42

Small farm, 5≤ beef cattle; Large farm, 5< beef cattle; SEM, standard error of mean; P<0.05, significant.

In conclusion, it may be stated that the carbon footprint of available feedstuffs in the beef cattle farms of the study area was 2.55 CO_2e, kg /t fresh. It may be 11.12 CO_2e kg/kg LW of beef cattle production.

Study on the improvement of existing manure management system of Bangladesh

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Executive summary

Animal wastes are important resources to supplement soil organic matter with mitigating several national challenges like renewable energy, the sector which got a noticeable priority from the Government of Bangladesh. Anaerobic digestion is now a forwarding step to turn animal waste into benefit where a major challenge of managing bio-slurry is being faced. Regarding this issue, the present study was designed to determine the extent of bio-slurry production from per kg dung, the existing bio-slurry management system at field level, to introduce the BLRI developed technique of it's improved utilization and to explore the potentiality of bio-slurry water (BSW) on controlling pests of crop field. At the same time vermi-composting of cow dung was also studied to define its sustainability as animal waste management tool for small scale farmers. To determine the extent of bio-slurry production from DM of per kg dung, an animal trial with10 growing bull of BCB-1 cattle was continued for 1 month. Laboratory scale biogas digester was used for partitioning the biogas and slurry production. A baseline survey was conducted to represent the field condition of bio-slurry management for which a pre-tested questionnaire was used. Total 180 farmers of twelve different districts of whole country was interviewed personally for collecting data on concerned issue. Three farmers having biogas digester was selected at Sharifbag village of Dhamrai upazila to introduce the BLRI developed bio-slurry management technique. A laboratory based experiment was designed to determine the microbial association of bio-slurry water. To test the response of bio-slurry water (BSW) on controlling pest infestation two summer crops (brinjal and chilli) was cultivated at research field of horticulture department of BAU..An RCBD (Randomized Complete Block Design) experiment was designed with 6 (T_1=Basal Soil application of BSW, T_2=100% Foliar application of BSW, T_3= 50% Foliar application of BSW, T_4= 50% Soil Application and 100% Foliar application of BSW, T_5= Farmers practice (chemical pesticide) and T_6= Control (no pesticide)) treatments and three replication of each. For vermi-composting study, total 9 cement made round shaped pot was used and each pot was filled with 20 kg dung previously decomposed for 21 days and three level of red worm (100, 300 and 500 nos) with three replication of each. Results showed that, on an average, daily an animal ingested 7.84±0.2 kg DM and voided amount was 10.43±0.3 kg DM. Only 29.17% of per kg dung DM converts into bio-gas during anaerobic digestion and remaining 70.83% was come out with slurry. About 1.84 kg slurry was produced from per kg dung digestion and this slurry converts into fertilizer at the rate of 15%.

Table 1. Bio-slurry utilization routes (%)

Parameter	Results (Mean±SEM)
Crop field	12.29±1.10
Fish pond	8.96±1.16
Compost	0.32±0.15
Horticulture	3.04±0.68
Fodder Cultivation	5.22±0.66
Wasted	70.31±1.57

On average farmers having 5 or 6 either local or crossbred cattle were found to be interested in anaerobic digestion of animal solid biomass. Daily 10.73±0.19 kg dung per animal was produced of which 75% was used for biogas purpose, and 9% became totally wasted. But incase of bio-slurry management, most of the respondents never remove slurry from tank at a fixed interval or immediate after fulfilling the tank. They showed no interest to use it due to its semi-solid physical structure and to quantify the total produced amount. A very few of respondents utilized it in a sporadic way and their utilization routes are presented in Table-1,

which reveals that, about 70% of total produced bio-slurry remains in unused condition. The implication of BLRI developed sun-drying method of fresh bio-slurry up to desired DM (40-45%) level showed that, farmers never gave any attention for bio-slurry management and maximum time it overflows the tank in nearby pond or field. During summer, some of them prepared burning fuel from it and locally sell at very nominal price which accounts only 1500-2000 taka per year. But using the BLRI technique, they produced organic fertilizer with an impressive return rate and nutrient content. Bio-slurry water was found to compose of *Pseudomonas fluorescence*, *Bacillus*, *Xenthomonas* and *Trichoderma* species. Association of 50% soil with 100% foliar BSW application (T_4) on selected crops (Brinjal and Chilli) resulted minimum incidence of pest infestation (Table 2) and maximum quantity of crop yield (16.10 ± 0.55 ^{a} and 5.64±0.22a ton/ha). In case of vermi compost, maximum amount of fertilizer was obtained from dung with 500 worms.. On an average 60-70 worm was required for producing per kg fertilizer and per kg production cost was 4.00 taka. To utilize this huge valuable resources appropriate management approach should be define first in accordance to farm and farmer type and this will ensure the sustainability of farm and enhance farmers' profit.

Table 2. Effect of liquid bio-slurry on pests infestation of vegetable crops (Mean±SEM)

Treatments	Brinjal (% incidence)		Chilli (% incidence)	Yield (T/ha)	
	Brinjal shoot and fruit borer	Phomophsis blight infection	Anthracnose	Brinjal	Chilli
T_1	67.67 ± 4.41 ^{ab}	2.33 ± 1.33 ^{a}	4.24±1.88^{a}	9.43 ± 0.87 ^{b}	4.02±0.32^{a}
T_2	53.00 ± 2.31 ^{cd}	1.06 ± 0.96 ^{a}	7.45±3.87^{a}	7.52 ± 0.21 ^{bc}	4.07±0.68^{a}
T_3	59.00 ± 2.89 ^{bc}	1.36 ± 0.85 ^{a}	7.04±3.73^{a}	7.66 ± 0.32 ^{bc}	5.54±0.91^{a}
T_4	41.67 ± 3.38 ^{d}	0.10 ± 0.00 ^{a}	3.47±0.39^{a}	16.10 ± 0.55 ^{a}	5.64±0.22^{a}
T_5	48.00 ± 4.36 ^{cd}	0.10 ± 0.00 ^{a}	5.96±1.57^{a}	8.08 ± 0.27 ^{bc}	4.04±0.4^{a}
T_6	75.00 ± 2.65 ^{a}	3.33 ± 0.33 ^{a}	13.22±2.66^{a}	6.04 ± 0.32 ^{c}	4.27±1.07^{a}

$p<0.05$*= $p<0.05$; ** = $p<0.01$; NS= Non-significant

Baseline study on available horse genetic resources in Bangladesh

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Executive summary

Horse (*Equus caballus*), a non-ruminant equine species, has played significant role in the human civilization especially in developed countries. In Bangladesh, horse is widely used for racing, transportation, cart pulling, draft and social festival purposes in horse pocket areas. Very little and scanty information are available on impact of horse rearing on socioeconomic, available genotypes, their distribution and phenotypic characteristics. This study aimed to evaluate the impact of horse rearing on socioeconomic status of their owners and characterization of horse genetic resources in Bangladesh. A questionnaire was developed and pre-tested before final data collection. Data were collected from randomly selected 233 horse owners covering each administrative division (Coxs bazar, Chittagong; Jaintapur, Sylhet; Bogra and Rajshahi Sadar, Rajshahi; Dinajpur and Lalmonirhat, Rangpur; Kuakata, Barisal, Muktagacha, Mymensingh; Bangabazar, Gopalganj and Modhupur, Dhaka and Dumuria, Khulna division) through direct and indirect questions with farmers. Baseline data of the selected farmers were collected and analyzed descriptively by using Microsoft Excel and SPSS programme.

Farmers kept horse as a secondary source of income and agriculture is their main occupation (43.30%) followed by business (18.50%). The highest literacy level among the horse keepers was HSC (0.9%) and most of the farmers were literate (could sign their name only) (53.20%) followed by primary (25.30%) and illiterate (9%). Horses are reared mostly in semi-intensive (90.60%) and extensive system (7.70%) with the purpose of carrying load (wood, paddy, pineapple, banana etc.), human transportation and recreation (horse riding competition, riding in beach) throughout the country. About 29.60, 38.20, 26.20, and 4.30% horse rearer earned a yearly amount of TK 0-50000, 50001-100000, 100001-150000 and150001-200000 respectively. Generally no specialized horse breed was observed during this study and available horses are non-descript indigenous types (86.70%). Farmers usually rear horse as a linkage of their family tradition. About 43.30% farmer rear horse as a business and 77.30% farmer's rear horse as a source of livelihood and rearing of horse is 40.30% more profitable and easier than other livestock species. Among different age and sex group, 43.30% horses were stallion followed by gelding (21.00%) and mare (17.60%) in surveyed areas. Farmers purchased about 85.00% of the horses from different market and they frequently change their animal on the basis of their performances. Farmers always maintain young and energetic horse in their farm for carrying load. After end of productive life, horses are kept free until natural death. Natural breeding is common all over the country (100.00%) and they use their own (22%) or neighboring (78.00%) stallion for breeding purpose. Phenotypic, productive and reproductive characteristics of indigenous horses were presented in Table 1. Chestnut and bay coat color is predominating whereas black, albino, grey and roan color are also available. Star, stripe and patch color was observed on the faces. More concentrate and less roughage based feeding practices for horses are almost common throughout the country. Horses are engaged with carrying load for larger part of the day so they have minimum chances to have green grasses and their ration comprises with rice polish, maize/wheat crushed, mustard cakes and wheat/maize bran and salt. Due to having higher percentage of concentrate in their ration, bloating is regular problem of horse throughout the country. Deworming was practiced (89.69%) by farmers, where 99.57% have no knowledge about vaccination and they do not vaccinate their animals. Farmers rear horse in traditional method and there is no technology in terms of breeding, feeding and managements. So, in survey it was focused that they are interested to get training about horse rearing and management.

From the survey it has been concluded that there is a great opportunity to contribute in livestock GDP through horse farming in rural areas of Bangladesh. Government should take immediate initiative to address this livestock species for its conservation and subsequent development as well as the farmers who rely upon this germplasm as source of their livelihood.

Table1. Phenotypic, productive and reproductive characteristics of indigenous horse in Bangladesh

Phenotypic characteristics	Mean±SD
Body weight (Kg)	166.437±41.315
Body length (cm)	110.120±11.452
Heart girth (cm)	126.832±11.391
Neck length(cm)	40.543±6.395
Head length(cm)	43.428±4.865
Ear length(cm)	14.870±1.503
Front height(cm)	115.778±7.931
Back height(cm)	112.820±7.829
Ear to tail length(cm)	156.875±17.459
Kesore length(cm)	67.092±9.850
Tail length(cm)	42.700±13.312
Milk yield (Li/day)	0.95±0.25
Lactation length (months)	3.21±1.28
Birth weight (Kg)	15.67±4.84
Age of 1st heat (months)	34.19±6.58
Gestation length (months)	10.55±0.83
Estrous period (months)	1.38±0.75

Determination of income elasticity of demand and forecasting demand for milk, meat and egg in Bangladesh in 2025 and 2030

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Executive summary

Bangladesh is now recognized as one of the middle-income countries by achieving all the indexes. Since January 2016, Bangladesh is working to implement the Sustainable Development Goals to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. To be promoted to a middle-income country, it is necessary to increase protein intake level especially for children, women and economically active population. Protein is an important nutrient requirement in food chart. Milk, meat and egg are the main source of protein. With this sense, our study presents the relationship between income and demand for milk, meat and egg which we get from income elasticity of demand for these products by estimating coefficients through log linear regression. To achieve the objectives, both primary and secondary data were collected. About 700 primary data collected from 7 upazillas of 7 divisions through using a structured interview schedule. Secondary data (Time series data on protein consumption and price) were collected from BBS. The study also considered data of milk, meat and egg production in Bangladesh during the time periods 1979-80 to 2015-16 to find out appropriate deterministic type growth model using model selection criteria. The study found that the average daily consumption of milk is 40ml per day/person while the recommended amount is 250ml/day. The amount of meat consumed in Bangladesh has increased three times over past 40 years. Animal products consumption has increased due to population growth, urbanization and income growth that created an absolute Livestock Revolution. Many people's diets have changed over time. Though a significant portion of people in Bangladesh can afford animal protein daily, still considerable number of people cannot afford milk, meat and egg as required. The overall income elasticity for milk is elastic (1.69) and for meat (chicken, mutton, beef) and egg the income elasticity is inelastic (Table 1).

Table 1. Income elasticity of demand for milk, meat and egg

Divisions	Coefficients				
	milk	Chicken	beef	mutton	Egg
Dhaka	1.73334***	0.9242**	1.0665***	0.0418**	0.9061**
Rajshahi	1.74379***	1.0495***	0.7466***	0.8557*	0.9574***
Rangpur	2.34078***	1.5211***	0.1749***	0.8983**	0.3691***
Khulna	0.58618***	0.5515**	0.4326***	0.5647***	0.4981***
Barisal	1.77854***	1.2459***	0.9755***	0.8793*	0.4783**
Mymensingh	1.90435***	0.9756***	0.3349**	1.0517***	0.6903***
Sylhet	1.76579***	0.4907***	0.5255***	0.6176***	0.3776***
Overall	1.69	0.97	0.61	0.7	0.61

Note: The asterisks ***, ** and * indicate the statistical significant at 1%, 5% and 10% levels, respectively.

Trend analysis was done to estimate the population, and demand for milk, meat and egg in 2030. It could be mentioned here that though protein consumption and production are increasing but inequality exist in consumption pattern. Besides, our study describes the growth pattern of milk, meat and egg production and demand in Bangladesh by growth model with time series data using model selection criteria where cubic model is best fitted and quadratic model is the 2nd best fitted for each product. By calculating demand, our study estimates the surplus/deficit amount of milk, meat and egg in 2025 and 2030. In 2025, there will be surplus in milk, meat and egg and the amount is 73.31 lakh metric ton, 124.07 lakh metric ton, 1641.33 crore numbers respectively (Table 2). In 2030, there will also exist surplus in milk, meat and egg and the amount is 216.61 lakh metric ton, 257.11 lakh metric ton and 3746.35 crore numbers respectively. This study also shows socio-economic graphing by descriptive statistics where 700 households have been used. The findings of

this study will help to recommend policies to take necessary steps for the demand and production of milk, meat and egg in near future. Finally, it can be said that as any country goes forward, demand for animal protein will rise but income elasticity of demand will be inelastic for those products. The study is thus likely to contribute in public policy research of Bangladesh.

Table 2. Demand, production, availability and surplus of milk, meat and eggs in 2025

Products	Cubic (best fitted)			
	Demand*	Production	Availability	Surplus/ Deficit
Milk	168.16 Lakh Metric Ton (250 ml/day/head)	241.47 Lakh Metric Ton	358.99 (ml/day/head)	73.31 Lakh Metric Ton
Meat	80.72 Lakh Metric Ton (120gm/day/head)	204.78 Lakh Metric Ton	304.45 (gm/day/head)	124.07 Lakh Metric Ton
Egg	1916.55 Crore numbers (104 numbers/year/head)	3557.88 Crore numbers	5289.46 (numbers/year/head)	1641.33 Crore numbers

*Estimated population of the country: 184283630, ** (+) sign= Surplus and (-) sign=Deficit

Determinants of Profitability of Cattle Fattening: A technical and allocative efficiency analysis of fattening enterprise in Bangladesh

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Executive summary

The illegal border trade monitoring, the consumer habits and the local cattle production increase rate exceeded the beef cattle demand. In this scenario, management systems for livestock enterprises are decently developed, with minimum cost exotic fodder, obtaining a concentrated feed and available medicine. With control and open-market policy, agriculture and milk production react quickly, intensifying their production and increasing external inputs with the objective of increasing production and profit margins. Beef cattle production does not react with the same speed, and due to land competency for these activities, it is relegated to marginal zones and of minor production. Regarding this scenario, the study assessed the determinants of profitability of cattle fattening enterprise in selected area of Bangladesh. The study uses a sample of beef cattle farms that belong to the representative fattening region which includes 340 farms. About 90 farms for the period 2017/2018 and 250 farms for 2018/2019, data were collected using structured questionnaire. Descriptive, inferential statistics as well as budgetary technique were used to analyse the data obtained.The production frontier identification technique was used for each farms in order to measure their efficiency. The Technical efficiency is obtained when comparing a farm's beef production with the one proposed by the model in the same conditions, while allocative efficiency is established according to economic results comparing the enterprise's gross margin with the best possible margin (Colom, 1994).

Allocative efficiency shows the ability to achieve the best possible economic results.It was observed that cost of feeder cattle accounts for 79% of Total Variable Cost (TVC), Feeds 10%, Labour 7% while Drugs and Vaccines 4%. On an average, respondents obtained about Tk13,500 per cattle as profit of 120 days fattening period. Regression estimates of factors affecting Gross Margin (GM) of cattle fattening enterprise show that the coefficient of cost of feeds, number of cattle fattened were positive and significantto GM of the enterprise. The coefficient of cattle fattening experience, was also positive and significant ($p \leq 0.01$) to GM of the cattle fattening business. The study revealed that inadequate financial capability, feed scarcity and land for fattening were the major constraints to the enterprise.

After analysing management records the simulation model was developed.The linear programming was developed to optimize beef production according to the following decision criteria: minimum cost under energy and time constraints; and maximum yield under energy and time constraints. These simulation models, which represent the production frontiers that these enterprises may achieve, are later compared to the management results obtained; this allows to analysed, the technical and allocative efficiency of farms, simulate management proposals and establish production possibilities for different scenarios. The actual scenarios indicate that production may be four folded by modifying breed, feeding strategy and increasing profits of around 40% if a criterion of maximum yield is adopted and the allocative efficiency is improved.

The analysis of the farms' data permitted that subject to study adjust well to a minimum cost decision model, not to a maximum yield model, maintaining scarce supplementation. This demonstrates the aversion to the risk of livestock fattener, and also the lack of the process optimization. The technical efficiency of the farms were very good, which may be 0.89 kg/animal/day, while the allocative efficiency, shown in little low. This indicates that small changes in the observed enterprises that analysed result in being general technically efficient, but poorly efficient in allocation.

This frontier always located above the minimum cost frontier, the point of maximum concentrated feed consumption superior to the ones of minimum cost. Maximum yield is obtained in this case

with 4.4 kg/cattle /day. The fattening of 120 days and produces 200 kg of beef on an average. A gross margin of 13,500/cattle per cycle is produced.

The allocation of resources and proper management of the capital will produce significant improvement in the production and in the economic result. The study concluded that cattle fattening enterprise is profitable in the study area and various factors affect profit of cattle enterprise. The study recommends that capital should be provided in form of loan to cattle fatteners by government and Non-Governmental Organisations (NGOs). This will go a long way in improving cattle production and provide job opportunities for the teeming unemployed youth.

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 sustainable livestock 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 the technologies and adaptation. Keeping this mind, three villages namely Shorifbag, Soibaria and Fukutia under Dhamrai Upazila (100 households/village) were surveyed through structured questionnaires for a model village selection considering livestock prone area; farmer's interest; Govt. and Non-Govt. activities scenario and natural barrier like river. After village selection, the whole household (301 households) of the selected village were surveyed to know existing scenario where the farming system pattern were 60% of livestock +vegetable; 20% of crop + lobber; 8% of livestock + fodder and 12% of livestock+ businessman. Based on these scenario three technologies based group was formulated focusing on disease control, livestock-chicken production, and fodder production and preservation model and that time three local service providers (LSP) developed to service the community peoples.

Out of 301 farmers 50 farmers were given hands-on training and demonstration. A Society was formulated with holistic approach by selected farmers, local leaders, imam, DLS peoples, specialist and also volunteers. Mass deworming, vaccination and vitamin supplementation programme (1st & 2nd dose) were completed for developing a FMD and PPR free control village and poultry biosecurity measures. Total 60 blood samples were collected randomly before vaccination and after one month of vaccination to detect Antibody titre level of vaccinated animal. Total 679 cattle, 183 goat, 15 sheep and 857chicken, 415pigeons, 45ducks were taken under this programme. Total 20% farmers were directly involved with BLRI developed eight technologies and intervention but almost 100% were involved with FMD, PPR control model and Community based poultry biosecurity practice. Three farmers were selected for adaptation of Total Mixed Ration (TMR) technology; seven farmers for high yielding fodder (HYF) cultivation and preservation (Pakchong & Moringa); 25 farmers for improved native chicken (ND) rearing model; 15 farmers for beef fattening; 3farmers for developed bio-slurry based bio-fertilizer management; 6 famers for sheep and goat rearing. The TMR were prepared by using maize stover as roughage (R) with the concentrate (C) (R:C=50:50). A feeding trial was conducted using TMR technologies on growing bull calves to determine the feeding effect on body weight gain where 15 growing calves were equally divided into 3 treatment groups and duration of feeding trial was 90 days. Total 70 decimal land were cultivated under HYF production and used this fodder for their livestock feeding and four new kids were born under sheep and goat rearing. The animal waste management model will be developed to validate of BLRI developed technique of organic fertilizer production from bio-slurry and bio-slurry water use as an organic pesticide. Under this study, a survey of existing system of bio-slurry management by farmers, organic fertilizer production using bio-slurry, feed feces, fresh bio-slurry and produced organic fertilizer sample collection for nutrimental evaluation was done. The end of feeding trial study revealed that body weight gain per day (0.955gm) was higher in beef cattle fed 50:50 (roughage: concentrate) TMR compared to control (0,669g). No clinical outbreaks against FMD, PPR, ND and duck plague were found during this period and antibody level was protective after one month. In case of native chicken, the age at sexual maturity at 20 wks. Mortality rate in growing and laying period were found 1.6% and 0-1.2%, respectively under semi-intensive condition compare to existing native chicken. The body weight at 12th, 20th and 26th weeks of age 813g, 1274g, 1406g for Desi fowls respectively. Average egg production at 21-27 weeks of age was 25% and feed intake was 70.00 (g/bird/day) and egg weight varied from 32-35g and afternoon egg production found 21.19% where scavenging local native birds with an annual average production of 35-49 eggs/hen

each weighing 35-39g. Based on results it was clearly indicated that the native germplasm is much more potential in respect of disease resistant and production and reproduction perspectives and act as tools of income source for rural women. Therefore, a sustainable community or technology based village may be developed through validation and adaptation of developed technologies in selected areas which will lead to an increase in farmer's income.

Impact of farmers training on adoption of BLRI developed technologies

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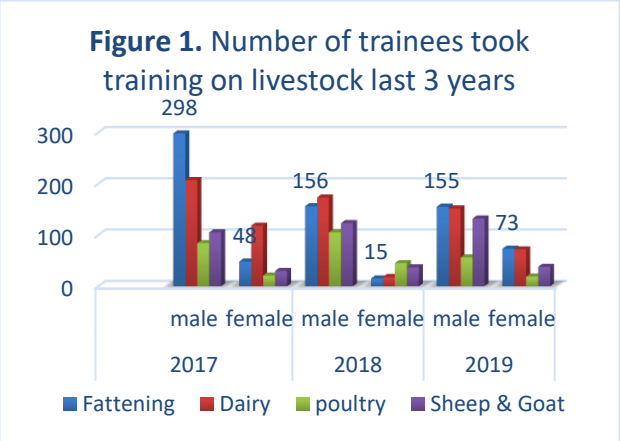
Executive summary

Most of the people in Bangladesh rear different species of livestock of indigenous chicken, cattle, buffalo, goat and sheep. Thus, the economy of Bangladesh is mostly dominated by Agricultural sector. Livestock also plays an important role in the national economy and its. Livestock contribution in GDP is about 2.5%. But almost all of them have no scientific knowledge and training on how to manage profitable livestock farming. Bangladesh Livestock Research Institute (BLRI) is providing training to livestock and poultry farmers alongside with research. This study was conducted to assess the impact of BLRI training on changes of socio-economic status of livestock and poultry farmers by taking information from poultry, goat, dairy and beef fattening farmers. Farmers of each category were taken face to face interview with a structured questionnaire prior to orientation of training and again after some period of training. Simple statistical measures like mean, average, and percentage were estimated for categorization and calculating data.



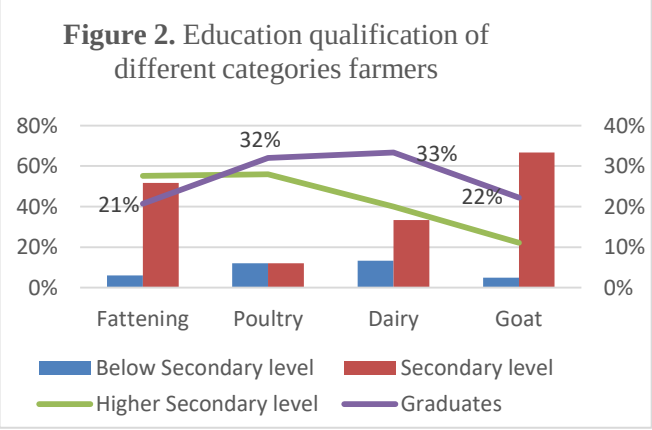


Figure 1 shows that the number of trainees taken training from BLRI last 3 years. Total 1756 number of male & 511 numbers of female had been trained in four technologies. Among them cattle fattening was the highest demanded technologies. To assess the output of training it should be essential to explore the socio-economic status of the farmers who were considered for interviewing. The analytical results revealed that respondent farmers were received various educational qualifications having graduation of 21%, 32%, 33%, 22%; fattening, poultry, dairy and goat rearing training respectively(figure 2). In case of occupation of the farmers most of them were occupied by business (33%), farming (27%), and service (13%). Rest 27% of them had different kind of occupations. Among the interviewed respondents about 73% household families had 4 to 6 family members. According to land lordship, about 35% were landless (0-49 d.m), about 36% were marginal (50-125 d.m), 17% were small (126-249 d.m), about 12% were medium (250-749 d.m), and only 1.28% were

large (>750 d.m),) farmers. Based on cropping pattern, about 21% farmers cultivate crops once in a year, about 47% twice in a year and about 32% thrice in a year.

Table 1. Technology adopted by different categories of farmers

Farmer category	% farmers adopted technology	
	Yes	No
Poultry	16	84
Goat	55.56	33.33
Dairy	100	-
Fattening	100	-

After getting specific training related to technology from BLRI, about 16% poultry farmers adopted poultry rearing technology, about 56% goat farmers adopted goat rearing technology and 100% dairy and fattening farmers adopted the relevant technologies in their own farms (table 1). Among poultry farmers, population size of chicken (native chicken) was 50.4 per household before training and it was increased to 250.4 chicken per household after training, while duck population was remain unchanged. In the goat keepers, the average population size per household of goat, sheep and kids before training were 5.56, 2.67 and 2.78 numbers, respectively, which increased to 5.78, 5.44 and 3.56. The average population size of dairy cows before training was 5.87 cows per household, which increased to an average of 10.00 cows. In the fattening farmers, the average population size of fattening bull before training was 4.04, which increased to 10.83 after training. The annual income of the different categories farmers are illustrated in (Table 2) which shows that a substantial percent of income is generated from poultry and others farming. Percent change have been found 34%, 29%, 15% and 18% for poultry, sheep & goat, dairy and fattening farmers respectively.

Table 1. Income of different categories farmers before and after training

Farmer category	Species	Income before training		Income after training		% change
		Range (lac BDT)	Average (lac BDT)	Range (lac BDT)	Average (lac BDT)	
Poultry (n=25)	Chicken	0-4.50	1.94	0-5.50	2.94	34%
	Duck	0-2.00	1.04	0-2.00	1.04	
	Total	0-5.30	3.44	0-5.30	4.44	
Sheep/Goat (n=09)	Sheep/Goat	0.80-3.55	1.55	0.80-4.55	2.00	29%
Dairy (n=15)	Cow	0.50-7.00	2.35	0.50-7.00	2.75	15%
	Bull	0.50-2.50	1.21	0.50-3.50	1.51	
	Total	3.50-4.05	1.61	3.50-4.55	1.75	
Fattening (n=29)	Bull	0.50-2.50	1.00	0.50-3.50	1.22	18%

Finally it concluded that the sign of increasing animal population size, income and food habit after getting training the improvement of socio-economic status of different categories of farmers. But they face several natural & marketing problems. To solve these, have to work more about disease control, vaccination, record keeping, marketing and women empowerment.

Comparison on different morphological parameter, biomass production and nutritive value of three fodder germplasms

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Executive summary

Scarcity of animal feeds and fodder has been identified as a major constraint for the development of livestock in Bangladesh.In this situation, it is of prime consideration to introduce suitable high yielding varieties of perennial fodder crops to the farmers.To meet up the increasing need of green fodder, it is very much essential to find out some potential fodder germplasms and recommend for extensive cultivation by the farmers for feeding their productive animals. Therefore, an experiment was conducted to compare the morphological characteristics, biomass yield and nutritive value of three fodder germplasms. The comparative agronomical trial was conducted at BLRI Regional Station, Baghabari, Shahajadpur, Sirajganj where the experiment was laid out in a Completely Randomized Design (CRD) with three treatments (Napier-4,Pukchong and Jumboo- Australian sweet) and each treatments having three replications. Three plots for every treatment having homogenous soil parameters were taken and the plot size was17ft×10ft. Fodder was propagated by stem cutting method and sowed in rows. Line to line and plant to plant distance were 70 and 30 cm, respectively. The plots were prepared by normal agronomical operations as routine weeding practices with the utensils like sickle, chen, spade etc. were done to remove undesirable grasses, bushes and plants, irrigation was performed by using a plastic pipe through a canal with the help of deep tube well in Baghabari station. In each experimental plot, irrigation was performed by using a plastic pipe through a canal with the help of deep tube well in Baghabari station. The first cut was made at 55 days after the stem sowing and then subsequent harvest was made at 40 days after each cutting. After each cutting, the plot was loosen manually by spade and urea was applied as top dressed.

Comparison on morphological characteristics and biomass yield of three fodder germplasms is presented in Table1. The result showed that plant height, stem length of three fodder differed significantly and highest plant height (267.00±13.45 cm) was observed at Napier but highest stem length was measure at Jumboo fodder. However, from the three germplasms it did not show any significant differences on leaf length and leaf per stem of plant. A significant effect ($P<0.01$) in biomass yield was observed between the groups and highest yield (182.00±4.04Ton/ha) was observed at Napier fodder. Comparison on morphological characteristics and biomass yield of three fodder germplasms is presented in Table2.The findings (at 55 days age) of the study showed that there were no significant differences ($P>0.01$) among the groups for DM, CP and ADF content but highest CP (17.37±0.36) and ADF (42.83±0.85) were observed at Pukchong grass and similarly highest DM (18.48±0.40) was observed at Napier grass. However the NDF and ash content of the germplasms were differed significantly ($P<0.01$).

Table 1. Comparison on morphological characteristics and biomass yield of three fodder germplasms

Parameter	Measuring unit	Groups (Mean ± SE)			P value
		Napier	Puctune	Jumboo	
Plant height	Centimeter	267.00±13.45	220.00±11.23	263.33±8.81	0.000
Stem length	Centimeter	158.00±24.84	112.66±8.83b	174.66±22.87	0.006
Leaf length	Centimeter	91.00±9.00	102.66±4.17	82.66±2.90	0.145
Leaf wide	Centimeter	4.16±0.60	3.16±0.44	6.66±0.66	0.004
Leaf per stem	Number	18.33±3.17	16.66±1.45	21.64±3.48	0.499
Till per hill	Number	17.33±0.88	7.66±0.33	7.00±0.57	0.000
Yield per hill	Kg	5.20±0.11	2.20±0.15	1.93±0.33	0.000
Biomass yield	Ton/hector	182.00±4.04	85.80±5.95	75.40±13.00	0.000

Table 2. Comparison on nutritive value of three fodder germplasms

Parameter	Measuring unit	Groups (Mean ± SE)			P value
		Napier	Puctune	Jumboo	
DM	%	18.48±0.40	17.37±0.36	17.94±0.14	0.133
CP	%	11.36±0.21	13.90±0.20	12.52±1.22	0.303
ADF	%	40.53±0.22	42.83±0.85	41.17±0.49	0.076
NDF	%	63.85±0.28	62.33±1.15	69.01±0.69	0.004
Ash	%	8.58±0.09	10.31±0.30	8.87±0.11	0.001

From the above findings it may be concluded that among the three fodder germplasms, Napier fodder was superior for biomass production while Puctune was better for nutritive values.

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

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Executive summary

The study was conducted to evaluate the performances of specialized fowl varieties at research farm of BLRI, to introduce new varieties of specialized fowl with the existing stock, and to know the existing turkey production system in some selected areas of Bangladesh. A total of 265 turkey poults were hatched including White and Mixed colored as new varieties with the existing Black and Bronze turkey germ plasm. Their weekly live weight and daily feed intake were recorded. A total of 100 turkey raisers were surveyed in Mymensingh, Gazipur, Narsingdi, Narayanganj and Dhaka district. A total of 460 hatching eggs of Pearl, White, Lavender and Black varieties of guinea fowl were collected and hatched for further breeding research. A total of 13 pairs were selected from the total of 52 pigeons on the basis of coat colour of Golla variety. There are 3 distinct colour were selected (White, White-Black and Mixed) to establish a foundation stock for high producing squab production.

At 1st, 4th , 8th and 12th week of age irrespective of varieties the average live weight, feed intake and FCR of turkey recorded 70, 316, 800 and 1700g/bird; 9, 31, 87 and 129g/bird/day, and 2.3, 2.0, 5.4 and 3.4, respectively. The mortality up to 12 week of age was 1.13%. Regarding turkey survey, business and farming was the main occupation by 56 and 12% respondents, respectively, and farming was secondary occupation by 90% farmers. Cent percent found literate and 40% got higher education, 71% respondents start turkey farming for higher profit, 37% for hobby and 59% started for commercial purposes. Sixty percent farms were small category (1-50 turkey) and among the 45% running farms, small category was 56%, and large scale was only 2%; 78% respondents did not have any knowledge on the variety of turkey reared. Cent percent farmers reared turkey with mixed varieties. The common varieties found as American Black, Bronze, White Holland, Beltsville Small White, Royal Palm, Bourbon Red, Silver and Mixed colored. American Black was the best turkey variety as per 55% respondents.

Table1. On station performance of turkey

Parameter	Week (Mean ± SD)			
	1st	4th	8th	12th
Live weight (g/bird/week)	70±2.36	316±14.90	800±44.64	1700±105.84
Feed intake(g/bird/day)	9.12±4.68	30.93±2.61	86.63±4.05	129.10±3.76
FCR	2.3	2.0	5.4	3.4

Higher growth rate, suitable for Bangladesh, low disease incidence, good meat quality were advantages of turkey rearing. Problems faced by the farmers in rearing turkey were unstable market, higher feed cost and low quality feed, lack of proper marketing channels, veterinary services and potential breeds. Cold, Pox, Ranikhet and Bird flu were reported as major diseases. Few years back the average price of per chicks, eggs and adult turkey was 840, 136 and 2650 Taka, respectively. The input (chicks and eggs) and the product prices of turkey was many fold higher than that of chicken and ducks that is the beyond capacity of common people. For making the price reasonable the cost of production must be lower. Therefore, some research initiative is imperative to overcome the existing problems in turkey production in Bangladesh e.g. i) Development of suitable breed ii) Formulation of low cost ration with the inclusion of nutritious forages, and iii) Established an organized marketing channels. The performance of existing pearl varieties of guinea fowl were live weight and feed intake at 20 weeks 1339g/bird and 100g/bird/day, respectively, age at sexual maturity was 17 week and hen day egg production up to 52 weeks was 20%.

Table 2. Field level performance of turkey

Sl. no.	Parameter	Average value
1	Age at first egg (months)	6.6
2	Egg production (number/year)	139
3	Clutch (Number	6
4	Fertility (%)	81
5	Hatchability (%)	74
6	Incubation by indigenous hen (number)	81
7	Incubation by turkey (number)	2
8	Incubation by incubator (number)	35
9	Marketing age (months)	6.3
10	Weight at marketing (Kg)	5.9
11	Feed required for 6 months (Kg)	23.5
12	Grass required for 6 months (Kg)	11.5
13	High mortality incidence (%)	28
14	Profitability (Tk. /50 turkey/year)	150,000.00 (Approx.)
15	BCR	1.79

The study revealed the actual turkey production scenario in Bangladesh and thorough research need to be conducted to make the turkey production sustainable. A good number of new varieties of specialized fowls were introduced and their performance study through selection and breeding is on-going to produce high producing specialized fowl breeds/varieties at BLRI.

Substitution of soybean meal by cotton seed meal as a source of protein supplement in the diet of broiler chicken

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Executive summary

Cotton is a versatile crop producing a number of products of value to man and domesticated livestock. The residue of cottonseed oil extraction industry commonly known as, cotton seed meal (CSM) is a fairly good source of protein (39%) and energy (15 MJ /kg). The use of CSM in poultry diet is limited due to the presence of some anti nutritional factors such as gossypol, cyclopropenoid fatty acids (CPFA) high fibre and poor protein quality. Hence, this study was conducted to find out the ability of substituting soybean meal by cotton seed meal to use in the broiler chicken diet. Two hundred eighty eight (288) day old broiler chicks were assigned to six dietary treatments for 5 weeks with four replications having 12 chicks per replication. Six dietary treatments were prepared from the basal feed as follows: control T_0 (100% Soybean meal (SBM) + 0% CSM), T_1 (90% SBM + 10% CSM), T_2 (80% SBM + 20% CSM), T_3 (70% SBM + 30% CSM), T_4 (60% SBM + 40% CSM), and T_5 (50% SBM + 50% CSM). Experimental diets were divided into three phases; starter 0-2 weeks, grower 3-4 and finisher 5th week of age. The diets were formulated following NRC (1998) standard and birds were reared by floor pen. The chemical composition of the diets was analyzed by following the detail guidelines of AOAC (2000), where the feed ingredients chemical compositions were analyzed.

Table 1. Effect of cotton seed meal (CSM) on the growth performance of broiler chicken (5th wk)

Treatment	T_o	T_1	T_2	T_3	T_4	T_5	SEM value
Initial BW (g/b)	43.67	44.07	43.55	43.84±0.15	44.00	43.37	0.92
Weight gain (g/b)	1459	1527	1566.87	1475.50	1452.47	1486.73	17.53
Final Wt (g/b)	1415.48	1443.77	1518.33	1431.67	1431.45	1444.35	17.52
Feed intake (g/b)	3004.35	3181.30	3162.15	3170.20	3142.87	3135.22	9.09
FCR	2.50	2.28	2.15	2.27	2.37	2.23	2.20

FCR : Feed Conversion Ratio

Numerically, highest weight gain was observed in 80% SBM + 20% CSM dietary group than other treatments (Table 1). The similar trend was observed in feed conversion ratio. This imply that up to 20% cotton seed meal can be incorporated to soybean meal that will obviously reduce the 20% demand or load in feed formulation in poultry. Kanyinji and Sichangwa (2014) also got the similar result; they compared the efficacy of unfermented and fermented CSM, used at the dietary levels of 15 or 20% as replacements of soybean meal in broilers nutrition. Addition of 600 ppm Fe (El Boushy and Raterink, 1989) was done in the treatments to mitigate the gossypol content in the cotton seed meal.

The proximate components of broiler breast and thigh (Table 2) meat were analyzed. Moisture and Dry matter (DM) in both types of meat didn't show any significant ($p>0.05$) variation among the treatments. The amount of crude protein (CP) in breast meat showed about 2% higher than thigh meat in all the treatments (Table 2). Crude fat (CF) content was found higher in all the thigh meat than breast meat. The ash content in the meat (80% SBM & 20% CSM) for both breast and thigh meat showed highest than less CSM content group

Table 2. Effects of dietary CSM treatments on breast and thigh meat composition (%) of broiler chicken

	To	T1	T2	T3	T4	T5
Breast meat						
Mo	74.26± 1.12	72.81±0.64	72.42±0.33	72.20±0.42	70.77±0.72	71.38±0.48
DM	25.74±1.12	27.19±1.29	27.58±0.33	27.80±0.42	29.23±0.72	28.62±0.48
CP	21.89±0.88^{ab}	22.24±0.42^{a}	21.39±0.77^{ab}	20.85±0.93^{bc}	20.72±0.41^{bc}	22.57±0.53^{a}
EE	0.96±0.17^{d}	1.70±0.47^{c}	2.32±0.21^{ab}	2.28±0.18^{a}	2.56±0.22^{ab}	2.26±0.16^{b}
CF	0.96±0.13^{a}	0.90±0.11^{a}	0.79±0.05^{b}	0.69±0.05^{b}	0.70±0.07^{b}	0.78±0.09^{b}
Ash	1.30±0.11^{c}	1.32±0.15^{c}	2.01±0.11^{ab}	2.14±0.19^{a}	1.80±0.05^{ab}	1.50±0.07^{bc}
Thigh meat						
Mo	71.39±2.56	71.74±2.16	73.83±0.77	74.04±0.81	73.30±0.86	73.37±0.69
DM	28.61±0.48	28.27±2.16	26.17±0.38	25.96±0.41	26.7±0.86	26.63±0.69
CP	19.90±0.67^{ab}	20.46±0.69^{ab}	19.36±0.85^{ab}	18.05±0.21^{c}	18.76±0.64^{bc}	20.03±0.62^{ab}
EE	1.36±0.22^{c}	2.88±0.31^{bc}	3.09±0.12^{ab}	3.69±0.22^{a}	3.62±0.42^{ab}	3.62±0.11^{ab}
CF	1.49±0.13^{a}	1.05±0.17^{bc}	1.02±0.09^{bc}	1.09±0.05^{bc}	0.97±0.03^{c}	1.10±0.07^{bc}
Ash	1.30±0.24^{bc}	1.06±0.17^{c}	1.42±0.21^{bc}	1.72±0.27^{a}	1.22±0.21^{bc}	1.14±0.05^{bc}

Mo = Moisture, DM = Dry Matter, CP=Crude Protein, EE= Ether Extract, CF=Crude Fat, NFE = Nitrogen Free Extract, The value are mean ± SE

It can be concluded that CSM is an acceptable ingredient in poultry diets, relatively rich source of protein and can be replaced up to 20 percent of soybean meal in the broiler production.

Improvement of Black Bengal Goat in rural areas

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Executive summary

Bangladesh has only one goat breed of its own, popularly known as Black Bengal Goat (BBG). The BBG is a dwarf breed of goat and known to be famous for its high adaptability, fertility, prolificacy, delicious meat and superior skin. Selection is one of the vital tools for improving the native animal genetic resources. Since 1988, Bangladesh Livestock Research Institute (BLRI) has taken attempted to improve BBG through selective breeding. In this situation, "Co-operative Village Breeding Program" may play a vital role in the improvement of indigenous goat. The objectives of this project were to improve the Black Bengal goat at farmer's level, to improve livelihood of community farmer through rearing Black Bengal goat and to operate community based Buck Park at farmer's level. The research was conducted at three villages namely Pachpai, Borochala and Gangatia under Bhaluka Upazilla of Mymensingh district. A well organized questionnaire was developed for baseline survey through Participatory Rural Appraisal (PRA) to know the goat population, management, feeding and breeding system, social status of the farmers etc. Fifty (50) farmers were selected randomly in the project areas to conduct baseline survey and finally fourteen (14) farmers were selected who had at least 4-5 years experiences of BBG rearing under community breeding program. Twenty (20) maiden does and six (6) superior bucks taken from Goat Research Farm, BLRI were distributed among 14 selected farmers. All the distributed goats were tagged for their identification. A well organized recording card was given to record all the data of the goat in the community. Routine vaccination and de-worming were practiced. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0.

Table1 shows the performance of BLRI BBG progeny. The birth weight, 3 month weight, 6 month weight, 12 month weight and litter size were significantly ($p<0.001$) higher in progeny of BLRI bucks than progeny of BLRI does. There was no significant difference of gestation length between progeny of BLRI bucks and progeny of BLRI does.

Table1. Performance of BLRI BBG progeny at farmer's level

Parameters	Progeny of BLRI does	Progeny of BLRI bucks	Level of significance
	Mean±SE	Mean±SE	
Birth weight (kg)	1.42±0.05^{b} (57)	1.52±0.06^{a} (66)	***
3 month weight (kg)	6.98±0.36^{b} (41)	8.74±0.28^{a} (46)	***
6 month weight (kg)	11.47±0.68^{b} (24)	14.96±0.44^{a} (40)	***
12 month weight (kg)	15.40±0.48^{b} (15)	19.14±0.94^{a} (24)	***
Litter size (no)	1.76±0.09^{b} (28)	2.21±0.11^{a} (33)	***
Gestation length (days)	145.22±0.68 (28)	148.81±0.77 (31)	NS
Kidding interval (days)	247.25±37.32 (14)	-	-

Figures in the parenthesis indicate the number of observation, ***= Significant at 0.1% level of probability ($p<0.001$). NS= Not significant ($p>0.05$).

The effect of sex, parity and litter size on performances of BLRI BBG progeny at farmer's level are shown in Table-2. Result shows that, sex had significant effect on birth weight ($p<0.05$), 3 month weight ($p<0.05$) and 6 month weight ($p<0.01$). There was no significant effect of sex on gestation length. There was no significant effect of parity on birth weight, 3 month weight, 6 month weight and gestation length. There was no significant effect of litter size on birth weight, 3 month weight, 6 month weight except on gestation length.

Table 2. Effect of sex, parity and litter size on performances of BLRI BBG progeny at farmer's level

Factors	Parameters			
	BW (kg)±SE	3M (kg)±SE	6M (kg)±SE	GL (days) ±SE
Sex				
Male	1.32±0.05 (25)	8.40±0.52 (15)	11.02±0.64 (10)	145.16±0.82 (15)
Female	1.20±0.08 (22)	6.47±0.66 (18)	8.94±0.72 (12)	146.67±1.02 (12)
LS	*	*	**	NS
Parity				
1	1.31±0.07 (11)	7.58±0.42 (9)	9.70±0.42 (8)	146.71±0.72 (10)
2	1.25±0.14 (14)	7.77±0.40 (6)	8.79±1.22 (9)	145.71±0.42 (9)
3^{+}	1.15±0.19 (10)	7.65±1.20 (8)	8.84±2.30 (6)	148.40±1.50 (8)
LS	NS	NS	NS	NS
Litter size				
1	1.49±0.15 (19)	8.05±0.81 (8)	10.40±0.49 (8)	148.14±1.42 (8)
2	1.30±0.17 (16)	7.19±0.35 (4)	9.22±0.69 (6)	146.10±0.64 (11)
LS	NS	NS	NS	*

BW= Birth weight, 3M= 3 month weight, 6M=6 month weight, GL= Gestation length, LS= Level significance. Figures in the parenthesis indicate the number of observation.*= Significant at 5% level of probability ($p<0.05$), **= Significant at 1% level of probability ($p<0.01$), NS= Not significant ($p>0.05$).

Superior bucks and does will be selected for breeding purpose according to their performance. The study will be continued until a significant level of achievement through community based goat production in the study areas.

Conservation and improvement of native sheep at BLRI

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Executive summary

Sheep production is an important component of livestock sector to address the food insecurity and reduce poverty among smallholder farmers in the developing countries like Bangladesh because of their unique adaptation to marginal environments with low level of input, high prolific nature and contributes much for sustaining rural livelihoods by producing a wide range of products. Conservation is the management of human use of the biosphere, so that it may yield the greatest sustainable benefits to present generation while maintaining its potential to meet the needs and aspirations of the future generations (FAO, World Watch List, 2000). Therefore, considering the above facts and circumstances this project has designed for conservation and improvement of native sheep at Goat and Sheep Research Farm, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. The breeding program was conducted at Goat and Sheep research farm. The breeding program was conducted through Open Nucleus Breeding System (ONBS) in such a way, which resists inbreeding. Ram was kept separately from ewes to avoid unplanned mating. 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. The subsequent data are being recorded throughout the year. Subsequently, a Nucleus Breeding Herd is being established by selecting superior ewes and rams of the respected breeds. All the sheep of this study were tagged to maintain the individual identity. During this study, phenotypic measurements on indigenous sheep populations (Barind, Jamuna river basin, Coastal) were recorded using measuring tape and hanging digital balance following the guidelines of FAO. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0.

Table 1. Morphological characteristics of different type of indigenous sheep in Bangladesh (Mean±SE)

Parameters	Type of indigenous sheep in Bangladesh			F-value	Sig.
	Coastal sheep	Barinda sheep	Jamuna river basin sheep		
Body weight (kg)	21.42±0.51^{a} (145)	17.91±0.68^{b} (58)	19.05±1.23^{ab} (24)	19.90	p<0.001
Body length (cm)	55.44±0.49 ^{a} (145)	51.76±0.76 ^{b} (58)	52.99±1.15 ^{b} (24)	8.75	p<0.001
Height at wither (cm)	54.48±0.42^{a} (145)	51.71±0.58^{b} (58)	52.83±1.00^{ab} (24)	7.08	p<0.001
Chest girth (cm)	64.12±0.83^{a} (145)	60.69±0.98^{b} (58)	61.81±1.72^{b} (24)	3.05	p<0.05
Tail length (cm)	12.67±0.14^{a} (145)	11.42±0.22^{b} (58)	11.64±0.43^{b} (24)	12.20	p<0.001

Means with uncommon superscripts differ significantly. Figures in the parenthesis indicate the number of observation.

Table 1 showed that, body weight, body length, height at wither, tail length were significantly (p<0.001) higher in Coastal sheep than Barind and Jamuna River Basin sheep. Chest girth was significantly (p<0.5) differed among Coastal, Barind and Jamuna River Basin sheep.

Table 2 showed that, post lambing ewe weight and Birth weight of lamb were significantly (p<0.01) differed among Coastal, Barind and Jamuna River Basin sheep. There was no significantly difference among Coastal, Barind and Jamuna River Basin sheep for Gestation Length, Litter size and Placenta weight. Superior rams and ewes will be selected by the individual performance. Therefore, the selection program will be continued until significant results.

Table 2. Productive and reproductive traits of different types of indigenous sheep at BLRI

Parameters	Coastal sheep	Jamuna river basin sheep	Barinda sheep	Sig.
	Mean±SE	Mean±SE	Mean±SE	
Gestation Length (days)	146.61±5.41(6)	152.81±3.76(14)	145.00±4.06(17)	NS
Litter size	1.75±25(0.19)	1.59±0.12(48)	1.65±0.13(53)	NS
Post lambing ewe weight (kg)	19.21±0.59(24)	17.83±0.38(46)	19.56±0.42(49)	P<0.01
Placenta weight (gm)	331.00± 18.59(23)	355.47±14.12(44)	335.91±15.51(47)	NS
Birth weight of lamb (kg)	1.42±0.06 (42)	1.34±0.04(86)	1.57±0.05(74)	P<0.01

Figures in the parenthesis indicate the number of observation.

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

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Executive summary

Cattle, goat and chicken are the major and popular sources of meat in Bangladesh. Numbers of programmes were implemented and some of them are under execution for increasing production efficiency of cattle, goat and chicken species. These initiatives results 76.11% increment in national meat production in 2010-11 compared to domestic production of the year 2005-06 (BBS, 2012).However, this rate of increment is not sufficient to meet the national demand of meat. Therefore, different species including sheep might be emphasized as a meat animal. Meat produced by different conventional sources like poultry, cattle, sheep and goat is quite insufficient to meet-up the growing demand of animal protein in spite of high density of livestock. Protein deficiency has been taken as the major contributory factor in malnutrition. It is therefore, important to develop crossbred to minimize the deficiency of animal protein. 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 Bangladesh Livestock Research Institute, Savar, Dhaka. A total of 75 native Coastal type ewes were crossed naturally with the ram of pure Damara, Dorper and Parendale sheep breed (25 ewes for each breed). The average body weight of costal ewes were 20 kg or above and 70 kg or above for the ram of foreign sheep. All the ewes and rams were housed in slated floor permanent house raise above the ground level with sufficient space to keep them comfortable. Ram was kept separately from ewes to avoid unplanned mating. Green grass was supplied at *adlibitum* basis and concentrate (17% CP, 11MJ ME/kg DM) was offered twice daily (morning and evening) at the rate of 1.5% of body weight per day. The birth weight of newborn kids was taken by digital weighing balance within one hour after birth. The subsequent weight of kids was recorded in the morning and before feeding at fortnight basis throughout the year. Subsequently, the data on productive and reproductive performances were recorded regularly. The collected data were analyzed by SPSS 17.0 Statistical computer programme.

Damara-Coastal crossbred lamb

Dorper-Coastal crossbred lamb

Parendale-Coastal crossbred lamb

Table 1. Production performances of different crossbred sheep genotype (Mean ± SE)

Parameters	Sheep genotypes		
	Damara-Coastal crossbred	Dorper-Coastal crossbred	Parendale-Coastal crossbred
Birth weight (kg)	1.98±0.06 (45)	1.97±0.19 (10)	1.87±0.86 (9)
3 month weight (kg)	9.80±0.35 (40)	11.56±0.76 (5)	8.57±0.78 (5)
6 month weight (kg)	12.12±0.52 (35)	13.98±0.74(4)	12.87±0.65(4)
3 month growth rate (g/d)	87.2±0.04 (40)	104.6±0.01 (5)	73.00±0.02 (5)
6 month growth rate (g/d)	71.00±0.02 (40)	65.2±0.01(4)	69.59±0.03(4)

The production performances of different crossbred sheep genotype are presented in Table 1. Birth weight, body weight at 3 months and 6 month t of Damara-Coastal crossbred genotype were 1.98±0.06 kg, 9.80±0.35 kg and 12.12±0.52 kg, respectively. On the other hand, 3 month and 6 month growth rate of Damara-Coastal crossbred genotype were 87.2±0.04 g/d and 71.00±0.02 g/d, respectively Birth weight, 3 month weight and 6 month weight of Dorper-Coastal crossbred genotype were 1.97±0.19 kg, 11.56±0.76 kg and 13.98±0.74 kg, respectively. Beside this, 3 month and 6 month growth rate of Dorper-Coastal crossbred genotype were 104.6±0.01 g/d and 65.2±0.01 g/d, respectively. Birth weight, 3 month weight and 6 month weight of Parendale-Coastal crossbred genotype were 1.87±0.86 kg, 8.57±0.78 kg, and 12.87±0.65, respectively. The growth rate of Parendale-Coastal crossbred genotype for 3 month weight and 6 month were 73.00±0.02 g/d and 69.59±0.03 g/d, respectively. Superior rams and ewes will be selected by the individual performance. This is on-going research program. The study will be continued until significant results.

Evaluation of new developed lines from BLRI Napier-3 cultivar under saline condition in coastal region of Bangladesh

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Executive summary

The South West region of Bangladesh is covers almost 29,000 km^2 (20% of the country), which contains 30% of the cultivable lands of the country. However, about 53% of the coastal areas are affected by different levels of salinity, in which approximately 49% of the population is engaged in farming crops, livestock or aquaculture. Saline intrusion is widely considered to have a negative impact on agriculture, reducing plant growth and decreasing productivity as well as grazing land and fodder crops for livestock production. Salinity levels do fluctuate between seasons and between different geographical areas along the coast. In the view of developing salt tolerant fodder crops, BLRI Napier-3 cultivar was exposed to gamma rays (Gys) irradiation and performs tissue culture (micro-propagation) for development of salt tolerant new Napier line(s). Two mutant lines (Line-2 and Line-3) from gamma irradiation and one line (Line-1) from tissue culture (micro-propagation) along with a control (mother cultivar) were selected for field testing in the Southern part of Bangladesh. Five innovative farmers were selected and plot size for each line was (10x12) ft. Soil and irrigated water samples taken in both wet (June-November) and dry seasons (December-May) from each farmer and were analyzed. Fertilizer dose was estimated on the basis of soil test following FRG-2012. First harvest was done at 60 days after plantation and subsequent harvests were done at 50 days interval. Plant survivability, biomass yield, plant height, number of tiller per clump, leaf and stem weight were recorded and analyzed statistically by SPSS 20.0 package.

In wet season, soil EC was estimated as 3.65±0.51 dS/m which significantly ($p<0.05$) increased as 5.02±0.63 dS/m in dry season. Water EC in dry season (11.98±0.12 dS/m) was significantly ($p<0.01$) higher than in wet season (4.95±0.09 dS/m). Survivability, biomass yield, tillering, plant height and leaf to stem ratio varied significantly ($p<0.05$; $p<0.01$) among lines in both wet (June-November) and dry seasons (December-May) except leaf to stem ratio in dry season. In wet season, highest survivability (82.90±1.93%), biomass yield (27.52±0.89 ton/ha/cut), tillering (39.52±1.48 numbers/clump) and plant height (62.20±1.13 inch) were obtained in Line-2 and leaf to stem ratio (1.19±0.03) in Line-1 (Table-1). However, in dry season, highest survivability (74.50±1.25%), biomass yield (21.13±0.65 ton/ha/cut), tillering (32.04±1.04 number/clump) and plant height (52.20±1.46 inch) were obtained in Line-2. Highest leaf to stem ratio (1.04±0.04) was obtained in Line-1 (Table-2).

Table 1. Comparative performance of different lines from BLRI Napier-3 during wet season (June-November)

Line	Parameters				
	Survivability (%)	Biomass yield (ton/ha/cut)	Number of tiller/clump	Plant height (inch)	Leaf : Stem ratio
Control	75.25^{c}±2.61	19.26^{c}±0.68	34.26^{b}±0.86	51.36^{b}±1.26	1.15a^{b}±0.05
Line-1	79.95^{ab}±1.88	25.99^{ab}±0.86	37.27^{a}±1.08	59.75^{a}±1.68	1.19^{a}±0.03
Line-2	82.90^{a}±1.93	27.52^{a}±0.89	39.52^{a}±1.48	62.20^{a}±1.13	1.01^{c}±0.03
Line-3	82.80^{a}±1.86	27.20^{a}±0.61	38.04^{a}±1.09	60.10^{a}±1.60	1.03^{bc}±0.04
Sig. level	**	**	**	**	*

^{abc}values in the same column with different superscripts differ significantly (*= $p<0.001$), NS- not significant ($p>0.05$

Table 2. Comparative performance of different lines from BLRI Napier-3 during dry season (December-May)

Line	Parameters				
	Survivability (%)	Biomass yield (ton/ha/cut)	Number of tiller/clump	Plant height (inch)	Leaf : Stem ratio
Control	68.95^{b}±1.64	16.36^{c}±0.53	27.20^{b}±0.87	39.20^{d}±0.95	0.96±0.05
Line-1	72.75^{a}±1.43	19.38^{b}±0.40	30.71^{ab}±1.43	43.25^{c}±1.27	1.04±0.04
Line-2	74.50^{a}±1.25	21.13^{a}±0.65	32.04^{a}±1.04	52.20^{a}±1.46	0.93±0.06
Line-3	73.25^{a}±1.09	20.35^{ab}±0.60	31.90^{b}±1.27	48.30^{b}±1.28	0.90±0.04
Sig. level	**	**	*	**	NS

^{abc}values in the same column with different superscripts differ significantly (*=p<0.01, **= p<0.001), NS- not significant (p>0.05).

The results revealed that mutant lines (Line-2 and Line-3) and tissue culture line (Line-1) performed better than control line in terms of yield and plant morphology in both wet (June-November) and dry seasons (December-May).

Feeding of vegetable waste silage to beef cattle at farm level

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Executive summary

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The vegetable wastes (VW) that pollute environment was reported earlier to be ensiled successfully and fed to lambs as a basal diet. Therefore, the study was conducted with the objectives to demonstrate ensiling process of vegetable wastes and its feeding practices in a beef cattle farm. The VW – including cabbage, cauliflower, reddish, carrot and other leaves at 31, 24, 22, 20 and 3%, respectively, as found during collection – was collected by a beef cattle farmer, Savar, Dhaka and ensiled by shredding, dewatering and adding molasses and chopped rice straw (2-3 cm) at 85:5:10 ratio in 65 kg plastic drums for 150 days under the supervision of Bangladesh Livestock Research Institute. Then, twelve native bulls of 2-2.6 years old with average initial live weight (LW) of 219 (±26) kg were randomly allocated into two groups. Maize silage, a conventional feedstuff of the farm, was fed ad libitum as basal diet to one group (control), while 50% maize silage was replaced with VW silage in another group. Fresh maize silage and VW silage was mixed manually at 1:1 ratio, and offered to bulls. A common concentrate mixture of conventional ingredients containing wheat bran, rice polish, maize broken, soybean meal, DCP and common salt was fed at 1.5% of LW of bulls. The trial was conducted for 56 days. Samples of feedstuffs and refusals were collected every other day during the whole trial period and stored at -20ºC. At the end of trial, samples were thawed at room temperature and composited before analyzing chemical composition. During digestibility trial, dung samples were weighed at 0700h daily and about 20% of them were collected and stored at -20ºC. The dung samples were processed and analyzed according to the same methods followed for feedstuffs and refusals. The data were analyzed by Paired sample *t*-test using SPSS-11.5 software. The chemical compositions of diets are presented in the Table 1.

Table 1. The chemical composition of diets (% DM)

Chemical composition	Maize silage	Mixed silage	Concentrate mixture
DM (% fresh)	23.2	25.8	91.3
OM	93.3	91.6	88.4
CP	8.6	11.2	17.1

DM, dry matter; OM, organic matter; CP, crude protein; Mixed silage, mixture of fresh maize silage and vegetable waste silage at 1:1 ratio.

The intake of nutrients and live weight gain of bulls are presented in the Table 2. The results of the study indicate that the dry matter (DM) intake of bulls - neither total, nor from roughage or concentrate separately - differ (P>0.05) between the groups. The daily DM intake represented about 2.95 and 3.27% LW of bulls, respectively in the maize and mixed silage groups. Similarly, organic matter (OM) intake between groups was also similar (P>0.05).

Table 2. Intake and digestibility of nutrients of bulls

Parameters	Maize silage	Mixed silage	SE	P-values
DM intake from roughage, kg/d	4.1	4.6	0.264	0.094
DM intake from concentrate, kg/d	2.85	3.25	0.097	0.051
Total DM intake, kg/d	6.9	7.8	0.620	0.066
DM intake, %LW	2.95	3.27	0.658	0.917
OM intake, kg/d	6.3	7.1	0.511	0.089
CP intake, g/d	838	1070	10473	0.003
Initial LW, kg/d	216.7	221.1	730	0.779
Final LW, kg/d	254.0	258.8	705	0.759
LW gain, g/d	667	673	4168	0.876

DM, dry matter; OM, organic matter; CP, crude protein; Mixed silage, mixture of fresh maize silage and vegetable waste silage at 1:1 ratio; LW, live weight; SE, standard error;

The crude protein (CP) intake was significantly higher ($P<0.01$) in the bulls fed mixed silage diet, compared to maize silage diet. The higher CP intake might be due to higher CP values of mixed silage (Table 1). The difference between initial and final LW of bulls in both groups was similar ($P>0.05$). As a result, the daily LW gain of bulls between diets was also similar ($P>0.05$). It may be concluded that replacing of maize silage at 50% in the diet of bulls at farm level did not effect on their dietary intake and live weight gain.

Field testing of BLRI Feed Master mobile application in selective locations of Bangladesh

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Executive summary

"BLRI Feed Master" is a farmer´s and extension personnel friendly android application. However, the efficacy of this technology has not yet been justified in field level. Considering this fact, the current research was designed to measure the efficacy, socio-economic impact and identifying the constraints of adaptation and sustainability of this technology at farmer's level as well as disseminating technology in field level. In the previous year, a baseline survey was conducted through a pretested questionnaire regarding the existing farming system of the farmers in Dhaka, Rajshahi and Sirajganj regions with a sample size 100 in each location. However, in this year efficacy of this application was evaluated by adopting different ways. Firstly, three days trading on the application was given to 19 District Livestock Officers working as a livestock expert in field level and efficacy of the software was evaluated through a pretested questionnaire. Secondly, a field demonstration of Feedmaster technology was conducted on Rajabarihat and Savar upazilla. For field demonstration 5 farmers were selected form each location and hands-on training was provided. Three months close supervision of farmers was conducted on each location. During close supervision feed, vaccination and production cost and income from milk as well as milk composition was recorded and compared with an existing condition. Finally, data were analyzed by using SPSS software version 13.

From the data analysis, it was observed that according to livestock expert BLRI Feedmaster application was very much helpful (100%) for ration formulation, animal weight calculation and technology dissemination in field level. However, only 15.79% and 10.52% expert were recommended for some modification on ration formulation and animal weight feature respectively. On ration formulation feature adding alternative feed ingredient option with nutritional composition was recommended. Whereas, on weight feature accuracy of calculation along with adding calculation of meat production option was recommended. However 63.16% and 63.15% expert recommended for no modification on ration and weight feature of application respectively. On the other hand, 89.47% of livestock expert believe that vaccination was helpful for the farmers at the field level. Among them, 47.37% recommended for modification of vaccination feature of the application. All of them (100%) recommended that this application is helpful for easy technology transfer on field level. Furthermore, applying this technology on field level reduced time, cost and visit significantly (P<0.001) (Table 1).

Table 1. Effect of application on TCV (Time, cost, visit)

Parameter	Existing condition	Using application	F value
Time (Minutes)	270±34.30	5.29±1.50	59.42***
Cost (Taka)	235.71±59.42	3.21±1.51	15.29***
Visit (Time)	3.07±0.38	0.36±0.13	44.43***

***= P<0.001

Moreover, during field testing, it was observed that before adopting BLRI FeedMaste farmers were providing an average 5.6 kg feed /animal and price of mixed feed was 29.75 TK./kg. However, after adopting the software in farm-level concentrate feed supply was reduced 12.73% per animal/day by providing optimum nutrition to the animals. On the other hand, feed price was reduced by 5.88% per kg than the existing system by formulating balanced ration on 28 TK/kg. Moreover, the average milk production of farmers increased by 12.2. % per animal /day along with milk fat percent was significantly increased (P<0.001). Although another milk component such as Protein, SNF and Lactose was increased, but statically non-significant.

Table 2. Effect of application on milk composition

Parameter	Existing system	Using application	F value
Fat (%)	4.12±0.13	4.91±0.14	15.014***
SNF (%)	3.65±0.07	3.67±0.06	0.018^{NS}
Protein (%)	10.26±0.11	10.30±o.12	0.070^{NS}
Lactose (%)	5.39±0.20	5.41±0.21	0.006^{NS}

***= P<0.001, NS= No significant

This is the second year of this research project. In this year the efficacy of BLRI FeedMaster technology on field level was conducted. However, the assessment of socioeconomic importance was not conducted due to time limitation. Moreover, BLRI FeedMaster was uploaded on Google play store for disseminating of this technology. From Google play store it was reported that this application was downloaded by more than 10000 downloaders and rated as 4.8 on the scale of 5. In near future socioeconomic impact and further up-gradation of this application will be conducted.

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

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Executive summary

Somatic cell nuclear transfer (SCNT) technology is applying to multiply genetically elite farm animals, to produce transgenic animals with the desired trait, or to conserve endangered species. Cloning may also be used to increase the accuracy of selection and the rate of genetic progress in a breeding programme through speeding up the dissemination of genes from animals of exceptionally high genetic merit to the commercial population and to reproduce transgenic animals. SCNT requires combination of some technologies including oocyte aspiration, *in vitro* maturation (IVM), enucleation, donor cell preparation, activation of reconstructed cell, *in vitro* embryo culture and embryo transfer into the recipient's uterus. Oocyte aspiration, *in vitro* maturation, *in vitro* embryo culture and embryo transfer protocols has already been adopted at Biotechnology Laboratory in BLRI. Considering the above facts, the proposed research project aimed to adopt SCNT technology at the same laboratory in BLRI. For this purpose, ovaries were collected from slaughtered cattle. Cumulus-oocyte-complexes possessing an even cytoplasm and covered with minimum three layers of compact cumulus cells was selected for IVM and placed into a 4-well culture dish containing IVM media (TCM199 + 10% fetal bovine serum, 1 µg/mL β-estradiol, 10 µg/mL FSH, 0.6-mM cystein, and 0.2-mM sodium pyruvate) for 24 hr (5% CO2 in air at 38.5°C with maximum humidity). After maturation, oocytes were denuded by gentle pipetting and treatment with trypsinase enzyme for complete removal of cumulus cells. For the development of fibroblast cell line, ear tissue was collected from slaughtered cattle in saline solution. 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 diaminetetra acetic acid solution 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 with different (0, 10, 15 and 20) percentages of [v/v] fetal bovine serum , 1% [v/v] l-glutamine, 1% [v/v] nonessential amino acids, and 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 37^0C in a humidified atmosphere of air containing 5% CO_2 for 15 days. After 15 days % of the viable cell were counted using hemacytometer followed by adding 0.4% solution of trypan blue dye. A 0.1 mL trypan blue stock solution was added to 1 mL of cells.

From data (Table 1), it was observed that FBS has a positive effect on fibroblast cell growth. Fibroblast cell culture adding with 15% FBS showed the highest viable cell count (96.39%). It was recommended that cell viability should be at least 95% for healthy log-phase cultures. Hence, this study has been suggesting addition of 15% FBS into the cell culture medium for preparation of donor nucleus. Moreover, the viable cell number was highest (6.74×105) in culture media containing 15% FBS. Moreover, skill on the preparation of holding and injection pipette for enucleation of recipient oocyte and injection of donor nucleus were developed during the experimental period. However, research on enucleation of recipient oocyte and injection of donor nucleus into the recipient oocyte is on-going. It was a new project with an objective to adopt SCNT technology at BLRI. Hence, baseline activity was conducted. After completion of this project, SCNT technology will be adopted which may help to produce transgenic animal in near future.

Table 1. Effect of level of FBS on cell viability during fibroblast cell culture

% FBS	% Viability	Viable cell/ml
0	0	0
10	90.0%	1.98×10^5
15	96.93%	6.74×10^5

20	94.59%	3.90×10^5

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

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Executive summary

There are so many indigenous farm animal genetic diversity of Bangladesh. Among the indigenous farm animals non-descript Deshi, Red Chittagong Cattle (RCC) are notable of them. Conservation of promising indigenous cattle genetic resources through utilization following pure breeding program and farmer-managed *in-situ* approaches may work for cattle development and rural livelihood enhancement in Bangladesh. So, it is an important issue that RCC needs to be conserved *in-situ* by keeping them into the rural farmers' house. Besides, increasing the production potentiality of this type should be considered, so that rural poor farmer can lead their live more securely. Considering these facts, present research work is designed to develop a model for the up-scaling livelihood of the rural poor people by keeping RCC and conserve RCC in the farmers' house (*in-situ*). For this purpose, 200 farmers from four Upazilas (Anowara, Patiya, Sakhipur and Godagari) of 3 Districts (Chattogram, Rajshahi and Tangail) under the project area were selected and baseline survey was conducted. The selected farmers were getting some privileges provided by the project like training, RCC semen, vaccine and medication, etc. These privileges will be continued and before end of the project final impact assessment will be conducted based on some livelihood, productive and reproductive parameters such as household income, expenditure, deposits/savings money, permanent assets, housing of cattle, feeds and feeding system, milk production, body weight, production of healthy calves, disease and health management, etc. From the base line survey it was found that from 200 sampled farmers male and female farmers were 84.73% and 15.26 % respectively. About 72.24 % farmers were found educated and 27.76% were uneducated. Agriculture was found as the main occupation of the farmers and 47.07% farmers were directly involved in agriculture. Livestock farm, laborer, Business, job, fisheries, remittance and others occupation were found 24.55%, 11.21%, 11.48%, 4.47%, 0%, 0.34% and 0.27% respectively. Average land holding per household was 97.87 decimal. Average cattle population per household of indigenous, RCC and crossbred were 4.98, 1.90 and 6.90 respectively. Semi-pakka, katcha, full tin and shabby housing of cattle were found 10.80%, 24.32%, 24.05% and 40.81% respectively. It was observed that 27.48 %, 32.65% and 39.87% households' cattle rearing systems were stall feeding, half grazing and full grazing system respectively. Cleaning and hygienic management such as regular cleaning, regular washing and regular disinfection performed by the farmer about 83.70%, 82.87% and 27.29% respectively. About 8.79% and 13.44% farmer supplied feeds with grass-straw and grass-concentrate respectively. About 34.67% farmers used natural insemination and 48.54% used artificial insemination and 16.78% used both natural and artificial methods. The average income from indigenous, RCC and crossbred cattle were found BDT 144985.66, 73748.00 and 312208.33 respectively in the last one year. The higher amount of income was generated from crossbred cattle. The average milk yield (lit/day) were found 2.26, 1.33 and 9.86 from indigenous, RCC and crossbred cow respectively. It was also found that average income from milk selling were BDT 18418.00, 15965.00 and 188195.00 for indigenous, RCC and crossbred cow in the last one year respectively. The average annual family income and expenditure were BDT 236933.33 and 195306.67 respectively. Average savings was BDT 41626.66 in the study area. About 79.37% farmers had deposited and 9.95% had deficit annually. About 10.67% farmers had found that income and expenditure were equal. This is an ongoing research and data on productive and reproductive parameters, disease incidence, location wise distribution and marketing channel should be discussed in the final assessment. From the findings of baseline data it was concluded that agriculture was the main occupation of the farmers. Average cattle population per household of RCC was lower than indigenous and crossbred cattle. In existing system management and feeding

system was not very well and income from RCC was lower than the indigenous and crossbred cattle. Finally, the impact of the model will be assessed before end of the project.

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

Numbering animal properly for identifying as well as recording different features of productive and reproductive performance of individual and pedigree are the key tools for improving genetic potentiality along with the production of livestock. In developed countries, farmers are recording animals properly by using different software on electronic devices. However, in Bangladesh record keeping is a tedious job for farmers as well as lack of willingness to record properly because there is lack of availability of farmer-friendly recording system. Considering these facts, the present activity was conducted to develop a smart animal recording system through a combination of mobile and computer applications. Animal population, phenotypic feature; breeding and reproductive condition, growth and milk production, health condition, feeding practice can be accurately recorded with the application of developed recording systems. Before recording individual animal data with developed system, animal numbering was conducted. For this purpose, 514 animalsunder6 project areas were numbered using tattoo marker. Then baseline data about animal type, source of cattle and milk production of individual animals were collected and analyzed using SPSS statistical software.
From the baseline data, it was observed that, among selected animals total RCC were 49.60% and the highest percentage of RCC was in Hathazari Upazilla. Among selected animals 81.90% were adult where as 18.10% animals were growing. It was also found that 72% cattle were owned by the farmers and 26% was purchased from local market. From the baseline data, it was also revealed that among selected animals overall average milk production of RCC was 2.36litter/animal/day but the highest was 3.07±0.22 litter/animal/day in Anwara Upazilla. Nevertheless, the highest milk production of RCC was 8.00 litter/animal/day in Anwara Upazilla and lowest milk production was found 1.00 litter/animal/day in Chandanish, Hathazari, Patiya and Sandwip. After completion of the project farmers will take part in keeping their animals' records by their smart cell phone and thus enabling accumulation of all records in a central RCC recording server. Finally, the selection of superior sires and dams with high genetic merit and controlling breeding road map will be established

Table 1. Types and source of cattle in the study areas

Areas	Types of animal				Sources of cattle		
	Local/Non descriptive (%)	RCC cattle (%)	Growing (%)	Adult (%)	Owned	Purchased	Others
Anwara	62.50 (35)	37.50 (21)	33.90 (19)	66.10 (37)	76.80 (43)	16.10 (9)	7.10 (4)
Chandanish	11.30 (7)	88.70 (55)	30.60 (19)	69.40 (43)	100.00 (62)	0.00 (0)	0.00 (0)
Hathazari	1.20 (1)	98.80 (81)	41.50 (34)	58.50 (48)	80.50 (66)	19.5 (16)	0.00 (0)
Patiya	57.00 (61)	43.00 (46)	19.60 (21)	80.40 (86)	91.60 (98)	6.50 (7)	1.90 (2)
Sandwip	63.20 (67)	36.80 (39)	0.00 (0)	100 (106)	38.70 (41)	61.30 (65)	0.00 (0)
Jaintiapur	87.10 (88)	12.90 (13)	0.00 (0)	100 (101)	59.40 (60)	40.60 (41)	0.00 (0)
Total	50.40 (259)	49.60 (255)	18.10 (93)	81.90 (421)	72.00 (370)	26.80 (138)	1.20 (6)

Note: Number in the parenthesis indicates number of cattle

Table 2: Milk production performance of RCC in different project areas

Areas	Average milk production (Litter/animal/day) (Mean±SE)	Highest milk production (Litter/day)	Lowest milk production
Anwara	3.07± 0.22	8.00	1.25
Chandanish	2.17±0.05	3.50	1.00
Hathazari	1.83±0.97	5.00	1.00
Patiya	2.27±0.12	4.00	1.00
Sandwip	2.12±0.24	3.00	1.00
Jaintiapur	2.70±0.12	3.00	2.50
Overall	2.36±0.45	8.00	1.00

Development of herd book based RCC recording system at the community level

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Executive summary

Red Chittagong Cattle (RCC) is one of the promising breed of cattle in Bangladesh. The habitat of these cattle is greater Chattagram and hill tracts. Notably, there is no evidence of foreign blood in RCC which have been developed in the locality by natural selection and breeding among themselves for a long historic period. But, this potential variety is under the threat of extinction due to indiscriminate crossbreeding across the country, especially in their home tract. Thus, an in-depth study on this type of cattle is our national demand in the perspective of conservation and improvement of local animal genetic resources (AnGRs). Therefore, 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. But due to interruption of succeeding activity for a long period, the outcome has not yet been reached up to the mark of expectation. Recently, BLRI has been implementing second phase of the previous research work taking a wider range of areas in the country. Community based breeding program is being conducted for the conservation and improvement of RCC. Pedigree & recording system is the utmost breeding tool for genetic improvement of livestock. Moreover, herd book is an essential component for the successful breeding operation of the breeding farm or community breeding programs. Considering this fact, the objective of this activity was not only adopting farmers for keeping records of their animals but also establishing a central information recording hub of Red Chittagong Cattle.

For this purpose, a farmer's friendly herd-book was formulated by analysis of different forms of herd book used by farmer and their recording system. Then the hard book was pretested and disseminated to the selected farmers of the project area. Moreover, Animals of the farmers were numbered using tattoo machine. A total 300 farmers were selected from six project areas (Anwara, Chandanish, Hathazari, Patiya, Sandwip, Jaintiapur) having local or RCC cattle and 514 animals were numbered. To accustom with recordkeeping on herd-book, three days of training in each project area was conducted. Moreover, with the help of scientific officer and community assistant proper recording was monitored. After baseline data collection, it was analyzed using SPSS software.

Table 1. AI activity under six project areas

Upazilla	AI using RCC semen (%)	Natural breeding Using local RCC bull (%)	Repeated breeding (%)	Service /conception rate
Anwara	50.00 (28)	5.40 (3)	25.80 (8)	1.55
Chandanish	21.00 (13)	0.00 (0)	0.00 (0)	1
Hathazari	18.30 (15)	1.20 (1)	12.50 (2)	1.14
Patiya	26.20 (28)	0.00 (0)	20.00 (7)	1.33
Sandwip	12.30 (13)	0.00 (0)	0.00 (0)	1
Jaintiapur	2.00 (2)	0.00 (0)	0.00 (0)	1
Total	19.30 (99)	0.80 (4)	15.50 (17)	1.002

After data analysis, it was observed that (Table:1) among selected animals, 50.40% were non-descriptive and 49.60 % were RCC cattle. Non descriptive cattle were dominating on Jaintiapur, Sandwip, Anwara and Patiya. However, RCC cattle was dominating on Hathazari and Chandanish. For genetic up-gradation, artificial insemination was conducted using frozen seamen obtained from RCC bull NO. 387,499 and 323. AI activity was on going and still now a total of 99 AI was conducted. Among them, highest number of AI was conducted in Anwara but lowest number was

Jaintiapur and the values were 50% and 2% respectively of total cattle numbered.Moreover, RCC bull were using for reproduction but the value was very poor (0.80%). Among the project area service per conception rate was higher in Anwara and among inseminated cow, 25.80% showed repeated heat. The second highest was in Patiya (1.33 %). Besides breeding, vaccination and deworming activity was on-going. After completion of the project, farmers of the selected community will be adopted to keep in their animals' records in the herd book, which will help in the selection of superior parents for producing progeny with higher genetic worth. Also, this will help in designing the breeding road map in the future.

Development of 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 yogurt, starter culture containing desirable live viable food grade LAB is pre requisite. However, unlike developed countries, packed starter culture in sachet is not available in local market in Bangladesh. Consumers are dependent mostly on traditional yogurt/dahi, 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 research was undertaken to develop a suitable starter culture for yogurt/dahi preparation at consumer's home.

In the previous year *Lactobacillus acidophilus* and *Streptococcus thermophiles*, bacteria were identified using genus and species-specific 16S rDNA primer sequence from yogurt/dahi sample collected from Dhaka. However, in this year fourteen yogurt samples were collected from the local market of Rajshahi, Bogra, Khulna and Bhola and cultured on MRS and M17 selective Agar culture media. 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 r DNA primer sequences.

After serial dilution, spreading on selected culture media, viable bacteria were observed for all yogurt samples. Viable bacterial colony number on culture plate ranged from 14 x 10^{-6} to 224 x10^{-6} CFU/ml on MRS culture media and 60 x 10^{-6} to 278 x 10^{-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 shaped and the rest of them were cocci shaped. Among rod shaped four colonies showed positive application for lactobacillus acidophilus and five bacteria showed positive application for *Lactobacillus bulgaricus* with genus property nine isolated bacterial colonies were belong to *Lactobacillus* genus whereas five of them were belong to *Befedobacterium* genus. Among cocci shaped bacteria four colonies were belonged to *Streptococcus* genus. However, among them one bacteria colony was identified as *Streptococcus thermophiles*. Isolation and identification process is going on for other bacteria suitable for starter culture.

Conservation and improvement of Munshiganj cattle

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Executive summary

Munshiganj cattle (MC) are predominantly found in Munshignaj and its adjacent areas. Farmers are replacing MC with high yielding crossbred cattle and population of MC is rapidly declining in their breeding tract. As this variety is only concentrated in a certain area, so conservation in its pure form and subsequent development is necessary. The on-going artificial insemination programme throughout the country is also popular in Munshiganj district. Despite having good quantity of milk production potentiality of MC farmers are yet intend to inseminate their pure MC with foreign germplasm in order to get more milk. Considering the above facts, Bangladesh Livestock Research Institute (BLRI) has taken an initiatives to conserve, characterize and subsequent improvement of MC germplasm at their own habitat and BLRI. For in situ conservation, a Munsiganj cattle rearing community was established in Munshiganj district having at least one MC cow. A mini nucleus herd was established in BLRI and this herd has been enlarged with a total population of 32 animals including 10 cows, 6 breeding bulls, 8 heifer calves and 8 bull calves. Different productive and reproductive performance was recorded in the nucleus herd. For conservation of this variety to regain its purity in the farmer's house artificial insemination is ongoing in their original breeding tract with pure Munshiganj frozen semen. Some non-descript indigenous cattle are also selected for AI to increase the population of MC. Following AI, 45 calves has been born so far and 220 AI was done with an average conception rate of 52.19%. Among 220 AI performed 190 AI was performed in MC and 40 Munshiganj calf has born so far in which 16 is male calf and 24 female calf.

Table 1. Artificial insemination statistics of MC in Munshiganj community

Cattle type	No of AI performed	No of animal conceived	Conception rate (%)	No of calf born	Calf sex	
					Male	Female
Munshiganj cattle	190	97	51.05	40	16	24
Indigenous cattle	30	16	53.33	5	2	3
Total	220	113	51.36	45	18	27

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 and 16.14 kg in on station. In on farm, birth weight of male and female calves were found 16.91 kg and 14.32 kg respectively (Table 2). Average lactation length (LL), daily milk yield (DMY), Gestation length (GL), postpartum heat period (PPH) and number of services per conception (NSPC) were found 218.82 days, 4.13 L, 279.17 days, 63.42 days and 1.58 for on station and 210.58 days, 3.03 L, 279.84 days , 70.89 days and 1.67 for on farm respectively.

Table 2. Comparative Productive and reproductive performances of Munshiganj cattle in on station on farm

Characteristics	On station (Mean±SD)	On farm (Mean±SD)
Body weight of male calf (kg)	19.47±0.79 (n=8)	16.91±1.24 (n=16)
Body weight of female calf (kg)	16.14±0.52 (n=8)	14.32± 0.79 (n=24)
Lactation length (Days)	218.82±16.78 (n=10)	210.58±14.44 (n=49)
Daily milk yield (L)	4.13±0.39 (n=10)	3.03±0.57 (n=73)
Gestation period (days)	279.17± 3.76 (n=10)	279.84±1.34 (n=49)
Postpartum heat period (days)	63.42± 22.08 (n=10)	70.89±9.32 (n=73)
No of service per conception	1.58± 0.79 (n=10)	1.67± 0.67 (n=73)

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.

Development of low input 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. This variety evolved in the locality by natural selection and breeding among themselves for a long historic period. Purebred populations 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. All animals of the registered farmers of the community were permanently marked with tattoo machine. 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.

Table 1. Semen quality parameter of RCC bull semen (mean ± SD)

Parameter	Volume	Concentration	Total motility	Progressive motility	Static motility
Fresh semen	3.9±1.2	1638.4±93.5	77.7±13.5	57.6 ± 14.4	22.4±13.5
Frozen semen	--	--	67.6±2.9	46.9±2.8	32.1±3.2

Table 2. Community breeding statistics of Red Chittagong Cattle

Project area	No. of farmer registered	Registered animal (RCC+Indigenous)	Adult cow (%)	RCC (%)	No. of AI performed	AI coverage (%)
Patia	50	107	80.4 (86)	43.0 (46)	23	26.74
Chandonaish	50	62	69.4 (43)	88.7 (55)	12	27.91
Anowara	50	58	66.1 (37)	37.5 (21)	18	48.65
Satkania	50	75	69.3 (52)	60 (45)	18	34.62
Hathazari	50	82	58.5 (48)	98.8 (81)	27	56.25
Swandip	50	106	100 (106)	36.80 (39)	30	28.30
Total	300	415	77.11(320)	58.31(242)	128	40

The mean volume, concentration, total, progressive, and static motility of fresh semen were 3.94±1.15, 1638.42±923.51, 77.68±13.48%, 57.59 ± 14.42%, 22.37±13.47 % respectively. The mean total, progressive, and static motility of frozen semen were 67.57±2.99, 46.86±2.79%, 32.12±3.24 % respectively (Table 1). Till date 15000 doses of frozen semen has been prepared and distributed and 128 AI (Patia=23, Chandanaish=12, Anowara= 18, Satkania =18, Hathazari=27,

Swandip =30) were done so far in the project area (Table 2). A total 300 farmers were selected in 6 upazilla of Chattogram district where 415 animals (Adult cow, heifer, bull and calf) were registered. Among the registered animals 77.11% were adult cow and 58.31% were registered as RCC. Among the registered adult cow, overall 40% animals were inseminated so far by using pure RCC semen (Table 2). No calves has so far born yet. All the reproductive data of the animals are being recorded in a herd book maintained by community farmers. 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.

Empowerment factors of rural women through homestead native sheep rearing in Hilly area at Naikhongchari

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Executive summary

This paper attempts to assess the empowerment factors of rural women of the community people at Naikhongchari upazilla in Bandarban district of Bangladesh through establishing the BLRI improved native sheep rearing. Rural women are unable to work outside their home or beyond their homestead because of family restrictions, social and traditional barriers. The determinants associated with the empowerment of rural women from selected community were identified. Data were collected from fifty rural women involved home-based in native sheep rearing practices through interviews using a structured questionnaire. All responses were measured using a five point like scale (1 = strongly disagree through 5 = strongly agree). Multiple regression analysis was used to identify the relationships between the six empowerment factors and the overall empowerment of rural women. From fifty women who were rearing native sheep for at least one year from seven villages (bisamara, kalukata, thandajiri, mandoliagona, chakheadman para, adorshogram and jaruliasiri) of Naikhongchari sadar upazilla included in this survey. Fifty completed questionnaires were obtained and these questionnaires were used in our analysis. Data of sample population, age of the respondents, number of years involved in sheep rearing practices and list of empowerment factors (husband's behavior, independence for spending money, independent decision making authority, control over sheep rearing practices, position in the family, involvement in family affairs) were used for analysis.

We used multiple regressions to identify which were the most significant factors in the empowerment of rural women. The results of the regression analysis indicated that the overall model was supported (R Square = .196, $p<.05$). Analysis of the significance levels indicated that independent decision making authority (b = 0.294, $p<.01$) and involvement in family affairs (b = 0.201, $p<.10$) are significantly associated with the empowerment of rural women in Bangladesh (Table 2). The findings of our study indicated that sheep rearing programs empowered women by improving their economic condition and enhancing their ability to contribute to their family. The first significant factor associated with the empowerment of rural women was independent decision making authority. When women were given the freedom to initiate and run their sheep rearing business, their status in the family improved considerably. Involvement of rural women in sheep production increases their disposable income. The husband's behaviors towards his wife become changed by observing that his wife can earn money and contribute to improve the living standards of the family. The second significant factor associated with the empowerment of rural women in Bangladesh was involvement in family affairs. Greater involvement results in women being able to provide financial assistance when buying household assets. Usually, rural women are not consulted when decisions are made in rural households. Historically, women are perceived as inferior to their husbands in Bangladesh. However, when they become important in the family by earning money they were asked by the husbands to take part in making family decisions. They also can make decisions on their own for the betterment of their children, husband and family. They can establish control over the income of the sheep business. The overall decision-making authority of rural women was increased when they exercise their own methods to initiate, run, and expand the sheep business. When the women had earned control over their sheep business, it was possible to help rural families in many respects such as, children's education, financial support for the family etc.

Table 1. Number of Years Involved in Sheep Rearing Practices

Number of years	Number of Respondents	Percentage of Respondents
Less Than 2 Years	07	14.7%
1 – 2 Years	18	30.7%
2– 3 Years	16	22.6%
More Than 3 Years	9	12.0%

Table 2. Results of regression analysis for empowerment of rural women

Variables	*b*	*s.e.*
(Constant)		0.064
Independent decision making authority	0.294***	0.053
Husband's behavior	-0.078	0.064
Control over sheep rearing practices	0.047	0.053
Involvement in family affairs	0.201*	0.053
Independence in spending money	-0.126	0.064
Position in the family	-0.021	0.064
R2	0.196**	0.064
N	50	0.053

** p < .10, ** p < .05, *** p < .01*

In summary, we found that simple sheep rearing practices do empower rural women and improve their social status. Hence, homestead sheep rearing and other similar business projects should be encouraged by government and non-government development agencies as it increases independent decision making authority and the involvement of women in their family affairs, which enhances the socio-economic development of the rural sector.

Cryopreservation of exotic ram semen for conservation and multiplication of sheep germplasm of BLRI

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Executive summary

Bangladesh Livestock Research Institute has imported 3 improved foreign sheep breeds (Perendale, Dorper and Suffolk) from Australia in march 3, 2016 to judge their efficacy and adaptability in Bangladesh as well as to improve productivity of indigenous sheep through cross breeding. Ram of this three breeds have been used for natural mating within breed and crossbreeding with indigenous stock for production of crossbreed offspring and therefore to produce a flock of improved sheep germplasm in BLRI. Besides, all of this improved valuable germplasm are now being conserved in live form which involves a huge maintenance and management cost. Therefore, the present study was designed to develop of ram semen cryopreservation technique using standardized semen extender to conserve this valuable germplasm to maintain their purity for future use through AI.

For semen collection ram was selected on the basis of their pedigree record and based on their true breed characteristics. A through physical examination was conducted to ensure that the rams are free from abnormality and do not display clinical symptom(s) of any infection or any contagious diseases. Prior to introduction of new rams for semen collection, breeding soundness examination was carried out. The rams was kept under hygienic conditions at all times. Balanced diet along with sufficient amount of clean drinking water was supplied to the rams regularly. Semen was collected from three different foreign sheep breeding ram on regular basis through artificial vaginal method.After collection, volume and concentration of semen was recorded. For AI purpose estrous synchronization was performed in indigenous sheep breed. Total animals were divided into two group each group consists of 7 animal. Synchronization process was done by GnRH and prostaglandin hormone treatment. Average volume was (0.88±0.13), (0.85±0.12), (0.8±0.11) ml and the mean of concentration was (1301.64±111.51), (2405.42±76.31) and (2258.05±108.39) million for Perendale, Dorper and Suffolk respectively. Here the highest volume was found in perendale and the lowest on dorper but concentration was the highest in dorper and the lowest in perendale. The semen sample was placed in a water bath at 30-34ºC and examined with Computer Assisted Semen Analyzer (CASA) for determination of motility. Then semen was diluted with commercial andromed semen extender at 34°C and was evaluated under microscope for progressive sperm motility. Sperm concentration, total volume of diluents and number of straws to be filled with diluted semen was determined by CASA. The degree of dilution was aimed at giving an insemination dose rate of 20 million sperm cells per straw. Till now we are able to prepare 500 straw from perendale, 120 straw from Suffolk and 200 straw from Dorper. Quality of stored frozen semen was evaluated after 24 hr of storage for different parameters.The semen quality characteristics of Perendale, Suffolk, Dorper are presented in table 1. The mean percentage total, progressive, static and slow motility of fresh and frozen semen samples of perendale was (72.36±6.82, 49.74±6.50), (51.36±5.45, 42.33±1.51), (27.64±7.63, 50.26±6.51), (21±2.34, 7.42±5.05), Suffolk was (67.85±3.32, 45.8±3.67), (47.11±3.80, 37.89±2.04), (32.15±3.32, 54.2±3.67), (20.74±0.48, 7.91±1.63) and Dorper was (64.23±12.40, 46.81±7.53), (41.02±6.75, 35.03±5.41), (35.76±12.40, 53.18±7.53), (23.21±5.65, 22.16±6.12); respectively. The highest mean value of total, progressive, static and slow motility was found in Perendale and the lowest in Dorper. This variation could be caused by the age of animals and different breed characteristics.

Table 1. Fresh and frozen semen quality of three exotic sheep breed (Mean±SD)

Parameter	Parendale		Suffolk		Dorper	
	Fresh	Frozen	Fresh	Frozen	Fresh)	Frozen
Volume (ml)	0.9±0.1		0.8±0.11		0.9±0.12	
Concentration (million/ml)	1301.6±111.5	-	2258.1 ±108.4	-	2405.4±76.3	-
Total motility (%)	72.4±6.8	49.7±6.5	67.95±3.3	45.8±3.7	64.2±12.4	46.8±7.5
Progressive motility (%)	51.4±5.5	42.3±1.5	47.1±3.8	37.9±2.04	41.0±6.8	35.0±5.4
Static motility (%)	27.6±7.6	50.3±6.5	32.2±3.3	54.2±3.7	35.8±12.4	53.2±7.5
Slow motility (%)	21.0±2.3	7.4±5.1	20.7±0.5	7.9±1.6	23.2±5.7	22.2±6.1

From this two group, twelve (12) animal show heat and artificial insemination was performed in BLRI sheep farm with prepared frozen semen for evaluation of semen quality. After AI, three (3) animal show repeat heat. So till now nine (9) animal is pregnant. Conception rate will be calculated by pregnancy diagnosis following AI.

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 dogs as sheep have a natural herding instinct and could be easily managed in groups. Sheep skin is used to produce 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.

Twenty one (21) raw sheep skin was collected from sheep research farm of Bangladesh Livestock Research Institute and twenty five (25) 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, the leather.

Figure 1. Development of ladies bag and purse from sheep 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 articles. 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.

Development of blended yarns and fabrics from jute, cotton and native sheep wool

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Executive summary

Native sheep are considered as an important and promising animal resource in Bangladesh. Bangladesh possesses 3.468 million sheep and the present annual rate of growth is ever increasing (Bangladesh Economic Review, 2018). Average 700 to 800 gms of raw wool can be collected from each sheep per year. Resulting three thousands (3000) metric tons of raw wool will be obtained. Cotton, jute, wool and silk are some of the major fibers which are widely used throughout the world for producing yarn and fabrics. Wool fiber is the natural hair grown on sheep and is composed of protein substance called as keratin. Wool is composed of carbon, hydrogen, nitrogen and this is the only animal fiber, which contains sulfur in addition. The characteristics of wool fiber are composed of amino acids, excellent absorbency, high moisture regain, tend to be warmer than others, poor resistance to alkalis but good resistance to acids and good elasticity and resiliency. Enormous quantity of local sheep wool is wasted due to lack of processing. This fiber can play a significant role if proper processing technology and products of today's necessity can be developed out of this fiber. Due to natural source, wool, jute and cotton blended yarn has tremendous potentiality for making good quality warm cloth, floor mate, blazer cloth etc. So, the development of local sheep wool blended yarn decorative fabrics and value added products may enable to unlock the enormous potential of this fiber and provide very good scope for sheep farmers to generate income. A research was conducted for commercial use of wool in the country producing yarn and fabrics with the joint collaboration of Bangladesh Livestock Research Institute and Bangladesh Jute Research Institute. The objectives of the research work are to produce blended yarn and fabrics from jute, cotton and Native sheep wool and to determine the physical properties of jute, cotton and Native sheep wool. Sheep wool was collected from sheep research farms of BLRI and also from the different sub-stations of sheep project and Bengal Meat Processing Industries ltd, Pabna and sent to the Bangladesh Jute Research Institute. Jute was collected from local market. Cotton was collected from the cotton board. The required chemical was collected from local market. Raw sheep wool was washed with detergent and carbonized with 8% H_2S0_4 at normal temperature (30°C). It is known that jute is long fiber but cotton is short staple length fiber so jute was cut at different length (1, 1.5 and 2 inch) blended the staple length of cotton. According to a standard procedure blending of wool, jute and cotton fiber was mixed at different proportion. By using cotton processing system blended yarn was produced. After producing blended yarn (jute, cotton and sheep wool), this yarn was used in weaving machine (loom) to produce blended fabrics.

For processing of wool, jute and cotton fiber, we should know about some physical properties of these fibers.

Table 1. Physical properties of jute, cotton fiber and sheep wool

Property	Jute fiber	Cotton fiber	Sheep wool
Fiber fineness (µg /inch)	5.05	3.35	8.03
Moisture regain (%)	13-14	7-8	9-10
Tenacity (g/tex)	35	25	32

Note: Tenacity is the customary measure of strength of a yarn

Fibers are generally classified as very fine if they have a µg /inch value up to 3.1; Fine if they have value between 3.1 to 3.9; Medium if they have value between 4.0 to 4.9; Slightly coarse between values of 5 to 5.9 and Coarse if they have a µg /inch value above 6. So, Sheep wool is coarse fibers, jute is slightly coarse fibers and cotton is fine fibers. For the production of smooth blended yarn, sheep wool is mixed with jute and cotton fibers. In the present study, it was observed that 30%, 30%

and 40% respectively wool, jute cotton fiber blended 12s (yarn count system) count yarn has been successfully developed. After operating, there were observed some limitation in spinning section. Wool dropping was more than jute and cotton fiber. Yarns were produced at different proportion. Jute and wool is available in the locality. Cotton fiber is costly. For this reason, the cost of blended yarn is less than 100% cotton yarn. Shawls, blanket and suiting fabrics (pant pieces, blazer piece) were produced successfully. Shawl is produced with the production cost of Tk. 244 (7ft×3ft) and suiting fabrics (pant piece, blazer piece etc.) with the production cost of Tk. 588 (per 1 meter). Comfortable blanket was produced from 50:50 ratio of wool-jute yarn with the production cost of Tk. 495 (6ft×8ft). Dining mate and floor mate were produced with the combination of wool and jute in the ratio of 40:60 and the production cost of Tk. 280 and Tk. 140.

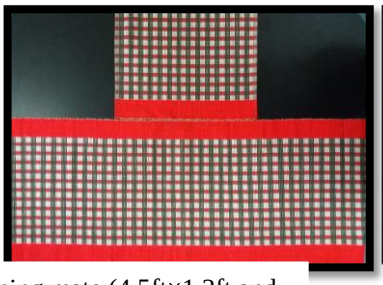
Spinning technique and types can play a vital role for the perfection of blended yarn properties and specific blended ratio is very important to get diversified products. Fine wool is more effective for making yarn than coarse wool. Wool, jute and cotton blended yarn may be a new horizon for developing diversified products. Handicraft sector and cottage industries can use this blended yarn for making their products. Sheep farmers will be encouraged by selling their waste wool and therefore, the country will be economically benefited.

Wool blended yarn

Shawl (7ft×3ft)

Suiting fabrics (1 meter)

Blanket (6ft×8ft)



Dining mate (4.5ft×1.2ft and 1.5ft×1.2ft)

Floor mate (2.5ft×1.5ft)

Phenotypic and genotypic profiling of antimicrobial resistance (AMR) in enteric bacterial communities in finisher livestock and poultry in Bangladesh

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Executive summary

Food safety is a global health concern which describing hygienic handling, preparation, and storage of food in ways that prevent foodborne illness. Food can transmit disease from person to person as well as serve as a growth medium for bacteria that can cause food poisoning. Foodborne diseases are widespread and becoming a growing public health concern not only for the developing countries but also for the developed nations. Antimicrobials or antibiotics revolutionized medicine in the 20th century and are probably one of the most successful forms of chemotherapy in the history of medicine. Antimicrobial agents have been used for the last 70 years to treat patients who have infectious diseases. Since the 1940s, these drugs have greatly reduced illness and death from infectious diseases. However, the emergence of resistance of bacteria to antibiotics is a common phenomenon. Emergence of resistance often reflects evolutionary processes that take place during antibiotic therapy and become a great concern. Considering these facts, the study was under taken with the objectives to assess herd-to-herd variation in antimicrobial resistance in faecal commensal enteric bacteria in finisher livestock and poultry, and to assess spatio-temporal variation in antimicrobial resistance profile in retail meat in LMBs (live bird markets) and slaughter houses.

During January to June 2019, a total of 476 samples were collected from 10 super shop of Dhaka city; categorized in chicken meat (n=170), beef (n=68), mutton (n=34) and environment (n=204). *Salmonella* spp. were isolated from the samples by using selective enriched media and confirmed by real-time PCR. Phenotypic resistance was determined by disk diffusion method according to CLSI guideline 219. Extended-spectrum *β*-lactamases (ESBLs) and quinolone resistance genes were determined by PCR. The overall prevalence of *Salmonella* spp. was 18.5% (n=88; 95% CI:15-22%) comprising in chicken meat 26% (n=44; 95% CI:19.5-32.5%), beef 15% (n=10; 95% CI:7-23%), mutton 18% (n=6; 95% CI:6-30%) and environment 14% (n=28; 95% CI:9.5-18.5%). In antimicrobial assay, 55% isolates were found multi-drug resistant (MDR). Among 22 tested antibiotics, extreme level of resistance was observed against Tetracycline and Erythromycin 99.1% (n=87, 95% CI: 94.5-99.9%), followed by Doxycycline 98%, Pefloxacin 93.9%, Azithromycin 92.2%, Enrofloxacin 91.2%, Moxifloxacin 89.7%, Nalidixic Acid 87.1%, Trimethoprim/Sulfamethoxazole 75%, Ciprofloxacin 53.4% and Streptomycin 49.6%. Nevertheless, only Ceftriaxone, Cefotaxime, Imipenem, Amoxicillin/Clavulanic acid showed good level of sensitivity as 82%, 73%, 73% and 68% respectively. Among the phenotypically resistant isolates, prevalence of ESBL encoding genes and Quinolone resistance genes determination is ongoing.

High level prevalence of MDR *Salmonella* spp. in retail meat which could cause foodborne illness is a great alarming issue for public health.

Canned meat production and its preservation quality assessment

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Executive summary

The most popular and demanding food item of Bangladeshi people is meat irrespective of age, social status and religious aspect. The existing traditional meat processing system from slaughter to cook is a time consuming and hardworking event. Moreover it is somewhat unhygienic too. Now people are reluctant to spend much time in cooking for arranging food as they are maintaining very busy working schedule. But at the same time they are interested in having safe and quality food by spending money. From this aspect the present study was undertaken to produce canned meat following an effective and cost-effective technique for having safe and hygienic ready product to cook along with the determination of its preservation quality. For this purpose, raw meat (beef) was purchased from local market immediate after slaughter and brought at meat processing laboratory of BLRI. The p^H of raw meat was measured immediate after collection. The pH of both raw & canned meat was recorded with a digital pH meter (Hanna; model no. HI2211-02) following the method of University of Nebraska-Lincoln (2005). The drip loss (%) and cook loss (%) of raw meat was measured following the method described by Joo et al. (1995) and Yang et al. (2006), respectively. The microbiological test viz, Total Viable Count (TVC), Total Coliform Count (TCC), presence or absence of *Salmonella spp.* and *Staphylococcus spp.* in both raw (fresh meat) and canned meat were done at Food Safety Laboratory in BLRI following the standard protocol. For the preparation and production of canned meat, raw meat was sliced with a knife in a standard size for filling the canning jar. Glass jar of half kilogram size was used in this study. Each jar was filled with about 470 g fresh sliced beef where common salt (NaCl), Na-nitrite ($NaNO_2$) and Kalojira (Fennel flower; *Nigella sativa*) oil were added and treated as preservative groups. Particularly, common salt and Sodium nitrite is being used globally for meat and meat product preservation. However, raw meat without added any preservative kept as control group. The number of replications in each treatment groups including control were nine.

Table1 1. Physical, chemical and microbiological properties of fresh beef used for can meat preparation

Physical properties	
Meat p^H	6.40
Drip loss (%)	5.55
Cook loss (%)	27.71
Chemical properties	
Moisture, %	74.61
Dry matter, % fresh	25.39
Crude protein, % fresh	19.36
Fat, %	-
Organic matter, %	95.88
Ash	4.12
Microbiological properties	
TVC (cfu/g)	8.8×10^6
TCC (cfu/g)	4.3×10^4
Salmonella spp.	Nil
Staphylococcus spp.	Present

The level of using NaCl, Na-nitrite and Kalojira oil were 5.0 g, 150 mg and 10 ml, respectively for per kg of fresh raw meat. Immediate after filling the meat and adding different preservatives in glass jars, the self-sealing screw cap jar lid were sealed tightly. The canner machine was prepared by applying moisturizer on both side and filled with water up to 2-3 inch from bottom. Then it was

placed on cooking burner until boiling of water. When boiling was started then the vapor was removed, glass jars were placed in pressure canner machine and proper pressure weight (10 lb) was settled. Canning was performed at 240^0 F under10lb pressures for 75 minutes. After removing the glass jars from pressure canner machine, checked the jar properly for any leakage. Finally, the lids of all the jar was again sealed with shrink paper using an electric hot gun. However, all the jars were kept under ambient room temperature for a period of 30 days. Both fresh and canned meat at 30 days aged samples were collected for proximate component analysis, microbial count and final recovery rate calculation. However, the proximate composition of both fresh and canned meat were determined by the method described by Association of Official Analytical Chemist (AOAC; 2005). Data on physical, chemical and recovery rate of both fresh raw meat and canned meat were compared statistically in an ANOVA of a Completely Randomized Design using General Linier Model Procedures of SPSS, 20 computer software packages.

Table 2. Effect of preservatives on physico-chemical, microbiological properties and loss or recovery rate of canned beef

Parameters	Preservatives				SED	Sig.
	Control	Klj. oil	$NaNO_3$	NaCl		
Physico-chemical properties						
P^H	6.47^{bc}	6.48^{bc}	6.55^{ac}	6.38^{b}	0.02	*
Moisture, %	63.36	59.21	63.31	61.96	1.11	NS
Dry matter, %	36.64	40.79	36.69	38.04	1.11	NS
Organic matter, %	97.03^{bc}	97.06^{bc}	97.34^{ac}	96.41^{b}	0.15	*
Crude Protein, %	28.31	28.99	28.54	28.57	0.24	NS
Total mineral, %	2.97	2.94	2.67	3.59	0.15	*
Loss or recovery rate						
Losses during canning process, %	3.83	2.13	6.70	6.28	1.26	NS
Water in canned jar, %	30.85	28.30	28.72	27.55	0.80	NS
Meat in canned jar, %	62.76	64.36	62.23	63.08	2.00	NS
Raw beef used, g	470.0	470.0	470.0	470.0	0.00	NS
Microbiological properties						
TVC (cfu/g)	Nil	Nil	1×10^2	1×10^2	-	-
TCC (cfu/g)	Nil	Nil	Nil	Nil	-	-
Salmonella spp.	Nil	Nil	Nil	Nil	-	-
Staphylococcus spp.	Present	Nil	Nil	Nil	-	-

The physical, chemical and microbiological properties of fresh raw beef used for canning purpose under this research, is presented in Table-1. It shows that the physical properties viz, p^H, drip and cook loss of fresh raw beef were 6.40, 5.55% and 27.71%, respectively. The moisture content and crude protein content in raw beef were 74.61 and 25.39%, respectively. The total viable bacteria count and Coliform count in fresh raw beef however, were 8.8×10^6 and 4.3×10^4 cfu/g (Table 1), respectively. This quality deterioration of market raw beef was due to the slaughtering system of our country which stands below the scientific standard and raw meat used in this study were collected from local market, so this could be the reason behind it. The effect of preservatives on physico-chemical, microbiological properties and recovery rate of canned meat is presented in Table 2. It shows that, the p^H of canned beef was significantly ($p<0.05$) higher in meat preserved with $NaNO_2$ and Kalojira oil than that of NaCl and control group. Preservatives, however, had no effects ($p>0.05$) on moisture or DM and CP content in canned beef. Similarly, the losses during canning process or recovery rate after 30 days of canning did not vary significantly ($p>0.05$) among the preservatives groups. Though, there was no significant ($p>0.05$) effect, but Kalojira oil performed as impressive preservative compared to others. The maximum DM (40.79%) and CP (28.99%) content was found in Kalojira oil which becomes proven in having maximum recovery rate (64.36%) and lowest loosing rate (2.13%) during the canning processes. The highest mineral content (3.59%) was in common salt (NaCl) 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 microbiological aspects of canned meat, the TVC, TCC, *Salmonella spp*. and *Staphylococcus spp*. were entirely absent in

Kalojira group. In case of $NaNO_2$ and NaCl group, only a very few number of viable bacteria was found (1×10^2). On the other hand only the Staphylococcus bacteria was found in case of control group. Moreover, it was estimated that the production cost of 0.5 Kg canned beef using preservatives and without preservatives were Tk. 357, Tk. 362, Tk. 357 and Tk. 357, respectively for control, Kalojira oil, Sodium nitrite and Sodium chloride as preservatives. Considering the physico-chemical and microbiological aspects in canned beef, it may be concluded that the Kalojira oil could be a suitable value added preservative in meat canning compare to NaCl and $NaNO_2$ the two recognized preservatives; may be for its own herbal or medicinal properties. Before marketing however, further in-depth study on shelf-life of canned meat and assurance of its quality will be needed for making it safe and consumer friendly.

Morphological features and growth traits of half sib local Pabna calves up to yearling stages

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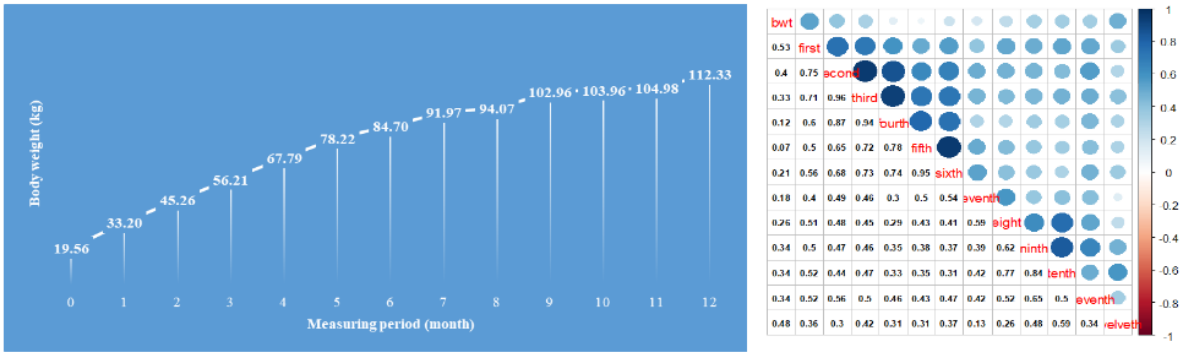
Executive summary

Phenotypic features and growth traits are important parameters for breed characterization and performance evaluation. The study was conducted to reveal the phenotypic and growth traits of half sib Pabna calves up to yearling stages to select the comparative best cattle based on increasing pattern of body size and morphological features towards the development of a uniform Pabna cattle herd. Data of various preselected phenotypic measures and growth were collected from 18 and 22 half sib Pabna calves, respectively, using measuring tape and digital weighing balance up to 12 months of calving at BLRI Regional Station, Baghabari during March, 2018 to June, 2019. The body weight of newborn calves and respective dams were recorded separately. Further body weights of calves were recorded in each consecutive measuring period of one month's interval (DDRP-BLRI solution, SourceTrace System, Massachusetts, USA). In case of phenotypic measurements of calves, same side and direction were followed for all individuals in each time. Each calf was allowed to drink 10% of milk for individual's body weight from respective dam twice per day at calf shed. In addition, dams were reared under specific farm management conditions (feeding regime on dry matter basis; 2.50% of body weight) at milking shed of BLRI Regional Station, Baghabari. Data analyses of phenotypic measurements were conducted following independent sample *t*-test and one-way ANOVA of Completely Randomized Design (CRD). Analysis on growth traits were performed using multivariate of GLM in Randomized Complete Block Design (RCBD) and also one-way ANOVA of Completely Randomized Design (CRD) following Bonferroni and Tukey's HSD mean separation *post hoc* tests, respectively.

Linear increasing trend identified in all morphological features from birth to yearling stages for both body and head characteristics of Pabna calves in which heart girth (63.33±1.31 cm at birth and 91.83±2.18 cm at pre-weaning), wither height (84.17±0.60 cm at pre-weaning), carpal circumference (10.50±0.50 cm at birth), mouth circumference (21.33±0.33 cm at birth and 26.58 cm at pre-weaning) and head length (30.08±0.99 cm at pre-weaning) had significant differences ($p<0.05$) in male calves compare to female (Table 1). These data indicated that phenotypic measures might use in selecting the desire individual from herd associating weight gain. Body weight of Pabna calves also showed linear fashion from birth (19.56±2.11 kg) to yearling stages (112.33±3.30 kg) including strong correlation at first (53%) and yearling (48%), and weak at weaning (7%) stages (Figure 1). The sex and birth weight of calf had significant effects ($p<0.05$) up to pre-weaning stage of calf. The average daily gains (ADG) of calf showed highest (449.33±17.07 g) and lowest (261.35±12.96 g) values at first and twelfth month of birth, respectively. In pre-weaning stage, the ADG observed highest in Winter season (471.11± 20.95 g) while at post-weaning stage in Summer (333.88±13.44 g). However, average monthly gain (AMG) did not show any statistical differences ($p>0.05$) among the growth rate from pre-weaning (365.06±22.29 g) to yearling (145.19±116.13 g) stages. These data suggested the growth rate patterns of local Pabna calves and also to provide special care through feeding management during adverse situation.

Table 1. Effect of sex on morphological features of Pabna cattle calves up to weaning period

Morphological features	Sex	At birth (n=18; M-6, F-12)		Pre-weaning (n=17; M-6, F-11)		Weaning (n=14; M-4, F-10)	
		Mean	SE	Mean	SE	Mean	SE
Body characteristics (cm)							
Heart girth (HG)	Male	63.33	1.31	91.83	2.18	101.00	2.58
	Female	59.42	0.74	86.50	1.00	102.90	1.92
	P value	*0.013*		*0.022*		*0.594*	
Wither height (WH)	Male	65.83	1.01	84.17	0.60	90.50	1.71
	Female	64.58	0.69	79.77	0.69	88.15	0.86
	P value	*0.317*		*0.000*		*0.196*	
Carpal circumference (CC)	Male	10.50	0.50	11.17	0.17	12.13	0.31
	Female	9.25	0.22	10.86	0.14	12.05	0.41
	P value	*0.016*		*0.193*		*0.915*	
Head characteristics (cm)							
Mouth circumference (MC)	Male	21.33	0.33	26.58	0.76	31.00	1.00
	Female	20.17	0.27	24.73	0.48	29.20	0.74
	P value	*0.020*		*0.047*		*0.204*	
Head length (HL)	Male	21.25	0.40	30.08	0.99	33.88	0.83
	Female	21.08	0.36	27.45	0.35	32.70	0.26
	P value	*0.779*		*0.007*		*0.094*	



a b

Figure 1. Body weight of Pabna calves up to yearling stages (a) including correlation (b) among the periods

Finally, the variations of phenotypic feature and growth trait from birth to yearling stages could be used for selection among the G_1 local Pabna calves for further breeding purpose.

Improving production performance of local buffalo through crossbreeding

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Executive summary

Evaluation of adaptability of crossbred buffaloes (Murrah× Local & Nili-Ravi× Local) at farmer's condition and on-station is very important for implementation of buffalo breeding programme. Considering above fact, this study was aimed 1) to produce crossbred buffalo, 2) to evaluate their production performances at BLRI Buffalo Research Farm and 3) to validate previously adopted estrus synchronization (ES) protocols. Indigenous buffalo was inseminated/naturally mated with pure Murrah and Nili-Ravi bull/semen at BLRI Buffalo Research Farm (39 cows with Murrah and Nili-Ravi bull/semen) and Godagari, Rajshahi (14 Cows with Murrah semen). Body weight from birth to 30 month age, age at first heat and calving and gestation period were recorded to evaluate the performance of Murrah×Local and Nili-Ravi×Local crossbred buffaloes at BLRI. BLRI has developed ES technology for buffalo. However, the efficacy of this technology has not been validated yet. Hence, ES protocols were validated on-farm at Fulbaria of Mymensingh district and on-station at BLRI. Two ES protocols (i. cows with corpus luteum were treated with $PGF_{2\alpha}$ followed by mating on day 3 and GnRH administration just after mating and ii. GnRH administration at any stage of the cycle and $PGF_{2\alpha}$ on day 7 and AI on day 9 followed by 2nd dose of GnRH) were applied during this experiment.

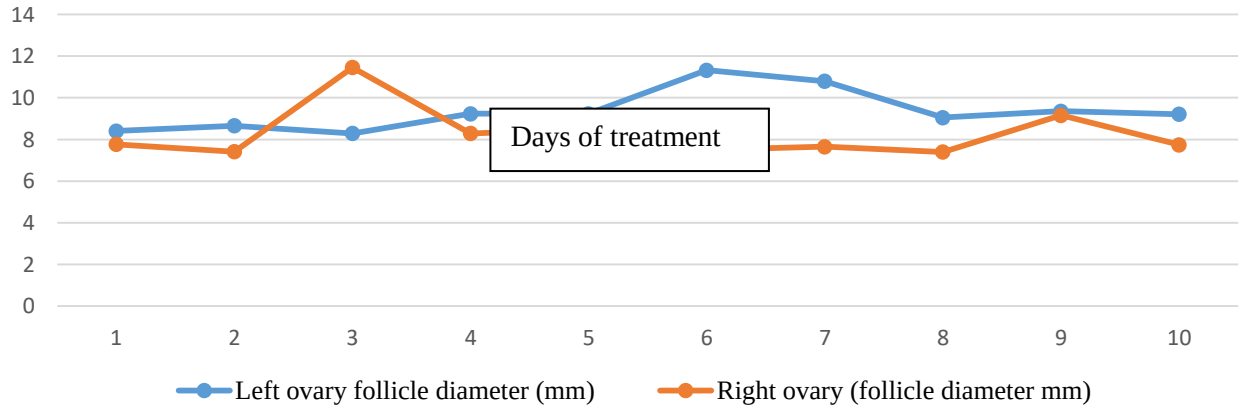
During this study period, 4 crossbred calves (Murrah×Local) were born at Rajshahi and 35 (21 Murrah×Local and 14 Nili-Ravi×Local) at BLRI. Conception rates in AI at Rajshahi and natural mating at BLRI were 35.71% (5 out of 14) and 92.31% (36 out of 39) respectively. Although both Murrah and Nili-Ravi crossbreds have almost similar birth weight (30.07±0.64 kg vs 29.93± 0.64 kg) but body weight of Nili-Ravi at 30 months (355±12.78 kg) was higher than Murrah crossbred (291±2.00 kg) (Table 1). Two Murrah crossbred heifers showed first heat at 767 and 1126 days, respectively. One heifer delivered first calf at 1065 days with a gestation period of 298 days. Responses of buffalo cows on ES protocol 1 and 2 at BLRI were 83.33% (10 out of 12) and 100% (12 out of 12), respectively. However, responses of buffalo cows against ES protocol 1 and 2 at Fulbaria, Mymensingh were 33.33% (2 out of 6) and 44.44% (4 out of 9). None of the experimental buffalo cow established pregnancy at Fulbaria. Research is conducting to find out the reason behind failure in conception following ES. For this purpose, 5 Animals were daily examined by ultrasonography from day 1 of treatment till day 10 after treatment (day of estrus) with ES protocol 2 to characterize the follicular statistics, pattern of growth and regression of the dominant follicle and CL.

Follicular growth (small, medium and large follicle) occurs in even manner in left (4.48±2.92) and right ovary (4.25±3.47) of the treated animal. Buffaloes that were subjected to ES 1 protocol at the beginning of treatment, the mean diameter of the largest follicle of left and right ovary was found (8.40±1.47 mm) and (7.765±1.58 mm) respectively. On day 7 of treatment (day of PGF2α administration) the mean diameter of the largest follicle of the left and right ovaries of the buffaloes was (10.79 ± 2.44 mm) and (7.65 ± 0.21mm) respectively. On day 10 of treatment the mean diameter of the largest follicle of left and right ovary was (9.20± 0.92mm) and (7.75± 0.22 mm) respectively (Fig 1). Out of 5 buffaloes, 4 buffaloes showed heat and inseminated with frozen semen followed by second dose of GnRH. After AI two animals shows repeat heat after 21 days and two animals has not shown repeat heat yet. Blood sampling was carried out every other day, from the 1st day of treatment till the day of estrus for estimation of serum progesterone and estradiol level. Collected blood samples were centrifuged immediately at 2500 rpm for 15 min and serum samples were stored at -20°C until hormone analyses.

Table 1. Productive performance (Mean ±SE) of Murrah and Nili-Ravi crosses at BLRI

Parameter	Murrah	Nili-Ravi
Average birth weight (Kg)	30.07±0.64	29.93± 0.64
Average male birth weight (Kg)	30.93±0.99	29.15±1.26
Average female birth weight (Kg)	29.39±0.82	30.32±0.75
0-3 month body weight (Kg)	41.0±2.70	39.5±0.86
3-6 month body weight (Kg)	115± 12.78	97±4.26
6-9 month body weight (Kg)	125±17.73	133±8.82
9-12 months body weight (Kg)	131±3.47	147±2.08
12-18 month body weight (Kg)	173±16.75	226±12.83
18-24 month body weight (Kg)	251±17.94	295±26.4
24-30 month body weight (Kg)	291±2.00	355±12.78

Figure 1: Follicular diameter (mean±SD) during ES 1 protocol in indigenous buffalo cows



Study on follicular physiology of repeat breeder cows in Baghabari milk shed areas

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Executive summary

The experiment was implemented at farmer's house and Bathan areas of Shahjadpur upazila under Sirajgonj district. This experiment was conducted to know the incidence rate in Holstein Frisian (HF) Repeat Breeder cows (RBC) compared with the normal HF cows; the physiology of different follicles of RB cows at different stages of estrus cycle; the deformity of ovary and uterus. Forty (40) RB cows of Holstein Friesian (HF) were selected initially on the basis of age and parity number. A herd comprising 10 cows at farmer's house and another 30 cows at Bathan areas were brought and maintained. All RBC were marked by ear tag and maintained breeding record by Cattle Herd Book. After selecting the RB cows, pyometra, endometra, cervicitis, sulphagitis and tumor like growth etc. in uterine wall were identified with the help of modern veterinary approaches. The status of ovarian follicles at different stages of estrus cycle observed. Finally Luteal and follicular cyst (if present) were also identified with the veterinary concerned researchers. All experimental cows were synchronized by the treatment of GnRH (day-0), PGF2α (day-7) and Artificial Insemination (AI) + GnRH (day -9). Pregnancy tests were done after 50 days of AI by rectal palpation and chemical test in the laboratory. Growing follicle number appeared ultrasonically, size of Graafian follicle, breed, cows body size, and inheritance level and parity, nutritional factors, heat stress (record temperature and Relative Humidity at the time of estrus), days calving to first service, hormone (estrogen, progesterone and LH) around the time of estrus, luteal and follicular cyst and different reproductive diseases were recorded. All collected data were statistically analyzed by the SPSS soft-ware program. Results revealed that, significantly ($P<0.05$) highest Body Condition Score (BCS) was 3.47±0.05 observed in the cows of group-D whose age was more than 8 years compared to others group (Table 1). In-case of average daily milk yield and remained dry condition differences were highly significant ($P<0.001$). Maximum milk yield (20.41±0.82 l/day) was observed in group-C compared to others group but minimum dry condition remaining period was observed in group-A than others. Days of heat showed number of AI service were non-significant ($P>0.05$) in the whole experiment (table-1). The percentage of infection (Pyometra, Endometra and Metratis) in the uterine wall differed non-significantly ($P>0.05$) among all the groups and minimum values were observed in group-A (Table 2). Percentage of cyst presented in both ovaries is given in table-2. Highest percent of cyst observed in the right ovary than left of the cows of group-D compared to others groups but the differences were non-significant ($P>0.05$).Comparatively higher percentage (58.82±12.30) of follicles observed in left ovary of group-D than right ovary in the whole duration of the experiment (Table 2). The highest average number (2.40±0.44) of follicles was observed in left ovary of the group-C than the cows of others group but the differences were non-significant ($P>0.05$). Though the follicle size in the end of luteal phase differed non-significantly ($P>0.05$) but comparatively larger (3.47±1.34 mm) follicle in diameter were observed in group-A than the follicles of others groups.

Table 1. Phenotypic parameter of repeat breeder cows

Parameters	Group				P Value	Level of Sig.
	A(2-4 years)	B(5-7 years)	C(7-8 years)	D(>8 years)		
BCS(0-5)	2.94±0.17	3.00±0.14	3.22±0.06	3.47±0.05	0.01	*
Milk yield(L/d)	18.15±1.52	15.27±0.76	20.41±0.82	20.06±0.94	0.00	**
Remained dry condition (M)	20.66±1.36	31.07±1.32	30.27±1.12	30.23±1.98	0.00	**
Heat showed interval(days)	31.50±6.91	47.56±7.71	44.90±4.11	41.47±9.28	0.71	NS
Service given (No)	8.67±1.95	6.74±0.95	5.79±0.62	8.18±2.34	0.37	NS

*= Significant, **= Highly significant, NS= Non significant

Table 2. Physiological parameters of the ovaries of repeat breeder cows

Parameters	Group				P Value	Level of Sig.
	A(2-4 years)	B(5-7 years)	C(7-8 years)	D(>8 years)		
Pyometra (%)	33.33±16.67	37.04±9.47	60.47±7.54	64.71±11.94	0.11	NS
Endometra (%)	22.22±14.69	29.63±8.95	23.26±6.51	29.41±11.39	0.91	NS
Metratis (%)	0.00	11.11±6.16	11.63±4.94	11.76±8.05	0.77	NS
Right ovarian cyst (%)	66.67±16.66	48.15±9.79	48.84±7.71	70.59±11.39	0.35	NS
Left ovarian cyst (%)	11.11±5.11	14.81±6.96	23.26±6.51	17.65±9.53	0.76	NS
Follicles in right ovary (%)	33.33±16.66	25.93±8.59	37.21±7.45	11.76±8.05	0.26	NS
Follicles in left ovary (%)	44.44±17.56	29.63±8.95	37.21±7.45	58.82±12.30	0.27	NS
Follicles in right ovary (no)	2.00±0.80	2.00±0.52	2.40±0.44	1.33±0.80	0.31	NS
Follicles in left ovary (no)	1.67±0.70	0.85±0.46	0.90±0.38	1.00±0.70	0.38	NS
Right ovarian follicle diameter (mm)	1.34±0.91	1.07±0.60	2.10±0.50	2.59±0.91	0.20	NS
Left ovarian follicle diameter (mm)	3.47±1.34	2.94±1.10	1.26±0.73	2.81±1.34	0.21	NS

NS= Non significant

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

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Executive summary

The present cattle breeding policy encouraging artificial insemination (AI) program throughout the country to increase productivity of milk and meat. Purebred populations are declining due to indiscriminate breeding within the native stock and crossbreeding with exotic breeds. In order to maintain the purity of indigenous genetic resources like Red Chittagong Cattle (RCC), it is important to maintain the purity during breeding with either natural mating or AI. But in both cases, quality of the breeding male is most important as AI allows semen from one bull to be used to inseminate thousands of females. 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 loss. Evaluation of semen quality and early prediction of fertility of RCC bull before mass AI will results more conception rate, more calves and reduces the cost of rearing low fertile bull in the breeding center. Therefore this study was designed to identify candidate genes or markers related with semen quality and fertility of bulls. In this study, twelve (12) RCC bulls were selected considering their true breed characteristics and pedigree records. The selected bulls were trained for semen collection. Semen was collected twice in a week from each bull using artificial vagina method. After initial evaluation with computer assisted semen analyzer, 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 hrs at 4°C for equilibration. The semen samples were filled and sealed in standard printed straws (0.25ml) using an automated sealing filling 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 overnight storage. Data were analyzed using Microsoft excel programme. The volume, concentration, total motility, progressive motility and static motility of fresh semen were 3.94±1.15, 1638.42±923.51, 77.68±13.48%, 57.59 ± 14.42%, 22.37±13.47 % respectively. The total, progressive, and static motility of frozen semen were 67.57±2.99, 46.86±2.79%, 32.12±3.24 % respectively.

Table 1. Semen quality parameter (Mean±SD) of RCC bull semen

Parameter	Volume	Concentration	Motility		
			Total	Progressive	Static
Fresh semen	3.9±1.2	1638.4±93.5	77.7±13.5	57.6 ± 14.4	22.4±13.5
Frozen semen	--	--	67.6±2.9	46.9±2.8	32.1±3.2

Fresh and post thaw semen samples were analyzed and different kinematic parameters were recorded (Table 2) for studied bulls. Results showed significant variations ($p<0.01$) for average path velocity (APV), straight linear velocity (SLV), straightness (STR) and linearity (LIN) of different sperm kinematic parameters of fresh and frozen semen as shown in Table 2.

Table 2. Kinematic parameters (Mean±SE) of fresh and post thawed RCC bull sperms

Freezing stage	APV (µm/s)	SLV (µm/s)	VCL (µm/s)	STR (%)	LIN (%)	ALH (Mm)	BCF (Hz)
Fresh	98.7^{a} ±0.7	79.7^{a}±0.7	140.8^{a}±0.7	88.9^{a}±0.8	57.9^{a}±0.4	7.4^{a}±0.6	27.9^{a}±0.6
Post thaw	84.7^{b}±0.5	68.7^{b}±0.7	139.8^{a}±0.7	85.3^{b}±0.7	54.2^{b}±0.5	7.0^{a}±0.5	26.2^{a}±0.5

APV: average path velocity, SLV: straight linear velocity, VCL: curvilinear velocity, STR: straightness, LIN: linearity ALH: Amplitude of lateral head displacement and BCF: beat cross frequency. Means bearing different superscripts ($^{a, b, c}$) among extenders at post-thaw stage differ significantly ($p<0.01$)

A number of previously studied gene transcript related with different biological functions of sperm were selected from published research articles for searching candidate marker genes to predict semen quality and fertility. Semen characteristics of RCC bull were studied and semen was cryopreserved for experimental purposes. AI is conducting for evaluation of conception rates of cryopreserved semen of individual bull. Moreover, gene expression analysis using quantitative real time PCR will be conducted for identification candidate gene/marker for prediction of sperm quality and fertility of bulls.

Effect of nitrogen fertilizer on morphological parameter, biomass yield and nutritive value of Napier fodder

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Executive summary

The yield and chemical composition of fodder varies due to many factors such as the soil quality, plant density, fertilizer dose, growing season and stage of maturity etc. Among the various factors, fertilizer application is important which directly contributes to the quality and quantity of fodder production. In our country nitrogen fertilizer is normally used in the form of Urea and excessive use of this fertilizer may increase the cultivation cost. So the appropriate level of Urea application in Napier fodder cultivation is needed to know. It is also established that crude protein content of forage is increased by increased level of N-fertilizer. Considering the above facts, the present investigation was carried out to study the effect of nitrogen fertilizer doses on morphological characteristics, biomass yield and chemical composition of Napier fodder at BLRI Regional Station, Baghabari, Sirajganj. For the work soil samples were analyzed for soil pH, nitrogen, organic matter, salinity, Ca, K, S, Zn, Pb, Co, Mg, Fe etc. at the Central Laboratory of Soil Resource Development Institute (SRDI), Dhaka. The p^H value, organic matter, total nitrogen (N), potassium (K), calcium (Ca), phosphorus (P), sodium (Na) content of the soil was 6.20, 1.75%, 0.088%,0.15millitulanko/100g,8.05millitulanko/100g,11.66 millitulanko/100 g, 0.15 millitulanko/100 g, respectively. The experiment was conducted by using 4 levels of Nitrogen fertilizer namely 0 (T1), 50 (T2), 100 (T3) and 150 (T4) kg Urea/ha at 12 plots. Three plots for every treatment having homogenous soil parameters were taken and the plot size was17ft×10ft. Fodder was propagated by stem cutting method and sowed in rows. Line to line and plant to plant distance were 70 and 30 cm, respectively. The plots were prepared by normal agronomical operations as routine weeding practices with the utensils like sickle, chen, spade etc. were done to remove undesirable grasses, bushes and plants, irrigation was performed by using a plastic pipe through a canal with the help of deep tube well in Baghabari station. In each experimental plot, irrigation was performed by using a plastic pipe through a canal with the help of deep tube well in Baghabari station. The first cut was made at 55 days after the stem sowing and then subsequent harvest was made at 40 days after each cutting. After each cutting, the plot was loosen manually by spade and urea was applied as top dressed. During the time of harvest, records of plant height, stem length, leaf length, number of leaf per stem, number of till per hill, yield per hill and total biomass yield were taken from each of the plot. All the recorded data were analyzed using 'SPSS' statistical program to compute analysis of variance following one way ANOVA for Completely Randomized Design (CRD).

Effect of nitrogen fertilizer doses on morphological characteristics and biomass yield of Napier fodder is presented in Table 1. The result showed that the application of nitrogen fertilizer had significant ($P<0.01$) effect on plant height and highest plant height (235.44±8.79 cm) was observed at 100 kgN/ha (T3) at 60 days age. However, application of nitrogen fertilizer from urea did not show any significant effect on stem length and leaf per stem of plant. A significant effect ($P<0.01$) in biomass yield was observed between the groups and highest yield (101.76±1.89 Ton/ha) was observed at 150 kg Urea/ha (T4). Effect of nitrogen fertilizer doses on chemical composition of Napier fodder is presented in Table 2. The application of nitrogen fertilizer significantly ($P<0.05$) increased the dry matter content of Napier grass and highest DM content (21.03±0.16) was observed at 150 kgN/ha. Here showed a highly significant difference ($P<0.01$) among the groups for chemical composition of Napier due to increasing rate of N fertilizer and highest CP (13.78±0.06), ADF (43.60±0.04) and NDF (64.27±0.04) were observed at 150 kgN/ha group.

Table 1. Effect of nitrogen fertilizer doses on morphological characteristics and biomass yield of Napier

Performance parameter	Measuring unit	Groups (Mean ± SE)				P value
		T1	T2	T3	T4	
Plant height	Centimeter	186.33±8.06^{b}	230.0±4.97^{a}	235.44±8.79^{a}	226.55±6.71^{a}	0.000
Stem length	Centimeter	87.11±6.35^{a}	94.55±6.06^{a}	86.88±4.58^{a}	99.11±2.55^{a}	0.281
Leaf length	Centimeter	95.11±2.40^{ab}	91.11±4.52^{b}	104.55±3.97^{a}	102.33±0.98^{a}	0.023
Leaf wide	Centimeter	2.74±0.16^{b}	3.76±0.49^{a}	2.74±0.13^{b}	3.31±0.19^{ab}	0.045
Leaf per stem	Number	13.11±1.59^{a}	14.66±0.66^{a}	14.55±1.68^{a}	13.11±0.67^{a}	0.699
Till per hill	Number	7.00±0.50^{b}	5.00±0.28^{c}	4.66±0.16^{c}	9.66±0.16^{a}	0.000
Yield per hill	Kg	1.16±0.14^{c}	1.95±0.08^{b}	1.34±0.07^{c}	2.36±0.04^{a}	0.000
Biomass yield	Ton/hector	50.02±6.26^{c}	84.13±3.83^{b}	57.62±3.01^{c}	101.76±1.89^{a}	0.000

N.B: T1 (0 kg Urea/ha), T2 (50 kg Urea/ha), T3 (100 kg Urea/ha) and T4 (150 kg Urea/ha)

Table 2. Effect of nitrogen fertilizer doses on chemical composition of Napier fodder

Parameter	Measuring unit	Groups (Mean ± SE)				P value
		T1	T2	T3	T4	
DM	%	20.29±0.25^{ab}	19.97±0.17^{b}	20.31±0.28^{ab}	21.03±0.16^{a}	0.042
CP	%	11.81±0.12^{c}	12.87±0.18^{b}	12.69±0.19^{b}	13.78±0.06^{a}	0.000
ADF	%	40.64±0.08^{c}	40.52±0.07^{c}	43.07±0.02^{b}	43.60±0.04^{a}	0.000
NDF	%	63.18±0.12^{c}	63.52±0.07^{b}	64.01±0.06^{a}	64.27±0.04^{a}	0.000
Ash	%	9.89±0.04^{a}	8.84±0.01^{c}	9.04±0.08^{b}	9.14±0.12^{b}	0.000

N.B: T1 (0 kg Urea/ha), T2 (50 kg Urea/ha), T3 (100 kg Urea/ha) and T4 (150 kg Urea/ha)

From the results of the present study, it may be concluded that the application of N at the rate of 150 Kg/ha could be used for Napier grass production.

Development of a mini processing plant for safe poultry meat production

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Executive summary

Meat consumption in developing countries has been continuously increasing and will reach per capita 37 kg around the year 2030 according to FAO projection. This forecasting suggests that in a few decades, consumption of meat will move towards that of developed countries where meat consumption remains stagnant at a high level. According to Gaya (2006), the main attributes related to poultry meat that may determine its quality are color and its water holding capacity. The ability of preserving food in general is related to environmental air quality and temperature, as well as conditioning and packaging characteristics (Fletcher et al., 2000). Poultry meat is a perishable product consisting of protein, carbohydrates, lipids, and water. Product conservation must meet certain standards in order to preserve its quality until consumption by the final user. In order to reduce risks, the standards of agricultural and food production such as Good Farming Practice (GFP), Good Slaughtering Practice (GSP) and Hazard Analysis Critical Control Point (HACCP) concept etc. have been implemented to control food chains thoroughly. Therefore, the present ongoing research was undertaken to know the effect of processing procedures, shelf life and other quality characteristics of poultry meat. These data will be required for labeling the nutrition fact on the packaged meat. Moreover, packing and branding of the products with BLRI logo & following HACCP guidelines. In previous year, as a part of the present study the existing problems of the mini processing plant were identified and accordingly the current activities of the project were designed.

At the end of a broiler trial at our division 10 birds per treatment were randomly selected and weighed. The samples of breast and thigh-drumstick were collected to determine the chemical composition of meat. The nutritional quality of breast and thigh meat was analyzed. The frozen samples of meat were dissected into small pieces and homogenized in a blender. Moisture, protein, fat, and ash contents of breast and thigh meat samples were determined following the standard procedures (AOAC, 2000). Ten samples per treatment were randomly selected and collected from breast and thigh meat. The pH values of each pectoral muscle sample were determined using a digital pH meter. Cooking loss was determined based on the formula:

Cooking loss = (cooked weight/initial weight) ×100

The meat color values were obtained using a Minolta colorimeter after calibration expressed as y = 92.80, x = 0.313, and y = 0.319, and duplicate readings per sample was determined. Each treatment reading was expressed as the CIE L*, a*, and b* color space value, respectively.

In Table 1 represented that thiobarbituric acid (TBA) values were not significantly different among the 4 dietary treatments. According to (Gheisari, 2011) the extent of oxidative rancidity in a fat may also be determined by its TBA number. The 2- thiobarbituric acid (TBA) test is believed to measure the breakdown products of unsaturated fatty acid oxidation.

Table 1. Different meat quality characteristics of broiler feeding with different feed additives

Treatment	P^H	TBA	Cooking loss	Color values		
				L*	a*	b*
T_0	6.30	8.81	18.25	53.33^{a}	4.44^{bc}	9.01
T_1	6.36	10.8	15.04	49.11^{b}	6.41^{a}	7.23
T_2	6.23	8.63	18.36	51.23^{ab}	3.48^{c}	8.21
T_3	6.42	11.19	17.76	51.99^{a}	5.31^{ab}	8.67
SEM	0.043	0.693	0.606	0.526	0.399	0.385
P-Value	0.498	0.472	0.169	0.016	0.038	0.42

* Meat color values of lightness (L*), redness (a*), and yellowness (b*)

T_0 = Control, T_1 = antibiotic, T_2 = Probiotic(*Bacillus*), T_3 = Probiotic(*Lactobacillus*)

For hygienic meat production proper processing procedure was following and will be followed with the principles of HACCP. Hence, after completion of all the planned activities this processing plant will serve the purpose of supplying safe poultry meat to the consumers. From next Financial Year (2020-21) similar replicated processing plants will be established in 5 regions (Rajshahi, Jashore, Faridpur, Saidpur and Nikhongchari) through the Strengthening of Poultry Research and Development Project for the different community people.

Impact of sheep project on socioeconomic conditions and sheep management practices in selected areas of Bangladesh

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Conservation and Improvement of Native Sheep through community and commercial farming project (Component A, Research-2nd phase), BLRI, Savar, Dhaka

Executive summary

Livestock plays a vital role for the economy of Bangladesh. Quality protein mainly comes from animal protein source. Small ruminants, specially goat and sheep are very effective source of quality protein supply through meat and milk. Most of the small ruminants of the country belong to landless, marginal and small farmers. Improvement in the productivity of small ruminants especially sheep will directly benefit the poorest part of the society, through poverty reduction, employment generation and improvement of nutrition. The present study was conducted to assess the impact of the project "Conservation and Improvement of Native Sheep through Community and Commercial Farming (Component A, Research-2nd Phase)". The objectives of the research work are to identify the socio-demographic characteristics of native sheep farmer; to assess the before and after effects of native sheep rearing on livelihoods of beneficiary farmer; to assess the before and after changes of native sheep management practices; to assess the problems facing by the farmer in native sheep rearing; and to suggest adequate policy recommendation. The project implementation created noticeable awareness and changes among the sheep farming communities of selected 11 Upazilas of 6 District. Relevant primary data was collected from project beneficiaries with the help of interview schedule through direct interview. Data will be analyzed with a combination of descriptive statistics & the appropriate econometric models.

From the research, it was found that the average age and family size of sheep farmers were found 42.86 years and 4.01 respectively. The male-female ratio of sheep farming households was 1.01. The dependency ratio of the households was 2.22. Most of the sheep farmer were found uneducated. About 53.31 percent farmers were found that they only can sing. About 52.42 percent family member including respondent were found agriculture as their main occupation. The average land holdings of the households were found 158.13 decimal. Average sheep per households was increased 100.79 percent in the project areas. Remarkable livelihoods improvement is occurred among the project beneficiary farmers. On an average all kinds of livelihood assets were increased by 54.09 percent.

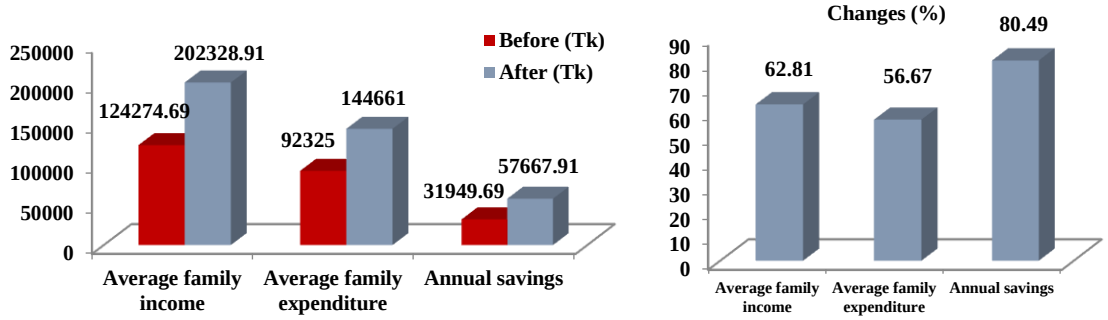

Figure 1. Changes in household income, expenditure and savings (yearly)

The average annual income of the sheep farming household was increased by 62.81 percent. Annual savings of the sheep farmers were increased by 80.49 percent. Both male and female participation in sheep rearing was found increased remarkably. Most of the household's expenditure increases remarkably. The average expenditure of sheep farmer were found 144661.00 (Tk.) per year which is 62.81 percent higher than before of implementation of sheep project. It implies that both demand and purchasing power of sheep farmers increased remarkably. A noticeable improvement occurred in neo-natal nourishment practices of sheep. Housing facility, anthelmentic and vaccine uses were found increased by 438.89, 1275.00 and 3567.00 percent respectively. Mixed feeding system was

increased by 168.10 percent. Remarkable improvement occurred in disease management of sheep in the project areas. Pneumonia, diarrhea, bloat and parasite infection were found the main diseases of sheep. A few numbers of problems that still faced by the sheep rearing farmers. About 46.08 and 38.85 percent sheep farmer reported for problem of grazing land and higher feed price. Furthermore, dog bite, sheep marketing, improved ram, housing, lack of finance, social obstacle and low milk production problems were also found. Most of the sheep farmer reported that sheep rearing was helping them to generate their income, reducing poverty, providing ready cash in hand and empowering rural poor women. They want credit facility, wool marketing facility, improved marketing system and also more social awareness. It is recommended that further improvement is needed to develop technologies related to sheep breeding, nutrition, health management and socioeconomic problems and make them available at the field level and to develop market institution capable of making markets work better for the sheep farmers by making awareness, improve market coordination and ensure availability of price information. Interventions should aim to improve the functioning of sheep markets and linkages. There is scope for increasing access in the lamb supply chain to improve linkages by increasing access through national and international meat supply agencies.

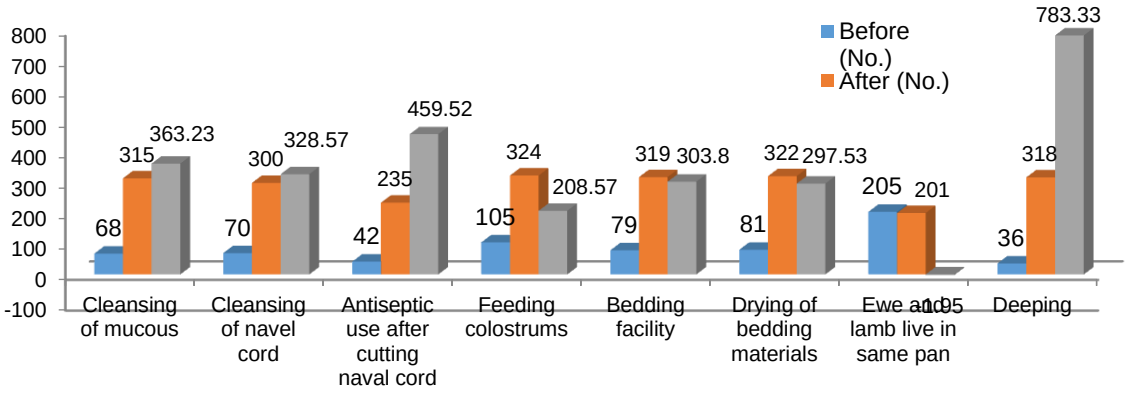

Figure 2. Changes of neo-natal nourishment and dipping practices of sheep

Development of system generated database at BLRI research farm for genetic evaluation in progressive generations

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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 have also helped in the collection 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 registeretc. BLRI also maintains such type of records. At present BLRI cattle and buffalo research farm owns three different genotypes of cattle as; BCB-1, RCC and Munshiganj and two genotypes of buffalo as indigenous and crossbred for conservation and research purposes. Since its inception, 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. 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 an up-to-date system generated database software that could be useable both in PC and mobile phone.

A team composed of a software developer; animal breeders and animal nutritionists planned and designed the thematic features of the software prior to develop. In the software, input facility of economic important traits of all individuals exposed from birth up to end of productive life was created with systematic arrangements (Fig. 1 and Fig. 2). Based on the imputed data, output will be obtained within a moment. The software will facilitate to filter the 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 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. In the software, vaccination, calving and feeding schedules along with breeding calendar, disease calendar, breeding plan etc. were incorporated for farm operation smoothly.

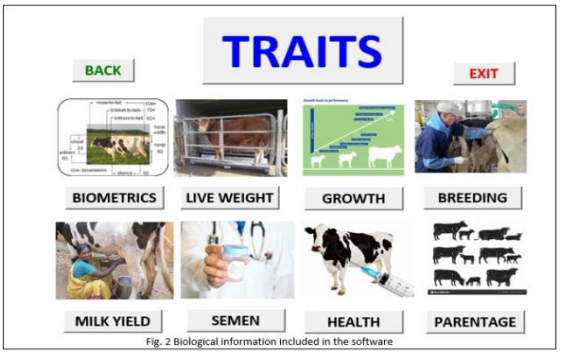

Fig. 2 Biological information included in the software

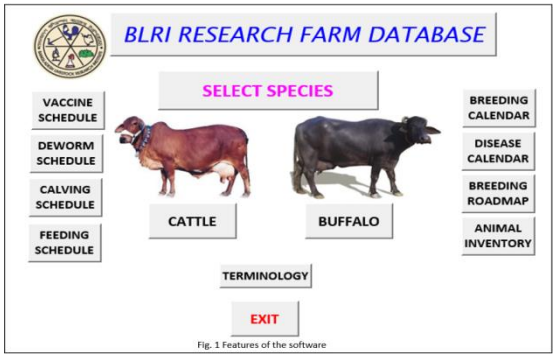

Fig. 1 Features of the software

Finally, it may be concluded that the developed database software will help in storing data permanently and hence, decision for selection and culling of animals based on the genetic merit analyzed by taking data from the software will be very convenient for farm manager.

Genetic variants of beta-casein in native and crossbred cattle 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 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 breeds, the present study was undertaken with the objectives to (i) identify genetic variability (A1/A2) of beta-casein in existing cattle genotypes of Bangladesh and (ii) to make breeding decision at policy and farmers level to enhance A2 milk production. To achieve the objectives, cattle 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, Sahiwal, Jersey, Brahman, exotic breeds & other available cattle genotypes were selected for the genetic variability study of A1 and A2 beta-casein. In the financial year of 2018-19, a total of 278 blood samples were collected from four native cattle breeds and crossbreds of which 47, 61, 69, 50 and 51 samples were from RCC, BCB-1, MC, NBG and crossbreds, 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 ethidium bromide staining and alleles were identified using UV-trans-illuminator (Figure 1).

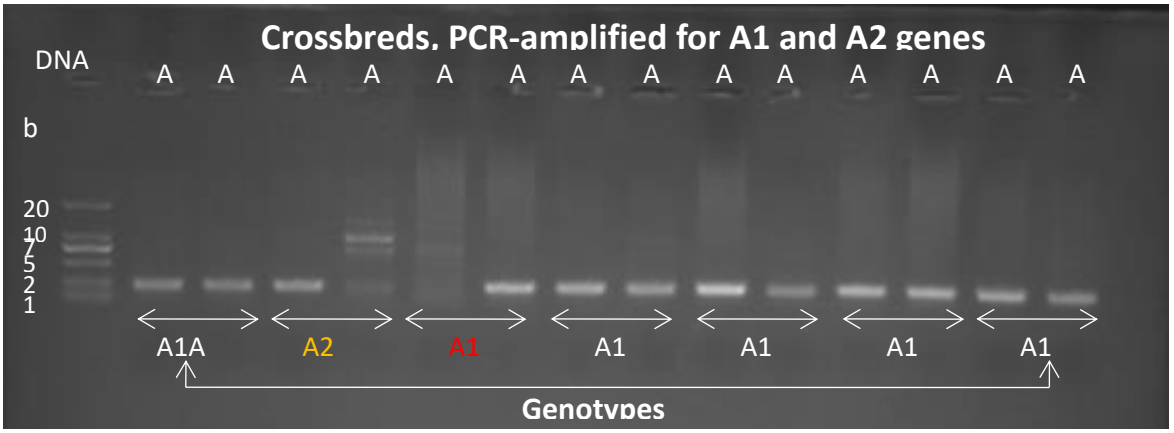

Figure 1. Identification of A1 and A2 alleles in crossbreds through AS-PCR and agarose gel electrophoresis

Genotype frequencies of A2A2, A1A2 and A1A1 in RCC were 89.40, 10.60 and 0.00. However, the corresponding frequencies in BCB-1 were 85.25, 13.11 and 1.64 and, in MC were 79.70, 18.80 and 1.40, and, in NBG were 72.00, 28.00 and 0.00 and, in crossbreds were 64.71, 29.41 and 5.88, respectively (Table 1).

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

Breeds	No. of Sample	Genotype frequency		
		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)
Crossbreds	51	64.71 (n=33)	29.41(n=15)	5.88(n=3)

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

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

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Executive summary

The aim of the study is to improve the production potentialities of the native genetic resources of livestock at Hilly regions. The Hilly Brown Bengal (HBB) goats, Hilly chickens and Gayal are available at hill tracts region of Bangladesh. The main objectives of the research work was to evaluate the productive and reproductive performances of HBB goats, hilly chickens and gayal and their improvement and conservation at Naikhongchari; to know the influence of dietary supplementation on growth of HBB goats at growing stage; to find out the current herd structure of gayal and their dynamic movement at hilltract areas. The experiment was conducted at Bangladesh Livestock Research Institute, Regional Station Research Farm, Naikhongchari, Bandarban. The hilly chickens were reared in open sided poultry house with standard management system. On the other hands, sixteen HBB goat of 5 month age were selected and their average initial body weight was 7.86 kg. The animals were randomly grouped into T_0, T_1, T_2 and T_3 having 4 replications in each group and duration of the experiment period was 105 days. The diet of different level of energy viz. standard energy (ME content 10.26MJ/kg DM) (NRC, 1981), low energy (10% less, ME content 9.25MJ/kg DM) and high energy (10% high, ME content 11.30MJ/kg DM) than standard energy and Napier-4 as a basal diet were supplied to T_1, T_2 and T_3 group respectively, and T_0 (control) were grazing in the field and reared in conventional system. All treatment groups were supplied concentrate @1.5% of the body weight of goat. Another activity of field survey of Gayal was conducted at Ruma, Thanchi and Bilaichariupazilla of Chittagong Hill tract region with the help of respective local Livestock Offices and tribal people through structured questionnaire. In hilly chicken study, result showed that average body weight of 861.10±17g in growing period up to 12 weeks of age. The body weights of hilly growing chicken were lower than previous year. The feed intake and mortality of hilly chicken up to 12 weeks of age was 33.5±13g/bird/ day and 8.46±1.87% which was higher than previous year. It was found that hatchability of eggs was 62.12±9.13% hatched by both broody hens and the incubator. However, hatchability percentage of hilly chicken is slightly lower than previous year. The adult body weight up to 30 weeks of age of hen and cock were 1852.67±17g and 3097.23±11g respectively. The egg production (H.D) of hilly chicken was 36.60±5% which was increase from previous year. Egg weight and day old chick weight of chicken were 45.34±7g and 30.01±5g respectively. Age at first egg, feed consumption and mortality of hilly chickens were 157 days, 84.48g and 15.27% respectively. Gayalsurvey result showed that about 18% and 38% farmers reared deshi cattle and chicken together with gayal, the average 82.48% farmers were illiterate, family size 5.23 and their farming experience about 22 years. The average monthly income of the farmers was found 18890.65taka. 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 were 5.12. About 95% farmers were not supplied concentrate feed to their gayal and 44% farmers provided anthelmintics and no vaccine were administered to their gayal whereas respondents replied about 72% gayals were affected by FMD and 74% affected by worm. Result showed that total DM intake of T_0, T_1, T_2 and T_3 treatment group were 278.18±22.15, 280.77±15.4, 250.67±9.87 and 298.23±8.35g/day; the initial body weight were 7.85±0.30, 7.50±0.33, 7.88±0.38 and 8.20±0.24 kg/goat and the final body weight (kg) of 12.57±0.46, 12.98±0.48, 12.10±0.30 and 13.88±0.37 kg/goat respectively. There were significant ($p<0.05$) differences of initial body weight and final body weight among T_2 and T_3 treatments groups of growing HBB goat. Daily weight gain of HBB goat were 44.96±3.15, 52.19±4.06, 40.21±2.93 and 54.09±2.79g/day at T_0, T_1, T_2 and T_3 treatment group respectively. It may be concluded that high energy level contents of the diet had significant ($p<0.05$) effect on body weight changes of growing hilly goat. The production potentialities of different type of

genetic resources of livestock and poultry at hill tracts region should be improved through better management, feeding, health care and genetics.

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ANIMAL AND POULTRY DISEASES AND HEALTH

SESSION II

ANIMAL AND POULTRY BREEDING AND GENETICS

SESSION III

FEEDS, FODDER AND NUTRITION

SESSION IV

BIOTECHNOLOGY, ENVIRONMENT AND CLIMATE RESILIENCE

SESSION V

SOCIOECONOMICS AND FARMING SYSTEM RESEARCH

POSTER SESSION