Proceedings

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Date: 09-10 October 2018

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

Annual Research Review Workshop 2018

Date: 09-10 October 2018

BLRI Conference Hall

3rd floor, Building 3

PROGRAMME

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

TECHNICAL SESSIONS

Day 1: Tuesday, 09 October 2018

Technical Session I : **ANIMAL AND POULTRY BREEDING AND GENETICS**

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

Co-Chairperson : **Md. Lutfor Rahman Khan**
Deputy Director
Central Cattle Breeding Station & Dairy Farm
Savar, Dhaka

Rapporteurs : **Dr. Gautam Kumar Deb**, SSO, BLRI
Md. Yousuf Ali Khan, SO, BLRI

11:30-11:40	Study of comparative production performance of F1 progeny of different crossbred beef cattle at BLRI cattle research farm	MP Mostari SSO
11:40-11:50	Study of genetic variants of beta-casein in cattle genotypes of Bangladesh	MYA Khan SO
11:50-12:00	Improvement of goat genetic resources (Black Bengal and Jamunapari goat) through selective breeding at BLRI	NH Disha SO
12:00-12:10	Conservation and improvement of quail: Performance of seventh generation	S Faruque SSO
12:10-12:20	Conservation and improvement of native chicken: Performance of seventh generation	S Faruque SSO
12:20-12.30	Conservation and improvement of native duck genotypes through selective breeding: performance of 4th generation and conservation of geese for meat production	S Sultana SO
12:30-12:40	Maintenance and conservation of pure lines and development of egg and meat type chicken	MR Hassan SSO
12:40-01:10	**Discussion**	
01:10-02:10	**Lunch and Prayer**	
02:10-03:00	**Poster Session**	

Day 1: Tuesday, 09 October 2018

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

Chairperson : **Dr. NC Debnath**
Ex-Vice Chancellor
Chittagong Veterinary & Animal Sciences University
Chittagong

Co-Chairperson : **Dr. MJFA Taimur**
Ex-Chief Scientific Officer
Bangladesh Livestock Research Institute

Rapporteurs : **Dr. Md. Abdus Samad**, SSO, BLRI
Dr. Md. Rezaul Karim, SO, BLRI

03:00-03:10	Phenotypic and genotypic profiling of antimicrobial resistance (AMR) *Enterococcus spp*. in finisher livestock and poultry in Bangladesh	MS Sagor RA
03:10-03:20	Development and validation of a low-cost mastitis detection kit	SM Rahman SSO
03:20-03:30	Development of Peste des Petits Ruminants (PPR) free zone in selected areas of Bangladesh to meet global control strategy	M Giasuddin PSO
03:30-03:40	Development of FMD free zone in Bangladesh as per OIE guidelines	M Giasuddin PSO
03:40-03:50	Prevalence of different dairy cattle diseases in selected dairy areas and farms of Pabna and Sirajganj districts of Bangladesh	SM Rahman SSO
03:50-04.00	Tick borne blood protozoan diseases of farm based & slaughter house animal	MZ Hassan SO
04:00-04:10	Seroprevalence of caprine brucellosis in Bangladesh	MH Rahman SO
04:10-04:40	**Discussion**	
04:40-05:00	**Tea and Snacks**	

Day 2: Wednesday, 10 October 2018

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

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

Co-Chairperson : **Dr. Md. Imtiaz Uddain**
Chief Scientific Officer and Head
Biotechnology Division
Bangladesh Institute of Nuclear Agriculture
BAU Campus, Mymensingh 2202

Rapporteurs : **Dr. Parvin Mostari**, SSO, BLRI
Md. Faizul Hossain Miraz, SO, BLRI

09:00-09:10	Adaptation of ovum pick up and somatic cell nuclear transfer technologies for cattle in Bangladesh	GK Deb SSO
09:10-09:20	Isolation and identification of LAB and *Streptococcus* bacteria for developing starter culture for Yogurt	MA Kabir SO
09:20-09:30	Growth and Physiological Response of Selected Mutant's Line of Napier Cultivar to Salt Stress in Hydroponic Technique	MK Alam PhD Fellow
09:30-09:40	Study on adaptability of HYV fodder cultivars in drought prone Barind areas of Bangladesh	MT Hasan SO
09:40-09:50	Use of water hyacinth and press mud as co-substrate with cow dung and layer droppings for improving biogas production	SM Amanullah, SSO
09:50-10.00	Study of value added livestock manure based product production	JS Khanam SO
10:00-10:10	Study on farm nutrient recycling in BLRI foreign sheep farm	M Yesmin SO
10:10-10:20	Assessment of methane emission in dairy production systems based on existing feed resources through GLEAM model under different climatic zones of Bangladesh and their mitigation options	MK Bashar SO
10:20-10:45	**Discussion**	
10:45-11:00	**Tea and Snacks**	

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

Chairperson : **Dr. Khan Shahidul Huque**
Ex-Director General
Bangladesh Livestock Research Institute
Savar, Dhaka 1341

Co-Chairperson : **Md. Mahbubur Rahman**
Director (Production)
Department of Livestock Services
Farmgate, Dhaka

Rapporteurs : **Dr. Sazedul Karim Sarker**, SSO, BLRI
Dr. Sadek Ahmed, SSO, BLRI

11:00-11:10	Study of production and supply chain development of Moringa feed (Mf) in different regions of Bangladesh	MK Bashar SO
11:10-11:20	Feeding oil versus calcium salt of n-3 and n-6 fatty acid on feed intake, digestibility, enteric methane emission and blood metabolic profile in cattle	MM Rahman, SO
11:20-11:30	Development of probiotic feed supplement for calves and their evaluation	SM Amanullah SSO
11:30-11:40	Buffalo fattening in the Southern Delta of Bangladesh	BK Roy SSO
11:40-11:50	Development of cost effective complete pellet feed and its utilization for commercial goat and sheep production	S Ahmed SSO
11.50-12.00	Development of cost effective crop residues based Total Mixed Ration (TMR) for Ruminant: On farm validation of TMR technology for dairy cow	D Yeasmin SO
12:00-12:10	Study of diversification and upgradation of market waste vegetable based feed manufacturing system	N Sultana PSO
12:10-12:20	Strategic development of feeding and management techniques to improve the performance of egg and meat type chicken and their qualities	MR Hasan SSO
12:20-12:30	Study on the comparative performance of turkey, guinea fowl and broiler in some selected areas of Bangladesh	MY Ali SO
12:30-01:00	**Discussion**	
01:00-02:00	**Lunch and Prayer**	
02:00-03:00	**Poster Session**	

Day 2: Wednesday, 10 October, 2018

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

Chairperson : **Professor Dr. Jahangir Alam Khan**
Vice-Chancellor
University of Global Village
Barisal

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

Rapporteurs : **Dr. Rezia Khatun**, SSO, BLRI
Md. Ashadul Alam, SSO, BLRI

03:00-03:10	Study on an economic impact of native chicken in some selected areas of Bangladesh	M Khatun SO
03:10-03:20	Study on cattle fattening and beef marketing in some selected areas of Bangladesh	S Yasmin SO
03:20-03:30	A baseline survey for field testing of BLRI FeedMaster mobile application in selective locations of Bangladesh	MA Kabir SO
03:30-03:40	A study on economic losses due to Foot and Mouth Disease outbreak in cattle and buffalo in some affected areas of Bangladesh	E Islam SO
03:40-04:00	**Discussion**	
04:00-05:00	**Closing Session**	
05:00-05:15	**Tea and Snacks**	

POSTER SESSION

Day 1: 02:10-03:00 pm
Day 2: 02:00-03:00 pm

Rapporteurs : **Shamim Ahmed**, SSO, BLRI
Jobaida Shovana Khanam, SO, BLRI

SL No.	Title	Presenter
1.	Improvement of Black Bengal Goat in rural areas	MP Choudhury SO
2.	Characterization of Munshiganj cattle	MFH Miraz SO
3.	Collection, conservation and improvement of specialized fowl (Pigeon, Guinea fowl and Turkey) production at BLRI	MSK Sarker SSO
4.	Variation of morphological features and growth traits in half sib baby calves of Pabna cattle	S Munira SO
5.	Production and evaluation of crossbred sheep of Coastal with Damara, Dorper and Parendale	MP Choudhury SO
6.	Study on the hormonal profile in crossbred dairy cows in relation to repeat breeding at Baghabari milk shed areas	MY Ali SO
7.	Characterization and screening of different coat color variants goat stock at BLRI	MF Afroz SSO
8.	Production and compositional studies of local Pabna cows' milk in Bangladesh	M Shahjahan SSO
9.	Prevalence Study and Molecular Characterization of Infectious Laryngotrachitis Virus in Selected Areas of Bangladesh	MZ Ali SO
10.	Genetic Evolution of highly pathogenic avian influenza virus (HPAIV) for interspecies transmission and spillover in Bangladesh: Emergence of HPAI H5N6	MA Samad SSO
11.	Sero-surveillance of circulating of PPR Virus and its Phylogenetic analysis in different areas of Bangladesh	MM Rahman SO
12.	A comparative study on pregnancy diagnosis in sheep (*Ovis aries*) using barium chloride and progesterone based- kit	MN Munsi SSO
13.	Effect of feed supplementation on age at puberty in growing buffalo heifers	MF Afroz SSO
14.	Physiochemical characteristics of silage prepared from BLRI Nepier-3, Pakchong-1 and Maize	MA Hemayet SO
15.	Feed intake, growth performance and nutrient utilization by local growing bulls fed different fodders as sole diet and their biometrical ranking	N Huda SO
16.	Comparative study on BLRI Napier hybrid and Pakchong fodders for yield, silage quality and growth performance of bull	MA Habib SSO

SL No.	Title	Presenter
	calves	
17.	Health risk assessment of heavy metals in animal origin food chain through feed and fodders pathway	MA Islam MS Student
18.	Study on availability of feed resources and comparison of nutrients composition of feed ingredients used by farmers and on station	MM Billah SO
19.	Identification of poultry processing problems and development of a model processing plant for safe poultry meat production	MSK Sarker SSO
20.	A baseline study about farmers training on BLRI developed technologies	MZ Rahman SSO
21.	Development of blended yarns and fabrics from jute, cotton and native sheep wool	MH Majumder SO
22.	Conservation and Improvement of Farm Animal Genetic Resources (FAnGR) at Hilly Region at Naikhongchari	MA Alam SSO
23	Study on the development of canned meat production techniques	JS Khanam SO
24	Community based sheep production in Hilly Area at Naikhongchari	MA Hemayet SO
25	Biomolecular characterization and diversity of the circulating *Bacillus anthracis* in Bangladesh	MR Karim SO
26	Development of energy and protein supplementation based feeding system of pregnant Bengal sheep under stall feeding condition	M Asaduzzaman PSO
27	Molecular characterization of BLRI improved indigenus chicken variety using microsatellite markers	MA Rashid SSO

INAUGURAL SESSION

(09 October 2018)

Chief Guest : **Mr. Narayon Chandra Chanda, MP**
Hon'ble Minister
Ministry of Fisheries and Livestock

Special Guest : **Dr. Md. Enamur Rahaman**, **MP**
Dhaka-19

Special Guest : **Mr. Md. Raisul Alam Mondal**
Secretary
Ministry of Fisheries & Livestock

Special Guest : **Dr. Md. Kabir Ikramul Haque**
Executive Chairman
Bangladesh Agricultural Research Council

Guest of Honor : **DR. Hiresh Ranjan Bhowmik**
Director General, Department of Livestock Services

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

08:30 am	Registration
09.20 am	Guests take their seat
09:25 am	Recitation from the Holy Qur'an & Holy Gita
09.30 am	Welcome address by **Mr. Md. Azharul Amin** Additional Director & Convener, Annual Research Review Workshop-2018
09:35 am	Address by the Guest of Honor **DR. Hiresh Ranjan Bhowmik** Director General, Department of Livestock Services
09:40am	Address by the Special Guest **Dr. Md. Kabir Ikramul Haque** Executive Chairman, Bangladesh Agricultural Research Council
09:45 am	Address by the Special Guest **Mr. Md. Raisul Alam Mondal** Secretary, Ministry of Fisheries & Livestock
09:55 am	Address by the Special Guest **Dr. Md. Enamur Rahaman**, **MP** Dhaka-19
10:05 am	Address by the Chairperson **Dr. Nathu Ram Sarker** Director General, Bangladesh Livestock Research Institute
10:10 am	Address by the Chief Guest **Mr. Narayon Chandra Chanda, MP** Hon'ble State Minister, Ministry of Fisheries & Livestock
10:25 am	Vote of thanks by **Dr. Md. Azharul Islam Talukder** CSO, Goat and Sheep Production Research Division, BLRI
10:30 am	Refreshment

CLOSING SESSION

(10 October 2018)

Chief Guest : **Mr. Md. Raisul Alam Mondal**
Secretary
Ministry of Fisheries & Livestock

Special Guest : **DR. Hiresh Ranjan Bhowmik**
Director General
Department of Livestock Services

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

04:00 pm	Recitation from the Holy Qur'an & Holy Gita
04:05 pm	Presentation of workshop recommendation Dr. Md. Giasuddin, PSO & Head, Animal Health Research Division
04:20 pm	Open Discussion
04:40 pm	Address by the Special Guest **Dr. Hiresh Ranjan Bhowmik** Director General, Department of Livestock Services
04:50 pm	Address by the Chief Guest **Mr. Md. Raisul Alam Mondal** Secretary, Ministry of Fisheries & Livestock
05:00 pm	Concluding by the Chairperson **Dr. Nathu Ram Sarker** Director General, Bangladesh Livestock Research Institute
05: 10 pm	Refreshment

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Session I

ANIMAL & POULTRY BREEDING AND GENETICS

Study of comparative production performance of F_1 progeny of different crossbred beef cattle at BLRI cattle research farm

MP Mostari, MYA Khan, BK Roy, SMJ Hossain and N Sultana

Executive summary

Beef is one of the most nutrient-dense foods in the human diet. It is a protein rich food and has a great demand to Bangladeshi consumers. Though 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 exotic beef sire (s) is requisite. Conventional beef production system coupled with intensive beef farming may help increasing beef production in the country. Brahman crosses are being produced to increase productivity of indigenous cattle, but strategic approach for breed development that needs screening of multiple genotypes is ignored. Thus, the present work was undertaken with an objective to develop market beef cattle of average 150.0 kg carcass weight with an average FCR of ≈ 6.50 at 2 years of age under on farm feeding and management conditions. Aiming at developing breeding bulls 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 (birth, weaning, 6th month, yearling & market age weight, average daily gains at different ages, total DM intake and FCR) are being recorded, evaluated and compared with BCB-1 (control). All calves were raised in an identical care and management. Under this program, a feeding trial was conducted using F_1 crossbreds and BCB-1 at 18 to 24 months of age to compare their production potentials. All animals received 55:45 mixed ration (DM basis) of german grass and a concentrate mixture of crushed wheat (18%), wheat bran (40%), khesari bran (20%), soybean meal (18%), common salt (1%), DCP (2%), limestone (1%) and premix (0.1%). The supplied concentrate mixture contained 18% CP. The effects of genotypes of F_1 progeny on growth performance were determined. 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_1crossbred 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 of F_1 male progeny on live weight at different ages

Live weight (kg)	Genotype Mean±SD(n)					Sig. Lev.
	Limousine× BCB-1	Simmental× BCB-1	Charolais× BCB-1	Brahman× BCB-1	Purebred BCB-1	
At birth	21.24 ^{bc}±3.36 (8)	23.00 ^{abc}±2.34 (5)	26.40 ^{a}±6.84 (7)	24.90 ^{ab}±2.48 (7)	18.84 ^{c}±3.41 (5)	*
At weaning (3 months)	62.74 ^{ab}±11.79 (8)	63.20 ^{ab}±18.23 (5)	66.30 ^{ab}±13.94 (7)	75.00 ^{a}±13.94 (7)	52.30 ^{b}±5.63 (5)	NS
At yearling (12 months)	253.17 ^{b} ±13.18 (6)	299.00 ^{a}±32.53 (2)	302.25 ^{a}±32.87 (4)	250.14 ^{b}±19.75 (7)	202.20 ^{c}±9.76 (5)	***
At market age (24 months)	486.40 ^{ab}±27.52 (5)	555.50 ^{a}±109.60 (2)	507.67 ^{a}±20.40 (3)	432.00 ^{b}±36.52 (4)	354.20 ^{c}±20.52 (5)	***

Table1 revealed that all crossbred F_1 male progeny performed better than BCB-1 in terms of live weight at different ages and they differ significantly among the groups except the weaning period. Similar to the male, crossbred female attained higher live weight than purebred BCB-1female at birth, weaning, 6 months, yearling and 24 months of age (Table 2). Females of Simmental cross also had the highest live weight (464.60±34.37 kg) at market age followed by Limousine×BCB-1 (446.50±19.09 kg), Charolais×BCB-1 (425.50±16.26 kg), Brahman×BCB-1 (333.3 ±11.02 kg) and BCB-1 (295.60 ±20.74 kg). In average daily weight gain, genotype had highly significant effect ($p<0.001$) in 0-12 and 0-24 months of age of male progeny (Table 3). During birth to market age, all crossbred males gained more than BCB-1 and Simmental cross gained the highest daily live weight (0.74±0.16) followed by Charolais (0.67±0.03), Limousine (0.65±0.04), Brahman (0.57±0.05) crosses and BCB-1 (0.46±0.03). Similarly, the male, Simmental female crosses grew faster than other crosses. Table 4

revealed that genotypes had no significant (p>0.05) effects on total DMI, %DMI, ADG and FCR at 18-24 months of age for the first 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 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.

Table 2. Effects of genotypes of F_1 female progeny on live weight at different ages

Live weight (kg)	**Genotype Mean±SD(n)**					**Sig.lev.**
	Limousine× BCB-1	Simmental× BCB-1	Charolais× BCB-1	Brahman× BCB-1	Purebred BCB-1	
At birth	22.59 ^{a} ±6.13 (7)	22.73 ^{a} ±3.21 (10)	25.55 ^{a} ±4.16 (6)	22.54 ^{a} ±2.01 (5)	16.84 ^{b} ±4.13 (5)	*
At weaning (3 months)	60.33 ^{a} ±11.44 (7)	68.34 ^{a} ±13.70 (10)	68.83 ^{a} ±13.35 (6)	59.80 ^{ab} ±7.82 (5)	45.86 ^{b} ±5.98 (5)	*
At yearling (12 months)	220.00 ^{ab} ±41.89 (4)	245.88 ^{a} ±42.40 (8)	232.20 ^{a} ±45.65 (5)	210.60 ^{ab} ±26.43 (5)	173.60 ^{b} ±9.32 (5)	*
At market age (24 months)	446.50 ^{a} ±19.09 (2)	464.60 ^{a} ±34.37 (5)	425.50 ^{a} ±16.26 (2)	333.33 ^{b} ±11.02 (2)	295.60 ^{b} ±20.74 (5)	***

Table 3. Effects of genotypes of F_1 male and female progeny on average daily body weight gains (ADG) at different ages

ADG (kg/d)	**Genotype Mean±SD(n)**					**Sig.lev.**
	Limousine× BCB-1	**Simmental× BCB-1**	**Charolais× BCB-1**	**Brahman× BCB-1**	**Purebred BCB-1**	
Male						
0-3 months	0.46±0.14(8)	0.45±0.21(5)	0.44±0.21(7)	0.56±0.15(7)	0.37±0.06(5)	NS
0-12 months	0.65 ^{b} ±0.04(6)	0.77 ^{a} ±0.09(2)	0.76 ^{a} ±0.08(4)	0.63 ^{b} ±0.05(7)	0.51 ^{c} ±0.03(5)	***
0-24 months	0.65 ^{ab} ±0.04(5)	0.74 ^{a} ±0.16(2)	0.67 ^{a} ±0.03(3)	0.57 ^{b} ±0.05(4)	0.46 ^{c} ±0.03(5)	***
Female						
0-3 months	0.42 ^{ab} ±0.14(7)	0.51 ^{a} ±0.15(10)	0.48 ^{ab} ±0.13(6)	0.41 ^{ab} ±0.10(5)	0.32 ^{b} ±0.09(5)	NS
0-12 months	0.55 ^{ab} ±0.14(4)	0.63 ^{a} ±0.12(8)	0.57 ^{ab} ±0.12(5)	0.52 ^{ab} ±0.08(5)	0.44 ^{b} ±0.02(5)	NS
0-24 months	0.60 ^{a} ±0.04(2)	0.61 ^{a} ±0.05(5)	0.56 ^{a} ±0.04(2)	0.43 ^{b} ±0.02(3)	0.39 ^{b} ±0.03(5)	***

Table 4. Effects of genotypes of F_1crossbreds and BCB-1 on intake, growth and FCR at 18-24 months of age.

Parameters	Genotypes(n)					Sig.lev.
	Limousine× BCB-1(3)	Simmental× BCB-1(3)	Charolais× BCB-1(5)	Brahman× BCB-1(6)	BCB-1(5)	
Initial LW (kg)	397.67±112.17	396.33±143.29	425.20±92.96	353.67±59.73	307.00±107.84	NS
Final LW (Kg)	445.67±118.73	445.67±151.58	479.00±88.70	397.67±60.06	360.40±106.01	NS
Total DMI (Kg/d)	8.40 ^{a} ±1.20	8.01 ^{ab} ±1.89	8.53 ^{a} ±1.23	7.44 ^{ab} ±1.12	6.02 ^{b} ±1.57	NS
% DMI/100kg LW	2.05±0.27	1.96±0.24	1.91±0.10	2.00±0.18	1.86±0.24	NS
Total Gain (Kg)	48.00±6.56	49.33±10.07	53.80±13.10	44.00±12.47	53.40±5.68	NS
ADG (Kg)	0.71±0.10	0.72±0.15	0.79±0.19	0.65±0.18	0.78±0.08	NS
FCR	11.90 ^{ab} ±0.15	11.22 ^{ab} ±2.47	11.33 ^{ab} ±3.39	12.16 ^{a} ±3.22	7.79 ^{b} ±2.46	NS

Considering the data so far obtained, it may be stated that among the four crosses Simmental×BCB-1 performed the best and showed more efficiency in feed utilization compare to Brahman crosses. The control purebred BCB-1 showed more efficiency in feed utilization compared to crosses. But more F_1 progeny is yet to be required to evaluate their production potentials for the production of market beef cattle. For that reason, this breeding program should be continued for the coming years to achieve its goal.

Study of genetic variants of beta-casein in cattle genotypes of Bangladesh

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Executive Summary

The bovine milk is worldwide most important food for human since it is the most common source of animal proteins and micronutrients. Caseins and whey proteins are the two major protein groups present in the milk. Caseins account for 80% of bovine milk protein and whey proteins constitute about 14%. The four caseins proteins are present in bovine milk: casein alpha s1 (39–46%), casein alpha s2 (8–11%), beta-casein (25–35%), and casein kappa (8–15%). The most frequently observed forms of beta-casein (CSN2 gene) in dairy cattle breeds are A1 and A2. The difference between the A1 and A2 beta-casein variants is a single amino acid substitution (CCT_CAT) at the 67th residue of the 209 amino acid chain. This difference in structure results in A1 beta-casein preferentially releasing an opioid peptide called beta-casomorphin-7 (BCM-7) upon digestion. The BCM-7 may lead to adverse physiological effects like gastrointestinal inflammation, worsening of post-dairy digestive discomfort (PD3) symptoms, triggers lactose intolerance, ischemic heart diseases, insulin-dependent diabetes, atherosclerosis, sudden infant death syndrome, autism and schizophrenia. Besides health promoting properties, the A2 variant has also been reported to have positive relationship with milk performance traits especially protein and milk yield, whereas A1 variant showed the opposite influence. Bangladesh possesses 25.67 millions head cattle of which 47% are crossbred. 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 and others available cattle genotypes were selected for the genetic variability study of A1 and A2 beta-casein. In the financial year of 2017-18, a total of 129 blood samples were collected from three native cattle breeds of which 47, 56 and 26 samples were from RCC, BCB-1 and MC respectively. Blood samples were taken from jugular vein using venoject tubes coated with EDTA (Di sodium ethylene di amine tetra acetate). The date and place of collection, sample number, sex of animals were recorded. The collected blood samples were carried in cooling box and preserved at -20ºC 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) were the reference work of Ganguly *et al.,* 2013 (Indian Journal of Biotechnology. Vol 12: P 195-198). AS-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. 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). The Genotype and gene (allele) frequency of individual breeds were calculated using Microsoft Excel program.

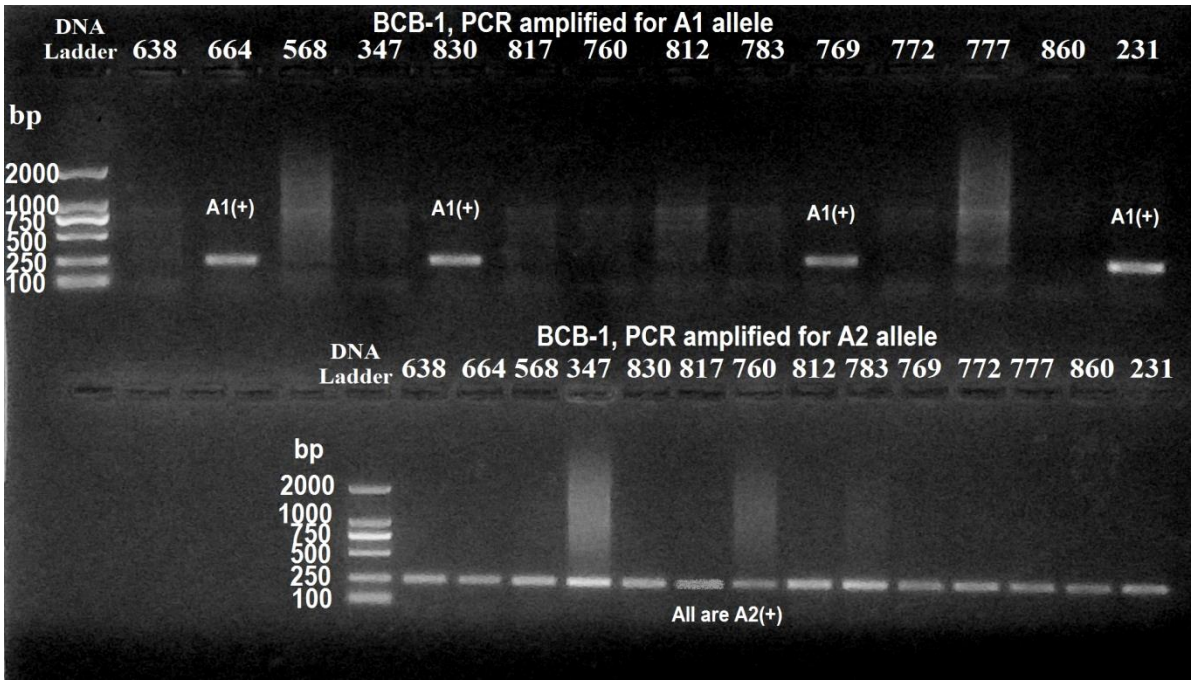

Figure 1: Identification of A1 and A2 alleles in BCB-1 through PCR and agarose gel electrophoresis

Genotype frequencies of A2A2, A1A2 and A1A1 in RCC were 89.4, 10.6 and 0.0. However, the corresponding frequencies in BCB-1 were 85.7, 12.5 and 1.8 and, in MC were 80.8, 15.4 and 3.8, respectively. The frequency of A2 allele was 94.7, 92.0 and 88.5 in RCC, BCB-1 and MC and, A1 allele was 5.3, 8.0 and 11.5 in corresponding breeds (Table 1). The genetic variability of beta-casein (A1/A2) in NBG, non descriptive native cattle and their crosses with Holstein-Friesian, Sahiwal, Jersey, Brahman and others available cattle genotypes will be analyzed in the following year.

Table 1: Genotype and gene (allele) frequencies of beta-casein in RCC, BCB-1 and MC genotypes.

Breeds	**No. of Sample**	**Genotype frequency**			**Allele frequency**	
		A2A2	**A1A2**	**A1A1**	**A2**	**A1**
RCC	47	89.4 (n=42)	10.6 (n=5)	0 (n=0)	94.7	5.3
BCB-1	56	85.7 (n=48)	12.5 (n=7)	1.8 (n=1)	92.0	8.0
MC	26	80.8 (n=21)	15.4 (n=4)	3.8 (n=1)	88.5	11.5

In conclusion, so far data obtained, it may be stated that, most of the native cattle have A2A2 genotype with a few A1A2. The present investigation offers a plenty of scope for changing gene frequency through using A2A2 genotyped bulls in artificial insemination program running by Government and Private sector.

Improvement of goat genetic resources (Black Bengal and Jamunapari goat) through selective breeding at BLRI

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Executive Summary

Goat is the important potential livestock species which contributing meat and skins, and to some extent, milk, fleece and manure which help economic development of country like Bangladesh. But, the available goat breeds are being diluted by unwanted crossing all over the country. Considering the fact, the project has designed with the objectives- i) improvement of goat genetic resources (Black Bengal and Jamunapari goat) through selective breeding and ii) evaluation of performances of goat genetic resources (Black Bengal and Jamunapari goat) at BLRI. 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 improvement of prolificacy, milk production and growth rate of respective goat breeds. The targeted prolificacy, milk production and 6 months body weight of Black Bengal and Jamunapari goat were, minimum 2 kids per kidding; 0.5 litter/day and 1.00 litter/day; 12 kg and 16 kg, respectively. The selection index was calculated by the following equation, $I_B = b_1x_1 + b_2x_2 + \ldots\ldots\ldots\ldots\ldots + b_nx_n$. 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.

The average prolificacy of Black Bengal goat were 1.78±0.06, 1.83±0.04, 1.58±0.08, 1.66±0.05, 1.49±0.08, 1.85±0.08 and 1.56±0.15 for 1st, 2nd, 3rd, 4th, 5th, 6th and 7th generation, respectively. The average six month body weight of Black Bengal goat were 8.95±0.39, 9.27±0.42, 7.65±0.47, 8.40±0.44, 7.9±0.52, 7.64±0.78 and 7.8±1.00 kg respectively, for 1st, 2nd, 3rd, 4th, 5th, 6th and 7th generation. In case of Jamunapari goat, the average prolificacy were 2.26±0.09, 1.61±0.06, 1.68±0.09, 1.97±0.22, 1.53±0.12 and 1.5±0.5 respectively, for 1st, 2nd, 3rd, 4th, 5th and 6th generation. The average six month body weights of Jamunapari goat were 10.9±0.71, 12.65±0.58, 12.57±1.25, 13.15±0.90 and 14.3 kg for 1st, 2nd, 3rd, 4th, 5th and 6th generation respectively.

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

Generation	Average prolificacy	Birth weight (kg)	3 months weight (kg)	6 months weight (kg)
1	1.78±0.06 (30)	1.35±0.05 (30)	6.28±0.30 (22)	8.95±0.39 (18)
2	1.83±0.04 (65)	1.23±0.03 (65)	5.58±0.19 (44)	9.27±0.42 (28)
3	1.58±0.08 (28)	1.13±0.05 (28)	5.46±0.19 (24)	7.65±0.47 (15)
4	1.66±0.05 (34)	1.29±0.06 (34)	5.85±0.29 (26)	8.40±0.44 (21)
5	1.49±0.08 (12)	1.16±0.10 (12)	5.51±0.35 (9)	7.9±0.52 (7)
6	1.85±0.08 (21)	1.17±0.05 (14)	5.22±0.23 (17)	7.64±0.78 (7)
7	1.56±0.15 (8)	1.19±0.07 (8)	5.09±0.31 (5)	7.8±1.00 (3)

Figure in the parenthesis indicate the number of observations.

Table 2: Productive and reproductive performance of Jamunapari Goat (Mean ± SE):

Generation	Average prolificacy	Birth weight (kg)	3 months weight (kg)	6 months weight (kg)
1	2.26±0.09 (8)	2.06±0.09 (8)	8.34±0.23 (5)	10.9±0.71 (5)
2	1.61±0.06 (32)	2.6±0.09 (32)	9.9±0.42 (25)	12.65±0.58 (20)
3	1.68±0.09 (18)	2.21±0.12 (18)	9.69±0.61 (12)	12.57±1.25 (7)
4	1.97±0.22 (10)	2.01±0.09 (10)	8.45±0.32(6)	10.43±0.61 (6)
5	1.53±0.12 (10)	2.19±0.19 (10)	10.59±0.73 (7)	13.15±0.90 (4)
6	1.5±0.5 (2)	2.6±0.3 (2)	10.55±0.85 (2)	14.3(1)

Figure in the parenthesis indicate the number of observations.

Data on milk production is being collected for all the generations. After collecting all the data, selection index of each individual will be calculated and the animal with higher total index score will be selected for the breeding purpose.

In conclusion, superior bucks and does from all the generations will be selected by the individual performance score. Therefore, the selection program should be continued for the coming years to achieve the targeted goal.

Conservation and improvement of Quail: Performance of seventh generation

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Executive summary

Individual selection is essential particularly in selection experiments for body weight in quail. Four genotypes of quail like Dhakai (D), White (W), Brown (Br) and Black (Bl) quail are being maintained at BLRI with the objective to develop a suitable meat type quail genotype for our existing farming. The parent males and females were being maintained in cages for single pair mating through selective breeding system for producing each generation. Pedigree records are being kept by using commercially available leg bands to identify quail of all ages. For producing seventh generation (G_7), parent quails of each genotype were selected from the sixth generation (G_6) on the basis of breeding value according to their 5th week body weight. Hatching eggs were collected from every single pen of the selected parent quails. A total of 1135-day-old chicks comprising of 4 types of quail namely D, W, Br, and Bl were hatched in a batch. 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, 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 'agricolae' package in R Software version 3.5.1. The expected genetic progress due to selection for 5thweek body weight was estimated for G_7 using the following equation (Falconer, 1981).

$R = h^2 \times S$where, R = Expected response, h^2 = heritability for 5thweek 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 2nd week, 4th week and 6th week of age (Table 1). The 6th week body weight was 158.16± 0.72, 139.72 ± 0.96, 129.76 ±0.36 and 127.90± 0.85g, respectively for D, W, Br and Bl genotypes. Significantly higher body weight was found in D followed by W, Br and Bl quail genotypes at different periods of age. The Dhakai genotype (2.35%) had non-significantly ($\chi^2 = 0.82$; $p>0.05$) higher chick mortality compared to other genotypes at 0-5 weeks (Table 2).The hatchability rate were significantly ($p<0.001$) higher in D (76.59%) compared to other three genotypes of quail (Table 3). The eggs production performance up to 24th week of age was83.17± 1.1, 78.52±1.7, 79.19±1.7 and 94.26±1.2, respectively for D, W, Br and Bland significantly ($p<0.001$) differed among all genotypes. Table 4 showed that 5th week body weight of males of D, W, Br and Bl quails were expected to increase by 3.19, 5.01, 1.62 and 2.16 g, respectively. While in females of D, W, Br and Bl quails, the expected responses were 5.39, 3.23, 2.63 and 2.73 g, 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 1 Least squares means (LSM) and standard error (SE) of different age groups as affected by genotype

Genotype	2ndwk body wt (g)	4thwk body wt (g)	6thwk body wt (g)
Dhakai	37.16^{a}±0.55	122.60^{a}±0.76	158.16^{a}±0.72
White	25.06^{b} ± 0.38	113.98^{b} ± 0.51	139.72^{b}±0.96
Brown	26.58^{c} ± 0.36	94.48^{c} ± 0.53	129.76^{d}±0.36
Black	25.66^{bc} ± 0.39	95.70^{c} ± 0.86	127.90^{c}±0.85
Level of significance	($p<0.001$)	($p<0.001$)	($p<0.001$)

Table 2 Effect of genotype on chick mortality (%) during 0-5 weeks of age

Parameter	Genotype				χ^2 (df=3)	P- value
	Dhakai	White	Brown	Black		
Mortality (%)	2.35	1.63	2.17	1.33	0.82	p>0.05

Table 3 Productive and reproductive performance of four quail genotypes

Parameter	genotype (Mean ±SE)				Level of Significance
	Dhakai	White	Brown	Black	
Hatchability on setting eggs (%)	76.59^{a}±1.6	75.37^{a}±1.5	67.19^{b}±1.8	73.06^{a}±1.7	P<0.001
Feed Intake(g/b/d)	18.12±1.17	17.42±1.19	16.39±1.13	17.06±1.15	NS
Egg production (%) (6-24 wks)	83.17^{b}±1.1	78.52^{c}±1.7	79.19^{c}±1.7	94.26^{a}±1.2	P<0.001

Table 4 Selection differential, selection intensity for 6 weeks body weight (g) in seventh generation

Genotype	Sex	Before selection		After selection		Selection Differential (S) (g)	Heritability (h^2)	Expected response to selection (R)
		No.	Aver.	No.	Aver.			
Dhak	M	90	150.9	40	158.3	7.4	0.432	3.19
	F	96	161.4	40	175.2	13.8	0.391	5.39
White	M	195	133.7	120	144.1	10.4	0.482	5.01
	F	233	149.8	120	156.6	6.80	0.476	3.23
Brown	M	165	127.3	120	130.9	3.60	0.451	1.62
	F	176	134.5	120	140.3	5.8	0.454	2.63
Black	M	92	129.1	40	134.5	5.4	0.401	2.16
	F	88	137.3	40	143.3	6.0	0.455	2.73

Conservation and improvement of native chicken: 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 performances of three native chicken genotypes under intensive management, (ii) to select parental birds (males and females) and breed them in an assortative plan for the production of seventh generation birds. A total of 1042-day-old chicks comprising of 3 types of chicken namely Naked Neck (NN-381), Hilly (H-313) and Non-descript Deshi (ND-348) were hatched in one batch for this study. In seventh generation (G_7), selection was practiced at 40 week of age according to 40 week body weight, egg production up to 40 week, egg weight at 40 week and age at maturity. The data were analyzed by factorial arrangement in a CRD by General Linear Model Univariate Procedure in SPSS Computer Program. The expected genetic progress due to selection in a generation for 40 week body weight (BW), egg production (EP) up to 40 week, egg weight (EW) at 40 week and age at maturity (ASM) were estimated for seventh generation (G_7) using the following equation (Falconer, 1981):
$R = 1/2h^2 \times S_f$ where, R = Expected response, h^2 = heritability (EP, EW, BW, ASM) and S = Selection differential for the selected females.

The hatching egg weight did not differ significantly. Day old chick weight was significantly ($p<0.001$) highest in H (32.52±0.32 g). Significant ($p<0.001$) body weight differences among the genotypes were observed at 8^{th} and 12^{th} weeks of age, with the highest body weight for H genotype (716.11±4.81 and 1212.08±7.27g) compared to other two genotypes (Table 1) in all stages of age. The chick mortality was affected by genotype which is shown in Table 1. The age at first egg laid was significantly ($p<0.001$) affected by genotype. The estimated age at 1^{st} egg of ND, H and NN were 145.54, 154.35 and 150.51 days, respectively. Hilly genotype started laying of eggs at a higher age (154.35 days) compared to ND genotype (145.54 days) in G_7 generation. The average age at first egg of ND (145.54 days) was 8.81 days earlier than that of H (154.35 days). Fertility was not significantly affected ($p>0.05$) by genotype. The percentage of fertility ranges from 82.12 to 87.14 in different genotypes. The highest fertility was observed in ND (87.14%). Hatchability on fertile eggs differed significantly ($p<0.05$) among the genotypes. The NN had the lowest hatchability ($p<0.05$) on fertile eggs. Table 1 indicates that among the genotypes hatchability tended to be highest in H (82.93%), intermediate in ND (80.85%) and lowest in NN (75.04%). The percentage of Dead in germ was affected ($p<0.001$) by genotype. Feed consumption from 9 to 16 weeks (Table 1) showed that there was significant ($p<0.001$) variation in feed intake among the native chicken genotypes. At the age of 16 weeks, the lowest (66.19 g) and the highest (85.61g) daily feed intake were recorded in NN and H genotypes, respectively. The effects of genotype on hen-day egg production (HDEP %) of native chicken is presented in Table 1. Hen-day egg production (HDEP %) observed in the present study were affected significantly ($p<0.001$) by genotype. In this study, the average HDEP% of ND, H and NN were found to be 63.34, 50.57 and 58.92, respectively. Table 4 showed that EP of ND, H and NN birds were expected to increase by 0.875, 1.585 and 0.255 %, respectively. The EW of ND, H and NN birds were expected to increase by 0.205, 0.250 and 0.015g, respectively. Responses to selection for EP and EW for three genotypes (ND, H and NN) were expected to be positive (increase). It is concluded that Hilly genotype may be chosen for meat production and Non-descript Deshi genotype for egg production. For further improvement selection should be continued.

Table 1 Productive and reproductive performance of native chicken genotypes

Parameter	Genotype (Mean ±SE)			Level of Sig.
	ND (Mean±SE)	H (Mean±SE)	NN (Mean±SE)	
Hatching egg wt (g)	49.22±0.39 (400)	48.68±0.42 (370)	48.57±0.39 (450)	p>0.05
DOC weight (g)	30.65^{b}±0.29 (348)	32.52^{a}±0.32 (313)	32.31^{a}±0.31 (381)	p<0.001
8^{th} week weight (g)	618.20^{b}±5.24 (344)	716.11^{a}±4.81 (308)	603.54^{b}±4.94 (375)	p<0.001
12^{th} week weight (g)	991.94^{b}±7.91 (339)	1212.08^{a}±7.27(306)	981.05^{b}±7.47 (372)	p<0.001
Age at first egg (d)	145.54^{c} ±1.08 (146)	154.35^{a}±1.01 (147)	150.51^{a}±1.08 (148)	p<0.001
Hen wt at maturity (d)	1370.1±13.2 (146)	1650.89±12.4 (147)	1233.3±13.1 (148)	p<0.001
Fertility (%)	87.14±2.67	85.29±3.16	82.12±2.32	p>0.05
Hatchability on fertile eggs (%)	80.85^{a}±2.76	82.93^{a}±2.44	75.04^{b}±2.29	p<0.05
Dead in germ (%)	2.35^{b}±0.23	3.532^{a}±0.41	3.90^{a}±0.70	p<0.001
Feed Intake(g/b/d) (9-16 weeks)	68.18^{b}±2.21	85.61^{a}±1.06	66.19^{b}±2.31	p<0.001
HDEP (%) (22-28 weeks)	63.34^{a}±1.69	50.57^{c}±1.75	58.92^{b}±1.99	p<0.001
Mortality (%) (0-8 week)	1.14	1.59	1.57	p>0.05

DOC= Day Old Chick; ND=Non-descript Deshi; H=Hilly; NN=Naked Neck; HDEP=Hen day egg production; figures in the parentheses indicate the number of observations; least squares means without a common superscript along the row within a factor differed significantly (p<0.05).

Table 2 Expected response to selection for EP (up to 40 weeks) and EW (at 40 weeks) in G_7 of native chicken

Genotype	parameter	Before selection		After selection		Selection Differential (S)	Heritability (h^2)	Expected Response to Selection ®
		No.	Average	No.	Average			
ND	EP	190	71.49	100	75.0	3.51	0.50±0.03	0.875
	EW	190	45.09	100	45.94	0.85	0.49±0.03	0.205
H	EP	149	54.00	100	60.48	6.48	0.49±0.03	1.585
	EW	149	45.09	100	46.18	1.09	0.46±0.05	0.250
NN	EP	114	67.02	100	68.49	1.47	0.35±0.10	0.255
	EW	114	44.88	100	44.94	0.06	0.49±0.03	0.015

Conservation and improvement of native duck genotypes through selective breeding: performance of 4th generation and conservation of geese for meat production

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Executive Summary

Study 1.Conservation and improvement of native duck genotypes through selective breeding: Performance of 4th generation

An individual selection program has been taken at BLRI to improve the egg laying performances of Desi White (Rupali) and White Breasted Black (Nageswari) of native duck genotypes. Productive and reproductive potentialities of native ducks have already been evaluated from foundation to third generations. Egg production performances of fourth generation (G_4) were studied in this FY 2017-18. In each generation selection were practiced on the basis of age at first lay, body weight at first lay, egg production % (168-336 days) and egg weight. Adult ducks were housed in an open sided shed with concrete floor and diet contained 17.5% Crude Protein and 2750 Kcal ME/kg DM during laying period. Egg production data of individual duck of 4th generation were recorded. Selected male and female were mated at the maximum ratio of 1: 5 by natural mating. Duck meat has a high consumer demand due to its high meat quality traits with unique texture and flavor (Kim *et al*., 2012). Aiming to develop a fast growing meat type mule duck by using different genotypes through 3-way crossing, Pekin×Rupali (F_1) were hatched and reared at duck shed for the production of mule ducks. Ducks were individually weighed weekly to determine the mean population weight. Body weight, feed consumption and feed conversion ratio (FCR) were measured weekly up to 12 wks of age. All recorded data were analyzed by SAS and difference were determined by Duncan Multiple Range Test.

Table 1: Selection differential, intensity and selection responses of Rupali and Nageswari ducks

Genotype	Traits	Before selection	After selection	Selection differential	selection intensity	selection responses
Rupali	ASM (d)	155.9	153	-2.90	-0.44	-1.16
	EW(g)	58.26	59.56	1.30	0.38	0.65
	BW(g)	1672.71	1680.91	8.20	0.12	4.10
	EP(%)	45.42	51.72	6.30	0.65	0.95
Nageswari	ASM (d)	152	149.50	-2.5	-0.31	-1
	EW(g)	56.97	57.68	0.71	0.22	0.35
	BW(g)	1618.88	1607.68	-11.2	-0.17	-5.6
	EP(%)	42.15	45.13	2.98	0.35	0.44

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

According to selection criteria of fourth generation (G_4), ASM was reduced more than 2 days in both Rupali and Nageswari ducks but BW was increased in Rupali whereas decreased in Nageswari after selection. Body weight was positively correlated with egg weight (Cheng *et al*., 1995) may be due to the reason that EW was higher in Rupali than Nageswari. Egg production EP) percent was also increased 2-6% in Nageswari and Rupali ducks. Selection intensity and selection responses in Rupali for EP% were 0.65 and 0.95, and in Nageswari ducks were 0.35 and 0.44, respectively. Annual egg production was recorded 221 for Rupali and 214 for Nageswari with the FCR for the laying ducks were 3.52 and 3.71, respectively. According to Ukil and Islam, (1991) deshi ducks are poor producer and lay only 60-80 eggs per bird per year against 250-300 eggs of exotic ones. In Chara and Chemballi ducks of Kerala, the egg number up to 72 weeks of age as being 116 and 125 eggs respectively. Egg numbers were higher in Rupali and Nageswari ducks than their results may be due to selection responses of both duck genotypes.

Table 2: Comparative selection criteria of Rupali and Nageswari ducks from first to fourth generation

Parameter	Rupali						Nageswari					
	G_1	G_2	G_3	G_4	SEM	P-Value	G_1	G_2	G_3	G_4	SEM	P-Value
ASM (d)	159.3	157.2	155.4	153	5.89	0.34	153.58	152.6	151.4	149.5	4.63	0.78
EW at 1st egg (g)	48.85	54.02	56.47	59.56	1.20	0.02	44.41	51.37	52.50	57.68	1.04	0.01
BW at 1st egg (g)	1560.9	1662.7	1657.8	1672.6	20.28	0.04	1496.6	1467.5	1448.3	1619.0	18.63	0.09
EP(24-48wk) Nos.	57.35	87.16	88.10	116.10	2.13	0.001	58.39	81.55	82.22	109.6	2.36	0.0001

Although Islam *et al.* (2003) and Sarker (2005) stated that the age at sexual maturity of indigenous duck varied 180-210 days. ASM of both two native ducks was decreased from generation after generation (153 in Rupali and 149.5 in Nageswari in G_4). Egg weight (EW) at first egg was also increased from 1st to fourth generations of both two genotypes. BW at first egg was increased in G_4 compared to G_1. Egg numbers were increased 57.35 to 116.10 in Rupali ducks and 58.39 to 109.61in Nageswari ducks from 1st to 4th generation. For the production of meat type ducks, selected Pekin male and Rupali female were crossed and F_1 progeny were reared to evaluate their growth performances. The BW of (Pekin×Rupali) ducks in 0, 4, 8 and 12 weeks of age was 47.29g, 467.34g, 1182g and 1832g, respectively. The average weight gain was 1784.71g and FCR was 2.64 from day old to 12 wks of rearing period. This research activity will be continued until generation 7 of both types of native ducks and in this fiscal year the field trial with generation 5 will be carried out.

Study 2: Collection¸ conservation and improvement of geese for meat production

Geese are water fowl belonging to the tribe Anserini of the family Anatidaethey are the good source of animal protein. The average body weight of geese is higher than chicken and duck. In Bangladesh¸ traditionally many people are rearing geese as their recreation as well as income source. Geese are reared mainly semi intensive condition. They have a good attribute to fulfill a part of their nutritional requirement by forage. Very little research has been undertaken on geese in Bangladesh. Considering the overall situation¸ BLRI has taken an initiative to do research on geese with the following objectives: i) collection and conservation of geese germplasm at BLRI. ii) maintenance¸ multiplication of geese to develop new technology in near future. A poultry shed was repaired in BLRI poultry farm, the house was cleaned with proper disinfectant. A brooding house was prepared and maintained the temperature and humidity as the recommended level. Then we collected both white and grey variety day old geese from Khulna. The goslings were reared first 5 weeks in brooder house. After finishing brooding period the goslings were transferred to grower house. The average body weight of gosling was 205 g in 1st week, 322 g in 2nd week, 552 g in 3rd week, 937 g in 4th week, 1183 g in 5th week, 1517 g in 6th week, 1875 g in 7th week and 2233 g in 8th week of age. The body weight of grey variety was higher than white variety. At 9th week, the body weight of grey variety was 2898 g compared to 2298 g for white variety respectively. Similar trend was observed in 12th week and 15thweeks where we recorded the body weight 3318g/bird and 3684 g/bird for grey and 2757 g/bird, and 3357 g/bird for white variety, respectively. It is an initial findings and the study will be continued to fulfill the above objectives.

Maintenance and conservation of pure lines and development of egg and meat type chicken

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Executive summary

Bangladesh is one of the densely populated countries in the world. During the last three decades poultry farming in Bangladesh has transformed itself from backyard venture to dynamic agro industry. Therefore, to meet its internal demand, Bangladesh imports parent and grandparents leading to use huge foreign currency and thus increase production cost. Therefore, Bangladesh Livestock Research Institute (BLRI) was undertaken a research program aiming to develop meat type chicken considering the existing climatic condition of Bangladesh. Recently, BLRI has developed a meat type chicken called Multi Colour Table Chicken (MCTC) using indigenous genetic resources through selection and breeding. Day old chicks of MCTC are mixed feather color and have a similar phenotypic appearance to that of native chickens. Therefore, to know the performance, meat quality, antibody titre level, adaptability and economic returns of MCTC were conducted under on station and on farm condition.

Study 1: Growth performance, carcass traits and economics of BLRI developed meat type chicken

In experiment 1, a total of 1020 day old chicks were allotted in 30 pens (34 chicks per pen, stocking density 15 birds/) 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 980.50 g, 940.50 g, 2269.48 g and 2.296 respectively. Average mortality was found 1.50 %. At 8 weeks of age, average dressing percentage, relative breast, thigh and drumstick weight percentage were found 72.37 %, 13.55, 8.57 and 15.47 % respectively. In meat qualities, cooking and drip loss percentages were found 12.89 and 5.68 respectively. In meat color, average lightness (L*), redness (a*) and yellowness (b*) were found 46.25, 2.69 and 7.78 respectively. The average pH of breast muscle was found 5.95.

Study 2: Comparison of growth performance, carcass characteristics and meat quality of different meat type chicken

To compare the performance with existing meat type chicken, experiment 2 was undertaken using 3 gentic group (Hilly, MCTC and Sonali) of chicken, a total of 540 day old chicks (180 chicks in each genetic group) were allotted to 18 pens. Each genetic group was replicated 6 times having 30 birds in each pen. All other management was followed according to experiment 1. Blood was collected and Hemagglutination Inhibition (HI) antibody titers of the sera samples were measured before and after vaccination based on the Sabrin *et al.* (2012). At 8 weeks of age, 8 birds per treatments were slaughtered and breast meat was collected and cooked under similar temperature and period using 1% salt. Cooked meat was cut in cubes (2x2 cm) and three cubes per treatment were placed into individual cup. The sensory panel consisted of 10 experienced and trained participants. In fried chicken sample, before the roasting the chickens meat were cut in similar size and seasoned with a mixture of salt, onion, pepper, garlic, ginger and coated with flour. The roasting was done with an electric roaster rented from a professional manufacturer of roast meat. The thermometer and timer of the roaster were used to set the similar cooking temperature and time for each treatment. Each parameter set up on a Hedonic scale (1 extremely dislike) to 9 (like extremely). From 0-8 weeks, both body weight and weight gain were significantly higher in MCTC than that of Sonali. But feed intake and FCR were not influenced among the treatments. In a sensory evaluation test, there is no significant variation of tenderness, chewiness, juiciness, fineness and mouth coating of meat. But significantly higher score on flavor, color and taste were found in hilly chicken meat than that of sonali chicken. But, no differences were found between Hilly and MCTC chicken meat. Before vaccination, HI antibody titre level was significantly lower in Sonali than that of MCTC and hilly

chicken genotypes (P<0.05). After vaccination of 7 and 14 days later, titre level did not significantly different among the treatments.

Table 1: Comparative performances of different meat type chicken

Parameters	Hilly	MCTC	Sonali	SEM	P value
Body weight (g)					
At 21 d	191.15^{ab}	254.50^{a}	176.12^{b}	10.47	0.001
At 35 d	426.20^{b}	502.50^{a}	380.76^{b}	18.90	0.0001
At 56 d	778.35^{b}	980.50^{a}	707.80^{c}	32.17	0.001
Weight gain (g)					
0-21 d	157.97^{b}	215.07^{a}	142.82^{b}	9.76	0.018
22-35 d	235.05^{ab}	248.00^{a}	204.64^{b}	9.34	0.021
36-56 d	352.15^{b}	478.00^{a}	327.04^{b}	16.99	0.013
0-56 d	745.18^{b}	941.07^{a}	674.50^{c}	31.45	0.035
Feed intake (g)					
0-21 d	351.03	386.5	287.51	14.11	0.079
22-35 d	622.54	564.71	422.68	37.39	0.098
36-56 d	1076.71	1283.06	1182.37	38.58	0.125
0-56 d	2050.28^{ab}	2234.27^{a}	1892.56^{b}	56.90	0.043
FCR					
0-21 d	2.222	1.797	2.009	0.06	0.087
22-35 d	2.648^{a}	2.277^{c}	2.065^{b}	0.11	0.038
36-56 d	3.057	2.684	3.615	0.10	0.279
0-56 d	2.751^{a}	2.374^{b}	2.805^{a}	0.07	0.035

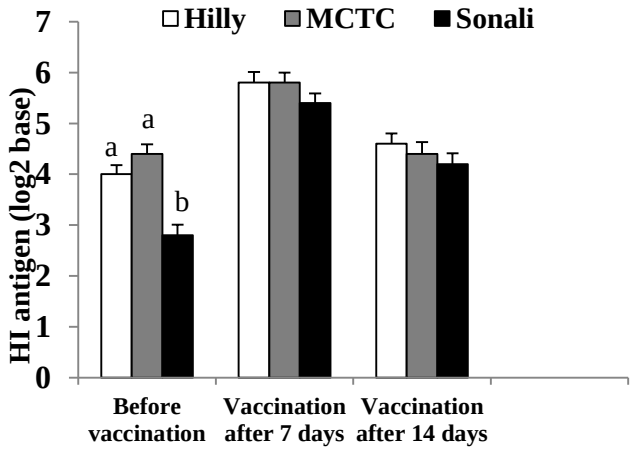

Figure 1 Effect of vaccination on the antibody titre level of meat type chicken

In experiment 3, a total of 2580 day old MCTC chicks were distributed at three different regions (Barisal 900 chicks, Khulna 1180 chicks and Pabna 500 chicks) of the country. Birds were reared under farmers existing condition. All data were recorded according to the supplied schedule. To examine the economic viability of MCTC farming, cost and returns were measured according to Singh and Saran (2007). The Straight Line Method was used to compute the depreciation. All data were analyzed by SAS and differences were determined by Duncan Multiple Range Test. At 8 weeks of age, average body weight was found higher in Barisal (1030.12 g) and lower in Pabna (966.09 g) district. Therefore, Feed Intake (FI) and FCR were not influenced among the location but better FCR was found in Barisal than that of other district. In economic evaluation, the total cost and gross return were found 164124.50 and 200566.20 taka respectively. So, the net returns were found 36441.73 taka within 8 weeks for one unit of 1000 MCTC meat type chicken rearing. Therefore, the input output ratio was found 1:1.222. The highest returns were found in Barisal than that of other region due to the variation of chicken market price. Based on the on station and on farm trial, results indicated that production performance of MCTC is consistent, adaptable and profitable under farmer's condition. Therefore, MCTC chicken may be suitable followed by Hilly and Sonali for meat production. Further follow up experiment is needed to know the performance under different extensive farming condition of Bangladesh.

Session II

LIVESTOCK AND POULTRY DISEASES AND HEALTH

Phenotypic and genotypic profiling of antimicrobial resistance (AMR) *Enterococcus* spp. in finisher livestock and poultry in Bangladesh

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Executive summary

Enterococcus spp. has been emerged as leading causes of hospital infection, surgical sepsis, and urinary tract infection (UTI) due to their harsh environment tolerance and intrinsic antimicrobial resistance. This study focused on determination of antimicrobial sensitivity and virulence characteristics of *Enterococcus faecalis* and *Enterococcus faecium* isolated from different finisher poultry, livestock and meat in Bangladesh. A total of 352 swab or meat samples were collected from different poultry and livestock origins including 230 cloacal swabs from poultry (n=136), cattle (n=35), goat (n=29), camel (n=30) and 122 meat samples comprises of chicken meat (n=60), beef (n=32) and mutton (n=30). Samples were primarily screened for enterococci using 6.5% NaCl Mueller hinton broth and Kanamycin aesculin azide agar. Initial selective culture positive samples were selected as presumptive enterococci which were then confirmed using *E. faecalis* and *E. faecium* specific primer with conventional PCR. Overall 40.1% (n=141; 95%CI 35-45.1%) sample were *Enterococcus* spp. positive which included 47.8% poultry (n=65; 95%CI 39.4-56.1%), 25.7% cattle (n=9; 95%CI 11.8-39.6%), 24.1% goat (n=7; 95%CI 9.5-38.7%), 46.7% camel (n=14; 95%CI 31.7-61.6%), 30% chicken meat (n=18; 95%CI 18.9-41%), 59.4% beef (n=19; 95%CI 43.2-75.4%) and 30% mutton (n=9; 95%CI 14.4-45.5%). A total of 141 *Enterococcus* spp. were isolated from 141 positive samples where prevalence of *E. faecalis* (74.5%; n=105) was predominant than *E. faecium* (18.4%; n=26) and overall co-prevalence of both enterococci species was 2.8% (n=10; 95%CI 1.1-4.5%) among all the tested samples. Significantly higher prevalence ($p<0.05$) of enterococci was observed in poultry (47.8%; n=65; 95%CI 39.4-56.1%) than livestock (31.9%; n=30; 95%CI 23-40.7%). The prevalence of *E. faecalis* was also significantly higher ($p<0.01$) in poultry (40.4%; n=55; 95%CI 32.1-48.6%) than chicken meat (23.4%; n=22; 95%CI 15.3-31.4%). But when the comparison was made within meat samples, the prevalence of enterococci in livestock meat was found higher (41.9%; n=26; 95%CI 30.2-53.5%) than poultry meat (20%; n=12; 95%CI 10.3-29.6%) although the variation was statistically non-significant (p=0.09).

As 12 individual antibiotics from 11 different antibiotic classes were tested against 117 isolates; a total of 107 (91.5%) isolates showed multidrug resistance (MDR) characteristics (non-susceptible to three or more antibiotics classes). The isolates that showed resistance against vancomycin (n=18) in phenotypic assay were subjected to test genotypic criteria. Plasmid mediated mobile gene *vanA* and *van*B commonly associated with vancomycin resistance (VR) were observed in 44.4% (n=8/18, 95%CI 21.4-67.3%) and 16.7% (n=3/18, 95%CI 0-33.9%) vancomycin resistance enterococci (VRE) isolates respectively whereas a single isolate (n=1/18) had both the genes. Some other resistance genes associated with VRE like *van*C1 (n=5/18, 95%CI 7.1-48.4%) and *van*$C_{2/3}$ (n=9/18,95%CI 27-73%) were also observed. High prevalence of VRE associated gene was found in *E. faecalis* isolates 16.3% (n=14/86, 95% CI 8.4-24.1%), among them 50% (n=7/14, 95% CI 23.8-76.1%**)** VR *E. faecalis* found to have *vanA* gene. The virulence factor gelatinase (*gel*E) was observed in 42 MDR isolates (39.3%, 95%CI 24.6-54%); the aggregation factor (*asa*1) in 20 MDR isolates (18.7%, 95%CI 6.6-38.9%) and the sex pheromones (*cpd*) in 35 MDR isolates (32.7.0%, 95%CI 20.6-44.8). The factors including cytolysin, surface protein, hyaluronidase, collagen-binding protein, transmembrane protein, endocarditis specific antigen, and aggregation protein were not observed among the MDR isolates. The resistance of *E. faecalis* and *E. faecium* to multiple antibiotics especially to vancomycin and the presence of virulence factors will allow the bacteria to survive and proliferate in patients receiving multiple antimicrobials and cause super-infection. So the presence of this vulnerable opportunistic pathogen with virulence criteria in finisher poultry and livestock origin is an alarming concern for public health in Bangladesh.

Development and validation of a low-cost mastitis detection kit

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Mastitis is the most costly and devastating disease condition in terms of economic losses from reduced milk production, treatment costs, increased labour, milk withheld following treatment, death and premature culling occurring throughout the world. Depending upon the climatic condition, animal species and disease management practices, etiological agents may vary place to place and case to case. That is the region that behind the isolation of largest number of pathogens in a single disease i.e. more than 135 is from the cases of mastitis. Subclinical mastitis is a serious problem in dairy industries because there is no gross changes occur in udder or glandular tissues and acts as a continuous source of infection to herd mates. Thus the control and prevention of mastitis is a challenge and despite of the early diagnosis it is a cause behind the severe economic losses to dairy industry. Therefore, the present research work was undertaken with the following objectives- study of validity and reproducibility of BLRI developed low cost, rapid screening of mastitis test kit (BMT kit) and to recheck the efficacy of the kit comparison with CMT kit on the basis of somatic cell count. The research activities were concern to reproduce the mastitis detection kit and recheck its validity, screening the milk samples to detect sub clinical mastitis through the kit extensively and establish the kit as a technology and use in field as a part of mastitis control package. The present study was conducted at *Shahjadpur, Sirajganj*, Bangladesh during July 2017 to June 2018 under BLRI Regional Station Baghabari, Sirajganj. We reproduced the BMT kit extensively and regular testing in detecting subclinical mastitis in dairy cows in the study area. BMT kit is cheap, easy and farmers friendly and its reagents are locally available. It has five categories of result like CMT (Negative, Trace, Weak, Distict and Strong). It provides the producer with simple and rapid method for the detection of elevated somatic cell counts (SCC) in mammary glands suspected of having mastitis. This inexpensive cow-side test requires no sophisticated equipment and is intended in part for use with good mastitis management practices. In operational procedure of the test in brief is 2 ml of milk is taken in a test paddle and add equal amount of the working solution and rotated the paddle. Result will come out within 10-20 secondy. The kit could be used regularly (eg. every two weeks) in individual quarters within your entire herd for subclinical mastitis. It can also be used to quantify SCC in composite and bulk tank samples. The BMT reagent reacts with leucocytes (Somatic cells) that are elevated during mastitis. The degree of gel formation was proportional to the increasing numbers of leucocytes present during mammary gland inflammation, characteristics of mastitis. Greater gel formation corresponds to a higher BMT score. BMT results recorded for -(Negative) while mixture remains liquid with no thickening; T(trace), slight thickening which disappears with paddle movement; 1 (Weak), distinct thickening but no gel formation; 2 (Districts), mixture thickens immediately moving to centre of cup; 3(Strong) distinct gel formation which tends to form a mass.
The mixing working solution of the kit remains unchanged within 2 years with in normal environmental temperature and humidity. The cost per test of milk (including reagents and materials) of the kit is 1.00 (One) Tk. The working solution contains three elements and their amount in per litter is Sodium carbonate 10 gm, Sodium laryl ethyl sulphate 7gm and Bromocresol purple 0.1gm. A total 400 quarter milk samples from 100 crossbred dairy cows were subjected to BLRI mastitis test (BMT) to justify its efficacy to validate as a individual test comparison with California mastitis test (CMT) in detecting sub clinical mastitis on the basis of somatic cell count (SCC) through direct microscopic count (DMC). CMT score 1+ was least scale of positivity for CMT and BMT and ≥2 lac cell/ml was scale of positivity in detecting mastitis. Milk samples positive by CMT and BMT were 179 and 175. All samples were subjected to somatic cell count and 222 samples were positive by DMC. The percentage accuracy of CMT and BMT were 76.75 % & 75.75 %; sensitivity 69.36% & 67.56 %; specificity 85.95 % & 85.85 %; positive predictive value 86.03 % & 85.7 %; negative predictive value 69.23 % & 68 % respectively. P value 0.001 is both for CMT and BMT and in case of comparison between them P value is 0.776. CMT and BMT has no difference in sensitivity. Both tests are sensitive at SCC count more than 2 lac/ml. There is no difference in sensitivity among the tests at

SCC level and it were more or less than 2 lacs/ ml. On the another study of 150 milk samples SCCs determined by DMC and DCC (De Laval cell counter®) categorized by CMT and BMT scores including average result. Average SCCs (cells/ml) determined by DCC (85.50 X 10^3, 345.20 X 10^3, 675.50 X 10^3, 1357.50 X 10^3, 2449.60 X 10^3) and DMC (55.50 X 10^3, 250.50 X 10^3, 550.50 X 10^3, 1250.0 X 10^3, 3944.50 X 10^3) respectively were mostly corresponded to the SCC range in each CMT and BMT score. BMT is reliable and accurate mastitis diagnostic test. It could be an independent, cheap, farmers friendly, country made and alternative method besides CMT and showed almost same accuracy, sensitivity, specificity with showed categorizing scores like CMT

Development of Peste des Petits Ruminants (PPR) free zone in selected areas of Bangladesh to meet global control strategy

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Executive summary

Peste des petits ruminants (PPR), also known as 'goat plague', is a viral disease of goats and sheep characterized by fever, sores in the mouth, diarrhea, pneumonia, and sometimes death. The project has the following objectives: to conduct surveillance and epidemiological studies to determine present status of PPR and PPR like diseases, risk factors for the spread and persistence of the disease, to undertake sero-monitoring activities (post vaccination), to determine the level of conferred immunity; to enhance the knowledge of small ruminant farmers, public and private technical personnel on PPR recognition, prevention and control through awareness campaigns; to get an in depth understanding of problems and prospects of implementing such control program. Sixteen different villages in Magura union under Jicorgacha upazilza of Jessore district were selected as treatment villages and one village for control. This development project was conducted at Magura union of Jhikargacha upazila under Jessore district. PPR prevention and control is based on four different stages at Magura union of Jikorghacha upazila. As OIE guideline, there are four stages that is correspond to a combination of decreasing levels of epidemiological risk and increasing levels of PPR prevention and control. The Stages range from Stage 1 – where the epidemiological situation is being assessed, to Stage 4 – when the country can provide evidence that there is no virus circulation either at zonal or national level, and is ready to apply for the OIE official country status of PPR freedom (Fig. 1).

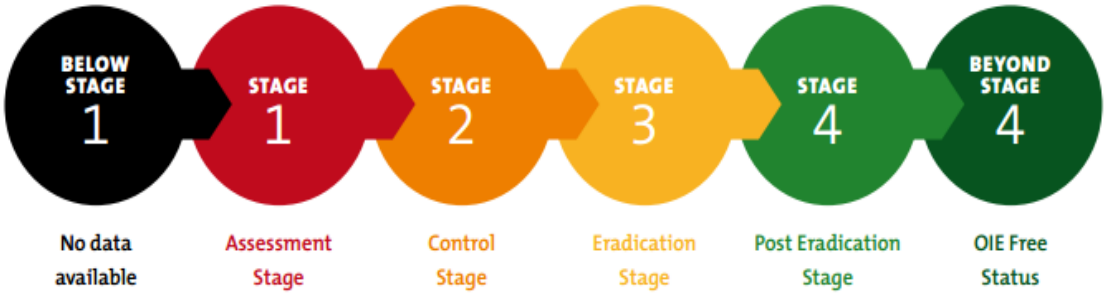

Figure 1. The Progressive Step-wise approach for the prevention and control of PPR.

For PPR Control and Eradication, Magura union has been achieved stage two in June 2018. Epidemiological studies were done for PPR and PPR like diseases. Mass vaccination program was carried out in all goats (3+ months of age) of 16 treatment villages where around app.15,000 goats were vaccinated against PPR. Sera from blood samples were collected to determine antibody against PPR after 2 months of post vaccination and tested with cELISA kit to assess the titer levels. Sero-positive goats in the treatment villages was 100% and in control Villages 28%. Enhanced capacities have been developed of LRI, BLRI and DLS on vaccine quality and field level PPR disease control intervention. Now we are situated stage three in our selected area following OIE guideline. Improved knowledge and awareness of farmers and technical staff (public and private) has been taken on PPR recognition, prevention and control. Developed model PPR Free Zone technology are being contributing towards a national PPR Strategic Control and Eradication Plan.

With the effective vaccines, diagnostics and knowledge of PPR now available to us, as well as the successful experience of eliminating rinderpest, Bangladesh can achieve the goal of controlling PPR. This, in turn, will open the door for the eradication of PPR from Bangladesh, as well as from other South Asian countries. The successful eradication of rinderpest in Bangladesh, thanks to the efforts of all the stakeholders, as well as the international community, should be celebrated. The successful global eradication of rinderpest shows that a similar programme could now be followed to globally eradicate PPR.

Development of FMD free zone in Bangladesh as per OIE guidelines

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Executive summary

FMD, a highly contagious transboundary animal disease, can cripple a country's economy due to reductions in animal productivity and high costs associated with control and vaccination efforts. It mainly affects countries in Africa, Latin America and southern Asia. The Food and Agriculture Organization (FAO) of the United Nations in collaboration with the European Commission for the control of Foot-and-Mouth Disease (EuFMD) and the World Organisation for Animal Health (OIE), have made it their mission to implement the Progressive Control Pathway (PCP) over the past six years with the aim of eradicating FMD at a global level. The aim of the research work was to establish a FMD free zone in a selected area of 'Pabna-Sirajgonj' of Bangladesh as per OIE guideline. Selection of an area/zone in 'Pabna-Sirajgonj' which is clearly separated from adjacent district/upazila with a physical or geographical barrier. In selected areas of Pabna-Sirajgonj, Progressive Control Pathway (PCP) have been implemented that can enable countries to progressively increase the level of FMD control to the point where an application for OIE-endorsement of a national control programme vaccination or official freedom from FMD with or without vaccination. The PCP is a step-by-step approach to control FMD in selected areas where the disease is endemic. The PCP stages are summarized in Fig. 1 and described below.

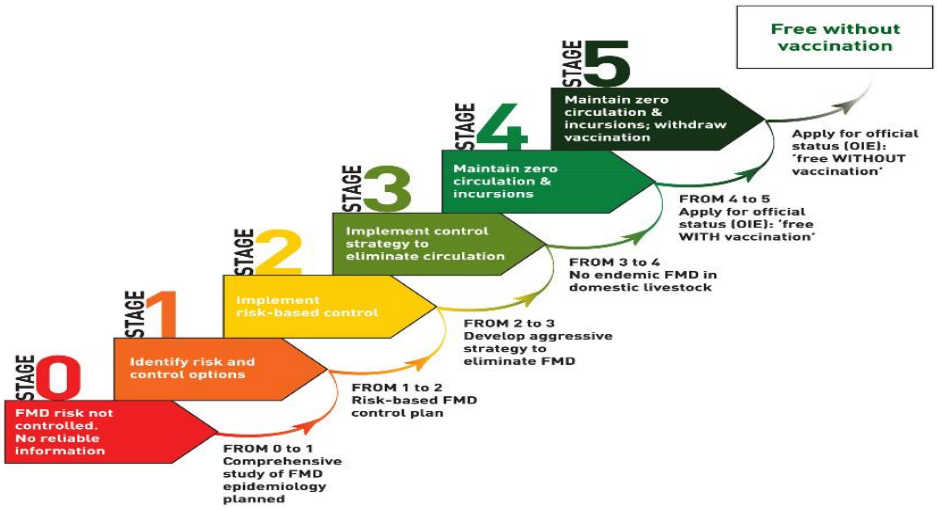

Figure 1. The step of Progressive Control Pathway (PCP) for FMD free zone.

The 'Stage Focus' represents the usual overall objective or aim of the stage and the numbered points outline the 'key outcomes' necessary to achieve that aim. This helps to endorse individual countries' requests for further national and international investment to control FMD. Countries where the disease is endemic with no reliable information on the disease status are classified as stage 0. A comprehensive study of the epidemiology of FMD is required to move from stage 0 to 1 (PCP-FMD Principles and Applications, 2011). Stage 1 assists in identifying appropriate control options. Countries in stage 1 are in the process of developing their control strategies in at least one animal production sector based on a comprehensive assessment of the epidemiology and control options. Progression from stage 1 to 2 requires a risk based FMD control plan. Stage 2 involves the implementation of the chosen policy. Countries in stage 2 implement risk-based FMD control strategy that aims to reduce disease in at least one animal production sector. In order to move from stage 2 to 3, an aggressive strategy to eliminate FMD needs to be developed. Countries in stage 3 should adopt a

control plan to progressively reduce/eliminate virus circulation in at least one region/production system (PCP-FMD Principles and Applications, 2011). Accoding to PCP-FMD road map for SAARC countries, the selected areas of Pabna-Sirajgonj is supposed to achieve stage 3 in 2018, provided that epidemiological studies, risk identification, and fixed risk-based control plan were completed. FMD control measures had been applied namely, improved biosecurity, active monitoring for FMDV circulation, movement control, deworming, vaccination, sero-survillence, quarantine, volunteer development, training etc. To develop immunity, animal was vaccinated regularly with trivalent FMD vaccine at 4-6 months of age and maintained booster dose at 6 months interval. Blood samples were collected for sera to identify antibody by ELISA during pre and post vaccination. The protection level of the antibody against FMD was 100 % in selected area of Pabna district and Sirajgonj district. According to OIE guideline, we are now staying in stage two at the selected upazilas (Bera, Sathia and Sujanagar) of Pabna district and Alokdiar village of Sirajgonj district. Implement risk-based control strategy such that the impact of FMD was reduced in the zones and control strategy had been taken to eliminate circulation of FMDV to ensure no endemic FMD in domestic livestock.

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

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Executive summary

Animal health is one of the many factors that conspire against productivity of cattle (Miranda, 2014).The present study was designed to have a comprehensive epidemiological data of the circulating diseases in Pabna cattle at the nucleus breeding herd (NBH) and the community of dairy development research project (DDRP). A total of 965 clinical cases of cattle of different breed and sex were diagnosed during the period from July, 2017 to June, 2018. Prevalence of different dairy cattle diseases in community and on station (the NBH) are presented in Table.1. The result of a paired t-test suggests that there is no significant difference in the pattern of disease occurrence in the two separate populations may be because in both the cattle population genotype is same (mostly local Pabna variety).

Table 1. Comparative prevelance of different dairy cattle diseases between community and the NBH

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	
	Aspiration pneumonia	2	0	0.21	0	0.702	0.40	0	0.528
General disorder	Non-specific fever	32	12	3.41	7.27		6.32	17.14	
	General debility(def)	45	7	4.80	4.24		8.89	10.00	
Parasitic	Blood protozoa	11	2	1.17	1.21	0.56	2.17	2.86	0.41
	Endo-parasite	147	36	15.67	21.82		29.05	51.43	
	Hump sore	2	14	0.21	8.48		0.40	20.00	
	Ectoparasite	27	4	2.88	2.42		5.34	5.71	
	Maggot	25	5	2.67	3.03		4.94	7.14	
Viral	FMD	258	0	27.51	0.00	0.29	50.99	0.00	0.293
	Bovine Ephemeral fever	31	1	3.30	0.61		6.13	1.43	
	Wart	7	1	0.75	0.61		1.38	1.43	
	Rabies	2	0	0.21	0.00		0.40	0.00	
Bacterial	Anthrax	3	0	0.32	0.00	0.22	0.59	0.00	0.183
	HS	5	0	0.53	0.00		0.99	0.00	
	Dermatophilosis	9	9	0.96	5.45		1.78	12.86	
	Conjuntivitis	14	8	1.49	4.85		2.77	11.43	
	Pneumonia	8	0	0.85	0.00		1.58	0.00	
	Mastitis	17	2	1.81	1.21		3.36	2.86	
	Black Quarder	4	0	0.43	0.00		0.79	0.00	
	Tetanus	1	0	0.11	0.00		0.20	0.00	
	Foot rot	5	25	0.53	15.15		0.99	35.71	
	Arthritis	6	1	0.64	0.61		1.19	1.43	
Digestive	Anorexia	23	3	2.45	1.82	0.37	4.55	4.29	0.515
	Ruminal acidosis	2	0	0.21	0.00		0.40	0.00	
	Constipation	1	3	0.11	1.82		0.20	4.29	
	Simple indigestion	1	0	0.11	0.00		0.20	0.00	
	Non-specific Diarrhoea	69	5	7.36	3.03		13.64	7.14	
	Blot	35	0	3.73	0.00		6.92	0.00	
Metabolic	Milk fever	10	0	1.07	0.00	0.99	1.98	0.00	0.839
	Grass tetany	3	0	0.32	0.00		0.59	0.00	
	Weak calf syndrome	15	5	1.60	3.03		2.96	7.14	
Reproductive	Retained Placenta	1	9	0.11	5.45	0.80	0.20	12.86	0.998
	UTIs	3	1	0.32	0.61		0.59	1.43	
	Repeat breeding	23	1	2.45	0.61		4.55	1.43	
	Post-partum anoestrus	73	2	7.78	1.21		14.43	2.86	
	Prolapse	1	1	0.11	0.61		0.20	1.43	
Surgical	Abscess	2	1	0.21	0.61	0.17	0.40	1.43	0.148
	Navel-ill	5	2	0.53	1.21		0.99	2.86	
	UPF	0	4	0.00	2.42		0.00	5.71	
	Hernia	2	0	0.21	0.00		0.40	0.00	
Others	Allergic reaction	7	1	0.75	0.61	—	1.38	1.43	—
	Congenital def.	1	0	0.11	0		0.20	0	

Table.2 Epidemiology of important community diseases

Category	Endo-parasite		FMD		Non-specific Diarrhea		Post-partum Anoestrus	
	n	%	n	%	n	%	n	%
Types of cattle								
No infestation	715	74.09	707	73.26	715	74.09	595	61.66
Male calf	20	2.07	11	1.14	35	3.63	0	0.00
Female calf	15	1.55	15	1.55	45	4.66	0	0.00
Heifer	5	0.52	45	4.66	5	0.52	25	0.00
Cow	95	9.84	86	8.91	137	14.20	345	38.25
Bull	115	11.92	101	10.47	28	2.90	0	0.00
	965	**100**	**965**	**100**	**965**	**100**	**965**	**100**
Age								
No infestation	810	83.94	785	81.35	735	76.17	765	79.27
<1	20	2.07	20	2.07	55	5.70	0	0.00
1-<2	15	1.55	5	0.52	25	2.59	0	0.00
2-3	25	2.59	35	3.63	15	1.55	15	1.55
>3	95	9.84	120	12.44	135	13.99	185	19.17
	965	**100**	**965**	**100**	**965**	**100**	**965**	**100**
Body Weight								
No infestation	810	83.94	810	83.94	700	72.54	785	81.35
<100	35	3.63	20	2.07	75	7.77	0	0.00
100-200	35	3.63	25	2.59	80	8.29	0	0.00
>200	85	8.81	110	11.40	110	11.40	180	18.65
	965	**100**	**965**	**100**	**965**	**100**	**965**	**100**
Season								
No infestation	815	84.46	815	84.46	760	78.76	785	81.35
Summer	55	5.70	70	7.25	95	9.84	90	9.33
Winter	75	7.77	20	2.07	85	8.81	60	6.22
Rainy	15	1.55	55	5.70	20	2.07	25	2.59
Spring	5	0.52	5	0.52	5	0.52	5	0.52
	965	**100**	**965**	**100**	**965**	**100**	**965**	**100**

Table.3 Epidemiology of important on-station diseases

Category	Endoparasite		Non-specific fever		Conjunctivitis		Dermatophilosis		Foot rot	
	n	%	n	%	n	%	n	%	n	%
Age										
No infestation	144	87.27	154	93.33	157	95.15	156	94.55	140	84.85
<2.5	4	2.42	3	1.82	8	4.85	8	4.85	0	0.00
2.50-3.50	12	7.27	7	4.24	0	0.00	1	0.61	12	7.27
>3.50	5	3.03	1	0.61	0	0.00	0	0.00	13	7.88
	165	**100.00**	**165**	**137.50**	**165**	**137.50**	**165**	**137.50**	**165**	**100.00**
Body weight		0.00		0.00		0.00		0.00		0.00
No infestation	144	87.27	154	93.33	157	95.15	156	94.55	140	84.85
<250	13	7.88	10	6.06	8	4.85	8	4.85	0	0.00
250-300	8	4.85	1	0.61	0	0.00	1	0.61	3	1.82
>300	0	0.00	0	0.00	0	0.00	0	0.00	22	13.33
	165	**100**	**165**	**100**	**165**	**100**	**165**	**100**	**165**	**100**
Season		0.00		0.00		0.00		0.00		0.00
No infestation	144	87.27	154	93.33	157	95.15	156	94.55	140	84.85
Summer	11	6.67	1	0.61	0	0.00	1	0.61	11	6.67
Winter	10	6.06	6	3.64	8	4.85	8	4.85	14	8.48
Rainy	0	0.00	4	2.42	0	0.00	0	0.00	0	0.00
Spring	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	165	**100**	**165**	**100**	**165**	**100**	**165**	**100**	**165**	**100**

Although, we routinely de-worm our cows in the community and in the NBH round the year we found some cases of parasitic gastro-enteritis in both the locations which suggested that our de-worming practice is not working for summer seasons. This need to be addressed and the causes should be explored.

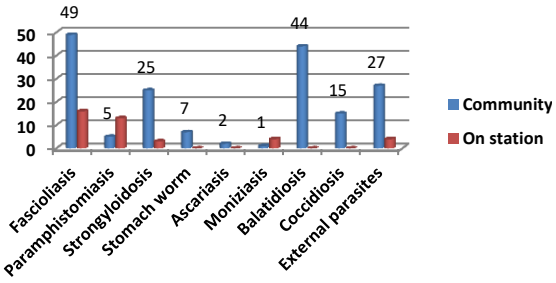

Figure 1. Comparative incidence of different parasites in the community and in the NBH

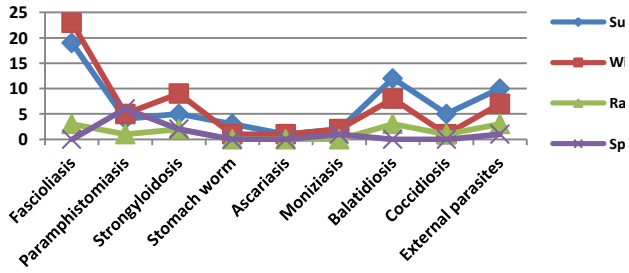

Figure 2. Seasonal variation in the occurrence of different parasitic diseases in community and NBH

According to the study, major diseases of cattle in the study areas include FMD, digestive disorder, parasitic disease, skin disease of which FMD and parasitic diseases are predominantly prevalent diseases in both the locations. Older female cattle are highly susceptible to most of the diseases. Our large set of data on cattle disease prevalence in the area may provide valuable insight to design and implement priority based research on specific disease and to take efficient control strategies against that disease.

Tick borne blood protozoan diseases of farm based and slaughter house animal

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Executive summary

Babesiosis, Anaplasmosis and Theileriasis are the most important economic tick borne blood protozoan diseases (TBDs) in Bangladesh. A prevalence study on blood protozoan diseases was conducted on high yielding crossbred (50% to above), indigenous cattle and exotic sheep, particularly in selected areas of Sirajganj & Naikhongchari and organized cattle & sheep farm of Savar upazila. A total 750 blood samples were collected randomly with the information on topography, season, age and sex with a pretested questionnaire in which 300 from dairy farm (Savar), 300 from milk vita Bathan area (Baghabari), 50 from native cattle (Sirajganj), 50 from hilly areas (Naikhongchari) and 50 from exotic sheep (Soffolk, Perandale, Dorper and Dhamara) farm (BLRI). The collected blood samples were examined by Giemsa's stained blood smear (GMS) method (OIE, FAO) and confirmatory diagnosis through Polymerase Chain Reaction (PCR). In case of *Babesia* spp. short and long loop formation was found at the periphery of RBC (Piroplasmosis). Whereas, in case of *Anaplasma marginale* and *Anaplasma central* pointed round dot at periphery of RBC and inside of RBC were found respectfully. In case of *Theileria spp*, RBC was slight triangle in shape and ring formation was found (annular), sometimes oval, round, dot or rod shape was found. Clinical sign had shown that high fever (105-107^{0}F), complete off feeding, respiratory distress, continual panting, rapid breathing, sometime diarrhea, sometime bloody diarrhea, coffee color urine at last stage of in Babesiosis. Post mortem lesion shown that epicardial and endocardial petechial haemorrhage, haemorrhagic spleenomegaly, highly congested and foamy lung, opaque and frazile liver, sometimes hepatomegaly and ruminal P^H>4.

In clinical investigation prevalence of TBDs was 80% (n=240) in dairy farm, 40% (n=120) in Bathan area, 20% (n=10) in native cattle, 35% (n=18) in hilly cattle and 100% (n=50) in exotic sheep. The overall prevalence of TBDs was 58.40% (n=438) in cattle in which *Anaplasma spp* was 43% (n=188), *Babesia spp* 19% (n=82), *Anaplasma spp* and *Babesia spp* 33% (n=145), *Theileria spp* 4% (n=18) and mixed infection 1% (n=5). Tick, flices (Vector) act as carrier of TBDs. Calf under 4 month and lamb under 2 month of age shown immunity due to maternal immunity of TBDs. From this positive sample (blood) multiplex Polymerase Chain Reaction (PCR) was done in which *Anaplasma marginale* shown positive band as 265 bp, *Babesia bovis* in 166 bp, and *Theileria annulata* in 312 bp, *Babesia ovis* in 422bp and *Babesia motasi* in 518bp. A autogenous blood protozoan killed vaccine was developed and a trial study was done on 45 exotic sheep @ 3 ml/animal at 6 month interval twice in a year. The vaccinated sheep were healthy and did not show any sign or symptoms of TBDs. On epidemiological study in Bangladesh it was observed that May to September environmental temperature is arise (above 30^{0}C, sometimes 40^0 C) and humidity is above 68% (sometimes above 90%) that triggers the multiplication of tick biologically and also multiplication of TBDs protozoa both in tick and animal blood that progresses havoc of TBDs in high yielding animal and local animal act as carrier. But when environmental temperature is 30^{0}C or below and humidity is below 70% ie; October to March animal act as carrier but not showing clinical sign. High environmental temperature (<30^0 C), high moisture (<68 %), new introduction of animal, mixed with locally habituated animal, humid- semi humid tropical climatic zone, physical stress are main risk factor of TBDs outbreaks. In case of high yielding animal (above 60% cross breed) and 100% pure exotic breed show high clinical sign and even death in high percentage and response of treatment is low. In case of local and under 50% cross breed animal usually act as carrier and in some cases show clinical sign, usually shown positive response to line of treatment.

Tick borne blood protozoan disease (Babesiosis, Anaplasmosis, and Theileriosis) are now a days, a crucial factor for livestock production in Bangladesh. Local animal act as carrier but it indicating

future havoc in livestock industry especially high yielding exotic animal (60% to 100 % pure breed). Because they are more susceptible to TBDs and it is very difficult to control environmental high temperature and humidity at optimal level as well as tick control. To introduce high yielding animal in a farm high Strict Farm Biosecurity as well as sound animal health security is essential for adaptation of pure breed exotic animal as well as organized animal farm.

Keywords: Tick, blood protozoa, cattle, multiplex PCR, vaccine

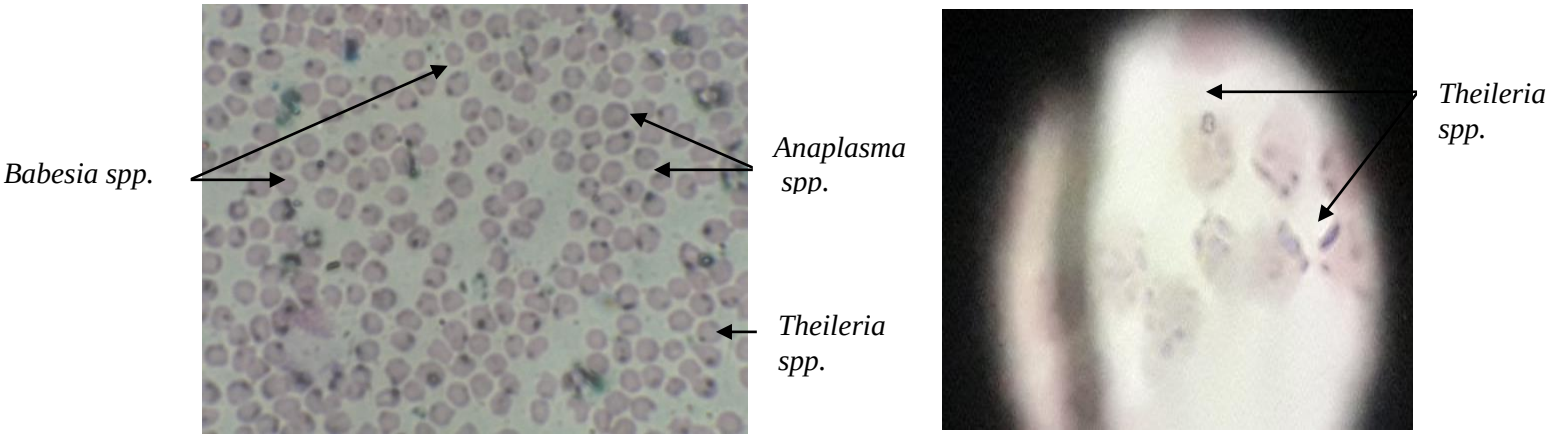

Figure: Laboratory detection of Anaplasma, Babesia and Theileria spp. under microscope

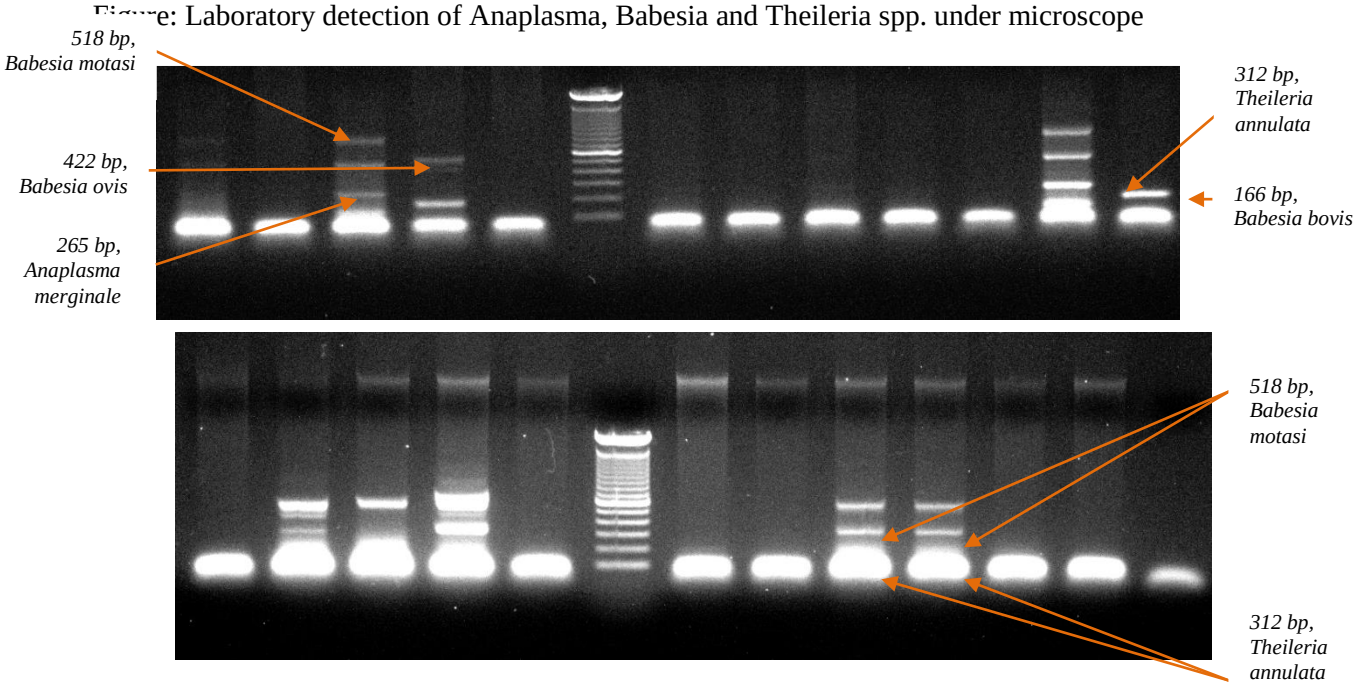

Figure Molecular detection of Anaplasma, Babesia and Theileria spp. by multiplex PCR

Seroprevalence of caprine brucellosis in Bangladesh

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Executive summary

Brucellosis is a highly contagious and important zoonotic disease caused by different species of the genus *Brucella,* a small, facultative, gram negative, non-motile, non-spore forming, rod shaped (coccobacilli) bacteria. In goats and sheep, brucellosis is mainly caused by *Brucella melitensis.* In animals, brucellosis mainly affects reproduction and fertility, reduces the survival of newborns, and diminshes milk yield and thus may cause significant economic losses. There are a lot of undiagnosed cases of abortion, stillbirth and retained placenta which are thought to be down to brucellosis and these have a significant impact on the development of livestock. So, the objective of the study was to determine the status of seroprevalence of brucellosis in goats of Bangladesh. The study was conducted in different agro-ecological zones in Bangladesh from July 2017 to June 2018 to estimate the brucellosis of goats through serosurveillance. About 208 (Buck-19, Doe-189) serum sample were collected from randomly selected goats in different areas in Bangladesh that includes Jashore (n=50, Buck-3, Doe-47), Jhenidah (n=22, Buck-1, Doe-21), Tangail (n=40, Buck-2, Doe-38), Savar (n=46, Buck-10, Doe-36), Thakurgoan (n=18, Buck-1, Doe-17), Bandarban (n=32, Buck-2, Doe-30) to determine the seroprevelance of brucellosis. Two different serological tests, Rose Bengal Plate Test (RBT) and Enzyme Linked Immuno Sorbent Assay (ELISA) were performed in Small Ruminants Health laboratory and Zoonosis laboratory of Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. The RBT was performed as per standard procedure. Some 30 µL of serum was taken on a glass plate by micropipette. The rose bengal colored antigen bottle was shaken well to ensure homogenous suspension and then 30 µL of the Rose Bengal colored antigen was added to the serum. The antigen and serum was mixed thoroughly and waited for 5 min. Definite clumping/ agglutination was considered as positive reaction, whereas no clumping/agglutination was regarded as negative and slight agglutination is also considered as a positive result. The c-ELISA was performed using commercial kits according the manufacturer's protocol from Svanovir® Brucella-Ab C-ELISA (Svanova Biotech AB, art. No. 10-2701-02 and 10-2701-10 Sweden). In our study, we found the prevalence of brucellosis on the basis of Rose Bengal Plate Test (RBT) was 6% (Buck-0%, Doe-6%) in Jashore, 4.5% (Buck-0%, Doe-4.5%) in Jhenidah, 2.5% (Buck-0%, Doe-2.5%) in Tangail, 4.35% (Buck-0%, Doe-4.35%) in Savar, 6.25% (Buck-0%, Doe-6.25%) in Bandarban and 5.56% (Buck-0%, Doe-5.56%) in Thakurgaon. On the other hand, we found the prevalence of brucellosis on basis of ELISA was 4% (Buck-0%, Doe-4%) in Jashore, 4.5% (Buck-0%, Doe-4.5%) in Jhenidah, 0% in Tangail, 0% in Savar, 3.13% (Buck-0%, Doe-3.13%) in Bandarban and 5.56% (Buck-0%, Doe-5.56%) in Thakurgaon.

In conclusion, the overall seroprevalence of brucellosis were 4.33% and 2.40% from RBT and ELISA respectively. Therefore, further study of the true seropositive goats is required for confirming the presence of brucella organisms in order to cull the individuals for keeping apart them from this detrimental zoonotic disease.

Session III

BIOTECHNOLOGY, ENVIRONMENT AND CLIMATE RESILIENCE

Adaptation of ovum pick up and somatic cell nuclear transfer technologies for cattle in Bangladesh

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Executive summary

Numbers of reproductive biotechnology approaches are adopted with traditional cattle breeding programme for increasing rate of genetic progress. The *in vitro* embryo production (IVEP) is one of them. This technology is used individually or jointly with other technology to increase reproductive efficiency and to reduce generation interval of farm animals. The OPU (full meaning) in combination with conventional IVEP (full meaning) has enabled repeated production of large number of embryos from donors of high genetic merits. Considering these facts, the present research programme was designed to produce calves from transfer of OPU derived embryos. Oocytes were collected throughout the experimental period from six regular breeder Red Chittagong cows, without subjecting the cows to hormonal stimulation. Follicles were visualized using an ultrasound scanner equipped with a sectorial probe fitted in a custom made intra-vaginal OPU probe-holder. Follicles number was recorded according to their diameter using ultrasonography. An 18 gauge disposable hypodermic needle connected to a 50 mL conical tube by Teflon tubing was used for follicular puncture. The COC (full name) collection tube and aspiration medium was kept at 38°C in a water bath. Oocytes were collected in Tyrodes lactate (TL)-HEPES medium enriched with 2% (v/v) fetal calf serum, 100 iu/mL penicillin, 0.1 mg/mL streptomycin and 5 iu/mL heparin in a 50-mL Falcon tube. To minimize abdominal straining during OPU, epidural anesthesia was performed with 5 mL of lidocaine. A twice/week OPU schedule was used for collection of oocytes from elite donor cows. During this experimental period, twenty OPU sessions were conducted. Oocyt were recovered from 5 sessions and subjected to *in vitro* maturation. The maturation rates were evaluated by expansion of cumulus cell. The matured oocytes were fertilized with fresh semen *in vitro*.

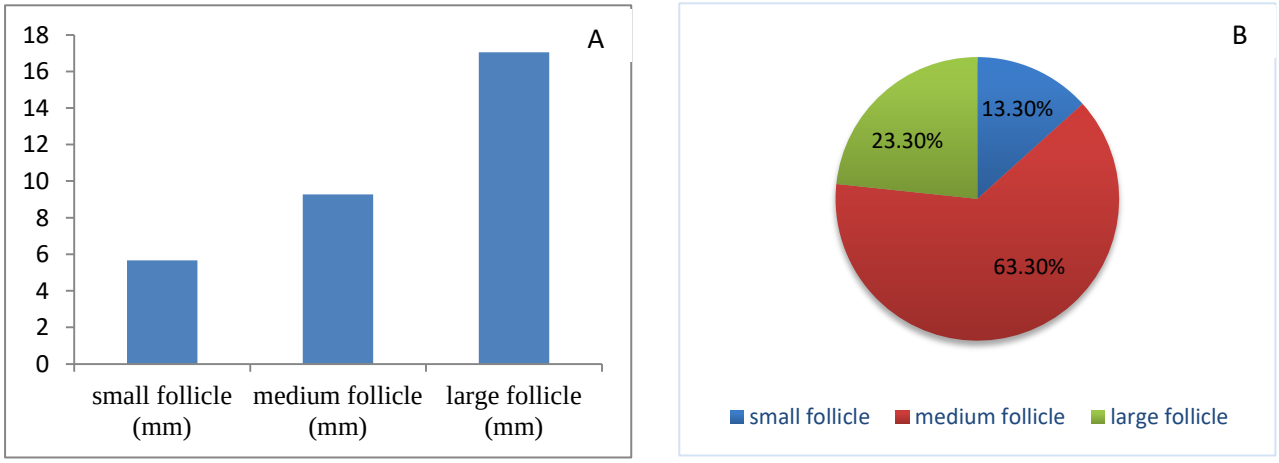

Figure 1. Follicular diameter (A) and proportion of different follicle (B) in RCC cows observed during ovum pick up (OPU) from live donor

Table 1. *In vitro* maturation status of OPU derived oocytes from RCC cows

Parameter	Value
No. of follicle punctured	26
No. of cumulus-oocyte-complexes recovered	12
Oocyte recovery rate	46.15%
No. of oocytes for IVM	12
No. of cumulus expansion	7
Maturation rate	58.33%
No. of zygote developed	0

The results showed that fig.1.the average diameter of ovary, large follicle and medium follicles were 17.04 mm, 9.28 mm, 5.66 mm respectively. Aspirated follicles were belonged to small (13.3%), medium (63.3%) and large (23.3%) follicles, (Figure 1) respectively. Total 26 follicles were punctured and 12 cumulus-oocyte-complexes were recovered. The *in vitro* maturation rate was 58.33%. (Table 1). However, no oocytes were developed into zygotes. In conclusion, oocyte recovery rate in the OPU was moderated.

Isolation and identification of LAB and *Streptococcus* bacteria for developing starter culture for Yogurt

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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 marketed yogurt, 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 preparation at commercial level as well as consumer's home.

In last year, 15 isolates of LAB from six locally available yogurt samples were isolated using *Lactobacillus* MRS Agar and identified through biochemical tests. This year, study was performed to isolate and identify bacteria of *Streptococcus* genus through biochemical characterization as well as molecular confirmation of isolates primarily identified as *Lactobacillus acidophilus* and *Streptococcus thermophilus* bacteria using PCR. For this purpose eight yogurt samples were collected from local market and *Streptococcus* bacteria were isolated through culturing it on selective M17 Agar media. Bacteria were initially identified by performing catalase test and Gram's staining. Catalase negative and Gram's stained and cocci shaped isolates were picked-up and purified by sequential culturing in M17 Broth and M17 Agar. Biochemical properties of isolates were evaluated through gas production from glucose, growth at different temperature (10ºC, 45ºC) and growth at 2%, 4%, and 6.5% NaCl concentration. Then DNA was extracted from isolated bacterial colony using hot cold method, concentration was quantified by Nanodrop 2000c confirmed by PCR followed by gel electrophoresis.

Out of eight samples, live viable bacteria were found all samples and the concentrations ranged from 6.00 to 8.54 Log $_{10}$cfu/ml. Based on catalase negative and gram's stain positive a total nine colonies (Ps1,Ps2, A, B, Ms1, Ms2, Mvs, Wf and Mvsw) were selected as lactic acid bacteria. Among nine colonies four colonies were cocci shape (A, Ms1, Mvs and Mvsw) and were selected for further biochemical and molecular identification. According to biochemical activity Mvs and Ms1colonies were identified as *streptococcus* genus however, A and Mvsw colonies were belong to *Leuconostoc* genus (Table1).

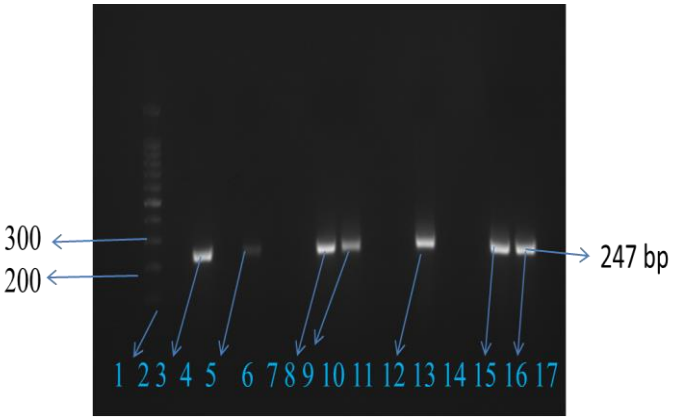
Table 1. Biochemical test results of isolated colonies

Biochemical Tests	A	Ms1	Mvs	Mvsw
Gas from glucose test	+	-	-	+
Growth at				
10°C	+	-	-	+
45°C	-	+	+	-
Growth of different NaCl				
2%	-	-	-	-
4%	-	-	-	-
6.5%	-	-	-	-
Genus	Leuconostoc	Streptococcus	Streptococcus	Leuconostoc

DNA was extracted from isolated colonies and the concentration of DNA varied from 22.2 to 422.6 nano gram/µl. The DNA from previously (last year) identified 15 colonies (Mv1,Mv2, Mv3, MW1, Ps1,Ps2, Ps3, P1,P2,P3,P4,B1,B2,Bo1,Bo2)of LAB were amplified by *Lactobacillus* genus (247 bp) and *Lactobacillus acidophilus* (227bp) species specific primer and after gel documentation 7 isolated

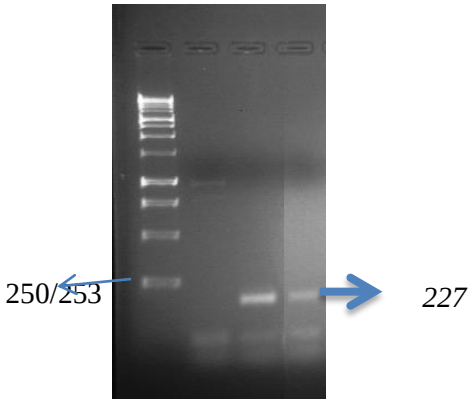
colonies (Mv1, Mv2, Ps1,P1,P2,B1,Bo1) (Fig1) were identified as *Lactobacillus* genus. However, among them 2 isolated colonies (Bo1 and Ps1) were detected *Lactobacillus acidophilus* (Fig. 2). On the other hand four colonies (A, Ms1, Mvs and Mvsw) isolated on M17 agar were amplified by *Streptococcus* genus and *streptococcus thermophiles* species specific primer. After gel documentation among four colonies Mvs and Ms1 showed positive PCR amplification of *streptococcus* genus (560bp) specific primer, however only Mvs showed positive amplification on *streptococcus thermophiles* species primer (157bp) (Fig. 3). Yogurt preparation and its quality assessment by using *streptococcus thermophiles* and *Lactobacillus acidophilus* are ongoing.

Figure 1. DNA amplification by *Lactobacillus* genus Specific primer



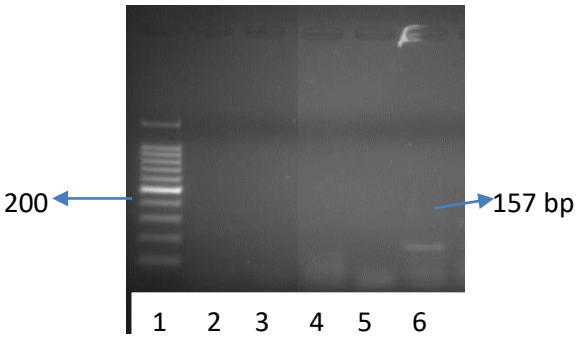
1= 100 lb ladder, 2= Bo 2, 3= Bo1, 4=B2, 5= B 1, 6= P 4, 7= P 3, 8= P 2, 9=P 1, 10= Ps 3, 11= Ps 2, 12=Ps 1, 13= Mw, 14= Mv 3, 15= Mv 2, 16=Mv 1, 17= Negative control.

Figure 2. DNA amplification by *Lactobacillus acidophilus* Specific



1= 1 Kb DNA Ladder, 2= Negative control, 3= B01, 4= Ps 1

Figure 3. DNA amplification by *Streptococcus thermophelous* species Specific



1= 100 bp DNA Ladder, 2= Negative control, 3= A, 4= Ms1, 5=Mvsw, 6= MSV

Growth and physiological response of selected mutant's line of Napier cultivar to salt stress in hydroponic technique

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Executive summary

Mutation (gamma -ray irradiation) has become increasingly popular in recent times as an effective plant breeding tool for improvement of existing fodder germplasm. BLRI Napier-3 and BLRI Napier-4 were exposed to 10 to 100 gamma rays (Gys), with an interval of 10 Gys doses to determine the morphological and nutritional quality in terms of cutting survivability rate, biomass yield, tiller numbers, and crude protein (CP%) content. Five mutants' lines of BLRI Napier-3 were selected followed after 10, 20, 30 and 50 Gys on the basis of morphological and nutritional quality and genetic variations (analyzed by using RAPD markers). In the present study, five mutants along with a control lines were assessed for salt tolerance under hydroponic system to determine the effect of saline stress on morphological and nutritional quality and Na^+& K^+ content under hydroponic condition. As per guidelines of Bangladesh Agricultural Research Institute (BARI) with some modifications, all the selected mutants and control lines were grown hydroponically by using BARI standard solution developed for horticulture. Salinity levels were accounted for 6 dS m^{-1}, 8 dS m^{-1}, 10dS m^{-1} and 12dS m^{-1} using different NaCl concentrations corresponding to the nutrient solution. Cork sheets were placed in water on 3 ft x 7ft steel plates. 10 holes were made in each cork sheet. Proper aeration of the culture solution was provided for 5 minutes daily by stirring a bamboo stick. At two nodes cutting of uniform size were planted in holes of cork sheets floating over nutrient solution. An analysis of variance was done to determine the varietals differences. Collected data were analyzed statistically by using Compare Means (CM) procedure of One-Way Analysis of variance (ANOVA): Post Hoc Multiple Comparisons of IBM SPSS 20 for Windows (SPSS Inc. 2010) following the method of Randomized Completely Block Design (RCBD).

Table 1. Effect of different salinity levels on biomass yield (kg)

Line	Biomass Yield (kg) at			
	6 dSm^{-1}	8 dSm^{-1}	10 dSm^{-1}	12 dSm^{-1}
Control	5.80^{c}±0.21	5.20^{c}±0.11	4.40^{c}±.05774	3.36^{c}±0.09
Line-1	7.00^{ab}±0.15	6.44^{a}±0.12	5.33^{ab}±.12019	3.73^{b}±0.08
Line-2	6.96^{ab}±0.08	6.53^{a}±0.14	5.03^{b}±.20276	4.03^{b}±0.09
Line-3	7.36^{a}±0.09	6.63^{a}±0.15	5.53^{a}±.20276	4.60^{a}±0.12
Line-4	6.96^{ab}±0.08	6.47^{a}±0.14	5.10^{ab}±.05774	3.86^{b}±0.10
Line-5	6.60^{b}±0.05	5.93^{b}±0.12	4.93^{b}±.17638	4.03^{b}±0.08
Sig.	**	**	**	**

N.B. dsm-1, dissolved solids per meter area. Different superscripts a, b, and c indicate significant differences within columns; (p<0.01), **-significant at 1% level (P<0.01).

The biomass yield was decreased with the increasing levels of salinity. Significant variations of biomass yields among different lines were found in all levels of salinity. The highest biomass yield was obtained from selected all mutant's line at different salinity levels and lowest was found from control line (Table1). Significant variations of CP contents among lines were observed in 6 $dSm^{-1}$and 8 dSm^{-1} level of salinity. On the other hand, no significant variations of CP contents among different lines were exhibited in10 $dSm^{-1}$and 12 dSm^{-1}salinity levels. Highest CP was obtained with the 6 dSm^{-1}. CP % gradually decreased with increasing salinity levels, except selected mutant's line-5 at 8 dSm^{-1} (Table 2).

Table 2. Effect of different salinity levels on crude protein % (CP %)

Line	Crude Protein (CP %)			
	6 dSm^{-1}	8 dSm^{-1}	10 dSm^{-1}	12 dSm^{-1}
Control	16.53^{ab}±0.38	16.28^{a}±0.03	15.28±0.70	14.91±0.08
Line-1	17.34^{ab}±0.48	16.07^{a}±0.03	16.03±0.24	14.45±0.62
Line-2	16.29^{ab}±0.26	16.14^{a}±0.60	15.52±0.30	14.15±0.61
Line-3	15.79^{b}±0.45	15.65^{b}±0.06	15.73±0.40	14.03±0.27
Line-4	17.36^{a}±0.47	16.85±0.26	16.06^{a}±0.24	14.02±0.25
Line-5	16.89^{ab}±0.31	17.09^{a}±0.39	16.79±0.48	14.15±0.39
Sig.	*	**	NS	NS

In the physiological parameters, more sodium ions were accumulated in plant with increasing the level of salinity, whereas, the maximum Na^+ concentrations were observed in control lines for different levels of salinity (0.194 to 0.579 mg g^{-1}). The concentrations of Na+ among different lines did not varied significantly in 10 dSm^{-1}. Highest Na+ content (0.324 to 0.579 mg g^{-1}) was found in 12 dSm^{-1} treatment and lowest (0.115 to 0.194 mg g^{-1}) was observed in control which followed by 6 dSm^{-1} (Table 3).

Table 3. Effect of different salinity levels on Na content

Line	Na content (mg g^{-1}) at			
	6 dSm^{-1}	8 dSm^{-1}	10 dSm^{-1}	12 dSm^{-1}
Control	0.194^{a}±0.019	0.260^{a}±0.061	0.403±0.019	0.579^{a}±0.009
Line-1	0.115^{c}±0.008	0.257^{a}±0.029	0.388±0.062	0.436^{cd}±0.026
Line-2	0.138^{bc}±0.016	0.169^{ab}±0.023	0.356±0.050	0.505^{b}±0.011
Line-3	0.156^{abc}±0.005	0.153^{b}±0.005	0.388±0.012	0.394^{a}±0.005
Line-4	0.167^{ab}±0.014	0.189^{ab}±0.006	0.328±0.034	0.462^{bc}±0.004
Line-5	0.156^{abc}±0.003	0.179^{ab}±0.005	0.324±0.019	0.408±0.026
Sig.	**	*	NS	**

K^+ contents in plant dry matter of different mutant lines were significantly influenced for 8 $dSm^{-1}$and 10 dSm^{-1} levels of salinity. The highest K^+ content was obtained on plant dry matter while salinity level was applied at 6 dSm^{-1}. Lowest was calculated from 12 dSm^{-1}. K^+ concentration decreased as salinity levels increased. In this experiment K^+ content was found highest in control line at all levels of salinity (Table 4).

Table 4. Effect of different salinity levels on K content

Line	K content (mg g^{-1}) at			
	6 dSm^{-1}	8 dSm^{-1}	10 dSm^{-1}	12 dSm^{-1}
Control	6.20±0.38	3.66^{a}±0.16	3.14^{a}±0.08	2.74±0.14
Line-1	5.66±0.05	2.46^{b}±0.22	2.32^{c}±0.19	2.21±0.15
Line-2	6.02±0.23	3.05^{ab}±0.04	2.79^{ab}±0.04	2.26±0.23
Line-3	5.95±0.35	2.54^{b}±0.15	2.41^{bc}±0.19	2.42±0.17
Line-4	5.23±0.26	3.08^{ab}±0.41	2.31^{c}±0.09	2.36±0.17
Line-5	6.13±0.32	3.56^{a}±0.12	2.93^{a}±0.09	2.33±0.08
Sig.	NS	*	*	NS

N.B. dsm-1, dissolved solids per meter area. Different superscripts a, b, and c indicate significant differences within columns; (p<0.05), *significant at 5% level; **-significant at 1% level (P<0.01). NS, non significant.

This study forwarded to observe salinity stress on biomass yield and crude protein (CP %) decreased with increasing salinity level. Physiological character of Na^+& K^+ content on control and selected mutant's line also affected due to salinity.

Study on adaptability of HYV fodder cultivars in drought prone Barind areas of Bangladesh

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Executive summary

Drought is being considered as the main cause which hampers the estimated agricultural production, here in Bangladesh over the last few decades. Apart from the agricultural losses, droughts have important effect on livestock population, land degradation, health and employment. In the drought prone areas, the scarcity of green fodder is one of the important problems in Bangladesh for rearing dairy cows. The Barind region is known as the major drought prone area, where the majority of households involved in rearing livestock. Lack of grazing facilities constrains mass rearing of cattle and goats. Therefore, the aim of this study was to increase the availability of green grasses in the Barind regions of Bangladesh. To achieve the goal, an adaptability trial with BLRI Napier cultivars (BN-1, BN-2, BN-3, BN-4, BN-5 and Pakchong) was conducted as pilot basis in three different locations (Chapai Nawabganj sadar, Nachol and Gomostapur) of Chapai Nawabganj district and BLRI regional station at Godagari, Rajshahi. Number of farmers in each location of Chapai Nawabganj was five as disperse replications. In Godagari five blocks comprising 5 plots (for 5 cultivars) in each block measuring an area of (9.64×8)m per plot were prepared for the experiment. Thus, the design of the experiment was randomized completely block design (RCBD). Stem cutting was planted in each plot. Before plantation, all plots were properly prepared by normal agronomical practice as farmers do conventionally (3-4 tillage, weeding and irrigation as per necessary), whereas in Godagari, standard agronomical practices as per BLRI was followed (3-4 tillage, fertilizing through cow dung@ 15-20MT/ha^{-1}, urea@50kg/ha^{-1}, TSP@70kg/ha^{-1} and MP@30kg/ha^{-1} at the time of land preparation and weeding and irrigation when required). Stem cuttings were planted in rows apart from 70cm and 35cm spacing between plants. Biomass yield and plant morphology along with nutritional evaluation were studied in the experiment. Data were collected up to 10 cuts from Chapai Nawabganj and 6 cuts from Godagari and analyzed statistically by 'R'(Agricolae and Pastecs packages). Tukey's HSD test was conducted for mean comparison of the variables.

Table 1. Performance of different Napier cultivars at Godagari rajshahi (Peri-Barind region)

Parameter	Bajra	Arusha	Hybrid	Dwarf early	Pakchong	SEM	P-value
BMY (MTha^{-1}/cut)	19.24^{c}	19.94^{bc}	19.67^{bc}	21.92^{ab}	22.82^{a}	0.412	0.002**
DMY (MTha^{-1}/cut)	3.71	3.88	4.02	4.15	4.15	0.093	0.101^{NS}
CPY (MTha^{-1}/cut)	0.264^{b}	0.313^{a}	0.329^{a}	0.319^{a}	0.322^{a}	0.008	0.000***
LSR	0.69^{b}	1.30^{a}	1.33^{a}	1.07^{a}	0.74^{b}	0.041	0.000***
DM (%)	21.05^{a}	19.12^{b}	20.05^{ab}	18.89^{b}	18.90^{b}	0.339	0.006**
CP (%)	6.74	7.85	7.65	7.07	7.55	0.380	0.796^{NS}

BMY-fresh biomass yield, DMY-dry biomass yield, CPY-CP yield, LSR-leaf and stem ratio; MT-metric tons, ha-hectare, SEM-standard error of means; Means with uncommon superscript within the same row differ significantly (p<0.05); **-p<0.01; ***-p<0.001; NS- p>0.05

Table 1 illustrates the performances of different Napier cultivars in Godagari, Rajshahi. The results show that unlike dry-biomass yield and CP composition, significant differences were found for all the parameters studied. Total fresh biomass, dry-biomass and CP yields in different cultivars varied significantly for sequence of harvest and season of harvest. Highest biomass production was obtained at 3rd harvest (26.31 MTha^{-1}) after plantation and in dry summer (22.14MTha^{-1}). On the other hand, highest dry-biomass production was obtained at 2nd harvest (5.04 MTha^{-1}) in dry summer (4.45MTha^{-1}) and highest CP yields at 6th harvest (0.391 MTha^{-1}) in dry summer (0.360MTha^{-1}). However, sequence and season of harvest have no significant effect on leaf and stem ratio (LSR). DM and CP contents differed significantly for botanical fraction of the plants. Highest % of DM and CP contained in leaf (25.86 and 7.25%), followed by sheath (18.57 and 4.1%) and stem (14.45 and 3.62%). Table 2 shows the performances of different Napier cultivars in Chapai Nawabganj. In Barind region total

fresh and dry biomass and CP yields differed significantly among cultivars, while not for LSR, DM and CP compositions.

Table 2. Performance of different Napier cultivars at Chapai Nawabgonj (Barind region)

Parameter	Bajra	Arusha	Hybrid	Dwarf early	MerkEron	SEM	P-value
BMY ($MTha^{-1}$/cut)	22.33^{ab}	24.24^{ab}	24.49^{a}	24.49^{a}	22.14^{b}	0.037	0.002**
DMY ($MTha^{-1}$/cut)	3.30^{bc}	3.46^{abc}	3.60^{ab}	3.65^{a}	3.21^{c}	0.052	0.002**
CPY ($MTha^{-1}$/cut)	0.296^{b}	0.298^{b}	0.336^{a}	0.296^{b}	0.258^{c}	0.005	0.002**
LSR	0.94	0.96	0.90	0.98	0.99	0.018	0.355^{NS}
DM (%)	15.42	14.86	14.85	14.98	14.85	0.199	0.739^{NS}
CP (%)	8.70	8.85	8.20	8.16	8.79	0.169	0.100^{NS}

*Means with uncommon superscript within the same row differ significantly (p<0.05); **-p<0.01; ***-p<0.001; NS- p>0.05

Results however, showing that biomass production differed within three locations in Barind region. Total fresh biomass yield was obtained highest in Nachol ($24.22^{a}MTh^{-1}$), followed by Gomostapur ($23.98^{ab}MTh^{-1}$) and Chapai Nawabganj sadar ($22.42^{b}MTh^{-1}$). On the other hand, highest dry-mass yield was obtained in Gomostapur ($3.57^{a}MTh^{-1}$), Nachol ($3.55^{ab}MTh^{-1}$) and Chapai Nawabganj sadar ($3.25^{b}MTh^{-1}$). And, highest CP yield was obtained in Gomostapur ($0.307^{a}MTh^{-1}$) and Nachol ($0.306^{a}MTh^{-1}$), followed by Chapai Nawabganj sadar ($0.281^{b}MTh^{-1}$). Highest LSR was obtained in Gomostapur (1.13^{a}), followed by Nachol and Chapai Nawabganj sadar (both 0.93^{b}). Results as obtained from chemical analysis, it was revealed that DM contents in different cultivars varied significantly within Barind locations. Highest DM was obtained in Gomostapur (15.15^{a}%) and Chapai Nawabganj Sadar (15.08^{a}%) followed by Nachol (11.91^{b}%). On the other hand, CP contents did not vary within Barind locations. Table 3 depicts the comparative performances of four cultivars between Barind (Chapai Nawabganj) and Peri-Barind (Rajshahi) areas. Data from first six harvests of four cultivars in both regions was analyzed and results expose that region has highly significant source of variation for all parameters estimated, except that of CP yields. Although, fresh biomass yield in Barind region was higher than Peri-Barind region, but due to higher DM composition, total dry biomass yield was found higher in Peri-Barind region. Better LSR was obtained in Peri-Barind and CP% in Barind. Except CP yield and LSR, other performance criteria were more or less same in four cultivars. However, best CP yield and LSR were obtained in Napier hybrid (BN-3). Region and cultivar interacted significantly for CP yield and LSR.

Table 3. Comparative performance of Napier cultivars between Barind and Peri-Barind regions

Factor	BMY ($MTha^{-1}$/cut)	DMY ($MTha^{-1}$/cut)	CPY ($MTha^{-1}$/cut)	LSR	DM (%)	CP (%)
Region (p-value)	0.009**	0.000***	0.200^{NS}	0.000***	0.000***	0.006**
Barind	22.76^{a}	3.28^{b}	0.288	0.91	14.95	10.02
Peri-Barind	20.09^{b}	3.91^{a}	0.304	1.09	19.75	08.56
Cultivar (p-value)	0.089^{NS}	0.060^{NS}	0.000***	0.006**	0.281^{NS}	0.552^{NS}
Bajra	21.27	3.30	0.284^{bc}	0.85^{b}	16.91	9.81
Arusha	23.40	3.46	0.295^{ab}	1.05^{a}	16.27	10.17
Hybrid	23.17	3.59	0.328^{a}	1.00^{a}	17.44	9.47
MerkEron	21.42	3.20	0.255^{c}	0.98^{ab}	16.16	9.26
Overall mean	22.32	3.40	0.290	0.97	16.71	9.70
SEM	0.385	0.055	0.005	0.023	0.316	0.230
Region×Cultivar	0.265^{NS}	0.269^{NS}	0.035*	0.000***	0.828^{NS}	-

Means with uncommon superscript within the same column differ significantly (p<0.05); *-p<0.05; **-p<0.01; ***-p<0.001; NS- p>0.05.

In the summing up, all cultivars are well adapted in drought prone Barind areas of Bangladesh. Considering the overall performance, Napier hybrid performed better compare to others. Besides, production performance in Peri-Barind is comparatively better than more drought prone Barind areas.

Use of water hyacinth and press mud as co-substrate with cow dung and layer droppings for improving biogas production

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Executive summary

Water hyacinth (WH) and press mud (PM; sugar mill by-product) were studied as co-substrate with cow dung (CD) and layer droppings (LD) for increasing biogas production, methane concentration in biogas and fertilizer characteristics of slurry. For this purpose, four different experiments were conducted separately. The WH was mixed either with CD (Exp. 1) or LD (Exp. 2) in four different ratios of 0:100(T1), 15:85(T2), 30:70(T3) and 45:55(T4) on total solid (TS) basis and incubated in triplicates in 3.5 litter laboratory simulated biogas digester. Similarly, in next two experiments, PM was mixed either with CD (Exp. 3) or LD (Exp. 4) following same ratios and procedure as previous experiments. The digesters were then sealed to provide anaerobic condition and kept in mesophilic temperature (35^0C) at about 38 days and 62 days of retention time (RT) for LD mixed with PM & WH and CD mixed with PM & WH, respectively. Gas production was measured several times in a day by a syringe connected with digester and pressure was released periodically. Gas sample was analyzed weekly with the help of sensor based digital biogas analyzer (Biogas5000, Geotech, UK). The incubation was stopped when gas production was in declining trend. At opening of digester, pH of bio-slurry was recorded and samples were collected for microbial enumeration (*E. coli* and *Salmonella*) and mineral analysis. Gas composition data were analyzed using repeated measures in General Linear Model (GLM), while all other data were subjected to analyzed for Analysis of Variance (ANOVA) in complete randomized design (CRD) in SPSS 20.

Table 1. Effect of mixing water hyacinth (WH) in different ratios with cow dung (CD) on biogas production, composition and fertilizer characteristics of bio-slurry

Variables studied	Treatment*				SEM	P-value
	Control, T1 (0:100)	T2 (15:85)	T3 (30:70)	T4 (45:55)		
Biogas production and composition						
Total gas, L	8.96^{c}	16.15^{b}	21.37^{a}	7.94^{c}	0.514	<0.01
Daily gas, ml/day	144.52^{c}	260.46^{b}	344.6^{a}	128.06^{c}	8.276	<0.01
CH_4, %	29.39^{b}	37.06^{a}	37.29^{a}	31.18^{b}	0.793	<0.01
CO_2, %	22.91^{b}	25.09^{a}	25.04^{a}	25.52^{a}	0.578	<0.05
NH_3, ppm	26.55^{c}	42.00^{b}	49.45	57.93^{a}	3.565	<0.01
H_2S, ppm	247.67^{b}	359.70^{a}	330.33	379.63^{a}	17.625	<0.01
Bio-slurry characteristics						
Slurry pH	7.09a	6.97^{b}	7.00^{ab}	6.99^{ab}	0.021	0.023
N, %	1.48	1.47	1.52	1.81	0.060	0.124
P, %	0.92	0.97	0.98	1.08	0.031	0.351
K, %	0.72^{c}	1.98^{bc}	3.17^{ab}	4.43^{a}	0.438	<0.01

*Ratios indicated WH: CD in mixed substrate; [a,b,c]Means having similar superscripts in the same row have significant difference

Important results of experiment 1 and 2 are presented in Table 1 and 2, respectively. In experiment 1 (Table 1), biogas production along with CH_4 concentration observed higher ($P<0.01$) in both T3 (WH: CD=30:70) and T2 (WH: CD=15:85) compared to T1 (WH: CD=0:100) and T4 (WD: CD=45:55). Potassium (K), magnesium (Mg) and Calcium (Ca) contents in bio-slurry were increased linearly ($P<0.01$) with the increasing level of WH in the digester. In experiment 2 (Table 2), gas production along with CH_4 concentration was found higher ($P<0.01$) in T3 (WH: LD=30:70) and T4 (WH: LD=45:55) compared to others. No effects ($P>0.05$) on mineral composition of slurry were observed

by mixing WH with LD. In contrast to first two experiments, addition of PM to both CD and LD (Exp.3 and 4) failed to improve biogas production and composition, rather deteriorated. In both experiment 3 and 4, T1 (control; 100% CD/LD) produced higher gas compared to all other treatments. Though the fresh CD contained *E. coli*, and fresh LD contained both *E. coli* and *Salmonella* but none of the slurries contained any of these public health concerned microorganism.

Table 2. Effect of mixing water hyacinth (WH) in different rations with layer droppings (LD) on biogas production, composition and fertilizer characteristics bio-slurry

Variables studied	Treatment*				SEM	P-value
	Control, T1 (0:100)	T2 (15:85)	T3 (30:70)	T4 (45:55)		
Biogas production and composition						
Total gas, L	4.56^{b}	10.12^{b}	18.28^{a}	13.59^{ab}	1.760	<0.01
Daily gas, ml/day	139.9^{b}	187.33^{b}	338.55^{a}	251.65^{ab}	32.58	<0.01
CH_4, %	9.76^{c}	20.64^{b}	40.28^{a}	40.49^{a}	7.794	<0.01
CO_2, %	48.03^{a}	44.25^{a}	34.16^{b}	34.85^{b}	6.619	<0.01
NH_3, ppm	631.88^{ab}	787.33^{a}	450.55^{b}	403.33^{b}	233.04	<0.01
H_2S, ppm	107.85^{b}	142.07^{b}	252.45^{a}	184.65^{ab}	24.415	
Bio-slurry characteristics						
Slurry pH	6.6^{b}	6.8^{b}	7.4^{a}	7.3^{a}	0.109	
N, %	1.53	.61	1.61	1.44	0.164	0.082
P, %	3.53	3.44	3.24	3.08	0.101	0.465
K, %	3.66	4.22	4.43	4.67	0.172	0.192

*Ratios indicated WH: LD in mixed substrate; ^{a,b,c}Means having similar superscripts in the same row have significant difference

From the results, it can be concluded that, water hyacinth can be added with cow dung at 15 to 30%, while with layer droppings at 30 to 45% for increasing biogas production and its methane concentration. On the other hand, press mud found not suitable for using as co-substrate both with cow dung and layer droppings.

Study of value added livestock manure based product production

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Executive summary

Bio-slurry, the an-aerobically digested by-product come from biogas digester after producing biogas. It carries higher fertilizer value which can recuperate the lost organic components and productive capacity of soil. Recently bio-slurry water is globally used as organic pesticide to some extent but no specific evidence of it's role on controlling pests yet not investigated. In past coupler years, cost-effective bio-slurry based organic fertilizer production technique with maximum nutrient was developed and it's efficacy on rice production was studied. Organic fertilization plays an indicatory role in horticultural cultivation. Recently fodder cultivation is also getting more attention by farmers than before. So, the present study was designed in Randomized Complete Block Design (RCBD)with three replications to know the impact of BLRI developed bio-slurry based organic fertilizer on horticulture crop and fodder production. Total six nutrient management packages viz. 100% inorganic fertilizer (IF,T_1), 75:25 (IF:OF, T_2), 50:50 (IF:OF, T_3), 25:75 (IF:OF, T_4), 100% organic fertilizer (OF, T_5) and native fertility of soil (Control,T_6) were cumulatively form each block and tested on spinach, tomato, carrot and maize. Experiment was conducted at BLRI and horticulture field of Bangladesh Agricultural University (BAU). Land was well prepared by local tillage, removing weeds and stubbles and finally dividing into 64 plots. Each plot was 16m^2 (4m×4m) in size. Fertilizer dose was calculated analyzing the N, P, K content of both soil and developed organic fertilizer and following the treatment it was applied during the final land preparation. So many organic fertilizers are available in market now which are extensively used by farmers without knowing its' veritable feature of quality. Representative amount of market available organic fertilizers were collected and analyzed at animal nutrition laboratory of BLRI, Soil science laboratory of BAU and soil science laboratory of BRRI under this study to compare the quality between market available organic fertilizer and developed bio-slurry based fertilizer. To harness the pesticidal potentiality of bio-slurry a pot experiment was carried out on Indian spinach leaf infection with four treatments viz. T_1 control (without any pesticide), T_2 bio-slurry, T_3 Commercial pesticide and T_4 Bio-slurry with neem leaves with three replications of each.After collecting all the data they were inserted in Microsoft Excel spreadsheet and analyzed by excel and analysis of variance (General Linear Model procedure) and Tukey's pair wise comparison test ($p < 0.05$) usingMinitab Version 16 (Minitab Inc., State College, PA, USA) as per requirement.

Table 1. Yield characteristics of crops and fodder under organic and inorganic fertilization

Crops	Final yield (ton/ha) (Mean±SE)					
	T_1	T_2	T_3	T_4	T_5	T_6
BLRI						
Spinach	6.94±0.53^{c}	8.50±0.24^{bc}	9.14±0.39^{ab}	10.65±0.15^{a}	6.96±0.68^{c}	4.35±0.16^{d}
Tomato	10.46±0.64^{b}	11.03±1.03^{b}	12.85±1.30^{ab}	16.41±1.06 ^{a}	10.14±0.90 ^{b}	3.79±0.26^{c}
Carrot	16.75±0.34^{a}	16.75±0.60^{a}	17.00±0.34^{a}	18.10±0.26^{a}	13.17±0.50^{b}	7.19±0.10^{c}
Maize	35.37±2.65^{bc}	40.13±6.41^{ab}	45.90±3.52^{a}	51.60±3.22 ^{a}	27.33±1.67^{bc}	22.00±1.15^{c}
BAU						
Spinach	5.87±0.11^{bc}	7.85±0.13^{b}	8.54±0.19^{a}	9.79±0.31^{a}	4.79±0.10 ^{bc}	2.66±0.16^{d}
Tomato	13.28±3.58^{ab}	14.25±4.09 ^{ab}	15.68±6.37^{ab}	18.32±2.95^{a}	10.70±0.43^{ab}	5.36±0.97^{b}
Carrot	13.67±0.48^{a}	14.19±7.05^{a}	15.19±7.05^{a}	16.88±2.84^{a}	9.56±0.15^{b}	5.45±0.15^{c}
Maize	32.33±2.00^{b}	35.52±3.44^{ab}	39.69±2.12^{a}	45.60±3.00 ^{a}	22.00±1.00^{c}	19.20±1.17^{c}

Table 1 represents the final yield characteristics of different crops and fodder studied under this research. Data reveals that maximum yield of spinach (10.65±0.15, 9.79±0.31 t/ha), tomato (10.14±0.90, 18.32±2.95 t/ha), carrot (18.10±0.26, 16.88±2.84t/ha) and maize (51.60±3.22, 45.60±3.00 t/ha) was obtained from the integration of 75% organic fertilizer with 25% inorganic fertilizer (T_4) in both BLRI and BAU field. Yield of T_4wassignificantly higher than other nutrient packages used in this study. No significant difference was observed in yield amount of 100% inorganic fertilizer (T_1) and 100% organic fertilizer (T_5) application. Yield trend of T_2 and T_3 was

almost similar and no significant difference was observed there.N,P and K is considered as major plant nutrient and the maximum uptaken amount of N, P, K was also found in T_4 treatment irrespective of crops (Table 2). Not only N, P, K but other macro and micro minerals were also analyzed and found in impressive amount in T_4 treatment and no heavy metals were found there (data not shown)..The comparative nutritional value of bio-slurry based organic fertilizer and market available organic fertilizer is presented in figure 1.

Table 2. Nutritive values of yielded crop under organic and inorganic fertilization

Crops	Spinach			Tomato			carrot			Maize		
	Nutrients (%, Mean±SE)											
Treatments	N	P	K	N	P	K	N	P	K	N	P	K
T_1	2.6±0.03	0.3±0.01	0.7±0.11	2.2±0.07	0.2±0.05	0.3±0.02	2.1±0.04	0.5±0.02	0.4±0.03	2.2±0.08	0.2±0.02	0.3±0
T_2	2.6±0.0	0.3±0.09	0.8±0.10	2.5±0.07	0.3±0.03	0.4±0.03	2.1±0.03	0.4±0.01	0.4±0.04	2.3±0.04	0.2±0.03	0.4±0.03
T_3	3.1±0.0	0.3±0.11	0.8±0.08	2.7±0.09	0.3±0.03	0.5±0.02	2.1±0.12	0.4±0.02	0.5±0.02	2.3±0.04	0.3±0.02	0.4±0.01
T_4	3.6±0.0	0.4±0.02	0.9±0.04	2.9±0.02	0.4±0.04	0.7±0.02	2.3±0.20	0.5±0.04	0.6±0.02	2.5±0.02	0.1±0.01	0.5±0.03
T_5	2.3±0.0	0.3±0.07	0.6±0.06	2.3±0.04	0.3±0.03	0.4±0.01	2.0±0.03	0.5±0.01	0.4±0.03	2.1±0.03	0.2±0.01	0.4±0.02
T_6	2.2±0.0	0.2±0.05	0.6±0.01	2.1±0.03	0.2±0.04	0.3±0.01	1.9±0.02	0.4±0.01	0.4±0.01	1.9±0.02	0.2±0.01	0.3±0.02

Data shows that the extent of macro nutrients (N,P,K and S) of bio-slurry based organic fertilizer was comparatively higher than organic fertilizers available at market, but the % share of micro nutrients (Zn Na, Mn, Fe, Cu, Mg and Ca) of bio-slurry based organic fertilizer and market available organic fertilizer was almost same. Bio-slurry water has potential pesticide properties and data originated from this study indicates that minimum number of infected plants (2.33 nos),leaves (4.33 nos) and infected leaf spot per pot (15.00 nos) was found when bio-slurry water mixed with neem leaf juice was sprayed as pesticide. Results of same parameters did not vary significantly when bio-slurry water solely sprayed as pesticide and the extent of infected plant, leaves and leaf spot was 2.33, 5.67 and 17.67 respectively. But significantly higher number of infected plants (3.00), leaves (9.67) and infected leaf spot per pot (34.00) was found in commercial pesticide group and it was almost similar to control i.e. no pesticide group. Although it is a preliminary work but a series of studies need to be conducted to find out specific compound and its associating factors playing role on pests control. It can be concluded that bio-slurry based organic fertilizer could be much more competent for horticultural crop and fodder production.

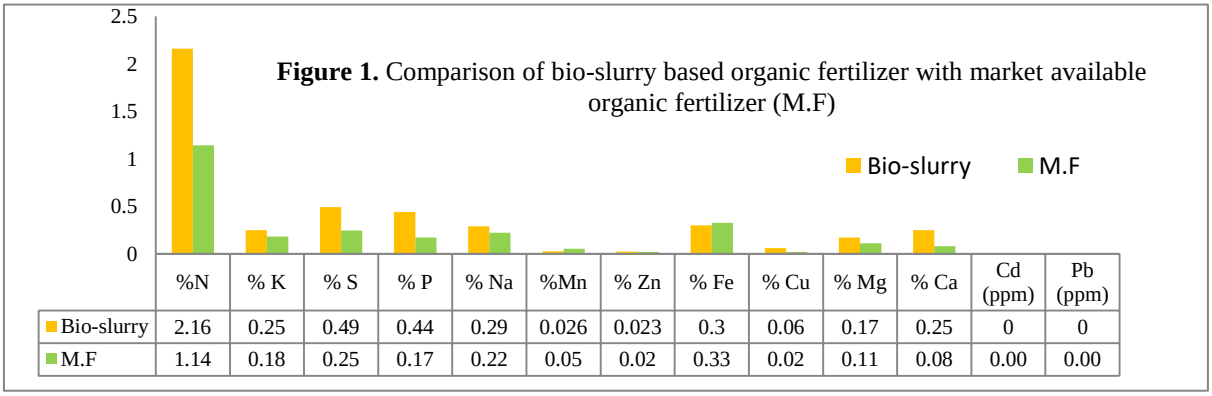

Figure 1. Comparison of bio-slurry based organic fertilizer with market available organic fertilizer (M.F)

	%N	% K	% S	% P	% Na	%Mn	% Zn	% Fe	% Cu	% Mg	% Ca	Cd (ppm)	Pb (ppm)
Bio-slurry	2.16	0.25	0.49	0.44	0.29	0.026	0.023	0.3	0.06	0.17	0.25	0	0
M.F	1.14	0.18	0.25	0.17	0.22	0.05	0.02	0.33	0.02	0.11	0.08	0.00	0.00

The integration of 75% organic with 25% inorganic fertilizer could achieve better output in both quality and quantity than traditional inorganic fertilization system for crop production of Bangladesh. At the same time using bio-slurry as organic pesticide will unpack new opportunities to the farmers to harvest maximum economic benefit with qualitative product production which ultimately make the livestock farming system more endurable.

Study on farm nutrient recycling in BLRI foreign sheep farm

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Executive summary

Nutrient recycling involves the movement and exchange of organic and inorganic matter back into the production of matter which assert more concern now at farming system to attain more profit than conventional key performance indicators of it. Feeding management involves the major cost of livestock farming system but almost half of this cost is being wasted through dung and urine due to their non-judicial management. In results, it creates social and public health hazards, tainted climatic condition and huge economic loss of farm and farmers. Recently, improved livestock manure management program is getting popularity to some extent but it is confined only in large ruminants and poultry and the small ruminant farmers are still submerged in darkness. Regarding this fact the present study was undertaken with the objective to develop an easy, profitable, environment friendly small ruminant farm waste management technique to recycle the feed nutrients into agriculture including the quantification of its daily input and outgo. A total of 16 animals of three different introduced sheep breed (Perendale, Dorper and Suffock) were classified into 4 different groups as- adult male, adult female, growing male and growing female. Roughage and concentrate mixture was supplied to the animals of each group on *ad-libitum* basis as regular farm practice. Daily feed intake and dung void of animals in each group was recorded and their nutrient composition was analyzed in animal nutrition laboratory, BLRI and soil science laboratory, BAU and BRRI. To alternate the common practice of dung management and to find out appropriate cost effective processing techniques of waste, the produced dung was goes under aerobic system of processing. In the present study, the processing system of waste involved both normal aerobic composting and vermin-composting. Total 3 pit of 2×2m size was prepared for normal composting purpose and each of three was filled with 150 kg dung. Regular temperature from four corner and center of the pile was recorded upto 42 days and recovery rate of final product was recorded. Vermin compost preparation from sheep feces was carried out with four different treatments with three replication of each at cement made chari of 2×2 ft size. Each chari was filled with 20 kg feces and then earth worm (*Eisenia fetida)* was added at four different levels (250, 350, 500 and 750 nos.). Temperature and humidity of vermin compost unit was recorded upto 35 days. Regular turning at 7 days interval was practiced. After 35 days, recovery rate of final product and cost of per kg compost production of both type was calculated and finally sample of both compost was taken and analyzed for quantifying p^H, nutritional composition and heavy metal content at the same laboratory mentioned earlier. The response testing experiment of both type compost on vegetable and fodder crop is going on . Data were inserted in Microsoft excel spread sheet and analyzed using excel and IBM SPSS 20 statistical packages as per requirement.

Table 1. Input-Output quantification of sheep (fresh basis, kg/day/animal)

Animal category	Intake		Outgo
	Roughage	Concentrate	
Adult male	11.19±2.71	0.21 ±0.0	2.56±0
Adult female	7.04±1.38	0.15 ±0.29	2.10±1.59
Growing male	8.29±1.05	0.2±0.0	1.9±1.48
Growing female	5.16±0.95	0.2±0.0	1.8±1.26

Initial p^H of sheep feces was 8.5 and it was reduced to 7.8 in normal compost and 5.26 to 6 in vermin compost. Maximum p^H (6.00) of vermin compost was found in T_3 (20 kg manure with 500 nos worm) treatment. The input and output quantification table (Table 1) shows that, the daily average roughage

and concentrate intake on fresh basis of adult male and female was 11.19 v_s 7.04 kg and 0.21 v_s 0.15 kg, respectively and their outgo i.e., fresh feces void was 2.56 and 2.1 Kg, respectively.

Table 2. Nutritive value of feed and feces (Fresh basis)

Feed	Macro nutrients (%) (Mean±SD)			Micro nutrients (%) (Mean±SD)		
	N	P	K	S	Zn	Cu
Roughage	2.97±1.91	0.30±.12	0.88±0.067	0.39±0.02	0.01±.01	0.004±0.00
Concentrate	2.28±1.1	0.35±0.21	0.72±0.05	0.31±0.01	0.005±0.001	0.006±.000
Feces						
Adult Male	1.77±0.54	0.22 ±0.27	0.44±0.06	0.27±0.04	0.01±.002	0.001±0.00
Adult Female	1.65±0.05	0.20 ±0.02	0.42±0.01	0.28±0.04	0.01±0.001	0.001±0.00
Growing male	1.94±0.58	0.24±0.067	0.44±0.025	0.25±0.014	0.01±0.000	0.002±000
Growing female	1.60±0.23	0.21 ±0.02	0.47 ±0.03	0.27±0.03	0.01±0.002	0.001±.000

The respective roughage intake of growing male and female was 8.29 kg and 5.16 kg and amount of consumed concentrate mixture was equal (0.2kg/day) and they produced 1.90 and 1.80 kg feces per day. The nutritional value (macro and micro nutrients) of both feed and feces is presented in Table 2. Data shows that more than 50% of received nutrient was being passed through feces and nutrient passing out tendency was comparatively higher in growing animal group. Although the result was found in this experiment but it needs to be further tested through a well-designed feed digestibility trial. No heavy metal entity was found in both feed and feces (data not shown). But the nutritional value of normal and vermin compost (Table-3) is higher than the same value of fresh feces which indicates that fermentation process may have role on enhancing the form and quantity of nutrients. The recorded temperature of aerobic and vermin composting was 65-70ºC and 22-25ºC respectively. In case of vermin compost maximum recovery rate of final product was obtained from T_3 and it was 15.02 kg fertilizer from 20 kg feces and required worm for per kg fertilizer production was 33 nos. Vermin compost was comparatively superior in quality than normal aerobic compost in terms of nutritional value and return rate of final product.

Table 3. Nutritive value of aerobic compost

Feed	Macro nutrients (%) (Mean±SD)			Micro nutrients (%) (Mean±SD)		
	N	P	K	S	Zn	Cu
Normal	2.05±0.07	0.26±0.012	0.16±0.051	0.34± 0.05	0.03±0.000	0.006±0.00
Vermin	2.66±0.04	0.36±0.017	0.24±0.00	0.46 ±0.008	0.01±0.00	0.004±.000

The respective return rate of normal and vermin compost is 55 and 75%. The production cost of per kg normal compost was Tk. 3.50 and vermin compost was Tk. 5.00. In terms money on an average each animal of adult and growing category received nutrients of Tk. 36.80 and Tk. 47.30 per day, respectively and voided nutrients of Tk. 15.00 and 12.64 per day which is become wasted now through the conventional management system. But when it undergoes a simple processing system then it recovered nutrients of Tk. 25.00 in normal compost and Tk. 49.5 in vermin compost which is higher than the wasted amount of money in per animal feces.

In conclusion, it could be said that to develop cost-effective and sustainable approach of small ruminant farming system there is no alternative to recycle the nutrients supplied to the animals and among the recycling systems vermin composting of feces could be a good choice to practice at farm level.

Assessment of methane emission in dairy production systems based on existing feed resources through GLEAM model under different climatic zones of Bangladesh and their mitigation options

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Executive summary

The Global Livestock Environmental Assessment Model (GLEAM) is a modeling framework that simulates the environmental impacts of the livestock sector. Enteric methane (CH_4) has been generated in the gastrointestinal tract of livestock is the single largest source of anthropogenic CH_4 which is responsible for Green House Gas (GHG). GHG resulting global warming is the burning issues that impact on human health, crop and livestock production and environment pollution. In Bangladesh, 82% of CH_4 production comes from rice field and livestock production with 43 % being due to enteric fermentation and manure breakdown from livestock production. Keeping the above factors in view, the present research work was undertaken to (i) assess the enteric methane emissions from dairy cattle through GLEAM model and (ii) demonstrate the mitigation options by adaptation of feeding interventions. For calculating the enteric methane emission from dairy animal through GLEAM model, a semi-structural questionnaire was formulated and a total of fifty (50) farmers were included from five districts namely coastal area (Bhola), saline prone area (Sathkhira), river basin area (Pabna), drought prone area (Chapainobabganj) and poor feed base area (Nilphamari) under this study. In addition, two lactating cows in each farmer were also selected for collecting the necessary information e.g. existing feeding practice, feed resources, feed intake; both roughages and concentrate , water intake, productive and reproductive parameters for seven days in each site considering two seasons dry (November – February) and wet (June- October). Temperature and humidity were recorded in the respected season. The data were analyzed through Completely Randomize Design (CRD) to evaluate the enteric methane emission. The farm practice of roughage feeding and their actual amount were shown in Fig.1. The study revealed that the consumption of rice straw in drought Prone area was the lowest where as the highest amount of rice straw was consumed in poor Feed based area which was 45% or 75% of the total roughage. But, the farmer in drought prone area supplied the highest amount of Napier grass that was 40%. It was double compared to the other climatic zones. Feeds and nutrient intake by dairy cows in different climatic zones of Bangladesh are shown in Table 2. Crude Protein (CP) and Metabolizable Energy (ME) requirements among the different areas did not differ significantly (P>0.05). But the dairy cows reared in river basin area were consumed significant (P=0.04) amount of dry matter (DM)

Fig1: Roughage availability in different climatic zones

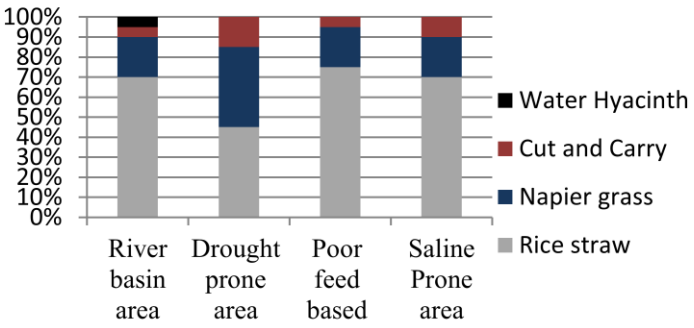

Table 1. Nutrient intake of crossbred dairy cows under different climatic zones

Parameters	Different Climatic Zones				Significance	
	River basin area	Drought prone area	Poor Feed Based area	Saline Prone area	Overall SE	Level
CPR (gm/day)	832.01	733.03	703.81	1025	50.34	P=0.09
MER (MJ/kg)	76.6	69.73	65.63	88.69	3.56	P=0.10
TDMI(kg/day)	16.5^{a}	15.4^{ab}	12.8^{b}	13.1^{b}	0.55	P=0.04
TCPI(g/day)	1751.0	1463.7	1370.9	1388.8	81.7	P=0.33

compared to others two zones. The highest amount of DM intake was shown in river basin area where, dairy cows in poor feed based area consumed the lowest amount of DM (16.5 kg/day *vs* 12.8

Table 02: Production performance and their methane production of crossbred dairy cows

Parameters	Different Climatic Zones				Significance	
	River basin area	Drought prone area	Poor Feed Based area	Saline Prone area	Overall SE	Level
Ave. live weight (kg)	283.8	276.3	248.8	282.3	8.09	P=0.39
AM prods. (kg/day)	9.06^{ab}	7.74^{b}	7.40^{b}	11.8^{a}	0.67	P=0.09
4% FCM yield(kg/day)	8.08	7.41	7.54	10.95	0.64	P=0.16
Fat yield(kg/day)	0.29	0.28	0.30	0.41	0.15	P=0.22
Methane production						
CH_4 prod. (g/day)	565.01^{a}	527.75^{ab}	440.78^{b}	448.54^{b}	18.82	P=0.04
CH_4 prod. (g/kg DMI)	34.21^{b}	34.24^{ab}	34.28^{a}	34.26^{ab}	0.01	P=0.05
g CH_4/kg milk prod.	77.0^{b}	88.0^{ab}	99.0^{a}	91.0^{a}	0.02	P=0.00

kg/day, respectively). There was no significant difference (P>0.05) on total CP intake from roughage and concentrate among different zones. The average live weight (kg), 4% Fat Corrected Milk (FCM) production (kg/day) and fat yield (kg/day) had no significant variation under different climatic zones of Bangladesh. The average daily milk production (11.8 kg/day) of dairy cows under saline prone area was significantly higher (p=0.09) than that of drought prone area and poor feed based area (7.74 kg/day and 7.40 kg/day, respectively) and their differences were significant. But the dairy cows reared under poor feed based area was produced significant (p=0.05) amount of methane from DMI and per kg milk production that was 34.28 g and 99.0 g respectively, compared to river basin area that produced 34.21g and 77.0g respectively, which was significantly different. Figure 2 Shows that, with the increase in milk production, methane production decreased linearly (R^2=1). So, balance feed may be the options in different climatic zones to reduce the enteric methane emission that converted to energy and finally positive impact on livestock production in Bangladesh.

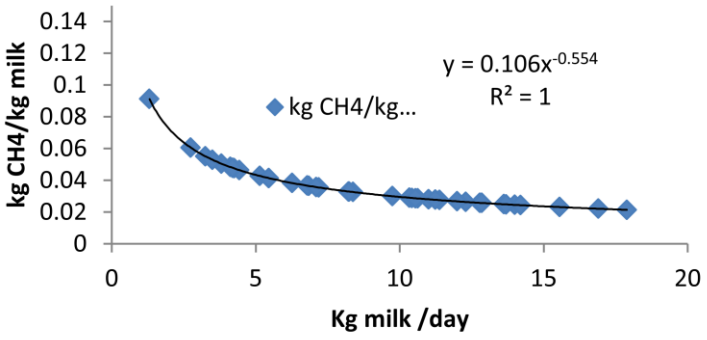

Figure 2: Relation between enteric CH4 production and daily milk yield of cows in

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Session IV

FEEDS, FODDER AND NUTRITION

Study of production and supply chain development of Moringa feed (M_f) in different regions of Bangladesh

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Executive summary

Moringa (*Moringa oleifera),* a plant fodder being researched and found responsive to increasing production and productivity of small (Sultana *et al*. 2012) and large ruminants (Huque *et al* 2016; Foidl *et al*. 1999; Sanchez *et al*., 2006 ;), and also poultry (Sarker *et al.,* 2017) was identified as one of the best options of the growing demand of quality feed in Bangladesh. Keeping the above factors the present research work was undertaken to (i) determine the Moringa feed (M_f) production in on farm condition (ii) determine feeding impacts of Moringa pellet feed on RCC growing bulls and (iii) develop value added Moringa food products.

Table 1. Production performance and quality of Moringa foliage

Parameters	Production Performance		Significance	
	On- Station	On-Farm	t-value	Level
Survival rate (%)	95.5	95.7	-0.10	NS
No of Prunes/plant	3.5	5.07	-4.5	*
DM yield; ton/ha/y	22.7	26.6	-7.7	*
Leaf to stem	0.45	0.45	-0.72	NS
Chemical Composition of tops (g kg^{-1})				
DM	197.0	200.1	-0.17	NS
Ash	50.9	49.1	-4.5	NS
CP	216.8	206.6	1.6	NS
ADF	331.7	315.3	-3.5	*

For determining the Moringa feed production at farmers fields the best agronomical practices in on-station was implemented to the on-farm condition. A uniformly plain land area of 1296.0 m^2 was divided into four replications, each of 18X18 sq m^2 separated by 1.0 meter wide walking alleys. Each plot was planted 1080 sampling at a space of 0.3mx0.3m per sampling. After 125 days of planting, first Moringa harvest was occurred then it was continued after 60 days interval with 40 cm above the ground level and analyzed the data in a t- test to determine the production response of on station and on-farm condition. The production performance and their chemical composition of Moringa fodder at on-station and on-farm condition is shown in Table 1. The average no. of prunes of Moringa at on-farm condition was significantly ($p<0.05$) higher (3.5 vs 5.07) than that of on-station. It becomes bushier than on-station. The survivability was not significantly ($P> 0.05$) affect by two climatic zones and it varied from 95.5 to 95.7 percent. The annual dry matter (DM) yield of tops at on-farm condition was the highest (26.6 ton/ha) compared to on-station (22.7 ton DM/ha/year) and their differences were significant ($p< 0.05$). The leaf to stem ratio was similar and their difference was not significant. The DM, ash and CP content of tops of Moringa foliage did not differ significantly between the treatments. But the ADF content of Moringa tops was significantly ($p<0.05$) higher in on-station condition followed by on-farm. For determining the Moringa pellet feeding impact on meat production, twenty RCC growing bulls aged 18-24 months with average live weight (186.05±0.02) were selected and divided into four dietary groups having five animals in each group. During 125 days feeding period including 10 days for adjustment and 7 days for digestibility trial; all experimental bulls were fed a control diet consisting of 60:40 ration (DM basis) of maize silage and a concentrate mixture (Table 2) of wheat bran-45%, Khesari bran-20%, crushed wheat-25%, soybean meal-12%, DCP-1% , mineral mixture-1% and salt-1%. The concentrate of the control diet was replaced by Moringa pellet feed (60:40) in diet T_1; Moringa mash feed (60:40) in diet T_2 and control

Table 2. Chemical composition of different feeds

Experimental diet	%, Chemical composition (DM basis)			
	DM	CP	ADF	NDF
Maize Silage	19.38	7.93	50.97	62.57
Con. mixture	89.91	17.08	35.36	51.04
Moringa feed	89.01	16.75	32.89	40.73

diet with additives (Catafox) in diet T_3. All the four concentrate diets were iso-nitrogenous. Feeding response of different diets on different parameters was analyzed in an ANOVA of a Completely Randomized Design (CRD).

Table 3. Effect of supplementation of Moringa pellet feed on nutrient intake of RCC growing bulls

Parameters	Experimental rations				Significance	
	T_0	T_1	T_2	T_3	Overall SE	*P*- value
TDMI(kg/day)	4.11±0.2	4.0±0.21	3.76[a]±0.2	3.92±0.15	0.09	0.65
TMEI(MJ/day)	41.2±1.9	40.2±2.1	37.7±2.3	40.4±1.6	0.97	0.62
TCPI(g/day)	503.8±28.1	455.0[b]±26.5	427.5±25.2	503.6±23.5	14.09	0.13

Here, T_0= Control (only concentrate); T_1= Moringa pellet feed; T_2= only Moringa Mash Feed and T_3= Control with additives, Figures with different superscript in the same row differ Non significant

The replacement of concentrate mixture by Moringa pellet feed had no effect on daily DM, CP or ME intake (Table 3). But the average daily live weight gain of RCC bulls was increased significantly (p=0.01) when Moringa pellet was added to the control diet and it also decreased the FCR from 5.3 in control diet to 4.8 in the Moringa pellet feed diet in T_1 without showing any significant changes. Fig1 shows that feeding of Moringa pellet feed decreased the cost of production from Tk.111 to Tk. 75 with controls with additive group and also shown the lowest FCR that was 4.8. BLRI made some Moringa food products like Moringa tea and Moringa capsule with Moringa Private Ltd as a nutritional supplementation for human health. The result so far generated that Moringa is cultivated as a commercial fodder crop at farmer level and the feed produced from it was increased daily live weight gain of growing bulls and reduction in cost of production. However, the effect of Moringa feed on keeping quality and meat quality needs to be determined through further research. The seasonal impacts on Moringa production on station and on farm needs to be determined through continuation of its cultivation in subsequent years.

Table 4. Feeding effect on growth performance of RCC growing bulls

Parameters	Experimental rations				Significance	
	T_0	T_1	T_2	T_3	Overall SE	Level
Initial Live weight (kg)	186.4	186.6	184.6	186.6	7.29	P=1.0
Final Live weight (kg)	236.5	238.7	223.1	233.7	7.63	P=0.90
ADG (gm/day)	807.1[a]	839.4[a]	620.0[b]	759.8[a]	4.42	P=0.01
FCR	5.3	4.8	6.1	5.2	0.22	P=0.23

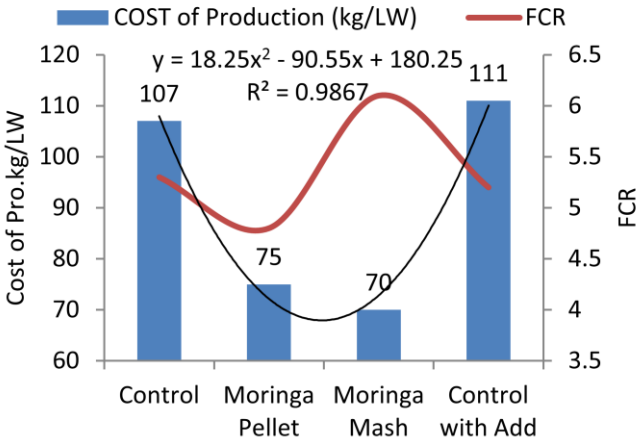

Figure 1. Moringa Pellet effect on FCR and cost of production per kg live weight

Feeding oil *versus* calcium salt of n-3 and n-6 fatty acid on feed intake, digestibility, enteric methane emission and blood metabolic profile in cattle

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Executive summery

The recent trends of feeding n-6 and n-3 fatty acids (FAs) sources are due to their enormous health benefits for human through animal product. Feeding rumen protected fat by producing calcium salt (Ca-salt) of FAs, can effectively overcome the biodegradation loses though increase the calcium supply in the diet. The objectives of this study were to know effects of dietary oils and Ca-salt sources of n-3 and n-6 FA on feed intake, digestibility, blood metabolic profile, rumen fermentation, enteric methane emission and fatty acid profile in bull. For this purpose, sunflower oil (SFO) and linseed oil (LSO) was collected as the source of n-6 and n-3FA, respectively. These oils were used to prepare Ca-salt on n-3 and n-6 FA, respectively in the laboratory. Four rumen cannulated bulls were used in 4 x 4 Latin square design (LSD) for this purpose. Animals were housed individually in digestion crates and supplied with Napier silage and concentrate mixture. Four dietary treatments were SFO (oil source of n-6 FA), LSO (oil source of n-3 FA), Ca-salt of SFO (Ca-SFO, protected source of n-6 FA) and Ca-salt of LSO (Ca-LSO, protected source of n-3 FA). Oils or salts were mixed with the concentrate part (Broken wheat, 37%; Khesari bran, 25%; Wheat bran, 20%; till oil cake, 12%; DCP, 2.50% and salt, 0.50%) of the ration at 3% of fresh weight. The formulated four diets contained 64.23% n-6 FA, 47.66% n-3FA, 60.16% n-6FA and 37.98% n-3FA according to the treatment SFO, LSO, Ca-SFO and Ca-LSO. In 4 x 4 LSD, diets were rotated among the animals in four different periods, consisting of 15 days for each period. The first 10 days of each period was for adaptation with the diets and the last 5 days was for sample collection. Feed refusal (orts) of every day was weighted and intake was calculated by subtracting refusal from the supplied amount. Representative samples of silage, feed and feces were collected, composited and subjected to chemical analysis separately. Rumen fluid and blood samples were collected at 3 hours after morning feeding on the 4^{th} and 5^{th} day of collection period from each treatment animal, respectively. The pH of rumen fluid was measured and blood was centrifuged to obtain plasma immediately after collection. Variation of data were subjected to analyzed for Analysis of Variance (ANOVA) in 2x2 factorial design using repeated measures in General Linear Model (GLM) in SPSS 20, where, Factor 1 was FA (n-6 *vs* n-3) and factor 2 was sources of FA (oil *vs* Ca-salt).

It was observed that intake and digestibility of DM, OM, CP, EE, ADF and NDF were significantly ($p<0.05$) reduced by feeding Ca-salt compared to oil sources of n-6 and n-3 FA (Table 1). Table 1 also showed that there were a significant interaction effect in CP ($P<0.01$) and NDF ($P<0.05$) intake as well as NDF ($P<0.05$) digestibility. The CP and NDF intake was found reduced in Ca-salt of n-6 and n-3FA than oil diet as well as n-3 FA than n-6FA irrespective of sources, while NDF digestibility was increased only in Ca-salt of n-3 FA. The EE intake and DM, OM and EE digestibility were significantly ($P<0.01$) increased in n-3 FA compared to n-6 FA diet irrespective of sources. The dietary effect of oil and Ca-salt of n-6 and n-3FA sources on plasma metabolic profiles are described in Table 2. The plasma glucose, urea nitrogen (BUN), cortisol and IgF-1 were neither affected ($P>0.05$) by FA (n-6 or n-3), nor by FA sources (oil or Ca-salt).However, total cholesterol, LDL and IgG were reduced ($P<0.01$) by both the Ca-Salt of n-6 and n-3 FA. On contrary, HDL and insulin content was increased ($P<0.01$) by the Ca-salts irrespective of n-6 or n-3 FA. The HDL and triglyceride concentration was found higher ($P<0.05$) in n-3 FA irrespective of sources, while LDL was reduced ($P<0.01$) by the same. However, there was no FA x Source interactions for any of these parameters studied. The dietary effect of oil and Ca-salt of n-6 and n-3FA sources on ruminal pH concentrations and methane production (%) at different feeding hours are also described (Table not shown). Ruminal pH content at 0, 3 and 6 hours of feeding were neither significantly altered by n-6 and n-3 FA, nor by FA sources but in all treatment cases reduced with the increment of feeding hours.

Table 1. The dietary effect of oil and Ca-salt of n-6 and n-3FA sources nutrient intake and digestibility

Parameters studied	Treatments				SEM	*P*-value		
	n-6		n-3					
	Oil	Salt	Oil	Salt		FA	Source	FA x Source
Nutrient Intake, Kg/d								
DMI	6.35	6.13	6.52	6.16	0.119	0.416	P<0.05	0.553
OM	5.71	5.50	5.95	5.40	0.121	0.573	P<0.01	0.184
CP	0.54	0.51	0.57	0.47	0.008	0.446	P<0.01	P<0.01
EE	0.21	0.19	0.25	0.21	0.005	P<0.01	P<0.01	0.096
ADF	2.50	2.47	2.68	2.46	0.044	0.070	P<0.05	0.057
NDF	4.72	4.71	5.01	4.46	0.098	0.841	P<0.05	P<0.05
Digestibility (%)								
DM	56.09	55.10	63.33	56.25	1.535	P<0.05	P<0.05	0.071
OM	60.13	60.09	65.98	61.35	1.116	P<0.01	P<0.05	0.062
CP	62.84	59.83	63.47	56.51	1.131	0.257	P<0.01	0.106
EE	46.02	42.89	56.70	49.42	1.662	P<0.01	P<0.01	0.235
ADF	37.98	34.21	40.56	34.47	1.181	0.251	P<0.01	0.345
NDF	54.99	54.72	59.39	60.35	1.260	0.568	P<0.01	P<0.05

In all feeding hours (at 0, 2 and 4 hours after feeding) methane production (%) were significantly (P<0.05) reduced by oils sources compared to Ca-salt of n-6 and n-3 FA, while except 2 hours after feeding (reduced, P= 0.194) methane production were significantly (P<0.01) reduced with n-3 FA compared to n-6 FA diet irrespective of sources. However, there was no FA x Source interactions for methane production at any feeding hours studied.

Table 2. The dietary effect of oil and Ca-salt of n-6 and n-3FA sources on plasma metabolic profiles

Parameters studied	Treatments				SEM	*P*-value		
	n-6		n-3					
	Oil	Salt	Oil	Salt		FA	Source	FAxSource
Glucose(m mol/L)	3.90	3.80	3.60	3.58	0.157	0.121	0.698	0.816
Urea nitrogen, mg/dl	25.38	29.03	26.63	28.50	1.317	0.788	0.058	0.513
Cholesterol, mg/dl	126.95	122.67	124.89	121.04	0.938	0.072	P<0.01	0.822
HDL, mg/dl	69.06	70.36	73.57	78.40	1.007	P<0.01	P<0.01	0.105
LDL, mg/dl	55.03	51.51	48.71	42.29	1.276	P<0.01	P<0.01	0.279
Triglyceride, mg/dl	9.54	9.49	10.05	10.76	0.299	P<0.05	0.284	0.227
Cortisol, µg/dl	1.08	1.08	1.05	1.09	0.095	0.938	0.816	0.857
IgG, ng/dl	13.93	11.54	14.92	10.95	0.367	0.600	P<0.01	0.053
IgF-1, g/L	1.03	1.15	1.01	1.08	1.276	0.739	0.479	0.856
Insulin, µIU/ml	1.43	2.64	1.58	2.49	0.938	0.072	P<0.01	0.822

Results suggested that Ca-salt of n-6 and n-3 FA was reduced DM intake and nutrient digestibility, while reduced total cholesterol and LDL, but increased HDL concentration in plasma of cattle. Results also suggested, oils compared to salt of n-3 and n-6 FA reduced more methane gas production, while n-3 FA source reduced more compared to n-6FA. More research in future is needed to derive a precise conclusion.

Development of probiotic feed supplement for calves and their evaluation

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Executive summary

The objectives of this research were to develop probiotic feed supplement for calves preferably of *Lactobacillus acidophilus* (LAB), *Bacillus subtilis* (BS) and *Sacharomyces cerevisae* (SC); their evaluation in terms of chemical, microbial and shelf-life characteristics and finally testing the best selected feed on fecal microbial load, growth performance and blood metabolites of milk-fed calves. Commercial sources were used to isolate target microbes using selective agar media and five feeds were developed based on wheat bran (WB), rice polish (RP), lentil powder (LP), WB fortified with LP at 4:1 ratio (WB+LP) and RP fortified with LP at 4:1 ratio. Each base substrate was mixed with a solution containing water, molasses and mixed bacterial culture followed by incubation at 37°C for 3 days. After 3 days, feeds were found dried and clumpy in physical form and microbial count was very low, but high in pH. Therefore, a second formulation was made by changing composition of 'molasses-bacteria solution' and incubation time was increased to 6 days. Feed based on sole LP was removed as color and odor of this feed was unpleasant. After 6 days of incubation, feeds were found in very good physical condition. The pH was down from 6.0 in fresh feed to 4.3 in probiotic feed on an average, and remained constant throughout the period of shelf-life study (status of pH, NH_3-N, microbial count, DM & CP) for 35 days. The concentrations of LAB, BS and SC were very high and sufficient to work as probiotic feed and remained constant as like pH remained. The dry matter (DM), crude protein (CP) and NH_3-N concentrations were good enough to keep probiotic feed quality in good. After evaluation it was found that these four feeds were all potential to be used as probiotic feed, however, sole RP and WB based feeds were found better than others. Then these two feeds were further subjected to a different approach of shelf-life study for the determination of probable expire date after manufacturing.

The WB based probiotic feed was selected for evaluation on growth performance, blood metabolites and calf health. Twelve 2 weeks old RCC calves were selected and distributed equally in two groups maintaining gender (3 ♂ + 3 ♀) and live weight (20.68 vs 21.20 kg) balance between the groups. Calves were reared in individual pan and provided with *ad libitum* suckling, calf starter according to manufacturer's (ACI-Godrez) recommendation and *ad libitum* green grass (German grass). Mineral block was provided for licking and fresh clean drinking water was supplied for all the time. The probiotic fed group was supplied with developed probiotic feed, while the control/placebo group was supplied with same feed substrate without probiotic microbes. The trial was continued for 90 days and data were collected on growth performance, blood metabolic profile, immune status, fecal microbial load, morbidity etc.

It was observed that milk intake, dry matter intake (DMI), daily gain and feed conversion ratio (FCR) were not differ ($P>0.05$) between the control and probiotic fed group (Data are not shown). Physical properties of feces, comprising color, odor and consistency, it was found that claves under probiotic fed group voided feces of better physical properties compared to the control (Data are not shown). On an average, 13% cases of yellowish/yellow/yellow-green feces with bad odor in control compared to 6.6% in probiotic group were observed. Similarly, consistency score of 2.12 *vs* 2.04 (higher number indicate more loose motion) was observed in the control *vs* probiotic group, respectively, while the cases of diarrhea were observed 14 vs 7.0**,** respectively. The *E. coli* count (log_{10} CFU/g) in feces at onset of trial (Day 1) was found 7.87 *vs* 8.16 in the control *vs* probiotic group, respectively that was not differ significantly ($P>0.05$). However, from the Day-15 onward, up-to the end of the experiment, weekly *E. coli* count (log_{10} CFU/g) in feces was found significantly (($P<0.01$) lower in probiotic group compared to the control. Again, *Salmonella* was not detected in any of the groups usually at weekly fecal count, but found 3 cases of *Salmonella* in concentration of more than 6.0 log_{10} CFU/g of feces during 3 cases of diarrhea. At the end (90 d) of the trial, LAB, BS and SC counts in feces of probiotic

group were observed 9.11, 4.11 and 3.63 $\log_{10}$ CFU/g, respectively, while in the control only LAB was found at a concentration of 6.96 $\log_{10}$ CFU/g, which was significantly (P<0.01) lower than that in probiotic. Table 2 showed the results of blood metabolic profile as affected by probiotic feed. The IgG (ng/ml) concentration was found significantly higher (P<0.05) in probiotic group than in the control, and the total cholesterol level was tended to be high in the same (P=0.071). All other metabolites were not differed significantly (P>0.05) between treatments.

Table 1. Effect of feeding probiotic feed supplement on fecal microbial load.

	Control	Probiotic	SEM	Sig.
Eschericia coli				
0 d	7.87	8.16	0.259	0.315
15 d	8.22	8.24	0.159	0.874
30 d	8.34	7.44	0.086	<0.001
45 d	8.45	7.36	0.052	<0.001
60 d	8.33	7.46	0.066	<0.001
75 d	8.27	6.71	0.306	0.004
90 d	7.28	6.14	0.128	<0.001
Salmonella spp	nd	nd	-	-
Lactobacillus acidophilus (90 d)	6.96	9.11	0.428	0.004
Bacillus subtilis (90 d)	nd	4.11	-	-
Sacharomyces cerevisae (90 d)	nd	3.63	-	-

Table 2. Effect of feeding probiotic feed supplement on blood metabolic profile of milk-fed calves

	Control	Probiotic	SEM	Sig.
Blood glucose (mmol/l)	3.7	3.9	0.118	0.152
BUN (mg/dl)	31.78	31.68	1.566	0.952
Total Cholesterol (mg/dl)	157.2	171.52	23.857	0.575
HDL (mg/dl)	25.8	37.55	5.136	0.071
LDL (mg/dl)	76.45	82.26	7.562	0.477
Triglyceride (mg/dl)	8.02	10.82	3.733	0.489
Cortisol (µg/dl)	0.52	0.66	0.147	0.401
IgG (ng/ml)	8.38	12.62	1.353	0.026
IgF-1 (g/l)	0.62	0.76	0.419	0.738
Insulin (mIU/ml)	0.76	0.52	0.212	0.319

BUN, Blood urea nitrogen; HDL, High density lipoprotein; LDL, Low density lipoprotein; IgG, Immunoglobulin G; IgF-1, Insulin-like growth factor-1/Somatotropin-c

It is concluded that, four probiotic feed supplements were formulated potentially to be used for calves, among which rice polish and wheat bran based feeds were found better considering their quality and shelf-life. Wheat bran based probiotic feed upon feeding to milk-fed calves from 15 to 105 days of age resulted improved fecal characteristics, lesser *E. coli* and *Salmonella* load, but higher probiotic microbes shedding in feces, lowered diarrheal incidence and improved immunoglobulin status in calves.

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Buffalo fattening in the Southern Delta of Bangladesh

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Executive summary

Buffalo, a unique livestock, nowadays draws a rapt attention for boosting strategic meat or buffen production of Bangladesh when the country forwards to be a middle-income country in 2021 with 160 million of dense population and a great concern of ensuring their food security. The largest deltaic floodplain of the world, Bangladesh has a fabulous opportunity to boosting the meat production of the country using buffalo in delta region. Thus, the present study was undertaken with the objectives: i) to validate the BLRI developed buffalo fattening technology and quantifies its response to animals raised by farmers in coastal region and ii) To develop a sustainable and cost effective buffalo fattening model as income generating and livelihood improvement tool for the farmers. To achieve the above objectives, coastal region (Charfashion, Bhola) was selected as the experimental site of the study. On account of that a baseline survey has conducted to perceive the existing production system as well as socio-economic status of farmers in coastal region. During the time of focus group discussion a "Buffalo Fattening Farmers Forum" was formed included 20 farmers on the basis of having growing buffalo bulls and trained them accordingly. For fattening of buffalo, a total of 7.5 acres of land was hired from the local farmers. Maize (BRAC Grass Bhutta) was cultivated, harvested at their optimum maturity and ensiled for feeding to experimental animals. A total of 22 local buffalo bulls of age ranges from 2-3 years were randomly divided into two groups. Farmers reared Buffaloes following the BLRI developed buffalo fattening technology was considered as experimental treatments denoted as T_1 (intensive feeding system) and buffalo reared under the existing feeding & management practices (extensive feeding management system) in the study area was treated as control and denoted as T_0. Though, the feed intake of animals under T_0 was not quantified, but their growth performances were recorded accordingly. However, the total number of buffalo bulls under T_0 and T_1 groups was 07 and 15, respectively. All the animals under T_1 group were reared on a single plane of nutrition of a 60:40 mixed diet (DM basis) of maize silage and a concentrate mixture of crushed wheat (20%), wheat bran (40%), khesari bran (20%), soybean meal (15%), common salt (1%), dicalcium phosphate (3%) & limestone (1%). Ad libitum feeding of Maize (*Zea mays*) silage during the trial period was ensured by supplying at least 10% more roughage, and the desired roughage to concentrate ratio (60:40) was adjusted by changing the daily per head allowances of a conventionally mixed concentrate mixture of 17.84 % CP. Animals were housed in individual tie stalls and offered daily rations in two equal meals at 9:00 and 16:00 h. At the onset of feeding trial the experimental animals were dewormed with anthelmentics. The feeding trial was continued for a period of 60 days. The animals were weighed at an interval of 15 days, and their feed intake,feed convertion ratio (FCR) and cost-net profit calculation were done using Excel computer programme. The growth performance data were analyzed statistically in an ANOVA of a completely randomized design (CRD) using the compare means with SPSS, 17 computer software packages.

Table 1. Chemical composition of experimental diets

Diets	DM, % of fresh biomass	Chemical composition (%DM)					GE (MJ/kg, DM)
		OM	CP	ADF	NDF	Ash	
Maize silage	31.63	91.80	7.51	43.67	70.87	8.20	15.82
Conc.mix.	91.71	90.48	17.84	18.62	39.56	9.52	15.32

Table 2. Yield (ton/h/cultivation) and production cost of maize silage in Charfashion, Bhola

Items	Maize
Fresh biomass yield	33.13
Dry matter yield	10.48
Crude protein yield	0.78
Production cost (ton silage DM)	BDT 6610 (US$. 79.88)
Price of conc. mixture (Tk./kg DM)	BDT 34.98

Table 1 presents the chemical composition of the different feeds used in the experiments. The DM, OM, CP, ADF and NDF of maize silage and concentrate mixture was 31.63, 91.80, 7.51, 43.67, and 70.87 and 91.71, 90.48, 17.81, 18.62 and 39.56 percent, respectively. The yield of fresh biomass, Dry matter, and crude protein yield of Maize (BRAC Grass Bhutta) fodder cultivated in Charfahion, Bhola were 33.13, 10.48 and 0.78 metric tons per hectare of land. Data from production and processing cost of maize, it was calculated that the cost involvement for Kg fresh biomass, Kg fresh silage or Kg DM yield of maize silage were Tk. 1.47, Tk. 2.19 and Tk. 6.61, respectively. Similarly, the prices of per kg fresh or kg DM concentrate mixture were Tk. 31.65 and Tk. 34.98, respectively (Table 2). The feed intake of buffalo bulls under intensive system (T_1) has been presented in Table 3. Its shows that the total per head daily DM, OM, CP, ADF and NDF intake of buffalo bulls were 9.52, 8.70, 1.06, 3.33 and 5.63 Kg, respectively. However, the DM intake of bulls based on percent live weight and metabolic body weight were 3.12% and 130 g/d, respectively. Growth performances and feed conversion efficiency of buffalo bulls fed under existing (T_0) and intensive feeding management condition are presented in Table 4. The initial live weight of bulls between the group did not differ significantly ($p>0.05$). However, the final live weight of bulls between the groups varied significantly ($p<0.01$). Bulls fed under the intensive condition (T_1) achieved significantly ($p<0.01$) higher body weight than bulls those fed with existing feeding & management condition (T_0). Similarly, the average daily gain (ADG) of buffalo bulls was significantly higher in intensive feeding and management condition than extensive and the respective ADG was 1.50 Kg and 0.32 Kg. The feed conversion efficiency of bulls fed under the intensive system was 6.48. The FCR of bulls fed under the existing (extensive) feeding system was not determined due to lack of feed intak data.

Table 3. Intake of bulls under intensive feeding & manage condition (Mean±SD)

Parameters	Intensive (T_1)
DM intake (Kg/d)	9.52±0.48
DM intake (Kg; % LW)	3.12±0.32
DM intake (g/Kg $W^{0.75}$.d)	130.0±0.88
OM intake (Kg/d)	8.70±0.43
CP intake (Kg/d)	1.06±0.08
ADF intake	3.33±0.11
NDF intake	5.63±0.21
Roughage to conc. ratio	65:35±0.03

Table 4. Growth & feed conversion efficiency of buffalo bulls (Mean±SE)

Parameters	T_0 (Extensive)	T_1 (Intensive)	F-value	Sig.
Initial LW(Kg)	277.9 ±20.3	274.7±10.7	0.02	NS
Final LW (Kg)	297.0±57.9	364.65±13.5	8.72	**
Total LWG (Kg)	19.2±7.9	89.93±3.8	86.0	***
ADG (Kg)	0.32±0.13	1.50±0.06	86.0	***
FCR	-	6.48	-	-

Table 5. Cost (Tk.) involvement of Kg, LWG of buffalo bulls fed under intensive feeding system in Charfashion, Bhola

Roughage cost/Kg gain	Concentrate cost /Kg gain	Refusal cost/Kg gain	Total feed cost/Kg gain	Management cost/Kg gain	Total cost/Kg gain
28.62	75.52	3.82	107.96	26.99	134.96

The cost and net benefit analysis of buffalo fattening under intensive feeding condition in Charfashion, Bhola revealed that the feed cost, management cost and total cost of Kg live weight gain were Tk. 107.96, Tk. 26.99 and Tk. 134.96, respectively (Table 5). The cost & benefit analysis of buffalo fattening under intensive condition in southern delta areas revealed that, the total cost (feed and management) involved for 60 days fattening was Tk. 11,922.00 per animal. Considering the market price and dressing percent obtained from on-station research, it was estimated that the selling price of meat (carcass) along with both edible and non-edible portion was to be Tk. 25,583.00. The total inputs (total cost) and output involved for 60 days rearing of a buffalo indicated that farmer in coastal areas may get net profit of Tk. 13,661 from fattening a buffalo following the BLRI developed buffalo fattening techniques.

Table 6. Cost & benefit (Tk.) analysis of buffalo fattening (60 days) under intensive feeding in Charfashion, Bhola

LWG (kg)	Feed cost	Management cost	Total cost	Carcass wt (kg)	Price carcass	Price of edible/non edible portion	Total price	Net profit
89.93	9538	2384	11922	46.86	19679	5904	25583	13661

From the above discussion, it may be concluded that the on-station based buffalo fattening techniques developed by BLRI was successfully validated and showed an economically viable system for buffalo fattening in the coastal areas under the intensive condition.

Development of cost effective complete pellet feed and its utilization for commercial goat and sheep production

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Executive summary

In Bangladesh, with changing socio-economic conditions, presently there is a little scope for free grazing of goats and sheep and stall feeding gaining popularity day by day. Feeding system based on complete pellet feeds may help to develop stall-feeding method for the commercial sheep and goat production as well as feed manufacturing entrepreneurs. Therefore, the objective of the study was to develop cost effective complete pellet feed and testing it on animal performances. For this purpose, a cost effective formulation (40% rice straw and 60% concentrate mixture) of complete pellet feed was developed based on some previous studies of our group. The concentrate mixture composed of Rice polish 50%, Maize crush 16%, Soybean meal 20%, Molasses 10%, Salt 2%, DCP 1%, Vitamin-mineral premix 0.5% and Pellet binder 0.5%. The ground rice straw was mixed very well with concentrate mixture and finally mixed with required amount of water to passing it to the pelleting machine. The prepared pellet was then sun dried and stored for animal feeding. Two on-station and one on-farm experiments were completed with this developed complete pellet feed. Data were analyzed according to CRD with one way ANOVA by SPSS-19.

Experiment 1. Effect of developed pellet feed on goat production under stall feeding condition (on station)

Three treatment groups (T_1, T_2, T_3) having 05 Black Bengal castrated male of 4-5 months of age in each group were used for this trial where T_1 and T_2 considered as conventional stall feeding system. The diet of T_1 group was ad-libitum oats grass + concentrate mixture @ 1.5% of body weight, T_2 fed ad-libitum UMS + concentrate mixture @ 1.5% of and T_3 group was fed ad-libitum complete pellet feed. Table 1 shows the chemical composition of the experimental diets. Table 2 shows the effect of complete pellet feed on the performances of goat compared to conventional stall feeding. Although, DMI, weight gain and FCR not differ significantly but considerable low FCR and significantly ($p<0.05$) low feed cost per kg weight gain was observed in pellet feeding group (T_3).

Table1. Chemical composition of the experimental diets

Ingredients/feed	DM	OM	Ash	CP	ADF	NDF
Complete pellet feed	91.70	85.71	14.29	13.40	32.24	51.56
Oats grass	13.74	94.22	5.78	16.54	51.6	78.8
UMS	61.73	87.7	12.3	9.45	61.31	73.8
Concentrated mixture	88.55	94.07	5.93	18.65	9.98	35.81

Table 2. Performances of goat fed pellet feed compare to conventional stall feeding

Parameters	Treatments			SEM	Level of sig.
	T1	T2	T3		
Initial weight, kg	7.01	6.98	7.01	0.266	NS
Final weight, kg	10.14	10.02	11.54	0.411	NS
DMI, kg/day	0.264	0.245	0.272	0.009	NS
DMI, % body weight	3.25	3.03	3.06	0.066	NS
FCR	8.32	8.03	5.7	0.607	NS
Feed cost/kg gain	203.85^a	214.74^a	124.22^b	17.297	*

*ab, different superscript in the same raw differ significantly, * p<0.05*

No disease or clinical symptoms observed during experimental period. Results suggest that complete pellet feed would be economic for commercial good production under stall fed condition. The DM, CP and NDF digestibility (%) were significantly high in T_1 (78.74, 85.24 and 77.23, respectively)

followed by T_3 (71.52, 75.41 and 65.67, respectively) and T_1 (70.62, 68.35 and 67.26, respectively). Results indicated that pelleting enhance the digestibility of rice straw (UMS).

Experiment 2. Effect of developed pellet feed on sheep production under stall feeding condition (on station)

This experiment was conducted with the similar methodology followed by experiment 1. The DMI and daily weight gain was significantly ($p<0.01$) increased in Pellet feeding group (T_3). Feed cost per kg weight gain and FCR not differ among the groups. No disease or clinical symptoms observed during experimental period. The CP digestibility (%) found significantly ($p<0.05$) high in T_1 group (69.77) followed by T_3 (54.75) and T_2 (45.72), but the DM, OM, ADF and NDF did not differ significantly among the treatment groups.

Table 3. Effect of complete pellet feed on the performances of growing sheep compare to conventional stall feeding.

Parameters	Treatments			SEM	Level of sig.
	T_1	T_2	T_3		
Initial weight, kg	10.69	11.01	10.80	0.325	NS
Final weight, kg	16.38[a]	16.84[a]	19.86[b]	0.639	*
Weight gain, kg	5.694[a]	5.83[a]	9.06[b]	0.485	**
Weight gain/day	63.27[a]	64.78[a]	100.67[b]	5.388	**
DMI, kg	0.415[a]	0.427[a]	0.768[b]	0.045	**
DMI, % body weight	3.07[a]	3.21[a]	5.13[b]	0.261	**
FCR	7.11	6.87	7.39	0.201	NS
Feed cost/kg gain	166.35	176.33	169.06	4.992	NS

*ab, different superscript in the same raw differ significantly, * p<0.05; ** p<0.01*

Experiment 3. On-farm performances of Sheep fed complete pellet feed

The experiment was conducted at Subornachar Upazila under Noakhali district of Bangladesh. Total 14 farmers were selected having at least one male lamb with 4-5 months of age. They were equally distributed in to two treatment groups having 7 lambs in each group. In T_0, lambs were reared under traditional semi intensive system, while in T_1, lambs were reared under stall feeding condition and fed complete pellet feed. The duration of the experiment was 3 months. Data from above two treatments were compared to on-station pellet feeding group, which was designated as T_2. The results (Table 4) indicated that daily weight gain increased about 4-5 times due to complete pellet feeding (T_1 and T_2) compared to the conventional farmers rearing (T_0).

Table 4. Performances of Sheep fed complete pellet feed (on-farm)

Parameters	Treatments			SEM	Level of sig.
	T0	T1	T2		
Initial weight	9.25	9.85	10.78	0.741	NS
Fina weight	10.82[a]	15.80[b]	19.86[b]	1.2497	**
Body weight change	1.57[a]	5.95[b]	9.08[c]	0.783	**
Total DMI	-	51.14	69.09	3.315	**
FCR	-	8.93	7.68	0.450	NS
Feed cost /kg gain	-	197.70	168.58	10.053	NS
Daily weight gain, g	22.42[a]	84.98[b]	100.67[b]	9.066	**

*ab, different superscript in the same raw differ significantly, ** p<0.01*

Finally, the results of the on-station and on-farm experiments suggest that body weight gain increased, FCR and feed cost reduced considerably by pellet feeding. No clinical symptoms and other health hazards observed due to complete pellet feeding. Therefore, complete pellet feed could be an alternative ready feed for commercial goat and sheep production under stall fed condition.

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Development of cost effective crop residues based Total Mixed Ration (TMR) for Ruminant: On farm validation of TMR technology for dairy cow

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Executive summary

Feed cost is a major deterrent to economic milk production of milking animals. It can be moderated by replacing concentrate in some extent with good quality forage and feeding it in the form of a complete ration to minimize wastages. This study depicts the effect of feeding maize stover based complete ration on feed intake and efficiency, milk production and composition and economic outcome in lactating cows. This field trial was carried out for a period of 60 days on 10 lactating animals belonging to the farmers of Alokdiar village at Baghabarighat, Shahzadpur upazilla in Sirajgonj district. The selected cows were in 1st to 3rd lactation at early stage (1-2 months) of production and were divided into two homogenous groups. In control group (T_0), animals were provided conventional feeds comprising of 20.0 kg Napier grass, 5.0 kg paddy straw, 2 kg pellet feed (Provita^R) and 10.0 kg concentrate mixture (composed of 5kg wheat bran, 2 kg kheshari bran, 2 kg red gram bran and 1.0 kg til oil cake), 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 dietary composition for the experimental animals is given in Table 1. The dry matter (DM), crude protein (CP), organic matter (OM), ash, neutral detergent fibre (NDF), acid detergent fibre (ADF) contents were 90.33, 15.6, 89.8, 10.2, 39.1 and 21.3 percent, respectively in the concentrate mixture (T_0), and 38.01, 16.7, 89.58, 10.42, 45.2 and 35.7 percent, respectively in complete ration (T_1). The animals in both groups were housed in well ventilated, conventional stalls maintained under hygienic conditions with individual feeding and watering arrangements. Daily milk yield was estimated adding two complete milk extraction in a day at 5.30 AM and 4.30 PM, and 4.5% fat corrected milk yield was computed. Representative milk samples taken once in a week were collected and stored in sterile bottles and milk constituents (*viz*. fat, protein, lactose, solids not fat) of those samples were estimated thereafter by Lactostar by Funk Garber. The data were analyzed by "IBM SPSS 20.0" statistical program in a completely randomized design (CRD).

Table 1: Dietary composition for animals in two groups

Feed Ingredient	DM%	CP%	Amount in 100 kg (T_0)	Amount in 100 kg (T_1)
*Napier/ Jumboo	16.38/15.92	09.30/10.11	53.33	-
Paddy straw	89.00	03.40	13.33	-
Maize stover	88.96	05.72	-	50.00
Wheat bran	87.43	15.06	13.33	8.00
Kheshari bran	86.55	12.22	05.33	4.00
Soybean meal	85.78	44.13	-	25.00
Til oil cake	85.19	35.27	02.67	
Molasses	80.19	05.20	-	10.00
Provita^R feed	87.80	10.25	05.33	-
Red gram bran	89.36	07.21	05.33	-
Salt	99.5	-	00.50	0.5
DCP	98.01	-	-	2.5
DM (%) in diet		-	47.91	58.21
CP (%) in diet		-	9.91	16.0
ME req. (MJ/day/animal)			50.13	50.09
ME sup. (MJ/day/animal)			56.71	52.00

*sometimes farmers provide Napier and sometimes Jumbo as per availability

The feed intakes of animals supplied with two dietary groups are shown in Table 2. Although, fresh feed intake in T_0 group was significantly higher than T_1 group, but DM intake did not differ between

groups. CP intake was significantly higher in T_1 group than T_0 group. Differences were not significant in case of dry matter intake on %live weight (DMI%LWT) of animals between groups.

Table 2: Feed intake of cows fed on conventional and complete ration (TMR)

Parameter	Control (T_0)	TMR (T_1)	Significance level
Fresh feed intake (kg/day)	37.4±0.008	16.42 ±0 .02	***
DM intake (kg/day)	11.39±0.48	11.46±0.16	NS
CP intake (kg/day)	1.25±0.05	1.60±0.02	**
DMI on %LWT	2.41±0.05	2.46±0.03	NS

Milk production and composition of two treatment groups were shown in Table 3 and 4. There were significant differences observed in milk yield between two groups. Highest milk yield was observed in T_1 group.

Table 3: Milk production of cows fed on conventional and complete ration (TMR)

Parameter	Control (T_0)	TMR (T_1)	Significance level
Initial milk yield (ltr)	9.30±0.29	9.35 ±0.11	NS
Final milk yield (ltr)	9.60±0.2	9.99±0.07	*

*-p<0.05; NS-p>0.05

Significant difference was observed in fat% of milk in two groups. However, there were no significant differences of protein, lactose and SNF contents in milk between groups. Highest fat% was obtained in T_1 group.

Table 4: Milk composition of cows fed on conventional and complete ration (TMR)

Parameter	Control (T_0)	TMR (T_1)	Significance level
Fat (%)	3.51±0.04	3.62± 0.06	*
Protein (%)	3.62±0.04	3.69±0.27	NS
Lactose (%)	4.96 ±0.29	5.04±0.32	NS
SNF (%)	9.57±0.5	9.79±0.08	NS

*-p<0.05; NS-p>0.05

At the end of the whole experiment, economic analysis was conducted based on feed cost and income from milk of two treatment group as shown in Table 5. In this experiment maximum profit was obtained in T_1 group.

Table 5: Economic analysis for two feeding groups

Parameter	Control (T_0)	TMR (T_1)
Feed cost (BDT/day/animal	384	320
*Income from milk (BDT/day)	559	594
Profit earned in a day/cow	175	265
Benefit cost ratio (BCR)	1.45	1.86

*Considering milk price @BDT 60.0/ltr.

Based on the results, it may be concluded that feeding of maize stover based complete ration (TMR) improved substantial amount of milk yield and milk composition, with concurrent reduction in the cost of milk production.

Study of diversification and upgradation of market waste vegetable based feed manufacturing system

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Executive summary

Recycling of market vegetable wastes as feed using sustainable technology may increase feed availability of the country and save environment from pollution. The objectives of this study were to investigate nutrient value of ensiled vegetables waste and its suitability as alternative to conventional feed for ruminants. Cabbage and cauliflower leaf (CL; 3:1, as fresh), after dewatering (DCL), was ensiled alone (DCL_0) or with 5% molasses (DCL_m) or 5% molasses including either of 10% wheat bran (DCL_{mWB}), rice polish (DCL_{mRP}) or rice straw (DCL_{mRS}) as absorbents in 5 replicates of 35 kg plastic drums. After 45 days of ensiling, they were evaluated regarding physical and fermentation properties for determining their silage quality. After evaluation, based on results, 2 silages were selected for testing on animal performances. Fifteen indigenous lambs of 9.92 (±1.25) kg initial live weight (LW) were divided equally into 3 groups having 5 lambs in each and assigned to fed maize silage (120 d maturity; ensiled 25 d), mixed silage (maize and DCL_{mRS}, 1:1, fresh) and DCL_{mRS} (108 d ensiled) as basal diet for 90 d to appetite, while supplementing similar concentrate at 1.5% of LW to all lambs in order to evaluate its suitability as a replacement of conventional roughage. The concentrate mixture was consisted of fresh wheat bran (30%), maize broken (30%), soybean meal (20%), kheshari bran (16%), DCP (1%), common salt (1.5%) and protein concentrate (1.5%). Chemical analysis was done according to AOAC (2004). Data were analyzed with the analysis of variance (ANOVA) of a completely randomized design (CRD) by SPSS 11.5.

The color, smell and structure of silages indicated that DCL_{mWM}, DCL_{mRP}, and DCL_{mRS} silages were of excellent quality. In fermentation properties (Table 1), level of pH, DM (% fresh), Flieg point, lactic acid bacteria and total volatile fatty acid differed significantly (P<0.01), and found that DCL_{mWM}, DCL_{mRP}, and DCL_{mRS} silages were successfully ensiled.

In feeding trial, live weight

Table 1. Fermentation properties of silage

Parameters	Different types of DCL silage					SEM	P values
	DCL_0	DCL_m	DCL_{mWB}	DCL_{mRP}	DCL_{mRS}		
pH	5.88^{c}	5.21^{b}	4.34^{a}	4.33^{a}	4.23^{a}	0.19	<0.01
DM, % fresh	12.28^{c}	16.86^{b}	25.08^{a}	24.82^{a}	24.18^{a}	0.67	<0.01
Flieg point	$<0.00^{c}$	30.16^{b}	81.54^{a}	81.36^{a}	84.06^{a}	7.78	<0.01
LAB, Log10 cfu/g	0.00^{d}	5.81^{c}	6.51^{b}	7.48^{a}	6.04^{b}	0.49	<0.01
TVFA, mM/L	21.00^{c}	29.20^{b}	32.40^{bc}	36.00^{a}	32.0^{bc}	2.93	<0.01

DCL, dewatered cabbage and cauliflower leaf (3:1 as fresh); DCL_0, 100% DCL silage, DCL_m, DCL with 5% molasses silage; DCL_{mWB} DCL_{mRP} or DCL_{mRS}, DCL silage with 5% molasses and 10% of either wheat bran (WB) or rice polish (RP) or rice straw (RS); DM, dry matter; LAB, lactic acid bacteria; cfu, colony forming unit); TVFA, total volatile fatty acids; SEM, standard error of mean; P<0.05, significant; ^{abcd}, means with different letters within same raw are significantly different (P<0.05).

Table 2. Nutrient intake and live weight gain of lambs

Parameters	Different types of silage			SEM	P values
	Maize	Mixed	DCL_{mRS}		
Initial LW, kg	9.79	10.06	9.90	1.34	0.951
Final LW, kg	19.72	21.57	22.59	1.78	0.070
Average LW, kg	14.76	15.82	16.25	1.46	0.288
Gain, g/d	110^{b}	128^{ab}	141^{a}	13.26	0.011
Silage DM intake, g/d	195^{c}	221^{b}	298^{a}	12.51	<0.01
Conc. DM intake, g/d	139^{b}	144^{a}	144^{a}	0.08	<0.01
Total DM intake, g/d	334^{c}	364^{b}	442^{a}	12.49	<0.01
OM intake, g/d	291^{c}	320^{b}	407^{a}	111.0	<0.01
CP intake, g/d	42.71^{c}	54.53^{b}	69.21^{a}	0.93	<0.01

Mixed silage, mixture of fresh maize silage and DCL_{mRS} silage at 50% each; DCL_{mRS}, DCL silage with 5% molasses and 10% of rice straw (RS); LW, live weight; DM, dry matter; OM, organic matter; CP, crude protein; SEM, standard error of mean; P<0.05, significant; ^{abc}, means with different letters within same raw are significantly different (P<0.05).

(LW) gain of lambs increased significantly (P<0.01) when maize silage was replace with DCL_{mRS} at 50% or 100%, which might be attributed to significantly higher (P<0.01) dietary dry matter (DM), organic matter (OM) and crude protein (CP) intake (Table 2). Dietary DM intake in DCL_{mRS} silage diet corroborates with the maintenance requirements of lambs according to BSTI (2008) (440 g/d), but low in other diets. However, CP intake, irrespective of diets, was above the maintenance requirements of lambs (33 g/d; BSTI, 2008).

Table 3. Digestibility and metabolism of nutrients

Parameters	Different types of silage			SEM	P values
	Maize	Mixed	DCL_{mWB}		
Digestibility coefficient					
DM	0.62	0.60	0.58	0.05	0.554
OM	0.54	0.57	0.58	0.04	0.441
N intake, g/d	7.31^{a}	9.39^{b}	11.53^{c}	0.22	<0.01
N in feces, g/d	0.22	0.22	0.23	0.03	0.564
N in urine, g/d	0.28	0.34	0.44	0.09	0.062
N balance, g/d	6.81^{a}	8.83^{b}	10.85^{c}	0.19	<0.01
GE intake, kJ/d	7004^{a}	7547^{b}	8560^{c}	339	<0.01
DE, kJ/d	3460^{a}	3958^{a}	4868^{b}	388	<0.01
ME, kJ/d	2837^{a}	3245^{a}	3358^{b}	318	<0.01

Mixed silage, mixture of fresh maize silage and DCL_{mRS} silage at 50% each; DCL_{mRS}, DCL silage with 5% molasses and 10% of rice straw (RS); DM, dry matter; OM, organic matter; N, nitrogen; GE, gross energy; DE, digestible energy; ME, metabolizable energy; SEM, standard error of mean; P<0.05, significant. ^{abc}, means with different letters within same raw are significantly different (P<0.05).

Digestibility coefficient of DM and OM was not affected due to replacing maize silage with DCL_{mRS} (P>0.05) (Table 3). However, significantly higher N balance in lambs of DCL_{mRS} silage diet was resulted from higher N intake in DCL_{mRS} silage diet compared to maize silage diet (P<0.01). Similarly, intake of GE, DE and ME was increased significantly (P<0.01) when maize silage was replaced with DCL_{mRS} silage. According to Oliveira et al. (2017), N balance of lambs of all dietary groups (6.81-10.85 g/d) was above the maintenance requirement (3.5-3.9 g/d). Similarly, ME intake of lambs (2837-3358 kJ) was above their requirements (1760-1930 kJ; Oliveira et al., 2017).

During metabolic trial, a strong and significantly linear relationship existed between daily gain and N balance {y (N, g) = 0.013 × gain (g) + 7.159, r = 0.555, n = 13; P<0.05}, irrespective of diets (Figure 1). Relationship between daily gain and ME intake was also significant {y (ME, MJ) = 5.978 × gain (g) + 2555; n = 14; r = 0.716; P>0.0005}. It seems that daily maintenance requirement of N was (7.159 g) within range reported by Oliveira et al. (2017) for tropical hair sheep. Unlikely, ME for maintenance (2555 kJ) was higher than the reported values. Estimation of ME for maintenance according to different methods might not represent local sheep; a calorimetric study could attribute the energy efficiency of them more accurately.

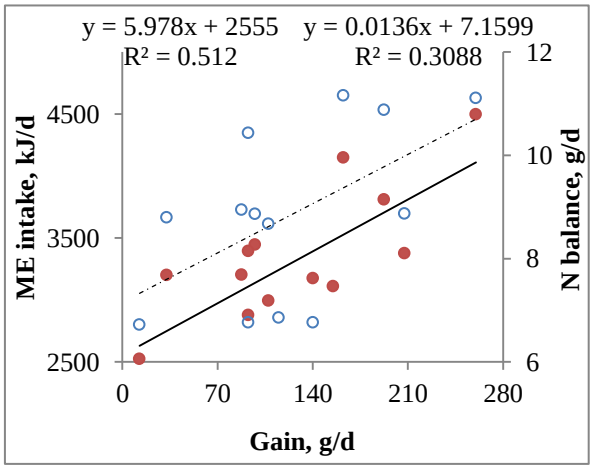

Figure 1. Relationship between daily live weight gain (g/d) and N balance (g/d) or ME intake (kJ/d) of lambs. Solid line and closed circles represent ME, while dotted line and open circles represent N.

It was concluded that DCL might be ensiled successfully by adding molasses and absorbents at 5% and 10%, respectively; DCL silage with molasses and rice and straw may be fed lambs, replacing conventional roughage.

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

Study 1. Dietary cottonseed meal on the growth performance, dressing yield, organ development and meat composition in broiler chicken

A feeding trial with broiler chicken was conducted to know the effect of cottonseed meal on the growth performance, dressing yield, organ development and meat composition. A total of 288 day old chicks were considered to be used cottonseed meal as feed additives in broiler diet. The treatments were control (basal diet) and other 5 different levels of CSM powder (1%, 1.5%, 2.0%, 2.5% and 3.0%) with basal diet. The broiler chicks were distributed in 6 different dietary treatments having 48 chicks in each with 4 replications and each replication contained 12 chicks. The experimental design was completely randomized design and the management practices were standard with dietary requirement. All the data were analyzed using SAS statistical analysis software. Highest weight gain (2295g/bird) was obtained in the 2% CSM fed group compared to other dietary groups with the lowest FCR (1.61) among the CSM added groups. The highest European Feed Efficiency Factor (EPEF) was calculated in 2% CSM added group among the cottonseed meal fed groups. The higher the EPEF value, the better the technical performance. The breast and thigh meat content in CSM fed (2%) group was observed 565 g/b compared to control 547 g/b and other CSM fed birds. Addition of CSM enhanced about 1% dressing percentage (74.22%) compared to control (73.20%) except the highest level (3%) of CSM. The values of internal organs were not varied significantly among the dietary treatments except abdominal fat pad. This response indirectly revealed that no negative impact was found after using CSM in the diet. Cottonseed meal has influence on reducing abdominal fat than non-fed CSM group. The crude fat contents in broiler chicken meat were found 2.84% in breast meat and 3.88% in thigh meat in control diet. Addition of CSM reduced the crude fat content in breast meat by 22 percent and in thigh meat by 32 percent compared to control that indicated to lean meat production from broiler chicken. Considering all the parameters it can be concluded that addition of cottonseed meal as it is can be added up to 2% in the broiler diet for maintaining production performance and lean meat production.

Study 2. Development of light wavelength based poultry production system in Bangladesh

The present experiment was undertaken to know the effect of different light wavelength on the performance, meat qualities and blood properties of broiler chicken. A total of 600 day old broiler chicks were weighted and equally allotted to the following 5 light treatments with 6 replications: red (R 660-670 nm), yellow (Y 590-610 nm) green (G 540-560 nm) and blue (B 460-470 nm) light colors. Fluorescent white light was the control. Light (24 L: 0 D) and intensity 15 lux was maintained at the bird's head level. Body weight, weight gain, feed intakes and feed conversion ratio were measured weekly. During the pre-starter period (0-7 days), G light treatment showed increased body weight compared to that in the other groups. A significant ($P<0.05$) increase in weight gain was found in the G treatment compared to that in the R and W treatments during the starter period (2-3 weeks). However, no significant difference was observed in weight gain among the Y, G, or B treatments. Therefore, weight gain was significantly higher ($P<0.05$) in the B treatment during the growing period (4-5 weeks) than that R and W treatments. Both feed intake and FCR were not affected by the light treatments.Serum erythrocyte sedimentation rate (ESR) was significantly decreased with light wavelengths. No significant effects of light treatments were found for hemoglobin level in the blood. On the other hand, serum lipid parameter (GLU, TP, Cholesterol and LDL) were not influenced by the

light color, but HDL level was significantly increased by the B light treatment. In the present results, dressing %, muscular pH and redness (a*) of meat were significantly increased with decreasing light wavelengths (G and B light). In conclusion, the G lighting treatment enhanced growth performance and improved meat quality of broiler chicks compared to those of monochromatic R and W light.

Study 3. Effect of dietary glutamine supplemented with low protein diet on the performance, meat quality and gas emission of broiler chicks

This experiment was undertaken to investigate the effects of low protein diets with glutamine supplementation on growth performance, meat quality and noxious gas emission of broiler chicken. A total of 600 day old cobb 500 chicks were equalized their body weight and were 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 (PrestarterT_1, 23x0; T_2, 21x0.1;T_3,23x0.25; T_4, 21x0; T_5, 23x0.1 and T_6, 21x0.25 % CP and glutamine level) respectively. During starter (2-3 weeks) and grower (4-5 weeks) period dietary CP level was reduced 2% in each treatment.Body weight, feed consumption, and feed conversion ratio (FCR) were recorded weekly. At the end of feeding trial, ten broilers from each treatment were randomly selected and allotted to individual cage. Fresh excreta from broiler chicks were collected to determine excreta noxious gas emission. Excreta samples (1000 g) were stored in 10L plastic bucket and were allowed to ferment for 1 day at room temperature. After the fermentation period, the gases that formed were determined using a Geotech (Biogas 5000) from approximately 5 cm above the excreta samples. At the end of the experiment, all data were arranged by 2-way ANOVA plus interaction mixed procedure of SAS and differences were determined by DMRT. During the prestarter period (0-7 d) there was no dietary interaction between CP and glutamine on body weight and weight gain of broiler chicks. With increasing dietary glutamine and decreasing CP levels (21 % CP and 0.25 % Glutamin)body weight gainwas increased (P<0.05) significantly during 2- 3 weeks of age. Therefore, higher body weight and better feed conversion efficiency were obtained when 21 % CP were fed with 0.25 % glutamine to the broiler chicken than that of other dietary treatments. Though the interaction of CP and glutamine were not influence the carcass characteristics but muscular pH and color (a* redness) of meat was higher in 21 % CP and 0.25 % glutamine in the diet as compared to other dietary treatments. Fecal ammonia and CO_2 emission was significantly (P<0.05) decreased with increasing level of glutamine and decreasing CP level in the diet (fig 1). Highest concentration of ammonia was found with the interaction of 23 % CP x 0% glutamine whereas 0.1 %glutamine had an intermediated effect on NH_3 emission.Similarly, lowest (P<0.05) fecal CO_2 concentration was foundin T_6 treatment. Therefore prestarter (21x 0.25 %), starter (19x0.25 %) and grower (17x0.25%) level of dietary CP and glutaminemay enhance performance and reduce gas emission of broiler chicks.

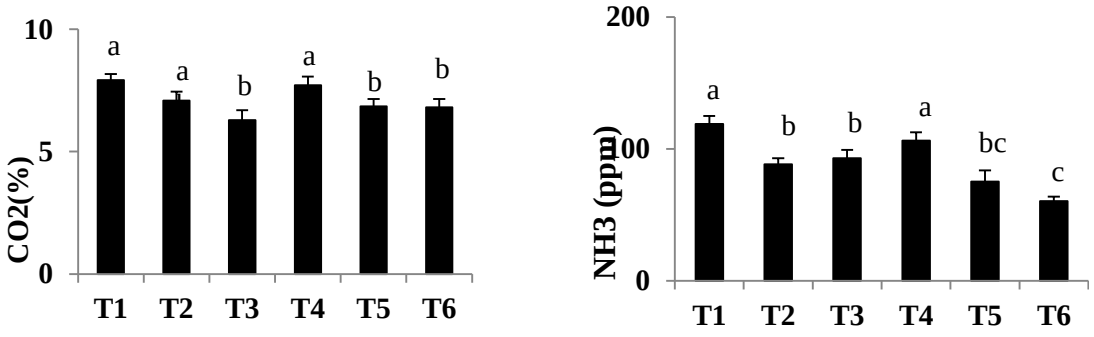

Figure 1. Effect of feeding glutamine on noxious gas emission in broiler manure

Study on the comparative performance of turkey, guinea fowl and broiler in some selected areas of Bangladesh

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Executive summary

Nowadays turkey rearing has drawn the attention of small to medium poultry farmers in some selected areas of Bangladesh. They are expecting for getting production technology or package detailed information about turkey production whether turkey farming is commercially profitable or not. The study was conducted (i) to know present status of feeding, rearing, problems and prospects of turkey farming and (ii) to analyze the production performances of turkey(bronze) compare to guinea fowl(perl) and broiler(Cobb 500) following the survey and farm trial(on turkey) techniques. The initial data was collected about the above species (turkey, guinea fowl and broiler) farming by the pre-structured questionnaire (4 hundred) in the selected areas of Dhaka (80), Chittagong (80), Sylhet (80), Mymensingh (80) and Rajshahi division (80) of Bangladesh. On the basis of collected data the maximum profit (2.02) was observed in turkey farming by investing each taka (table 1). To validate the collected data, a trial was conducted at farmer's level to find out the actual scenario of turkey production in Bangladesh. The duration of the trial was 24 weeks and recorded the data as per plan of the project to fulfill the objectives. There were four treatments (T_0 to T_3 including control group (T_0). The total number birds were 60 and the design of the experiment was CRD. Each treatment had three replications and each replication was allocated 5 birds randomly. T_1 contained 28%, 22% and16% CP and 2800,3150,3250 kcal energy/kg, T_2 contained 27% ,21% and 15% CP and 2900,3100,3300 kcal energy/kg and T_3 contained 26%, 20%,14% CP and 2700,3000 and 3200 kcal energy/kg in the diet for 0-8 ,9-16 and 17-24 weeks of age respectively. The control group contained 22% CP and 2900 kcal energy/kg in the diet which was provided by the farmer's in the whole duration of the experiment. The management practices were same for each group. The birds were supplied feed twice a daily and fresh drinking water was supplied *ad-libitum*. The feeders and drinkers were cleaned every day. The growth rate was measured weekly and others related data like feed intake, temperature, humidity, mortality, disease-out break were also recorded accurately. Average body weight gained of four treatments was significantly differed ($p \leq 0.01$) among the treatments. At the age of 8, 16 and 24 weeks of age observed the highest final weight gain for treatment T_3 (3.65±0.93) than others three treatment (table 2). The interaction effect of sex on BW was significant ($p \leq 0.05$). The body weight of turkey males at 24 weeks of age (3.91±0.068) kg which was significantly ($p \leq 0.05$) higher compared to female (2.96±0.064) at end of the experiment.

Table 1. Poultry birds with few production parameters of the survey

Parameter	Genotypes		
	Turkey	Guinea fowl	Broiler
Number of bird (bird/farm)	86.63(200)	91.83(100)	1001.18(100)
Average price of day old chick(Tk/chick)	440.87	338.04	41.06
Feed intake for each kg body wt gain(excluding grass)	2.53	3.17	1.88
Mortality (%)	0-2	0-2	0-5
Profit margin(for each taka investment)	2.02	1.96	1.08

Table 2. Average body weight gained (kg) up to 24 weeks of age

Age (Week)	Treatment (Mean±SE)				P Value
	T_0	T_1	T_2	T_3	
0-8	0.51±0.029	0.64±029	0.57±029	0.50±029	0.006
9-16	1.54±0.070	2.06±0.070	1.84±0.070	1.73±0.070	0.000
17-24	3.18±0.93	3.53±0.93	3.38±0.93	3.65±0.93	0.005

The average feed intake (kg) of four treatments were significantly differed ($p \leq 0.001$) among the treatments at 8,16 and 24 weeks of age with the lowest value 8.99±0.002 and 20.13±0.002 observed respectively in T_3 at 16 and 24 weeks of age than others three treatments (table 3).

Table 3. Average feed intake (kg) up to 24 weeks of age

Age (Week)	Treatment (Mean±SE)				P Value
	T_0	T_1	T_2	T_3	
0-8	1.74±0.002	1.71±0.008	1.99±0.003	1.84±0.001	0.000
9-16	9.99±0.004	9.15±0.016	9.86±0.023	8.99±0.002	0.000
17-24	21.34±0.004	20.28±0.019	20.98±0.018	20.13±0.002	0.000

The FCR was estimated for four different treatments of their age including 0-8, 9-16 and 17-24 weeks. Differences among the treatments for FCR at different periods of age were also significant ($p \leq 0.05$). Average FCR at the age of 16 and 24 weeks significantly lowest for T_3 group which were 5.32±0.21 and 5.42±0.25 respectively compared to others treatments group (table 4).

Table 4. Average FCR (kg) up to 24 weeks of age

Age (Week)	Treatment (Mean±SE)				P Value
	T_0	T_1	T_2	T_3	
0-8	3.83±0.18	2.76±0.18	3.68±0.18	3.77±0.18	0.000
9-16	6.58±0.21	4.51±0.21	5.54±0.21	5.32±0.21	0.000
17-24	6.41±0.25	5.56±0.25	5.97±0.25	5.42±0.25	0.034

Mortality% of four different treatments was not varied statistically ($p \leq 0.05$) although maximum mortality percentage (0.133±0.091) was observed in control (T_0) group compared to others treatments at all stages of trial (table 5).

Table 5. Effect of treatment on mortality (%) up to 24 weeks of age

Parameter	Treatment (Mean±SE)				P Value
	T_0	T_1	T_2	T_3	
0-24 Weeks	0.133±0.091	0.066±0.066	0.066±0.066	0	0.561

The Benefit Cost Ratio (BCR) among the treatments varied significantly ($p \leq 0.001$) with maximum profit (1.582±0.088) was observed in T_3 (table 6). It can be conclude that from turkey farming with this genotype, farmers can get maximum 1.58 taka (treatment 3) by investing each.

Table 6. Effect of treatment on BCR up to 24 weeks of age

Parameter	Treatment (Mean±SE)				P Value
	T_0	T_1	T_2	T_3	
Up to 24 Weeks	1.068±0.035	1.452±0.067	1.384±0.062	1.582±0.088	0.000

Session V

SOCIOECONOMIC AND FARMING SYSTEM RESEARCH

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 the Black Bengal goat. It is also observed that there are wide variations in color, body size and weight of goats found in different locations. The Black Bengal is a dwarf breed of goats 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 genetic resources. Since 1988, the Bangladesh Livestock Research Institute has been attempted to improve Black Bengal goat through selective breeding. In this situation, "Co-operative Village Breeding Program" may play a vital role in the improvement of indigenous goat. Such type of breeding program was tested in Africa as "Community Breeding Program" and found to be very successful.The primary objectives of community breeding program is to improve indigenous goat and provide smallholder goat farmers with improved breeding animals particularly males. 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, Mymensingh district. A well organized questionnaire was developed for baseline survey through Participatory Rural Appraisal (PRA) which was helped to know population number of Black Bengal goat, local management, feeding and breeding system of Black Bengal goat, available local breed of goat, social status of farmers etc. Fifty (50) farmers were selected randomly in the project area to conduct baseline survey. Fourteen (14) farmers were selected randomly on the basis of elaborate questionnaire who had at least 4-5 years Black Bengal goats rearing experiences to form goat rearing community in the project area. Twenty (20) maiden does from Goat Research farm, BLRI were given to 10 selected farmers and 6 superior bucks were also given to another 4 buck rearing farmers. Goats of each farmer in the community were identified through the giving identification number. A well-organized record keeping card was given for recording of each of the goat in each farmer's house in the community. After certain period the buck will be exchange to prevent inbreeding at farmer's level. Routine vaccination and de-worming were practiced. Obtained information was putted and stored on to the Excel spread sheet. Then data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0.

Table 1. Growth and reproductive performances of BLRI Black Bengal goat at farmer's level

Parameters	Progeny of BLRI doe	Progeny of BLRI buck	Level of significant
	Mean±SE	Mean±SE	
Birth weight (kg)	1.11±0.05 (39)	1.37±0.04 (50)	***
3 month weight (kg)	6.58±0.36 (24)	8.66±0.28 (46)	***
6 month weight (kg)	8.71±0.68 (14)	13.26±0.44 (30)	***
12 month weight (kg)	12.40±0.48 (5)	19.14±0.94 (14)	***
Litter size (no)	1.54±0.09 (28)	2.21±0.11 (23)	***
Gestation length (days)	146.22±0.68 (18)	145.81±0.77 (21)	NS
Kidding interval (days)	257.25±37.32 (4)	-	-

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

Table 1 shows the progeny performances of BLRI Black Bengal goat at farmer's level. Birth weight, 3 month weight, 6 month weight, 12 month weight and litter size were significantly $p<0.001$) higher in progeny of BLRI buck than progeny of BLRI doe. There was no significant different of gestation length between progeny of BLRI buck and progeny of BLRI doe.

Table 2. Effect of sex, parity and litter size on performances of BLRI Black Bengal goat at farmer's level

Factors	Parameters			
	BW (kg)±SE	3M (kg)±SE	6M (kg)±SE	GL (days) ±SE
Sex				
Male	1.22±0.05 (20)	7.40±0.51 (10)	10.02±0.64 (5)	147.00±0.82 (12)
Female	1.00±0.08 (19)	5.31±0.37 (10)	7.44±0.72 (8)	144.67±1.02 (3)
LS	*	*	**	NS
Parity				
1	1.21±0.06 (11)	6.58±041 (5)	9.45±0.62 (5)	146.17±0.70 (6)
2	1.21±0.12 (9)	6.63±0.89 (6)	7.93±1.02 (3)	144.71±0.92 (7)
3^{+}	1.09±0.17 (7)	6.68±1.23 (4)	7.80±3.30 (2)	148.40±1.60 (5)
LS	NS	NS	NS	NS
Litter size				
1	1.29±0.10 (13)	7.05±0.82 (8)	9.40±0.49 (4)	148.14±1.52 (7)
2	1.07±0.07 (14)	6.14±0.32 (7)	8.18±0.69 (6)	145.00±0.64 (11)
LS	NS	NS	NS	*

BW= Birth weight, 3M= 3 month weight, 6M=6 month weight, GL= Gestation length, LS= Level significant. 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 ($p>0.05$).

Table 2 shows Effect of sex, parity and litter size on performances of BLRI Black Bengal goat at farmer's level. Sex had significant effect on birth weight ($p<0.05$), 3 month weight ($p<0.05$) and 6 month weight ($p<0.01$), while no significant effect on gestation length. There was no significant effect of parity and litter size on birth weight, 3 month weight, 6 month weight and gestation length except gestation length which was varied with litter size of Black Bengal goat at farmer's level. Four maiden doe (s) from community farmers were given to another selected goat rearing farmer on the basis of contact. Different data were recorded in flock record keeping book regularly and the study will be continued until significant to build model community based goat production.

Characterization of Munshiganj cattle

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Executive summary

The cattle of Bangladesh are indigenous (Bosindicus) type which constitutes about 90% of the total cattle population. The indigenous cattle are of various sizes and possess varied coat color such as red, grey, white, black or mixture of these in different proportion. Munshiganj cattle (MC) are one of the promising varieties of indigenous cattle genetic resources in Bangladesh, generally found in the Munshiganj district and its surrounding areas. Farmers are replacing MC with high yielding crossbred cattle and population of MC is rapidly declining in their breeding tract. Considering the above facts, steps have been taken by BLRI for conservation, characterization and subsequent improvement of this valuable cattle genetic resource at their own habitat (*in-situ*) and at BLRI (*ex-situ*). For *in-situ* conservation, a Munshiganj cattle rearing community was established in Munshiganj district with 104 households having at least a single MC cow. For *ex-situ* conservation, a mini nucleus herd was established at BLRI which has been enlarged with a total population of 30 animals including 10 cows, 4 breeding bulls, 8 heifer calves and 8 bull calves. Different productive and reproductive performance was recorded throughout this period.Semen was collected from 3 sexually matured Munshiganj bull, analyzed and diluted with Tris- egg -yolk citrate diluter. After 4hrs equilibration, semen was frozen with liquid nitrogen vapor with a programmable bio freezer (Minitube, Germany) at -140ºCand finally stored at -196ºCin liquid nitrogen. After that post thawing semen qualitieswere observed and evaluated after 24 hrs of storage.

The fresh semen was thick creamy in colour with an average volume and concentration of 4.273±0.54 ml and 1796 ±122.29 milion/ml, respectively. Total progressive, static and slow motility of the fresh and post thawed semen samples were 84.69±4.28 and 52.97±3.13, 72.53 ± 2.91 and 43.71±1.57, 15.31±4.28and 47.03 ±3.13 and 1.23± 0.60 and 0.58± 0.18%, respectively (Table 1).

Table 1. Fresh and frozen semen quality of Munshiganj bull

Parameter	Fresh semen (Mean±SD)	Frozen semen(Mean±SD)
Volume (ml)	4.273±0.54	-
Concentration (million/ml)	1796 ±122.29	-
Total motility (%)	84.69 ±4.28	52.97± 3.13
Progressive motility (%)	72.53 ± 2.91	43.71±1.57
Static motility (%)	15.31± 4.2	47.03 ±3.13
Slow motility (%)	1.23± 0.60	0.58± 0.18

The average birth weights of male calves (19.47±0.79 kg) were significantly ($p<0.05$) higher than those of female calves (16.14±0.52 kg). Average lactation length (LL), lactation milk yield (LMY), daily milk yield (DMY), postpartum heat period (PPH) and number of services for each conception (NSPC) was found 187.5±9.54 days, 728.46±88.80 kg, 3.84±0.31 kg, 65.5±5.25 days and 1.58± 0.79respectively (Table 2 & 3). The gestation length is a species characteristic. The duration of gestation is genetically determined. Variation may be due to maternal or other influence.

Table 2. Productive performances of Munshiganj cattle

Characteristics	**(Mean±SD)**
Body weight of male calf (kg)	19.47^{a}±0.79
Body weight of female calf (kg)	16.14^{b}±0.52
Lactation length (Days)	176.25±26.47
Lactation yield (L)	731.53±140.61
Daily milk yield (L)	4.13±0.39

Table 3. Reproductive performances of Munshiganj cows

Characteristics	(Mean±SD)
Gestation period (days)	279.17± 3.76
Postpartum heat period (days)	63.42± 22.08
No of service per conception	1.58± 0.79

Milk fat and protein content of evening milk were significantly higher than morning milk, where no significant differences were found in lactose and SNF content (Table 4). Artificial insemination (AI) is ongoing in Munshiganj rearing community with pure Munshiganj semen. Till date 82 AI has been conducted with an average conception rate of 54.88%.Eight calves have been born so far following AI.

Table 4. Milk composition of Munshiganj cows

Milk properties	Morning	Evening	Overall mean	Sig level
%Fat	4.89^{b}±0.28	6.34^{a}±0.35	5.61±0.29	**
%Protein	4.23^{b}±0.04	4.38^{a}±0.05	4.31±0.04	*
%Lactose	6.11±0.06	6.28±0.07	6.19±0.05	NS
%SNF	11.25±0.11	11.60±0.13	11.43±0.09	NS

*-significant at 5% level ($p<0.05$); **-significant at 1% level ($p<0.01$); NS-not significant ($p>0.05$)

In conclusion, Munshiganj cattle are highly potential for most of the productive and reproductive point of view. This valuable endangered germplasm needs to be conserved for future multiplication. The ongoing program of artificial insemination (AI) with pure semen of Munshiganj bull may be a potential initiative to increase the population size of Munshiganj cattle in their habitat.

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

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Executive summary

Study 1. Collection, conservation and improvement of pigeons at BLRI research farm

Pigeon production in rural and urban areas of Bangladesh has got great importance for supplying family protein nutrition by squab meat and supplementary income generation. Some of these are comparatively lowest keeping cost, short generation interval, rapid growth, early sexual maturity i.e. 5-6 months of age, less feed and housing cost required. Moreover, they are friendly to environment, associated with ecological balance, natural beautification and fancy pigeons are keeping as a good source of recreation. People of all religions like squab meat. Squab meat is very lean, easily digestible and rich in proteins, minerals and vitamins. It is also used as tasty, delicate and fancy meat (Aliza, 2005; Morgan, 2006). The objectives of this study were to collect, conserve and improve few potential pigeon germplsms through selective breeding. The research facility for pigeon rearing at BLRI was developed in FY 2017-18. Local and exotic pigeon germplasms were collected for assessing their economic return, squab production and meat quality in this current plan. Before collection of pigeon at BLRI research shed a survey was conducted to six regions of the country taking 15 questionnaires each side (total 90) because of generating basic information bank of the pigeon raisers. From that survey report we found that family members of the pigeon raisers are 4 to 5 persons in each family. The land area showed a wide variation from 41.07 decimal in Feni sadar to 162.27 decimal in Dinajpur areas. Farmers of Dumuria showed higher education among other 5 regions. HSC educated farmers concentration are found highest in Nokla areas than other regions followed by Dinajpur and others. No farmers were found illiterate in the study area. Among the 6 sites, pigeon farmers of Feni sadar were 100% in SSC or below followed by 93% Gopalgonj and 73% in Joypurhat. Highest number of pigeon as well as poultry was found in Dinajpur areas per farm followed by Joypurhat, Feni, Khulna, Gopalgonj and Nokla. The supplementary income is also followed the same trend, meaning highest income per pigeon farm was recorded 14571 taka / farm with 22 pairs of pigeon in Dinajpur that other regions. Their experience on pigeon rearing is also more (5.77 yrs) than others. New castle, fowl pox, cholera are common diseases found in the study areas with diarrhoea sometimes. As a remedy most of the farmers provide ND vaccine with few Fowl pox vaccines. Some problems of predator were also found in different areas of the study. Only 6 pigeons taking golla 4 (1 pair white and 1 pair black) and giribaz 2 were collected from Savar Bazzar. Later a pair of King pigeon (752g/male and 740 g/female) was introduced. Adult body weight of white 376g for male and 320 g for female were recorded white black matured 370 g and 330 g for male and female respectively. The number of pigeon increased to 52 number including nine pairs of baby pigeon (squab). Our intention is to identify suitable pigeon genotypes for producing more squabs to increase supplemental income and generate profitable pigeon production technology for the raisers.

Study 2. Collection, conservation and improvement of Guinea fowl production at BLRI

Guinea fowl are seasonal breeders and lay eggs during the warm season (Moreki, 2009). Bell and Smith (2010) in Australia also reported that guinea fowl hens start laying in spring (with increasing daylight) and continue laying for about nine months. In Ghana, Konlan *et al.* (2011) argued that guinea fowl hens (pearl) are capable of laying fertile eggs throughout the year when given adequate supplementary feeds with the provision of water *ad libitum.* The study was conducted with the objectives i) collection and conservation of Guinea fowl at BLRI germplasm ii) maintenance and multiplication of Guinea fowl for further investigation. One hundred fifty guinea fowls were collected and are conserving for multiplication. The management practices were standard.The feed conversion

ratios (FCR) were calculated 2.26, 4.46 and 5.58 in 5-8; 9-12 and 13-16 weeks of age for foundation stock. At 16 weeks of age in generation 1, the live weight was found 1214.22 g/bird, weight gain 1186g/bird, feed intake (5320 g/bird), FCR 4.38 with mortality 3.50%.Age at sexual maturity of guinea fowl was 168d and body weight was 1304.64g at that time. It was found the hen guinea fowl lay about 100 to 110 eggs per bird per year with a mortality of up to 8%. Average egg weight of guinea fowl was recorded 42g and albumen index (%) was 7.31, Yolk index (%) was 40.94 and Haugh unit was 85.077. The dressing percentage of guinea fowl was found 65.79. It can be concluded that guinea fowl might be a potentiality poultry species for meat and egg production. Further study should be conducted to increase its egg production performances. The study is ongoing to investigate the different guinea fowl variety, production performance of eggs, measurement of egg quality characteristics under intensive rearing system and improvement of BLRI selected guinea fowl in Bangladesh. At least 5th generation will need for improvement of guinea fowl through selection and breeding program.

Study 3. Collection, conservation and improvement of Turkey germplasm at BLRI

Turkey (*Meleagris gallopavo)* belongs to the family of birds called Meleagrididae. Turkey rearing is very popular in many parts of the world especially Europe and America and their meat is popular in the developed country due to low fat as well as cholesterol content in meat (Sarker and Sarker, 2018). They can be raised successfully almost anywhere in the world if they are well fed and protected against diseases, predators, and adverse weather conditions. The young birds are called poults, the male birds are referred to as turkey cocks or toms while the female are called turkey hens. Turkey was probably domesticated firstly in Mexico, it was also used as a domestic fowl by Indian communities the place is now the South-Western USA (Smith, 1990). The standard weights for adult toms and adult hens are 16-26 and 9.18kg for the Bronze, 15 and 8.18kg for white Holland, 10.45kg and 5.91kg for Beltsville small white. Normal mature males of all varieties of turkey have a conspicuous black beard attached to the skin of the upper breast region and occasionally have small beard but beards are reared in females of colored varieties. Turkeys are gaining in popularity in Bangladesh and for good reasons that it can produce huge and high-quality meat. Turkey can substitute for broiler because some consumers do not like broiler meat. In particular, Bangladesh Livestock Research Institute is the only research institute related to livestock in Bangladesh but there was no Turkey stock in their poultry germplasm. Thus the present research proposal was undertaken with the objectives to collect, multiply and improve a flock of Turkey at BLRI poultry germplasm.

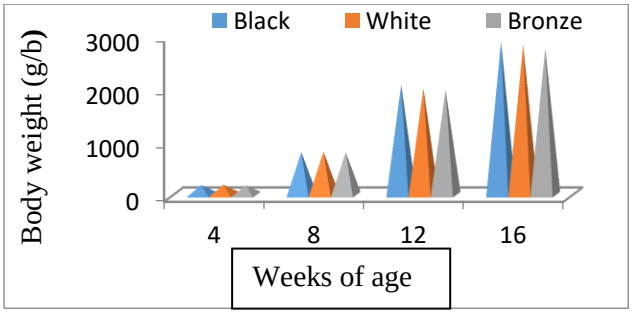

Figure 1. Body weight of turkey at different weeks of age

Figure 2. Turkey flock at growing age

Recently, BLRI has introduced with turkey with a flock of 100 birds consisting bronze, black and white. Their performances data are recording (BW showed in Figure1) routinely. In FY 2018-19, performance of this turkey variety will be carried out followed by egg production and meat quality parameters. Bangladesh government has allocated bank loans for the turkey farmers to encourage the innovative and dedicated farmers of the country. We are also committed to provide the technological support for making turkey production a profitable business in near future and to supply lean and safe meat for the consumers.

Variation of morphological features and growth traits in half sib baby calves of Pabna cattle

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Executive summary

Pabna cattle are one of the most promising local varieties for milk production and growth among the available cattle varieties in Bangladesh. This study was aimed to reveal the phenotypic features of local Pabnacalves including their growth traits attribute at BLRI regional station, Baghabari. Data on different phenotypic measurements and growth traits were collected from 12 half sib Pabnababy calves having same sire using measuring tape and weighing balance within three months of calving, respectively.Each calf was allowed to drink10% of milk for individual's body weight from respective dam. Data analyses were conducted following independent sample *t*-test and one-way ANOVA using SPSS software (SPSS Inc. Chicago, USA). The morphological features of Pabna calves at birth had significant differences in body weight ($p<0.001$), body length ($p<0.05$), heart girth ($p<0.05$) and mouth circumference ($p<0.05$) based on two types of birth weight groups in calves (<20 kg and ≥20 kg) where the values found higher in 20 kg weight group for 20.97±0.52 kg, 53.33±1.20 cm, 61.33±0.67 cm and 21.33±0.33 cm, respectively (Table 1). In case of dam's body weights (<250 kg and ≥250 kg), there were no variation observed in the baby calves except head length ($p< 0.05$) in two groups, respectively. However, this phenotypic feature (head length) also showed significant ($p<0.001$) increasing pattern at three month of age in half sib calves (Table 2). These data are indicating few phenotypic characters which could be considered as effective differentiating features of calves during selection. In addition, these data suggested that higher body weight of dam might not responsible of changing overall phenotype of calves.The body weight of local Pabna calves at birth, first, second and third months were found as 18.73±0.47, 31.11±0.66, 43.09±1.12 and 53.67±1.47 kg, respectively (Table 3). There were no variations ($p>0.05$) observed in the growth rates of those measuring periods in baby calves (Figure 1). These data showed that half sib calves originated from the same sire had similar growth in the early stage.

Table 1. Effects of own and dam's body weight on phenotypic features of half sib baby calves at birth in local Pabna cattle

Phenotypic features	Calves' body weight (Mean±SE)			Dams' body weight (Mean±SE)		
	<20 kg (n=9)	≥ 20 kg (n=3)	*t*-test	<250 kg (n=6)	≥ 250 kg (n=6)	*t*-test
Body characteristics						
Body weight (kg)	17.99±0.33	20.97±0.52	0.001	19.22±0.76	18.25±0.55	0.326
Body length (cm)	50.56±0.53	53.33±1.20	0.034	51.50±0.85	51.00±0.89	0.693
Heart girth (cm)	58.78±0.52	61.33±0.67	0.028	60.00±0.86	58.83±0.60	0.291
Wither height (cm)	64.22±0.70	65.67±1.45	0.347	64.17±0.98	65.00±0.86	0.536
Carpal circumference (cm)	9.22±0.28	9.67±0.33	0.418	9.50±0.22	9.17±0.40	0.485
Tarsal circumference (cm)	10.56±0.29	10.83±0.17	0.614	11.00±0.26	10.25±0.31	0.092
Tail length (cm)	33.22±0.52	33.67±2.19	0.768	34.17±0.98	32.50±0.62	0.181
Tail dock circumference (cm)	8.67±0.33	9.33±0.67	0.356	9.17±0.31	8.50±0.50	0.282
Pelvic length (cm)	11.44±0.29	12.00±1.00	0.468	11.50±0.43	11.67±0.49	0.804
Rump length (cm)	11.56±0.24	12.33±0.67	0.190	11.83±0.40	11.67±0.33	0.756
Head characteristics						
Mouth circumference (cm)	20.22±0.22	21.33±0.33	0.028	20.83±0.31	20.17±0.31	0.156
Ear length (cm)	13.56±0.47	12.67±0.33	0.329	13.83±0.48	12.83±0.54	0.197
Ear diameter (cm)	8.33±0.17	8.00±0.58	0.448	8.50±0.22	8.00±0.26	0.174
Head length (cm)	21.00±0.37	21.00±0.58	1.00	20.33±0.21	21.67±0.42	0.018
Head width (cm)	10.00±0.24	10.33±0.67	0.554	10.17±0.31	10.00±0.37	0.734

Table 2. Phenotypic features of half sib baby calves at three months based on dams' body weight in local Pabna cattle

Phenotypic features	<250 kg body weight (n=3)		≥ 250 kg body weight (n=5)		*t*-test
	Mean	SE	Mean	SE	
Body characteristics					
Body weight (kg)	56.54	0.46	54.09	1.71	0.328
Body length (cm)	70.67	1.76	74.90	1.21	0.86
Heart girth (cm)	84.67	1.48	85.50	1.52	0.729
Wither height (cm)	78.33	1.20	79.20	0.70	0.524
Carpal circumference (cm)	10.67	0.17	10.80	0.12	0.537
Tarsal circumference (cm)	11.83	0.33	11.90	0.10	0.818
Tail length (cm)	43.83	0.73	44.90	0.33	0.173
Tail dock circumference (cm)	12.50	0.29	12.50	0.32	1.00
Pelvic length (cm)	19.83	0.93	20.40	0.40	0.535
Rump length (cm)	23.50	0.87	24.80	0.62	0.260
Head characteristics					
Mouth circumference (cm)	23.50	0.50	24.20	0.34	0.274
Ear length (cm)	18.00	0.58	19.50	0.50	0.106
Ear diameter (cm)	10.67	0.17	10.60	0.24	0.855
Head length (cm)	26.00	0.00	27.20	0.12	0.000
Head width (cm)	12.67	0.88	12.70	0.25	0.965

Table 3. Body weight (kg) of half sib baby local Pabna calves

Body weight	n	Minimum	Maximum	Mean	SE
At birth	12	16.60	22.00	18.73	0.47
First month	10	27.55	34.65	31.11	0.66
Second month	9	37.90	48.45	43.09	1.12
Third month	8	46.66	57.41	53.67	1.47

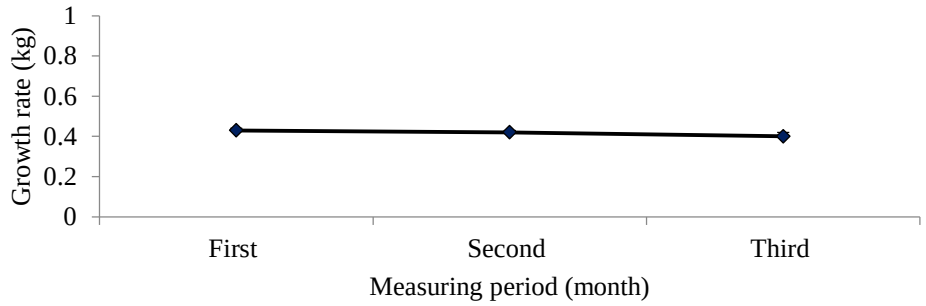

Figure 1. Variation of growth traits at early stage in local Pabna calves

It is concluded that phenotypic variation and growth traits were almost similar for half sib Pabna baby calves; in addition, dams' body weight had limited effects on those features rather than individual calf weight.

Production and evaluation of cross bred 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. However, after implementation of these programmes, the rate of increment of meat production 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 cross bred to minimize the deficiency of animal protein. The objectives of this project are to evaluation of the productive and reproductive performances and also the adaptation 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. At starting period 25 Coastal ewes were crossed with ram of Damara sheep. More 25 Coastal ewes are being crossed with ram of Dorper sheep. Beside this, 25 Coastal ewes are being crossed with ram of Parendale sheep. All the ewes and ram were housed in slated floor permanent house raise above the ground level with sufficient space to keep them comfortable. Ramsare being kept separately from ewes to avoid unplanned mating. Green grass was supplied *adlibitum* basis and concentrate (17% CP, 11MJ ME/kg DM) was offered twice daily (morning and evening) at the rate of 300g per head 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 up to fortnight throughout the year. Subsequently, data on productive and reproductive performances were recorded regularly. The collected data was analyzed by SPSS 17.0 statistical computer programme.

Figure 1. Damara-Coastal cross bred lamb

Figure 2. Dorper-Coastal cross bred lamb

Figure 3. Parendale-Coastal cross bred lamb

Table 1 shows Production performances of different cross bred sheep genotype. The birth weight of Damara-Coastal, Dorper-Coastal and Parendale-Coastal cross bred genotype were1.98±0.06 kg, 1.97±0.19 kg and1.77±0.86kg respectively. Average body weight of Damara-Coastal and Dorper-Coastal cross bred sheep genotype were9.80±0.35 kg; 12.12±0.52 kg and 11.56±0.76 kg and 13.98±0.74 kg at 3 and 6 months of age respectively. Average growth rate of Damara-Coastal and Dorper-Coastal cross bred sheep genotype were 87.2±0.04 g/d; 71.00±0.02 g/d, and 104.6±0.01 g/d

and 65.2±0.01 g/d at 3 and 6 months of age respectively. This is ongoing research program. Data on productive and reproductive performances of three cross bred sheep genotypes during this study might help in decision making on evaluation of performance of above said three cross bred sheep genotype.This study need to be continued for developing a cross bred sheep genotype in Bangladesh.

Table 1. Production performances of different cross bred sheep genotype

Parameters	Genotypes		
	Damara-Coastal cross bred	Dorper-Coastal cross bred	Parendale-Coastal cross bred
Birth weight (kg)	1.98±0.06 (45)	1.97±0.19 (9)	1.77±0.86 (7)
Body weight in kg (3 months)	9.80±0.35 (40)	11.56±0.76 (5)	-
Body weight in kg (6 months)	12.12±0.52 (35)	13.98±0.74(4)	-
Growth rate-g/d(3 months)	87.2±0.04 (40)	104.6±0.01 (5)	-
Growth rate-g/d(6 months)	71.00±0.02 (40)	65.2±0.01(5)	-

Study on the hormonal profile in crossbred dairy cows in relation to repeat breeding at Baghabari milk shed areas

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Executive Summary

Repeat Breeding (RB) is a major reproductive disorder caused a great economic loss in dairy herds. It increased production cost of insemination, treatment, feed, labor and management, calving interval, culling rates and decreased calf and milk production. RB is a multi-factorial problem involving a number of extrinsic factor as well as intrinsic factors coupled to the individual animal. Lack of balanced feed, poor quality semen, hormonal deficiency, incidence of reproductive diseases, unskilled Artificial Insemination Workers (AIW), maltreatment of RB cows, crossbred genotype, high yielding cow, improper heat detection at the time of artificial insemination, seasons and lack of deworming were found the major causes of repeat breeding problems at Baghabari milk pocket areas. It was also found that incidence of repeat breeding problems was about 29 percent in dairy cattle which is very much alarming for dairy cattle production in the Baghabari milk shed areas. Presently, dairy farmers have been suffering a lot due to RB problem. No systematic works are done to minimize major causes of RB problems in the aforesaid areas. Hence, this study was undertaken to determine the hormonal profiles of repeat breeder cows before and after synchronization.The present study was conducted at the different sheds of dairy farmers at the Bathan area of Shahjadpur Upazila under Sirajgonj district. A total of 30 repeat breeder cows were selected randomly to determine their hormonal profiles in the study areas.. Selected repeat breeder cows were marked by ear tag and collected breeding history of each individual cow. Experimental cows were reared under the bathan feeding and management system. In addition, 50g mineral supplementation was given daily to all experimental cows. All experimental cows were synchronized using following hormonal treatment-

0 days	7 days	9 days
GnRH	PGF2α	GnRH

A total of fifty three (53) blood samples were collected into vacutainer tube from the jugular vein of each experimental repeat breeder cow. Blood samples were collected before synchronization from all experimental cows. Blood samples were collected after synchronization during standing heat period of estrous cycle of each cow measured by Estrous Detector Device for AI in appropriate time. The serum samples were prepared in the Animal Health Laboratory of Bangladesh Livestock Research Institute, Regional Station, Baghabari, Shahjadpur, Shirajgonj-6770. The plasma serum was separated by centrifugation (1500 rpm for 20 min). The separated serum was collected in a sterile vial and preserved at −20°C until analysis. All serum samples were analyzed in the Laboratory in the Department of Biochemistry and Molecular Biology, Faculty of Biological Sciences, Jahangirnagar University (JU), Savar, Dhaka by using endocrine detection kits (Mono Lelac^{R} USA). Values of different reproductive hormones between before and after synchronized repeat breeder (RB) cows are shown in Table 1. From the results of the present study clearly found that different reproductive hormones of LH, FSH and progesterone were significantly differed between before and after synchronization of repeat breeder cows except estradiol value. This result may be attributed due to synchronized of repeat breeder cows.

Table 1. Values of different reproductive hormones between before and after synchronized repeat breeder (RB) cows

Name of hormones	Hormonal values before Synchronization of RB cows	Hormonal values after Synchronization of RB cows	Level of significance
	Mean ± SE	Mean ± SE	
LH(mIU/ml)	0.8251 ± 0.08153	2.481 ± 0.4806	***
FSH(mIU/ml)	4.647 ± 0.7999	17.04 ± 2.743	***
Progesterone (ng/ml)	1.807 ± 0.2148	5.927 ± 0.4219	***
Estradiol (E2)(pg/ml)	82.23 ± 2.402	107.3 ± 6.974	NS

SE=Standard error, ***= highly significant, NS=Non-significant,LH=Luteinizing hormone,FSH=Follicle stimulating hormone.

It can be concluded that the level of luteinizing hormone (LH), follicle stimulating hormone (FSH),progesterone were significantly differed between repeat breeder cows and synchronized repeat breeder cows. It may also be inferred from the present findings that synchronized effect might be influence the results of hormonal values. However, more detailed studies s may be needed for drawing a specific inference.

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

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Executive summary

Goats are prolific small ruminants mostly reared by ultra-poor and poor peoples in Bangladesh. That's why it is said in our country that goat is the poor people's cow. Goats provide meat and skin which contribute national economy of Bangladesh by earning foreign exchange. There are about 25.77millions goats in our country.But, inheritance of coat color in goatreceived less attention than that of quantitative economic important traits and lack of a similar importance for color in most goats. However, attempts to develop and conserve different color variety of goat have not yet been done for the satisfaction of consumer's preference. Coat color is also an identity of a specific breed's character. However, people have a fascination on color phenotype of animals. Goats have great variation in color and the genetic control can be tricky. Considering the point of view, the present study had been taken with the objectives to develop pure-line goat genotypes based on coat color variant and phenotypic characterization of different coat color goat genotype. The research conducted pachutia goat shed at BLRI. To develop different color variants' goat stock, primarily goats having three distinguished colors viz. solid white (SW), Dutch belted (DB) and Toggenburg (TB) comprising flocks with 24; 39 and30 had been established. Within color pure breeding are being followed for designing mating plan. Progeny are being screened based on their color inheritance. Admixture of genes responsible for more than single color pattern are being discarded from the flock to maintain pure line generation. Semi-intensive management are being followed for animals of each flock. Genetic and phenotypic characterization of different coat color variants' goat are being recorded. The collected data were analyzed using computer software statistically with R (agricolae, pastecs pacakages).

Table 1. Body weight of goat 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
Male	1.26±0.03 (41)	7.53±0.35 (41)	11.44±0.47 (36)	69.16±3.63 (41)	37.76±4.05 (36)
Female	1.16±0.05 (38)	7.21±0.42 (38)	11.31±0.51 (34)	66.48±4.32 (38)	40.43±4.39 (34)
Genotype	NS	NS	NS	NS	NS
SW	1.3±0.05 (17)	7.67±0.44 (15)	11.94±0.57 (15)	69.91±4.52 (20)	45.39±4.93 (15)
DB	1.235±0.04 (18)	8.24±0.42 (17)	13.79±0.61 (17)	76.60±4.37 (23)	49.31±5.15 (17)
TB	1.15±0.04 (18)	7.05±0.41 (15)	10.83±0.53 (15)	65.14±4.25 (21)	37.06±4.93 (15)
Parity	NS	NS	NS	NS	NS
1st	1.22±0.04 (22)	7.15±0.41 (19)	10.86±0.46 (17)	66.00±4.14 (19)	39.10±4.34 (17)
2nd	1.33±0.09 (32)	8.65±0.44 (20)	12.17±0.46 (20)	79.87±4.39 (20)	39.05±4.36 (20)
3rd	1.08±0.05 (6)	-	-	-	-
Overall	1.21±0.03 (79)	7.9±0.27 (79)	12.08±0.35 (70)	88.82±2.82 (79)	71.09±2.99 (70)

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

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 3to 6 month (GR_{0-6}) were 1.21±0.03kg, 7.9±0.27kg, 12.08±0.35kg, 88.82±2.82g/d and 71.09±2.99g/d,

respectively. BWT of male kids were significantly ($p<0.001$) higher than those of female kids. However, sex, genotype and parity had no significant effect on3MWT, 6MWT, $GR_{0-3}$and GR_{3-6}.

Table 2 shows the reproductive performances for different coat color genotypes of goat. The overall age at puberty(days), number of service per conception, gestation length (d), age at first kidding (d), litter size (no), post-partum heat period (d) and kidding interval (d) obtained in this study were 236.0±6.71, 1.37±0.06, 166.5±3.01, 413±15.29, 2.17±0.13, 72.3±15.59 and 235.7±15.53, respectively. However, coat color genotype of goat, and parity had no significant effect on age at puberty, number of service per conception, gestation length, age at first kidding, and kidding interval. On the other hand, litter size and post-partum heat period significantly varied for the effect of coat color genotype and parity.

Table 2. Reproductive performance for different coat color genotype of goat

Factor	Reproductive parameters (Mean±SE)						
	Age at puberty (Days)	N. of service per Conception (no.)	Gestation length (Days)	Age at first kidding (Days)	Litter size (no.)	Post-partum heat period(Days)	Kidding Interval
Genotype	NS	NS	NS	NS	*	**	NS
SW	225.6±0.38 (7)	1.33±0.02 (24)	161. 7±1.22 (20)	397.7±12.28 (6)	2.59±0.04 (22)	57.7±8.17 (6)	199.78±4.44 (9)
DB	237.5±3.46 (12)	1.39±0.02 (23)	171.5±0.97 (19)	411.8±8.14 (11)	1.88±0.04 (24)	27.0±2.73 (6)	240.88±7.48 (8)
TB	245.3±5.13 (6)	1.42±0.04 (12)	170.8±2.02 (10)	430.5±6.55 (6)	1.92±0.04 (12)	144.0±25.04 (4)	256.8±19.82 (5)
Parity		NS	NS		***	*	NS
1st	-	1.48±0.02 (25)	173.5±0.98 (23)	-	1.69±0.02 (26)	88.5±20.15 (2)	243.5±8.81 (8)
2nd	-	1.35±0.02 (23)	158.1±1.11 (17)	-	2.23±0.03 (22)	72.0±8.42 (9)	213.64±6.08 (11)
3rd	-	1.18±0.03 (11)	168.8±2.6(8)	-	3.33±0.14 (9)	62.75±4.83 (4)	237.0±17.83 (3)
Overall	236.0±6.71 (25)	1.37±0.06 (59)	166.5±3.01 (49)	413±15.29 (23)	2.17±0.13 (58)	72.3±15.59 (16)	235.7±15.53 (22)

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

The results as obtained in this study show that body weight and growth rate of three coat color genotypes performed almost similar. However, reproductive performance varied among color types. Best litter size and post-partum heat period obtained from SW and DB types, respectively.

Production and compositional studies of local Pabna cows' milk in Bangladesh

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Executive summary

Milk is an ideal food which contains all the essential nutrients for physiological functions of human being. The aim of the present study was to know the effect of lactation length, parity and management on production performance and nutritional composition of local Pabna cows' milk. The daily milk yield data were recorded at 15 days interval from calving to till experimental period for animals raised at BLRI Research station. The trial was continued from January-September,2018. The cows raised at BLRI research station had the same parity (2^{nd})and similar feeding regime (DM basis; 2.5% of body weight using concentrate, straw and/or green grass).However, the overall management system varied between on-station and community. To determine the nutritional composition of milk, a total of 12 and 16 milk samples, respectively were collected from the cows raised at BLRI research station and DDRP community at Bera, Pabna district during June, 2018. All the collected milk samples were shifted by ice box until analyzed at laboratory using Lactoscan MMC50 (Nova Zagora, Bulgaria). Data on milk production were statistically analyzed in an ANOVA of Completely Randomized Design and nutritional composition were statistically analyzed using independent sample *t*-test by SPSS version 16 (SPSS Inc. Chicago, USA).

The average daily milk yield was significantly ($p<0.05$) higher during the first month (4.72 L) of lactation and the lowest daily milk yield was at 5^{th} month (3.44 L). However, daily milk yield of Pabna cows raised at BLRI research station did not vary significantly ($p>0.05$) during 1^{st} to 4^{th} months of lactation period (Table 1). Among the test days milking(Figure 1) better yield was observed at 15 days (4.79L) of lactation ($p<0.05$).The effect of lactation stages (up to three or above months) had no significant variations ($p>0.05$) on nutrient composition of local Pabna cows' milk (Table 2). Based on the effects of parity number and lactation stages of cows, similar trends ($p>0.05$) were also found in the milk collected from community cows (Table 3). However, the overall characteristics of milk between on-station and community had significant differences on the composition of total solids ($p<0.001$), SNF ($p<0.001$), fat ($p<0.01$), and protein ($p<0.05$where the highest values were 14.81, 8.65, 6.17and 3.53% at on-station cows' milk, respectively (Table 4).

Table 1. Effect of lactation period on milk production of local Pabna cows at on-station

Lactation period (month)	n	Mean (L)	SE	Minimum	Maximum
First	12	4.72^{a}	0.35	3.58	7.96
Second	10	4.17^{ab}	0.16	3.48	5.28
Third	9	3.90^{ab}	0.13	3.34	4.38
Fourth	8	3.68^{ab}	0.17	3.03	4.53
Fifth	4	3.44^{b}	0.25	2.82	4.02
Sig. level		*	-	-	-
Overall	43	4.10	0.13	2.82	7.96

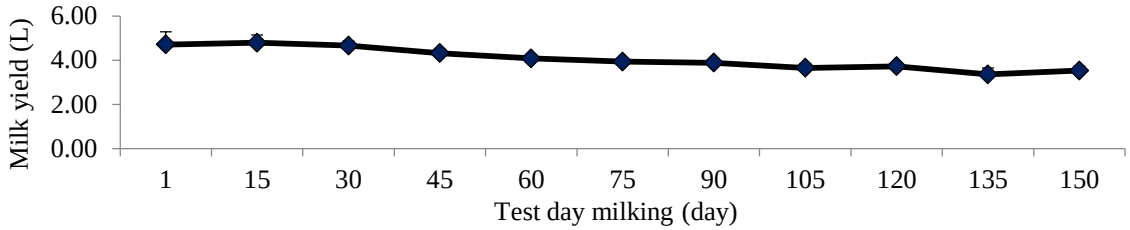

Figure 1. Milk yield of local Pabna cows in different test days of lactation

Table 2. Effect of parity and lactation stages on milk characteristics of local Pabna cows at on-station

Parameters	Parity number (Mean±SE)		*t* test	Lactation stage (Mean±SE)		*t*-test
	≤2 parity (n=12)	>2 parity (n=0)		≤3 months (n=9)	>3 months (n=3)	
Total solid (%)	14.81±0.19	-	-	14.85±0.24	14.70±0.37	0.756
SNF (%)	8.65±0.08	-	-	8.68±0.09	8.55±0.16	0.512
Fat (%)	6.17±0.16	-	-	6.17±0.20	6.15±0.26	0.958
Protein (%)	3.53±0.11	-	-	3.51±0.10	3.59±0.38	0.768
Lactose (%)	4.45±0.09	-	-	4.49±0.10	4.30±0.18	0.365
Ash (%)	0.68±0.01	-	-	0.68±0.02	0.67±0.04	0.829
Specific gravity	1.027±0.001	-	-	1.027±0.001	1.026±0.001	0.382
pH	6.72±0.01	-	-	6.71±0.02	6.73±0.01	0.720
Conductivity	4.04±0.04	-	-	4.09±0.03	4.13±0.03	0.504

Table 3. Effect of parity and lactation stages on milk compositional characteristicsfrom local Pabna cattle at community

Parameters	Parity number (Mean±SE)		*t*-test	Lactation stage (Mean±SE)		*t*-test
	≤2 parity (n=10)	>2 parity (n=6)		≤3 months (n=5)		>3 months (n=11)
Total solid (%)	13.91±0.51	12.97±0.35	0.211	13.55±0.66	13.55±0.44	1.00
SNF (%)	7.88±0.18	8.05±0.10	0.493	7.80±0.27	7.99±0.13	0.487
Fat (%)	6.04±0.51	4.92±0.39	0.150	5.75±0.68	5.56±0.46	0.822
Protein (%)	3.10±0.07	3.15±0.04	0.515	3.07±0.09	3.13±0.05	0.507
Lactose (%)	4.15±0.10	4.25±0.06	0.472	4.11±0.15	4.22±0.07	0.481
Ash (%)	0.63±0.02	0.64±0.01	0.546	0.62±0.02	0.64±0.01	0.433
Specific gravity	1.025±0.001	1.027±0.001	0.228	1.025±0.001	1.025±0.001	0.607
pH	6.81±0.06	6.77±0.09	0.669	6.80±0.07	6.80±0.07	0.987
Conductivity	4.13±0.03	4.14±0.12	0.863	4.17±0.07	4.11±0.02	0.272

Table 4. The overall milk compositional characteristics of local Pabna cows (≤2 parity) raised under on-station and community

Parameters	Management systems (Mean±SE)		*t*-test
	On-station (n=12)	Community (n=10)	
Total solid (%)	14.81±0.19	12.97±0.19	0.000
SNF (%)	8.65±0.08	8.05±0.10	0.000
Fat (%)	6.17±0.16	4.92±0.39	0.003
Protein (%)	3.53±0.11	3.15±0.04	0.034
Lactose (%)	4.45±0.09	4.25±0.06	0.162
Ash (%)	0.68±0.01	0.64±0.01	0.099
Specific gravity	1.027±0.001	1.027±0.001	0.702
pH	6.72±0.01	6.77±0.10	0.438
Conductivity	4.10±0.02	4.14±0.05	0.411

It is concluded that first month of lactation was the best milk producing period among the five months of lactation and the management system had positive association with milk composition of local Pabna cows.

Prevalence study and molecular characterization of infectious laryngotrachitis virus in selected areas of Bangladesh

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Executive summery

Infectious Laryngotrachitis (ILT) is an important respiratory disease of chicken caused by gallid herpes virus-I of the family *Herpesviridae*, subfamily *Alphaherpesvirinae*, genus *Iltovirus*. It is an enveloped, non-segmented and linear double-stranded DNA virus. Clinical signs associated with the severe form of the disease include gasping, depression, nasal discharge, conjunctivitis, and expectoration of bloody mucus. Upon gross examination of the trachea, characteristic severe hemorrhages and mucus plugs are observed. The clinical signs associated with less severe forms of the disease include conjunctivitis, swelling of the infraorbital sinuses, closed eyes, persistent nasal discharge and mild tracheitis. Total 350 tracheal swab samples were collected from suspected cases of ILT from commercial layer of selected areas (Gazipur, Bogura, Chattogram and Dhaka) of Bangladesh. After collection the samples were kept in viral transport medium (VTM) containing antibiotics. After collection, the samples were transported to the Virology Laboratory of the Animal Health Research Division, BLRI, Savar, Dhaka and stored at -80^{0}C until tested. The samples swab samples were grinded and homogenized, and 10% suspension was be prepared by using phosphate buffer solution (PBS). The suspension was centrifuged at 4500 rpm for 10 min for the collection of supernatant and extracts the genomic DNA by QIAamp DNA Mini Kit according to manufacturer guideline. Then qPCR were performed for the confirmation of ILTV positive samples by reference primer and probe. About 5.14% (n=18) samples were found positive for ILTV with distribution of prevalence as 8, 7, 2 and 1 in Gazipur, Bogura, Dhaka and Chattogram district respectively. Highest prevalence was revealed in young chicks (72.22%) than adult (27.78%). The study carried out to detect ILTV circulating in Bangladesh and young chicks are more susceptible to infection.

Genetic evolution of highly pathogenic avian influenza virus (HPAIV) for interspecies transmission and spillover in Bangladesh: Emergence of HPAI H5N6

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Executive summary

Highly pathogenic avian influenza virus (HPAIV) A/H5N1 subtype – is a major issue for the poultry industry in Bangladesh during first incursion of HPAIV in 2007. Bangladesh has one of the highest reported numbers of outbreaks of highly pathogenic avian influenza (HPAI) H5N1 in poultry. As of July 20, 2015, a total of 548 outbreaks of HPAI H5N1 have been reported; these outbreaks have resulted in serious economic repercussions in poultry sector in this country. Furthermore, 7 cases of human infection with HPAI H5N1 were confirmed emphasizing the public health aspect of the on-going HPAIV H5N1 outbreaks. Following the initial spread of clade 2.2 H5N1 HPAI virus in Bangladesh in 2007, there have been new introductions of clade 2.3.2.1 and clade 2.3.4 virus in 2011. Genetic information about those circulating AIVs have shown natural reassortment HPAI H5N1 virus containing a H9N2-PB1 gene in poultry in Bangladesh. The HPAI A/H5 virus is a significant menace not only to the poultry industry but also to human health due to its pandemic budding. The aim of the study was the detection of molecular evolution and identification of novel HPAIVs circulating in Bangladesh. Cloacal and oropharyngeal swab samples were collected from the live bird of LBMs (birds; n=754, ducks; n=414) and morbid materials such as trachea were collected from dead birds (n=108), and environmental samples of LBMs (n=242) from sub district Savar, Dhamri, Gazipur Sadar during July 2017 to June 2018. All samples were tested by qRT-PCR for influenza A (M gene), H5, H7, H9, N1, N2, N6, N8, N9 genes of avian influenza virus. Of the total, 3 of the chicken were found positive for A/H5N6. The identified H5N6 viruses were cultured and further characterized by qRT-PCR which also revealed A/H5N6. Partial HA gene sequencing was performed by Sanger sequencing and subjected to phylogenetic analysis. Phylogenetic analysis based on partial sequences of the HA gene of A/H5N6 subtype belongs to 2.3.4.4 clade. Whole genome sequencing of A/H5N6 samples were performed in Animal and Plant health Agency, UK and subjected to phylogenetic analysis. Phylogenetic analysis based on whole genome sequences also revealed that circulating A/H5N6 subtype belongs to 2.3.4.4 clade.

Sero-surveillance of circulating of PPR Virus and its Phylogenetic analysis in different areas of Bangladesh

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Executive summary

Peste des Petits Ruminants (PPR) is a highly fatal viral disease of goat and sheep. This research work was done in 2017-18 by executing, surveillance and epidemiological studies to determine present status of circulating PPR virus and its molecular characterization in different areas of Bangladesh. cELISA was used PPR antibody detection and RT-PCR also used for N gene identification. Sera samples and nasal swabs were collected from eight (8) selected villages under Meherpur sadar upazila of Meherpur district on questionnaire basis. Considering two villages as control and six villages as treatment villages. The total 3656 sera was collected at pre vaccination (0 days), 21 days, 2 months, 6 months of post vaccination at the selected areas that was tested by cELISA and 12035 goats and sheep received local PPR Vaccine. Baseline study showed that a total of 950 household rear goats in selected 8 villages where number of goats per household ranges from 4.0-5.0. Deworming was done before vaccination in the treatment villages. Pre-vaccination sera analysis showed that in six treatment village seropositive goats were 55.95%, 50.76%, 37.68%, 41.12%, 44.62%, and 43.26% in Chakshamnagar, kola, Amjupi, Amdaoah, Gopalpur and Chadbill respectively, whereas in the control villages seropositive goats were 40.00% and 42.57% in Doforpur and Mayamari, respectively that presented in figure number 01.

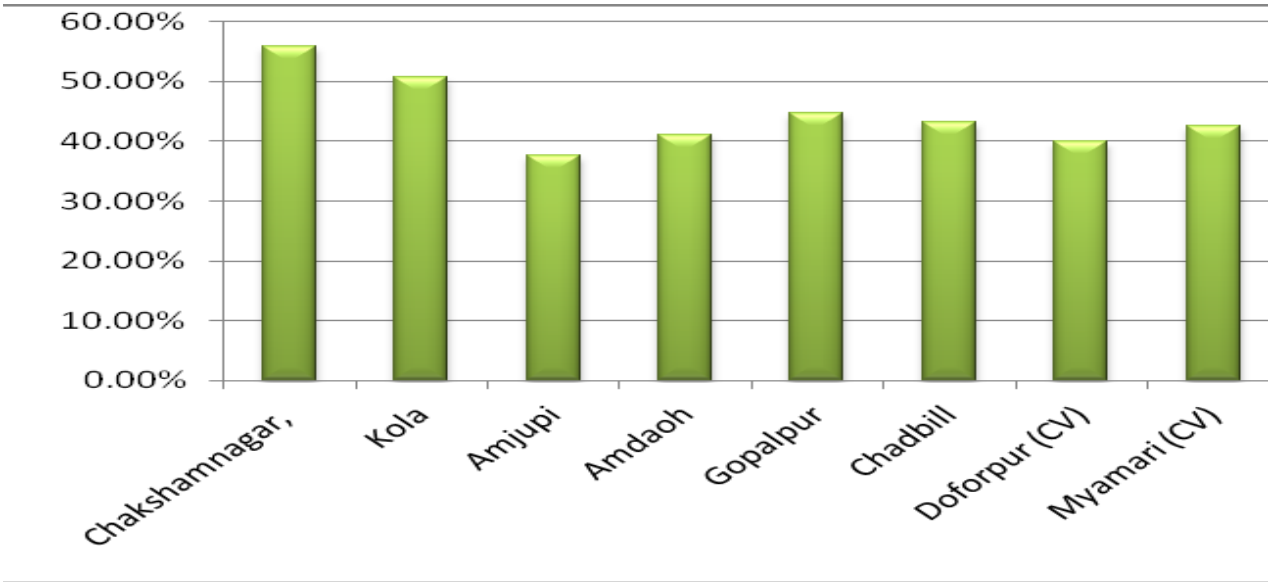
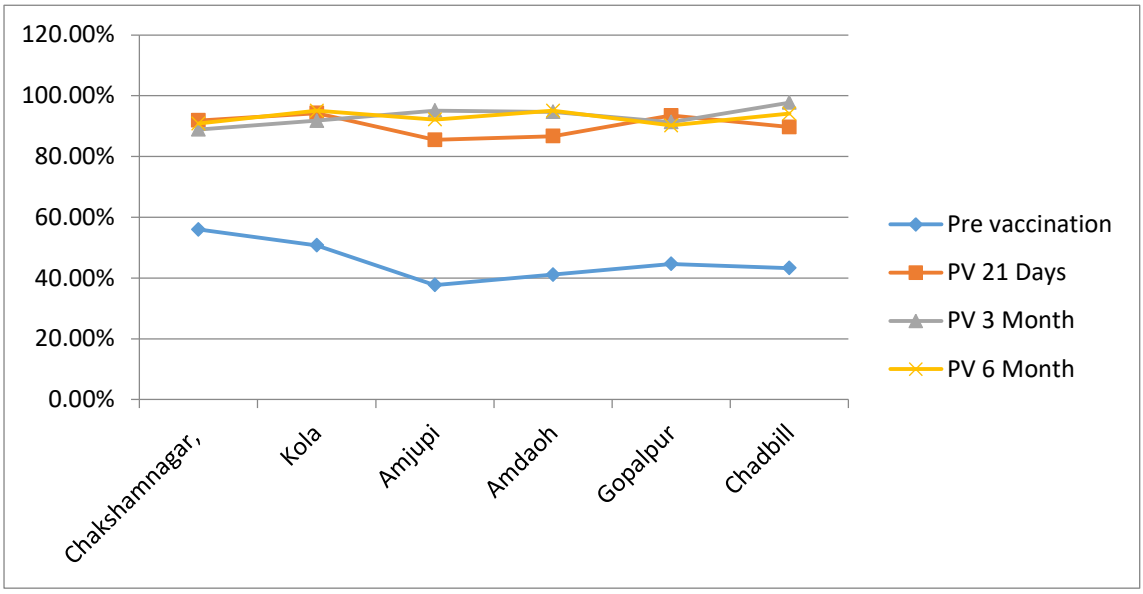


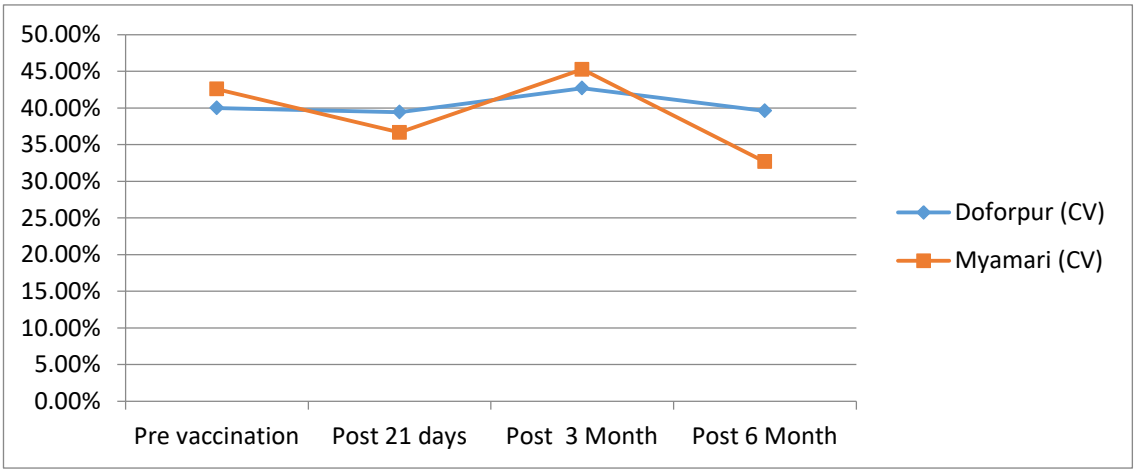
Figure 1. Sero-Prevalance of PPR antibody in goats at treatment (6 villages) and control (2 villages)

Overall 44.90% goats were seropositive against PPR Virus in treated villages before vaccination. Sera was analysed from 21 days, 2 months and 6 months of post-vaccinated goat from the treatment 6 villages showed the herd immunity level of goats rose to 89.10%, 93.25% and 93.37% respectively shown in Graph-1.



Graph 1. The herd immunity against PPR virus at treatment (6 Villages) of Meherpur district.

Whereas in the control villages seropositive against PPR virus in goats was 38.14%, 43.98% and 35.64%, respectively shown in Graph 2.



Graph 2. The immunity status against PPR virus at control (2 Villages) of Meherpur district

Awareness building campaigns with villagers have been conducted involving both men and women through meeting, regular visit of household, distribution of poster and leaflet. Morbidity and case fatality rate recorded were 15% and 70.55%, respectively due to PPR outbreaks. In clinical case, total 172 nasal swabs were tested by RT-PCR and 119 samples were N gene positive. The PCR Products were storage for phylogenetic analysis. There was no PPR outbreak in the vaccinated villages though two farmers introduced PPR infected goats in their herds bought from market. No spread of PPR in other goats due to vaccination program. New entry of goats in the household or village is most important risk factor for PPR virus circulation which was found in several outbreaks in the non-vaccinated and surrounding villages. It is reflected that locally produced PPR vaccine confers sufficient herd immunity that can protect PPR disease in goat and helps to meet global PPR control programme.

A comparative study on pregnancy diagnosis in sheep (*Ovis aries*) using barium chloride and progesterone based- kit

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Executive summary

This study aiming at developing a low cost technique for early diagnosis of pregnancy in sheep was conducted in Goat and Sheep Research Farm and Small Ruminants Health Laboratory under Goat and Sheep Production Research Division of Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka from July 2017 to June 2018. About 100 sheep of different age groups were randomly selected for the trial and sheep were categorized under four groups according to their gestation length and blood and urine sample were used for this experiment. Then 1%, 1.5% and 2% barium chloride solution were prepared and test was done by using 1 ml barium chloride of each concentration after mixing with 1 ml of urine sample and allowed for 5 and 10 minutes for interpretation. Presence of precipitation was interpreted as negative for pregnancy and absence of precipitation was interpreted as positive for pregnancy. For each blood sample, after adding 3 to 5 drops of serum in each insertion hole of the Bovipreg kit and observe for 5 minutes to notice the presence of one or two red line in. One red line was interpreted as negative pregnancy and two red lines were interpreted as positive pregnancy. In our study,1.5% barium chloride showed the highest accuracy of 67.75% for sheep with 0.5 to 1 month of gestation (Table 1), 68% for sheep with >1 to 1.5monthof gestation (Table 2), 69.25% for sheep with >1.5 to 2months of gestation (Table 3), and 67.75% for sheep with >2 to 2.5 months of gestation(Table 4).Conversely, the accuracy levels for progesterone-based early pregnancy diagnostic kit were 80%, 82%, 83%, and 85% for sheep with 0.5 to 1 month, >1 to 1.5month, >1.5 to 2months, and >2 to 2.5months of gestation respectively (Table 1, 2, 3, and 4).

Table 1. Comparative results of barium chloride and progesterone- based kit pregnancy diagnosis in sheep with 0.5 to 1 month of gestation

Number of Goats	Barium Chloride (Concentration and diagnostic accuracy)						Progesterone - Based Kit (Diagnostic accuracy)
n=25	1% (Conc.)		1.5% (Conc.)		2% (Conc.)		
	5 min.	10 min.	5min	10min	5 min.	10 min.	5 min.
	66.5%	67.5%	68%	67.5%	67.5%	66.5%	80%
Mean	67%		67.75%		67%		-

Table 2. Comparative results of barium chloride and progesterone- based kit pregnancy diagnosis in sheep with >1 to 1.5 month of gestation

Number of Goats	Barium Chloride (Concentration and diagnostic accuracy)						Progesterone - Based Kit (Diagnostic accuracy)
n=25	1% (Conc.)		1.5% (Conc.)		2% (Conc.)		
	5 min.	10 min.	5min	10 min	5 min.	10 min.	5 min.
	68%	67.5%	68.5%	67.5%	68.5%	67%	82%
Mean	67.75%		68%		67.75%		-

Table 3. Comparative results of barium chloride and progesterone- based kit pregnancy diagnosis in sheep with >1.5 to 2 months of gestation

Number of Goats	Barium Chloride (Concentration and diagnostic accuracy)						Progesterone-Based Kit (Diagnostic accuracy)
n=25	1% (Conc.)		1.5% (Conc.)		2% (Conc.)		
	5 min.	10 min.	5 min	10 min	5 min.	10 min.	5 min.
	70%	67.5%	70.5%	68%	67.5%	66.5%	83%
Mean	68.75%		69.25%		67%		-

Table 4. Comparative results of barium chloride and progesterone- based kit pregnancy diagnosis in sheep with >2 to 2.5 months of gestation

Number of Goats	Barium Chloride (Concentration and diagnostic accuracy)						Progesterone - Based Kit (Diagnostic accuracy)
n=25	1% (Conc.)		1.5% (Conc.)		2% (Conc.)		
	5 min.	10 min.	5min	10min	5 min.	10 min.	5 min.
	69%	68%	70%	71%	66.5%	67.5%	85%
Mean	68.5%		70.5%		67%		-

To conclude, it is obvious that incase of sheep, the progesterone-based early pregnancy diagnostic kit cannot be replaced by barium chloride test but 1.5% barium chloride can be used for primary screening.

Effect of feed supplementation on age at puberty in growing buffalo heifers

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Executive summary

Buffalo is a potential animal genetic resource. At present, buffalo population in the world is approximately 150 million. Based on karyotypes, buffaloes are two types such as river and swamp type. The swamp buffaloes are raised in countries extending from Assam to China and used for drought power and river buffaloes are found in the Indian sub-continent, and used primarily as a source of milk. The fertility of buffalo was significantly higher (83.5%) when kept on higher plain of nutrition as compared to 66.6% for those maintained on low plain of nutrition. Age at first calving may be reduced through providing balanced feeding, improved management and minimum disease prevalence. To get faster growth rates for early puberty on cost effective, it is recommended that forge should be the basal diet and concentrates as supplementation. Our local buffalo attained puberty at 30.3months age at on-station and 39.4 to 54.5 months at on-farm condition. But, in the majority of dairy buffaloes in Bangladesh, calving occurs at 4-6 years of age. This is due to an inadequate supply of feed and nutrients during the growing phase. Most buffalo cease ovarian cyclicity during hot summers, probably due to the combined effects of nutrition, environment and management. Nutritional manipulations may influence the period of sexual maturation. In Bangladesh, buffalo is an important large ruminant; estimated the population of about 1.47 millions and they are mostly local type. Pakistani Nili-Ravi and Indian Murrah buffaloes were widely used to increase dairy characteristics of local buffalo population in Indo-Chinese Region and South America through crossbreeding. These crossbreeding programmes resulted increase in lactation milk yield from 700 to 2,000 kg per year in China. So, considering the above facts genetic potentiality of local buffalo breeds has to improve for increasing their milk and meat production through crossing local buffalo with high yielding exotic Murrah and Nili-Ravi buffalo breed. It needs also to evaluate the adaptability of those crossbred buffaloes to our farmer's condition. Low reproductive efficiency (late maturity, long calving interval and silent heat etc.) is a serious constraint to buffalo production. To overcome these problems, a feeding trial was conducted with different levels of concentrate supplement along with urea-molasses-straw (UMS) was supplied *adlib* as basal diet. Thus, the aim of present study was to investigate the effect of different levels of concentrate supplement on age of sexual maturity of buffalo heifers and is too increase genetic makeup of local buffalo through crossbreeding with Murrah & Nili-Ravi buffalo.

To conduct this study, sixteen buffalo heifers aged from 6 months to 12 months were selected and divided randomly into four homogenous (considering age and body weight) treatment groups (Group A, B, C and D). Buffaloes of all groups received urea molasses straws as basal diet. The experimental buffaloes were also received concentrates@ 0.5% on body weight for group A, 0.75% for group B, 1.00% for group C and 1.25% for group D, respectively. Required amount of concentrates were provided twice in a day (50% in the morning and 50% in the evening). *Adlib* fresh water was supplied to separate manger for each group. The age of puberty were recorded when the animals had showed first sign of heat or responded to teaser bull. The susceptibility of buffalo with common diseases was evaluated. Any reproductive diseases were monitored. Daily feed intake; body weight; feed evaluation; nutrient requirement calculations, date of birth; feed conversion ratios were recorded. Regular de-worming and vaccination against common diseases were ensured during experimental periods for all groups. The trial was conducted for a period of 482days. The relevant data were compared statistically in an ANOVA of a Completely Randomized Design using IBM SPSS 20.0

Table 1 represents feed intake, growth and FCR values of buffalo heifer fed graded levels of concentrate mixture. The total DM intakes during the entire experimental periods differed significantly ($p<0.001$) among treatment groups. As the level of concentrate increase in diet the DM intake increased linearly and significantly ($p<0.001$). Significantly lowest amount of DM was consumed in the animals of group A. The feed conversion efficiency had significantly better in group A than that of group B, C, and D respectively. FCR however, did not differ significantly ($p>0.05$)

among the group B, C and D, although overall difference among groups were not significant. The average daily gain as well as the total live weight gain did not differ significantly among the treatment groups ($p>0.05$).

Table 2 shows the age at puberty and body weight at puberty of buffalo heifers among four treatment groups. As shown in Table 2 that quantity of concentrate feeds allocated by different proportions among four treatment groups had no significant ($p>0.05$) effect for either attaining age at puberty or body weight at puberty.

Table 1. Feed intake (up to 482 days) and efficiency of buffalo heifers for different treatment groups

Intake	Treatment group (Mean±SE)				Level of significance
	A	B	C	D	
Initial body weight (Kg)	195.5±19.62	220.38±41.23	194.75±28.51	203.5±37.19	$P=0.939^{NS}$
Final body weight (kg)	302.5±19.50	319.25±40.77	297.25±22.46	292.25±31.69	$P=0.924^{NS}$
Total weight gain (kg)	221.75±16.61	191.25±25.82	192.75±11.42	205.50±22.04	$P=0.680^{NS}$
Daily weight gain (g/d)	460.06±0.03	396.78±0.05	399.89±0.02	426.35±0.04	$P=0.680^{NS}$
Total DM intake (Kg)	2501.75^{a}±160.4	2926.50^{b}±28.05	3189.50^{b}±93.09	3593.50^{c}±70.28	$P=0.0^{***}$
FCR	11.31^{a}±0.23	16.21^{ab}±2.27	16.68^{b}±0.82	18.21^{b}±2.25	$P=0.060^{NS}$

A=UMS (*adlib*)+0.5% concentrate; B=UMS (*adlib*)+0.75% concentrate; C=UMS (*adlib*)+1.0% concentrate; D= UMS (*adlib*)+1.25% concentrate; NS-not significant ($p>0.05$); ***-significant at 0.1% level ($p<0.001$); mean with uncommon superscripts within the same row differed significantly ($p<0.05$).

Table 2. Age and body weight at puberty of buffalo heifer for different treatment groups

Pubertal age and weight	*Treatment group (Mean±SE)				Level of significance
	A	B	C	D	
Age at puberty (month)	22.94±1.07 (03)	23.40±0.80 (02)	23.90±0.40 (03)	24.30±0.60 (02)	$P=0.678^{NS}$
Body weight at puberty (kg)	346.67±16.91 (03)	372.30±2.50 (02)	355.0±1.73 (03)	372.50±10.61 (02)	$P=0.351^{NS}$

*Treatment combinations have given in footnote of Table 1; NS-significant at 5% level ($p<0.05$)

Based on the results so far obtained from this study, it may be concluded that buffalo heifers could be allowed concentrates @0.5% on body weight along with UMS *adlib* for obtaining optimum puberty, as more concentrates than this had not shown significantly better results. However, more researches including more animals need to be done to draw a concrete decision.

Physiochemical characteristics of silage prepared from BLRI Nepier-3, Pakchong-1 and Maize

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Executive summary

Goat and sheep are widespread in the country and are important for the subsistence, economic and social livelihoods of a large human population of Bangladesh. Being much smaller than cattle, they require less money to purchase and need little investment facilities. Feed and fodder scarcity is a major limiting factor of livestock production in Bangladesh and in particular resulting in low productivity, poor growth and reproduction of animals. As arable land is decreasing day by day stall feeding system of goat and sheep farming is increasing. Thus, farmers are practicing perennial fodder production for their goat and sheep. BLRI Napier-3, Pakchong-1 and maize fodders are commonly cultivated by farmers regarding this purpose. As Pakchong-1 is a newly introduced fodder germplasm in the country, no systematic information available about the production and the forage quality of Pakchong-1 in Bangladesh condition. Therefore, the study was aimed to know the silage quality of Pakchong-1 compare to BLRI Nepier-3 using Maize silage as a control group.All the mention fodders were cultivated at Bangladesh Livestock Research Institute fodder field. BLRI Nepier-3 and Pakchong-1 were harvested at 50 days of maturity while the fodder maize was harvested at about 50% flowering stage after sowing(75days) and chopped at 01–04-cm length for silage preparation. Silages were packed tightly in plastic drum and sealed to remain air tight. All experimental silages were replicated three times and stored in room temperature for 60 days for ensiling. The fodder samples before and after fermentation were collected forphysical and chemical analysis.

Table 1. The chemical composition of fodders used for silage preparation

Parameters	Grasses		
	BLRI Nepier-3	Pakchong-1	Maize
DM, %	21.58	21.42	18.61
OM, %	78.42	78.58	81.39
Ash, %	9.93	7.61	10.20
CP, %	7.33	7.08	8.47
ADF, %	50.48	48.00	51.68
NDF, %	81.84	83.20	82.30

Physical characteristics of BLRI Nepier-3, Pakchong-1 and Maize silage are presented in table2. The colour of all types of silages wasacceptable but aroma indicated that the ensiling quality of Pakchong-1 and Maize fodderwasbetter compared to BLRI Napier-3. The aroma of Pakchong-1 and Maize silage indicated that thedesirable lactic acid fermentation occurred where aroma of BLRI Nepier-3 indicated the production of acetic acid along with lactic acid. However, both the colour and aroma are in acceptable range for silage quality.

Table 2. The physical characteristics of different fodder silages

Parameters	Silage		
	BLRI Nepier-3	Pakchong-1	Maize
Colour	Pale yellowish green	Light green to yellowish green	Light green to yellowish green
Aroma	Mild and Slightly vinegary	Mild, pleasantly acidic, sour milk or natural yoghurt smell	Mild, pleasantly acidic, sour milk or natural yoghurt smell
Texture	firm	firm	firm

Table 3. Fermentation characteristics and chemical composition of different fodder silages

Parameters	Silages		
	BLRI Nepier-3	Pakchong-1	Maize silage
pH	4.78	3.54	3.58
NH_3N (mg/100g)	97.12	29.95	11.62
DM, %	15.84	20.24	22.56
OM, %	84.16	79.76	77.44
Ash, %	6.91	6.84	4.54
CP, %	8.08	7.05	7.09
ADF, %	39.50	47.54	46.96
NDF, %	74.32	73.93	77.17

The fermentation characteristics and chemical composition of BLRI Nepier-3, Pakchong-1 and Maize silage are shown in Table3. The lower pH produced by Pakchong-1 and Maize silage indicated that the ensiling properties of Pakchong-1 was better than BLRI Napier-3. Higher concentration of NH_3-Nin BLRI Nepier-3 compared to Pakchong-1 and maize silage also suggested that more proteolysis occurred in BLRI Nepier-3 silage. Therefore, the results suggest that ensiling characteristics of Pakchong-1 is better than BLRI Nepier-3 cultivar based on current study.

Feed intake, growth performance and nutrient utilization by local growing bulls fed different fodders as sole diet and their biometrical ranking

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Executive summary

The efficiency of a fodder to animal production performances is important as about 55 to 75 % of the total costs of farming are associated with feed costs (NRC, 2000; Basarab and Okine, 2002). Feed evaluation systems are used to match the dietary nutrient supply with animal requirements for a specific level of production. These systems are important in order to optimize the efficiency of feed utilization, to improve animal performance and to reduce nutrient losses to the environment. The germplasm of different varieties of fodder crops are available in the country, some of them are popular as cultivars to farmers and a number of private organizations have been introducing new seeds of fodder crops of exotic origins to a backdrop of demand and supply gaps of green grass in the country (Huque and Sarker, 2014). Without considering nutritional benefits to animals or comparative production performances with existing crops new fodder crops are being introduced. The efficiency of on-farm biomass production, it's response to growth & milk production to bovine animals and the reduction of enteric methane emission in the rumen and the cost-effectiveness are major factors affect benefits of a fodder crop in farming systems (Huque *et al*., 2014).Biometrical ranking based on Maize Index (M_i) of Maize, Napier, Jumbo (sugar graze), Australian sweet Jumbo, UMS of Rice straw (Boro and Aman), Moringa plant fodder, Green Jumbo, German and Para have been done and a Maize index (M_i) has been developed through a series of feeding trial from 2014-2017.Maize Index (M_i) is a co-efficient of production efficiency of biomass and animals, reduction efficiency of enteric CH_4 emission in the rumen, and of benefit-cost ratio compared to Maize silage. Thus, the Maize Index(M_i) equation of afodder was developed (Huque *et al*, 2017) and putted below.

Table 1. Chemical composition of experimental diets

Diets	DM, % of fresh BM	Chemical composition (%DM)					GE (Mj/ kg, DM)
		OM	CP	ADF	NDF	Ash	
Maize	18.89[b]	93.8	7.8[b]	42.5[a]	68.47[a]	6.16	16.11[b]
Oat	20.18[b]	94.1	10.1[a]	42.9[a]	65.72[b]	5.87	15.96[c]
Triticale	22.20[a]	93.3	10.7[a]	38.8[b]	64.45[c]	6.73	16.39[a]
SED	0.83	0.43	0.16	1.68	0.33	0.43	0.003
Sig.	**	NS	***	**	***	NS	***

$$M_i = \frac{\frac{y\,(\boldsymbol{Fodder\ DDM})}{\boldsymbol{Maize\ DDM}} + \frac{y\,(Kg\ LW\ of\ Fodder)}{Kg\ LW\ of\ Maize} + \frac{\frac{\mathbf{KgCH_4}}{\mathbf{Kg\ LW\ gain}}\ \mathbf{of\ Maize}}{y} + \frac{y}{\frac{GR_f}{GC_f}\boldsymbol{of\ Maize}}}{\mathbf{4}}$$

In continuation of research works, Oat (*Avena sativa*) and Triticale (*Triticosecale*), two important fodders being cultivated by the farmers in the winter are considered to be ranked accordingly. Thus, the present research work was undertaken with the objectives of evaluating intake, digestibility and growth performances of local growing bulls fed Oat or Triticale silage alone keeping Maize (*Zea mays*) silage as control and to scaling up the available roughages. Maize, Oat and Triticale were cultivated and harvested at their optimum maturity and ensiled for feeding to experimental animals. The three different types of fodder were randomly fed to 18 local growing bulls (*Bos indicus*; BCB-1) of average 179.7±33.4 Kg initial live

Table 2. Nutritional and growth responses of different roughages

Parameters	Diets			SED	Sig.
	Maize	Oats	Triticale		
DMI (Kg/d)	3.67	3.60	3.54	0.04	NS
CPI (Kg/d)	0.28[b]	0.37[a]	0.39[a]	0.004	***
OMI (Kg/d)	3.44	3.38	3.31	0.03	NS
DMI (kg, % LW)	1.97	1.92	1.92	0.03	NS
DM dig.	59.8[b]	64.7[a]	62.6[ab]	4.32	*
CP dig.	58.2[b]	64.5[a]	60.0[b]	4.47	**
OM dig.	61.2[b]	66.1[a]	64.4[ab]	4.05	*
DDMI (Kg/d)	2.20	2.32	2.23	0.02	NS
DCPI (Kg/d)	0.17[b]	0.24[a]	0.23[a]	0.004	***
Initial LW (Kg)	181.3	179.5	178.5	596	NS
Final LW (Kg)	197.0	199.5	195.9	585	NS
ADG (g)	248	305	290	2.35	NS
FCR	15.23	12.55	12.60	3.46	NS

weight dividing them into three equal groups. The animals were housed individually and fed the roughage diets *ad libitum* for a period of 60 days including a 7 days digestibility trial after 40 days of feeding. Fresh and clean water was available in the animal sheds for the whole experimental period. At the onset of feeding trial, animals were dewormed properly with Endex ® (Levamesol BP 600 mg per bolus).The animals were weighed at an interval of 10 days, and their feed intake, digestibility of nutrients and growth performances were used for comparing the nutritional qualities of different roughages. The enteric CH_4 emission in the rumen was calculated using the equation of IPCC (2006).The nutritional responses were compared statistically in an ANOVA of a Completely Randomized Design (CRD) using General Linier Model Procedures of SPSS, 17 computer software packages.

Among the three different roughages, Maize had higher biomass yield in terms of both fresh (46.9 MT/h) and dry matter basis (10.6 MT/h) than that of Oat (31.3 & 6.32 MT/h, respectively) and Triticale (25.4 & 5.64 MT/h, respectively) considering a single cultivation. The production cost per ton DM silage of Maize was lower (US$ 85.0) than that of Oats (US$152.0) and Triticale (US$165).Both the Triticale (10.7%) and Oat silage (10.1%) had significantly ($p<0.001$) greater CP concentrations than the Maize (7.8%). The ADF ($p<0.01$) and NDF ($p<0.001$) content on the other hand were greatest with Maize, intermediate with Oat and lowest with Triticale silage(Table 1).Maize, Oat and Triticale silage had per head daily DM intake of 3.67 Kg, 3.60 Kg and 3.54 Kg, respectively, and their intake percent live weight was 1.97, 1.92 and 1.92%, respectively. Daily DM intake, DM intake on percent live weight and OM intake of bulls did not vary significantly ($p>0.05$) among the three different roughages. However, per day CP intake of bulls fed Triticale silage (0.39 Kg/d) was significantly higher ($p<0.001$) followed by bulls those fed Oat silage (0.37 Kg/d) and Maize silage (0.28 Kg/d). The DM ($p<0.05$), CP ($p<0.01$) and OM ($p<0.05$) digestibility appear to be greatest for Oat (64.7, 64.5 & 64.4%, respectively), intermediate for Triticale (62.6, 60.0 & 64.4%, respectively) and lowest for Maize (59.8, 58.2 & 61.2%, respectively). Similarly, Oat silage had the highest ($p<0.001$) intake of digestible DM followed by DDM intake of Triticale and Maize. However, the intake of DDM and DOM did not vary significantly ($p>0.05$) among the roughages. Feeding Oat silage had higher ($p>0.05$) average daily gain of 305 g compared to 290 g of Triticale or 248 g of Maize with an average feed conversion efficiency of 12.55, 12.60 and 15.23, respectively ($p>0.05$; Table 2).The cost involvement for kg DM yield of Maize, Oat and Triticale silage were Tk. 7.03, 12.59 and 13.63, respectively. However, the total roughage cost including refusal losses of Kg live weight gain were significantly ($p<0.01$) lower for bulls fed Maize silage (Tk. 119.0) than bulls those fed with Oat (Tk. 176.0) and Triticale silage (Tk. 193.0). Considering feed cost, Maize silage fed bulls required less feed cost for Kg live weight gain than other two roughages. Therefore, considering the feed cost data the roughages may be ranked as Maize silage>Oat silage>Triticale silage. The calculated Maize index (M_i) based on biomass production efficiency (X_{ddm}), animal production efficiency (X_{ap}),enteric methane emission reduction efficiency(X_{CH4}) and benefit to cost efficiency(X_{bc}) of fodder crops has been presented in Table 3. Considering all these factors, the M_i of Maize was the highest (1.00) followed by Oat (0.88) and Triticale (0.80), respectively.

Table 3. Maize index (M_i) of different fodder crops

Fodder	X_{ddm}	X_{ap}	X_{CH4}	X_{bc}	M_i
Maize	1	1	1	1	1
Oat	0.64	0.74	1.27	0.87	0.88
Triticale	0.56	0.64	1.19	0.80	0.80

Finally, it may be concluded that considering the Maize index (M_i) of fodder crops, the biometrical rank of roughages may be as Maize>Oat>Triticale.

Comparative study on BLRI Napier hybrid and Pakchong fodders for yield, silage quality and growth performance of bull calves

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Executive Summary

Scarcity of feed is one of the major problems for rearing livestock in Bangladesh. Sustainable livestock production is highly dependent on the availability of quality feed and forage resources. Napier or elephant grass has been the most promising and high yielding fodders giving considerable nutritional characteristics and adaptability that suppresses most tropical grasses. But with the increasing demand of feeds and forages for livestock, Napier alone does not meet the requirements. So, it is an urgent need to search for alternative grasses those may perform better than Napier. Recently, a high yielding grass has been imported from Thailand named Pakchong which has been derived from Napier and mostly adapted to our climate. This study was undertaken to compare the biomass production and nutritional evaluation of Pakchong with Napier hybrid (BN-3)at different stages of maturity (SM) and feeding impacts of both fodders on growing bull calves after making silage. For this study, 10 experimental plots each of 25m^{2}were prepared at Pachutia Research Farm, BLRI, Savar, Dhaka. After land preparation, stem cuttings of both cultivars were transplanted into 5 plots for each cultivar. Fodder crops were harvested in three different periods at 70, 80 and 90 days. Data were recorded up to three cuttings for the same periods of harvest. After harvest, silage was prepared from both grasses. Nutritive value and feeding effects of silage for both grasses were examined. Both silages were fed to 10 RCC growing bull calves for comparing the effects of feed intake and growth of calves. No concentrate feeds were supplied to animals of each group. All data related to yields, nutritive value of silage, silage intake, body weight changes and nutrient digestibility of silage in two cultivars were recorded and analyzed for statistical outputs by IBM SPSS 20.0 in a 2×3 factorial CRD design.

Biomass yield and botanical fractions of two cultivars are shown in Table 1, which shows that both cultivars differed significantly on biomass yield and botanical fractions. Although, biomass yield of Pakchong was significantly higher than BN-3, but in terms of leaf production and leaf-stem ratio (LSR), BN-3 performed better than Pakchong. Different stages of maturity (SM) caused variations for stem weight and LSR significantly with increasing stem weight and decreasing LSR in latter stages. Cultivar and SM interacted (Cultivar×SM) significantly for plant height, stem weight and LSR.

Table 1: Comparative performances of Napier-3 and Pakchong fodder at different stage of maturity

Stage of maturity (SM)	Biomass Yield (MT/ha)		Plant Height (inch)		Leaf Weight (g/plant)		Sheath Weight (g/plant)		Stem Weight (g/plant)		Leaf:Stem (LSR)	
	BN-3	Pak	BN-3	Pak	BN-3	Pak	BN-3	Pak	BN-3	Pak	BN-3	Pak
70	50.1 (4.2)	46.6 (10.5)	64.7 (1.9)	90.0 (7.0)	498.6 (21.6)	154.6 (54.5)	131.4 (8.4)	93.3 (21.2)	325.9 (12.6)	231.6 (44.9)	1.53 (0.08)	0.68 (0.2)
80	43.5 (4.1)	62.4 (10.5)	76.2 (2.8)	101.3 (7.0)	429.1 (15.3)	146.6 (54.5)	148.0 (5.9)	79.0 (21.2)	350.6 (17.8)	258.0 (44.9)	1.23 (0.05)	0.58 (0.2)
90	41.3 (2.9)	69.3 (10.5)	80.5 (2.8)	104.6 (7)	355.3 (21.6)	142.6 (54.5)	171.8 (8.4)	128.3 (21.2)	556.3 (17.8)	276.3 (44.9)	0.65 (0.08)	0.53 (0.2)
Overall mean	44.9	59.5	73.9	98.7	427.8	148.0	150.5	100.2	411.0	255.3	1.17	0.63
SEM	2.2	6.1	1.5	4.1	11.4	31.5	4.4	12.3	9.4	25.9	0.04	0.12
Sig (cultivar)	*		***		***		***		***		***	
Sig (SM)	NS		NS		NS		NS		***		*	
Cultivar×SM	NS		*		NS		NS		**		**	

#values in the parenthesis are standard errors. ***-p<0.001; **-p<0.01; *p<0.05; NS-not significant (p>0.05)

Table 2 represents the nutrient compositions after making silage of both cultivars. As shown in Table 2 that the quality of Pakchong silage is comparatively better than the quality of Napier-3 silage in terms of nutritional facts.

Table 2: Nutritive value of Napier-3 and Pakchong silage

Nutrients in silage	Pakchong silage	Napier-3 silage
Dry matter, DM (%)	24.71	20.11
Crude protein, CP (%)	09.86	09.17
Organic matter, OM (%)	91.65	93.11
Ash (%)	08.35	06.89
Anti-detergent fiber, ADF (%)	61.89	56.09
Neutral detergent fiber, NDF (%)	88.06	86.45

Table 3 shows the comparative evaluation of intake of silage made from both cultivars and growth performance of growing bull calves after feeding silage. Result shows that both group of calves consumed similar amount of silage, but DM and CP intakes of calves consumed Pakchong silage were significantly higher than DM and CP intakes of calves consumed Napier-3 silage. There were no significant variations of total and daily average live weight gains of calves between groups.

Table 3: Comparative study for intake and growth of growing bull fed Napier-3 and Pakchong silage

Parameters	Napier-3 silage	Pakchong silage	Significance level
Fresh feed intake (kg/day)	9.95±.48	9.12±.01	NS
DM intake (kg/day)	2.00±0.9	2.25±0.004	*
CP intake (kg/day)	0.18±0.08	0.22±0.00	**
%DM intake on LW	1.68±0.12	1.90±0.15	NS
Total live weight gain (kg)	2.26±0.62	3.88±1.2	NS
Daily weight gain (kg/d)	0.098±.018	0.117±.04	NS

**-p<0.01; *p<0.05; NS-not significant (p>0.05)

Table 4 illustrates the nutrient digestibility of silage made in both cultivars after feeding to growing bull calves. Nutrient digestibility of Pakchong silage was significantly better than the nutrient digestibility of Napier-3 silage.

Table 4: Comparative study for nutrient digestibility of growing bull fed Napier-3 and Pakchong silage

Nutrient	Napier-3 silage	Pakchong silage	Significance level
% digestibility of DM	45.63±1.69	55.07±1.15	**
% digestibility of CP	52.66±1.23	62.35±1.02	***
% digestibility of OM	46.58±1.87	57.85±1.24	***
% digestibility of Ash	20.57±2.45	30.89±2.02	*
% digestibility of ADF	65.09±0.90	73.02±1.05	***
% digestibility of NDF	71.42±1.47	78.19±0.746	**

***-p<0.001; **-p<0.01; *p<0.05; NS-not significant (p>0.05)

This study reveals that Pakchong is comparatively better than Napier-3 in respect to total fresh biomass yield, nutrient composition of fresh and silage and nutrient utilization for growing bull calves. However, Napier hybrid is good for early harvest with more leaf yields compare to Pakchong.

Health risk assessment of heavy metals in animal origin food chain through feed and fodders pathway

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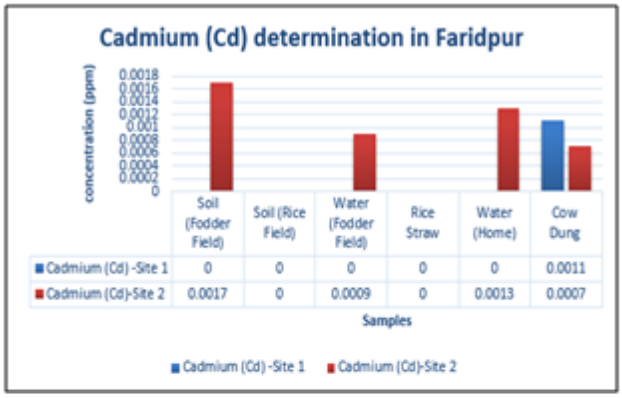
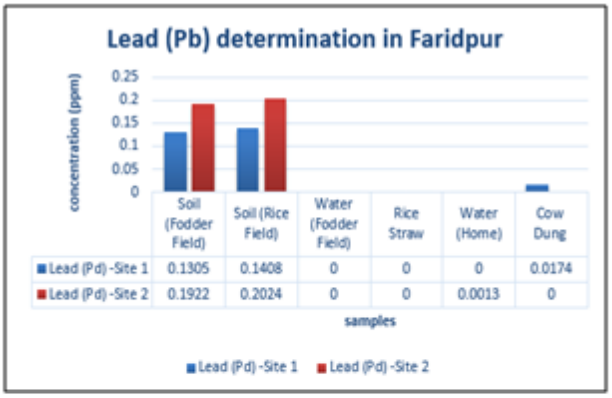
Executive summary

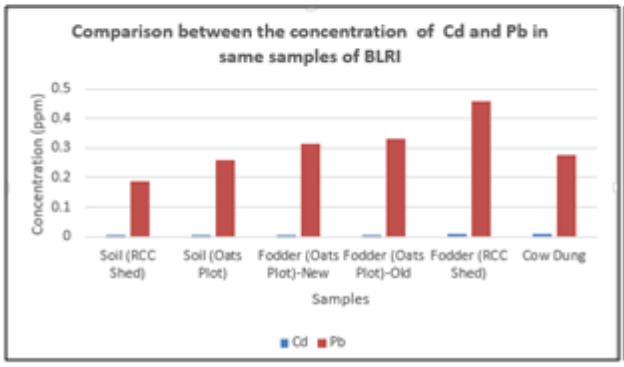
Heavy metals are those metals with relatively high densities or atomic weights. Some heavy metals are essential as nutrients which are harmless for the survival but some of them are highly poisonous. Physical and chemical properties of heavy metals should be handled very carefully. Poisonous heavy metals have a great negative influence on almost every living organisms. The persistence nature and bioaccumulation of those metals in the food chain remains the major threat for those organisms. Bioaccumulation of heavy metals is the main threat or concern for the migration of heavy metals in the food chain. We, humans are the consumers or being depended on the food from animal source or plant source. Those two major sources can be poisonous through heavy metals, mainly by Arsenic. It will directly affect the human health. Already many peoples from the selected regions of Bangladesh are suffering from different diseases formed by the heavy metals. This study will focus on the migration of heavy metals through the food chain in those selected regions. The risk assessment program can also be initiated through this study. This study will also follow up the risks of heavy metals in animal origin food chain through feed and fodders pathway. Identification of the presence of heavy metals in feeds & fodders of selected locations to investigate the potential heavy metal tolerance fodders in the country and to identify the heavy metals in milk, meat and cattle blood of selected locations are the key objectives in this study. Standardization of guidelines of arsenic and other poisonous heavy metals free safe food of animal origin in the context of animal and public health concern is also another objective of this research. For the extraction and identification of heavy metals, samples are needed to be digested. There are several ways to extract the heavy metals from the desired samples. But most of the cases, acid digestion is mostly used for its wide acceptance. In this study, we used the acid digestion process to extract the heavy metal. Different types of acid digestion process are available for the heavy metal extraction. Aqua regia (mixture of nitric acid and hydrochloric acid), Perchloric acid ($HClO_4$), Nitric acid (HNO_3), Hydrochloric acid (HCI) etc. or their combinations are being used mainly. It depends on the samples from where heavy metals are needed to be extracted.For this study samples were collected from six regions of heavy metal affected area of Bangladesh. Those sites are Faridpur, Kuakata, Bangladesh Livestock Research Institute (BLRI), Narayanganj, Jossore and Chadpur. We have collected soil, water, fodder, rice straw, cow milk, cow dung and blood samples from these six regions. Cow dung, milk and blood samples were collected from a wide ranges of cattle species. Different protocols of digestion are being followed for those sample types to standardize the final protocols to get an accurate and excellent result of the concentrations of the heavy metals.

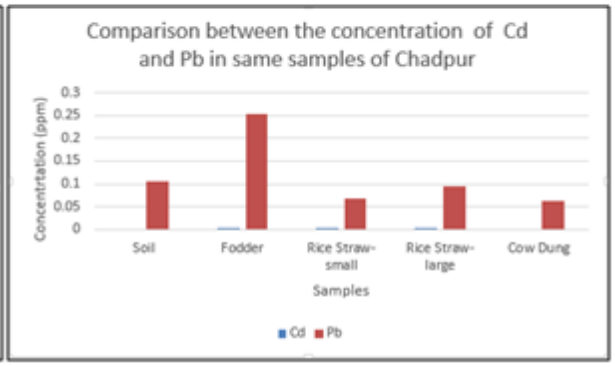
Arsenic (Ar), Lead (Pb), Cadmium (Cd), Chromium (Cr) and Mercury (Hg) are the heavy metals, we are working on. We are going to determine their existence in concentrations from the collected samples. Those five heavy metals are so much poisonous for human health. It is very much important to determine their existing levels and evaluate their adverse effect on human health. AAS or atomic absorption spectrometry is a procedure for the quantitative determination of chemical elements by measuring the absorption of free atoms in the gaseous state. It is a widely acceptable method for the determination of the concentration of heavy metals. In this study, AAS is going to be used for the heavy metal determination. Till now we got the concentration of Lead (Pb) and Cadmium (Cd) from the samples from Bangladesh Livestock Research Institute (BLRI), Faridpur and Chadpur. The determination of other heavy metals and samples from those and others sites are going on very fast. The following first two figures shows the cadmium (Cd) and Lead (Pb) determination in two different

sites in Faridpur district respectively. The last two figures shows the comparison between the concentration of Cd and Pb in same samples of BLRI and Chadpur, respectively. Work is going on with other resulted data from other sites and locations.









Till now the resulted outcome provides the information that, food chains through the fodder pathway are being highly contaminated with heavy metals. Longer persistence of those metals in nature extremely affect different organisms and exacerbates different health problems in human being. Risk assessment program can also be initiated through the above study. Proper treatment and further precautions can also be developed to overcome heavy metals problem in Bangladesh.

Study on availability of feed resources and comparison of nutrients composition of feed ingredients used by farmers and on station

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Executive summary

Based on the dairy cattle population, Bangladesh has secured 15th position among the top dairy cattle populated countries in the world (FAO, 2012). The current milk production in Bangladesh is about 7.2 million whereas the demand is 14.7 million MT considering 250 ml per head/day (DLS, 2016). In Banladesh the district of Pabna and Sirajganj are the most promising and recognized area where farmers keep dairy cows mainly for milk production (Sikder et al., 2009). Hence, feed availability varies over the year in this area that may affect the cattle nutrition, production and reproduction. Therefore, it is necessary to assess the availability of feed resources and their nutrient composition. Thus, a baseline survey were conducted for identify the available feed resource of dairy cattle in rural villages of Pabna district. Data on available feed resource of dairy cattle were collected from total 50 households from three selected villages (Umarpur, Khorbagan and Hatail Aralia) under BeraUpazila of Pabna district with a pretested survey questionnaire. The collected feed sample were chemically analysed for knowing the nutritive value at Animal Nutrition laboratory of BLRI Regional Station Baghabari. The collected data were complied, tabulated and analyzed (descriptive statistics) by SPSS version 16 (SPSS Inc. Chicago, USA).

Available feedstuffs used in surveyed area are shown in Figure 1. It was observed that highest number of farmers (82%) used rice straw for cattle feeding as roughage source while 76% farmers used jamboo and 44% farmers used Napier grass. Beside these it was observed that 54% farmers used maize crush, 46% used wheat bran, 24% used til oil cake and 44% farmers used mixed feed for cattle feeding. Proximate composition of available feedstuff from surveyed area is presented in Table 1.where for concentrate it shows that highest DM% is observed in wheat bran (89.69±0.57%), highest Ash% is observed in til oil cake (17.23±0.27%), highest CF% is observed in til oil cake (29.33±0.29%), highest CP% is observed in khesari (19.56±0.25%) and more EE% and EEE% is observed in til oil cake (12.64±0.03%) and maize (65.06±0.02%), respectively. For roughage they used rice straw which served more DM% (98.57±0.13%) but less CP% (straw, 6.60±0.11%) than napier (13.81±0.01% CP) and jamboo (12.50±0.17% CP).Proximate composition of available feedstuff that used in BLRI Regional Station is presented in Table 2. It shows that highest DM% is observed in til oil cake (92.15±0.60%), highest CF% is observed in khesari (24.78±1.01%) and highest CP% is observed in soybean meal (43.84±0.19%). Comparative nutrient value of feedstuff between on-station and community is depicted in Table 3.

Table 1. Proximate composition of available feedstuff from surveyed area (%DM basis)

Feed Stuff	Nutrient Parameters/Variables (Mean±SE)					
	DM%	Ash%	CF%	CP%	EE%	NFE%
Khesari	86.28±0.42	5.05±0.08	26.17±0.48	19.56±0.25	1.30±0.01	34.19±0.41
Maize	89.10±0.52	2.86±0.02	3.98±0.13	13.72±0.16	3.48±0.01	65.06±0.20
Straw	98.57±0.13	10.78±0.02	33.57±0.21	6.60±0.11	1.68±0.01	45.92±0.21
Wheat bran	89.69±0.57	6.00±0.23	11.18±0.10	15.86±0.19	2.43±0.02	52.22±0.41
Tiloil cake	86.62±0.50	17.23±0.27	29.33±0.27	11.45±0.03	12.64±0.03	15.97±0.04
Mixed	85.95±0.19	8.90±0.11	13.53±0.04	14.22±0.06	1.30±0.02	48.00±0.08
Napier	36.20±0.11	6.00±0.05	12.00±0.11	13.81±0.01	1.90±0.01	2.49±0.06
Jamboo	35.00±0.28	5.60±0.06	10.80±0.05	12.50±0.17	1.86±0.01	4.24±0.12

Results showed that Proximate component of maize (except DM) as CP% (8.44±0.32 vs13.72±0.16), CF% (2.72±0.03 vs3.98±0.13), Ash% (1.78±0.02 vs 2.86±0.02) from on-station and community have a highly significant ($p<0.001$) relation. Proximate component of til oil cake (except DM) as CP%

(17.54±0.09 vs 11.45±0.03), CF% (13.92±0.16 vs29.33±0.27), Ash% (21.58±0.24 vs 17.23±0.27) from on-station and community have also highly significant ($p<0.001$) relation. There is no significant difference ($p>0.05$) of DM%, Ash%, CF% between on-station and community khesari feed but have a highly significant ($p<0.001$) difference between CP% (15.13±0.50 vs 19.56±0.25) of khesari. There is no significant difference ($p>0.05$) of DM%, CP% between on-station and community wheat bran but have a significant ($p<0.002$) difference between CF% (6.30±0.69vs 11.18±0.10) on-station and community wheat bran.

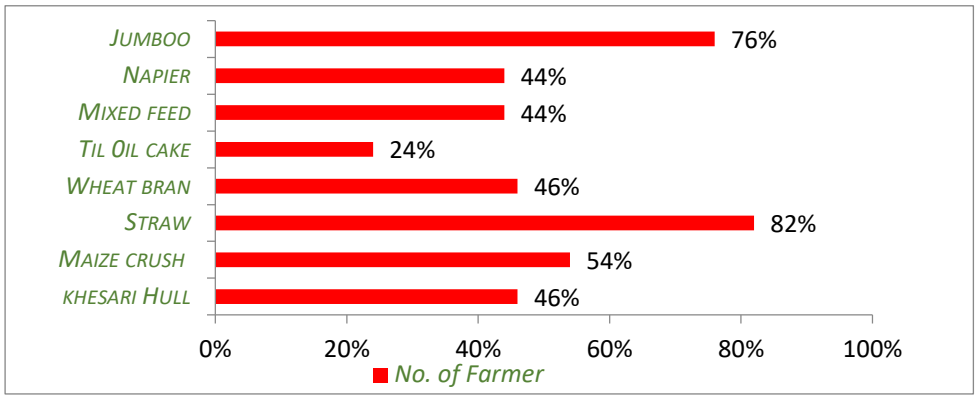

Figure1.Available feedstuffs used in dairy project community

Table 2. Proximate composition of available feedstuff that used in BLRI Regional Station (%DM basis)

Feed Stuff	Nutrient Parameters/Variables (Mean±SE)					
	DM%	Ash%	CF%	CP%	EE%	NFE%
Maize	87.01±0.57	1.78±0.02	2.72±0.03	8.44±0.32	2.82±0.05	71.25±0.19
Khesari	86.75±0.70	5.05±0.60	24.78±1.01	15.13±0.50	2.58±0.24	39.17±1.63
Wheat Bran	87.44±0.66	3.08±0.27	6.30±0.69	15.36±0.49	1.36±0.09	61.34±0.88
TilOil Cake	92.15±0.60	21.58±0.24	13.92±0.16	17.54±0.09	6.97±0.02	32.14±0.09
Soybean meal	89.85±0.09	6.18±0.10	6.41±0.05	43.84±0.19	3.12±0.04	30.30±0.30

Table 3.Comparative nutrient value of feedstuff between on-station and community (%DM basis)

Feed and Location	Nutrient Parameters/Variables (Mean±SE)					
	DM%	Ash%	CF%	CP%	EE%	NFE%
Maize						
On station	87.01±0.57	1.78±0.02	2.72±0.03	8.44±0.32	2.82±0.05	71.25±0.19
Community	89.10±0.52	2.86±0.02	3.98±0.13	13.72±0.16	3.48±0.01	65.06±0.20
P value	0.054	0.00	0.001	0.00	0.00	0.00
TilOil Cake						
On station	92.15±0.60	21.58±0.24	13.92±0.16	17.54±0.09	6.97±0.02	32.14±0.09
Community	86.62±0.50	17.23±0.27	29.33±0.27	11.45±0.03	12.64±0.03	15.97±0.04
P value	0.002	0.00	0.00	0.00	0.00	0.00
Khesari						
On station	86.75±0.70	5.05±0.60	24.78±1.01	15.13±0.50	2.58±0.24	39.17±1.63
Community	86.28±0.42	5.05±0.08	26.17±0.48	19.56±0.25	1.30±0.01	34.19±0.41
P value	0.619	0.988	0.282	0.001	0.006	0.042
Wheat Bran						
On station	87.44±0.66	3.08±0.27	6.30±0.69	15.36±0.49	1.36±0.09	61.34±0.88
Community	89.69±0.57	6.00±0.23	11.18±0.10	15.86±0.19	2.43±0.02	52.22±0.41
P value	0.791	0.001	0.002	0.402	0.00	0.001

From the study it may say that the farmers of surveyed area are used both cultivated and ready feed for cattle feeding.

Identification of poultry processing problems and development of a model processing plant for safe poultry meat production

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Executive summary

Poultry is a fast growing industry that supporting the livelihood of about 1.50 crore people directly and indirectly with about 40% female engagement. The poultry meat consumption is currently 5 kg/person/year which is targeted to increase more than 8kg/person/year by next two years. Poultry meat is preferable than other types of meat due to its various attributes namely high in protein, prevent bone loss, polyunsaturated fatty acids content, good for heart, rich in phosphorus, improve eyesight and vitamin B3 and B6 content. There is an estimated 150,000 poultry farms in Bangladesh (Wikipedia, 2017), The poultry sector will require up to Tk 30,000 crore in fresh investments to meet the increased demand for chicken meat and eggs by 2021 (The Daily Star, March 3, 2017). A growing number of small producers are raising poultry outdoors on pasture, processing the birds on-farm, and selling the meat directly to customers at the farm or at a farmers' market. Poultry and poultry products become as a cheap source of animal protein in terms of meat and eggs. Poultry meat alone contributes 37% of the total meat production in the country and 22 to 27% of total animal protein (Hamid et al, 2017). Khatun *et al* (2016) stated that the demand for food in Bangladesh and around the world is changing rapidly. This changing pattern is driven by economic growth, rising incomes, urbanization and demand is shifting away from traditional staples toward high-value food commodities. Considering the situation this research was started with two objectives i) identifying the existing poultry processing problems and prospects ii) analyzing the nutrient contents and meat oxidation of fresh and preserved poultry meat for safe consumption. A survey was conducted among the mini poultry processors earlier in nearby areas of Savar and Nabinagar. According to their statement all birds are slaughtered in Halal method. About half of the processing wastes were used in the pond as fish feed. The most notifiable problem of the processors has no technical training. About 60 % processors managed their fund of their own and remaining had got loans. Their monthly income ranges from 20000 to 40000 taka from this mini poultry processing operation, their education level were primary to SSC level. It was pointed out that science based knowledge and technological support can enhance their business enterprises and also providing the safe poultry meat to the consumers.
Experimentally about 8500 poultry birds (chicken, ducks, quail, guinea fowl and turkey) were dressed, packaged, stored and supplied from our mini poultry processing plant to the consumers in last fiscal year 2017-18. Currently at our mini poultry processing plant some equipment's were locally made (below figure) as killing cone stand, evisceration table, working table, trey, digital weighing balance, stainless steel trolley, aluminum saucepan, burner, plastic container, packing machine, dissecting box etc. We have installed an ice cube making machine to produce ice cubes to keep the processed poultry birds in good condition. We processed the broiler chicken at our mini poultry processing plant. Then with this meat TBA value of broiler breast and thigh meat of fresh and frozen sample were analyzed for determining MDA (melon di aldehyde). The value was calculated 8.81 (micro mole / 100 g meat) for control which was reduced to 7.63 after addition of additive.

Figure 1. Equipment's with related pictures of our developed poultry processing plants

Slaughtering process: At the end of the broiler trial 10 chickens per treatment were randomly selected and were weighed properly. The chickens were bled by section of the jugular vein and then scalded in hot water (70-80 ° C) and plucked manually. Then, birds were eviscerated and heart, kidney, crop and intestines were taken off. The samples of breast and thigh-drumstick were collected to determine the chemical composition of meat. The nutritional quality of breast and thigh meat of guinea fowl was analyzed: The frozen samples of the breast and the thigh were dissected into small pieces and homogenized in a blender at - 10°C. Moisture, protein, fat, and ash contents of breast and thigh meat samples were determined following the standard procedures (AOAC, 2000).

For hygienic and safe poultry meat production proper processing procedure are following with the principles of HACCP. Hence, after completion of all the planned activities a model processing plant will be developed which finally distributed to different communities for safe poultry meat production to the consumers. This research and development activity should have to be continued to produce need based technology generation for the mini poultry processors and to enhance their knowledge by training on the generated technologies.

A baseline study about farmers training on BLRI developed technologies

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Executive summary

Bangladesh is basically an agricultural country and nearly three-fourth population depends on agriculture, livestock and allied sectors for livelihood. The share of agriculture sector in national GDP is 18.70 and the share of livestock sub-sector is 2.45 (BER, 2013). As a national research institute for livestock development BLRI is committed to develop native breeds of cattle, chicken and duck, techniques for their feeding and nutrition, disease prevention and health management and models for milk, meat and egg production system through strategic research. Since inception BLRI has developed 83 packages/technologies on livestock and poultry production. These technologies have presumably made a significant response to increase milk, meat and egg production and generation of income and creation of employment at farm level. BLRI developed technologies are important for livestock rearing in our country. During the last 3 years BLRI has conducted training on cattle, goat and poultry rearing and management. But after training we have no information about how good or useful it is in the field condition. Considering the situation a study was under taken to know the socio-economic status of trainee on adoption of technologies in the field. A total of 300 farmers who took part in training on livestock rearing & management were selected for this study. Survey method was followed to collect data. Mostly descriptive analysis was used to achieve the objectives.

The education level of the farmers were 45% primary level, 25% SSC, 18% HSC and 12% graduates/masters level. The family members of male were below 18 years 1.8 and over 18 years 2.6 number per family. The females below 18 years accounted for 1.72 and over 18 years 2.11 number per family. The land availability such as housing area were 0.86 acre, cultivated area 2.780 acre, uncultivated area 0.46 acre and fodder land area 0.21acre per family. The Agriculture was the highest (55%) occupation followed by business (35%), services (3%) and others (7%).The possessions of cattle was 5.43 no./family. In case of small ruminants, average no. of goat and sheep were 5.88 and 1.10 no./family, respectively. Most of dairy cows were indigenous/ local. Some farmers reared crossbred cattle. The average milk production (l/d), birth wt. (kg), calf mortality (%) and lactation period (d) of cattle were, 4.53, 23, 22.31 and 173, respectively. The average litter size (no. per year), kid birth wt (kg) and kid mortality (%) were 1.86, 0.81 and 33%, respectively. Fodder land (acre) use and fodder production (ton/year) were 0.034 and 1.66, respectively (Table 1).

Table 1. Information on livestock productivity, mortality and fodder production

Parameters	Mean±SE
No. of dairy cows	3.25±0.23
No. of bulls	2.18±0.33
Milk production (l/d) (Dairy cow)	4.53±0.77
Birth wt.(Kg) (cattle)	23.00±2.41
Calf mortality (%)	22.31±1.99
Lactation period (d) (Dairy)	173±21.21
Litter size (no/year) (Goat)	1.86±0.98
Kid birth wt. (kg)	0.81±0.04
Kid mortality (%)	33%±5.22
Fodder land (acre)	0.034 ±0.19
Fodder prodn(ton/year)	1.66±0.21

Table 2 shows incomes (Tk per year per farm) from milk, cattle sale, cowdung, compost and goat sale (live) were 71523.40, 90812.33, 10220.40, 20150.66 and 60000.00, respectively. The total annual income was Tk. 252706.79.

Table 2. Annual income from livestock products or by-products of farm families (Tk./year/farm)

Source of income	Mean±SE
Milk	71523.40±35.44
Cattle sale	90812.33±22.46
Cowdung	10220.40±21.88
Compost	20150.66 (3) ±10.11
Goat sale (live)	60000.00±4144
Total	252706.79±42.52

Table 3. Total livestock (cattle & goat) rearing cost (Tk./year)

Particulars	Mean±SE
Rearing cost (Feed, medicine, labor)	199840.00±51.42

Table 4. Annual household expenditure (Tk./year)

Particulars	Mean±SE
Food	100000.00±22.57
Clothing	12310.58±24.99
Health care	6750.24±17.77
Education	18000.00±19.22
Cosmatics	5000.00±14.21
Total	142060.82±28.56

On average, the total annual household expenditure was Tk. 142060.82

Table 5. Consumption of different food items (g/d/capita)

Food item	**Mean±SE**
Rice	400.10±8.21
Ata	90.21±9.23
Pulse	35.11±4.11
Fish	5.77±8.76
Meat	33.11±2.99
Milk	180.11±23.42
Egg	5.21±0.99
Vegetables	280.00±18.96
Total	1029.52±27.78

Farmers overall consumption of all food items was 1029.52g per day per capita. The finding of the study represents small scale livestock production. Calf mortality rate was higher and less fodder production than needed. On the other hand marginal profit was observed from livestock rearing in the surveyed areas.

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 3.313 million sheep and the present annual rate of growth is ever increasing (Bangladesh Economic Review, 2016). Average 700 to 800gms of raw wool can be collected from each sheep per year. Then 3.0 thousands 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 farmer to generate income. A research was conducted for commercial use of wool in Bangladesh through yarn and fabrics production with the joint collaboration of Bangladesh Livestock Research Institute and Bangladesh Jute Research Institute. The aims 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-station 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 at 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	5.05µg /inch	3.35µg /inch	8.03µg /inch
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% wool, 30% jute and 40% 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.

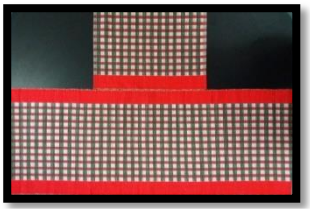
Spinning technique and types of spinning can play a vital role for the perfection of blended yarn properties and specific blended ratio is very important to get diversified products. Fine wool is more effective for making yarn than coarse wool. Wool, jute and cotton blended yarn may be a new horizon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

Produced 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)

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

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Executive summary

The majorities of the tribal people live in the Hilly forests with primitive ways of life. These regions possess slightly different type of genetic resources of livestock and poultry rather than the common indigenous. In this part, attempt has been taken to improve the production potentialities of the native genetic resources of livestock at Hilly regions. The Hilly Brown Bengal goats (HBBG), Hilly (HC) and Naked Neck Hilly chickens (NNHC) are available at Hill tracts region of Bangladesh. However, the production characteristics of both type of HC are not well documented. Systematic information on genetic and phenotypic parameters of Hilly goats, HC and NNHC is very limited. Therefore, the main objectives of the project are to evaluate the productive and reproductive performances of goats and chickens and their improvement and conservation at Naikhongchari.

For Hilly goats, the breeding program was conducted initially through Open Nucleus Breeding System (ONBS) at Naikhongchari BLRI Regional Station Research farm and was designed in such a way, which resists inbreeding. Animals were maintained in a semi-intensive rearing system. All goats were allowed to graze for 6-7 hours per day and concentrate was offered twice daily during morning and evening at the rate of 1% of body weight and supplied clean drinking water. Goats were de-wormed on regular intervals and only PPR vaccine was given at the age of 2 month. Data on productive, reproductive and disease incidence were recorded regularly. Reproductive parameters studied were: litter size (LS), kid birth weight (KBW) Gestation length (GL), Age at first conception (AFC), Age at first kidding (AFK) and Kidding interval (KI). On the other hands, a total of 121 adult HC and 21 NNHC were reared in open sided poultry house under intensive management system for collecting hatching eggs. Both broody mother hen and incubator were used for hatching chicks. The chicks were reared on floor, littered with rice husk. Standard starter, grower and layer feed was fed during rearing period. The birds were allowed to take *adlibitum* feed and clean drinking water. Birds were de-wormed on regular intervals. A standard vaccination schedule was followed during rearing period.

The statistical analysis of the Hilly goat's data was performed using compare mean with one way ANOVA and univariate analysis of variance procedure of SPSS package. Subsequently, the productive and reproductive performance of birds were recorded and analyzed by R statistical computer programme. The Results showed from (Table-1) that kid birth weight were significantly ($P<0.01$) differ among generation whereas birth weight of generation_3(1.21±0.013kg) highest than generation_5 (1.20±0.031kg), 4 (1.18±0.012 kg), 2 (1.16±0.016 kg) and generation_1 (1.11±0.01 kg). Result also showed that 3 month, 6 month and 9 month age of body weight were non-significant among generation.

Table 1. Effect of Generation on body weight of Hilly Brown Bengal goat

Generation	Parameters (kg)			
	Birth wt. (Mean±SE)	3-m wt. (Mean±SE)	6-m wt. (Mean±SE)	9-m wt. (Mean±SE)
G-1	1.11^{b}± 0.01 (75)	4.69±0.15	7.12±0.28	8.65±0.38
G-2	1.16^{ab}±0.016 (61)	4.47±0.16	7.07±0.29	8.52±0.23
G-3	1.21^{a}±0.013 (51)	4.71±0.15	7.43±0.22	9.68±0.32
G-4	1.18^{a}±0.012 (67)	4.90±0.21	7.21±0.32	8.96±0.30
G-5	1.20^{a}±0.031 (13)	5.03±0.24	7.86±0.50	9.15±0.85
Sig. level	**	NS	NS	NS

Sig=Significance; m=month; Fig in the parenthesis indicates the number of observation. Means with different superscripts within the same column differ significantly. *=Significant at 5% ($p<0.05$) level of probability, **=Significant at 1% ($p<0.01$) level of probability, NS=Non significant ($p>0.05$).

The age at first conception (AFC) were significantly ($p<0.05$) differ among generation (Table-2). The weight at first conception (WFC) were also significantly ($p<0.01$) differ among generation (table-2).The kidding interval and Gestation length was not significant ($P>.05$) effect on generation. Results showed that according to parity there was not significant ($P>.05$) effect on kid birth weight but significantly ($p<0.01$) differ of Kid litter weight and litter size (Table-3).

Table 2. Reproductive performance of Hilly Brown Bengal goat according to generation

Parameters	Generation				
	AFC (d) (Mean±SE)	WFC (kg) (Mean±SE)	AFK (d) (Mean±SE)	GL (d) (Mean±SE)	KI (d) (Mean±SE)
G-1	359.80^{a}±18.87 (32)	13.23±0.47	506.60±19.02	146.80±0.78	225.90±10.27
G-2	336.27^{ab}±11.36 (23)	12.09±0.48	481.45±11.44	145.18±0.69	217.72±7.76
G-3	328.65^{ab}±9.07 (17)	11.89±0.47	475.33±9.22	146.66±0.68	216.11±8.30
G-4	301.57^{b}±9.06 (13)	10.65±0.52	448.85±9.45	147.28±0.74	211.42±10.39
Sig. level	*	**	NS	NS	NS

AFC=Age at first conception, WFC=weight at first conception, AFK=age at first kidding, GL=Gestation length, KI=kidding interval, Sig=Significance; Means with different superscripts within the same column differ significantly. *=Significant at 5% ($p<0.05$) level of probability, ** =Significant at 1% ($p<0.01$) level of probability, NS=Non significant ($p>0.05$).

Table 3. Reproductive performance of Hilly Brown Bengal goat according to parity

Parity	Parameters		
	KBW (kg) (Mean±SE)	KLW (kg) (Mean±SE)	LS (No.) (Mean±SE)
P-1	1.17±0.031 (24)	1.40^{e}±0.52	1.20±0.022
P-2	1.16±0.02 (31)	1.80^{d}±0.63	1.60±0.11
P-3	1.13±0.02 (38)	2.16^{b}±0.31	1.70±0.13
P-4	1.18±0.04 (29)	1.94^{c}±0.34	1.90±0.04
P-5	1.09±0.06 (32)	2.26^{a}±0.41	2.06±0.03
Sig. level	NS	**	**

KBW=kid birth weight, KLW=kid litter weight, LS=litter size, Sig=Significance; Means with different superscripts within the same column differ significantly. **=Significant at 1% ($p<0.01$) level of probability, NS=Non significant ($p>0.05$).

It was also showed that according to birth type single kid (1.21±0.08 kg) was highest birth weight than double kid (1.15±0.13 kg) followed by triplet (1.10±0.17 kg) and quadruplet (1.08±0.13kg) kids and it was found that kids mortality were 12.23±0.53% during one year period.

Result showed that there were no significant differences of body weight between HC and NNHC in growing period up to 12 weeks of age. The body weights of HC were higher than previous year. The feed intake and mortality of HC was lower than that of NNHC. It was found that there were no significant difference of hatchability between HC (68.28±11.13%) and NNHC (60.97±13.2%) hatched by both broody hens and the incubator. However, hatchability percentage of HC is slightly higher than that of NNHC. The adult body weight of Hilly hen (2111.32±146g) and cock (2869.20±141g) up to 30 weeks of age were higher than that of NNHC (1990.94±118g and 2531.20±107g) and were no significant difference. However, the egg production (H.D) of HC (34.30±8%) was reduced than previous year where as egg productions of NNHC were 28.3±6. Egg weight of HC and NNHC was 41.99±4g and 40.17±4g respectively. Age at first egg, feed consumption and mortality of both HC and NNHC were 152 days, 159 days, 89.68 g, 95.2 g, 12.97 % and 18.42 %, respectively and there were no significant difference among the breeds.

It was also found that the HC and NNHC reared at Naikhongchari regional station was improved in body weight but reduced egg production from previous year. The performance of both type of HC is better than other indigenous chicken. It may be suggested that both Hilly (feathered) and Naked Neck Hilly chicken and Hilly goat's need to be conserved and improved further through selective breeding and better management system. This project will assist to conserves the potential Hilly animals of Bangladesh

Study on the development of canned meat production techniques

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Executive summary

Meat is a popular food item of Bangladeshi people irrespective of clusters. Diversification of this product with high value addition may contribute to more agricultural growth and employment opportunities along with the diversification in consumption, required for healthier and more balanced diets. Propelled by increased income, urbanization and increasing amount of people cumulatively enforces the demand of diversified feature and quality attribute of this product as it is one source of quality animal protein. It will also ensure the world recognized reliable food safety issue of developed countries. Considering this circumstance an experimental work was undertaken to develop and diversify of value addition technology through canning for processing of red and white meat. Canning is a globally accepted popular food preservation technique which involves processing and sealing of food products in air-tight container which improves the shelf life duration and preservation quality of that product along with saving cooking time of consumers. Now, irrespective of gender people are working at same level outside of home and they have no time to give for cooking like our traditional system. Many people are dependent on processed food. From this aspect canned meat could be a popular value added product in Bangladeshi market both for industrial people and consumers. The research work was corroborated in meat processing laboratory of BLRI. Fresh meat of beef, chevon and chicken were purchased from local market and pH of both beef and chevon was recorded at about 6 h postmortem (fresh meat). However, the chicken meat pH was recorded immediate after slaughtering. The pH of both fresh & canned meat were recorded with a digital pH meter following the method of University of Nebraska-Lincoln (2005). For this, 90 ml. distilled water was added with 10 g of blended meat sample to measure the pH of meat. Drip and cook loss was calculated by following the procedure of Joo et al. (1995) and Yang et al. (2006) respectively. Samples of both fresh and canned meat 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).Before starting the canning procedure meat of all the can and glass jar was sterilized properly at 120-121ºc for 60 minutes. About 500g of fresh meat of each species (beef, chevon and chicken) was weighed and poured into different glass jar without keeping any free space within the meat cut. Three treatments were applied for meat of all species viz. control (no preservatives), meat treated with Na-nitrite and meat treated with Sodium chloride. All the treatments were replicated for three times for each species meat. The level of using Na-nitrite and salt was 150 mg and 5g respectively for per kg meat. After filling all the glass jars the self-sealing jar lid were tightly sealed. However, in case of can, the lid were tightly sealed with semi-auto sealer machine. The canner machine was prepared by applying moisturizer on both side and filled with water up to 3 inch from bottom. Then it was placed on cooking burner until boiling of water. When boiling was started then the vapor was removed, jars/cans were placed in canner machine and proper pressure weight was settled. Canning was performed at 240^0 F under10lb pressures for 90 minutes. Thereafter, the can were cooled with water for 1 hr. Finally, the lids of all the can or jar was again sealed with shrink paper using electric hot gun. Data on quality of fresh meat were compared statistically in an ANOVA of a CRD and canned meat were compared statistically in a 3*3 factorial design using General Linier Model Procedures of SPSS, 17 computer software packages.

Table 1. Physical and chemical properties of fresh meat in different species used for can meat preparation

Items	Meat in different species			SED	p-value	Sig.
	Beef	Chevon	Chicken			
Meat p^H	5.45^b	5.96^a	6.00^a	0.004	56.77	***
Drip loss (%)	10.37^b	14.06^a	14.34^a	0.50	24.22	***
Cook loss (%)	19.14^b	21.75^a	19.69^b	0.20	19.04	**
Chemical composition (%)						

The physical and chemical properties of fresh meat used for canning purpose under this research, is presented in Table-1. Results obtained from this study revealed that, both chicken meat and chevon had significantly ($p<0.001$) higher meat pH than that of beef. The pH value of chicken meat, chevon and beef were 6.00, 5.96 and 5.45, respectively. Both chicken (14.34%) and chevon (14.06%) had significantly ($p<0.001$) higher drip loss of meat juice than that of beef (10.37%). In case of cook loss, chevon losses higher juice during cooking than meat of two others species. The chemical composition of fresh meat did not vary significantly ($p>0.05$) among the species except the protein content of meat and the protein content was significantly ($p<0.01$) lower in chevon (17.4%) than that of beef (19.8%) and chicken meat (19.7%). Table 2 represents the effect of preservatives on losses and recovery of beef during canning process. During canning, the maximum loss (25.41%) was observed in control i.e., no preservative group and highest final product recovery rate (63.42% meat) was in beef treated with Na-nitrite. Amount of loss of this group was only 4.69%. The recovery rate in beef treated with NaCl was comparatively lower (60.88%) than Na-nitrite treated group but much higher than control (53.91%) group. The p^H and proximate composition of canned meat was also analyzed after 30 days of processing. The p^H value of both red and white meat was increased after canning as compare to pH of fresh meat. Irrespective of preservatives, chicken meat had significantly ($p<0.001$) higher pH value than that of beef and chevon. Irrespective of meat type, meat treated with Sodium nitrite had higher ($p<0.001$) pH value than that of control or meat treated with common salt. Type of meat had an influential impact on the nutritional composition in canned meat. It was also observed that in canned meat, the crude protein increased by 5.44, 11.02 and 8.67% when used in beef, chevon and chicken as compared to their fresh product. In microbiological aspects, there was no botulism spore was found in canned meat. It was estimated that the production cost of 0.5 Kg canned meat was Tk. 330, Tk. 430and Tk. 95, respectively for beef, chevon and chicken. Though, it is a preliminary work, further more study is needed to dig out the reasons hinder it. In conclusion, it can be said that canning has an impressive influence on meat processing system. So it could be a good option to be introduced for meat value addition at industrial level of Bangladesh.

Table 2. Loss or recovery rate of beef during canning process using preservatives or without preservatives

Beef meat	% Losses during canning	% water in can/jar	% meat in can/jar	Total fresh meat (g)
Control	25.41	20.67	53.91	500
Sodium nitrite	4.69	31.88	63.42	500

Table 3. Effect of meat type and preservatives on Physical and chemical composition of canned meat

Meat type, preservatives & their interactions		p^H	%DM	%CP	%EE	% Ash
Meat	Beef	6.00	31.3^b	25.2^b	3.9^a	3.1
	Chevon	6.30	35.4^a	28.7^a	2.6c	3.1
	Chicken	6.91	34.8^a	28.4^a	3.5^b	2.7
Preservatives	Control	6.28	34.9	28.5	3.4	3.1
	Sodium nitrite	6.47	34.0	26.4	3.3	2.9
	Sodium chloride	6.45	32.5	27.5	3.3	2.9
SED		0.0003	3.21	1.72	0.02	0.23
Sig.lev.	Meat	***	*	*	***	NS
	Preservatives	***	NS	NS	NS	NS
	m×p	***	NS	NS	NS	NS

Community based sheep production in Hilly Area at Naikhongchari

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Executive summary

The study was planned to reduce poverty by making income generation activity of the community people at Naikhongchari upazilla in Bandarban district of Bangladesh through establishment of BLRI improved native sheep. After three years, impact study results indicated positive response to technological and heath management interventions in regards to reduce mortality and increased productivity. This year, a training program was conducted to improve community farmer's technical knowledge on 2nd week of march'18 regarding all managemental issues on BLRI improved sheep rearing along with demonstration of some BLRI developed technologies, such as UMS, UTS, UMB, silage and hay etc. The sheep marketing channel, where the product reached from producer to consumer have identified and the problems regarding sheep marketing and rearing have also identified through a questionnaire. The percentages of women participation index have calculated to determine the participation rate of women in each farming activity. Personal, social and economic constrains to sheep rearing activities of women have also analyzed.

Farmer sell sheep for various reasons and on different occasions, like 'Biju, Boishabi' for the tribal people mostly in April, 'Eid-Ul-Azha' for muslims in July-August, 'Durgapuza' in September-October, 'Barodin' in December, and others reasons (to pay annual credit bill, household purchase, farm input purchase, sending children to school and their educational cost etc.) in the year-round. Figure 1 showed that, seasonality of demand for and supply of sheep expressed as proportions (%) sold each month and the demand was almost always high than supply which proves that the sheep meat has become very popular to the tribal peoples. Factors affecting sheep supply in order of importance are holidays, household expenditures, agricultural inputs and religious occasions. In holidays farmers expect high price for their sheep. Men and women do not receive the same price for their animals. We came to understand that women negotiate harder than men when they sell or buy animals. As a result, traders prefer to buy sheep from men over women. So, it is women who get the higher price. Sheep marketing was conducted based on 'eyeball' estimation. There were no experiences of using scientific weight measuring scales to sell or buy sheep.

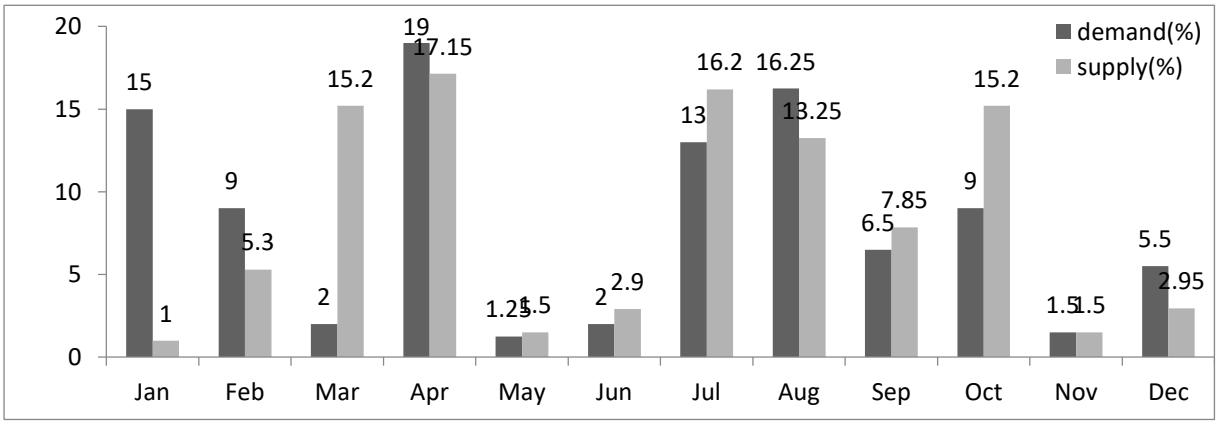

Figure 1. Seasonability of demand for and supply of sheep as proportions (%) sold each month

From the initial data we found that the marketable live sheep of community farmer reach to consumer following different ways like, from the data of questionnaire it was estimated that 16% of sheep were sold to big traders, 13% to small traders, 15% to hotels/butchers, 11% to individual consumers and 43% to other types of farmers (Fig.2).Among the sheep sold to different buyers, 43% was fattened sheep that mostly sold to hotels/butchers, the rest are sold to the other farmers and individual consumers. Yearlings (20% (9% male, 11% female) were more demanded from traders and farmers. Farmers have preferred breeding ram and ewes (19%) for breeding purpose (replacement and

foundation stock) and also to sell their old ewes. Few farmers and traders have showed interest to buy castrated male (18%) for fattening purpose (Figure 3).

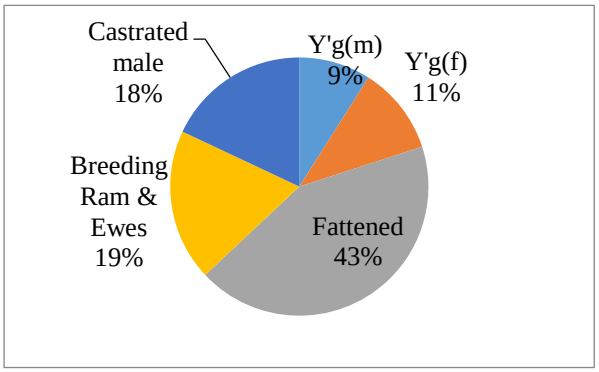

Figure 2. % of buyers purchased sheep

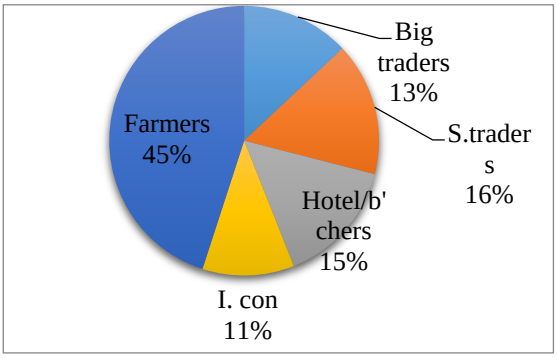

Figure 3. Categories of sheep sold (%)

The major factor affecting prices in the sheep market was dependent on the time of the sale. When there was a high supply, the trader can set a lower price and when there was high demand (low supply) the farmer can demand a higher price. From the survey, we have identified some factors that affect the sheep marketing were as follows, their market concept was not well developed, constant and uniform animal supply for the market cannot be ensured, marketing infrastructure was poor or non-existent in most places, lack of standards and grading procedures, they were economically poor and thus lack the resources to invest on their businesses. To improve sheep marketing system/channel of the community farmer, we have some plan like, by producing market extension material and conducting increasing farmers awareness, by linking farmers to the sheep marketing chain, by identifying the best buying and selling season, by organizing farmers' marketing cooperatives, by improving animal welfare at the time of transportation, by providing fresh and reliable market information. 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. Despite of some constraints, it can be concluded that this project plays a significant role in changing the socio-economic status of the rural people of hilly area. Progress so far has met almost all the objectives of this project including livelihood, economic, food security, health status and empowering women. Finally, it can be concluded that if the limitations and constraints can be minimized, this project will more feasible.

Biomolecular characterization and diversity of the circulating *Bacillus anthracis* in Bangladesh

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Executive Summary

Anthrax is an acute to peracute, non contagious infectious disease of domestic and wild mammals. Human is also susceptible to this disease. The causal bacterial agent is *Bacillus anthracis*, whose main feature is to form spores that can survive outdoors for several decades, which increase its viability and pathogenicity. *B. anthracis* is considered one of the pathogens of greatest interest as a bacteriological weapon in a bioterrorist attack. Anthrax was reported in Bangladesh from 1980 to 1984 affecting both cattle and man, but it reemerged in 2009-2010 with wider involvement. Soil conditions, together with ambient temperature and rainfall in Bangladesh represent an ideal situation for the spread of *B. anthracis*. The persistence of *B. anthracis* in soils is related to a lack of knowledge about butchering sick animals, and disposing of carcasses and wastes where animal graze. To effectively combat the threats posed by this disease, there is a need for clear understanding of the epidemiology of the respective diseases. Rapid and sensitive detection is necessary for the diagnosis of anthrax organism to formulate a nationwide strategic control. The objective of the present work was to establish effective and rapid diagnostic methods for the detection of *Bacillus anthracis,* a highly virulent zoonotic pathogen. About 50 swab samples had been collected from anthrax suspected dead animals with history of vaccination and epidemiological information on anthrax outbreak of those areas. Blood smear slides were prepared from dead animals of suspected cases of anthrax and were analyzed. at the zoonoses laboratory, BLRI, Savar, Dhaka, DNA was extracted from Swab samples of suspected cases of anthrax by Qiagen mini extraction kit following the specific protocol for tissue. DNAs was subjected to real time PCR using anthrax-specific primers (pXOl and pXO2 plasmids, and chromosome) according to Fasanella *et al.* (2001) with positive and negative control. PCR test was performed with system Only 5 samples showed positive ct value (25.61, 24.55, 27.83, 23.45, 30.53) out of 50 samples. The Real time PCR presented in the current work has been shown to be highly specific for the simultaneous detection and characterization of *B. anthracis* chromosomal DNA and the pXO1 and pXO2 virulence plasmids. The PCR has a rapid turnaround time (≈1 hour, 35 min), requires no culture, gel electrophoresis and is easy to read and interpret, making this molecular diagnostic assay well-suited for the high-throughput comprehensive identification and characterization of *Bacillus anthracis.*

Development of energy and protein supplementation based feeding system of pregnant Bengal sheep under stall feeding condition

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Executive summary

There are about 3.45 million sheep in Bangladesh (BES, 2018). Their concentration is relatively higher in Barind, Jamuna basin and coastal area. They are phenotypic differences and highly prolific compared to the other breeds. They live mainly on naturally grown grasses with no supplementation. There is no energy and protein supplementation based feeding system of pregnant sheep in Bangladesh. Over the years no study has been made to develop energy and protein supplementation requirement based feeding system of pregnant ewes. It is necessary to develop energy and protein supplementation requirement based feeding system of pregnant ewes. Present study was conducted to determine the intake, requirement and nutritional status and development of energy and protein supplementation based feeding system for pregnant ewes. The experiment was conducted in the Goat and Sheep Production Research Farm of BLRI with 15 pregnant Bengal ewes of Jamuna river basin origin for a period of five months. Pregnant ewes between 2-3 parities were used in this trial. The animals were randomly grouped into three, i.e., Group T_0, T_1 and T_2.

Concentrate diet (10.85 MJ ME/kg DM and 148 g/kg DM CP) was offered at 100% requirement, 5% more of 100% requirement and 5% less of 100% requirement, for T_0, T_1 and T_2 group, respectively with freshly cut German grass (*Echinocloa crous-galli*). Animals were weighed individually at fortnightly interval and recorded. Nutrient requirements were estimated according to ARC (1995) standard. All experimental animals were de-wormed (Endex®; Triclabendazole & Levamisole HCL) and given intramuscularly injection of 2ml of Vit. AD_3E (Dutch Farm, Veterinary Pharmaceuticals, Holland) to the start of the experiment and also dipped in 0.5% melathion solution. The data were analyzed statistically.

Table 1. Nutrient requirement (ARC, 1995), intake and balance of pregnant ewes of T_0 group

Parameter	Nutrientren quirement (ARC, 1995) ± SED	Nutrient intake ± SED	Balance surplus
Average live wt. (kg)	25.23± 1.43		
Average metabolic live wt.($kgW^{0.75}$)	11.23±0.47		
Total DM (kg/d)	1.42±0.06	0.65±0.05	0.77 (Surplus)
Total ME (MJ/d)	13.65±0.55	6.30±0.43	7.35 (Surplus)
Total CP (g/d)	171±5.91	89 ± 6.20	82 (Surplus)
Total DM(kg/100kg live weight)	5.68 ± 0.95	2.70±0.08	2.98 (Surplus)
Total DM ($g/kgW^{0.75}$/d)	127± 0.48	60±2.30	67 (Surplus)
Total ME (MJ/ $kgW^{0.75}$/d)	1.21±0.005	0.58±0.02	0.63 (Surplus)
Total CP (g// $kgW^{0.75}$/d)	15 ± 0.14	8±0.28	7 (Surplus)

SED = Standard error of difference.

Nutrient requirement (ARC, 1995), intake and balance of pregnant ewes of T_0 group is shown in Table1. The pregnant ewes of Jamuna river origin were not consumed nutrient according to ARC (1995) standard. Feed and nutrient intake of pregnant ewes of Jamuna river basin origin is presented in Table 2. Feed and nutrient intake of all groups was nonsignificant ($P> 0.05$). Overall average live weight was significantly ($P< 0.05$) higher in T_2 group (28.19kg) than the T_1 (27.09 kg) and T_0 group (25.23 kg). The higher live of T_2 group may be due to better utilization of feed. There was significantly ($P< 0.05$) difference in the average daily live weight gain of animals of T_2 group to that of the T_1 and T_0 group. The lower growth rate was observed in T_0 (81g/d) group than the T_1 (99g/d) and T_2 (116g/d) group. Digestibility of DM, OM, CP and ADF was significantly ($P< 0.05$) higher in T_2 group than the T_1 and T_0 group. The higher feed digestibility of T_2 group may be due to the better digestive efficiency.

Table 2. Feed and nutrient intake of pregnant ewes of Jamuna basin origin

Parameter	Dietary treatment groups			SED	Level of Significance
	T_0	T_1	T_2		
Overall average live weight (kg)	25.23^{c}	27.09^{b}	28.19^{a}	0.89	*
Average metabolic live weight ($kgW^{0.75}$)	11.23^{c}	11.42^{b}	11.98^{a}	0.27	*
Daily live weight gain (g/d)	81^{c}	99^{b}	116^{a}	5.37	*
Grass DM intake (kg/d)	0.28	0.29	0.28	0.019	NS
Grass ME intake (MJ/d)	2.26	2.30	2.28	0.09	NS
Grass CP intake (g/d)	33.49	34.98	33.75	1.41	NS
Concentrate DM intake (kg/d)	0.37	0.42	0.32	0.011	NS
Concentrate ME intake (MJ/d)	4.04	4.50	3.48	0.12	NS
Concentrate CP intake (g/d)	55	58	53	1.79	NS
Total DM intake (kg/d)	0.65	0.71	0.60	0.02	NS
Total ME intake (MJ/d)	6.30	6.80	5.76	0.21	NS
Total CP intake (g/d)	89	97	86	2.99	NS
Total DM intake (kg/100 kg live weight)	2.70	3.43	2.60	0.09	NS
Total DM intake ($g/kgW^{0.75}$/d)	59	62	57	0.96	NS
Total ME intake ($MJ/kgW^{0.75}$/d)	0.57	0.60	0.55	0.08	NS
Total CP intake ($g/kgW^{0.75}$/d)	8	9	7	0.12	NS

Table 3. Lamb birth weight of Jamuna river basin origin ewes

Parameter	Dietary treatment group						Level of Sig.
	T_0		T_1		T_2		
	No.	Mean ±SE	No.	Mean ±SE	No.	Mean ±SE	
Lamb birth wt. (kg) of single-born	-	-	2	1.85±0.30	-	-	-
Lamb birth wt.(kg) of twin-born	8	1.79^{b}±0.30	6	1.73^{b}±0.18	6	2.05^{a}±0.19	*
Lamb birth wt. (kg) of triple-born	3	1.63±0.17	-	-	6	1.65±0.18	-
Male birth wt (kg)	6	1.92^{b}±.09	3	1.93^{b}±0.47	5	2.10^{a}±0.13	*
Female birth wt. (kg)	5	1.62±0.04	5	1.66±0.08	7	1.67±0.33	NS
Mean of lamb birth wt. (kg)	11	1.75^{b}±0.28	8	1.76^{b}±0.18	12	1.85^{a}±0.13	*
Total lamb birth wt. (kg)	19.20^{b}		14.10^{c}		22.20^{a}		*
Average litter size (no.)	5	2.2±0.20	5	1.5±0.24	5	2.4±0.54	*
Average litter wt. (kg.)	5	3.38^{c}±0.38	5	3.60^{b}±0.29	5	4.98^{a}±0.02	*

Table 3 shows the lamb birth weight of Jamuna river basin origin ewes. Significantly ($P< 0.05$) higher average lamb birth weight was observed in T_2 (1.85 kg) group than the T_1 (1.76 kg) and T_0 (1.75kg) group.

The results of the present study indicated that the fresh chopped German grass plus 5% less concentrate diet of supplemented concentrate diet of T_0 group had beneficial effect on feed digestion, lamb birth weight and ewes live weight. Therefore, the fresh German grass plus 5% less concentrate diet was a better feeding system of pregnant sheep of Jamuna basin area. This observation need to be confirmed through data from other Bengal sheep genotype.

Molecular characterization of BLRI improved indigenous chicken varieties using microsatellite markers

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Executive Summary

Domestic chickens, native and locally adapted breeds or varieties those represent a diverse gene pool in the world. Among them, important components are available in developing countries including Bangladesh.Moreover, red jungle fowl; the wild progenitor of domestic chickens is still available in some regions of the country. This fact warrants and would be worthwhile to assess the genetic relationships and differentiation in indigenous chickens of Bangladesh. Therefore, the study was conducted to investigate genetic diversity, relationships and/or distances among the three indigenous chicken populations (Non-descript deshi, Naked Neck and Hilly) of Bangladesh. Besides, a panel of samples from red jungle fowl (JF); and a fighting breed Aseel were also included in this study. A total of 161 DNA samples were included in this study. All 5 chicken populations were discriminated using 16 highly polymorphic microsatellite markers those were screened and optimized at Animal Molecular Genetics Lab, Chungnam National University, Republic of Korea. PCR reactions were carried out using the C1000 Thermal Cycler in the aforementioned lab. The fragment size analysis was performed using the Genetic Analyzer 3130 (Applied Biosystems, USA) and allele score was determined using Genemapper ver. 4.1 ((Applied Biosystems, USA).

Our result showed that the mean number of alleles ranged between 5.81 (in red jungle fowl) and 7.13 (in Non-descript deshi). The average observed and expected heterozygosity in the studied populations was 0.67 ± 0.01 and 0.70 ± 0.01, respectively, whereas the overall heterozygote deficiency (F_{it}) was found 0.15 ± 0.02. AMOVA (analysis of molecular variance) analysis revealed 88.07 % of the total genetic diversity was accounted for within population variation and the rest 11.93 % was incurred with population differentiation (F_{st}). This result indicates little genetic differentiation among the investigated populations.Structure analysis depicted that the studied samples can be categorized into 4 distinct types (ΔK=3.74) or varieties (Non-descript deshi, Naked Neck, Hilly, Aseel/JF)where Aseel and JF grouped together. This finding suggests massive introgression of JF to Aseel breed and is also supported by our previous mitochondrial DNA study. In conclusion, these results provided important insight in relation to genetic diversity and population structure aspects which could be utilized forBangladeshi chicken genetic resource conservation as well as future breeding strategy development.

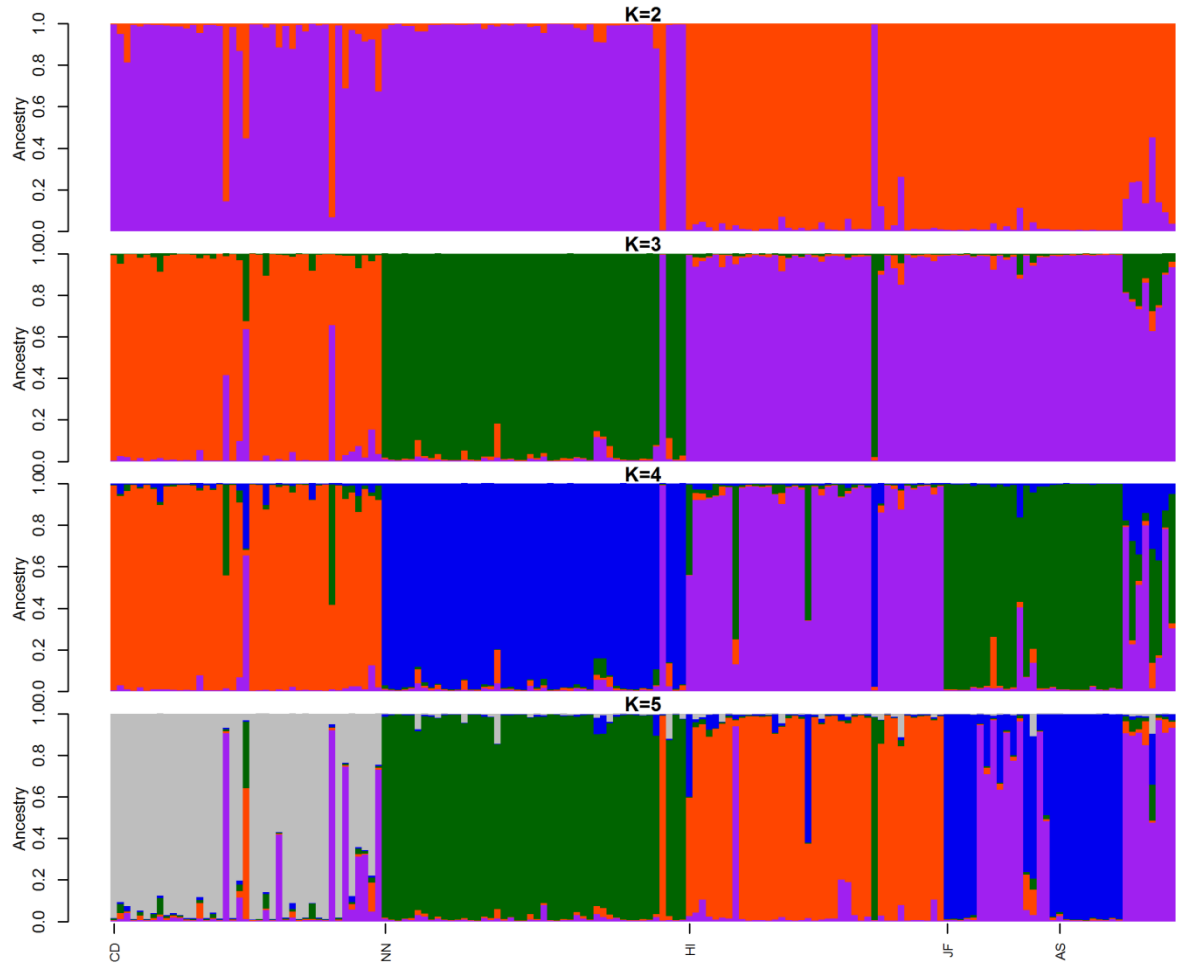

Figure 1: Structure analysis among 5 different chicken populations of Bangladesh using 16 polymorphic microsatellite markers.

POSTER SESSION

Study on an economic impact of native chicken in some selected areas of Bangladesh

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Executive summary

Native chickens are important for the rural poor women and marginalized section for subsidiary income and safe nutrition. Considering these views, the study was conducted taking objectives, namely, to assess the profitability of improved native chicken and to delineate the impact on household dietary diversity.Study areas were selected from six districts, namely,Joypurhat sadar under Joypurhat, Dinajpur sadar under Dinajpur, Dumoria under Khulna, Kotalipara under Gopalgonj, Nokla under Sherpur and Sonagazi under Feni district basis of improved native chicken project implementation areas. Primary data were collected through structure questionnaire during the months of January to March 2018 from two types of native chicken farmers. Project beneficiary group was treated as treatment group and served with training on scientific rearing and management practices and improved native chicken breed, on the other hand, control group those who reared native chicken in a traditional manner that means scavenging system. Both tabular and statistical techniques were adopted to analyze data. From the light of research findings, it was evident that treatment group produced 60 number native chickens annually and on the other hand, control group produced half of the treatment group that means 30 numbers of native chickens. On average, the treatment group hatched egg 2.57 times annually and each time they produced 23 numbers of chicks. On contrast, control group hatched 2.36 times annually and each time they produced 13 numbers of chicks. The study identified cost items such as feed, beginning stock , medicine & vaccine, electricity, transportation, labour and housing etc. Feed and labour were built the highest cost among the cost items for both the groups. For control group, labour cost occupied the 42 percent and the feed cost captured 28 percent. On the other hand, for treatment group, feed cost occurred 39 percent and the labour cost was 34 percent. The study also identified some cash inflow items such as closing stock, number of chicken sold, number of egg sold, number of chicken consumed, number of egg consumed, gift out chicken and gift out egg etc. we found that the improved native chicken had laid 141 number of eggs per year per bird, on the other hand, native chicken under scavenging system and traditional management practices laid only 50 number of eggs per year per bird indicating that the improved native chicken was better than the control in terms of egg production. The purpose of native chicken rearing was diversified namely additional family income, home consumption, ceremonies and creating employment opportunities partially. Fifty percent farmers opined that they reared native chicken for additional family income followed by 37 percent home consumption, 9 percent ceremonies and 4 percent creating employment opportunity. Farmers utilized the income from native chicken in a good way. The treatment group, 24 percent money spent for child education, 53 percent family expenses (food, clothing), 4 percent health treatment (medicine) and 19 percent savings whereas control group only 17 percent for child education, 66 percent family expenses (food, clothing), 9 percent health treatment (medicine) and 8 percent savings. The income utilization pattern was observed significantly different between these two groups and the treatment group obviously in convenient and well off position compare to control group. In case of profitability, the treatment group earned BDT 3,450 per 10 birds per annum followed by control group earned BDT 2,476. The BCR was found 2.04 and 1.45, respectively for treatment and control group (Table 1). Among the cash inflows, value of chicken sold was found highest. For treatment group, value of chicken sold was calculated 39 percent followed by value of egg sold 20 percent, value of chicken consumed 14 percent, value of egg consumed13 percent and the value of closing stock 11 percent. On contrast, for control group, value of chicken sold was calculated 44 percent followed by value of egg sold 7 percent, value of chicken consumed 27 percent, value of egg consumed 16 percent and the value of closing stock 4 percent.

Table 1. Revenue comparison between treatment and control group

10 birds/year

Area	Treatment				Control			
	Total revenue	Gross margin	Net return	BCR	Total revenue	Gross margin	Net return	BCR
Sherpur	3051	1801	1437	1.89	1618	750	289	1.22
Gopalgonj	3993	3168	2379	2.47	2375	1701	764	1.47
Feni	3316	2648	2147	2.84	3699	2835	1427	1.63
Dinajpur	2591	1521	1018	1.65	1711	810	255	1.18
Joypurhut	3027	1726	1206	1.66	2173	981	360	1.20
Khulna	4724	3607	2367	2.00	3280	2677	1549	1.89
Average	3450	2412	1759	2.04	2476	1626	774	1.45

Source: Field survey, 2018

We found that women were the sole reared of native chicken and logically the controlling power of money received from native chicken should be on the hands of women but study result showed that money usage depends on mainly the decision of the family head in most of cases. Rearing of native chicken entirely depends on women's decision but the usage of money controlled by women and men i. e. for treatment group 73 percent and for control group 52 percent, meaning that the treatment group was more empowered than the control group. We had constructed a household dietary diversity score on the basis of food items consumed by the family members. The food items were namely food grain, pulses, edible oil, leafless vegetables, leafy vegetables, meat, egg, milk fruits, fish, spices and beverage etc. We found that the household dietary diversity score for treatment group was calculated 8.33 for household members and 7.93 for household main women, on the contrary, for control group, 7.95 for household members and 7.64 for household main women. It was indicating that the treatment group had better supply of family dietary items. A Cobb-Douglas production function was drawn adopting multiple regression model comprising the independent variables were housing cost, treatment cost, labour cost, initial investment, feed cost, age, education, occupation and farm size. It was predicted that treatment cost, labour cost initial investment, feed cost, education and farm size might have positive influence to household native chicken production. It was apparent from the value of coefficient that most of the prediction was justified and statistically significant at different levels of confidence intervals (Table 2).

Table 2. Coefficient of explanatory variables of cost items and socioeconomic parameters

Explanatory variable	Coefficients	Std. Error	Sig. Level
Housing cost	-14.335	10.960	0.193
Treatment cost	12.669***	3.090	0.000
Labour cost	0.795	0.479	0.099
Initial investment	6.309***	1.857	0.001
Feed cost	1.775***	0.488	0.000
Age	11.003	11.277	0.330
Education	5.304	151.651	0.972
Occupation	158.078	104.488	0.132
Farm size	-1.504	4.294	0.727
Constant	-452.616	1375.885	0.743
R^2	0.280	-	-
F value	7.903***	-	0.000

Source: author's calculation. (*** represent 1% significant level).

In conclusion, we would like to state that the BLRI developed improved native chicken species has high potential over the traditional native chicken in terms of production performances.

Study on Cattle Fattening and Beef Marketing in some selected Areas of Bangladesh

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Executive Summary

By adopting BLRI developed much popular and commonly practiced Cattle Fattening Technology (CFT) on compensatory growth concept, farmers produce huge fattened cattle over the year, specially taking Eid-ul-Azha as a target point for selling and making profit. With a view to analyse the issue, this study was conducted comprising objectives, namely, to assess the profitability of cattle fattening; to determine the marketing of fattened cattle; and to examine the socioeconomic impact of cattle fattening farmers. Study areas were selected from three districts, namely, Dhamrai under Dhaka; Kustia sadar under Kustia and Pachbibi under Joypurhat district on the basis of more cattle fattening areas. Primary data were collected through structured questionnaire during the months of March to May 2018 from two types of sample interviewees-cattle fattening farmers and butcher/meat seller. Total sample size was 105 constituting 90 from cattle fattening farmers and 15 from butcher in the respective areas. Both tabular and statistical techniques were adopted to analyze data by R software.
From the study, it was found that 61% farmers had taken crossbred followed by 27% native and 12% both types of cattle for fattening. Farmers opined that crossbred was a fast growing and more profitable than the native one. In addition, fat composition is low in crossbred meat stated by the butcher. As source, 79% farmers had collected cattle from the recognized cattle market in the Upazila followed by 14% from own farms and the rest from farm and market for fattening of cattle. Farmers fattened 100%. The initial average age of fattened cattle was found 2.26 years. We found that 53% farmers did cattle fattening whole year, on contrast, 47 farmers only before Eid-ul-Azha, the biggest religious festival for the Muslim Community in Bangladesh. In the case of feed processing for cattle fattening, 41% farmers had given positive statement that they had knowledge on silage, hay and Urea Molasses Straw (UMS) preparation and conservation but the remaining 59% farmers had no proper knowledge on feed processing. Study also found that among the cattle fatten farmers only 22% had taken training on scientific management practices on cattle fattening from the department of livestock services (DLS) and the average duration was 4.25 days. Moreover, 94% farmers opined that for the purpose of treatment of their livestock, they had taken treatment and other advisory services from the Upazila Veterinary Hospital. On average, per farm fattened cattle population was found 2.74 and duration of fattening was 3.4 months. For fattening, among cost items, initial price of cattle that means purchase price of cattle was the highest (65.51%) followed by feed cost 21.22%, labour cost 10.47% and the rest of other cost. On average, total cost was calculated BDT 68,813/cattle/batch (Table 1).

Table 1. Cattle fattening cost (BDT/cattle/batch)

Cost items	Damrai	Kustia	Pachbibi	Average	Percentage (%)
Initial price of cattle	45256	53667	36315	45079	65.51
Treatment	466	423	277	389	0.57
Feed cost	16267	16438	11102	14602	21.22
Equipment	117	169	130	139	0.20
Electricity	169	177	102	149	0.22
Interest on operating capital	1254	1427	882	1188	1.73
A. Total variable cost	63529	72301	48808	61546	89.44
Labor cost	6816	8954	5853	7208	10.47
Housing cost	59	71	47	59	0.09
B. Total fixed cost	6875	9025	5900	7267	10.56
C. Total cost (A+B)	70404	81326	54708	68813	100.00

Source: Field survey, 2018.

The study identified some cash inflow such as value of cattle sold, value of cow dung and sold value of feed sacks etc. We found the highest return in Kustia sadar followed by Dhamrai and Pachbibi.

Average return was estimated BDT 86,171 per cattle and value of cattle sold contributed 99.16% of the total return. The estimated BCR was found in Pachbibi, Dhamrai and Kustia Sadar, respectively, 1.36, 1.26 and 1.18. Average BCR was 1.25 indicating that cattle fattening was a profitable enterprise (Table 2).

Table 2. Return from fattening cattle (BDT/cattle/batch)

Return items	Damrai	Kustia	Pachbibi	Average	Percentage (%)
Cattle sold	87972	94850	73524	85449	99.16
Cow dung	580	607	605	598	0.69
Feed sacks	123	142	108	124	0.14
D. Total return	88675	95599	74237	86171	100.00
E. Gross margin (D-A)	25146	23298	25429	24625	
F. Net return (D-C)	18271	14273	19529	17358	
G. BCR (D/C)	1.26	1.18	1.36	1.25	

Source: Field survey, 2018.

A Cobb-Douglas production function was drawn adopting multiple regression model comprising the independent variables was age, education, family size, farm size, occupation, initial value of cattle, treatment cost, feed cost and labour cost. It was predicted that treatment cost, labour cost, initial investment, feed cost, education and farm size might have positive influence to cattle fattening and income. It was apparent from the value of coefficient that most of the prediction was justified and statistically significant at different levels of confidence intervals (Table 3).

Table 3. Coefficient of explanatory variables of cost items and socioeconomic parameters

Explanatory variable	Coefficients	Std. Error	Sig. Level
Constant	56515.377***	14678.744	0.000
Age	-160.639	199.866	0.424
Education	1880.481	1968.108	0.342
Family size	-43.075	1351.791	0.975
Farm size	-14.452	18.254	0.431
Occupation	-5059.534**	2206.129	0.024
Initial value of cattle	0.068	0.139	0.625
Treatment cost	23.134**	10.257	0.027
Feed cost	1.332***	.454	0.004
Labour cost	1.876**	.946	0.051
R^2	0.284	-	-
F value	3.531***		.001

Source: author's calculation. (*** and ** represent 1% and 5% significant level).

In the case of beef marketing, on average, 45 numbers of cattle were slaughtered in each Upazila every day. In Bangladesh, total number of Upazila/thana was 550 (BBS, 2013) and in accordance, about 7,548,750 numbers of cattle were slaughtered every year except Eid-ul-Azha. Meat seller/butcher slaughtered 63% native breed and 37% crossbred cattle in the local *Hut* or market. About 93% butcher stated that they did not examine the health condition of cattle before slaughtering. Among the cattle slaughtered by the butcher, 86% was ox/bull and the remaining 14% was cow. In addition, 60% butcher opined that the place where cattle were slaughtered was not hygienic or wholesome. A butcher earned BDT 65,778 as total return where purchased price of cattle was BDT 60,384 and the marketing profit was calculated BDT 4,164 per cattle. For cattle fattening farmers, sector wise average annual household income was found BDT 384,061 where livestock sub-sector alone contributed BDT 192,772 which was 50.19% of the total income. On contrast, household annual expenditure on food was found highest 48.20% and second highest on education (17.83%). Farmers did not apply any types of steroids or growth hormone for cattle fattening. In conclusion, it may be stated that the BLRI developed cattle fattening technology was widely used by the farmers and it made their farm profitable and sustainable.

A baseline survey for field testing of BLRI FeedMaster mobile application in selective locations of Bangladesh

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Executive summary

"Feed Master" is a farmers and extension personnel friendly android application that can calculate animal ration according to their stage of production as well as help the farmers for year round fodder production planning, vaccination and scientific management of animals developed at Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. However, the efficacy of this technology has not yet been justified in field level. Considering this fact, the current research programme was designed to judge the efficacy, socio economic impact and to identify the constraints to adopt and sustain this technology at farmer's level. For this purpose, a baseline survey was conducted through a pretested questionnaire regarding the existing farming system of the farmers in Dhaka, Rajshahi and Sirajgonj regions as a preliminary step of this work. The data collected from the said regions were statistically analyzed with IBM SPSS 20.0 software. Results as obtained from this study reveal that contribution of male (84.6%) dominates over female (15.4%) in livestock farming in all of the surveyed area and average age of the farmers was 39.79 years. 44.2% respondents have an average family size of 4-5 people and 59.3% family have single earning member in their family. Primary education is the basic education level for 31.5% respondents and agriculture (85.5%) is the main occupation whereas, 4.6% involved in cattle farming. Majority of the respondents use smart mobile (66.3%) and 65.9% respondent have knowledge about mobile apps. Most of the farmers reared cattle in semi intensive system (61.3%) followed by intensive (29%) and extensive (9%) system. Although, crossbred cattle rearing farmers (67.9%) dominate over the indigenous cattle rearing farmers (44.9%) in the surveyed areas, but average number of indigenous and crossbred cattle per cattle keeper household are 5.55 and 5.33, respectively. Highest percentage (94.0%) of indigenous cattle keeper households were found in Rajshahi, followed by Sirajganj (21.8%) and Dhaka (20.2%), whereas 97% farmers in Sirajganj rear crossbreed cattle followed by Dhaka (90.4%) and Rajshahi (15%). Farmers in Sirajganj area have higher numbers of crossbred cows (6.37 per household) than Rajshahi (3.13) and Dhaka (4.6), whereas higher number of indigenous cattle per household was obtained in Rajshahi (6.90) than Dhaka (2.71) and Sirajganj (2.45). This study reveals that Sirajganj region is rich for crossbred cattle and Rajshahi for indigenous cattle. Almost equal percentage of farmers supply sole green grass or rice straw (46.1 and 45.1%, respectively), whereas only 8% farmers supply a combination of both green grass and rice straw. However 66.9% farmers supply concentrate mixture to their cattle, whereas 31.1% and 63% farmers supply sole roughage and both roughage and concentrate to their animals respectively. When farmers prepare concentrate mixture at farm, the cost of feed (24.0 Tk./kg) is lower than that of purchased ready feed (35.8 Tk./kg). Despite the higher price of purchased ready feed 24.8% of the farmers supply ready feed which proportion is higher in Dhaka (54.8%), followed by Rajshahi (11.6%) and Sirajganj (8.5%). This indicates that farmers do not have adequate knowledge about balanced ration formulation as they have to rely on commercial feed. 95.5% farmers supply concentrate feeds to their animals on the basis of eye estimation of requirements. However, 33.7% farmers have idea about balanced ration. Wheat bran, rice polish, oil cake, khesari bran, broken rice, mosur bran and crashed maize are the most common types of concentrate feeds used in the surveyed area. Among the concentrate feed ingredients, wheat bran is especially used by about 26.1% farmers. About 64.4% farmers cultivate fodder for feeding their cattle where Napier is cultivated by most of the farmers (41.6%). Body weight of cattle is estimated by 98.3% farmers based on eye estimation, which is mainly due to administration of drugs (87%). Vaccination and deworming is practiced by 94.4% and 96.7% farmers, respectively in the selected regions. But regular vaccination and deworming are followed by 79.1% and 76.6% farmers respectively. Among the farmers, 36.3% have proper knowledge about vaccination and rest of them vaccinate without having any knowledge on it. FMD (45.8%) and Anthrax (37.9%) are the most common types of vaccines used by the farmers for their animals. There is a huge gap between the supply and demand of Government vaccines, as

42.5% farmers purchase vaccines from private sources. Most of the cases 62.5% vaccination is done by Quack or Livestock service provider. About 46.6% of the farmers deworm their animals twice in a year. Most of the cases 31.2% deworming is done by farmers themselves. Different types of diseases (most commonly FMD, Diarrhoea, Bloat, Fever, Anthrax and HS) are found in different rates of prevalence in the surveyed areas. FMD is the highest (37.4%) prevalent disease in the surveyed areas and about 91.0% of the farmers take their animals under treatment when disease occurred. 84.4% of the disease affected animals recover from the diseases after proper treatment and rest of the animals die. In most cases, treatment is facilitated by Quack (Livestock service provider), whereas, 26.6% registered veterinarian facilitate for treatment. Only 36.7% farmers have idea about disease condition and 46.5% of the farmers face problems to avail registered veterinarian. Average milk production of the surveyed areas was found to be 13.42 kg/day. Average milk production was highest in Sirajganj (27.01 kg/day) followed by Dhaka (10.23 kg/day) and Rajshahi (4.85 kg/day). Milk selling price average 43.6 Tk./kg) with highest in Dhaka (52.6 Tk./kg), followed by Rajshahi (41.7 Tk./kg) and Sirajganj (35.5 Tk./kg). Although, Sirajganj is rich in milk production among the surveyed areas, lower price of milk results in economic loss of the dairy farmers. Only 15.3% farmers are acquainted with different technologies related to livestock and 25% farmers have training on livestock rearing and management, based on economic analysis for dairy and fattening farming in the selected areas. It was found that dairy and fattening are more profitable in Rajshahi (BDT. 59,150.0 and BDT 49,122.0 Per annum) than Dhaka (BDT 45,732.0 and BDT. 20,000.0 Per annum) and Sirajganj (BDT. 99,818.0 and BDT. 18,200.0, respectively Per annum). This might be due to lack of proper synchronization of production and cost of production along with low milk price. This feed based mobile application will help in economic production for both dairy and fattening farming in those areas. After baseline survey, 30 farmers were selected from each of the three locations for two days long orientation and practical demonstration program on 'Feed Master' mobile apps. Among the trainees, 5 (five) farmers were selected for documentation of the technology in each of the locations. The socioeconomic impact and status of technology analysis will be performed in next year.

A study on economic losses due to foot and mouth disease outbreak in cattle and buffalo in some affected areas of Bangladesh

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Executive summary

Foot and mouth disease (FMD) is a severe, highly contagious disease that causes immense economic loss due to mortality, reduced milk production, treatment cost for affected cattle and weight loss of fattening cattle, which occurs in Bangladesh almost every year. Outbreak of this disease causes immense economic loss to the farmer as well to the national economy. In this study, an attempt was made to analyze the morbidity, mortality and fatality of cattle affected by Foot and Mouth Disease (FMD) and financial loss incurred therein. For this study data were collected from 652 affected households of Dhaka, Rajshahi, Rangpur, Khulna, Chittagong divisions. Data were collected from July 2017 to June 2018 using a predesigned questionnaire responding to the objectives of the study.

In total, there were 3792 crossbred and 1959 native cattle in the affected households. According to area the overall morbidity, fatality and mortality were 50.29%, 13.11% and 6.59%, respectively in crossbred cattle (Table 1). Morbidity in crossbred cattle was found the highest in Khulna (83.87%) followed by Rajshahi (70.00%), Rangpur (66.67%), Dhaka (64.53%) and Chittagong (28.53%). Fatality was highest in Chittagong (24.85), followed by Khulna (11.54%), Dhaka (9.27%), Rajshahi (8.83%) and Rangpur (6.25%). Mortality was highest in Khulna (9.68%), followed by Chittagong (7.09%), Rajshahi (6.18%), Dhaka (5.98%) and Rangpur (4.17%). It was found that morbidity, mortality and fatality in crossbred cattle differed significantly (χ^2=621.98, p<0.01; χ^2=665.99, p<0.01; χ^2=145.16, p<0.01). The overall morbidity, fatality and mortality were 77.59%, 9.67% and 7.50%, respectively in native cattle. Morbidity in native cattle was found the highest in Khulna (85.47%) followed by Rangpur (77.14%), Dhaka (74.77%) and Rajshahi (60.31%) but mortality was highest in Rangpur (10.06%), followed by Dhaka (6.85%), Khulna (7.68%) and Rajshahi (1.17). Fatality was highest in Rangpur (13.06%), followed by Dhaka (9.17%), Khulna (8.99%) and Rajshahi (1.94%). Morbidity and fatality in native cattle differed significantly (χ^2=71.28, P<0.01; χ^2=9.86, P<0.01 and χ^2=14.36, P<0.01) by area. No buffalo was found in the affected farms.

Table 1. Morbidity, Fatality and mortality of crossbred and native cattle by area.

Area	No. of farms	Crossbred cattle				Native cattle			
		Total no. of cattle	Morbidity	Fatality	Mortality	Total no. of cattle	Morbidity	Fatality	Mortality
Dhaka	150	468 (12.34)	302 (64.53)	28 (9.27)	28 (5.98)	321 (16.39)	240 (74.77)	22 (9.17)	22 (6.85)
Rajshahi	160	1520 (40.08)	1064 (70.00)	94 (8.83)	94 (6.18)	257 (13.12)	155 (60.31)	3 (1.94)	3 (1.17)
Rangpur	202	24 (0.63)	16 (66.67)	1 (6.25)	1 (4.17)	665 (33.95)	513 (77.14)	67 (13.06)	67 (10.08)
Khulna	110	31 (0.82)	26 (83.87)	3 (11.54)	3 (9.68)	716 (36.55)	612 (85.47)	55 (8.99)	55 (7.68)
Chittagong	30	1749 (46.13)	499 (28.53)	124 (24.85)	124 (7.09)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
All area	652	3792 (100)	1907 (50.29)	250 (13.11)	250 (6.59)	1959 (100)	1520 (77.59)	147 (9.67)	147 (7.50)
χ^2 values* Significance			621.98 P<0.01	665.99 P<0.01	145.16 P<0.01		71.28 P<0.01	9.86 P<0.01	14.36 P<0.01

Figures in parentheses are percentages the respective area total; χ^2 was estimated from absolute numbers and not from percentages

Prevalence of FMD was found to be the highest in the months of January-February (31.44%) followed by March-April (21.78%), September-October (16.26%), July-August (15.64%) and November-December (14.88%).

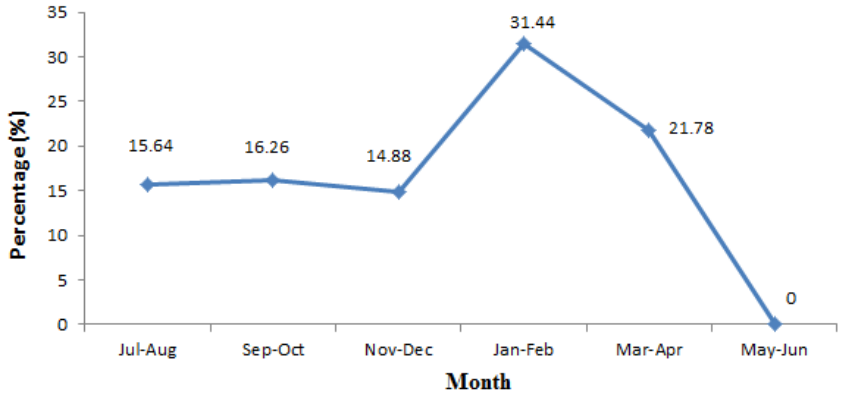

Figure 1. Prevalence of FMD by month (% of respondents)

It was reported that only 20.71% farmers vaccinated their cattle against FMD. Of the farmers vaccinated their cattle, 89.63% used vaccine produced by Department of Livestock Services (DLS) and 10.37% used imported vaccines. For calculating financial loss due to FMD outbreak only direct losses such as milk production loss of affected in-milk cows, veterinary costs for treatment of affected cattle, death loss, weight loss of fattening cattle, labour cost for taking care of affected cattle were considered. The total financial loss was calculated as Taka 3,96,23,121 for 652 affected households. The percentage of loss incurred was the highest for death of affected cattle (58.34%) followed by weight loss of fattening cattle (13.14%), treatment cost (12.29%), reduction in milk yield (9.54%) and man power loss for taking care of affected cattle (6.67%) Based on this calculation the estimated financial loss due to FMD outbreak would be Tk. 16,000 crores per year.

Table 2: Financial loss due to outbreak of FMD (Taka)

Description	Dhaka	Rajshahi	Rangpur	Khulna	Chittagong	Total loss in Taka	% loss
Loss of milk	478195.56	1567750.7	149279.87	322115.82	1263947.3	3781289	9.54
Death loss	4190000	6618000	3279000	1836000	7195000	23118000	58.34
Treatment cost	851700	1596280	524150	372000	1527000	4871130	12.29
Weight loss	3564000	804000	830000	10000	0	5208000	13.14
Labour cost	449197	1040423	231947	480207	442928	2644702	6.67
All area	9533093	11626454	5014377	3020323	10428875	3,96,23,121	100

From the study it revealed that breed type, seasonal influence are the major risk factors for occurrence of FMD. Both crossbred and native cattle are susceptible to this disease. Outbreak of FMD was found higher in January-February (31.44%) and March-April (21.78%) and this disease causes immense economic loss to the farmer as well to the economy. Therefore, findings of this study provide information on epidemiology of FMD and its potential impacts on household income, signifies the need of effective disease management and control strategies.

Annual Research Review Workshop 2018

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