Proceedings

Annual Research Review Workshop 2021

Date: 27-28 January 2022

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

Annual Research Review Workshop 2021

Date: 27-28 January 2022

BLRI Conference Hall

3rd floor, Building 3

PROGRAMME

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

TECHNICAL SESSIONS

Day 1: Thursday, 27 January, 2022

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

Chairperson : **Dr. Md. Nazrul Islam**
Former Director General, BLRI

Co-Chairperson : **Dr. Mohammad Shamsul Alam Bhuiyan**
Professor, Department of Animal Breeding and Genetics
Bangladesh Agricultural University, Mymensingh 2202

Rapporteurs : Nani Gopal Das, SSO, BLRI
Md. Panir Choudhury, SSO, BLRI

11:30-11:40	Strategic development of beef cattle and their qualities in Bangladesh	MYA Khan, SSO
11:40-11:50	Conservation and Improvement of Native Chicken: performance of ninth generation	S Faruque, CSO (RC)
11:50-12:00	Conservation and improvement of locally adopted exotic germplasm for the development of egg and meat type chicken	MR Hassan, PSO
12:00-12:10	Ex-situ conservation and improvement of native sheep at Bangladesh Livestock Research Institute	NH Desha SO
12:10-12:20	Regional livestock Research Reinforcement at Naikhongchari	MS Hasan, SO
12:20-12:30	Conservation and Improvement of Black Bengal Goat at Bangladesh Livestock Research Institute	NH Desha SO
12:30-12:40	Performance evaluation of crossbred buffalo at on-farm and on-station	MA Alam, SSO
12:40-01:00	**Discussion**	
01:00-02:00	**Lunch and Prayer**	
02:00-02:30	**Poster presentation**	

Day 1: Thursday, 27 January, 2022

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

Chairperson : **Dr. Nathu Ram Sarker**
Former Director General, BLRI

Co-Chairperson : **S.M. Awal Hoque**
Director
Central Cattle Breeding and Dairy Farm, Savar, Dhaka

Rapporteurs : Md Rezaul Hai Rakib, SSO, BLRI
Dr. Shabiha Sultana, SSO, BLRI

02:30-02:40	Determination of best practice management of Napier grass to doubling the milk production of cows	BK Roy, CSO (RC)
02:40-02:50	Identification of existing management approaches of both commercial and traditional fattening in some selected area of Bangladesh	N Huda, SSO
02:50-03:00	Effect of creep feeding on the performance of Black Bengal kids up to weaning	S Ahmed, PSO
03:00-03:10	Production of safe broiler chicken through feed additives in different regions	MSK Sarker, PSO
03:10-03:20	Determination of cholesterol, fatty acid profile and lipid oxidation of poultry eggs through a validated method	MF Sharmin, Post Doc Fellow
03:20-03.30	Quality and safety assessment for poultry meat products	MR Amin, PhD Fellow
03:30-03:40	Effect of dietary methionine and lysine on growth performance, carcass traits and economic efficiency of Hilly chicken	S Sultana, SSO
03:40-04:00	**Discussion**	
04:00-04:10	**Tea and Snacks**	
04.10-05:00	**Poster Presentation**	

Day 2: Friday, 28 January, 2022

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

Chairperson : **Dr. Talukder Nurun Nahar**
Former Director General, BLRI

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

Rapporteurs : Md. Ahsanul Kabir, SSO, BLRI
Md. Faizul Hossain Miraz, SSO, BLRI

09:30-09:40	Carbon footprint of different livestock production system in Bangladesh	NG Das, SSO
09:40-09:50	Low cost and sustainable business model development of bio-slurry management	JS Khanam, SSO
09:50-10:00	Measurement of noxious greenhouse gases at the poultry shed and their possible remedies	MAG Rabbani, SSO
10:00-10:10	Whole genome re-sequencing of Gayal (Bos frontalis) and genome annotation to unveil genetic variations to explore the evolution and adaptation at genome level.	GK Deb, PSO
10:10-10:20	Development of semen bank for conservation of germplasm at Bangladesh Livestock Research Institute	MFH Miraz, SSO
10:20-10.30	Development of microbial silage inoculant and evaluation of its efficacy on ensiling roughages	M Miah, SO
10:30-10:40	Recycling of poultry wastes for environment friendly low cost poultry production	MA Rashid, SSO
10:40-11:00	**Discussion**	
11:00-11:10	**Tea and Snacks**	

Day 2: Friday, 28 January, 2022

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

Chairperson : **Dr. Md. Giasuddin**
CSO (PRL), Animal Health Research Division, BLRI

Co-Chairperson : **DR. Nilufa Begum**
Director (Research)
Department of Livestock Services

Rapporteurs : DR. Md. Zulfekar Ali, SO, BLRI
DR. Sonia Akther, SO, BLRI

11:10-11:20	Surveillance and molecular evolution of highly pathogenic avian influenza virus (HPAIV) in Bangladesh	MZ Ali, SO
11:20-11:30	Monitoring and evaluation of Peste des Petits Ruminants (PPR) virus isolates circulating in Bangladesh.	MS Alam, SSO
11:30-11:40	Phenotypic and genotypic profiling of antimicrobial resistance (AMR) in enteric bacterial communities in finisher livestock and poultry in Bangladesh	ASMA Uddin, SSO
11:40-11:50	Molecular characterization of continuous ecthyma virus from goats	S Akhter, SO
11:50-12:10	**Discussion**	
12:10-01.00	**Poster Presentation**	
01:00-02:00	**Lunch and Prayer**	

Day 2: Friday, 28 January, 2022

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

Chairperson : **Dr. Jahangir Alam Khan**
Former Director General, BLRI

Co-Chairperson : **Dr. Md. Mosharraf Uddin Molla**
Member Director (cc), Agricultural Economics and Rural Sociology Division, BARC

Rapporteurs : Jobaida Shovona Khanam, SSO, BLRI
Sabina Yasmin, SSO, BLRI

02:00-02:10	Development of Model village through BLRI Technologies at Dhamrai areas.	R Khatun, PSO
02:10-02:20	Consumers' preference and perception between broiler and indigenous chicken meat in Bangladesh	S Yasmin, SSO
02:20-02:30	Developing a model for up-scaling livelihood of the rural poor farmers by rearing Red Chittagong Cattle	MA Kabir, SSO
02:30-02:50	**Discussion**	
02:50-03.40	**Poster Presentation**	
03:40-04:40	**Closing session**	
04:40-05:00	**Tea and Snacks**	

POSTER SESSION

Day 1: 2:00-2:30 pm & 04:10-05:00 pm
Day 2: 12:10-01:00 pm & 02:50-03.40 pm

Rapporteurs : Ataul Goni Rabbani, SSO, BLRI
DR. Habibur Rahman, SO, BLRI

SL No.	Title	Presenter
1.	Evaluation of Moringa (Sajna) Feed for Livestock Production	N Sultana, CSO
2.	Collection, conservation, multiplication of high yielding fodder and evaluation of their production performances under different climatic conditions	BK Roy, CSO (RC)
3.	Up-gradation and diversification of value addition technologies of livestock products & by-products	BK Roy, CSO (RC)
4.	Conservation and improvement of Munshiganj cattle	MYA Khan, SSO
5.	Development of a system generated database for cattle and buffalo research farm BLRI	S Ahmed, SSO
6.	Performance and meat quality of BLRI improved Hilly chicken in different production systems	MA Rashid, SSO
7.	Conservation and Improvement of Native duck and geese genotypes	H Khatun, SSO
8.	Conservation and Improvement of Quail: Performance of tenth generation	S Faruque, CSO (RC)
9.	Investigation of Lumpy Skin Disease (LSD) in Bangladesh	MZ Ali, SO
10.	Adaptation and attenuation of duck plague virus in chicken embryo fibroblast cell as vaccine seed	MS Alam, SSO
11.	Efficient management of livestock and poultry farm wastes for pollution control	D Das, SO
12.	Development of animal ID & recording system of RCC and their graded cattle through computer and mobile application technology	MA Kabir, SSO
13.	Development of low cost feeding system for Red Chittagong Cattle through the supplementation of locally available fodder.	D Das, SO
14.	Development of community breeding model for Red Chittagong Cattle	MFH Miraz SSO
15.	Ovum pick up based in vitro embryo production technology for production of Red Chittagong calves	MFH Miraz SSO
16.	Effect of papaya leaf extract on growth performance, carcass characteristics and meat quality in broiler chickens	MZ Rahman, CSO (RC)
17.	Intervention of BLRI Technology; adoption and improvement of livelihood of trained farmers in different zone of Bangladesh	KN Monira, PSO
18.	Morphometric characterization and productive performance of Jamunapari goat at BLRI	MMH Pasha, SO
19.	Exotic sheep adaptation and their crossbreds production in Bangladesh	NH Desha SO
20.	Production and adaptation of Bio-char as soil amendment and C-sequestration for sustainable improvement of soil fertility in sandy	US Alam, SO

SL No.	Title	Presenter
	soil	
21.	Comparative study on livestock structure at regional station of BLRI	MA Islam, SO
22.	COVID-19 Pandemic – Impact on Livestock Sector of Bangladesh	MH Rahman, SO
23.	Impact of recent outbreaks of lumpy skin disease (LSD) on Northern dairy dominant areas in Bangladesh.	SB Sodrul, SO
24.	Impact study of establishment of community based Buck park along with GSMS software at farmer's level	MA Hemayet, SSO
25.	Identification and evaluation of locally available fodders, leaves used for Black Bengal Goats in different selected areas in Bangladesh	MA Hemayet, SSO
26.	Screening for causative mutations of major prolificacy genes in Black Bengal Goat	NH Desha SO
27.	Identification of the polymorphisms in low-density-lipoprotein receptor related protein-8 gene and association study with gastrointestinal nematodes infection in goat	MH Rahman, SO
28.	Problems and prospects of ostrich *(Struthio cantelus)* production in Bangladesh	TI Khondoker, PhD Fellow
29.	Determination of essential minerals with heavy metals in feed, meat and eggs of different poultry species	MM Rana, SSO
30	Growth performance of Aseel chicken for developing meat type chicken	F Tabassum, PhD Fellow
31	Performance of Pekin and Muscovy duck for meat type duck production	F Tabassum, PhD Fellow
32	Collection, conservation and improvement of specialized fowl production	MA Rashid, SSO
33	Conservation and improvement of indigenous buffalo for milk production through open nucleus breeding program	KT Tahira, SO
34	"Greenway Business Apps" an Android Mobile Applications for the Farmers	S Akther, SO

CONTENTS

Session I:

ANIMAL AND POULTRY BREEDING & GENETICS

Strategic development of beef cattle and their qualities in Bangladesh

M. P. Mostari, M.Y.A. Khan, M. P. Choudhury, B. K. Roy and M.A. Jalil
Animal Production Research Division, BLRI, Savar, Dhaka-1341

Executive summary

Bangladesh is a highly cattle dense country which have 188 head cattle per km^2. The cattle density per thousand people is 204, which is not sufficient to meet the demand of beef in the country due to their poor meat production efficiency. The per capita intake of meat is only 8.6 kg in Bangladesh against 42.1 kg and 32.2 kg for world and developing countries, respectively. To meet this gap, meat production of the country must be increased many folds but, because of high density of cattle, there is limited opportunity to increase cattle population instead of increasing their productivity. Considering these facts, the present program was undertaken to evaluate the comparative growth performance of different exotic crossbred beef genotypes and selection of suitable candidate beef producer, which will be able to produce at least 150.0 kg of carcass within 2 years of age under on farm feeding and management condition. Therefore, semen from four exotic beef sire i.e. Simmental, Charolais, Limousine and American Brahman were used to inseminate BLRI Cattle Breed-1 (BCB-1), purebred dams for the production of F_1 crossbred progeny. A total of 65 F_1 crossbred progeny were produced in a period of 6 years (2015 to 2021), where, 18 Limousine, 20 Simmental, 15 Charolais and 12 Brahman crossbreds (Table 1). All animals received 55:45 mixed ration (DM basis) of german grass and a concentrate mixture containing 18% CP. They were raised under similar feeding and management condition and their feed intake, body weight, average daily gains, disease incidence and mortality were recorded and evaluated all over the year. At 2 years of age Simmental×BCB-1 male showed the highest (Please give P value??) body weight (543.50a±105.35 kg) followed by Charolais (495.00ab±40.92 kg), Limousine (472.66b±38 kg), Brahman (407.14c±15.23 kg) crosses and purebred BCB-1 (348.00d±20 kg). Purebred BCB-1 bulls had the lowest daily DM intake and showed the lowest FCR among others. Consequence of this evaluation process a total of 24 cattle were slaughtered for a comparative study on carcass and meat yield characteristics of F_1 crossbreds and purebred BCB-1 at 2 years of age. There were no significance differences for dressing percentage among the F_1 crossbreds and purebred BCB-1 in a similar body condition score. However, Brahman crossbred showed lower meat tobone ratio than others. So, Simmental×BCB-1 and Charolais×BCB-1 crossbred were selected as future beef producer and used for production of F_2 crossbreds through *inter-se* mating and a total of 21 F_2 crossbreds were produced where, 14 Simmental, 07 Charolais crosses (Table 1). The economic important traits of F_1 and F_2 crossbred male and female were recorded and compared statistically in a 3-Way ANOVA using "agricolae" package (Statistical Procedures for Agricultural Research) in R program version 1.3-5. Growth performance between F_1 and F_2 generation of Simmental and Charolais crossbred male-female were compared and found significant variations for genotype (at birth weight), for generation (at 6 months, 1 year 6 months and 2 years live weight) and for sex (at 1 year 6 months and 2 years live weight) (Table 2 and 3). A reasonable amount of milk production is needed for profitable calf production and its subsequent growth. Therefore, we also recorded the milk production of dams for breed development. The average daily milk yield of F_1 female of Simmental and Charolais crossbreds found 5.9 and 6.5 kg, respectively (Table 4).

Table1: Production of crossbred beef genotypes

Genotype of calves	Sex		Total
	Male	Female	
	F_1 Crossbred		
Simmental×BCB-1	7	13	20
Charolais×BCB-1	10	8	18
Limousin×BCB-1	8	7	15
Brahman×BCB-1	7	5	12

Sub Total	32	33	65
	F_2 Crossbred		
Simmental×BCB-1	5	9	14
Charolais×BCB-1	4	3	7
Sub Total	11	12	21
Grand Total (F1+F2)	41	45	86

Table 2: Effect of genotype, generation and sex on body weight gain of F_1 and F_2 male and female of Simmental and Charolais crossbreds.

Variables / Sources of interaction	At birth	6 months	1 year	1 year 6 months	2 years
	F value (Sig.)				
Genotype	0.025(*)	0.787	0.399	0.611	0.703
Generation	0.681	0.000954(***)	0.000617(***)	0.0544(*)	0.0365(*)
Sex	0.265	0.509	0.216	0.0234(*)	0.0149(*)
Genotype*Generation	0.680	0.804	0.685	0.449	0.696
Genotype*Sex	0.999	0.527	0.596	0.808	0.858
Generation* Sex	0.644	0.387	0.757	0.827	0.444
Genotype*Generation*Sex	0.927	0.704	0.431		

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 3: Live weight of F_1 and F_2 male and female of Simmental and Charolais crossbreds

Live weight (kg)	Genotype Mean±SD(n)			
	Charolais cross	Simmental cross	Charolais cross	Simmental cross
	F_1 Male		F_1 Female	
At birth	27.30±7.01(6)	23.35±2.54(4)	25.55±4.16(6)	22.43±2.82(10)
6 months	127.16±39.28(6)	119.00±39.11(4)	116.83±37.63(6)	124.10±30.20(10)
1 year	260.66±69.52(6)	244.25±65.98(4)	225.83±43.70(6)	232.30±47.10(10)
1 year 6 months	369.50±85.01(6)	364.75±107.44(4)	299.0±44.53(6)	312.5±70.83(10)
2 years	456.33±66.67(6)	499.66±123.92(3)	391.20±46.84(5)	402.70±71.51(10)
	F_2 Male		F_2 Female	
At birth	25.70±6.51(4)	23.48±2.77(5)	23.25±4.59(2)	23.00±3.62(7)
6 months	95.0±11.43 (4)	99.8±7.85(5)	78.00±5.65(2)	86.85±13.90(7)
1 year	187±40.20(4)	198±32.13(5)	174.50±45.96(2)	170.57±33.67(7)
1 year 6 months	260±45.25(2)	317.33±41.23(3)	-	-
2 years	355.5±62.93(2)	386.0±39.94(3)	-	-

Table 4: Milk yield Characteristics of Simmental and Charolais crossbreds

Milk yield characteristics	Simmental cross	Charolais cross
	Mean±SD(n)	
Lactation Length (days)	239±113(8)	212±52(3)
Lactation Yield (kg)	1412±641(8)	1387±310(3)
Average yield/day (kg)	5.9±2.2(8)	6.5±2.4(3)

From the above results it may be concluded that Simmental cross showed as the highest live weight at market age in both F_1 and F_2 generations. Collection, evaluation and a number of frozen semen straws were produced from selected Simmental×BCB-1 and Charolais×BCB-1 crossbred bulls for future use in *inter-se*-mating and production of market beef cattle containing 25% exotic genetics. This is an ongoing research program. Therefore, more progeny of selected F_1 & F_2, production and evaluation of market beef cattle through field trial and thus sustainable high yielding beef breeds of different (75%, 50% and 25%) blood levels are yet to be produced to calculate their precise performance and achieve the goal.

Conservation and improvement of native chicken: performance of ninth generation

S Faruque[1], AKFH Bhuiyan[2], MA Rashid[1], S Sultana[1], T Akter[1], MRA Sumon[1], MMR Manu[1], MSK Sarker[1]

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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 performance 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 ninth generation (G_9) birds, iii) To determine carcass characteristics, free amino acid content, fatty acid composition, bioactive components and nucleotide content of meat. A total of 7621-day-old chicks comprising of 3 types of chicken namely Naked Neck (NN-2567), Hilly (HI-2462) and Non-descript Deshi (ND-2592) were hatched in two batches to produce G_9. The progeny were wing banded and reared separately according to genotypes. Improvement target of egg production rate is to increase by 2% per generation, improvement target of egg weight is to increase by 1 g, and improvement target of growth rate is to increase by 20g per generation. In G_9, selection was practiced at two stages. Firstly, at 8 week of age according to 8 week's body weight and secondly, selection was practiced at 40 week of age on the basis of selection index to produce next generation comprising the parameters of body weight (BW) at 40 week, egg production (EP) up to 40 week, egg weight (EW) at 40 week and age at sexual maturity (ASM). The selected males and females were mated assortatively with a maximum male : female ratio of 1 : 5 using artificial insemination avoiding mating among close relatives. Egg productions from birds wererecorded up to 72 weeks of age from hens of ND, HI, NN. Chick weight (g), body weight at different stages of age, annual egg production, hen-day egg production (HDEP) (%), fertility (%), hatchability (%), feed intake (g/b/d) were recorded. All recorded data were analyzed in a CRD by Generalized Linear Model (GLM) procedure using SPSS 20.0 for Windows. For mean comparison Duncan Multiple Range Test (DMRT) was used.The expected selection response for EP, EW, BW and ASM were estimated using the following equation (Falconer, 1981). $R = 1/2\ h^2 \times S_f$, where, R = expected response in mass selection, h^2 = heritability, h^2 of EP and EW, S_f = selection differential for dam.

Chick weightsand 8th week body weights (males and females) were significantly ($p<0.001$) higher in HI compared to other genotypes(Table 1). Annual egg production was significantly ($p<0.001$) higher in NN (190.88), intermediate in ND (188.48) and lowest in HI (160.56). Genotype had significant effect ($p<0.001$) on HDEP. The HDEP% of eggs obtained from NN hens was significantly ($p<0.001$) higher with the values of 51.85%. The percent hatchability of eggs obtained from HI hens was significantly ($p<0.001$) higher with the values of 82.14%. Table 2 showed that EP of ND, HI and NN birds were expected to increase by 0.51, 1.421 and 0.105 %, respectively. The EW of ND, HI and NN birds were expected to increase by 0.117, 0.188 and 0.436g, respectively. The number of effective population size (Ne) was 46-100 (Table 3). The rate of inbreeding (ΔF) calculated for the native chicken considering the existing flock size and management practice was 0.002 to 0.010 (0.2% to 1.0%). It is concluded that inbreeding rate in *ex-situ* conservation system is found very low. This study reveals that different genotypes and generations of selection have significant effect on 8th week body weight, egg production as well as egg weight.

Table 1: Performance of three genotypes of native chicken at 9th generation

Parameter	Genotype			Sig. level
	ND (Mean±SE)	HI (Mean±SE)	NN (Mean±SE)	
Day-old chick weight (g)	31.55±0.12	33.36±0.13	30.95±0.11	p<0.001
Body weight at 8th week (g) (Male)	638.22^{b}±7.25	821.85^{a}±6.76	648.47^{b}±7.34	p<0.001
Body weight at 8th week (g)	489.77^{b}±5.51	628.58^{a}±4.50	479.23^{b}±4.50	p<0.001

(Female)				
Annual egg production (no.)	188.48^{a}±1.28	160.56^{b}±1.56	190.88^{a}±1.27	p<0.001
Annual HDEP (%)	48.83^{b}±0.51	37.43^{c}±0.51	51.85^{a}±0.51	p<0.001
Fertility (%)	81.55±1.97	78.02±2.01	84.39±1.98	NS
Hatchability (%)	77.69^{ab}±1.92	82.14^{a}±1.98	72.57^{b}±1.94	p<0.01
Feed Intake (24-40 weeks)	88.66±0.34	89.43±0.34	88.76±0.34	NS

Table 2: Expected response to selection for EP (up to 40 weeks) and EW (at 40 weeks) in G_9 of native chicken

Genotype	Traits	Before selection	After selection	Selection differential (S)	Selection intensity (i)	Heritability (h^2)	Expected response (R)
ND	EW(g)	46.36	46.6	0.24	0.258065	0.49	0.1176
	EP (%)	66.51	67.53	1.02	0.257576	0.50	0.51
HI	EW(g)	46.36	46.77	0.41	0.398058	0.46	0.1886
	EP (%)	49.91	52.81	2.9	0.413105	0.49	1.421
NN	EW(g)	45.87	46.76	0.89	0.872549	0.49	0.4361
	EP (%)	64.76	65.06	0.3	0.04878	0.35	0.105

Table 3: Estimation of effective population size and rate of inbreeding of selection of three indigenous chickens from G_7-G_9

Generation	Sires	Dams	Effective population size (N_e)	*Selection intensity (i)	Rate of inbreeding (ΔF)
Non-descript Deshi					
S_7	20	100	66.667	0.491	0.007
S_8	30	150	100.00	0.390	0.005
S_9	20	100	66.667	0.725	0.007
Hilly					
S_7	20	100	66.667	0.658	0.007
S_8	30	150	100.00	0.503	0.005
S_9	30	150	100.00	0.644	0.005
Naked Neck					
S_7	20	100	66.667	0.317	0.007
S_8	30	150	100.00	0.474	0.005
S_9	30	150	100.00	0.081	0.005

S_7- S_9 indicates the generations of selection; *Selection intensity only for egg production (%)

Conservation and improvement of locally adopted exotic germplasm for the development of egg and meat type chicken

Md. Rakibul Hassan*, Md. Ataul Goni Rabbani, Shabiha Sultana, Shakila Faruque and Nathu Ram Sarker

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Executive Summary

During the last several years, demand of slow growing colored chicken meat is increased in the market. Therefore, commercial companies are interested to produce colored slow growing chicken. Considering the demands, Bangladesh Livestock Research Institute (BLRI) has developed Multi Colour Table Chicken (MCTC) and parent line handed over to commercial producer for marketing of MCTC. Evaluation of performance of parent line at commercial sector and development of new varieties for future marketing are essential for sustainable slow growing colored chicken production. Considering the above facts, the present experiment was carried out to determine the performance of MCTC parent line, and also to develop another meat type chicken using locally adopted exotic female line along with the BLRI improved native male line. In activity 1, paretline of MCTC were reared under on station and commercial farming condition at Aftab Bahumukhi Farms Ltd. The experimental period was divided into two phases, phase I (0 - 20th week), phase II (21th – 74th week) production. The experiment was carried out in open sided houses and standard management practices of birds were followed during rearing. Egg production (EP) and feed intake were recorded daily and body weight (BW) and egg weight (EW) were weighed monthly. The feed conversion ratio (FCR) was determined as gram of feed consumed per gram of egg produced (g of feed/g of egg). All data were recorded and analysed by one-way analysis of variance using the PROC GLM procedure in SAS and differences were determined by DMRT. A P value of <0.05 was considered significant.

Table 1: MCTC Parents performance under on station and commercial condition (20-74 weeks)

Parameter	On station (BLRI)	Commercial farm (Aftab)	SEM	P value
Day old chicks weight (g)	39.50	38.17	1.57	0.519
Age at sexual maturity (d)	135.32	136.54	2.22	0.382
5% Egg production (d)	151.08	150.47	0.491	0.729
Egg weight at sexual maturity (g)	44.48	45.40	0.256	0.241
Peak production %	85.88	86.66	0.378	0.375
Body weight (g)	1954.12	2031.89	15.05	0.009
Egg production (%)	70.95	71.42	1.827	0.918
Egg weight (g)	60.19	59.54	0.382	0.394
Egg mass (g)	45.01	44.61	1.135	0.862
Feed intake (g/d)	109.92	118.43	0.667	0.0001
FCR	2.442	2.654	0.191	0.0001
Annual egg production (no.)	259.29	260.68	4.183	0.871
Annual hatching egg (no.)	236.65	191.07	1.29	0.002
Hatching egg (%)	87.88	70.59	1.27	0.0001
Fertility (%)	89.03	70.93	1.79	0.038
Hatchability on setting egg (%)	79.32	63.68	2.97	0.016
Livability (%)	95.68	93.79	4.24	0.413

In phase I, the day old body weight of MCTC male parent line was 32.83g. Growth curve of both male and female parent line were found very close between the on station and commercial farming

situation (0-8 weeks). But during 9-20 weeks of age, body weight (BW) of maleline was significantly higher in commercial condition than that of on station. On the other hand, BW of female line is in similar trend (ranges of ±5% of the on station body weight). The feed consumption of birds was found similar between on station and commercial farming condition. During phase II, the birds showed sexual maturity at 135-136 days of age in both condition. The variation in rearing system did not influence day old chick's weight, egg production, egg weight, egg mass and livability of parent line. But mature body weight and feed intake were significantly higher ($p<0.05$) in commercial condition than of on station condition. In contrast, fertility %, hatchability, annual hatching egg production percentage significantly higher in on station condition might be due to the variation of housing and rearing system of the flock. It indicated that that MCTC parent line could be reared under open sided houses and their performance is acceptable for the commercial production of day old MCTC chicks.

In activity 2, was executed for the development of meat type chicken through two and three way cross breeding using improved native with locally adopted exotic breed. Therefore, a total of 500 day old F_1 progeny (R♀ X H ♂) were hatched and reared for the development of meat type chicken. When F_1 progeny come into production, a total of 1400 unsexed day old chicks (200 in each crossbred, 7 treatments D♂×B♀, B♂×F_1♀, D♂×F_1♀, R♂×F_1♀, D♂× R♀, H×R♀, 4 replications, 50 chicks in each pen) were hatched and marked by the leg band and performance, phenotypic characteristics, meat quality and disease incidences were tested upto 12 weeks of age. BLRI improved native chicken was considered as control. Birds had *ad libitum* access to feed and water. Birds were weighed individually to determine body weight, weight gain, feed intake and feed conversion ration weekly.

Table 2: Comparative performances of different meat type chicken (0-8 weeks)

Meat chicken type	Body weight (g)	Weight gain (g)	Feed Intake (g)	FCR
B (♀) × D (♂)	907.44^{ab}	867.44^{ab}	2015.12^{a}	2.364^{bc}
F_1(♀) × B (♂)	1024.92^{a}	984.92^{a}	2085.01^{ab}	2.117^{c}
F_1 (♀) × D (♂)	830.36^{bc}	790.36^{bc}	2053.35^{a}	2.598^{ab}
F_1 (♀) × R (♂)	824.87^{bc}	784.87^{bc}	1934.38^{c}	2.464^{ab}
R (♀) × D (♂)	818.28^{bc}	778.28^{bc}	1937.16^{b}	2.491^{ab}
R (♀) × H (♂)	923.02^{ab}	883.09^{ab}	2051.43^{a}	2.323^{bc}
Control	771.58^{c}	733.83^{c}	1978.37^{a}	2.726^{a}
SEM	13.896	13.769	26.13	0.018
P value	0.0352	0.0349	0.0003	0.027

B: Exotic female parentline[1]; D: Native Male line[1]; R: Exotic Female Parentline[2]; H: Native Male line[2]; [abc]value with the same letters in the row are not significantly different at 5% level

In the starting period (0-3 weeks), body weight, weight gains, feed intake and FCR of F_1(♀)×B(♂) treatment showed significantly higher performance than the other treatments. During the growing period (4-5 weeks), the performance trends were similar to those of starting period. When the rearing was extended further, body weight and weight gain were significantly higher in the finisher period (6-8 weeks). Meanwhile, body weight, weight gain, feed intake and FCR pattern of F_1(♀)×B(♂) treatment was significantly higher among the treatments, but no differences were found with R (♀) × H (♂) treatment. In conclusion, the three-way crossbred chickens of F_1 (♀)×B(♂) treatment ranked first followed by R(♀)×H(♂)>B(♀)×D(♂)>F_1(♀)×D(♂)>F_1(♀)×R(♂)>R(♀)×D(♂)>Control treatments. Further follow up experiment is needed to know the performance of the parent line, meat quality, uniformity, vaccination and validation under on station and different on farm (smallholder and commercial farming) condition of Bangladesh.

Ex-situ conservation and improvement of native sheep at Bangladesh Livestock Research Institute

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Executive Summary

Sheep has the potentiality to provide meat and fiber for a growing world population. Having the unique advantage to adapt in marginal environments with low level of input, high prolific nature and multiple birth in each lambing, this species contributes much for sustaining rural livelihoods. These advantages need to be properly exploited to enhance the contribution of sheep in a developing economy. The project has designed to develop superior native sheep germplasm at BLRI, to study the productive and reproductive performance of native sheep and to utilize candidate genes polymorphisms associated with prolificacy trait in native sheep. The breeding program was conducted at goat and sheep research farm, BLRI, Savar, Dhaka. The research was conducted with three different types of sheep viz. Coastal, Barind and Jamuna river besin. All the sheep were housed in slated floor permanent house raise above the ground level with sufficient space to keep them comfortable. Green grass (ad-libitum) and concentrate (17% CP, 11MJ/kg DM) were supplied twice daily (morning and evening) at the rate of 1.5% of the body weight of animal per day. The open nucleus breeding System (ONBS) was adopted in order to improve the genetic and phenotypic traits of existing breeding sheep stock avoiding inbreeding. The selection targets of the study were to improve litter size, birth weight and 6 month body weight. The targeted litter size, birth weight and 6 month body weight were minimum 2 kids per lambing, 1 kg and 12 kg, respectively. Data on productive and reproductive performance were recorded regularly. To investigate possible association of (bone morphogenetic protein receptor type-1B (BMPR1B) gene polymorphisms with litter size, a total of 77 DNA samples extracted from the blood of 3 different type of indigenous sheep (24 Coastal, 24 Barind and 14 Jamuna river basin sheep) and Nagpuri sheep (11) rearing at BLRI research farm by PCR based RFLP method. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0.

Table 1 shows the productive and reproductive performance of different sheep genotypes. The average litter size, birth weight and 6 month body weight of Coastal sheep were 1.49±0.55, 1.60±0.26 and 11.31±2.14 kg, respectively. In case of Jamuna river basin sheep, average litter size, birth weight and 6 month body weight were 1.67±0.70, 1.35±0.20 and 10.51±1.52 kg, respectively. The average litter size, birth weight and 6 month body weight of Barind sheep were 1.47±0.50, 1.34±0.18 and 10.14±1.47 kg, respectively. There was no significant difference in litter size but in case of growth trait, there were significance differences ($p<0.001$ and $p<0.01$) among the genotypes. The highest birth weight and 6 months body weight was found in Coastal sheep while the highest litter size was found in Jamuna river basin sheep.

The current study revealed that genotype and allele frequency varied among the different types of native sheep. The genotype (GG, AG, AA) frequency were 11.27%, 56.33% and 32.39% and the allele (G and A) frequencies in the overall population were 39% and 61%, respectively. There was a significant association of BMPR1B gene polymorphism with litter size. The homozygous GG genotype had the highest litter size ($1.60^{a} \pm 0.25$; n=08) and homozygous AA genotype had the lowest litter size ($1.09^{b} \pm 0.05$; n=23).

Table 1: Productive and reproductive traits of different types of indigenous sheep at BLRI (Mean±SD)

Parameters	Native sheep genotype			Significance level
	Coastal sheep	Jamuna river basin sheep	Barind sheep	
Litter size	1.49±0.55 (116)	1.67±0.70 (117)	1.47±0.50 (49)	NS
Birth weight (kg)	1.60±0.26 [a] (116)	1.35±0.20 [b] (117)	1.34±0.18 [b] (49)	***
3 months body weight (kg)	6.84±1.54[a] (82)	6.28±1.47[b] (88)	5.79±0.88[b] (44)	***
6 months body weight (kg)	11.31±2.14[a] (50)	10.51±1.52[b] (64)	10.14±1.47[b] (32)	**

Figure in the parenthesis indicate the number of observations. ***= significant (p=0.000-0.001), **= significant (p=0.001-0.01), NS= Non significance (p>0.05)

Table 2. Genotype and Allele frequency of BMPR1B gene in indigenous sheep populations of BLRI

Genotype Frequency			**Gene Frequency**		**χ^2 test**
AA	**AG**	**GG**	**A**	**G**	P<0.01 (7.479)
0.32 (23)	0.56 (40)	0.11 (8)	0.61	0.39	

Table 3. Average litter size (Mean ± SE) of different BMPR1B genotypes in different sheep populations of BLRI

Gene	**SNP**	**Genotype**	**N**	**Litter size**
BMPR1B	c.746 A>G	FecB $^{++}$ (AA)	23	1.09[b] ± 0.05
		FecB $^{+B}$ (AG)	40	1.31[ab] ± 0.06
		FecB ^{BB} (GG)	8	1.60[a] ± 0.25

The findings of this study specially the polymorphism of FecB together with genotyping of some sheep could be utilized in the selection program to increase the lamb production potentiality of indigenous sheep of Bangladesh. Furthermore, superior rams and ewes will be selected for breeding purpose according to their individual performance score. The findings suggested for further research until a significant level of achievement to improve the native sheep at BLRI.

Regional Livestock Research Reinforcement at Naikhongchari

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Executive Summary

The present study was undertaken to reinforce regional livestock research activities, to maintain and improvement of FAnGR at Hilly region, Naikhongchari. The objectives were to maintain the purity of native sheep and evaluate their productive & reproductive performances, to observe the effect of season on some productive and reproductive performance of Brown Bengal goat and to find out a suitable Napier variety that will grow better in the hill tracts areas. The study was conducted at research farm, BLRI regional station, Naikhongchari. Three types of native sheep *i. e. Jamuna, Barind and Coastal* are available at Naikhonhchari regional station. Each type of sheep has some unique feature that is different to other. The animals that were capable for breeding purpose were selected and divided into three different lines (*Coastal, Barind and Jamuna*) depend on their phenotypic characteristics. After that, some superior rams were selected for natural services and a mating chart was prepared. During the experimental period, we maintained a male-female ratio of 1:8. The breeding ram within a particular line was changed rotationally in order to avoid inbreeding. There was significant difference (P<.05) observed in reproductive parameters i.e. age at first heat, age at first lambing and lambing interval. However, there was no significant difference in ram wt. at mature age, ewe wt. at mature age, birth wt., weaning wt., daily gain, no. of service/conception, gestation length and litter size of three lines of native sheep (Table 1). The Brown Bengal goat is only found at hilly areas and that has a high genetic potentiality. Although this goat is originated in this geographical area, it's productivity is highly variable and largely depends on seasons. For this experiment, existing stock were used and a total of 130 goats were taken into consideration. We provided concentrate feed twice daily (morning and afternoon) with a provision of 8 hours grazing per day and maintained some record that varies with environmental temperature, humidity, solar radiation, rainfall and so on (Table 2). The duration of the experimental period was one year and divided the total time into four season i.e. winter, spring, summer and rainy.

Table 1: Productive and reproductive parameters of three lines of native sheep

Parameters	Costal	Barind	Jamuna	P-value
Ram wt. at mature age (kg)	26.84±4.23	21.88±3.14	24.20±0.07	.072
Ewe wt. at mature age (kg)	16.90±0.80	16.18±1.31	16.26±2.03	.704
Birth wt. (kg)	1.30±1.28	1.29±0.19	1.15±0.24	.573
Weaning wt. (kg)	5.24±1.95	5.79±1.83	5.07±0.83	.769
Daily gain (g/d)	41.96±18.14	48.51±14.88	44.11±10.63	.781
No. service/conception	1.2±0.45	1.8±0.45	1.4±0.55	.178
Gestation length (days)	149.6±1.14	149.6±1.14	150±1.58	.857
Age at first heat (days)	342.2^{c}±1.30	329.2^{a}±1.30	333.0^{b}±1.58	.000
Age at first lambing (days)	500.0^{b}±1.58	489.2^{a}±2.17	490.6^{a}±1.52	.000
Lambing interval (days)	213.8^{a}±1.30	228.4^{c}±1.14	220.8^{b}±0.84	.000
Litter Size	1.60±0.55	1.20±0.45	1.80±0.84	.344

a,b,c Means bearing uncommon superscripts in a row differ significantly and value indicate- Mean ± Standard Deviation (SD)

Table 2: Temperature, humidity, rainfall and solar radiation at different season at Naikhongchari

Parameters	Summer season (April-May)	Rainy season (June- October)	Winter season (November- January)	Spring season (February-March)
Temperature (°C)	28.5	28.3	20.2	22.5
Rainfall (mm)	97.43	349.66	8.30	6.65
Humidity (%)	75	86	62	72
Solar radiation ($KWh/m^2/d$)	5.192	3.721	4.209	4.497

Significant difference have been observed in birth weight of female, weaning weight of male, daily gain of male and litter size (Table 3). The highest birth weight of female kid observed in spring (1.28 kg) and summer (1.15 kg) followed by winter and rainy 1.08 kg and 1.01 kg respectively. The highest weaning

weight of male kid observed in spring (7.02 kg) followed by winter, summer and rainy 6.26 kg, 6.05 kg and 5.57 kg respectively. The highest litter size was found in spring (2.20) followed by winter (1.80) and rainy (1.80) and summer (1.40) and spring is the best season in terms of productive performance. However, no significant difference have been observed in birth wt. of male, weaning wt. of female, daily gain of female and reproductive parameters i.e. age at first heat, no. of service/conception and kidding interval.

Table 3: Productive and Reproductive Performance of Brown Bengal goat at different season

Parameters	Summer	Rainy	Winter	Spring	P-value
Birth wt. of Male (kg)	1.16±0.98	1.09±0.98	1.11±0.10	1.22±0.16	.078
Birth wt. of Female (kg)	1.15^{ab}±0.14	1.01^{b}±0.16	1.08^{b}±0.14	1.28^{a}±0.27	.019
Weaning wt. of Male (kg)	6.05^{b}±0.45	5.57^{b}±1.0	6.26^{ab}±1.28	7.02^{a}±0.95	.018
Weaning wt. of Female (kg)	5.57±1.24	5.27±0.92	5.33±1.50	5.93±1.01	.602
Daily Gain of Male (g/d)	54.35^{ab}±4.67	49.77^{b}±11.46	57.26^{ab}±14.56	64.37^{a}±9.97	.034
Daily Gain of Female (g/d)	49.18±13.71	47.32±10.17	47.22±16.14	51.63±10.55	.856
Age at first heat (days)	314.4±23.65	312.2±19.08	323±12.04	309.4±13.72	.657
No. service/conception	1.2±0.45	1.6±0.89	1.4±0.55	1.2±0.45	.695
Kidding interval (days)	201.4±10.38	209.6±6.58	208.4±12.70	203.8±4.76	.469
Litter Size	1.40^{b}±0.51	1.80^{ab}±0.63	1.80^{ab}±0.42	2.20^{a}±0.63	.027

[a,b] Means bearing uncommon superscripts in a row differ significantly and value indicate- Mean ± Standard Deviation (SD)

Napier grows better than other fodders in hilly areas. Keeping this point in mind the study was undertaken to find out find out a suitable Napier variety that will grow better in the hill tracts areas. For this experiment we considered six Napier variety i.e. BLRI Napier-1, BLRI Napier-2, BLRI Napier-3, BLRI Napier-4, Napier Pakchong and Red Napier and replicates each item 3 times. The size of each plot was 25 m^2, Line to line distance was 70 cm, and Plant to plant distance was 30 cm. There was significant difference among six Napier varieties in terms of biomass yield, No. of hill/ha, No. of tiller/hill, Plant height, steam wt., Sheath wt. and Leaf wt. (Table 4).

Table 4: Biomass yield and morphological characteristics and botanical fractions of different Napier cultivars

Parameters	BLRI Napier-1	BLRI Napier-2	BLRI Napier-3	BLRI Napier-4	Napier Pakchong	Red Napier	P-value
Biomass(ton/ha)	23.36^{d}±1.71	40.01^{c}±1.32	54.70^{b}±1.95	38.63^{c}±0.85	60.70^{a}±2.23	37.73^{c}±0.76	.000
No.of hill/ha (thousand)	41.96^{c}±1.30	46.43^{ab}±0.47	47.33^{a}±1.52	44.66^{b}±1.10	48.26^{a}±1.30	45.66^{ab}±2.08	.002
No. of tiller/hill	10.0^{b}±1.0	20.33^{a}±1.52	10.66^{b}±1.52	11.0^{b}±2.0	9.96^{b}±0.20	9.0^{b}±1.0	.000
Plant height (ft)	5.80^{b}±0.10	5.80^{b}±0.26	6.10^{b}±0.36	5.93^{b}±0.73	7.40^{a}±0.45	6.06^{b}±0.56	.009
Steam wt. (g/kg)	508.33^{c}±5.7	387.33^{d}±5.68	647.66^{a}±17.2	527.33^{b}±6.42	542.66^{b}±7.50	528.66^{b}±9.01	.000
Sheath wt (g/kg)	127.66^{cd}±2.5	210.66^{a}±6.02	113.0^{d}±14.73	136.33^{bc}±7.09	133.33^{bc}±7.63	144.33^{b}±7.37	.000
Leaf wt. (g/kg)	364.0^{b}±5.3	402.0^{a}±1.0	239.33^{d}±8.14	336.33^{c}±9.60	324.0^{c}±1.73	327.0^{c}±16.09	.000

[a,b,c,d] Means bearing uncommon superscripts in a row differ significantly and value indicate- Mean ± Standard Deviation (SD)

The highest biomass yield was observed in Napier Pakchong (60.70 ton/ha) and BLRI Napier-3 (54.70 ton/ha) followed by BLRI Napier-2 (40.01 ton/ha), BLRI Napier-4 (38.63 ton/ha) and Red Napier (37.73 ton/ha). However, the lowest biomass yield was observed in BLRI Napier-1 (23.36 ton/ha).

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

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Executive Summary

Goat is one of the potential livestock species which contributing meat, skins, and to some extent, milk, fleece and manure. The Black Bengal goat is the heritage and pride of Bangladesh which is popular for higher prolificacy, short generation interval and better adaptability to adverse environmental conditions. But, the breed is being diluted by unwanted crossing all over the country resulting genetic erosion of this valuable goat breed. Considering the fact, the project has designed with the objectives- i) To conserve and improve Black Bengal goat through selective breeding, ii) To evaluate the performance of different coat color variants of Black Bengal goat (Solid Black, White Bengal, Dutch belt, Toggenburg and Brown Bengal) and iii) To produce frozen semen and Artificial Insemination in Black Bengal goats on-station. The study was conducted in Goat and Sheep Research Farm of Bangladesh Livestock Research Institute, Savar, Dhaka. The breeding program was conducted through Open Nucleus Breeding System (ONBS) avoiding inbreeding in order to improve the genetic and phenotypic traits of existing breeding goat stock. The selection objectives of the study were to improve the prolificacy, milk production and growth rate of the breed. The targeted prolificacy, milk production and 6 months body weight of Black Bengal goat were, minimum 2 kids per kidding; 0.5 litter/day and 12 kg, respectively. The selection index was calculated by the following equation, $I_B = b_1x_1 + b_2x_2 + \ldots + b_nx_n$. Where, b_1, b_2,.., b_n were phenotypic values for the traits and x_1, x_2,…, x_n were relative economic values given to each of the traits. Semen was collected from healthy and sound buck of Black Bengal Goat with superior pedigree record to produce frozen semen. Semen was further processed for frozen semen production after evaluation. Furthermore, frozen semen was inserted artificially in heated doe and data was recorded regularly. Data were analysed using Statistical Package for the Social Sciences (SPSS) version 17.0.

Table 1 shows the productive and reproductive performance of different coat colour variants of black Bengal goat. All the measured trait had significance effect on the different genotype of black Bengal goat. The average litter size, milk production and 6 months body weight of solid black, White Bengal, Dutch belt and Toggenburg genotype were 2.16±0.07, 289.76±13.99 ml/d and 9.79±0.10 kg; 2.25±0.13, 510.67±24.03 ml/d and 11.50±0.22 kg; 2.30±0.12, 467.78±31.99 ml/d and 12.23±0.13 kg; 1.88±0.11, 361.82±24.01 ml/d and 9.55±0.20 kg, respectively. The highest milk production was found in White Bengal genotype while the highest litter size and 6 months body weight was found in Dutch Belt genotype. The yearly performance of different traits indicate positive trend of improvement of the selection traits. In case of artificial insemination double AI at 24 and 36 hours after showing heat (treatment 2) results 93.33% conception rate of goat.

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

Parameters	Solid Black	White Bengal	Dutch Belt	Toggenburg	Sig. level
Litter size	2.16^{ab}±0.07 (100)	2.25±0.13^{ab} (43)	2.30±0.12^{a} (35)	1.88±0.11^{b} (31)	*
Milk production (ml/d)	289.76±13.99^{c} (34)	510.67±24.03^{a} (15)	467.78±32.99^{a} (9)	361.82±24.01^{b} (11)	***
Birth weight (kg)	1.16±0.02^{a} (100)	1.11±0.03^{ab} (38)	1.07±0.02^{b} (31)	1.11±0.03^{ab} (31)	*
3 months body weight (kg)	5.70±0.08^{b} (57)	6.30±0.18^{b} (34)	6.12±0.16^{b} (27)	5.97±0.12^{a} (22)	*
6 months body weight (kg)	9.79±0.10^{b} (69)	11.50±0.22^{a} (25)	12.23±0.13^{a} (9)	9.55±0.20^{b} (22)	*

Figure in the parenthesis indicate the number of observations. ***= significant (p= 0.000-0.001), *= significant (p<0.05)

Table 2: Year wise performance of nucleus Black Bengal Goat flock

Parameters	Solid Black		White Bengal		Dutch Belt		Toggenburg	
	2017-18	2020-21	2019-20	2020-21	2019-20	2020-21	2017-18	2020-21
Litter size	1.73	2.16	2.32	2.25	2.4	2.30	1.68	1.88
Milk production (ml/d)	140	289.76	500	510.67	460	467.78	155	361.82
Birth weight (kg)	1.13	1.16	1.14	1.11	1.19	1.07	1.01	1.11
3 months body weight (kg)	5.65	5.70	6.19	6.30	6.18	6.12	5.66	5.97
6 months body weight (kg)	8.53	9.79	11.52	11.50	13.21	12.23	8.68	9.55

Table 3: Semen quality of Black Bengal Buck (Mean ± SE)

Semen Volume (ml)	Semen color (%)		Sperm motility (%)			
	Cream	Light cream	Motile	progressive	Static	Sig. level
0.42±0.04 (26)	92.30 (26)	7.69 (26)	62.27±3.85 (12)	52.93±4.29 (12)	33.73±3.85 (12)	NS

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

Table 4: Conception rate of Artificial Insemination

Treatment 1 (double AI at 12 and 24 hours after showing heat)		Treatment 2 (double AI at 24 and 36 hours after showing heat)	
Conception rate (%)	Repeat heat (%)	Conception rate (%)	Repeat heat (%)
80 (15)	20 (15)	93.33 (15)	6.67 (15)

Figure in the parenthesis indicate the number of observations

Superior bucks and does will be selected from every genotype by the individual performance score. It can be concluded that, white Bengal genotype may be developed as milk type black Bengal goat. For better understanding in Artificial Insemination, more research needed to conclude a concrete result. Therefore, the research program should continue for the coming years to achieve the targeted goal.

Performance evaluation of crossbred buffalo at on-farm and on-station

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Executive Summary

Buffalo is an important livestock resource in Asia and the contribution of buffalo to the Asian economy is considered by way of milk, meat and draught power production and as a source of social security. It is reported that indigenous type of buffalo in Bangladesh produces low milk (Lactation yield: 500-700 liters) with late age at puberty (28-30 months on station & 39.4 to 54.45 months on farm). Crossing local buffalo with high yielding exotic buffalo breed may improve the genetic potentiality of local buffalo for increasing their milk production. Hence, this study was undertaken to evaluate the productive and reproductive performance of crossbred buffaloes and to develop a feeding and management system for crossbred buffaloes at on-farm and on-station.

The activities to achieve the above-mentioned goals were 1) to develop online software and herd-book for data recording, storage and management of crossbreed buffalo, 2) to prepare frozen semen from pure and crossbred breeding bulls and 3) to produce F_1 crossbred buffalo calves (50% Murrah x 50% Local and 50% Nili-Ravi x 50% local) at on-station in BLRI Buffalo Research Herd. The duration of the research project was 4 months (March 2021 to June 2021). Buffalo semen was collected from selected breeding buffalo bulls (2 Indigenous, 2 Murrah, 2 Nili-Ravi, 1 Murrah×Local and 1 Nili-Ravi×local F_1 crossbred buffalo bulls) and semen quality was evaluated using an automatic computer-assisted semen analyzer (CASA) system and finally, semen was stored by cryopreservation following previously adopted protocol. To produce crossbred buffalo calves, buffalo cows at BLRI Buffalo Research Herd were bred with pure Nili-Ravi or Murrah buffalo bulls using artificial insemination on natural estrus or artificially induced estrus. Estrus synchronization (ES) protocol was applied in 24 buffalo cows at BLRI Buffalo Research Farm. The ES protocol included GnRH administration at any stage of the cycle (day 0) followed by administration of $PGF_{2\alpha}$ on day 7 (Figure 1). Two times AI were done on day 11 (morning and evening) followed by administration of 2nd dose of GnRH. Follicular growths were recorded throughout the experimental period using ultrasonography once daily up to 11th day and daily four times until sign of ovulations were observed for optimization of AI time. Phenotypic (body weight at different interval), reproductive (age at first heat and calving) and disease related traits were recorded throughout the experimental period. A on-line data system named as Buffalo Breeding management Software (BBMS) were developed and under trial and error for finalization of data formatting.

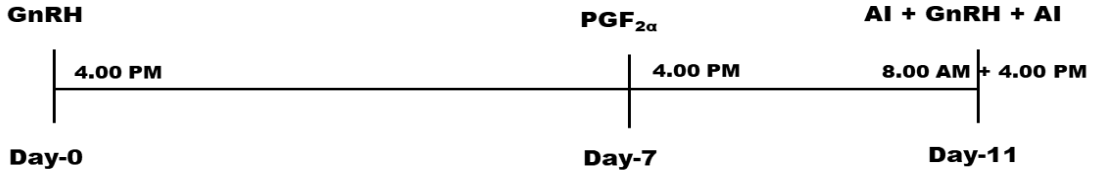

Figure 1. Estrus synchronization protocol used for production of crossbred buffalo calves

During this study period about 2892 semen straws was cryopreserved from 2 Indigenous (650), 2 Murrah (620), 2 Nili-Ravi (672), 1 Murrah×Local (600) and 1 Nili-Ravi×local (350) F_1 crossbred buffalo bulls. Total and progressive motility of fresh semen was 82.35% and 59.76% respectively. Whereas, progressive motility of cryopreserved semen were 57.71% and 38.28% respectively. Diameters of ovulatory follicles were within 11 to 12 mm. After administration of Estrus synchronization (ES) protocol 54% ovulation occurred within 90-102 hours, 13% within 103-108 hours and 33% with 127-138 hours, respectively (Figure 2). Considering frequency of ovulation after $PGF_{2\alpha}$ administration, twice AI (morning and evening) on day 11 were resulted 50% conception in ES. During this study period, 12 buffalo cows were conceived among total 24 subjected to ES. During current study period, total 14 crossbred buffalo calves were produced through AI at BLRI Buffalo Research Herd. Data on body weight at different interval, age at first heat, age at first calving and diseases were not analyzed due to minimum observation numbers. Therefore, data recording on production, reproduction and disease related traits are continuing. Considering above

finding, this study summarized that ES protocol may be used for production of crossbred calves to evaluate their performances in Bangladeshi condition.

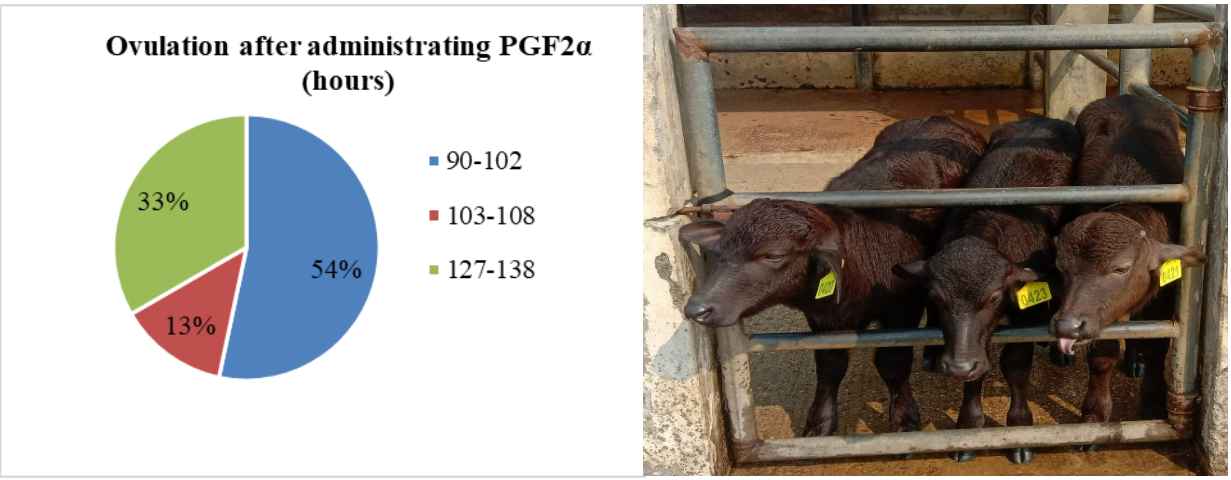

Figure 2. Frequency of ovulation following $PGF_{2\alpha}$ administration during estrus synchronization and buffalo calves born following ES.

Session II:

FEEDS, FODDER AND NUTRITION

Project title: Determination of best practice management of Napier grass to doubling the milk production of cows

Sub-title: Study on the production performance and physiological characteristics of available Napier cultivars in BLRI under the similar agronomic management practices

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Executive summary

Roughage feed plays an important role in the development of diets for dairy or beef cattle, as it directly or indirectly determines the diet cost and influence animal performance. Napier (*Pennisetum purpureum* Schumach) is a perennial grass widely used for ruminants particularly for dairy & beef production in Bangladesh. Napier grass is a popular grass in the tropics and subtropics also and is widely used for animal production by the small holder farmers in these regions because of its robust growth. This grass comprises up to 80% of the animal diet in many regions. Napier is the most important fodder among the germplasms suitable for production in the context of Bangladesh climate. To meet up the increasing need of green fodder, it is very much essential to find out some potential variety of Napier and recommend for extensive cultivation by the farmers for feeding their productive animals. In this situation, it is of prime consideration to introduce suitable high yielding varieties of perennial fodder crops to the farmers (Ali *et al.*, 1987). The present study was therefore designed to evaluate the production performance & morphological characteristics of available Napier cultivars in BLRI under the similar agronomic management practices.

The agronomical trial was conducted at Fodder Research Field of BLRI, Savar, Dhaka-1341 where the experiment was laid out in a Completely Randomized Design (CRD) with eleven treatments and each treatments having three replications. Eleven (11) treatments were BLRI Napier -1 (Bajra), BLRI Napier -2 (Arosha), BLRI Napier -3 (Hybrid), BLRI Napier -4 (Vietnam), Packchong, Purple colored Napier (PCN), Merkeron, Wrukwona, Dwarf early, Dwarf late and Zara, which is conserving in BLRI Fodder Germplasm Bank. All the cultivars were grown from stem cutting with 2 nodes of a piece and placed at 45^{o} with 2 pieces a hole. The plant spacing were considered for 50 cm x 50 cm. The size in each experimental plot was 4m x 4 m. The harvest interval (HI) was considered for 50 days. However, for all treatments the cutting height was considered 10 cm above the ground. Each plot was applied urea fertilizer at a rate of 312.5 kg ha^{-1}at fortnightly basis during the whole experimental period. The experiment was continued for 365 days. The whole experimental period was divided in to three season such as Kharif-1 (summer), Kharif-2 (rainy) and Rabi (winter). According to necessity, all plots were watered by sprinkler irrigation to ensure adequate soil moisture for plant growth. Plant height, dead and green leaf number, tiller number, node number, leaf- stem ratio etc. and biomass yield were recorded during harvesting time. The treatment responses were analyzed statistically in an ANOVA (Steel and Torrie, 1980) of a 3×11 factorial experiment in completely randomized design (CRD) using Univariate GLM procedure of SPSS, 2020 computer software packages and mean separation was tested by least significant difference (LSD).

Effect of variety & season on biomass yield and nutritive value of Napier grass is presented in Table 1. Results obtained from the study revealed that, both season ($p<0.001$) and variety ($p<0.05$) had significant effect on fresh biomass yield (FBMY) and dry matter biomass yield (DMY) of Napier grass. Irrespective of varieties, the total fresh and DM biomass yield per year per hectare land was significantly ($p<0.001$) higher in Kharif-1 (101.7 & 13.8 ton/ha/y) followed by Kharif-2 (88.0 & 12.2 ton/ha/y) and Rabi season (52.2 & 8.4 ton/ha/y). Irrespective of season, Packchong produced significantly ($p<0.05$) higher fresh (336.8 ton/ha/year) and DM biomass (45.3 ton/ha/year) than that of other Napier verities. Varieties had significant ($p<0.05$) effect on total crude protein yield (CPY) & Packchong grass yielded higher CP (5.04 ton/ha/y) than that of other Napier variety. However, season did not show any effect on CP yield. Both season and varieties had significant effect on

different nutritive values of Napier grass managed under similar agronomic condition. Irrespective of varieties, highest dry matter & acid detergent fibre (ADF) content was obtained in Napier from Kharif-1 season; crude protein (CP) content was obtained in Rabi season. Irrespective of season, the highest CP content was obtained both in Dwarf Late (12.9% and Purple colored Napier grass (12.9%) than that of other Napier variety. However, no interaction effect was observed for total fresh biomass yield, dry matter biomass yield, crude protein yield, % DM, % ADF and % NDF content except % OM and % CP content. Results obtained from the study also revealed that, season ($p<0.001$) had significant effect on morphological characteristics of Napier grass and highest plant height (135.80 cm), leaf length (87.86 cm), leaf width (3.24 cm) and number of leaf (10.89) was observed at kharif-2 season than that of other season. Both season and variety had significant effect on leaf to stem ratio and number of tiller per hill. The production cost of Kg fresh, DM and dry matter crude protein (DMCP) of different Napier cultivars varies from Tk. 0.80 to Tk.1.24, Tk. 5.93 to Tk. 8.50 and Tk. 53.27 to Tk. 75.21, respectively. Irrespective of season, the production cost of Kg fresh, DM and DMCP was lower for Packchong grass than that of other Napier variety.

Table 1: Effect of variety & season on biomass yield (ton/ha/y) and nutritive value of Napier grass

Variety, season and their interactions		Total FBMY	Total DMY	Total CPY	% DM, fresh basis	% OM	% CP	% ADF	% NDF
Season	Kharif-1	101.7^{a}	13.8^{a}	1.41	15.9^{a}	88.8^{a}	10.2^{c}	50.4^{a}	76.9
	Kharif-2	88.0^{b}	12.2^{b}	1.38	13.9^{b}	89.1^{a}	11.4^{b}	48.5^{b}	77.1
	Rabi	58.2^{c}	8.4^{c}	1.29	15.7^{a}	87.9^{b}	15.3^{a}	49.8^{ab}	76.6
Variety	BLRI N-1	277.0	39.6	4.27	15.4	86.8	11.4	49.5	78.2
	BLRI N-2	253.6	34.6	4.20	15.4	88.2	12.6	50.2	77.3
	BLRI N-3	245.9	34.4	4.06	15.3	88.0	12.5	50.1	78.5
	BLRI N-4	294.2	37.5	4.34	13.9	88.0	12.5	45.7	75.6
	Packchong	336.8	45.3	5.04	14.1	88.9	11.8	51.7	76.5
	PCN	217.1	31.7	3.64	15.0	88.2	12.9	49.6	72.9
	Merkeron	255.2	35.9	4.13	16.4	89.2	12.1	52.1	78.0
	Wrukwona	306.5	42.1	4.76	14.7	88.5	11.9	48.1	75.7
	Dwarf Early	221.8	31.6	3.57	15.5	89.9	12.3	48.2	80.3
	Dwarf Late	233.3	34.0	4.13	17.0	89.3	12.9	48.5	74.7
	Zara	292.5	39.3	4.69	13.9	89.6	12.3	51.4	77.6
SED		11.48	1.12	0.05	0.30	0.14	0..07	0.42	0.35
Sig.lev.	Season	***	***	NS	***	***	***	*	NS
	Variety	*	**	*	*	***	***	**	***
	S×V	NS	NS	NS	NS	***	***	NS	NS

- FBMY= Fresh biomass yield; DMY= Dry matter biomass yield; CPY= Crude protein yield; DM= dry matter; OM= Organic matter; CP= Crude protein; ADF= Acid detergent fibre; NDF= Neutral detergent fibre.

In conclusion, it can be concluded that, both season and varieties had significant effect on FBMY, DMY, CPY, chemical composition & leaf-stem ratios of Napier grass available in BLRI. Irrespective of varieties, total FBM, DM and CP yield per hectare land was significantly higher in Kharif-1 followed by Kharif-2 and Rabi season. Irrespective of season, Packchong produced significantly higher FBM, DM and CP yield per hectare/cut or year than that of other Napier cultivars. Finally, based on the FBM, DM, CP yield and cost of production, the best 4 Napier cultivars may be ranked as Packchong> Wrukwona>Zara> BLRI-4.

Project Title: Identification of existing management approaches of both commercial and traditional fattening in some selected area of Bangladesh

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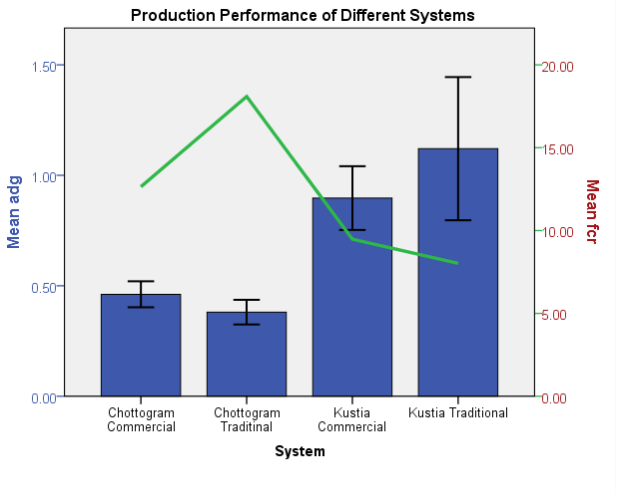
Executive Summary

It is estimated that to meet the country's meat demand three million cattle need to slaughter every year. The demand is hiking and farmers are producing meat without knowing or adopting the actual scientific profitable approach. So, identify the best suitable approach for cattle fattening both the commercial and traditional farmers should consider as a most admissible issue. This study has formulated and undertaken to find out the the existing management approach of both commercial and traditional cattle fattening in some selected region of Bangladesh. This research work is compatible with BLRI prepared SDGs work plan of 7th FYP Goals/Targets (to increase meat production) related to SDG Targets and Indicators (SDG Targets No. 2.3). At first a field survey was conducted to understand the existing cattle fattening production system of Chottogram and Kustia; these regions are previously famous for cattle fattening and supplying fattened bull all over the country. On the basis of collected surveyed data, five commercial farms who kept more than thirty bulls for fattening and five traditional farms who kept at least 3-5 bulls for fattening at a time was nominated for further evaluation from each regions. So, the experimental design was 2 x 2 factorial with 5 replications in CRD manner. All the selected farm will be monitored for six months. All the collected and recorded data processed accordingly for each treatment. All the data was analyzed through biological data analysis software of "R". From the whole observation period it is revealed that commercial farmers choose cattle for fattening from 2 to 2.5 years aged on average, whereas traditional farmers prefer young animals mostly. The traditional farmers also prefer to fatten the animals for few days than commercial farmers (101 & 114 days, respectively). Significant ($p<0.001$) regional variation also observed between Chottogram and Kustia (136 & 78 days, respectively). Significant higher ($p<0.001$) DMI was seen in Kustia than Chottogram (8.2 7 6.3, respectively) and CPI ($p<0.001$) in Chottogram than other (1.6 & 0.89, respectively). A better growth performance ($p<0.001$) was observed in kustia region than Chottogram regarding ADG (1.08 & 0.50, respectively) and FCR (8.49 & 13.86, respectively) though the production cost was significantly low ($p<0.001$) in kustia (174 & 418 BDT/kg) but that was not affect the profit margin. However, between two factors interaction effects ($p<0.001$) only observed in case of duration and DMI (Table 1). The figure of production performances showed that in two region behavior of production flowed differently. In Chottogram, farming are costly and less productive than

Table 1. Production performance of fattened bulls

Factors		Age	Duration	DMI	CPI	ADG	FCR	Cost	profit
Area	Chottogram	29.16	136.6	6.3	1.6	0.50b	13.86	418	629
	Kustia	30.18	78	8.2	0.89	1.08a	8.49	174	645
System	Commercial	32.4	114	7.4	1.3	0.78	11.4	210	579
	Traditional	26.9	101	7.1	1.2	0.79	10.9	283	696
	SED	0.76	2.94	0.13	0.04	0.02	0.23	7.25	44.96
Sig.	area	NS	***	***	***	***	***	***	NS
	system	***	*	NS	NS	NS	NS	*	NS
	area : system	NS	***	***	*	NS	*	NS	NS



Kustia. Whatever the systems are, farms in Kustia produced more meat using less input than the farms of Chottogram.

This is how existing cattle fattening approach either commercial or traditional were observed in Chottogram and Kustia. Several approaches including unconventional feeding was seen in two regions. But at the end of the experimental period it is evaluated that constructive farming doing well to run the enterprise. From twenty farms, one commercial and one traditional farm from each region were selected those are performed best. Among them Soudia Dairy from Chottogram and Sat vai-bon Agro from Kustia, commercial farms, used standard concentrate mixture having 14.03 and 17.39 % crude protein, respectively. In case of traditional farming 3 star from Chottogram and Alif-lam Agro from Kustia performed best using only two types of ingredients named bran and polish as concentrate feed having 13.5 and 11.8 % CP, respectively. It is lighted that fattening in Kustia are depends on straw, whereas in Chottogram it solely depends on green grass (Table 2).

Table 2. Different types of fattening approach and feeding behavior

Type	Chottogram Commercial	Chottogram Traditional	Kustia Commercial	Kustia Traditional
Farm Name	Soudia Dairy Farm	3 star dairy farm	Sat vai agro farm	Alif-lam agro
Roughage	German grass	German grass	Straw	Straw
Concentrate used	Wheat bran, Soyabean meal Broken maize/wheat, Rice polish, Chira Polish	Wheat bran Chira Polish	Mixed feed, Wheat bran, Rice polish Oil cake, Maize powder	Wheat bran Rice polish
CP %	14.03	13.5	17.39	11.8

Throughout the monitoring tenure, seven types of breed were found reared by farmers with variations in number. Their initiatory and growth performance and business were analyzed to rank them accordingly. It was found that local (RCC/ Pabna) and Friesian cross bulls were the best among the seven types of breed. These two breeds were mostly preferred by farmers (168 and 202 in number, respectively). Their age limit and their fattening duration was maintained the standard parameter. They also grown well with admissible ADG and FCR. Most importantly, their feeding cost and business return was significantly ($p<0.001$) higher comparing with others. All the tested parameters showed highly significant difference ($p<0.001$) among the breeds, shown in Table3. It can be said that local (RCC/ Pabna) and Friesian cross bulls would be the best choice for fattening. However, to find out the other types of fattening approaches, further research should conduct in other fattening pocket areas like Dhaka, Rajshahi and Shirajgonj.

Table 3. Production performance of seven types of breed

Breed	Age	Duration	ADG	FCR	DMI	CPI	Cost	Profit
	Mean ± SE							
Local	25.19±0.66	110.4±4.8	0.61±0.03	12.1±0.33	6.3±0.1	1.2±0.04	327±12	626±52
Friesian cr.	34.19±0.86	105.9 ±3.5	0.94±0.04	10.1±0.32	7.6±0.2	1.1 ±0.03	255±11	555±37
Shahiwal /Sindhi cr.	37.51±1.24	138.4 ± 8.9	0.61±0.02	14.5±0.43	8.6±0.2	2.4 ±0.11	473±18	792±155
Brahman cr.	35.67 ± 1.5	166.8 ± 8.4	0.57±0.04	14.2±1.16	7.9±0.3	1.7 ±0.06	388±31	117±66
Jersy cr.	30.4 ± 1.4	178.2 ± 0.8	0.41±0.02	17.6±0.63	7.2±0.4	1.4 ±0.09	476±18	437±90
Nepali	32.14±3.01	130.1±15.8	0.56±0.04	13.2±1.26	7.1±0.6	1.5 ±0.12	367±34	509±99
Vutani	29.0±0.001	177.5 ± 2.5	0.48±0.03	16.6±0.25	7.9±0.6	1.6± 0.12	452±4	640±39
Sig.	***	***	***	***	***	***	***	NS

Effect of creep feeding on the performance of Black Bengal kids up to weaning

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Executive Summary

Black Bengal goat is a highly prolific breed but due to low milk production most of the time it can't support all the kid's milk requirement. As a result, malnutrition, disease incidence and mortality of kids increases during weaning period and farmers are not able to get optimum profit from the goat farming. Creep feeding is the practice of supplementing suckling kids with a concentrate feed in addition to their dam's milk that may enhance the production performances and reduce the kid mortality to minimize the shortage of dam's milk. Thus, the objective of the present study was to know the effect of supplementation with creep feed on the performances of black Bengal suckling kids. A trail was conducted with a total of 36, seven days old, Black Bengal kids. They were randomly assigned into three treatment groups (A, B and C). Each group comprised of 12 kids having similar group average weight. Kids in group A were fed dam's milk + Creep feed 1 (Broken maize 68%, Soybean meal 30%, Vitamin mineral premix 1%, Salt 1 %). Group B were fed dam's milk + Creep feed 2 (Broken maize 55%, Soybean meal 18%, Moringa leaves 25%, Vitamin mineral premix 1%, Salt 1 %). The kids of Group C were only given access to the dam's milk and was considered as the control group. The kids in all three groups were allowed to suckle their mothers' milk until they weaned. Kids stayed together with their mothers from 1800 h to 0800 h and from 1200 h to 1400 h throughout the experimental period. During feeding, the kids from all three groups were separated from the dams and kept in the feeding pan adjacent to their pens. The treatment groups (A and B) were fed with creep feed according to their assigned feeds, twice a day; (800-1200 h and 1400-1800 h) while the control kids were separated but given only water. With 10 days adjustment period, each kid of two treatment groups were offered 20g of creep feed then the amount was gradually increased in every week @ 5 g per week.

The chemical composition of creep feed was shown in Table-1. Body weight gain, growth rate, disease incidence, kid mortality and economy of the creep feeding were recorded. Data were analysed statistically in an ANOVA of a Completely Randomized Design (CRD) using SPSS (25) and Duncan's Multiple Range Test (DMRT) was used to find out the differences between means.

Table1. Chemical composition of creep feed supplemented to sucking kids

Sample name	DM	Ash	CP	ADF	Fat	GE(MJ/Kg)
Creep feed 1	88.29	6.44	20.19	5.87	1.93	15.89
Creep feed 2	90.3	9.83	18.98	8.77	2.03	16.26

Performances of different groups of kids are presented in Table 2. Although, total weight gain and daily weight gain from birth to weaning age were found non-significant ($p>0.05$) among all three groups but considerable weight gain observed due to creep feeding. The total profit per kid was Tk. 358.82 and 147.43 for treatment group A and B, respectively obtained by creep feeding compared to Control. That may also impact the post weaning performances and enhance profitability of the goat farming.

Table2. Performances of different groups of kids supplemented with creep feed

Parameters	**Treatment groups**			**SEM**	**Level of Sig.**
	A	**B**	**C**		
Birth weight of kids, kg	1.17	1.15	1.14	0.03	NS
Average weight gain from birth weaning, kg	5.97	5.37	4.95	0.25	NS
Daily gain from birth weaning, g	66.37	59.67	54.99	2.76	NS
Return up to weaning, TK	2093.58	1882.19	1734.76	87.15	NS

The health problems were also mentioned during the experimental period for different groups of kids (Table 3). The common diseases or health problems observed during the experimental period were Pneumonia, Coccidiosis/Diarrhoea and Lameness. During the weaning period 8.33%, 25.00% and 33.33% kids were faces different diseases or health related problems for the group A, B and C, respectively. The kid mortality rate was 8.33%, 8.33% and 16.67% for the group A, B and C, respectively.

Table3. Occurrences of diseases or health problems during experimental period in different treatment groups of kid

Disease/Health Problem	Treatment groups		
	A	B	C
Pneumonia (no.)	0	1	2
Coccidiosis/Diarrhoea (no.)	2	2	1
Lameness (no.)	0	0	1
Total (no. of kids)	2	3	4
Incidences of diseases or health problems, (%)	16.67	25.00	33.33
Death (no.)	1	1	2
Kid mortality (%)	8.33	8.33	16.67

The result suggested that creep feeding enhances growth performance of the kids although not significant but enhance considerable profit per kid until weaning. Creep feeding also reduce the disease incidences and kid mortality that may have positive impact on farm profitability and concentrate based creep feed perform better.

Production of safe broiler chicken through feed additives in different regions

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Executive Summary

Safety is the composite of some characteristics that differentiate individual units of a product and which have significance in determining the degree of acceptability of that unit to the user. However, for meat safety it is a term used to describe the overall meat characteristics including its physical, chemical, morphological, biochemical, microbial, sensory, technological, hygienic, nutritional and culinary properties. It is a well-known fact that broiler production at mass level has already been achieved and now emphasis is given on increasing meat quality and safety by altering the said characteristics of broiler meat. Consumers, with increasing health consciousness, are becoming more aware of the nutritional value of the foods they eat. A proverb goes “healthy food, healthy nation". Poultry meat and egg is considered as one of the cheapest healthy foods for all classes of people. Poultry contributes about 30% of the total animal protein supply in the country. Commercial broiler and layer farming ensure 35.25% of the total meat and 63.65% of the total egg respectively. FDA, USA - action taken to stop illegal manufacture and sale of unapproved animal drug (2010 April 29). Among them medicinal plants, probiotics, prebiotics, organic acids or combination are used in poultry. WHO enlisted some 21,000 medicinal plant species (Penso, 1980). Bangladesh have got about 500 (Ghani, 2000). Therefore, the objective was ensuring no use of antibiotic among the model broiler producers considering food safety issues and use of natural feed additives in the farmer’s field for safe broiler production.

Two hundred forty (240) day old mixed sex broiler chicks were purchased from a commercial hatchery. The chicks were weighed and randomly allocated to 20 floor pens containing fresh rich hash to the depth of 5 cm in an environmentally controlled shed. The experiment was divided into five dietary treatments with four replicates having 48 chicks in each group, T_1-Control Diet; T_2- OCT 0.05 % (oxytetracycline);T_3-Moringa leaf meal 1%; T_4- Spirulina 1%; T_5- Mushroom 1%. Feed and fresh water were offered ad libitum throughout the 35-d rearing period. Feed intake (FI, g) was calculated as feed allocated minus feed refused. In addition, serum cholesterol and heavy metal content in meat were determined.

The final body weight gain was significantly higher ($p < 0.05$) in the T_2 and T_5 groups compared to T_1 control group (Table 1). FCR were improved significantly in 1.0% additives group than control. Dressing yield increased about 4 percent after addition of feed additives. In addition, serum cholesterol (mg/dL) level was found to be reduced in additives group 118.02±2.62 in T_4 group. The proximate components of broiler breast and thigh (Table 2) meat were analyzed. Moisture and CF (Crude fiber) in both types of meat didn’t show any significant variation among the treatments. The amount of Crude protein (CP) in breast meat showed about 2% higher than thigh meat in all the treatments (Table 2). Heavy metal content in meat were found in negligible range.

Table 1. Effect of diets added with OCT, *M. oleifera* leaf meal, ***S. platensis*** **and Mushroom** on body weight, feed intake, feed conversion ratio (feed: gain) and serum cholesterol of broiler chickens

Parameter	T_1 (Control)	T_2 OCT (0.05%)	T_3 (Moringa 1%)	T_4 (Spirulina 1%)	T_5 (Mushroom 1%)
BW(g/b)					
0d	47.45±0.32	47.45±0.32	46.78± 0.43	47.35±0.88	47.05±0.22
21d	880.30±10.45[a]	885.30±10.45[a]	887.16±6.05[a]	852.14±3.45[b]	861.43±9.56[b]

	35d	1912.44±21.41[b]	1920.44±21.41[b]	2012.21±23.21[a]	2105.61±14.78[b]	2078.22±25.09[b]
FI (g/b)						
	21d	1443.69±19.45[a]	1441.29±18.45[a]	1428.32±13.25[a]	1363.42±7.85[b]	1369.67±14.22[b]
	35d	3404.14±35.44[ab]	3414.14±35.44[ab]	3320.14±31.32[b]	3495.31±29.65[a]	3470.62±42.14[a]
FCR						
	21d	1.64±0.07[a]	1.64±0.03[a]	1.61±0.08[b]	1.62±0.08[ab]	1.59±0.07[b]
	35d	1.78±0.06[b]	1.78±0.04[b]	1.65±0.04[a]	1.66±0.04[b]	1.67±0.05[b]
Serum Cholesterol		141.24±2.47[a]	139.24±2.47[a]	126.12±1.26[c]	131.11±3.04[b]	118.02±2.62[d]

[a, b] Mean with different superscripts within same row are significantly different ($p<0.05$). BW-Body weight (g), FI- Feed intake, FCR – Feed conversion ratio, OCT; oxytetracycline

Table 2. Effects of different feed additives on meat composition

Treatments	Meat samples	Moisture (%)	CP (%)	EE (%)	CF (%)	Ash (%)
T_1(Control)	Breast	74.35	22.05	0.40	0.28	1.10
	Thigh	76.20	19.98	1.40	0.38	0.90
	Drumstick	77.23	21.13	0.80	0.35	0.58
T_2 OCT (0.05%)	Breast	74.45	21.15	0.43	0.29	1.00
	Thigh	75.70	20.01	1.05	0.41	0.93
	Drumstick	76.75	21.35	0.91	0.37	0.59
T_3 (Moringa 1%)	Breast	79.55	21.82	0.50	0.28	1.03
	Thigh	77.23	20.21	1.10	0.35	1.40
	Drumstick	77.38	18.60	0.80	0.35	0.80
T_4(Spirulina 1%)	Breast	73.92	21.36	0.60	0.27	1.40
	Thigh	75.32	21.35	1.80	0.35	1.20
	Drumstick	76.70	19.29	1.20	0.37	0.25
T_5(Mushroom 1%)	Breast	75.30	21.82	0.40	0.30	0.85
	Thigh	76.93	19.29	1.00	0.38	0.80
	Drumstick	77.28	17.91	0.60	0.38	0.88

CP-Crude protein, EE-Ether extract, CF-Crude Fiber

Based on these findings, it can be concluded that inclusion of above-mentioned feed additives has no detrimental effect in performance. Hence, addition of 1.0% feed additives may have the potential in replacing oxytetracycline (OCT) for safe broiler production in farmer's field.

Project title: Dietary effects of feed additives on egg quality, cholesterol and fatty acid profile of laying hens

Sub-title: Determination of cholesterol, fatty acid profile and lipid oxidation of poultry eggs through a validated method

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Executive Summary

Eggs are highly favored as an excellent source of nutrients and for their valuable functional properties in the food industry. Coagulation, emulsification, and foam formation are key functional attribute of eggs that makes it highly desirable as a food ingredient in food industry. Eggs can also be designed through dietary manipulation of specific nutrients, or certain herbs or plants that have functional and therapeutic properties.

The fatty acid profile and cholesterol of eggs can be changes by the alteration in the fat diet of poultry. Therefore, the objective of the study was to evaluate the feeding effect of *M. oleifera* leaf (MOL) meal, *Linum usitatissimum* (flaxseed) and *Trigonella foenum-graecum* (fenugreek) on egg quality, fatty acid profiles and cholesterol content of egg yolk.

One hundred and sixty-eight (168) Fayoumi laying chickens at age 27 weeks were selected for this study, and the experiment continued until they were aged 43 weeks. Seven dietary treatment groups were produced from the basal feed as follow T_1-Control Diet; T_2-Flaxseed 0.5% + MOL 1%; T_3-Flaxseed 1% + MOL 1%; T_4-Flaxseed 1.5% + MOL 1%; T_5-Fenugreek 0. 5% + MOL 1%; T_6-Fenugreek 1% + MOL 1%; T_7-Fenugreek 1.5% + MOL 1%. After completed the experiments (4 months) egg quality such as egg weight, shape index, shell thickness, shell weight (g), albumen index, yolk index and yolk color were measured. In addition, cholesterol and fatty acid were determination by GC.

It was observed that the egg weight, egg length, egg width, shape index and shell thickness of the eggs laid by hens fed diets were similar during the experimental period. These results indicated that feeding flaxseed and fenugreek with moringa leaf (1%) meal up to 1.5% had no adverse effects on the external or internal qualities of eggs. The results also showed that the addition of flaxseed and fenugreek with moringa meal to the hens' diet for a longer period of time (16^{th} week) improved the egg weight in additives group (51.58 to 54.72g) compared to the control (T_1) group (48.07g). However, shape index, albumen width and albumen index were not significantly difference compared to control group. Moreover, slightly higher yolk colour value (8.33) was observed in the T_2 group compared to the control group (7.33). The serum lipid profile of the hens was also favourably altered by additives added to feed (Table 1). A reduction in yolk cholesterol levels was noted upon feeding with flaxseed and fenugreek 0.5% with MOL 1% added to the diet, which may be due to hypocholesterolemic effect of MOL. Among the additive groups **both** 0.5% of flaxseed and fenugreek were found to be most effective in reducing yolk cholesterol levels. Higher amounts of Σω3 fatty acid were found in the eggs of T_2 and T_5 group with values of 1.86 and 1.30% respectively, and total PUFA content was also higher in the T_2 and T_5 groups (17.44 and 18.31 %, respectively) compared to the control (Table 2).

The results obtained in this study revealed that the addition of different levels of **additives** in the hens' diets had no effect on production performance in terms of egg nutritional composition and external quality parameters of egg. Fatty acid composition, especially ω-3 fatty acid content, was improved, and egg cholesterol concentration was numerically reduced at the lower levels i.e., 0.5% of flaxseed and fenugreek with MOL 1% added to diet. Therefore, it can be concluded that diets up to 0.5% dietary flaxseed and fenugreek with MOL 1% could be used in layers' diets. However, further

follow-up research is required to know the mechanisms of various pathways of reducing cholesterol and enrichment of ω-3 fatty acids content in the egg yolk.

Table 1 Serum and yolk cholesterol levels in hens fed with **Moringa, Flaxseed and Fenugreek as natural feed additives**

Parameter (mg/dL)	T_1	T_2	T_3	T_4	T_5	T_6	T_7	SME	*p*-value
TC	201.33	206.00	188.67	196.00	188.33	213.00	212.00	13.05	0.09
HDL	23.67	27.33	29.67	29.67	27.00	27.67	25.00	4.04	0.17
LDL	170.33	164.33	143.33	136.00	162.33	154.67	149	6.51	0.08
Triglyceride	2290.00	2135.00	2260.00	2088.00	2290.00	2175.00	2198.00	40.30	0.20
Yolk cholesterol (mg/100g)	304.25	259.24	269.05	284.01	291.06	264.83	210.86	9.00	0.08

T_1-Control Diet; T_2-(Flaxseed 0. 5% + MOL) 1%; T_3-(Flaxseed1% + MOL 1%); T_4-(Flaxseed 1.5% + MOL 1%); T_5-(Fenugreek 0. 5% + MOL1%); T_6-(Fenugreek 1% + MOL 1%); T_7-(Fenugreek 1.5% + MOL 1%). TC: Total cholesterol; HDL: High density cholesterol; LDL: Low density cholesterol. [a] Results expressed as a mean of the three replicates.

Table 2 Effect of **Moringa, Flaxseed and Fenugreek as natural feed additives on fatty acid profile of egg yolk (g/100g fatty acids)**

Parameters (g/100g)	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Myristic acid (C14:0)	---	0.32	0.33	0.41	0.29	0.43	0.65
Palmitic acid (C16:0)	23.30	22.31	24.85	25.50	25.02	27.99	28.43
Stearic acid (C18:0)	3.44	6.80	7.13	3.56	4.70	4.13	5.82
Arachidic acid (C20:0)	0.23	0.12	0.09	0.30	0.15	0.37	0.26
Palmitoleic acid (C16:1)	3.22	2.21	3.50	4.35	4.17	3.15	4.69
Oleic acid (C18:1)	56.83	50.65	49.60	47.46	46.35	52.13	45.69
Eicosenoic acid (C20:1)	0.11	0.11	---	0.20	0.30	0.15	0.06
Linolenic acid (C18:3n3)	0.41	0.66	0.47	0.96	0.65	0.24	0.46
Eicosapentaenoic acid (C20:5n3)	0.07	---	0.07	0.02	0.02	0.04	0.03
Docosahexaenoic acid (C22:6n3)	0.62	1.20	0.63	0.53	0.63	0.39	0.02
Linoleic acid (C18:2n6)	1.08	1.10	1.21	2.10	1.20	0.81	0.94
Arachidonoic acid (C20:4n6)	10.14	14.48	11.81	13.68	15.81	9.60	12.54
ΣSFA%	26.97	29.55	32.41	29.76	30.15	32.92	35.16
ΣUFA**%**	72.49	70.30	67.28	69.30	69.12	66.51	64.43
ΣMUFA%	60.16	52.86	53.10	52.01	50.82	55.43	50.44
ΣPUFA%	12.33	17.44	14.18	17.29	18.31	11.08	13.98
Σn-3	1.10	1.86	1.17	1.51	1.30	0.68	0.51
Σn-6	11.22	15.58	13.01	15.78	17.01	10.40	13.47

T_1-Control Diet; T_2-(Flaxseed 0. 5% + MOL) 1%; T_3-(Flaxseed1% + MOL 1%); T_4-(Flaxseed 1.5% + MOL 1%); T_5-(Fenugreek 0. 5% + MOL1%); T_6-(Fenugreek 1% + MOL 1%); T_7-(Fenugreek 1.5% + MOL 1%). [a] Results expressed as a percentage of the total fatty acids. SFA: Saturated fatty acids; MUFA: Mono unsaturated fatty acids; PUFA: Poly unsaturated fatty acids. Σ ω-3 = total omega-3 fatty acid; Σ ω-6 = total omega-6 fatty acid.

Quality and safety assessment for poultry meat products

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Executive Summary

A lot of chicken meat products are available in the market. These products are being popularized in Bangladesh. Now, we are finding of these products by varieties of brand name. The available chicken meat products are chicken meat ball, chicken sausage, chicken nugget, chicken fry, chicken frence fry, chicken burger patty, chicken strips, chicken popcorn, chicken drumstick, chicken lollypop, chicken kabab, chicken cutlet and chicken sandwich etc. Among these product, chicken nuggets, chicken sausage and chicken meat ball is very much popular in Bangladesh. Their market share is 22% for chicken nuggets, 17% for chicken sausage, 17% for chicken meat ball. In our study, we have four objectives, those are – To conduct a baseline survey on the availability of poultry meat products in Bangladesh, to evaluate the nutritional quality of poultry meat products, to determine the heavy metals of poultry meat products, to determine spoilage microorganism of poultry meat products.

For conducting baseline survey, total 10 companies (CP Bangladesh, Aftab, Paragon, AG food, Holy seed, Bengal Meat, Uttara Broiler, Agro Link, Kazi Farms and Quality Foods) were selected for data collection in case for processed chicken. Data was collected from companies sales and marketing division. Processed chicken production per day was recorded for each company for each month. The average daily production was recorded and monthly production was divided by the total days of month. Finally, the average daily production for each month was divided by 12 (1 year=12 months) and thus the final daily production was obtained. In this way, total 12 months that means one year in 2020's production was estimated. Average processed chicken production per month was divided by 12 and the average monthly production was calculated. Based on the company's total processed chicken production, the market share was identified and the amount of production was converted into monetary value. In the same way, the further processed chicken production (here, 14 companies was considered) was calculated. The data was collected from company's corporate sales division mainly Dhaka city.

The market share of processed chicken, CP Bangladesh was the highest producer, their monthly production is 130 metric ton and its daily production was 4.3 metric ton. The market share of CP Bangldesh is 12% and its monetary value of production was 2.6 crore taka. The second market share was for Paragon and Quality Foods Limited, their monthly production was 80 metric ton and daily production was 2.7 metric ton. The monetary value of these two companies was 3.2 crore taka. Golden Harvest was the highest monthly production for further processed chicken, its monthly production was 56.2 metric ton and its production monetary value was 2.1 crore taka. The second highest production was for Kazi Farms Limited.

Competitor market information about processed and further processed chicken are presented below:

Table 1. Competitor market share of processed chicken

SL.	Company Name	Day(MT)	Monthly(MT)	%	Tk
1	CP Bangladesh	4.3	130	12%	26,000,000.00
2	Aftab	2.0	60	5%	12,000,000.00
3	Paragon	2.7	80	7%	16,000,000.00
4	AG Food	1.7	50	4%	10,000,000.00
5	Holy Seed	1.3	40	4%	8,000,000.00

6	Bengal Meat	1.3	40	4%	8,000,000.00
7	Uttara Broiler	1.3	40	4%	8,000,000.00
8	Agro Link	1.0	30	3%	6,000,000.00
9	Kazi Farms	0.5	15	1%	3,000,000.00
10	Quality	2.7	80	7%	16,000,000.00
11	Others	18.3	550	49%	110,000,000.00
	Total	37	1115	100%	223,000,000.00

Table 2. Competitor market share of further processed chicken

Company Name	Market Share	Total Quantity Monthly(MT)	Total Amount Monthly(BDT)
Golden Harvest	27%	56.2	21,304,000
Kazi Farms	17%	36.7	14,351,000
Pran	10%	21	7,630,000
AG Food	3%	6.5	2,488,000
Harvest Rich	4%	9	3,810,000
BRAC Chicken	5%	11	5,170,000
Aftab	5%	10	4,140,000
Uroasia	1%	3	1,130,000
CP Bangladesh	6%	12	6,600,000
BD Food	2%	4	1,320,000
ATR	2%	4	1,880,000
Paragon	1%	3	1,200,000
Bengal Meat	2%	5	2,350,000
Lamisa	4%	9	3,390,000
Others	10%	20	6,880,000
Total	**100%**	**210.4**	**83,643,000**

The leading company for processed chicken was CP Bangladesh Limited, consequently, other companies were Paragon, Quality, Aftab, AG Food, Holy Seed, Bangle Meat, Uttara Broiler, Agro Link and Kazi Farms. The monthly production was higher for Golden Harvest in case for further processed chicken, the other following companies according their production were Kazi Farms, Pran, CP Bangladesh, BRAC Chicken, Aftab, Harvest Rich, Lamisa, AG Food, Bengal Meat, BD Food, ATR, Paragon and Urosia.

Effect of dietary methionine and lysine on growth performance, carcass traits and economic efficiency of Hilly chicken

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Executive Summary

Methionine (Met) and Lysine (Lys) are the first and second limiting amino acid respectively, in poultry diets, which improve their health, survival, growth, development, and reproduction. But a requirement of methionine and lysine for BLRI improved hilly chicken is not determined yet. Therefore, this study was taken to evaluate the dietary Lys and Met levels on growth performance and carcass characteristics of BLRI developed hilly chicken. A total number of 432 day old hilly chicks were equalized and allocated to 9 dietary treatments (4 pen replications per treatments and 12 birds per pen for a total of 36 pens). Basal diets based on corn-soybean meal were formulated, those were iso-energetic and iso-nitrogenous. Diets were formulated to meet the nutrient requirement of experimental birds according to NRC (1994) for broiler. The experimental design was a completely randomized design with a 3x3 factorial arrangement of treatments. Treatments consisted of both Lys and Met in a basal diet with dietary increment and reduced level were 0 and 10% in each treatment in each 3 phases. Three levels of lysine (NRC, 90% NRC, 110% NRC) and three levels of methionine (NRC, 90% NRC, 110% NRC). The diets were available *ad libitum* in the starter (0-2wks), grower (3-5wks) and finisher (6-8 wks) periods. Therefore, the treatments of Starter periods were T_1 (1.05 Lys+0.48Met), T_2 (1.05 Lys+0.53Met), T_3(1.05 Lys+0.43Met), T_4(1.15 Lys+0.48Met), T_5(1.15 Lys+0.53Met), T_6(1.15 Lys+0.43Met), T_7(0.94 Lys+0.48Met), T_8(0.94 Lys+0.53 Met) and T_9(0.94 Lys+0.43Met). During grower (3-5 wks) and finisher period (6-8wks), dietary Lys and Met were reduced 5% in each treatment. Body weight, weight gain and feed intake (difference of offered feed and refused feed) were measured and FCR was calculated weekly. At 8 weeks of age, 8 birds per treatment were sacrificed and samples were collected to analyze the carcass characteristics. All recorded data were analyzed by SAS (2009) and differences were determined by DMRT.

Table 1: Effect of various levels of dietary Lysine and Methionine on the performance of hilly chicken (0-8 weeks)

	0-8 weeks			
Treatments	**Body weight(g)**	**Weight gain (g)**	**FI (g)**	**FCR**
T_1	738.53^{a}	709.76^{a}	1960.74	2.76^{c}
T_2	698.28^{b}	669.78^{b}	1907.05	2.84^{b}
T_3	722.23^{ab}	693.69^{ab}	1968.08	2.83^{b}
T_4	715.17^{ab}	686.61^{ab}	1928.71	2.80^{bc}
T_5	710.93^{ab}	657.82^{ab}	1923.49	2.92^{ab}
T_6	667.38^{c}	638.94^{c}	1949.81	3.05^{a}
T_7	697.80^{b}	668.94^{b}	1933.35	2.89^{ab}
T_8	697.52^{b}	668.83^{b}	1893.60	2.83^{b}
T_9	684.15^{bc}	669.02^{bc}	1926.81	2.88^{ab}
SEM	5.32	5.31	11.30	0.01
P value (Lys x Met)	0.042	0.043	0.72	0.039

Results found that different dietary levels of Lys and Met during starter period had shown no significant differences between the treatments. Dietary recommendations of NRC (1994) for Lys (1.05%) and Met (0.48%) led to maximum growth performance in growing phase (3-5 wks) where body weight ($P<0.039$) and weight gain ($P<0.041$) were significantly different but feed intake ($P<0.880$) and FCR ($P<0.072$) had no additional effects. Similarly, different levels of Lys and Met had influenced on the improved hilly chicken finisher diet. Body weight showed significantly higher ($P<0.042$) in the T_1. But weight gain was significantly higher in 1.05% lys and 0.53% Met though

Methionine 0.48% (353.43[a]) and 0.53% (360.98[a] g) had no difference between the treatments. Finally, overall (0-8) weeks of age, body weight, weight gain and FCR were significantly different in different levels of Lys and Met. Higher body weight ($P<0.042$) and weight gain ($P<0.043$) and lower FCR ($P<0.039$) were found in 1.05% and 0.48% lysine and methionine interaction respectively. Results showed that dietary recommendations of NRC (1994) for Lys (1.05%) and Met (0.48%) led to maximum growth performances in growing phase and finisher period where body weight and weight gain had a significant difference. But, during starter period, no significant differences were found. In carcass characteristics, there were no dietary Lys and Met interactions on meat of hilly chickens.

Our study showed that, supplementation of Methionine and Lysine provided no additional effects. Optimum growth performance was achieved when the dietary levels of Lysine and Methionine followed the NRC (1994) recommendation for BLRI improved hilly chicken.

Session III:

BIOTECHNOLOGY, ENVIRONMENT AND CLIMATE RESILIENCE

Project title: Carbon footpraint of different livestock production system in Bangladesh

Sub-title: Greenhouse gas emission from beef cattle production at south-west region of Bangladesh

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Executive summary

Production of beef cattle contributes to greenhouse gas emission associated with its fees recourses (either purchased or cultivated), enteric fermentation of feedstuffs, manure management system and farm management activities. Exploration on carbon footprint of beef cattle production is needed in order to identify major sources of greenhouse gas and to take mitigation measures. In order to do this, twenty beef cattle farmers at Kumarkhali, Khustia and Alomdanga, Chuadanga were studied. Feeds, feeding and management of beef cattle were recorded at farmer's house. Data on manure management practices, utility supports, and other inputs were collected by interviewing farmers. The carbon footprint was calculated by following Tier 2 methods of IPCC and expressed as kg CO_2-e/d/kg LW of beef cattle. A "gate to gate" system boundary was followed to calculate carbon footprint. The diet of the bulls was consisted of rice straw at 37%, followed by concentrate mixtures, Napier grass, local grass, jumbo and maize at 36, 17, 4, 3 and 2%, respectively. Results indicated that the length of average fattening program of indigenous beef animal was 118 (17) days, and the average live weight (LW) was 199 (33) kg (Table 1). The estimated carbon footprint was 11.12 kg CO_2-e/d/kg LW of beef cattle. It was also found that methane emission from enteric fermentation contributed the highest part of carbon footprint (49.9%), followed by direct nitrous oxide emission (30.12%), methane emission from manure management (9.4%), farm operation (8.7%), and indirect nitrous oxide and farm feedstuff (2%) (Table 1).

Table 1: Nutritional status of a beef cattle and their GHG emission

Parameters	Mean	SD/range
No of beef cattle in a farm	7	3-18
% of indigenous cattle	47	0-100
Fattening duration, days	118	60-210
DM intake, kg/day	5.96	3.11-10.5
GE intake, MJ/day	99.6	51-177
N intake, g/day	97.5	54-167
N excretion rate, kg/d/1000 kg LW	0.38	0.27-0.56
Volatile Solids in the manure, kg/day	1.73	0.97-3.23
Average LW, kg	199	110-405
Gain, kg/d	0.94	0.4-1.56
Emission of GHG (kg CO_2e/kg LW		
CH_4 from enteric fermentation	5.54	4.00-7.59
CH_4 from manure management	1.05	0.04-7.35
Direct N_2O emission	3.35	2.37-4.91
Indirect N_2O emission	0.12	0.00-0.39
CO_2 emission from farm operation	0.97	0.08-2.64
CO_2 emission from farm feedstuffs	0.10	0.002-0.50
Carbon footprint (kg CO_2e/kg LW)	11.12	7.59-19.42

Low cost and sustainable business model development of bio-slurry management

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Executive Summary

Biogas slurry is a secondary product produced from anaerobic digestion process of bioresources generated from animal farm. It is an environment friendly organic fertilizer could be used for excavated soil treatment in an enclosed vessel. But it is a matter of great regret that this most valuable worth become wasted daily only because of knowing how to utilize this semi solid materials in a convenient way. Concerning this issue, BLRI is working on developing sustainable approaches of utilizing bio-slurry with minimum spent and maximum outcome since 2014 to till yet. Initially suitable bio-slurry based organic fertilizer production technique was developed through following globally recognized techniques and sun drying was preferred method there. But mechanical partitioning of bio-slurry solid and liquid fraction is much more acceptable method now as because appropriate DM content can not be recognized by farmers in sun drying method. Moreover, nitrogen (N) content of bio-slurry based organic fertilizer is highly related to its DM content and excess dryness reduce the N content and its fertilizer value and this urges the necessity of mechanical processing of bio-slurry more. From this aspect a research was designed aiming to develop organic fertilizer production technique from mechanical separation of bio-slurry and its efficacy testing on fodder and vegetable production. To start this study a screw press de-watering machine was procured and calibrated to build up experimental capacity first. Then continuous separation was performed to define the actual DM content at which maximum N was obtained. After getting this organic fertilizer was produced and packaged to define its shelf life quality. An experiment was designed to test the effect of organic fertilizer quality on vegetable and fodder crop production. Both fruit (Tomato) and leafy (Spinach) vegetables were considered there along with Maize as fodder. All the crops were subjected to organic and chemical fertilization to get their response. When organic fertilizer was used then a very minimum level of chemical fertilizer was used depending on demand and supply principles. On the other hand, no organic fertilizer was used incase of chemical fertilization treatment. Soil was suitably prepared and seed and seedlings were transplanted. Number of replications was five in both treatment for all crops. Initial soil composition before fertilization is shown in Table 1. Data reveals that, the vital plant required nutrient N was present in very minimum amount in soil. Nature of soil was acidic.

Table-1: Soil Composition before and after fertilization

Parameter	N (%)	P (ppm)	K (ppm)
Initial	0.61±0.02^{b}	216.06±8.29^{a}	0.72±0.01^{b}
Organically fertilized	0.67±0.04^{b}	217.82±1.94^{a}	0.70±0.02^{b}
Chemically fertilized	0.82±0.03^{a}	154.43±3.73^{b}	0.91±0.06^{a}
P value	.014	.000	.027

Properties of fresh bio-slurry is semi-solid having more than 90% water. The comparison among fresh, sundried and mechanically separated bio-slurry is presented in Table 2. Data shows that the most important plant required nutrient N is highest in mechanically separated bio-slurry based organic fertilizer following sundried based fertilizer. Other nutrients (P

Table 2: Characteristics of fresh bio-slurry and bio-slurry based organic fertilizer

Bio-slurry	Chemical Composition (%) (Mean±SE)				
	DM	N	P	K	Ash
Fresh	6.4±0.6^{c}	0.35±0.04^{c}	0.53±0.04^{a}	0.39±0.01^{b}	32.57±1.4^{b}
Sundried	57.43±5.3^{a}	1.68±0.1^{b}	0.55±0.01^{a}	0.56±0.41^{ab}	34.63±0.69^{ab}
Mechanically dried	35.7±2.54^{b}	2.68±0.1^{a}	0.63±0.02^{a}	0.63±0.44^{a}	37.3±0.98^{a}
P value	.000	0.000	0.116	0.067	0.054

and K) are also present in significant amount in mechanically separated fertilizer than other two. Table two shows that bio-slurry having 35% moisture containing maximum nitrogen, phosphorus and potassium (2.68, 0.63 and 0.63%). Incase of sun drying, excess amount of moisture become reduced for which nitrogen and other nutrient become reduced. Table 3 shows the biomass yield of three considered crops under two different fertilization system. Results revealed that all the considered crops yielded best under organic fertilization following chemical or traditional fertilization process. So, it can be recommended that organic fertilizer production based on bio-slurry is much more economical solution for safe crop and fodder production. It also ensures scientific animal waste management with minimum pollution. To ensure all the benefits in a nutshell mechanical bio-slurry separation system might be introduced in all the commercial farmers managing their farm waste scientifically.

Table 3: Production under chemical and organic fertilization

Crops	Biomass Yield (Ton/ha)	
	Organic	Chemical
Tomato	16.41±1.06	10.46±0.64
Spinach	10.65±0.15	6.94±0.53
Maize	51.60±3.22	35.37±2.65

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

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Executive Summary

This experiment was undertaken to investigate the effects of low protein diets with specific amino acids (e.g. glutamine, methionine and lysine) supplementation on growth performance, meat quality and noxious gas emission of slow growing chicken (MCTC-Multi Color Table Chicken). A total of 600 day old MCTC chicks were taken from BLRI hatchery, equalized their body weight and distributed into 30 pens (5 replicate pens/treatment; 20 birds/pen) and were provided 2 level of CP and 3 level of L-Glutamine resulting in a 3×2 factorial arrangement of dietary treatments [Starter T_1 (22×0); T_2 (22×0.1); T_3 (22×0.15); T_4 (20×0); T_5 (20×0.10) and T_6 (20×0.15%)] CP and glutamine level) respectively. During grower (3-5 weeks) and finisher (6-8 weeks) period dietary CP level was reduced 2% in each treatment. MCTC were weighed individually to determine body weight (BW) and weight gain (WG). Total feed intake (g) and left over feed over the experimental period were measured per pen weekly until the end of the experiment. Feed conversion ratio (FCR) was calculated for the experimental period from feed intake and WG. Mortality was considerated to calculate the FCR correctly. At the end of feeding trial, ten birds from each treatment were randomly selected and allotted to individual cages. After three days adapting period, fresh excreta from MCTC chicken were collected to determine excreta noxious gas emission. Excreta samples (1000 g) were stored in 10L plastic bucket and allowed for fermentation for 1 day at room temperature. After the fermentation period, the gases (NH_3, CO_2, O_2, H_2S, CH_4, NO_2, CH_4S, SO_2 and CO) that formed were determined using a Portable Multi Gas Detector (BH-4S, China) from approximately 5 cm above the excreta samples and Geotech (Biogas 5000, USA). All recorded data are on analysis phase to evaluate the performance, meat quality and noxious gas emission of MCTC chickens. 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 Duncan Multiple Range Test (DMRT).

After the end of 56 days experiment, BW, WG and FCR were found (Table 1) significant while comparing six dietary treatment groups. Significantly higher BW and WG were found in both T_3 (20×0.15) group with lower CP content, although almost numerically similar BW and WG were observed in T_5 (22×0.10) and T_6 (22×0.10) group with higher CP. Better FCR were observed in T_3 and T_6 dietary groups although FCR and FI were found non-significant.

Table 1: Effect of dietary glutamine on the performance of slow growing chicken (MCTC)

Parameters	Treatments (CP%×AA%)						SEM	P value (CP x AA)
	T_1 (20x0)	T_2 20x0.1)	T_3 20x0.15)	T_4 (22x0)	T_5 22x0.1)	T_6 (22x0.15)		
BW (g)	887.55^{b}	948.08^{ab}	**983.95^{a}**	974.48^{ab}	985.36^{a}	**994.66^{a}**	8.092	0.024
WG (g)	848.36^{b}	908.85^{ab}	**944.73^{a}**	935.31^{ab}	946.12^{a}	**955.48^{a}**	7.948	0.031
FI (g)	2240.01	2228.09	2244.58	2266.14	2254.51	2262.77	14.64	0.326
FCR	2.640	2.452	**2.375**	2.442	2.383	**2.368**	0.137	0.078

The results of noxious gas emission (Table 2) showed that there were significant differences in production of NH_3, CH_4S and H_2S gas among the dietary treatment groups. Least gas emission was found in T_3 (20×0.15) treatment group which contained low CP and 0.15% glutamine. Highest

amount of NH_3, CH_4S and H_2S gases were produced in T_4 (22×0) experimental group with high CP and zero level of glutamine while significantly lower amount of those greenhouse gasses were produced in the dietary group having low CP and higher amino acid. However, production of CO_2, CO, O_2, CH_4, SO_2, and NO_2 gases were found non-significant among the study groups.

Table 2: Effects of feeding glutamine on noxious gas emission of slow growing chicken (MCTC)

Parameters	Treatments (CP%×AA%)						SEM	P value (CP x Glu)
	T_1 (20x0)	T_2 20x0.1)	T_3 20x0.15)	T_4 (22x0)	T_5 22x0.1)	T_6 (22x0.15)		
O_2 (%)	21.43	21.60	23.34	19.50	17.67	19.50	1.75	0.964
CH_4 (%)	13.40	12.83	9.35	14.35	5.80	19.57	2.30	0.669
H_2S (ppm)	**30.10^{ab}**	**30.69^{ab}**	**22.60^{b}**	**45.75^{a}**	**33.56^{ab}**	**29.93^{ab}**	**3.25**	**0.046**
CO (ppm)	793.30	695.45	741.60	786.00	763.85	843.75	54.66	0.986
NH_3 (ppm)	**72.46^{ab}**	**71.32^{ab}**	**59.72^{b}**	**82.63^{a}**	**84.68^{a}**	**79.17^{a}**	**5.26**	**0.038**
CH_4S (ppm)	**52.35^{b}**	**40.90^{ab}**	**49.75^{c}**	**76.97^{a}**	**54.85^{b}**	**50.70^{b}**	**4.23**	**0.029**
NO_2(ppm)	0.14	0.25	0.11	0.21	0.21	0.21	0.02	0.651
CO_2 (%)	4.42	4.55	4.72	3.89	4.47	4.58	0.163	0.792
SO_2 (ppm)	15.93	15.07	16.52	15.09	15.37	17.14	0.775	0.972
pH	6.22	6.10	5.78	6.70	6.46	6.29	0.211	0.901
Temp. (^{0}C)	35.42	34.67	34.75	34.92	35.00	35.17	0.356	0.995

In conclusion, it was found after conducting 56days trail on slow growing chicken (MCTC) that low CP containing diet CP (starter-20, grower-18, finisher-16) with 0.15% glutamine may be suitable for low cost diet formulation mainlining optimum growth and beneficial for reduced noxious greenhouse emission from poultry litter. Repeated trials with various levels of CP and ME with MCTC or any other slow growing birds should continue to reach a final recommendation.

Whole genome sequencing of Gayal (*Bos frontalis)* and genome annotation to unveil genetic variations to explore the evolution and adaptation at genome level

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Executive Summary

Gayal (*Bos frontalis*), is a large endangered semi-domesticated bovine species, found mostly in Bandarban Hill tract district of Bangladesh. Itis a valuable sacrificial animal and regarded as a symbol of social status of tribal people in Bangladesh. Gayal is primarily reared as a meat animal as well as a ceremonial animal and plays an important role in the economic, social and cultural life of the tribal people. Whole genome sequencing (WGS) technology has revolutionized the biosciences and proven to be essential and invaluable to the identification of gene functions and their involvement in disease. The feasibility of WGS analysis is under the support of next generation sequencing (NGS) technologies, which require substantial computational and biomedical resources to acquire and analyze large and complex sequence data. There is debate in origin of Gayal and information on its genomic architecture is scanty. Therefore, this study aimed to unveil WGS of Goyal for providing substantial genomic datasets which are required in planning further relevant research on this unique resource. Fresh ear tissue samples were collected from eight adult male Bos frontalis. Genomic DNA isolated and purified in Department of Pathology and Parasitology, Chattogram Veterinary and Animal Sciences University, Khulshi, Chattogram, Bangladesh before library preparation for WGS at BGI, China. DNA was sequenced using Illumina HiSeq X Ten platform. ABySS ver. 2.2.4 and Platanus ver.1.2.4 assembler were used for assembling of DNA sequence data. Gene prediction was conducted using MAKER ver. 3.01.03. Functional annotation was obtained by InterProScan ver. 5.46-81.0. Web-based open-source software Bandage and Cortex were used for visualizing de novo assembly graphs. QUAST were also used for genome assembly evaluation and comparison. A total of 2.7 Gbp reads were generated and assemblers generated 1,262,134 scaffolds along with 1,262,134 contigs in Abyss (Table 1). A total of 55,264,452,615 polished reads were composed in the assembly with 48X coverage. Gene annotation has yielded 21610 protein-coding genes, of which 18638 have been functionally annotated (Figure 1). GC content of the genome was 37.03% and a repeat content was 48.27%. The genome sequence data has been deposited in the NCBI Gene Bank under the Accession numbers JAFDUV000000000.This de novo draft assembly is the first genome assembly of Bangladeshi Gayal constructed using a mongrel approach. This Gayal genome assembly will give genomic coffers to evolutionary studies combined with other bovine species as well as it will also help to understand the genomic armature of colorful

phenotype and genotype relations underpinning this unique bovine species from a distinct geographical niche.

Table 1: Goyal genome statistics

Total sequence length	2,795,315,450
Total Ungapped length	2,795,315,450
Gaps between scaffolds	0
Number of Scaffolds	1,262,134
Scaffold N50	9,646
Scaffold L50	76,340
No. of contigs	1,262,134
Contigs N50	9,646
Contigs L50	76,340
Number of component sequences [WGS or clone]	1,262,134

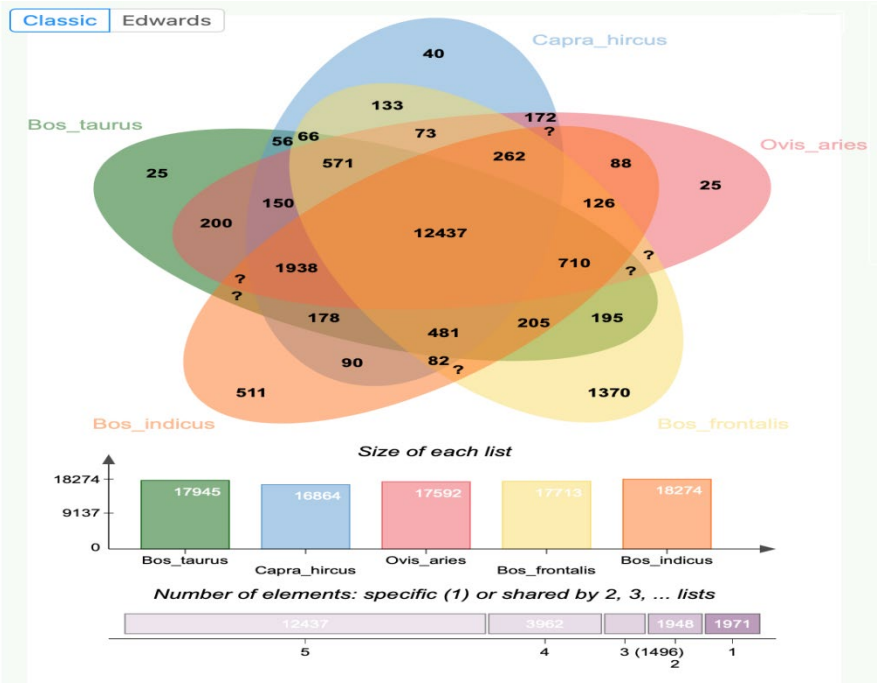

Figure 1: The orthologous groups and evolution of Gayal Genes. The distinct and shared ortholog groups of *Bos indicus, Bos frontalis, Ovis aries, Capra hircus* and *Bos taurus,* were detected by OrthoVen2.

Development of Semen Bank for Conservation of Germplasm at Bangladesh Livestock Research Institute

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Executive summary

Bangladesh Livestock Research Institute (BLRI) has improved the production and reproduction potentialities of Red Chittagong cattle, BLRI Cattle Breed 1 (BCB 1), Munshigonj cattle, Black Bengal goat, and Indigenous sheep and buffalo over long periods of research. All of this improved valuable germplasm are now being conserved in live form which involves a huge maintenance and management cost and any loss of this valuable germplasm by endemic diseases, natural or man-made disaster may result severe loss for the BLRI as well as for the country. Therefore, this research aimed to conserve the germplasm through establishment of a semen bank. Initially, fifteen (15) breeding bull (5 bull from each RCC, BCB 1 and Munshiganj variety) and six (6) buffalo breeding bull (2 Murrah, 2 Nili Ravi and 2 indigenous) have been selected. Semen was collected regularly twice a week semen collection schedule. All the breeding bulls were maintained uniform standard management and nutritional practices. Semen ejaculates were collected and analyzed by computer assisted semen analyzer (Hamilton-thorne). Ejaculates that fills all the standard values were selected for freezing and diluted with Andromed diluter. Diluted semen was equilibrated, cryopreserved and finally evaluated for post thaw sperm quality evaluation. Both cattle and buffalo bull produced semen of creamy color with thick creamy consistency. No significant differences were found of semen volume and concentration among different varieties of cattle (RCC, BCB 1 and Munshiganj). Motility parameters (total, progressive, and static slow motility) did not varied significantly among different cattle varieties. Different morphological deformities of bull sperm was studied. Most common deformities were bent tail, coiled tail, DMR, proximal droplet and distal droplet. In bull spermatozoa, (60.86± 6.27%) normal spermatozoa was found, among different sperm abnormalities higher percentage (34.74± 6.57%) of proximal droplet was found.

Table 1: Fresh semen analysis **(Mean± SE)** of different cattle varieties (RCC, BCB 1 and MC)

Parameter	**RCC**	**BCB 1**	**MC**	**Level of significance**
Volume (ml)	3.97±0.13	3.62±0.31	4.13±0.11	NS
Concentration (million/ml)	1699.4±95.8	2046.5±212.5	1907.4±71.9	NS
Total motility (%)	78.40±1.37	80.27±3.13	81.7±1.30	NS
Progressive motility (%)	57.21±1.6	55.7±5.7	58.3±1.42	NS
Static motility (%)	21.60±1.8	19.73±3.13	18.3±1.30	NS

NS =Non-significant

Different motility parameters (total, progressive, static and slow motility) varied significantly ($p<0.01$) irrespective of different freezing stages (Fresh, prefreeze and postthaw) for both cattle and buffalo bull (table 2 &4).

Table 2: Motility parameter (Mean± SE) of bull spermatozoa based on freezing stage

Motility Parameter (%)	**Fresh**	**Pre freeze**	**Post thaw**	Level of significance
Total motility	81.56^{a}±1.13	76.34^{a}±1.11	58.98^{b}±1.08	*
Progressive motility	58.16^{a}±1.57	52.37^{a}±1.48	40.12^{b}±1.02	*

Static motility	17.44^{b}±1.08	23.66^{b}±10.16	41.02^{a}±1.01	*

*=significant at 1% level

The mean volume and concentration of buffalo bull semen was found (3.09±0.10 ml) and (2787.84 ± 139.19 million/ml) respectively. However, Different motility parameter (total, progressive, static and slow motility) varied significantly ($p<0.01$) irrespective of breed and significantly and higher total and progressive sperm motility was found for Murrah bull followed by indigenous and Nili Ravi bull. Different morphological deformities of buffalo sperm were studied. Most common deformities were bent tail, coiled tail, DMR, proximal droplet and distal droplet. Overall spermatozoa abnormality in the buffalo bull was 39.68 percent.

Table 3: Fresh semen analysis (Mean± SE) of different buffalo breed (Murrah, Nili Ravi and Indigenous)

Parameter	**Murrah**	**Nili ravi**	**Indigenous**	**Level of significance**
Total motility	92.16^{a}±0.74	81.31^{c}±0.46	87.64^{b}±1.64	*
Progressive motility	70.8^{a}±0.71	63.8^{c}±0.47	66.73^{b}±0.57	*
Static motility	7.84^{c}±0.74	18.7^{a}±0.46	12.36^{b}±1.64	*

*=significant at 1% level

Table 4: Motility parameter (Mean± SE) of buffalo spermatozoa based on freezing stage

Parameter	**Fresh**	**Pre freeze**	**Post thaw**	Level of significance
Total motility	86.40^{a}±1.26	83.90^{a}±1.26	50.70^{b}±1.08	*
Progressive motility	68.99^{a}±1.77	66.87^{a}±1.78	40.48^{b}±1.06	*
Static motility	13.90^{b}±1.28	16.10^{b}±11.26	49.30^{a}±1.06	*
Slow motility	1.71^{c}±0.34	3.06^{b}±0.38	4.40^{a}±0.41	*

*=significant at 1% level

The frozen semen is now using for artificial insemination. Average conception rate was found 62.17% for RCC, 52.19% for MC and 58.33% for BCB 1. Murrah and Nili Ravi semen is using in Buffalo Research farm of BLRI with average conception rate of 61.3% of Murrah and 62.3% for Nili Ravi respectively. Till date 17500 doses of RCC, 1200 doses of BCB1, 2500 doses of MC, 620 doses of Murrah, 672 doses of Nili Ravi, 650 dose of indigenous, 650 doses of Murrah Cross and 350 doses of Nili Ravi cross frozen semen was prepared and stored. Semen bank with valuable graded germplasm of BLRI was developed that need to maintain properly for conservation and subsequent future use.

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

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Ensiling usually takes place with the help of epiphytic lactic acid bacteria (LAB). The composition and concentration of epiphytic LAB may varied by many factors. Selective microbial inoculants may help to accelerate fermentation at initial stage to reduce pH sharply and thereby preserved forage nutrients. Hence, silage inoculant is very much important for commercial silage producers. In feed-out phase, silage is quickly decomposed, initiated by the growth of yeast (lactic acid eater), followed by increasing temperature and growth of mold. Some hetero-fermentative bacteria were found to be effective to increase aerobic stability of silages in many folds, e.g., *Lactobacillus buchneri* .Consequently, It may be opened-up an opportunity to incorporate silage in Total Mixed Ration (TMR) and silage commercialization. Considering these facts objectives of the research is developing microbial inoculant for ensiling fodder, test the efficacy of developed inoculant in fodder preservation, evaluate the growth and production performances of dairy cows fed silages ensiled with bacterial inoculant.

For that purpose, in previous year isolation, identification and characterization (Biochemical & molecular) of potential bacterial inoculum were done. Following gene sequencing results 21 bacterial strains were identified that was collected from different sources. Among them *Lactobacillus fermentum* and *Bacillus subtilis* were found potential for silage preparation. Hence, these two bacteria were selected for testing efficacy of silage preparation. For this purpose liquid inoculum was prepared contained minimum bacterial cell concentration of 10^8 CFU/ml and was applied at 2 ml per kg chopped Napier. A total 80 (Eighty) laboratory mini silo's were prepared and ensiling was conducted according to experimental design (Table.1). The ensiling processes were carried out for 1, 3, 7, 21 and 45 days at room temperature. LAB was enumerated by culturing bacteria on DeMan, Rogosa and Sharpe (MRS) agar media, while Potato Dextrose Agar (PDA) was used for yeast and mold. Moreover, silage quality was analyzed by proximate analysis, pH and NH_3-N contain.

Table 1: Experimental Design

Items	Treatment			
Treatments	Control	LF	BS	Combo
Replications	4	4	4	4
Ensiling periods	1, 3, 7, 21 and 45 days			

After data analysis it was observed that there was no significant effect of microbial inoculum and on silage quality however keeping quality of silage was increased by introducing microbial inoculant. It may be concluded that, isolated *Lactobacillus fermentum* and *Bacillus subtilis* are not suitable for silage inoculant. Other, potential microbes had to find out for suitable microbial inoculant.

Table2. Effects of silage inoculation on fermentation characteristics of silage (at 45 days)

Parameter	Control	LF	BS	Combo	SEM	Sig.
pH	4.63	4.5	4.65	4.65	0.105	NS
NH_3-N mg/100g)	1.77	2.21	2.52	2.36	0.675	NS
LAB ($\log_{10}$ CFU/g)	6.17	6.2	6.27	6.17	0.298	NS
Yeast ($\log_{10}$ CFU/g)	6.1	5.2	5.4	5.8	0.472	NS
Mold ($\log_{10}$ CFU/g)	-	-	-	-	-	NS

- LF, *Lactobacillus fermentum;* BS, *Bacillus subtilis;* Combo, LF+BS; SEM, Standard Error Mean; LAB, Lactic acid bacteria

Recycling of poultry wastes for environment friendly low cost poultry production

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Executive Summary

In Bangladesh, Commercial poultry industry is growing rapidly and annual growth rate of chicken population is 5.3 percent (GOB, 2010). The total poultry population in Bangladesh is 365.85 million (DLS, 2020-21). The total number of commercial poultry farms is 65-70 thousand and around one crore 70 lakh lakh Day old chicks (DOC) produced each week in Bangladesh (WPSA-BB,2021). Slaughterhouse wastes from poultry processing include processing water and organic solid by-products. Inedible parts approximately account for 28% of the live weight of a broiler chicken. Thus, a typical processing plant slaughtering 200,000 broilers per day with a mean live weight of 2.3 kg will produce 127 MT of offal (ARY. Boushy, and AFB. Poel, 2000). The slaughter house by product which include feather, viscera and other inedible carcasses are mainly processed by rendering to produce 300.000 tons of poultry feed ingredient. On the other hand, the poultry industry produces large amounts of hatchery waste which includes solid waste and wastewater. The solid hatchery waste comprises empty shells, infertile eggs, dead embryos, late hatchings and dead chickens and a viscous liquid from eggs and decaying tissue. Total amount of poultry processing wastes is 20 million MT and hatchery wastes production is 108.13 lakh kg in Bangladesh per year (Sarker *et.al*, 2017). Poultry dressing and hatchery waste disposal is one of the major problems facing poultry industry. Efficient utilization of by-products has direct impact on the economy and environmental pollution (Jayathilakan et al., 2012). The objectives of the present study were to find out the amount and nutritive value of poultry dressing and hatchery waste.

Table 1: Analytical value of nutritional parameters of poultry offal meal

Parameters	Mean	±SD
Dry Matter (DM)	87.48	0.88
Moisture	12.52	0.88
Crude Protein (CP)	62.67	2.09
Crude Fiber (CF)	0.90	0.27
Ether Extract (EE)	7.04	0.99
Ash	8.46	1.36

DM-Dry matter, CP-Crude protein, CF-Crude Fiber

Approximately 3.5 metric ton poultry dressing waste and 1.95 metric ton poultry hatchery wastes is produced at BLRI per year. Poultry offal was collected from poultry processing plant and poultry hatchery wastes was collected from poultry hatchery of Bangladesh Livestock Research institute (BLRI). After collection poultry offal was washed with clean water and then cooked in warm water for 5 minutes and dried in the sun. After drying the sample was grinded in fine powder. During processing of whole hatchery wastes, the sample was autoclaved at 125◦c for 20 min and then cooked hatchery waste was crushed and sun dried for reducing moisture content. After that the sample was dried in the oven at 70◦c for 1 hour and the dried waste was grinded. Mean of dry matter (DM), moisture, crude protein (CP), crude fiber (CF), ether extract (EE), ash of offal meal was 87.48, 12.52, 62.67, 0.90, 7.04 & 8.46 respectively (Table 1) and mean of dry matter (DM), moisture, crude protein (CP), crude fiber (CF), ether extract (EE), ash of hatchery wastes meal was 93.79, 6.20, 55.82, 2.62, 25.80 & 18.3 respectively.

Table 2: Analytical value of nutritional parameters of poultry hatchery wastes meal

Parameters	Mean	±SD
Dry Matter (DM)	93.79	1.20
Moisture	6.20	1.20
Crude Protein (CP)	55.82	2.09
Crude Fiber (CF)	2.62	0.55
Ether Extract (EE)	25.80	3.73
Ash	18.3	0.75

DM-Dry matter, CP-Crude protein, CF-Crude Fiber

Poultry dressing and hatchery wastes can be developed into high protein feedstuffs or other value-added products after appropriate treatment for environmentally friendly low-cost poultry farming.

Session IV:

ANIMAL AND POULTRY DISEASES AND HEALTH

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

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Executive Summery

Avian Influenza is a highly contagious viral disease and it is causing tremendous economic losses to the poultry industries throughout the last decade. It is very difficult to control the disease because of its enormous number of serotypes and mutation nature. The virus is zoonotic in nature and easily mutates from LPAI to HPAI. Bangladesh contains wetlands of great biological diversity and is considered to be of international ecological importance due to the extensive migratory waterfowl population using these wetlands as its habitat. Bangladesh is within the Central Asian Flyway (CAF) of migratory birds providing roosting and feeding habitats on its resourceful wetlands, such as Tangua Haor, Hakaluki Haor, Baikka Beel, Sonadia Island, Nijuhm Dweep, and many more. The routes of the introduction of the virus are thought to include international commerce in the trade of poultry and poultry products, contaminated people and materials, illegal wildlife trading, pet trade and migratory birds. Multiple routes have probably been responsible for introductions, and perhaps within a single event, some species may have acted as reservoirs or bridge species may have been involved. Transmission risk factors also include commercial farms with low biosecurity and free-range duck flocks. Wild birds are natural hosts of Low Pathogenic Avian Influenza (LPAI) sub-types. However, the circulation of LPAI in domestic poultry can lead to mutations that cause poultry death. HPAI H5N1 appears to be rare in wild birds. In spite of this, there is some evidence that wild birds may play some role in moving the virus.

The research was conducted under two objectives- detection, isolation and molecular evolution of avian influenza viruses circulating in Bangladesh; and monitoring of avian influenza viruses from migratory birds. The research methodology was collection of oropharyngeal swab samples, confirmation of AIV by RT-PCR and serotyping of AIV; and isolation of AIV through 7 to 9 days embryonated chicken eggs from chickens of commercial layer farm and migratory birds. The samples were collected from two highly poultry populated districts named- Dhaka and Gazipur from 2020 to 2021. A total of 192 individual oropharyngeal swab samples were collected in virus transfer media (VTM) from 48 chickens of commercial layer farms of Gazipur, Dhamrai and Savar. Then a total of 55 fresh fecal samples were collected from migratory birds of BLRI Lake. A structured and validated questionnaire was developed and administered to the chicken farmers to record farmers' demographic information, followed by farm demography, biosecurity practices, and management practices. Samples were labeled and placed within an insulated ice-box and transferred to the National Reference Laboratory for Avian Influenza, Bangladesh Livestock Research Institute, Dhaka, and stored at -80 °C for testing. The magnetic bead-based RNA isolation technology was applied for RNA extraction from collected samples individually by using MagMAX™-96 AI/ND Viral RNA Isolation Kit (Applied Biosystems™, USA) in KingFisher™ Flex 96 well robot (Thermo Scientific™, USA) according to manufacturer protocol. The samples were screened first for the presence of M gene by RT-PCR test using reference primers and probes. Then M gene positive samples were further assessed for H5 and H9 sub-typing using specific primers and probes by RT-PCR test.

Totals of 7.8% (15/192) oropharyngeal swabs were found positive for avian influenza (AIV) M gene (Figure 1). We found 80% (25/80) AIV positive in clinically suspected chickens where 52% was H5N1 HPAI and 24% H9N2. In the fecal samples of migratory birds, only 2 samples were found AIV positive (Figure 1). We did not find any H7 and N6 subtypes from tested samples. Finally, 30 selected positive samples were grown into embryonated chicken eggs through the chorioallantoic

membrane route. The isolates were stored for further molecular characterization.

The results demonstrated that AIV is circulating in commercial chickens of selected areas. The migratory birds are carrying AIV that might be a potential risk factor for AIV spreading to the domestic Anseriformes. Further study of amino acids arrangement of the cleavage site of the HA molecule for the determination of HPAIV H5N1 and LPAIV H9N2 is suggested.

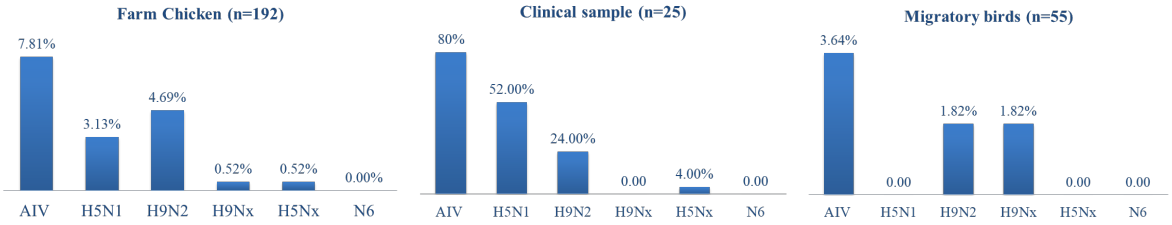

Figure 1. Prevalence of Avian influenza in collected samples of farm chickens (left image), clinical samples (middle image) and migratory birds (right image).

Monitoring and evaluation of Peste des Petits Ruminants (PPR) virus isolates circulating in Bangladesh

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Executive summery

Pestides Petits in Ruminants (PPR) is the most significant infectious endemic disease in small ruminants (Sheep and Goat) in the Indian subcontinent especially in Bangladesh which causes remarkable economic losses annually. This study was conducted during the period of July, 2020-June, 2021 aiming, to monitor the PPR control strategy in the selected areas of Bangladesh and to detect and characterize PPR virus from the recent outbreaks in Bangladesh and maintain the PPR virus repository at different number of passages. Blood sera were collected randomly from vaccinated goats flocks at different ages in the selected areas and tested with cELISA kit (ID.Vet, France) to assess the antibody against PPRV. For this purpose, a total of 650 goats were vaccinated by PPR vaccine at Elangi village under Gangni upazilla in Maherpur district and 394 serum samples were collected. Of the 394 serum samples, 114, 101, 93, and 86 were collected randomly at before vaccination and 28, 60, and 180 days of post-vaccination (DPV), respectively. Subsequently, the sero-surveillance was conducted by cELISA-based antibody tests. Additionally, outbreak investigation of PPR in goat was conducted throughout the country and a total of 45 and 21 nasal swabs (clinical cases of PPR) were collected from the outbreak areas of Savar and Dutch Dairy (Munshigong), respectively and then transported to the SAARC Regional Leading Diagnostic Laboratory for PPR and stored at –80ºC. The samples were processed and RNA was extracted using the protocol of RNA extraction kit (Invitrogen, Thermo Fisher scientific®, USA) and performed RT-PCR for the confirmation of PPRV targeting on N gene of PPRV, molecularly. Inoculam was prepared from swab samples according to the methods described in OIE, 2012 for the isolation of PPRV in primary lamb testicular cell (LTC). In sero-surveillance, the results showed that 29.82% (34/114), 88.11% (89/101), 82.79% (77/93) and 79.06% (68/86) samples were antibody positive to PPR disease respectively, at before vaccination and 28, 60, and 180 DPV. Molecular detection was confirmed by RT-PCR and found 68.07% (31/45) and 52.38% (11/21) samples were N gene positive respectively in Savar and Munshigong (Dutch Dairy). The expected PCR amplicon was appeared at 352-bp for N gene (Figure1).

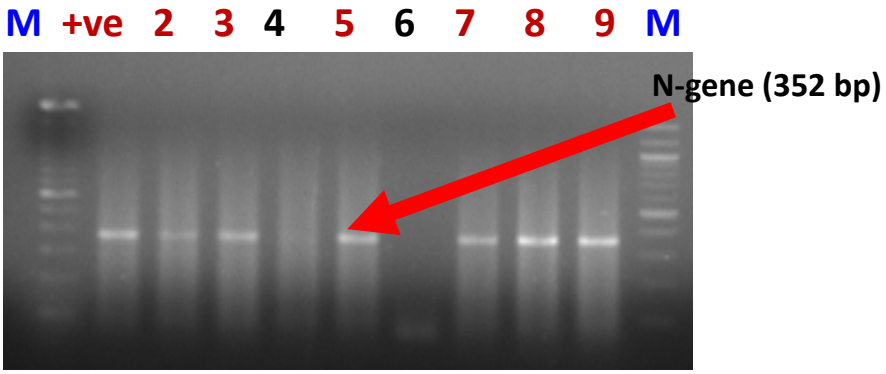

Fig.-1: Amplification of the portion of N gene (352bp) of PPR virus. Here, Lane M: 100 bp Marker; Lane 1: positive control, Lane 2-9 PPR suspected field samples.

Four RT-PCR positive samples were further confirmed as PPRV by gene sequencing (partial N gene) and performed phylogenetic analysis. In addition, primary lamb testicular cell was prepared and maintained at PPR laboratory for the isolation and propagation of PPRV from RT-PCR positive field samples. RT-PCR positive samples were inoculated (0.5 ml) into the confluent cell monolayer (Figure 2) of primary LTC and then observed cell cytopathic effect (CPE) regularly for up to 7 days. Then virus containing cell culture fluid was harvested after 7 days of post inoculation. For the isolation and propagation of PPRV at least three serial blind passages were conducted and harvested

virus containing cell culture fluid and then labelled. All the harvested samples were stored at -80ºC for further propagation and attenuation and for the virus repository at different passages.

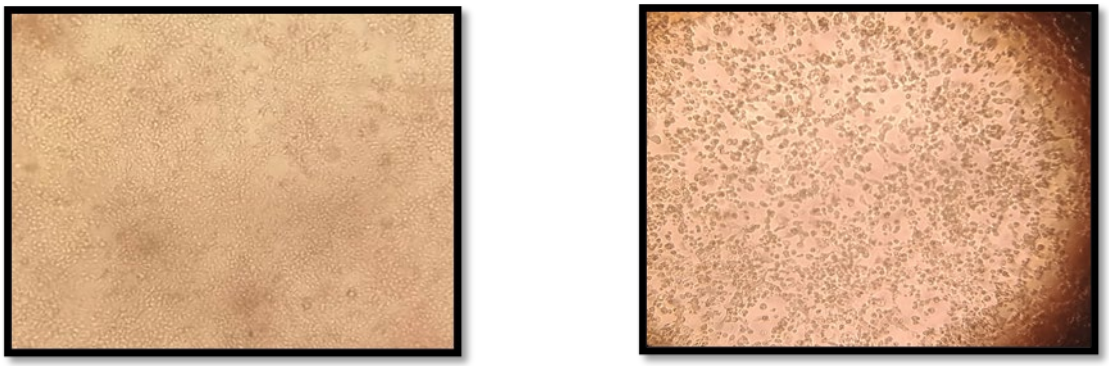

Fig 2: Confluent cell monolayer of LTC (left) and cytopathic effect on LTC at 7 days of post inoculation (right).

In our study, we found our four PPRV isolates have 100% identity to each other's and also high homology with viruses from Chinese and Indian variants of PPRV (Figure 2). In our study we also found that our circulating virus belongs to Lineage-iv. Therefore, it is presumed that Bangladeshi, Chinese and Indian isolates of PPRV may have a common ancestor. In addition, we found CPE at 3 days of post inoculation (dpi) and after 7 dpi almost all cells become round, detach and aggregation of intracytoplasmic or intranuclear aggregation, indicates CPE of PPRV in LTC. In conclusion, it can say that the current study will be helpful for the eradication program of PPR by 2030 to achieve SDG goal 2

Figure 3. Phylogenetic relationship of N gene of PPR virus. The tree was prepared using neighbor joining method. Red circle indicates our isolates.

Title: Phenotypic and genotypic profiling of antimicrobial resistance (AMR) in enteric bacterial communities in finisher livestock and poultry in Bangladesh
Sub title: Prevalence of vancomycin non-susceptible and multi-drug resistant enterococci in farmed animals and fresh retail meats in Bangladesh

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Executive Summery

Enterococci are Gram-positive bacteria belonging to the lactic acid bacterial group which consists of over 50 diverse species, and inhabit the gastrointestinal flora of humans and a wide variety of warm-blooded animals as well as insects. Over the past few decades, *Enterococcus* spp., particularly *Enterococcus faecium* and *Enterococcus faecalis,* have emerged as one of the most challenging healthcare associated pathogens, and is one of the three most common causes of nosocomial infections worldwide. Antimicrobial resistant enterococci have been observed in food animals and food of animal origin, such as poultry, duck, swine and cattle, which is an indication of fecal contamination; meat products are therefore at risk of becoming contaminated during the slaughtering process.

In Bangladesh, the prevalence and diversity of enterococci such as *E. faecalis* and *E. faecium* in livestock, poultry and animal origin food products are poorly defined. Furthermore, little is known about the antibiotic resistance and virulence genes harbored in these bacteria. To address this evidence gap, we have undertaken this study to determine the prevalence of enterococci in farm animals and retail meat, and explored their AMR patterns. *E. faecalis* and *E. faecium* were isolated and tested for susceptibility using a panel of eight antimicrobials important in human and veterinary medicine, and vancomycin resistant isolates were further screened for the presence of virulence genes.

A total of 352 samples were collected from selected farms and at retail markets of Savar, Gazipur, and Dhaka from 2016 to 2017. The sampling frame for the farm component constituted poultry (n=136), cattle (n=35), goat (n=29) and camel (n=30). All samples were processed using routine bacterial culture for enterococci as per standard protocols stated by Kuiken et al. 2005. Final confirmation of species identification was done for one or two selected pure isolates for each primary positive sample, using u-PCR I and m-PCR I based on enterococci specific *sod*A gene.

Kirby-Bauer disk diffusion assay was performed according to Clinical and Laboratory Standards Institute standards M02-A12 and M07-A10. Quality control strain *E. faecalis* ATCC 29212 was used as control for antimicrobial susceptibility testing. *E. faecalis* and *E. faecium* isolates were susceptibility tested using a panel of eight antimicrobials commonly used in veterinary and human medicine belong to phenicols. The presence of the vancomycin resistance genes *van*A, *van*B, *van*C_1 and *van*C_2/C_3 were determined using a multiplex PCR (m-PCR II) according to previously published protocol.

A total of 211 *Enterococcus spp*. comprising 115 (105 single and 10 co-isolation) *E. faecalis*, 36 (26 single and 10 co-isolation) *E. faecium* and 60 enterococci not assigned to a species by PCR were isolated from 352 collected samples. The overall prevalence of *Enterococcus spp*. was 57% (95%, CI 52-62). In poultry, farm samples yielded the significantly higher recovery of enterococci ($p < 0.05$) compared to poultry meat samples of retail markets. Conversely, for livestock a greater the proportion of meat samples was positive for enterococci compared to fecal samples. In case of samples collected on farm, a significantly greater proportion of poultry isolates were culture positive for *E. faecalis* compared to livestock, however, retail livestock meat carried a greater proportion of *E. faecalis* than poultry meat.

A high prevalence of VNSE (44%) was observed in both farm (41%) and meat (52%) isolates, in addition, resistance level was also noteworthy for tetracycline (74%) and erythromycin (65%).

Moreover, twenty isolates (17%) were resistant to linezolid which includes 14 and 6 isolates from farm and meat respectively. MDR was observed in 80% of the isolates with a similar proportion for both *E. faecalis* (79%) and *E. faecium* (81%). One *E. faecium* isolate and seven *E. faecalis* isolates were possible-XDR, having resistance to ≥7 antibiotic classes. Almost all the *E. faecalis* and *E. faecium* from poultry, including poultry farms (n=57/60) and poultry meat (n=9/9) were MDR. The full antibiotic resistance patterns and profiles towards the eight antimicrobials tested is presented in Figure 1

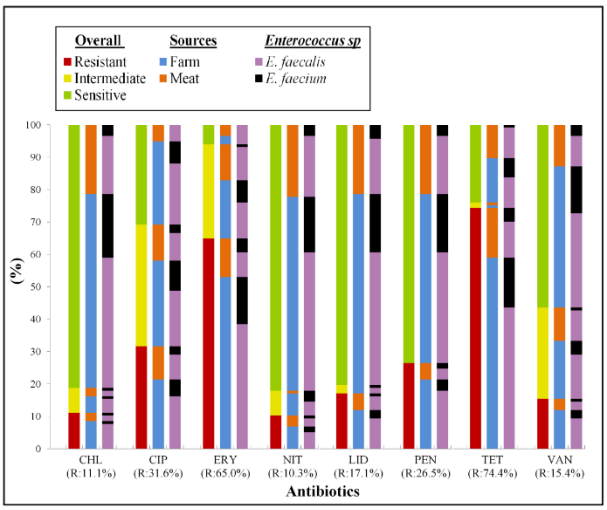

Figure 1: Overall antimicrobial resistance of *Enterococci* isolates against each antibiotic:

A total of 51 VNSE isolates were further characterized to determine the presence of vancomycin resistance genes. Twenty isolates were PCR positive for at least one vancomycin resistance gene, of which nine isolates were phenotypically resistant to vancomycin. Nonetheless, eleven isolates harbored at least one vancomycin resistance gene without being phenotypically resistant, though these were vancomycin non sensitive. The most commonly detected vancomycin resistance genes were vanA and vanC2/3. The 51 VNSE isolates were also tested for the presence of ten virulence factors. The gelatinase gene (gelE) was observed in 79% isolates (42), aggregation factor (asa1) in 38% isolates (20), and the sex pheromones (cpd) in 66% isolates (35).

A high prevalence of VNSE (44%; n=51) has been observed in this study which is higher than some other studies. Nonetheless, the most alarming finding was the co-occurrence of linezolid resistance and VNSE, where most linezolid (90%) resistant isolates were VNSE, which could drive a therapeutic crisis for treating infection caused by VNSE. In addition, this study detected low susceptibility of isolates to antimicrobials that are concurrently being used for both human infection and animal production in Bangladesh. In our study, the frequency of resistance to tetracyclines and macrolides was relatively high whereas comparatively low resistance was observed to DNA synthesis inhibitors including nitrofurantoin (10%) and ciprofloxacin (31%), which are consistent with similar studies conducted elsewhere.

MDR prevalence was high in farm and in fresh meat sold at retail markets (i.e. products originating from the same geographical locations where they were raised) and most of the VNSE isolates were also MDR (92%, 47/51). Remarkably, isolates that were possible-XDR were mostly recovered from poultry farms, this also raises the potential public health concern of exposure to and consumption of products from this species. These findings may be reflective of the indiscriminate use of antimicrobials in poultry in Bangladesh, notably, the high use of CIAs and thus support the need for surveillance of AMR and monitoring of AMU to inform changes in usage policy and to better understand AMR and AMU relationships. The comparative pairwise antibiotic resistance matrix reveals that the combination between chloramphenicol or ciprofloxacin with nitrofuratoin, linezolid or vancomycin may produce better efficiency against multidrug resistant isolates as combined resistance level to those antibiotics is very low compared to the other antibiotics. These findings warrant further research.

Project title: Identification of major goat health problems and their mitigation in different agro-ecological zones of Bangladesh

Subtitle: Molecular characterization of contagious ecthyma virus from goats

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Executive Summary

Contagious ecthyma (CE) also known as contagious pustular dermatitis, sore mouth, or orf, is an acute dermatitis of sheep/goats caused by a member of the *Parapoxvirus* genus. CE is a highly contagious and zoonotic viral disease of goats and sheep caused by contagious ecthyma virus (CEV) under the family Poxviridae. Vaccination is the eminent method for the control of CE in goats and sheep but still we are not using any vaccine for the control of this disease due to lack of vaccine. Additionally, there are very limited study on molecular detection, isolation, and adaptation of CEV. To effectively control of this disease, there is a need for the production of effective CE viral vaccine from the circulating current isolates. As a consequence, the present study was carried out, to isolate, identify and characterize the circulating CEV from CE suspected animals from fields and organized farms. The study was conducted with the samples collected from typical lesions (scab formation in mouth and gum) of CE suspected goats and sheep during the period of July 2020 to June 2021. During this study, a total of 100 CE suspected samples were collected from different regions of Bangladesh. Of the 100 samples, 30, 15, 20, 10, 10 and 15 were collected from Savar, Rajshahi, Nikhonchori, Meherpur, Mymensingh and Chuadanga respectively and transported to Animal Health Research Laboratory (AHRL), BLRI. Subsequently, the collected samples were processed and DNA was extracted using the protocol of DNA extraction kit (Monarch®, USA). Polymerase chain reaction (PCR) was performed for the amplification of the VIR genes of CEV (OIE, 2012). Two PCR positive samples of CEV were used for characterization by gene sequencing (VIR genes) and performed phylogenetic analysis. Inoculum were prepared from PCR positive samples according to the method described in OIE (2012) and, then 0.5 ml were inoculated into primary lamb testicular cell (LTC) thrice for the propagation and isolation of CEV, at each time virus containing cell were harvested (three times freezing and thawing) and used for next inoculation.

Out of 100 CEV suspected samples, 57% (57/100) were found positive (Fig: 1) by PCR targeting VIR gene, on the other hand 50%, 66.6%, 60%, 50%, 70% and 53.3% were found positive in Savar, Rajshahi, Nikhonchori, Meherpur, Mymensingh and in Chuadanga, respectively (Table-1). Two samples (BLRI-CEV S1 and S3) were further confirmed as CEV by gene sequencing and our two confirmed CEV isolates have 100% homology to each other's and our circulating isolates is closely related with some Indian variant of CEV (Fig; 2). Therefore, it is presumed that Bangladeshi and Indian isolates of CEV may have a common ancestor. In addition, we found cytopathic effect (CPE) at 3 days of post inoculation (dpi) in LTC. CPE is comprised of rounding and detaching of cell and also intracytoplasmic or intranuclear aggregation. At 7 dpi (all most all cells become round and detach) virus containing cell was harvested and stored at -80^{0}C for further propagation and attenuation.

Table-1. Prevalence of CEV from suspected field sample.

Location	No. of samples tested	Positive samples	Prevalence
Savar	30	15	50%
Rajshahi	15	10	66.6%
Nikhonchori	20	12	60%
Meherpur	10	5	50%
Mymensingh	10	7	70%
Chuadanga	15	8	53.3%
Total	**100**	**57**	**57%**

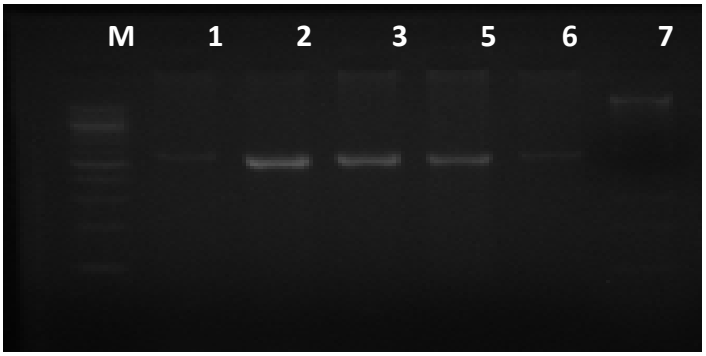

Figure:1 Amplifications of VIR gene (549bp) of contagious ecthyma virus. Here, Lane M: 100 bp Marker; Lane 1-6 contagious ecthyma suspected field samples.

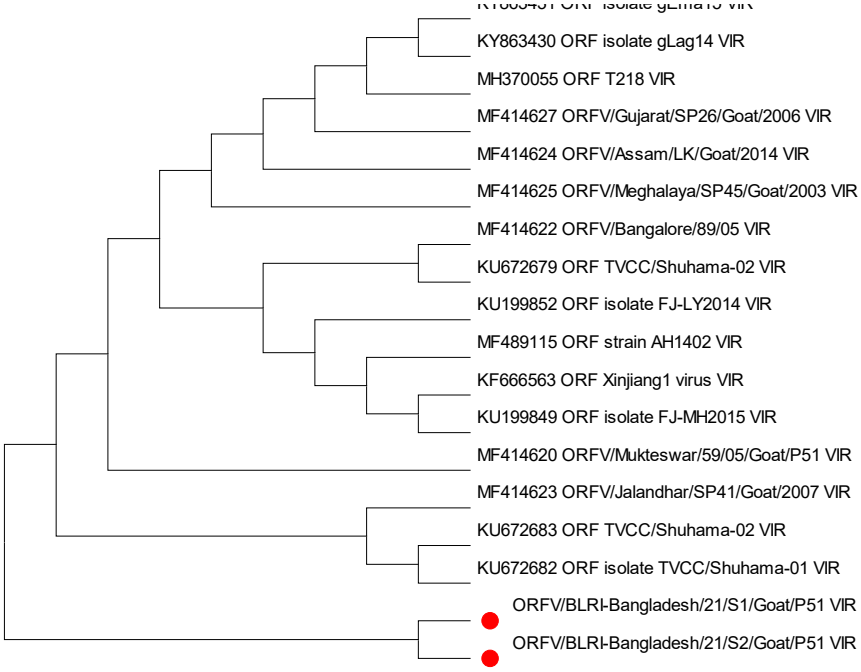

Figure 2. Phylogenetic relationship of VIR gene of contagious ecthyma virus. The tree was prepared using neighbor joining method. Red circle indicates our isolates.

Session V:

SOCIOECONOMICS AND FARMING SYSTEM RESEARCH

Development of Model village through BLRI Technologies at Dhamrai areas

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Executive Summary

The aim of the study was i) to disseminate BLRI developed most popular and commonly practiced livestock based information and technology to farmers level for increasing productivity ii) observe the impact of their interventions on socioeconomic status of farm families iii) identification of constraints facing during acquaintance with technologies and adaptation and finally iv) develop a Hub of improved animal, poultry and fodder germplasm. Keeping this in mind, a village namely Shorifbag was selected for a Technology village in Dhamrai Upazila of Dhaka District. The study has been ongoing at past three years where at 1st year was preliminary phase, at 2nd year was intervention phase and 3rd year was impact phase. The preliminary action such as field visit, participatory meeting of all stockholders, field survey, hands on training & group formation for technology demonstration, society formation with holistic approach, development of Livestock Service Providers (LSP) and Green helpline mobile service for emerging issue were done at 1st year and consistently research inputs supply, mass deworming, vitamin supply & vaccination programme and 17 technology demonstration, adoption & evaluation programme were conducted at 2nd year and continuously at 3rd year for developing a Technology village. To achieve the above mentioned objectives, a base line and an end line survey were conducted covering with 260 beneficiary farmers where 130 farmers in treatment group and 130 control group. The data was analyzed with descriptive analysis (Stata-16), a logistic regression model. The results so far obtained from the study revealed that the mean age of the farmers was 46 years, most of the farmers age was in 31 to 40 years of age. Among the respondents, 95% of them were male and 5% were female. Most of the Household (HHs) had 4-5 family members. Agriculture was the main occupation around 70% of the householdsfamily, 51% had a secondary level of education. Among the household about 63% had an annual income range between 2-5 lacs takaand 25% having more than 5 lacs taka. In livestock rearing, 54% of farmers had 11 to 20 year and 13% of farmers had more than 20 years' experience although they had no technological knowledge. The study found that, after introducing technological intervention, the number of cattle and poultry was found increased in the case of 65% household while it was 83.33% for sheep and goats. More than 80% farmers adopted Fodder production and preservation technologies and few farmers started to transfer those to others. More than 70% farmers adopted deworming and biosecurity technique for health management, but 91% farmers came to know about of community involving in poultry farm biosecurity model, yet to adopt it. Before intervention, the farmers did not know about when to use anthelmintic. But after all of them did it with the interval of 4 months. In case of vaccination, no clinical outbreaks against FMD, PPR, ND and Duck plague were found during this period and antibody level was protective level in ELISA report. However, antibody titre was 29.33% (n=230), 80% (n=195), and 94% (n=215) in cattle and 33% (n=30), 82% (n=30), and 96% (n=30) in goat and sheep at pre-vaccination, vaccination without anthelmintic and vaccination with anthelmintic respectively. Hence, 14% immunity was increased due to anthelmintic application before 7-14 days of vaccination. There was herd immunity developed against FMD, PPR, strong immunization against LSD and ND titre remained in BLRI model village. It can focus safe animal protein production through controlling circulation of infectious organisms. Previously, farmers bought vaccine from NGOs/medicine companies and their cost was between BDT 1000 -1550 per animal, but now, all of them take vaccine from DLS and now the cost is only BDT 20 only. Previously, they did not take any precaution of disease control but now, almost all of them (98%) are aware of these issues. Before starting model village based on BLRI developed most commonly technologies, farmers did not know about modern farm management practices but after getting intervention, they came to know about those. In case of using of "Khamer Guru Apps" for cattle farm management, 76% of them adopt and 22% shared their knowledge others. For online cattle marketing almost all farmers (98%) adapted to sell their cattle

during korbani ceremony. Number of livestock per household increased in treatment group than control group. There was 52.84%, 111.48%, 138.36% in treatment group and -18.49%, 1.08%, 27.72 in cattle, sheep and goat, and poultry in control group respectively. For feed supply to the animal or bird cases, before intervention, almost all farmers neither produced nor purchased the animal/bird feed but after intervention, more than 80% farmers produced and purchased feed for the well-being of their animal/birds. Before starting the model village, 95%' cattle were affected by different type of diseases and having very few numbers of animals due to farmers are more conscious about their animal/bird production scenario. For goat disease cases only 14% farmers faced that their goats were affected by any kind of disease. Only 14% farmers found that their birds were affected before and after, no farmers faced that their bird was affected by different disease incidence. It revealed that after the intervention in the village all production parameter in different animal/birds such as average milk production (Litter/day/animal) and lactation length (day) adult body wt. (Kg/Bird) average egg production was increased for all types of livestock and poultry,
After the intervention, household income increased largely from livestock farming (96%), followed by business (32%) and crop farming (27%). The study also found that after the intervention the expenditure of most of the farmers (80–90%) increased for all food and non-food items. After intervention, human capital improved regarding for education (23%) followed by health and sanitation (18%), Knowledge/Efficiency (18%) and training (17%), and no change occurred for access to information. In Social capital case, improved social prestige (21%), followed by women empowerment (17%), decision making ability, involved in social group/activities and self-managerial capability (14%), and political involvement (13%). Actually, it indicated social status in each cases improved slow and steady way. On the other hands, Natural capital was found in increased track especially for cultivable land (leased in/mortgage in) (23%), followed by cultivable land (own) (20%), Pond (9%), using open water access (7%). It was found that after intervention, open water access decreased (41%) and land use decreased by 15%. It may be due to the fact that farmers put their time and effort on livestock after the intervention. Physical capital increased especially for electric fan mobile phone and furniture. In Financial capital dimension, increased for cash in banks/savings and jewelry (31% and 37%), and at the same time, it also extremely decreased for both (31% and 48%) might be due to the fact that the respondents may have invested on livestock.

After intervention it was found that, the women's participation in animal and poultry rearing were improve much as per technological guideline. Farmers in studied area stated that the main problems that is faced are low prices of cattle/goat during marketing, lack of veterinarian support. But having different interventions may create availability of fodder, vaccination, deworming, overall good husbandry practices, online marketing that triggers overall production scenario at all. A video documentation was prepared based on all activities where was done in BLRI pojukti polli. In Community business model and entrepreneur development aspect we were started "Green Way Apps" for products marketing, milk marketing through community approach, two Fodder cutting supplier & TMR Entrepreneurs, seven sheep and goat new farm and one native chicken parent farm & hatchery was established at Dhamrai area. In case of control group, no farmers adapted any of the technologies. The control group farmers only had introduction with different grass production, only 5–10% knew about poultry rearing, farm management, women empowerment and awareness programme. Based on results, it stated that technology adaptation rate increased day by day, Farmers able to handling the situation using with community approach. BLRI developed model village as free from major diseases and source of safe protein for the people.

Consumers' preference and perception between broiler and indigenous chicken meat in Bangladesh

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Executive summary

Chicken is a vital source of meat as well as protein consumption. Globally consumers are increasingly attracted by chicken meat, but their tastes and preferences are determined by several factors related to food quality as well as the individual consumer's personality. Both increasing incomes and urbanization are leading to diversifying diets. Consumption of non-grains is growing faster and/or further in urban areas than in rural areas. As a result, chicken consumption is increasing for which poultry production is also increasing. This steadily increasing consumer preference for chicken meat is due to lower cost, increased convenience and ease of preparation as well as increased consumer awareness of health factors.

The objectives of the research are to find the consumer's preference for broiler and indigenous chicken, along with to examine the factors influence preferring broiler and indigenous chicken meat products. Besides, the study has also examined preference heterogeneity among consumers and their willingness to pay (WTP) for chicken meat traits.The study has been conducted on 748 respondents of different urban and peri-urban areas of Bangladesh where the areas are categorized as: Mega city (Dhaka city corporation, Gazipur city corporation), City corporations (Chittagong city corporation, Patia) and other urban areas (Mymensingh, Jamalpur) using stratified random sampling technique. A combination of descriptive and statistical techniques as demanded by the study was used to achieve the objectives and to get meaningful results. Preference scale and respondent's nutrition knowledge score were employed to assess the consumer's preference for indigenous chicken and broiler. Preference scale was developed an index with 13 questions. Each of the questioned had a level of preference scale where 1=strongly disagree, 2= disagree, 3=neutral, 4=agree, 5=strongly agree. Respondent's nutrition knowledge was measured by Mother's nutrition knowledge is a composite variable that is created using the response of ten different questions in a binary form. The principal component analysis was used to predict the continuous form of this nutrition knowledge score. Afterward, this nutrition knowledge was categorized using the quartile distribution method.

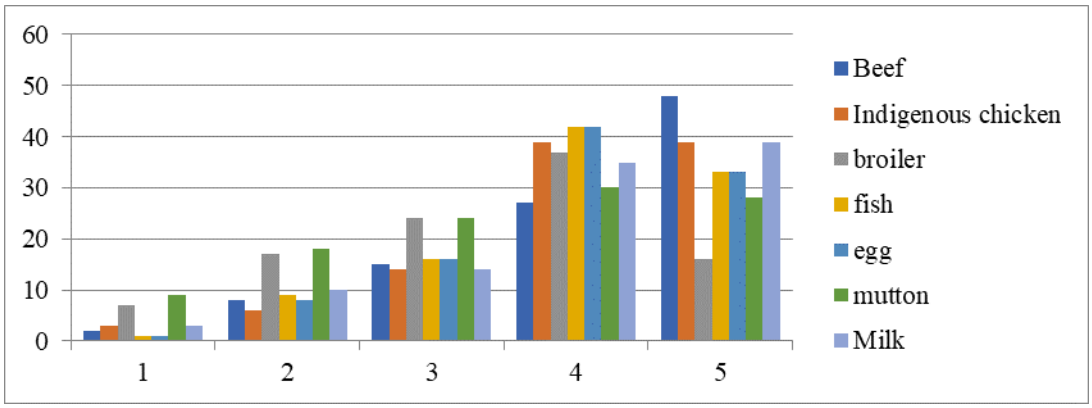

Figure 1: Preference scale of different sources of protein (1 is least and 5 is most preferred)

Our descriptive result shows that 56% of the consumers prefer indigenous chicken, 26% like broiler and 20% have no preference over one another, though people mostly consume broiler. It is evident from the study that consumers are mostly concerned with availability, children's liking, delicious taste, easy to cook, freshness, health, nutrition, price, safety, size, smell etc. and less concerned about plumage color, skin texture, age, tenderness of meat, texture of meat, fat content, color, package, childhood memory, animal welfare, attention to environment and biodiversity.

Most of the consumers like red colour meat, 21-28 weeks of chicken, female chicken, tender meat, low fat and fresh meat. A level of awareness index was created with 13 questions where consumers give least importance on "I care about knowing the source of indigenous chicken" and most

importance was given on "Indigenous chicken is rich in protein". People consume more broiler because of less price followed by less cooking time needed, liked by children, price stability, available in the dressed form, good taste, softness of meat etc. Consumers prefer indigenous chicken as they think that it is healthier than broiler and it has more natural content that means indigenous chicken doesn't contain artificial ingredients like preservatives.

About 98% of the respondents mentioned that the price of indigenous chicken is high and 94% think that price influenced their choice of indigenous chicken. The reasons for high price are: lower supply, high market demand, long rearing time etc. About 25% consumers think that the price of indigenous chicken meat would be<Tk 150, whereas, 55% and 20% think that price would be Tk. 150 – 200 and >Tk 200.

We have also constructed a nutrition knowledge index where we found among the respondents, 47%, 20% and 33% have lowest, medium and highest level of knowledge, respectively.

The statistical analysis shows that both types of chicken are more consumed in mega city than city corporations and other urban areas. Moreover, broiler consumption frequency is positively affected by education and negatively affected by concerned about food safety. On the other hand, indigenous chicken consumption frequency is positively affected by socioeconomic status, and concerned about safety; and negatively affected by nutrition knowledge and concerned about cooking time.

The study also found that consumers' WTP for indigenous chicken is positively influenced by nutrition knowledge, socioeconomic status, and when they are concerned about the sex of chicken, packaging and biodiversity; and negatively influenced by age of respondent and when they are more concerned about age of bird, tenderness of meat and its' naturalness. Binomial logistic regression was conducted to measure the 'factors affecting consumer preference of chicken'. The result shows that, when the nutrition knowledge of consumer upgrades, they are more likely to consume chicken. The more aged and respondents of all professions are more likely to take indigenous chicken. When the consumer is concerned about the tenderness, size, smell and age of chicken, then they prefer indigenous chicken. When the consumer is concerned about the cooking time, then they prefer broiler than indigenous chicken.

Consumers are mostly concerned with price, children's liking, delicious taste, easy to cook, freshness, health, nutrition, safety, size, smell etc. and less concerned about age, tenderness and texture of meat, fat content, animal welfare and environmental factors. The study also found that consumers' willingness to pay for indigenous chicken is positively influenced by nutrition knowledge, and socioeconomic status, and negatively influenced by age of respondent. Based on the findings, the study recommends exploring the species of attributes with indigenous type chicken but with less price, that may also need less cooking time.

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

Sub-title: Impact study of supplementation for the up-scaling livelihood of the rural poor farmers by rearing Red Chittagong Cattle

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Executive summary

Livestock is the living bank for many farmers and has a critical role in the intensification of agriculture through the provision of draught power and manure for fertilizer and fuel. They are also closely linked to the social and cultural lives of millions of resource-poor farmers for whom animal ownership ensures varying degrees of sustainable farming and economic stability. In densely populated Bangladesh, cattle fulfill multiple roles in generating income and ensuring food security. Income generation and livelihood improvement of the poor people through cattle rearing have great potential in the country. Considering the fact the current research was conducted to develop a sustainable model for up-scaling the livelihood of poor farmers by rearing Red Chittagong Cattle.

To achieve the objective a baseline survey was conducted in 4 selected Upazillas' and data on their socioeconomic status were collected through a standard questioner. After that, some inputs like RCC semen, vaccine, medicine, and treatment were continuously provided to RCC rearing farmers and impact of supplement was evaluated through questionyer. Data was collected from RCC rearing farmers and analyzed descriptively using SPSS 20.0 software.

From the study, it was observed that 68.9% of respondents were household heads and among all respondents, male and female were 84.7% and 14.9%, respectively. The main occupation of the respondent was agriculture (67.6%) and 82.0% family had only one earning member. Management practices in RCC rearing like regular bathing (before vs after= 21.2% vs 68.5%), supply of clean water (before vs after=60.8% vs 98.6%), regular cleaning and hygienic management (before vs after= 58.10 vs 83.3%) improved remarkably. Semi-pakka (before vs after= 5.90% vs 31.50%) and full tin (before vs after = 44.60% vs 53.20) housing for cattle were also increased. Most of the farmers reared cattle for dairy purpose (before vs after = 49.5% vs 47.7%) followed by both types (Dairy & fattening) (before vs after = 20.7% vs 22.5%). However, in the cattle rearing system, farmers shifted full grazing (before vs after = 37.4% vs 5.0%) to half grazing (before vs after = 41.4%vs 76.6%) system and the feeding system shifted extensive (beforevs after = 41.9%vs 4.5%) to semi-intensive (before vs after = 45.5% vs 87.4%) system. Moreover, deworming (before vs after =42.8% vs 99.5%) and vaccination (before vs after= 25.2% vs 99.1%) practices were improved remarkably compare to before. Farmers` interest was increased for cultivating fodder (before vs after = 5.4% vs 19.4%) for RCC rearing. The average annual incme (before vs after =BDT 38566.6 vs BDT 51326.4) from RCC cattle rearing improved significantly ($p<0.05$). Furthermore, The average annual income (before vs after =BDT 103900.0 vs BDT 136133.1), expenditure (before vs after =BDT 101296.03 vs BDT 124816.1) and savings (before vs after =BDT 2604.0 vs BDT 11316.9) were also imporeved significantly ($p<0.05$) (Figure-1 & 2). Livelihood assets of RCC farmers were also increased. Health and sanitation condition, education, knowledge/efficiency, information access ability, self-managerial capability, social prestige, decision making ability, women empowerment some physical and financial assets were also increased. Hence, scientific RCC rearing may up-scale the income and livelihoods of poor farmers in Bangladesh.

Figure-1: Annual household income from different income-generating activities

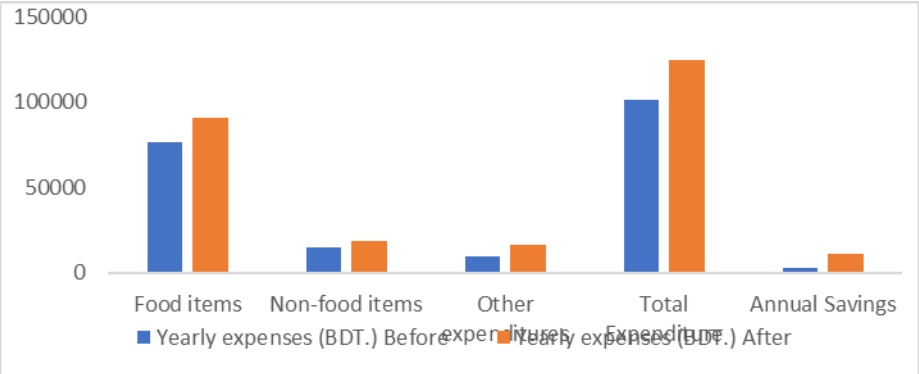

Figure-2: Annual expenditure and savings of the farmer

POSTER SESSION

Evaluation of Moringa (Sajna) Feed for Livestock Production

Yield and Growth Performance of Exotic variety of Moringa and its Comparison with Local Variety

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Executive Summary

Being a livestock concentrated country still, Bangladesh is facing a huge feed crisis rather than her demand accounting 40-45% roughage and 80-85% concentrate. Some obstacles like land shortage to cultivate fodder, spending money to import feed ingredients, lack of proper knowledge about animal requirement calculation, etc are potential reason remaining behind this situation. So alternative potential feed resource hunting could be a promising solution to improve sustainable livestock production. Considering this issue BLRI is working on deriving the magical potentiality of local, white and black seed Moringa as livestock feed since 2014 as Moringa, a multi-purpose tree (MPTS) has already gained a lot of publicity because of its multi-dimensional use like medicinal applications, industrial use, animal and public health and finally nutrition. The present study was designed depending on the outstanding response of Moringa to dairy and beef animal productivity aiming to introduce exotic variety of Moringa and quantification of their germination rate and biomass production; to determine the effect of plant density and cutting interval on biomass production and their nutritional value. This experiment was carried out at Cattle Research Farm, Bangladesh Livestock Research Institute, Savar, Dhaka. A total of four varieties of *M. oleifera* namely PKM-1, PKM-2, Paraynal, and Black were used in this experiment of which PKM-1, PKM-2, and Paraynal were imported from India, and Black seeds were collected locally from previously cultivated BLRI plots. For germination purpose total 4120 seeds were used where number of seed was 1030 for each variety. The 15 ×15 cm polybags were used for seed seedling growth and establishment. For determining biomass yield of four different variety at different plant density an experiment was designed in RCBD having 16 treatment combinations comprising four variety marked as V1=PKM-1, V2=PKM-2, V3=Paraynal, and V4=Black. Besides that, four spacing was used in this study as D1=1×1 feet spacing, D2=1×1.5 feet spacing, D3=2×2 feet spacing, and D4=1.5×1.5 feet spacing. The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. Total land was divided into four blocks; each block was again divided into sixteen experimental sub-plots. The size of each plot was 8×8 feet.

For data recording, total five plants from each plot were randomly selected and tagged. The cultivated *M. oleifera* seedlings were allowed to grow for 180 days while monitoring growth and development. Some morphological parameter like plant height, number of leaves, and stem girth was collected at each 40 days interval at 180, 220 and 260 Days of Transplanting (DAT).All the generated data were subjected to analysis of variance (ANOVA) and tested for significance by Least Significant Difference (LSD) using R-3.5.1 software (R Core Team, 2013). Results revealed that, highest germination rate was found with PKM-1 variety 83.98% followed by Perennial 82.52%, PKM-2 81.17% and black 77.09%.

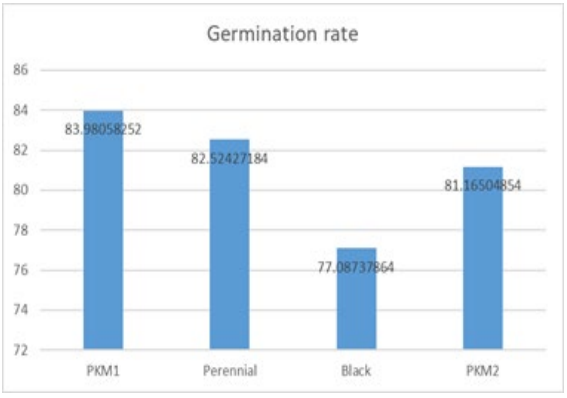


Figure 1: Effect of variety germination rate of Moringa

Figure 2 represents the biomass yield of 4 different Moringa varieties at different plant density and at three different ages of harvesting (180 DAT, 220 DAT and 260 DAT). At 180 days PKM-1 was best in performance (47.88 t/ha) at 1×1 feet (T1) followed by remaining three (3) variety and density. Inter plant density treatment 2×2 performed low irrespective of all varieties. Same trend of performance was observed at 220 and 260 DAT also. Corelation between plant spacing on growth parameter was analyzed where a negative significant correlation was found between planting space and biomass yield of Moringa at 180 DAT (r=-.536**), 220 DAT (r= - 584**) and 260 DAT (r= -.258**).On other hand negatively week relationship was found between plant spacing and crude protein and dry mater. Chemical component specifically crude protein of Moringa was found significantly different due to different plant to plant spacing among different varieties at different sampling DATs (Table 2).

Table 2: Effect of variety and spacing on plant height (cm) of *M. oleifera* at different DATs

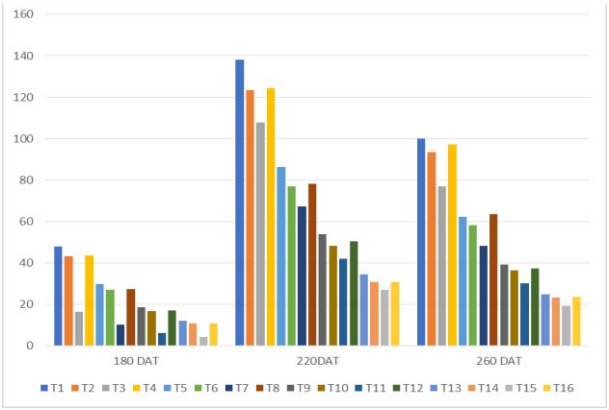
Treatment	180 DAT	220DAT	260 DAT
T1	18.950abc	16.720de	17.163def
T2	19.335ab	19.350a	19.185a
T3	19.305ab	17.100cd	17.343bcdef
T4	19.428ab	16.705de	16.970f
T5	18.455c	16.663de	16.827f
T6	19.458ab	17.300cd	17.128ef
T7	17.425d	17.097cd	17.215cdef
T8	14.605f	17.810bc	17.848bcd
T9	17.620d	16.110ef	16.793f
T10	16.325e	17.770c	17.765bcde
T11	17.502d	19.525a	19.865a
T12	18.888bc	18.705ab	19.203a
T13	17.298d	17.218cd	17.935b
T14	16.570e	15.623f	16.078g
T15	19.595a	17.055cd	17.893bc
T16	19.420ab	17.545cd	17.915bc
LSD	0.6629	0.9116	0.7118
CV%	1.43	2.05	1.57
Sig.	**	**	**

Table 1. Correlation between planting spacing and growths

Relationship between	Different cutting interval		
	180 DAT	220 DAT	260 DAT
Different planting distances (feet) and			
Plant height (cm)	-.594**	-.605**	.055
No. of leaves/plant	-.268*	-.409**	.193
Stem girth (cm)	-.564**	-.485**	-.197
Survival rate	.027	-.009	-.030
Biomass	-.536**	-.584**	-.258**
Dry mater	-.010	-.232	-.271*
Crude protein	-.236	-.106	.058

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Figure 2: Effect of variety and spacing on Biomass of Moringa different measurement date



T1= PKM-1 (1×1 feet); T2= PKM-2 (1×1 feet); T3= Paraynal (1×1 feet); T4= Black (1×1 feet); T5= PKM-1 (1×1.5 feet); T6= PKM-2 (1×1.5 feet); T7= Paraynal (1×1.5 feet); T8= Black (1×1.5 feet); T9= PKM-1 (1.5×1.5 feet); T10= PKM-2 (1.5×1.5 feet); T11= Parayn Paraynal (1.5×1.5 feet); T12= Black (1.5×1.5 feet); T13= PKM-1 (2×12 feet); T14= PKM-2 (2×2 feet); T15= Paraynal (2×2 feet); T16= Black (2×2 feet). Different alphabetical letters within the same column indicate significant differences among various treatments according to a least significant

It can be concluded that, from apparent view PKM-1 performed best in terms of vegetative growth and production quality and quantity. But the growth of local variety Black is almost similar PKM-1. Furthermore study is required to draw a specific conclusion.

Project title: Collection, conservation, multiplication of high yielding fodder and evaluation of their production performances under different climatic conditions
Sub-title: Biomass yield and quality of Maize sown alone and intercropped with cowpea at different row proportions

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Executive Summary

Forages are considered to be the most palatable, economical and nutritious animal feed resource for livestock particularly for dairy animals. Cereal forage Maize is the most used forage crop worldwide due to its many advantages such as high dry matter yield, high energy content, consistent-palatable feed, reduced total feed cost, rapid harvest and storability potential (Lempp *et al.,* 2000), although, its low crude protein content may play a limitation on its use (Oliveira *et al.,* 2017). Forage legume Cowpea is a rich source of plant protein but their forage yield only half in comparison with cereal forages (Iqbal *et al*., 2015). The concept of intercropping is to get increased total productivity per unit area and time besides equitable and judicious utilization of land resources and farming inputs (Marer *et al*., 2007). Intercropping legumes contribute to increased productivity of other crops when incorporated into cropping systems as intercrops (Giller and Wilson, 1991). Maize-legume intercropping is currently receiving global attention because of its prime importance in world agriculture. Cereal-legume intercropping can provide good nutrition to livestock with higher forage yields, when grown in association. Further, it may also be beneficial for improving the fertility status of the soil. Hence, the present experiment was designed to determine the effect of different row ratio on biomass yield and quality attributes of cowpea and maize and the influence of various plant patterns on different intercropping indices.

This field experiment was conducted during the *kharif* season (May to August of 2021) at Fodder Research Field of Bangladesh Livestock Research Institute, Savar, Dhaka. Hybrid maize (*Zea mays* L) variety Pacific-11, Advanta (marketed by BRAC, Bangladesh) and Cowpea (*Vigna unguiculata* L) variety local (black seed) were used in the study. The experiment was laid out in randomized complete block design (RCBD) consisting of 6 treatments [sole maize, sole cowpea, maize + cowpea intercropping each with 1:1 (M_1C_1), 1:2 (M_1C_2), 2:1 (M_2C_1), 2:2 (M_2C_2) row ratio]. It has three replications and a net plot size is 6m×5m with 11 rows in each plot. For this experiment, the density of maize and cowpea are expressed, sole crop densities being 13 and 20 plant m^{-2} maize and cowpea. However, the seed rate of maize and cowpea was applied at the rate 43 and 20 kg ha^{-1} respectively. The experimental plot size was 30 m^2 with 1m alley and 1m between plots. Maize and cowpea were sown by hand. Inter-row spacing was 17 and 9 cm in the sole crops of maize and cowpea were used with a between-row spacing of 30 cm. Normal cultural practice was followed uniformly for all experimental units. The plots were hand weeded in different vegetative stages. Irrigation was applied at fortnightly interval. Areas of 4m^2 from middle rows were hand harvested when the maize component reached milky doughy stage (forage harvested at 70 days of age). The data on yield, quality parameters, morphological characteristics and total land equivalent ratios (LER; as per Mead and Willey, 1980) were analyzed statistically in an ANOVA technique using SPSS, 20 computer software packages. Treatment means were compared using LSD test at 0.05 probability level.

Effect of row ratios on biomass yield, nutritive value and land equivalent ratio of maize intercropped with cowpea are presented in Table 1. The intercropped of maize and cowpea in different planting ratios significantly affected the quantitative and qualitative characters of the forage. The maximum ($p<0.05$) total green fodder (27.55 t ha^{-1}) and dry matter (4.63 t ha^{-1}) yield was obtained by sowing the maize alone than other intercropped fodder, while intercropping of maize with cowpea in 1:2 (M_1C_2) row ratio and mono crop cowpea yielded the lowest green fodder and dry matter, respectively. However, the total crude protein yield of crops was found to be significantly ($p<0.05$) highest (0.59 t ha^{-1}) with 2:2 (M_2C_2) row

ratio as compared to other intercrop patterns. Maize intercropped with cowpea in different row ratios vary significantly for the DM, OM, Ash, CP, ADF and NDF content (Table1). The highest ($p<0.01$) DM (19.83%) content was recorded with 1:1 (M_1C_1) row ratio and the lowest was observed by cowpea sole cropping (13.57 %). The maximum ($p<0.001$) crude protein was found in sole cowpea (15.84%) followed by intercropping of maize with cowpea in 1:2 (M_1C_2) row ratio (14.33^{d} %). Maize sown alone produced minimum crude protein (9.77 %). Among different intercropping patterns, 2:2 row ratio of maize with cowpea recorded highest ($p<0.05$) land equivalent ratio (LER; 1.13) as compared to rest of the treatments. Hence, it can be stated that 2:2 row ratio of maize intercropped with cowpea will be most advantageous in terms of land utilization and profitability. Such results were also reported by Saban *et al.,* (2007), Dahmardeh *et al.*. (2010) and Jan *et al*., (2016). The morphological characteristics of intercropped fodder did not vary significantly ($p>0.05$) except plant height and leaf length of cowpea.

Table 1: Effect of row ratios on biomass yield, nutritive value and land equivalent ratio (LER) of maize intercropped with cowpea

Items	Panting pattern						SED	Level of sig.
	Maize sole	Cowpea sole	M_1C_1	M_1C_2	M_2C_1	M_2C_2		
				Biomass yield (t ha^{-1})				
Green forage	27.55^{a}	18.62^{cb}	21.61^{acd}	16.40^{bd}	21.83^{acd}	24.68^{ac}	1.36	*
Dry matter	4.67^{b}	2.56^{a}	4.26^{bc}	3.02^{ac}	3.99^{bc}	4.49^{bd}	0.24	*
CP yield	0.46^{ac}	0.40^{a}	0.54^{ac}	0.43^{ac}	0.52^{ac}	0.59^{bc}	0.03	*
				Chemical composition (%)				
DM, fresh	17.05^{a}	13.57^{b}	19.83^{c}	18.42^{ac}	18.20^{ac}	18.23^{ac}	0.44	**
OM	95.41^{a}	91.14^{b}	94.74^{ad}	92.66^{c}	94.49^{ad}	94.12^{d}	0.23	***
CP	9.77^{b}	15.84^{a}	12.88^{c}	14.33^{d}	13.12^{c}	13.11^{c}	0.12	***
ADF	44.51^{b}	54.69^{a}	52.26^{a}	51.70^{a}	53.19^{a}	54.37^{a}	0.86	**
NDF	75.39^{a}	59.43^{b}	70.91^{ac}	69.50^{c}	73.77^{ac}	73.39^{ac}	0.99	***
Ash	4.59^{a}	8.86^{b}	5.25^{ad}	7.34^{c}	5.51^{ad}	5.88^{d}	0.23	***
Leaf stem ratio	18.50: 81.50^{a}	47.67: 52.33^{b}	25.32: 74.68^{ac}	31.46: 68.54^{c}	26.76: 73.24^{ac}	27.47: 72.53^{ac}	1.84	***
				Partial land equivalent ratio(LER)				
Maize	1.0	-	0.36^{a}	0.17^{b}	0.41^{a}	0.42^{a}	0.02	**
Cowpea	-	1.0	0.63	0.63	0.57	0.71	0.04	NS
Total LER	1.0	1.0	0.99^{a}	0.80^{bc}	0.98^{ac}	1.13^{a}	0.04	*

***-significant at $p<0.001$; **-significant at ($p<0.01$); *-significant at ($p<0.05$); NS -significant at ($p>0.05$) means with different superscript differed significantly.

On the basis of these findings, it is concluded that, intercropping of maize with cowpea in 2:2 (M_2C_2) row ratio had highest crude protein yield (CPY) and land equivalent ratio (LER) than other planting patterns. Based on these fact, it can be recommended that, intercropping maize with cowpea, in a row proportions of 2:2 (M_2:C_2) were equally good, harvest more yields per unit area of land and significantly superior to rest of the systems.

Project title: Up-gradation and diversification of value addition technologies of livestock products & by-products

Sub-title: Production of canned beef using graded level of Kalojira oil ((*Nigella sativa*) as preservative

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Executive Summary

Beef is a highly concentrated source of biologically valuable proteins. It contains all amino acids that are essential for human health. It is an important source of vitamin B complex and vitamin A. Value added meat and meat products are getting popularized to Bangladeshi people day by day. People are moving forward to processed product due to increasing trend of work pressure outside the home irrespective of gender. The use of preservatives/antioxidant in beef to minimize oxidation, decelerated the formation of toxic oxidation and development of off-flavors, improve color stability, maintain nutritional quality and increase keeping quality. Kalojira (*Nigella sativa*) extract is a potential source of natural antioxidant and been reported to be a source of thyroquinone, carvacrol, t-anethole and 4-terpineol, flavonoids, phenolics, alkaloids, unsaturated fatty acids (linoleic acid and palmitic acid) etc which acts as good preservatives. From this aspect the present study was undertaken to determine the effect of graded level Kalojira oil as a preservative of canned beef.

For canning purpose, raw beef was purchased from local market and brought at meat processing laboratory of BLRI. The p^H of raw meat was measured immediate after collection. The pH of both raw & canned meat was recorded with a digital pH meter (Hanna; model no. HI2211-02) following the method of University of Nebraska-Lincoln (2005). The drip loss (%) and cook loss (%) of raw meat was measured following the method described by Joo *et al.* (1995) and Yang *et al.* (2006), respectively. The microbiological test viz, Total Viable Count (TVC), Total Coliform Count (TCC), presence or absence of *Salmonella spp.* and *Staphylococcus spp*. in both raw beef and canned beef were done at ARAC Laboratory of BLRI following the standard protocol. For the production of canned beef, raw beef was sliced with a knife in a standard size for filling the canning jar. Each jar was filled with about 200 g raw sliced beef where Kalojira oil at different level as 0.5%, 1.0% and 1.5% were added and treated as preservative groups. The seeds of Kalogira were purchased from local market and the oil extracted from seeds using oil extraction machine. However, raw beef without added any preservative kept as control group. The number of replications in each treatment groups including control were ten. Immediate after filling the beef and adding different level Kalojira oil in Poly propylene food grade jars, the self-sealing screw cap jar lid were sealed tightly. Then it was placed on cooking burner until boiling of water. Canning was performed at 240 ^{0}F under 10lb pressures for 75 minutes. After removing the jars from pressure canner machine, checked the jar properly for any leakage. Finally, the lids of all the jar was again sealed with induction sealer machine. However, all the jars were kept under ambient room temperature for a period of 150 days (5 Months). Canned beef at 150 days aged samples were collected for proximate analysis, microbial count and final recovery rate calculation. Sensory qualities of beef was judged by trained 7-member panel at 150 day of storage. Data on physical, chemical, sensory attributes and recovery rate of both raw beef and canned beef were compared statistically in an ANOVA of a Completely Randomized Design.

The physical, chemical and microbiological properties of raw beef used for canning purpose under this research, is presented in Table-1. It shows that the physical properties viz, p^H, drip and cook loss of fresh raw beef were 5.92, 10.01% and 23.83% respectively. The moisture content and crude protein content in raw beef were 75.65% and 18.76% respectively. The total viable bacteria count and Coliform count in fresh raw beef were 7.9×10^3 and 3.8×10^3 cfu/g (Table 1) respectively. Total bacterial load was higher in raw beef as meet were collected from local market. The effect of preservatives on physico-chemical, microbiological properties and recovery rate of canned beef is presented in Table 2. It shows that

following the level of Kalojira increased the pH value of canned beef gradually decreased significantly ($p<0.001$). However, pH of canned beef of 5 month ages was significantly ($p<0.001$) higher in T_0 (7.23) and lower in T_3 (6.10) group. Significant variation was observed in chemical composition and recovery rate of canned beef in using graded level of Kalojira oil as preservatives. The CP and OM content in canned beef of 5 month ages were significantly ($p<0.01$) higher in T_3 preservatives group than that of others. Losses during canning process was also differed significantly ($p<0.001$) and highest losses was observed in control group (2.92%) and no losses was observed in the group which was preserved with 1.5% (T_3 group) Kalojira oil. There was no TVC, TCC, Salmonella, E-coli and Streptococcus spp. in both T_2 & T_3 groups after 5 months of preservation (Table 2). The scores (Hidonic scoring system; 1-9 scale point) of sensory attributes (color, flavor, juiciness, tenderness, taste and chewiness) of beef treated with 1% Kalojira oil was in slightly like category and beef treated with 1.5% Kalojira oil was in moderately like category (Table 3). However, canned beef of control group and canned beef treated with 0.5% Kalojira oil were rotten and produced bad odor after 5 months of storage period.

Table 1: Physico- chemical & microbiological quality of raw beef used for can beef preparation

Physical quality		Chemical quality		Microbiological quality	
Meat p^H	5.92	Moisture, %	75.65	TVC (cfu/g)	7900
Drip loss (%)	10.01	DM, % fresh	24.35	TCC (cfu/g)	3800
Cook loss (%)	23.83	CP, % fresh	18.76	E.coli *spp.*	$+^{ve}$
		Ash	4.52	Salmonella *spp.*	$-^{ve}$
		OM, %	95.48		

Table 2: Effect of using graded level of Kalojira oil on physico-chemical, microbiological qualities and loss or recovery rate of canned beef

Parameters	*Nigella sativa* oil (% of raw beef)				SED	Sig.
	T_0 (Control)	T_1 (0.5%)	T_2 (1.0%)	T_3 (1.5%)		
Physico-chemical quality						
p^H	7.23^a	6.70^b	6.40^c	6.10^d	0.04	***
Moisture, %	71.59^b	65.04^a	65.42^a	66.17^a	0.55	**
DM, %	28.40^b	34.95^a	34.58^a	33.83^a	0.55	**
CP, %	21.10^b	21.56^b	23.65^a	23.81^a	0.22	**
OM, %	96.35^a	97.21^b	97.42^b	97.56^b	0.13	**
Ash, %	3.64^a	2.80^b	2.58^b	2.43^b	0.13	**
Loss or recovery rate						
Losses during canning process, %	2.92^c	1.03^b	0.60^b	0.00^a	0.10	***
Water in canned jar, %	53.61^a	30.54^b	36.19^c	33.84^b	1.10	***
Meat in canned jar, %	42.29^c	67.65^a	60.07^b	64.30^a	0.86	***
Microbiological properties						
TVC (cfu/g)	1560	1310	Nil	Nil		
TCC (cfu/g)	Nil	Nil	Nil	Nil	-	-
Salmonella spp.	-ve	-ve	-ve	-ve	-	-
E.coli spp.	-ve	-ve	-ve	-ve	-	-
Streptococcus spp.	-ve	-ve	-ve	-ve	-	-
Cost 0.5 kg canned beef	357	362	363	364	-	-

Table 3: Effect of Kalojira oil on sensory qualities of canned beef

Items	*Nigella sativa* oil (%)		SED	Sig.
	1.0	1.5		
Tenderness	6.71	7.29	0.31	NS
Chewiness	6.85	7.15	0.27	NS
Juiciness	6.28	7.15	0.47	NS
Fineness	5.57	6.14	0.61	NS
Flavour	6.00	7.00	0.37	*
Taste	5.43	7.00	0.40	*
Color	6.57	6.57	0.36	NS

Based on the above results, it can be concluded that, Kalojira oil at 1.5% level could be used as suitable value added preservatives in canned beef up to 5 months of preservation.

Conservation and improvement of Munshiganj cattle

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Executive summary

Munshiganj Cattle (MC) is one of the improved varieties of cattle found mainly in Munshiganj district and adjunct areas of the district. The MC is also locally known as "Mirkadim" or sometimes "Hasha". It is a typical milk type variety, mostly of creamy to white in coat colour with a pink hue and looks different from other varieties. Despite having good quantity of milk production farmers are yet intend to inseminate their pure MC with foreign germplasm in order to get more milk. As a result, population of MC is rapidly declining in their breeding tract. Hence, conservation of MC and subsequent improvement of production performance of the variety is necessary. Considering the above facts, steps has been taken by BLRI for conservation, characterization and subsequent improvement of this valuable germplasm at their own habitat and BLRI cattle research farm. For *in situ* conservation, a MC rearing community was established in Munshiganj district. A nucleus herd was established in BLRI and this herd has been enlarged with a total population of 66. After selection of MC with pure phenotype, comparative higher milk production performance and presence of A2 beta-casein a total of 35 cattle remains in nucleus herd of BLRI, which including 9 cows, 13 breeding bulls, 8 heifers and 5 growing calves. Different productive and reproductive performance was recorded in the nucleus herd. For conservation of this verity to regain its purity in the farmer's house, artificial insemination (AI) is ongoing in their original breeding tract with pure MC frozen semen. Some non-descript indigenous cattle are also selected for AI to increase the population of MC. The average birth weights of male calves and female calves were found (13.69±2.89 kg) and (14.68±3.21 kg), respectively in on station. Average lactation length, lactation yield, average daily milk yield, postpartum heat period and number of services for each conception was found 196.61 days, 696 Kg, 3.54 Kg, 64.52 days and 1.57± 0.82, respectively for on station. Genotype frequencies of beta-casein in MC cattle in BLRI nucleus herd and Munshiganj field were analyzed, where, low frequency of A1A1 (1.82%) genotype found in field and no A1A1 genotype found in BLRI herd (Table 3). A mating plan of MC in BLRI nucleus herd has produced developed considering the production performance, inbreeding and beta-casein results. To increase mass awareness regarding its conservation and maintaining purity of MC at Munshiganj district, cattle fair/show, seminar, farmers training and door to door personal communication has done in previous years and will be continue in future.

Table 1: MC population in BLRI nucleus herd

Types	Number
Milking cows	3
Dry cows	6
Breeding Bulls	2
Mature and Growing bulls	11
Growing Heifers	8
Calves	5
Total	35

Table 2: MC milk production traits

Milk production traits	Mean±SD (n)
Lactation Length (Days)	196.61±64.01(31)
Lactation Yield (K)g	696±217.67(31)
Average daily milk yield (Kg)	3.54±0.65(31)

Table 3: Genotype frequencies of beta-casein in MC cattle in BLRI nucleus herd and Munshiganj field

Breeds	No. of Sample	Genotype frequency% (n= number of samples)		
		A2A2	A1A2	A1A1
MC (BLRI)	41	87.80 (n=36)	12.20 (n=5)	0 (n=0)
MC (Field)	55	78.18 (n=43)	20.00 (n=11)	1.82 (n=1)

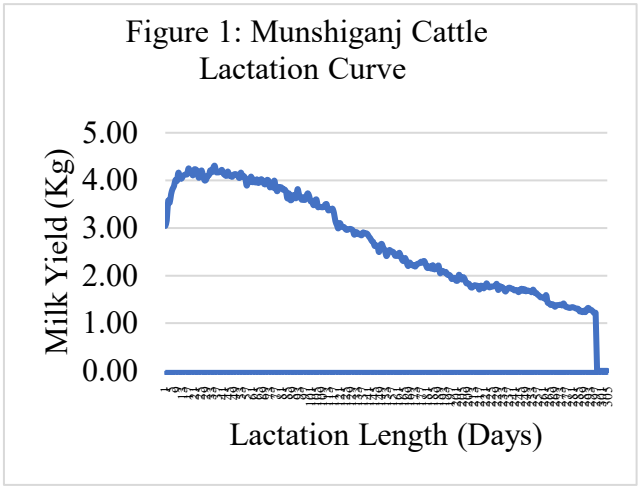

Table 4: Mating Plan for Munshiganj Cattle

Bull ID	Cow/Heifer ID	Bull ID	Cow/Heifer ID
M-33	M-03	M-54	M-24
	M-05		M-28
	M-06		M-39
	M-08		M-56
	M-55		M-60
	M-57		
M-45	M-07	M-31	M-47
	M-38		M-52
	M-50		M-59
	M-61		M-65

Figure 2(a)

Figure 2(b)

Figure 2: (a) MC milking cows & dry cows (Left side), (b) MC growing bulls and heifers (Right side) at nucleus herd of BLRI

The current ongoing AI program in the community will ensure availability of potential MC conforming pure characteristics ready in hand for sustaining their unique features, so that it can be disseminated in their original breeding tract.

Development of a system generated database for cattle and buffalo research farm BLRI

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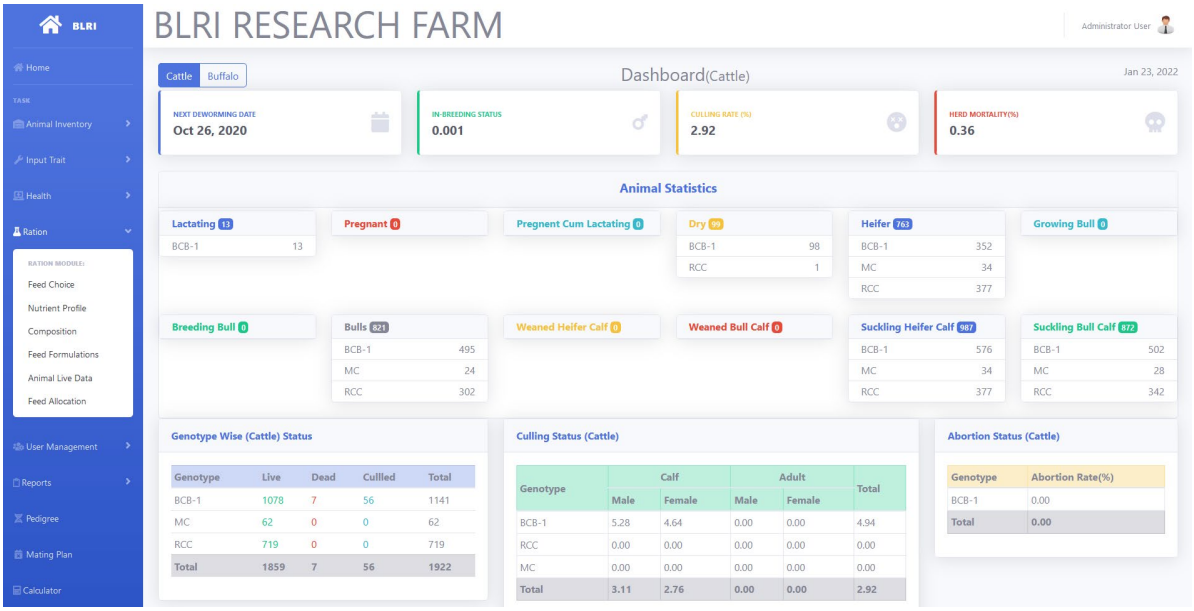
Executive Summary

Animal recording is a generic term that integrates animal identification and registration, animal traceability, animal health information and animal performance recording. Animal identification is a top priority for any genetic improvement program. Errors in identification can lower estimates of genetic variability and can result in biased genetic evaluations. Animal recording and registrations are needed to improve the breed or population. So, successful animal breeding requires collection and storage of data on individually identified animals; complete pedigree information and appropriate statistical methods and computing hardware. Without these pieces of information little genetic change can be made in a population. Records need to be stored electronically for computer manipulation and data analyses. On-farm computer database systems help for collection and storage of data. A good farm management keeps lots of register to run their farm more precisely like livestock register, breeding register, milk register, calf register, feed register, health and disease register etc. BLRI also maintains such type of records. At present BLRI cattle and buffalo research farm owns three different genotypes of cattle as; BCB-1, RCC and Munshiganj and two genotypes of buffalo as indigenous and crossbred for conservation and research purposes. Since its inception, BCB-1, RCC and Munshiganj cattle productive and reproductive related lot of data had been generated to date. These data were mainly being kept in paper book. However, it is very difficult to pick up all data in a summarized form from this paper book for genetic evaluation of all individuals in the herd. It is a routine activity of a farm manager to select best dams and sires for producing next generation and to cull inferior animals (for selling) regularly. But selection or culling decision is taken based on the estimated breeding values (EBVs) of all individuals in the herd. It is a best practice for an animal breeder to analyze data in a population applying different models using computer-based programming for estimation of breeding values of all individuals. Animals are ranked on the basis of their EBVs, and then superior animals are selected for mating and inferiors are culled (i.e. not allowed to mate). Animals are usually evaluated for several traits and these are weighted by their relative economic values allowing for the heritability of each trait and the genetic correlations among the traits. Computer aided analytical programs (CAAP) are now very much convenient ways to make it ease of such type of complex task. To do so, a system generated computer based database is essentially needed for BLRI animal research farm. Therefore, to digitalize farm database, this work was designed with a view to develop an up-to-date system generated database software that could be useable both in PC and mobile phone.

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

also been incorporated in the database. As a part of nutrition, a system generated in-built feeds and fodder requirement estimator has been developed in the existing database software securely stored in the cloud. Proximate components of conventional feed ingredients to be used at BLRI animal research farm can be incorporated in the software. A balanced ration in accordance with different methods (thumb rule, ME and TDN) for different categories of animals (milking cow, pregnant cow, dry cow, calf, bull) can be formulated by choosing feed ingredients enlisted in the software. Subject to postulating animal live body weight, daily body weight gain, daily milk yield, milk fat content and pregnancy status, the software is automatically able to estimate the allocation of daily feed requirements for different categories of animals. So far, a total of 1923 individuals (3 genotypes; BCB-1, RCC and Munshiganj) have been incorporated in the animal inventory of the software, and till now productive and reproductive data of BCB-1 have been incorporated. Incorporation of other data is in progress and it will be continued. Ration formulation, nutrient requirements (based on thumb rule, ME and TDN systems) and feed allocation estimator have been completed and it is under trial process. After completion of this database work help to make a guideline or to explore the real productive & reproductive features, feed requirement of BLRI conserved local cattle germplasms those are going to be declared native breed near future.

Finally, it may be concluded that the developed database software will help in storing data permanently and hence, overall farm management and decision for selection and culling of animals from the software will be very convenient for a farm manager. Besides, balanced ration formulation, nutrient requirements and feed allocation on the basis of production status of animal will be facilitated within very short time on daily basis or all the year round.



Performance and meat quality of BLRI improved Hilly chicken in different production systems

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Executive summary

The study was designed to know the performance and meat quality of BLRI improved Hilly chicken in 3 different production systems (intensive, semi-intensive and scavenging). A total of 27 farmers were selected from 3 locations of Bangladesh (Sonagazi, Feni; Joypurhat Sadar and Dumuria, Khulna) having 9 farmers from each location. The 9 farmers were divided into 3 groups for 3 different production systems replicating 3 times of each. A total of 810 chicks at the age of 5 weeks were distributed to the selected farmers. Initially, each farmer was given a total of 30 unsexed birds and reared up to 10 weeks of age in different production systems. At 10 weeks, 3 male and 3 female birds from each farmer from Sonagazi, Feni location were collected and meat quality for carcass characteristics, physico-chemical, and sensory tests were studied. After 10 weeks only 13 pullets and 2 cocks are kept in each farm for further laying performance study (up to 40 weeks of age) and sold out rest of the birds. The semi-scavenging birds were allowed to scavenge inside the fence and scavenging group of birds were allowed to scavenge around the house during day time. The locally available ready broiler starter up to 10 weeks of age, then layer grower from 10 to 18 weeks and layer layer from 19 to 40 weeks were supplied to the birds. The adult birds were supplied 100, 60 and 30g for intensive, semi-scavenging and scavenging birds, respectively. This ratio followed from 40g/bird at 6 weeks of age for intensive group. The growth, laying and meat quality data were recorded and analyzed using SPSS (22.0 version) computer software.

Table 1 represents that the live weight at 6, 8 and 10 weeks of age differed significantly ($p<0.001$) amon g the different rearing systems. The highest, lowest and intermediate live weight at 10 weeks of age was recorded 781, 718g and 679 for intensive, semi-scavenging and scavenging rearing systems, respectively . Table 2 implies that the egg production at different ages also varied significantly ($p<0.001$) among the different rearing systems. The highest average hen day egg production at 40 weeks of age were recorded for intensive rearing system followed by semi-scavenging and scavenging group of rearing system to be 50, 49 and 42% respectively. However, the average hen day egg production up to 280 days of age were r ecorded 57, 44 and 38% for intensive, semi-intensive and scavenging rearing system, respectively.

Table-1. Live weight (g/bird) of indigenous chicken up to 10 weeks in different rearing systems

Rearing system	6 Week	8 Week	10 Week
	(Mean±SE)		
Intensive	429.9^{a}±4.46 (252)	625.3^{a}±8.91 (254)	780.9^{a}±11.77 (250)
Semi-intensive	401.5^{b}±4.05 (251)	572.4^{b}±9.20 (245)	717.7^{b}±11.12 (251)
Scavenging	361.8^{c}±4.27 (250)	520.1^{c}±6.92 (255)	679.4^{c}±8.93 (218)
Overall mean	397.9±2.66 (753)	573.2±5.11 (754)	728.1±6.44 (719)
Significance level	***	***	***

***-significant at $p<0.001$; means with different superscript differed significantly; Figures in the parenthesis indicate number of observation.

Table 3 represents that the live weight among the studied birds did not differ significantly ($p>0.05$). But, the carcass weight, dressing percentage and breast meat weight differed significantly ($p<0.05$). The high est, lowest and intermediate dressing percentage found 57, 52 and 56.5 percent from intensive, scavengi ng and semi-scavenging rearing system, respectively. On the other hand, the other meat quality parame ters e.g. cooking loss, water holding capacity and texture did not differ significantly among the different rearing systems. The sensory test e.g. overall acceptability also did not differ significantly among the gro

ups. The scavenging birds always got the good score regarding the taste and meat quality concern. The n on-significant results indicated the equal acceptability of the other rearing systems.

Table 2. Hen-day-egg production (%) of Hilly chicken in different rearing systems

Rearing system	25 Week	30 Week	35 Week	40 Week	Up to 280 days
	(Mean±SE)				
Intensive	46.22^{a}±2.9 (63)	64.14^{a}±2.5(63)	67.36^{a}±1.6(63)	50.41^{a}±2.2 (63)	57.03^{ab}±3.1(09)
Semi-intensive	22.25^{b}±3.3 (63)	49.25^{b}±1.3(63)	57.11^{b}±1.9(63)	49.07^{a}±1.7(63)	44.42^{a}±3.25(09)
Scavenging	08.44^{c}±2.1 (63)	48.40^{b}±1.9 63)	54.74^{b}±1.8 (63)	41.94^{b}±2.1(63)	38.38^{b}±3.36 09)
Overall mean	25.64±1.1(189)	53.93±1.2189)	59.73±1.1 (189)	47.14±1.1(189)	46.61±1.96 (27)
Significance level	***	***	***	***	*

*-significant at p<0.05; ***-significant at p<0.001; means with different superscript differed significantly; Figures in the parent hesis indicate the no. of observation.

Table 3: Carcass characteristics of male Hilly chicken in different production system

Traits	Production system			Significance level
	Intensive	Semi-intensive	Scavenging	
Live weight (g)	941.7^{a}±60.46	843.4^{ab}±45.23	771.1^{b}±39.79	NS
Carcass weight (g)	537.7^{a}±28.71	476.5^{ab}±35.03	402.6^{b}±23.50	*
Dressing percentage (%)	57.09^{a}±2.51	56.50^{ab}±2.21	52.21^{b}±2.01	*
Breast meat weight (g)	80.3^{a}±5.06	66.9^{b}±2.84	61.1^{b}±3.96	*
Drumstick weight (g)	91.6^{a}±7.95	81.9^{ab}±5.60	71.7^{b}±5.11	NS
Thigh weight (g)	91.0^{a}±7.83	79.2^{ab}±6.41	70.0^{b}±4.15	NS

*-significant at p<0.05; NS-(p>0.05)

Table 4: Meat quality and sensory analysis of Hilly chicken in different production system

Traits	Production system			Significance level
	Intensive	Semi-intensive	Scavenging	
Cooking loss	2.81^{b}±0.17	3.60^{a}±0.21	2.52^{b}±0.43	NS
WHC	0.09±0.02	0.09±0.01	0.06±0.01	NS
Texture	6.00±0.58	6.33±0.33	5.33±0.33	NS
Juiciness	6.00±0.58	5.67±0.88	6.00±0.58	NS
Overall acceptability	6.33±0.33	6.00±0.58	6.00±0.58	NS

NS-(p>0.05); WHC- Water Holding Capacity.

From the above mentioned results, considering the amount of feed supplementation it may be concluded that the semi-scavenging system could be a suitable option for rearing of BLRI improved Hilly chicken by the rural farmers in terms of early marketable live weight, a good number of egg production as well as the quality of meat. However, further study including more agro-ecological zones of the country considering the profitability of the farmers is suggested to validate as well as to establish a model with this type of rearing system.

Conservation and improvement of native duck and geese genotypes

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Executive summary

Duck breeding is very important for maintaining pure line and to improve the duck's genetic potentiality of existing local duck. So far, there is a lack of guided breeding and scientific management practices followed in the country, which would lead to loss of the rich native duck germplasm. With the view, Bangladesh Livestock Research Institute has been conserved two native duck genotypes since 2012 and already improved their production potentialities remarkably through selective breeding named as deshi white (Rupali) and Desi black (Nageswari). This study was under taken to know the growth performance and carcass characteristics of 7th generation at BLRI improved native duck. A total of 470 ducklings of both genotypes were hatched and brooded in brooder house in poultry research shed at BLRI. Male and female ducks were separated and marked with wing band at 12 weeks of age. Diets containing 20 % CP and 3000 Kcal ME/kg DM and 16% CP and 2750 Kcal ME/kg was provided during starter and grower periods respectively. The drinking water was provided *adlibitum* throughout the day. All the birds were reared in a natural-ventilated duck house. All hatching, productive, and carcass data were recorded. In ducklings (8, 10 and 12 weeks) males and females life carcass dissection was carried out applying the method described by Ziolecki and Doruchowshi (1989). After 8, 10 and 12 weeks of rearing 4 males and 4 females of each variety were chosen with the body weight similar to average specimen weight of particular sex. All recorded data were analyzed by SAS and differences were determined by DMRT.

Egg weight and duckling weight ratio at hatch of BLRI improved two native duck are shown in table 1. Egg weights prior to setting and subsequent duckling weights were determined from two types of native duck genotype namely Rupali and Nageswari duck. Egg weight means were 66.00 and 65.79 g, respectively for Rupali and Nageswari genotypes. The data on chick-egg ratio have shown that newly hatched chicks in the Nageswari genotype had higher percentage (56.81) than chicks in the Rupali (55.74). Body weights, body weight gain, feed consumption and feed conversion ratio from day-old to 12th weeks of age are shown in Table 2. The average initial body weight of day-old chicks of Rupali and Nageswari duck was 36.6 ± 5.44 and 37.13 ± 4.8 g, respectively and the difference was not significant (P>.05). But the body weight gain of duckling at 12th weeks of age was differ significantly (P>0.001) for Rupali and Nageswari genotypes. The lowest feed intake were recorded by Nageswari duck (P<0.01). The carcass characteristics of BLRI improved native duck are shown in Table 3. The dressing and wing percentage of the male and female duck within each breed at different stages were not significant (P>0.05). The Rupali duck (P<0.01) at 12 weeks of age gave the highest skin percent of 16.75 and 16.97 for male and female respectively. The results obtained in this study showed that the female of Rupali and Nageswari duck (P<0.01) at 12 weeks of age has the highest percent of liver 2.75 and 3.09 respectively. The head as proportion of live weight was significantly different of Nageswari duck at 8 week (P<0.05) and 10 week (P<0.01) of age. The male of Nageswari duck has higher head weight than the female duck head (P<0.05). The Nageswari duck genotype had higher percent of shank weight at 12 weeks of age than the Rupali breeds and found significant difference (P<0.01), but found no significant difference male and female duck within the breed. At 8 weeks of age female duck had higher breast meat percentage than other stages and found significant difference (P<0.05) irrespective of sex.

Table 1: Egg weight and duckling weight ratio at hatch of BLRI improved two native duck (Mean±SD)

Genotypes	Egg weight (g)	duckling weight (g)	Duckling-egg weight ratio
Rupali	66.00±4.45	36.63±5.40	55.74±9.19
Nageswari	65.79±4.96	37.13±4.91	56.81±8.44
P value	0.075	0.363	0.672
Level of sig.	0.785	0.548	0.414

Table 2: Growth performance of BLRI improved duckling up to 12 weeks of age

Age in week	Genotypes (Mean±SD)		Level of sig.
	Rupali	Nageswari	
Day old duckling weight (g/b)	36.6±5.44	37.13±4.8	0.543
Body weight gain at 12 weeks of age (g/b)	1467.50±135.9	1321±135.76	0.000***
Daily feed intake (g/b)	135.37±0.94	133.31±1.50	0.01**
Total feed Intake up to 12 weeks of age (g)	6665.79±50.42	6446.90±65.81	0.543
FCR (Feed: gain)	4.54±0.05	4.88±0.06	0.632

Table 3: Carcass characteristics of BLRI improved native duck at different stages

Parameter (%)	Age in week	Genotype (Mean±SD)				Level of sig.	
		Rupali		Nageswari		Genotype	Sex
		Male	Female	Male	Female		
Dressing	8	46.78±3.98	51.50±2.98	52.04±5.13	50.38±2.04	0.387	0.521
	10	49.67±0.91	52.26±3.49	52.45±0.63	50.41±3.8	0.267	0.695
	12	46.98±1.46	47.80±2.4	49.00±1.07	46.65±2.2	0.654	0.432
Skin	8	16.83±2.04	14.81±0.34	16.54±1.06	17.26±0.24	0.203	0.430
	10	17.03±2.9	13.99±1.57	12.63±1.93	15.17±0.85	0.192	0.833
	12	**16.75±1.29**	**16.97±1.67**	**14.61±1.00**	**14.82±0.25**	**0.003****	0.724
Liver	8	3.17±0.55	2.57±0.33	2.33±0.11	2.86±0.83	0.440	0.929
	10	2.67±0.32	2.75±0.99	2.69±0.25	2.97±1.07	0.811	0.834
	12	**1.96±0.10**	**2.75±0.40**	**2.70±0.47**	**3.09±0.18**	**0.007****	**0.004****
Wing	8	7.19±0.60	8.8±0.88	9.04±0.66	8.5±0.66	0.165	0.311
	10	7.74±0.25	8.38±3.8	8.54±0.57	8.12±0.62	0.357	0.709
	12	5.2±3.04	7.98±0.93	8.45±0.65	7.64±0.43	0.102	0.251
Head	8	6.09±0.15	6.07±0.40	**6.80±0.19**	**6.49±0.33**	**0.010***	0.353
	10	5.2±0.42	5.48±0.25	**6.15±0.04**	**5.77±0.34**	**0.007****	0.767
	12	4.68±0.38	4.36±0.31	5.23±0.56	4.59±0.22	0.730	**0.031***
Shank	8	2.94±0.12	3.07±0.30	3.2±0.21	2.84±0.29	0.900	0.442
	10	2.38±0.26	2.85±0.64	2.81±0.28	3.05±0.69	0.314	0.261
	12	**2.1±0.31**	**2.2±0.09**	**2.4±0.09**	**2.57±0.29**	**0.004****	0.360
Breast	8	**4.2±0.70**	**5.7±1.40**	**4.7±0.97**	**6.08±0.67**	0.105	**0.028***
	10	8.66±0.92	8.39±1.85	6.85±0.77	7.85±1.26	0.150	0.637
	12	9.89±0.66	9.93±1.02	9.41±0.66	9.19±0.94	0.175	0.834

From this findings, Rupali duck had better performance (body weight gain and egg weight) than Nageswari duck whereas, Nageswari duck intake less feed than Rupali duck. Carcass characteristics at different stages of Rupali and Nageswari duck almost similar results whereas breast meat is found better in female duck in both genotypes.

Conservation and improvement of Quail: Performance of tenth generation

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Executive Summary

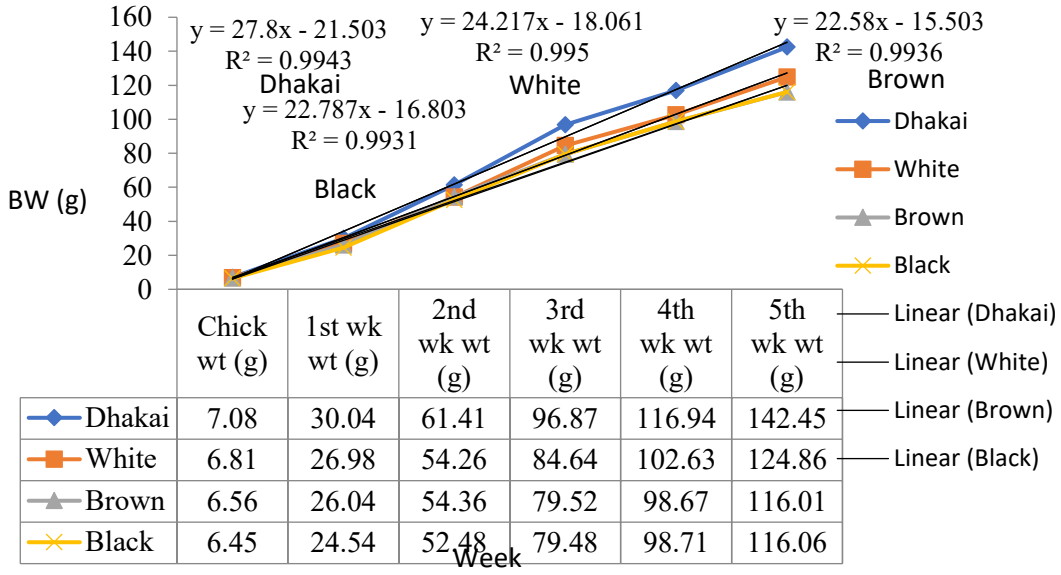
One of the most important poultry species in Bangladesh is quail. Four genotypes of quail like Dhakai (D), White (W), Brown (Br) and Black (Bl) quail are being maintained at Poultry Production Research Division, BLRI. In this study, 6th week body weight (BW) is considered as selection criterion and maintained the accurate pedigree records for developing meat type quail genotypes. Therefore, the present study was undertaken with the objectives to increase the sixth week body weight of 4 different quail genotypes through selective breeding and to select parental birds (males and females) and breed them in an assortative plan for the production of tenth generation birds for better meat production.The breeding program was conducted at poultry research farm in Poultry Research Centre, BLRI. Commercial poultry feed was supplied during starter (0-4 weeks, 24% CP, ME 3000 Kcal/kg DM), grower (4-5 weeks, 21% CP, ME 2800 Kcal/kg DM) and laying period (6-40 weeks, 18% CP, ME 2600 Kcal/kg DM) period twice daily (morning and evening). The water was supplied ad-libitum.Single pair mating through selective breeding system were practiced and pedigree record were maintained properly.A total of 1059 day-old quail chicks (344White, 264 Black, 185 Brown and 266 Dhakai) were hatched in one batch to produce tenth generation (G_{10}). Progeny were leg and wing banded and reared separately according to genotypes. Expected genetic progress due to selection for 6th week body weight was estimated for tenth generation (G_{10}) using the following equation (*Falconer, 1981).*Expected response was calculated using following formula, $R = h^2 \times S$ where, R = Expected response, h^2 = heritability for 6th week body weight, S = Selection differential for the selected males and females. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0.

Table 1 showed that higher chick weight and body weight at 5th weeks of age was found in Dhakai genotypes (7.08±0.06 and 142.45±1.26g) followed by White (6.80±0.04 and 124.86±1.26g), Brown (6.56±0.14 and 116.00±2g) and Black genotypes (6.45±0.04 and 116.05±1.26g). Both egg production number and egg production percentage from 14 to 30 weeks and hen day egg production percentage from 7 to 30 weeks of age were significantly ($p<0.001$) higher in white genotypes (83.15±1.3, 69.29±1.08 and 67.85±0.47) followed by Black, Brown and Dhakai genotypes. On the other hand, Egg weight from 27 to 32 weeks and 33 to 37 weeks were significantly higher ($p<0.001$) in Dhakai genotypes but feed intake from 0 to 9 weeks of age was not differ (NS) among four genotypes. The feed intake (g/d/b) from 10 to 30 weeks of age was significantly higher ($p<0.001$) among the genotypes. The value was 22.50±0.04, 22.31±0.04, 21.70±0.04 and 19.93±0.04g for Black, Brown, Dhakai and White genotypes, respectively. Dhakai genotype had higher body weight at all stages of age (up to 5th week) (Figure 1).Selection differential varied from 4.5g body weight in Brown quail male to 11.6g body weight in Black quail male. The selection differentials for the males were 7.4, 5.5, 4.5 and 11.6g; respectively for D, W, Br and Bl quails. For the females, the corresponding values were 10.7, 7.9, 7.7 and 11.3g (Table 2). Table 2 also showed that 6th week body weight of male quails of D, W, Br and Bl were expected to increase by 3.20, 2.65, 2.03 and 4.65g; respectively. While in female quails of D, W, Br and Bl; the expected responses were 4.18, 3.76, 3.50 and 5.14g; respectively. Finally, based on the performance among four types of genotypes, Dhakaigenotypes was superior for body weight and white quail for egg production.The findings suggested for further research and improvement of body weight and egg production of next generation (11th) of quail genotypes at BLRI.

Table 1. Performances of four quail genotypes at tenth generation (G_{10})

Traits	Genotype*(Mean±SE)				Level of Sig.
	Dhakai	Brown	White	Black	
Chick weight (g)	7.08^{a}±0.06	6.56^{c}±0.14	6.80^{b}±0.04	6.45^{c}±0.04	p<0.001
Body weight (g) at 5th weeks	142.45^{a}±1.26	116.00^{c}±2.1	124.86^{b}±1.26	116.05^{c}±1.26	p<0.001
Egg production (no.) (14-30 weeks)	68.70^{b}±1.58	65.86^{b}±1.55	83.15^{a}±1.3	80.45^{a}±1.4	p<0.001
Egg production (%.)(14-30 weeks)	57.25^{b}±1.32	54.88^{b}±1.29	69.29^{a}±1.08	67.06^{a}±1.19	p<0.001
HDEP (%) (7-30 weeks)	56.40^{c}±0.47	54.77^{d}±0.47	67.85^{a}±0.47	65.86^{b}±0.47	p<0.001
Egg weight (g) (27-32 weeks)	10.67^{a}±0.13	9.89^{b}±0.13	10.64^{a}±0.11	10.55^{a}±0.13	p<0.001
Egg weight (g)(33-37 weeks)	10.93^{a}±0.17	9.98^{b}±0.17	10.81^{a}±0.14	10.71^{a}±0.16	p<0.001
Feed intake (g/d/b) (0-9 weeks)	15.61±0.80	15.79±0.80	16.05±0.80	16.23±0.80	NS
Feed intake (g/d/b) (10 -30 weeks)	21.70^{c}±0.04	22.31^{b}±0.04	19.93^{d}±0.04	22.50^{a}±0.04	p<0.001

*Least squares mean without a common superscript along the row within a factor differedsignificantly (p<0.001), NS=non-significance



	Chick wt (g)	1st wk wt (g)	2nd wk wt (g)	3rd wk wt (g)	4th wk wt (g)	5th wk wt (g)
Dhakai	7.08	30.04	61.41	96.87	116.94	142.45
White	6.81	26.98	54.26	84.64	102.63	124.86
Brown	6.56	26.04	54.36	79.52	98.67	116.01
Black	6.45	24.54	52.48	79.48	98.71	116.06

Figure 1: Body weight of quail up to 5th week of age at tenth generation

Genotypes	Sex	Before selection		After selection		Selection Differential (S) (g)	Selection Intensity (i)	Heritability (h2)	Expected response to selection(R)
		No.	Averag	No.	Averag				
Dhakai	M	61	133.3	40	140.7	7.4	0.70	0.432	3.20
	F	68	155.1	40	165.8	10.7	0.79	0.391	4.18
White	M	144	121.8	100	127.3	5.5	0.64	0.482	2.65
	F	160	138.5	100	146.4	7.9	0.68	0.476	3.76
Brown	M	85	120.6	40	125.1	4.5	0.48	0.451	2.03
	F	80	133.4	40	141.1	7.7	0.71	0.454	3.50
Black	M	153	114.7	100	126.3	11.6	1.44	0.401	4.65
	F	155	128.2	100	139.5	11.3	0.82	0.455	5.14

Investigation of Lumpy Skin Disease (LSD) in Bangladesh

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Executive Summery

Lumpy skin disease (LSD) is a contagious viral disease of cattle caused by lumpy skin disease virus (LSDV). LSD has recently spread in Asia following outbreaks in the Middle East and Europe. The disease emerged in Bangladesh in July 2019 in the Chattogram district and then rapidly spread throughout the entire country. The disease caused enormous economic losses in livestock industry. The objectives of this research were to perform the Isolation, identification and molecular characterization of LSDV; and development of LSD live attenuated vaccine seed. In this study, a total of 36 clinically suspected LSD samples (skin crust nodules, pus and ocular discharge) were collected respectively from suspected cattle of Dhaka (Dhamrai), Jessore, Jhenaidaha, Chattogram, Rajshahi, and Pabna and then stored at -80°C in animal health research laboratory, BLRI. The genomic DNA was extracted by Monarch® Genomic DNA Purification Kit according to manufacturer protocols. Samples were tested by PCR with the specific primers and standard protocol for LSD virus, goat pox virus, and sheep pox virus. Out of 36 samples, 28 (78%) were found PCR positive. LSD virus was also identified from pus and ocular discharge of infected cattle. The positive samples were cultured into primary lamb testicular cells (LTC) and observed regularly until 7 days of post infection to observe the CPE produced by LSDV and reconfirmed by PCR (figure 1). The RNA polymerase subunit (RPO30) gene (606bp) of Capripoxviridae was sequenced and constructs a phylogenetic tree. The phylogenetic analysis has shown that all 4 samples were identical and a single strain was circulating in the study area. In the Genbank, the sequences show an identity of 100% with LSD strain isolated in Kenya (MN072619) and a strain used in a commercial vaccine (KX683219) the NI-2490 isolate Neethling 2490 (AF325528) from South Africa. Adaptation and attenuation of LSD isolates in vero cell is going on for the development of live attenuated LSD vaccine seed.

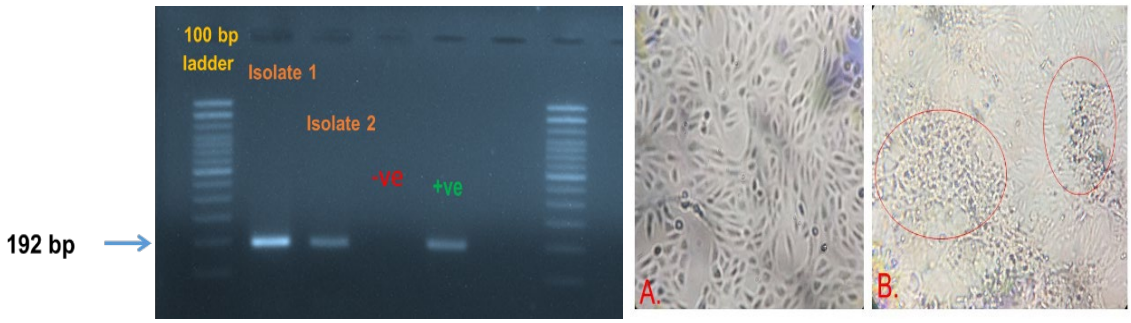

Figure 1. Amplification of the RPO30 gene (192bp) of LSD virus (showing positive band of 192bp in left image) and cytopathic effects (CPE) in Vero cell culture of LSDV (right image).

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

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Executive summery

Duck plague (DP) or duck viral enteritis (DVE) is an acute, highly contagious disease of ducks, geese, and swans, characterized by sudden death, high mortality (particularly among older ducks), hemorrhages and necrosis. The causative agent of DP is the Anatid alphaherpesvirus-1 of the family Herpesviridae. Duck plague Virus (DPV) is a main threat to all age groups of ducks, which is characterized by high morbidity and mortality varying from 5-100%, depending on virulence of the infecting viral strain. DPV is mainly transmitted by direct contact from infected to susceptible ducks or by indirect contact with contaminated environment. Water seems to be a natural route of viral transmission. Migratory waterfowl and recovered ducks are asymptomatic carriers and play a vital role in spreading DPV. In Bangladesh, DP was first confirmed in 1980 and a significant number of ducks died each year mainly in Haor areas, due to this endemic disease, therefore, enormous economic losses occur. Livestock officials in Bangladesh have expressed extreme concern over the outbreaks of DP, especially prevailed in Haor areas. Vaccination is only the well-known method for the control of DP but in Bangladesh, the vaccination program is not widely straightforward owing to the limited volume of DP vaccine. Moreover, very few studies have been conducted on molecular detection, isolation, and adaptation of DPV. To efficiently combat this threat, there is a need for the mass production of efficient DP vaccine. Therefore, the present study was executed, to isolate, detect and characterize the circulating DPV from DP suspected samples and to adapt the virulent DPV strain in developing duck embryo and chicken embryo fibroblast cell (CEF) for the development of attenuated live DP vaccine seed.

In this study, a total of 49 DP suspected samples (liver, spleen, kidney, esophagus, and intestine) were collected and transported to Animal Health Research Laboratory (AHRL), Bangladesh Livestock Research Institute (BLRI), Savar. Of the 49 samples, 30 and 19 were respectively, from the Hoar area (Kisorgonj) and BLRI duck farm. All field samples were processed and made 10% suspension using phosphate buffered saline (PBS). Prepared suspension of each sample was used for molecular detection by polymerase chain reaction (PCR) and inoculam preparation for the inoculation and isolation of DPV in specific pathogens free (SPF) embryonated chicken egg (ECE). Prepared inoculam was treated with equal volume of 100X antibiotic-antimycotic solution for removing bacterial contamination and, then confirmed by sterility test on agar media. Chromosomal DNA was extracted from processed tissue samples using the protocol of DNA extraction kit (Monarch®, UK) and, then performed PCR for targeting the amplification of the DNA polymerase and gC gene according to the methods described in OIE, 2012. Out of 30 samples in Kishorgonj, 3 (10%) were found positive by PCR both in DNA polymerase and gC gene but in BLRI samples could not find any positive. The expected PCR amplicon was appeared at 446-bp and 78-bp respectively for DNA polymerase and gC gene (Figure1). In addition, a total of 21 PCR positive samples (last year 18 and this year 3) were inoculated (0.2 ml) into SPF 10 days old ECE through CAM route and observed regularly up to 7 days. Then, allantoic fluid (AF) and CAM were harvested after 7 days of post inoculation (dpi). Susequently, Molecular detection of DPV from harvested AF and CAM was reconfirmed by PCR and found 3/21 (14.28%) samples were positive. One from 3 fresh field samples and 2 from last year PCR positive samples.

For the isolation and propagation of DPV, three serial blind passages on ECE were conducted and harvested AF and CAMs each time and, then labelled and stored at -80ºC. Adaptation and attenuation of DPV isolates in Chicken Embryo Fibroblast (CEF) is also going on for the development of live attenuated DP vaccine seed.

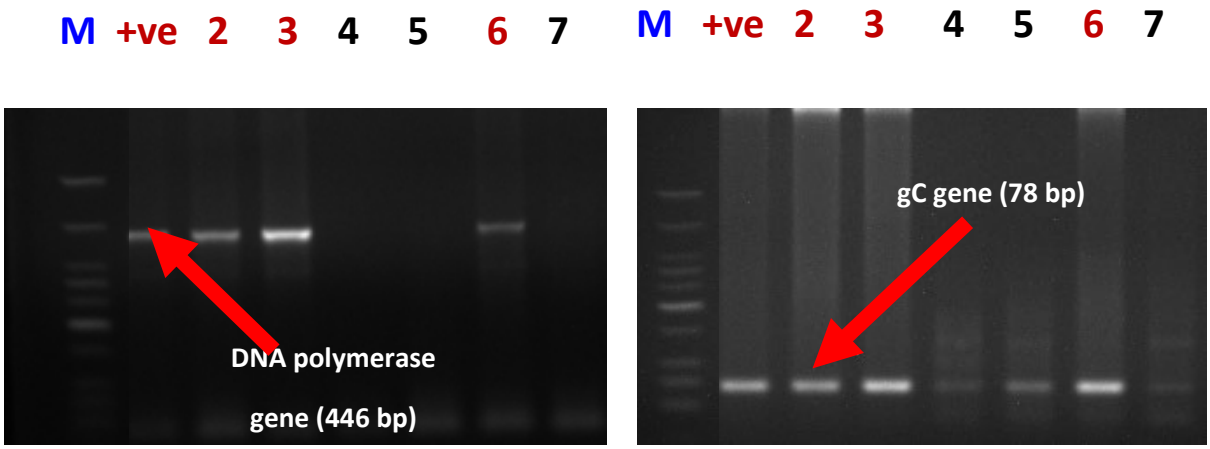

Figure 1. Reconfirmation of DPV targetting DNA polymerase gene (A) and gC gene (B) after three blind passage in embryoated chicken eggs. Here, Lane M: 50 bp Marker; Lane 1: positive control, Lane 2-6 hervested CAM and allantoic fliud.

Efficient management of livestock and poultry farm wastes for pollution control

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Executive summary

Livestock and poultry manure are blamed to be a major source of environmental pollution, especially water pollution. Overall, traditional waste management systems instead of modern environment friendly management systems are being practiced in farms irrespective of their size and capacity. The scenario is much worse in case of small scale producers. In many cases liquid manure and wash water are being drained off either directly into water bodies or into low land and ditches which eventually are connected to water sources for human or agricultural uses. Solid manures are usually piled-up for composting or producing manure stick as cooking fuel. However, a portion of solid manure is also being wasted that turned into a source of pollution. On the other hand improper storage and utilization of solid manure also cause leaching and drained off to water sources. Poultry manures are mostly used in fish ponds, to some extent in agricultural land and bigger portion are wasted and became a cause for pollution. Excess flow of liquid or solid manure and wash water causes accumulation of excess nutrients in water, especially N and P, organic debris and spreading of public health concern microorganism, especially *E. coli* and *Salmonella.* All these may make surface water harmful for household or agricultural use. However, the extent of water pollution due to livestock farm waste is unknown as there were no such research has been conducted in Bangladesh to the best of our knowledge. Therefore, this research was conducted to study the water quality as affected by livestock and poultry farm waste.

For the above purpose, total 52 cattle and poultry farms were selected from Sirajganj, Munshigonj and Dhaka (Savar) those are adjacent to water bodies and somehow connected or have chance to contaminate water bodies by farm manure. Farm waste water/liquid slurry/water samples were collected from three different points; exit point of waste from farm (S-1), point of mixing waste to water bodies (S-2) and finally from the point where water is used by households (S-3). Laboratory analysis on pH, total dissolved solids (TDS), electrical conductivity (EC), dissolved oxygen (DO), chemical oxygen demand (COD) and microbial load determination concerning public health hazard (*E coli*, *Salmonella*) were performed.

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

Sampling point		Physicochemical characteristics				
		pH	TDS (ppm)	EC (µS/cm)	DO (mg/L)	COD (mg/L)
S-1	**Mean**	**7.42**	**2601.0**	**5173.0**	**0.68**	**3822.7**
	Max	8.03	10000.0	20000.0	1.68	20780.0
	Min	6.15	340.0	660.0	0.11	488.0
S-2	**Mean**	**7.63**	**210.0**	**417.0**	**3.97**	**201.2**
	Max	8.43	950.0	1820.0	5.95	1268.0
	Min	6.5	70.0	140.0	2.05	21.0
S-3	**Mean**	**7.78**	**154.0**	**311.0**	**4.87**	**40.4**
	Max	8.39	810.0	1610.0	6.94	223.0
	Min	6.81	60.0	120.0	2.55	10.0
ECR 1997*		6.5-8.5	Max 1000	Max 1200	4.5-8.0	Max 200

*ECR, 1997; Environment Conservation Rules, 1997

Table 2. Microbial contamination in effluent and water for household use as affected by farm manure.

Sampling point	Microbial load (Log_{10}CFU/ml)			
	E. coli		*Salmonella*	
	% Positive	Count	% Positive	Count
S-1	100	5.7	23.1	0.83
S-2	40.4	1.86	21.2	0.67
S-3	17.3	0.79	9.2	0.40
ECR, 1997*	1.0-1.7		0	

*ECR, 1997; Environment Conservation Rules, 1997

Table 1 showed the water quality parameters like, pH, TDS, EC, DO and COD as affected by farm manure. It was found that the average pH as well as the highest value were within the limit of ECR 1997 in S-1, S-2 and S-3. However, in some cases in S-1 minimum value was found lower than ECR 1997. Average TDS and EC values were remained in normal range in S-2 and S-3, while it exceeded in S-1. Maximum value of EC in S-2 and S-3 was recorded higher in some observations compared to ECR 1997. Average DO and COD levels were found in normal range only in the case of S-3. However, overall DO level was tended to be below the standard as indicated by Minimum value, while COD tended to be exceeded as indicated by Maximum value. Again, fecal *E. coli* was found positive in 100, 40.3 and 17.3% of total samples in S-1, S-2 and S-3 with concentrations were 5.7, 1.86 and 0.79 log_{10}CFU/ml, respectively. While *Salmonella* was found positive in 23.1, 21.2 and 9.2% cases in S-1, S-2 and S-3 at a rate of 0.83, 0.67 and 0.4 log_{10}CFU/ml, respectively.

Based on the current study, it can be concluded that, the livestock farm manure is contaminating surface water for household use in variable levels. Measures are needed to stop flow of farm manure effluent to any water bodies. However, expanded study should be conducted to derive final conclusion.

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

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Executive Summary

Tagging animals properly for identifying as well as recording different features of productive and reproductive performance of individuals and pedigree are the key tools for improving genetic potentiality along with the production of livestock. In developed countries, farmers are recording animals properly by using different software on electronic devices. However, in Bangladesh record keeping is a tedious job, and sometimes due to lack of available records further forecasting on breeding becomes stunted. Considering these facts, the present activity was conducted to develop a smart animal recording system through a combination of mobile and computer applications and store information in a central recording pool (unit) maintained by BLRI.

To achieve these objective animals were selected and Artificial Insemination (AI) was conducted in the project area. For developing a central recording pool, data recording software was developed and it was validated in Anwara, Chittagong. After validation, a data recording training program was conducted. Subsequently, farmer and animal enrolment was conducted by a field assistant under the supervision of a scientific officer. However, in this year Artificial insemination (AI), reproductive and productive data were enrolled in the software throw mobile and data was recorded analyzed in the software by couture.

After data analysis, it was observed that a total of 1495 AI was conducted in the project area and after AI 665 calves were born, based on pedigree records 279 newborn calves were recorded as pure RCC and 386 calves were recorded as graded RCC. Considering reproductive traits it was observed that, Age at puberty (months), Age at first calving (months), and Post-partum heat period (PPHP) (days) were significantly ($p<0.05$) lower in RCC compared with indigenous cattle (Table: 1). On the other hand, considering dairy productive traits it was observed that daily average milk yield and total lactation milk yield was significantly ($p<0.05$) higher in RCC compared to indigenous cattle. Moreover, the highest milk production was recorded at 5.50 L/day and average milk production was highest (3.10±0.13) on the fourth lactation with a 230±5.16 day's lactation period (Figure: 1). Considering, the comparative growth performance of pure and the graded RCC calves up to 12 months it was observed that the growth rate of RCC was higher than graded RCC and, the average daily weight gain of RCC and graded RCC was 0.197g/day and 0.175g/day respectively (Figure: 2). In the experimented area most of the RCC and graded RCC was in the growing stage. As, it is an ongoing project, we can harvest only 12-month data of RCC calves produced after AI. Hence, after completing the project, the selection of superior sires and dams having high genetic merit will be established.

Table 1: Reproductive and dairy traits of RCC in the selected areas

Parameter	**Traits**	**RCC (Mean±SD)**	**Indigenous (Mean±SD)**	**Level of significance**
Reproductive traits	Age at puberty (months)	27.28±7.44	33.31±8.03	**
	Age at first calving (months)	38.15±7.66	44.45±8.50	**
	Post-partum heat period (PPHP) (days)	59.37±28.77	88.46±56.94	**

	Calving interval (months)	12.18±1.65	12.66±1.73	NS
Dairy productive traits	Lactation length (days)	188.43±2.09	186.76±2.05	NS
	Total lactation milk yield (liters)	572.48±59.13	420.16±25.75	**
	Daily average milk yield (liters)	2.14±0.22	1.26±0.10	**

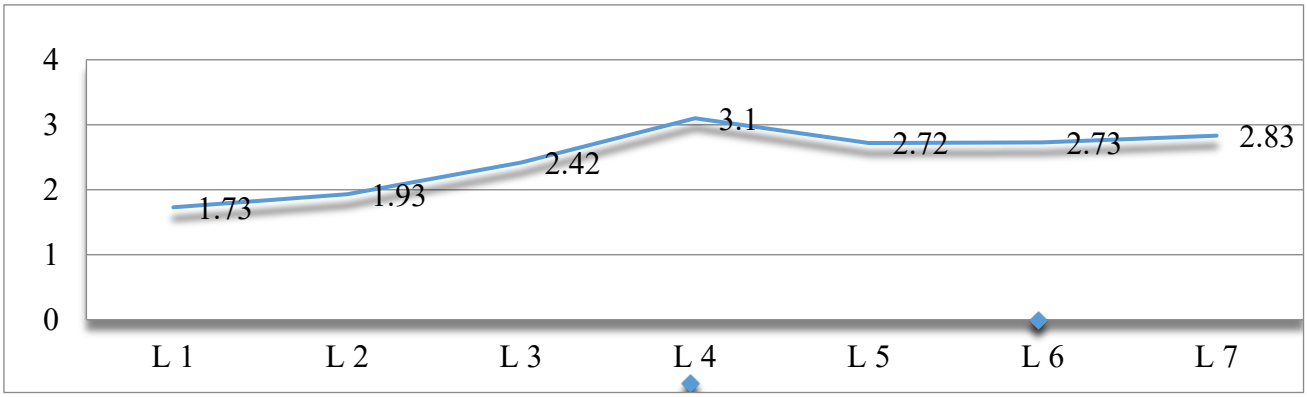

Figure: 1. Lactation carve of RCC cattle

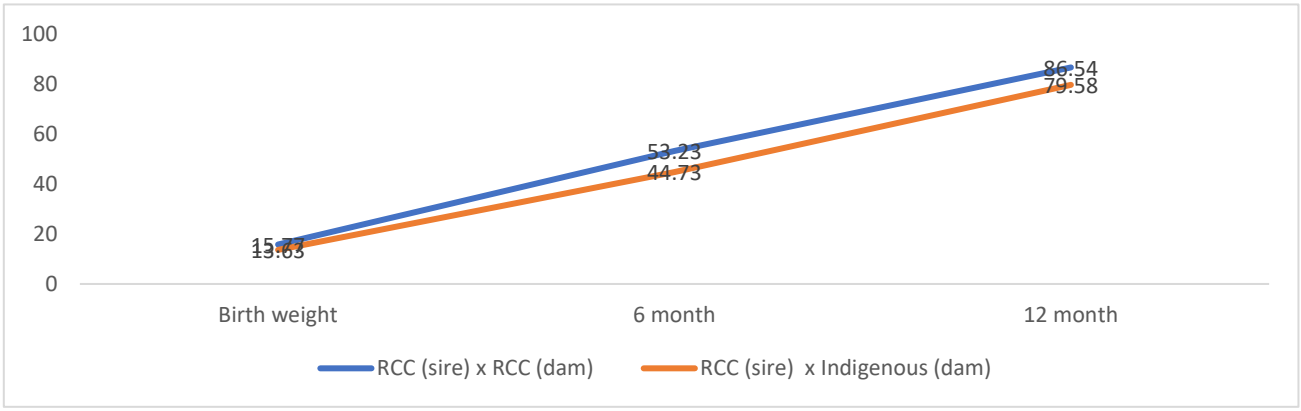

Figure: 2. Comparative growth performance of pure and graded RCC calves up to 12 months

Development of low cost feeding system for Red Chittagong Cattle through the supplementation of locally available fodder

Sub title: Baseline survey of available feed resources in RCC rearing area

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Executive Summary

The Red Chittagong cattle (RCC) have been historically identified as one of the promising variety of domestic animal genetic resource mostly localized in southern part of Bangladesh. Recently, most of the promising farmers are pointing out their interest to rear and established the modern farms with the RCC verities throughout the country. However, improvement of feeding/management through high cost involvement can restrict their use in proper amount, causing obstruction in RCC production. Thus development of low cost feeding system is a growing interest day by day with the motivation of farmers on the benefits of RCC rearing, feeds and fodder fortification, fodder production, profitability assessment, health management, etc. Therefore, to assess the low cost feeding practice on the RCC prone areas based on straw with green forages/legumes, straw with household vegetable wastes, locally available fodders, a baseline survey of existing population of RCC, distribution pattern, feeding and management practices in substance rural RCC farming system was executed. This study was conducted in four RCC concentrated areas (Satkania, Anowara, Patia and Chandanaish Upazila of Chattogram) previously selected location of "Red Chittagong Cattle Conservation and Development" project executed and funded by BLRI, Savar, Dhaka. A survey with direct interview method was conducted during April to July, 2021, on twenty eight (28) RCC raising farmers from these four locations taking 7 farmers in each location. Data were collected from these selected farmers with well-developed, pre-tested objective-based questionnaire contained information on the existing RCC population and distribution, existing feeding practice and management systems of RCC, feeds availability and fodder cultivation. Collected data were analyzed using MS Excel and SPSS 20 software with descriptive statistics.

Result showed that, about 67.45, 64.66, 55.98 and 69.88% farmers reared RCC among the total livestock population in Satkania, Anowara, Patia and Chandanish Upazila, respectively. The distribution of RCC population with the different categories of cattle, highest number of average herd size in Chandanish (3.45±0.09) was found with comprises highest number of milking cows (9.56) followed by Anowara (2.08±0.07), Satkania (1.98±0.11) and Patia (1.78±0.02). However, all the regions comprises maximum number (76.56%) of milking cows ranging from 3.22 to 9.56 followed by heifers (2.88 to 5.44) and pregnant cows (2.85 to 3.32), while dry cattle, breeding bulls and bullock were found lowest number in all the study areas. Maximum milking cows were found in Chandanish (7-9) and minimum were in Patia (3-7). Considering four rearing systems (Table 1), maximum farmers in Satkania (34.99%), Patia (39.88%) and Chandanish (31.76%) upazila were practiced extensive rearing system, while in Anowara, farmers were found to practice more intensive system (40.00%) for rearing their RCC cattle. Regardless of areas, stall feeding and grazing system were found 29.40% and 45.97%, respectively. Result revealed that, only in summer season crushed rice, broken wheat, maize kernel, ready feed etc., straw, hay, silage, stover etc. and Napier, Para, German, sorghum etc. were provided as concentrates, roughage and fodders for RCC in these four locations. However, only mixer of concentrates and straw were provided in rainy and winter seasons for RCC cattle (Table not shown).

Table 1 RCC Rearing systems practiced by farmers (%) in four areas

Rearing system (%)	Areas				Overall
	Satkania	Anowara	Patia	Chandanish	
Tethering	13.55	10.03	9.19	19.88	15.77
Extensive	34.99	29.88	39.88	31.76	32.99
Semi-intensive	26.77	20.09	17.98	22.27	22.78
Intensive	24.69	40.00	32.95	26.09	28.46

Table 2 Feed processing technology adopted by the farmers

Areas (%)	Hay	Silage	Treated straw	Chopped roughages	Ready feed
Satkania	-	2.66	12.88	57.88	14.99
Anowara	0.88	4.77	5.99	61.64	8.55
Patia	1.55	3.88	2.77	45.77	23.66
Chandanish.	2.65	5.87	9.86	66.33	18.99

Result of different feed processing technology adopted by farmers in four locations are presented in Table 2. Maximum farmers from this locations (57.88% in Satkania, 61.64% in Anowara, 45.77% in Patai and 66.33% in Candanish) were adopted chopped roughages techniques for feeding their RCC cattle.

Farmers are less interested to use roughages as hay for supplying feed to their animals. But, they are more interested to use cultivate maize than kalai fodder for their animal. About 35.67%, 45.55%, 51.78 and 39.66% farmers cultivated maize as fodder from four areas, respectively.

Farmers in the study areas were supplied with grass, straw and concentrate as 8.78-15.55kg, 7.96-9.78kg, and 0.88-1.58kg daily per cow, respectively (Table 3). The whole rice straw was fed by the majority of farmers (about 49%) in the study areas (Table not shown). Many farmers (about 27%) preferred to soak it with water before feeding. In fact, feeding method of straw followed by the farmers was almost similar in two areas except feeding straw mixed with green grass.

Table 3 Quantity of feed supplied to the RCC cattle

Types of Cow	Feed supply (Kg/head/day)		
	Fodder/grass	Straw	Concentrates
Milking cow	13.89	9.09	1.33
Pregnant cow	12.66	8.55	1.78
Dry cow	8.78	7.95	0.88
Adult cattle	15.55	9.78	1.58

Based on the study conducted in the field there were four systems of cattle rearing, while intensive system was more preferred in Anowara and the farmers from there, reared 64.66% cattle as RCC bred types. Farmers from the study areas preferred to cultivate maize, kalai and napier and chopped their grass to their cattle. Over all, farmers supplied grass, straw and conc. as 8.78-15.55kg, 7.96-9.78kg, and .88-1.58kg daily per cow, respectively. This findings represents only four locations with considering very few sampling data, thus for drawing more precise perception about the feeding practices and management system more data should counted in further documentation of these areas.

Development of community breeding model for Red Chittagong Cattle

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Executive summary

Red Chittagong Cattle (RCC) is one of the promising variety of cattle in Bangladesh. This variety evolved in the locality by natural selection and breeding among themselves for a long historic period. Purity of this variety are declining due to indiscriminate breeding within the native stock and crossbreeding with exotic breeds. In order to maintain the purity of Red Chittagong Cattle, it is important to maintain the purity during breeding with either natural mating or artificial insemination. Community based breeding program have been considered as a sustainable option to conserve and to improve RCC production under smallholder conditions and in low-input system. Local communities have a vested interest in all the natural resources on which their livelihoods depend. As a result, communities are the best places of conserving local farm animal genetic resources. Thus, the present study was designed with the objectives to develop a sustainable community led pure breeding program for Red Chittagong Cattle. For the formation of model RCC community, farmers having at least one RCC cow or heifer preferably nearest peripheral circle was selected and registered under the project in the selected upazilla of Chattogram division. Other than Chattogram division, farmers having at least one pure indigenous cow or heifer preferably nearest peripheral circle was selected and registered under the project. Total 2800 farmers were selected in 15 project area and their animals (RCC and pure indigenous) were registered with permanent marking.Among the registered adult cow, overall 62% animals were inseminated so far by using pure RCC semen Among the registered animals 58% are RCC and rest of them are pure indigenous cattle. To ensure semen of pure meritorious RCC bull for the community members, semen collection, evaluation and cryopreservation was done at BLRI. Six (6) pedigree tested pure meritorious RCC bull was supplied to DLS for production of frozen semen. Both BLRI and DLS ensure the supply of RCC frozen semen to the community on regular basis for artificial insemination to maintain purity of Red Chittagong cattle. Till date 15000 doses of frozen semen has been prepared and distributed and 2995 AI were done so far in the project area with an average conception rate of 62.17% (Table 1). Till date 568 RCC and graded calves has born where 324 were male calf and 244 were female calf (Table 1). Body weight of pure RCC and graded RCC calves was found (15.77 ± 0.62) and (13.69 ± 0.78) kg respectively.

Table 1 Community breeding statistics of Red Chittagong Cattle

Project area	No of AI performed	Non-return after 60 days of AI	Non - return rate (%)	No of calf born	Calf sex	
					Male	Female
Patia	143	118	82.52	48	28	20
Chandonaish	115	82	71.30	49	32	17
Anowara	126	93	73.80	52	22	30
Satkania	120	33	71.67	47	32	15
Hathazari	113	74	65.49	43	28	15
Bashkhali	87	60	68.96	40	22	18
Swandip	64	42	65.63	13	7	6
Jaintapur	83	50	60.24	32	13	19

Keshobpur	60	26	43.33	26	14	12
Naikhongchori	18	13	72.22	9	5	4
Rajshahi	1800	1114	61.89	150	87	63
Sakhipur	196	115	58.67	43	26	17
Kurigram	70	42	60.00	16	8	8
Total	2995	1862	62.17	568	324	244

Table 2 Productive and reproductive characteristics of RCC at community level

Parameter	Mean±SD
Male calf body weight (kg)	15.39 ±0.87
Female calf body weight (kg)	13.22 ± 0.81
Service per conception (no.)	1.54±0.16
Postpartum heat period (days)	73.41± 8.34

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

Ovum pick up based *in vitro* embryo production technology for production of Red Chittagong calves

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Executive summary

In vitro embryo production (IVP) technology is used to exploit female genetic superiority. The IVP technology has been using in many developed and developing countries for assisting genetic progress in conventional cattle breeding programme. The ovum pick up (OPU) in combination with conventional *in vitro* embryo production (IVEP) 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 Red Chittagong Cattle (RCC) through transfer of OPU derived embryos. The ocytes were collected throughout the experimental period from six regular breeder RC cows of BLRI RCC herd 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 Cumulus oocyte complex 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 iuml penicillin, 0.1 mg/ml streptomycin and 5 iu/ml heparin. To minimize abdominal straining during OPU, epidural anesthesia was performed with 5 ml of lidocaine. A twice/week OPU schedule was used for collection of oocytes from elite donor cows. The aspirated material were poured onto a 100-mm petridish containing TL-HEPES (114-mM sodium chloride, 3.2-mM potassium chloride, 2-mM sodium bicarbonate, 0.34-mM sodium biphosphate, 10-mM sodium lactate, 0.5-mM magnesium chloride, 2.0-mM calcium chloride, 10-mM hepes, 1 µl/ml phenol red, 100 IU/mL penicillin, and 0.1 mg/ml streptomycin) solution and the cumulus-oocyte-complexes (COCs) were searched under a microscope at low magnification (4x). All the OPU derived COCs irrespective of their quality were subjected to *in vitro* maturation. The COCs were washed 2-3 times in TL-HEPES and 2-3 times in IVM medium (TCM199 + 10% FBS, 1 µg/mL β-estradiol, 10 µg/mL FSH, 0.6-mM cystein, and 0.2-mM sodium pyruvate) before placing them into GPH dish containing IVM medium for 22 to 24 hr.

During this experimental period, thirty OPU sessions were conducted. Oocyte were recovered from twelve 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*. Results showed that average diameter of small, medium and large follicles were 5.76 mm, 9.44 mm and 11.54 mm, respectively. Aspirated follicles were belonged to small (11.0%), medium (61.7%) and large (27.3%) follicles, respectively. Total 62 follicles were punctured and 34 cumulus-oocyte-complexes were recovered. The *in vitro* maturation rate was 65.63%. However, no embryo developed beyond 4-cell stage.

Table 1 *In vitro* embryo production status of OPU derived oocytes from RCC cows

Follicle punctured	COCs recovered	COCs for IVM	COCs with cumulus expansion (%)	In vitro culture		
				Two cell (%)	Four cell (%)	Blastocyst (%)
62	34	32	21 (65.63%)	17 (53.13%)	13 (40.63%)	0

*Percentage was calculated on the basis of total no. of COCs placed for IVM

In conclusion, oocyte recovery rate in the OPU was moderated. This experiment concludes that current culture system support OPU derived in vitro embryo production upto 4-cell stage. Improvement of culture condition and higher quality of the OPU derived embryo may improve the efficiency of embryo production.

Project Title: Studies on the Farmers Innovative Technologies for Livestock Production in Bangladesh

Sub title: Effect of papaya leaf extract on growth performance, carcass characteristics and meat quality in broiler chickens

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Executive summary

Several types of alternatives have been used to alter the role of antibiotics in poultry production including prebiotic, probiotics, enzymes and fermented feed. Also, phytogenic feed additives have currently attracted more considerable attention among the poultry specialists. Even some innovative farmers are traditionally being used it as a medicinal action in poultry production instead of the application of an antibiotic or vaccine and being reduced the unnecessary cost of medicine. Phytogenic products commonly used in the diet of poultry as a feed additive for the improvement of performance, destroy or inhibit growth of microbes as well boost up the immune response. Of the sources of phytogenic, papaya leaf and seed both have been incorporated in diets of poultry as protein supplement as well feed additives to enhance the growth and well-being of birds. It has already been documented that papaya contain a natural source of papain, chymopapain A and B, and papaya peptidase A. Papain is a proteolytic that is able to increase protein digestion. Additionally, it contains broad-spectrum phytochemical components such alkaloids and phenols. Phenolic compounds which have high anti-oxidant activity and free radical scavenging ability, with the mechanism of inhibiting enzymes responsible for the production of reactive oxygen species. Therefore, the present study was conducted in the farmers' house based on the information of innovative farmers to assess the effect of supplementing papaya leaf extract (PLES) in drinking water on the growth performance, carcass characteristics and meat quality of broiler chickens. A total of 520 unsexed one-day-old Cobb-500 broiler chicks were randomly assigned to five treatment groups, with four replicates having twenty-six chicks in each group. Treatment groups were consisted as follows: 0.00 cc (control), 0.5 cc, 1.00 cc, 1.5 cc and 2.00 cc of PLES in 1000 ml of drinking water, respectively. The pre-starter, starter and grower diet were fed from 0 to 11, 12 to 26 and 27 to 37 days of age respectively. The birds were fed *ad-libitum* feed and drinking water during the entire experimental period. Body weight, weight gain, feed intake, feed conversion ratio (FCR) and broiler production efficiency factor (BPEF) were measured. For assessing carcass traits and meat quality, five birds were sacrificed from each group at the end of the experiment. The statistical analyses were performed using R-software.

In Table 1, the performance results of the present study showed that the cumulative body weight and weight gain were found higher in PLES groups as compared to the non-supplemented group during starter, grower and at end of the experimental period, but the effect did not reach to the significant level. The BPEF was also observed greater value under PLES groups. Feed intake and feed conversion ratio were not differed significantly among the treatment groups. Meat quality parameters in terms of drip loss and cooking loss of breast meat did not differ significantly between the treatments (Table 2). In addition, there was no significant difference in the carcass traits with respect to the relative proportion of dressed yield, breast, thigh, drumstick, back, wing and giblets (heart, liver and gizzard) weight in broiler chickens under this study (Table 3). Thus, the supplement of papaya leaf extract in drinking water can be used for the production of broiler chickens without any adverse effect.

Table 1 Effect of supplementing PLES in drinking water on growth performance of broiler chickens (mean ± SD)

Items	Treatments					P-value
	0.0 cc PLES	0.5 cc PLES	1.00 cc PLES	1.5 cc PLES	2.00 cc PLES	
Body weight (g/bird)						
0 day	42.462±0.031	42.462±0.031	42.471±0.037	42.481±0.022	42.471±0.019	0.868
11 day	390.804±4.897	387.308±8.123	388.269±4.768	380.769±9.085	380.096±15.887	0.432
26 day	1378.21±32.34	1373.99±39.10	1393.20±46.16	1382.16±36.71	1402.71±25.41	0.798

37 day	1881.93±62.50	1917.85±14.53	1932.28±56.33	1927.89±49.97	1952.43±45.24	0.377
Weight gain (g/bird)						
0-11 days	348.342±4.919	344.846±8.132	345.798±4.760	338.289±9.070	337.625±5.876	0.431
12-26 days	987.40±30.81	986.68±36.28	1004.93±44.79	1001.39±31.77	1022.61±16.50	0.553
27-37 days	503.72±76.27	543.86±35.44	539.08±56.16	545.73±67.82	549.72±22.77	0.768
0-37 days	1839.47±62.49	1875.39±14.56	1889.81±56.31	1885.41±49.97	1909.96±45.24	0.377
Feed intake (g/bird)						
0-11 days	376.908±7.699	371.539±0.146	374.135±0.249	373.558±0.161	376.635±0.259	0.204
12-26 days	1603.70±34.01	1601.93±36.45	1614.60±19.44	1606.48±15.90	1644.91±10.34	0.153
27-37 days	1209.03±151.67	1289.49±29.50	1271.76±53.15	1274.97±50.78	1291.21±83.33	0.651
0-37 days	3189.63±149.61	3262.96±24.91	3260.49±50.57	3255.00±42.20	3312.76±91.63	0.403
FCR						
0-11 days	1.082±0.04	1.078±0.03	1.082±0.01	1.105±0.03	1.117±0.05	0.445
12-26 days	1.625±0.02	1.624±0.02	1.609±0.06	1.605±0.04	1.609±0.02	0.882
27-37 days	2.409±0.096	2.377±0.123	2.372±0.164	2.354±0.193	2.349±0.112	0.975
0-37 days	1.733±0.03	1.740±0.02	1.726±0.04	1.727±0.03	1.734±0.02	0.950
BPEF						
0-37 days	106.10±2.56	107.80±2.11	109.58±5.57	109.23±4.59	110.13±2.90	0.579

Treatments: 0.00 cc PLES, 0.5 cc PLES, 1.00 cc PLES, 1.5 cc PLES and 2.00 cc PLES means supplementing 0.00 cc, 0.5 cc, 1.00 cc, 1.5 cc and 2.00 cc of papaya leaf extract (PLES) in 1000 ml of drinking water, respectively.

Table 2 Effect of supplementing PLES in drinking water on meat quality of broiler chickens (mean ± SD)

Item	Treatments					P-value
	0.0 cc PLES	0.5 cc PLES	1.00 cc PLES	1.5 cc PLES	2.00 cc PLES	
Drip loss (%)	6.104±0.22	7.243±1.04	6.686±0.45	5.822±1.30	6.517±0.46	0.306
Cooking loss (%)	26.163±0.13	27.531±5.19	29.840±2.25	25.260±5.90	26.026±1.66	0.608

Treatments: 0.00 cc PLES, 0.5 cc PLES, 1.00 cc PLES, 1.5 cc PLES and 2.00 cc PLES means supplementing 0.00 cc, 0.5 cc, 1.00 cc, 1.5 cc and 2.00 cc of papaya leaf extract (PLES) in 1000 ml of drinking water, respectively.

Table 3 Effect of supplementing PLES in drinking water on carcass characteristics of broiler chickens (mean ± SD)

Particulars	Treatments					P-value
	0.0 cc PLES	0.5 cc PLES	1.00 cc PLES	1.5 cc PLES	2.00 cc PLES	
Live wt. (g)	1900.00±10.00	1900.00±20.00	1930.00±36.06	1936.67±37.86	1910.00±20.00	0.367
Dressed wt. (g)	1226.67±59.53	1192.67±18.93	1270.33±49.32	1198.00±54.34	1216.00±60.51	0.405
Dressing (%)	64.56±2.82	62.77±0.46	65.81±1.71	61.90±3.70	63.65±2.50	0.401
Liver wt. (g)	39.67±2.52	38.33±3.06	38.67±2.89	40.33±4.04	40.67±3.51	0.875
Heart wt. (g)	7.33±1.53	9.33±3.51	10.67±1.53	6.67±1.53	7.33±1.53	0.180
Gizzard wt. (g)	34.33±6.51	32.33±6.66	34.33±8.62	33.33±5.03	36.67±4.04	0.937
Breast wt.(g)	399.33±22.74	393.33±34.08	402.67±23.18	404.67±5.03	406.67±5.03	0.943
Thigh wt. (g)	187.33±9.02	214.67±20.23	198.67±14.74	203.33±23.09	206.67±18.58	0.466
Drumstick wt.(g)	166.67±15.14	152.67±7.02	160.00±21.17	163.33±10.26	158.00±8.00	0.754
Wing wt. (g)	114.00±12.53	102.67±16.26	108.67±17.01	103.67±14.57	115.00±7.55	0.740
Back wt. (g)	244.00±24.88	192.33±47.96	194.67±20.21	198.00±28.48	193.67±11.37	0.220

Treatments: 0.00 cc PLES, 0.5 cc PLES, 1.00 cc PLES, 1.5 cc PLES and 2.00 cc PLES means supplementing 0.00 cc, 0.5 cc, 1.00 cc, 1.5 cc and 2.00 cc of papaya leaf extract (PLES) in 1000 ml of drinking water, respectively.

The intervention of BLRI Technology; adoption and improvement of livelihood of trained farmers in different zones of Bangladesh

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Executive summary

The intervention of Bangladesh Livestock Research Institue's (BLRI) technology, adoption of the technology among the livestock farmers, and its impact on the livelihood of trained farmers need to be assessed for strengthening the capacity of training and extension of technology in the livestock sector. The present study was conducted in Dhamrai, Jessore Sadar, and Naikhongchhari Upazilas of Dhaka, Jessore, and Bandarban districts respectively. A purposive sampling method was used to select 80 previously in 2019-20. trained livestock farmers to examine the extent of transfer of livestock technologies, adaptability and impact on livelihood in the selected areas for dairy & Poultry technology. Quantitative and qualitative data were collected using a questionnaire and were analyzed descriptively.

The majority of respondents were male (66.25%) compared to female (33.75%). The average age of the livestock farmers was 37.10±0.86 years. The average year of schooling was 9.05±0.24 years indicating the livestock farmers were not much educated. The level of education was found slightly higher in Jessore Sadar Upazila of Jessore district. Agriculture was the main occupation and 72.50% of livestock farmers found agriculture as their main occupation. The average family member was 5.10±0.19 and the highest (5.97±0.41)family member was found in Dhamrai Upazila and the lowest was in Jessore Sadar Upazila (4.57±0.14) that was mentioned in Table 1..

Table 1: Demographic characteristics of livestock farmers

Variables	Dhamrai	Jessore Sadar	Naikhongchhari	Overall
Gender				
Male (%)	50 (15)	83.33 (25)	65 (13)	66.25 (53)
Female (%)	50 (15)	16.67 (5)	35 (7)	33.75 (27)
Age (Mean±SE)	39.40±1.49	35.37±1.29	36.40±1.64	37.10±0.86
Year of schooling (Mean±SE)	9.13±0.31	9.60±0.44	8.10±0.52	9.05±0.24
Main Occupation				
Agriculture (%)	100 (30)	26.66 (8)	100 (20)	72.50 (58)
Family member (Mean±SE)	5.97±0.41	4.57±0.14	4.60±0.24	5.10±0.19

(Number in the parenthesis indicates the respondent number)

The average number of cattle reared by the respondent was highest in Dhamrai Upazila (5.83±0.20) followed by Naikhonchhari (2.45±0.62) and overall was 3.60±0.27. In the case of goats, the average number was found highest in Naikhonchhari (2.90±1.05) and the overall value was 1.58±0.34. The average number of poultry found was 279.76±43.98 and the highest was in Jessore Sadar (727.20±54.79). The results also showed that the livestock farmers were moderately knowledgeable and skilled in some of the following topics: housing or shed management, feeds or feeding management, breeding management, and health management. However, they were less knowledgeable and skilled in record keeping, account management, and marketing management. Moreover, in most of the cases, there was a difference found between knowledge and skill level. In most of the case skill level score was lower than knowledge level and were found statistically non-significant. It was also observed that after training all parameters of human assets were improved remarkably reported by most of the livestock farmers. However, most of the parameters of social assets, natural assets, and physical assets moderately improved reports by the livestock farmers. In the case of financial assets, cash in hand improved more than other

parameters found in the study. The annual income of all study areas was improved and the highest improvement occurred in Dhamrai Upazila (BDT 76133.33±4287.12) The overall change in annual income was BDT 65700.00±17309.35 and was also found statistically significant ($p<0.05$). The annual savings of all study areas was increased and overall improvement was (BDT 43232.88±17632.76) and found statistically significant ($p<0.05$). The highest increase of annual savings occurred in Naikhongchhari Upazila (BDT 51500.00±17612.87) and found was statistically significant ($p<0.05$).

Table 2: Livelihood improvement of trained farmers

SL. No.	Assets	Parameters	Improved (%)
1	Human Assets	Health and sanitation	91.25 (73)
		Education	90.00 (72)
		Training	91.25 (73)
		Knowledge/efficiency	53.75 (43)
		Access to information	82.50 (66)
2	Social Assets	Involvement in social group/activities	91.25 (73)
		Political involvement	37.50 (30)
		Self-managerial capability	52.50 (42)
		Social prestige	21.25 (17)
		Decision-making ability	91.25 (73)
		Women empowerment	43.75 (35)
3	Natural Assets	Cultivable land (Own)	15.00 (12)
		Cultivable land (mortgage in)	50.00 (40)
		Pond area	37.50 (30)
4	Physical Assets	Housing	50.00 (40)
		Furniture	58.75 (47)
		Agricultural Equipments	48.75 (39)
		Bicycle/motor cycle or van	57.50 (46)
		Tube well/pump	91.25 (73)
		Electricity	53.75 (43)
		TV/radio/DVD	48.75 (39)
		Cable network	43.75 (35)
		Freeze/computer	37.50 (30)
		Electric fan	91.25 (73)
		Mobile phone	53.75 (43)
		Toilet facility	53.75 (43)
5	Financial Assets	Cash in hand	52.50 (42)
		Cash in bank	13.75 (11)

(Number in the parenthesis indicates the respondent number)

It may be concluded that livestock farmers were moderately knowledgeable and skilled in most of the technologies. There were some lackings found in record keeping, account management, and marketing management than other managements, which are important components in the livestock production system and should be integrated into all livestock extension training programs. Furthermore, the intervention of BLRI technology was found effective in the improvement of the livelihoods of the livestock farmers. The technology intervention contribues to the dissemination and adoption of technologies at the field level and the development of the livestock sector in Bangladesh.

Morphometric characterization and productive performance of Jamunapari goat at BLRI

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Executive Summary

Goat is an important animal genetic resource in Bangladesh, obtained the fourth position in goat population in Asia. Jamunapari goat is a well-adaptive goat breed of Bangladesh mostly found in Chuadanga, Meherpur, Kushtia, Jhenidah, Pabna, and Jessore districts. Jamunapari goat originated in India and is known as the best dairy goat breed due to its heavier size and more milk production. The purpose of this research was just how much Jamunapari goat's production potentialities under the semi-intensive system at BLRI. A total of 283 Jamunapari goats were dispersed with 26 bucks and 95 does exploit for morphometric research. Several morphometric and productive attributes of the experimental goats were recorded during the period of January 2020 to March 2021. Animals were given a concentrate mixture containing 17% CP, 11 MJME/kg DM provided twice daily in the morning and the evening at the rate of 200, 250 and 100 g/d/h, respectively.

The mean along with standard errors for phenotypic observation of Jamunapari goat were in kid (0-6) 13.36±0.67(cm) head length, 15.92±0.93 (cm) ear length, 0.80±0.95 (cm) horn length, 11.16±0.33 (cm) eye to eye length, 9.44±0.44 (cm) tail length, in growing goat 17.26±0.87 (cm) head length, 21.20±1.20 (cm), ear length, 3.30±1.23 (cm) horn length, 13.13±0.42(cm) eye to eye length, 11.60±0.57 (cm) tail length, and in adult goat 20.93±0.37 (cm) head length, 21.49±0.51 (cm) ear length, 7.08±0.53 (cm) horn length, 14.76±0.18 (cm) eye to eye length,13.03±0.24 (cm) tail length. The mean along with standard error for morphometric characterization of Jamunapari goats body wt. (kg), body length (cm), wither height (cm), heart girth length (cm), height of rump (cm) in male and female, respectively 15.65±2.20, 41.30±2.18, 55.61±2.36, 57.03±2.56, 58.76±2.27, 21.12±1.15, 46.40±1.14, 58.22±1.23, 61.94±1.34, 60.95±1.19. The means along with standard errors for the productive performance of Jamunapari goat were 1.78±0.05 Litter Size, 0.60±0.01 ml/d dam milk production, 1.98±0.04 kg birth weight, 8.68±0.15 kg 3 month body weight, 13.06±0.20 kg 6 month body weight 73.87±1.75, 61.61±1.14 (g/d) 3 m growth rate, 1.91±0.09 (g/d) 6 m growth rate in winter, respectively in Summer (0.56±0.02 LS, 2.02±0.06 ml/d, 8.15±0.248 kg, 13.47±1.14 kg, 68.17±2.66 (g/d) 3 m growth rate, 63.54±7.63 (g/d) 6 m growth rate) in rainy season (1.86±0.10 LS, 0.53±0.02 ml/d, 1.97±0.06 kg, 8.25±0.28 kg, 13.13±0.40 kg 69.81±3.0 (g/d) 3 m growth rate, 61.44±2.20 (g/d) 6 m growth rate.

Table: Variance component and heritability estimation for different traits of Jamunapari Goat

Parameter	ϵ^2A	ϵ^2E	ϵ^2P	H^2±SE
Birth Weight (kg)	0.054	0.021	0.129	0.42±0.07
3 Month Body Weight (kg)	0.437	0.043	0.919	0.48±0.07
6 Month Body Weight (kg)	0.001	0.00	0.002	0.50±0.03

The effect of season on litter size, dam milk production (ml/day); 3 and 6 month body weight (kg); and 3 and 6 month growth rate (g/day) were found highly significant ($p<0.001$). The estimated heritability for birth weight (kg), 3-month body weight (kg), 6-month body weight (kg), were 0.42±0.07, 0.48±0.07 and 0.50±0.03, respectively. Negative correlation present litter size, dam milk production, 3 month body weight, growth rate (0-3 m), and growth rate (0-6 m) ranged (-0.01 to -0.10). Positive correlation present between dam milk production (ml/d), litter size, 3 month body weight, 6 month body weight, growth rate (0-3 m) and (0-6 m) ranged (0.01 to 0.96). Heritability estimation for birth weight (kg) (0.42±0.07), 3 month body weight (kg) (0.48±0.07), 6 month body weight (kg) (0.50±0.03) all reflect moderate heritable trait.

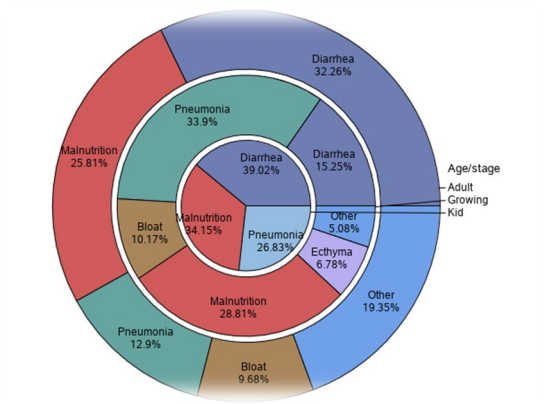

Figure: Causes of Death according to age (kid, growing, adult)

At BLRI, the most prevalent causes of mortality in Jamunapari goats were according to age (kid, growing, adult) pneumonia (26.83%, 33.9%, 12.9%), diarrhea (65.85%, 15.25%, 32.26%), malnutrition (34.1%, 28.81%, 25.81%), mechanical, poisoning, weakness, bloat and so on.

The observation mostly growth traits have a strong genetic and phenotypic correlation implies that selecting for one trait improves the other. As a result, top-ranked animals should be prioritized during selection and breeding, with these attributes being taken into account for the next generation's improvement. In conclusion, superior bucks and does will be selected by the individual performance score. The findings suggested for further research until a significant level of achievement to improve the Jamunapari goat at BLRI.

Exotic sheep adaptation and their crossbreds production in Bangladesh

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Executive Summary

Cattle, goat and chicken are the major and popular sources of meat in Bangladesh and animal protein demand is increasing day by day. Therefore, different species including sheep might be emphasized as a meat animal and crossbred sheep can be a potential resource to minimize the deficiency of animal protein in Bangladesh. Synthetic breed can be developed from a combination of two or more breed and with varying proportion of inheritance from each of the participating breeds. Once the desired blood level reached the synthetic breed can be treated as pure breed in the making and the breeding program will be selective breeding. However, no research has been done on synthetic sheep breed development in Bangladesh. Thus, the present study was undertaken to adapt high yielding exotic sheep breeds in local climatic condition and production of their crossbreds, to evaluate the productive and reproductive performances of different crossbred genotypes and to evaluate the adaptability of different crossbred genotypes in hot and humid climatic conditions. The breeding program was conducted at Sheep Research Farm, BLRI, Savar, Dhaka. All the sheep were kept in a well-ventilated permanent house on the slated floor raised above the ground with sufficient space to keep them comfortable. Green grass (*ad-libitum*) and concentrate (17% CP, 11MJ/kg DM) were supplied twice daily (morning and evening) at the rate of 1.5% of the body weight of animal per day. Pure breeding program was conducted with four different sheep breeds (Suffolk, Perendale, Dorper and Damara). For the production of synthetic sheep, cross breeding program was conducted initially with Suffolk, Dorper, Perendale and Damara as male line with Native sheep as female line. Superior native ewe which had passed at least one parity was selected as dam. Later, 50%-50% Damara-Coastal, Dorper-Coastal, Suffolk-Coastal and Perendale-Coastal sheep crossbred genotypes was produced and *inter-se* mating within all the crossbred genotype was practiced. The selection targets for the crossbreds were to improve birth weight, 6 months and 12 months body weight. The minimum targeted body weight at birth, 6 and 12 months were minimum 3, 20 kg and 30 kg, respectively. Data on productive and reproductive performances were recorded regularly. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0.

The production performance of exotic sheep is presented in table 1. The average litter size, birth weight (kg) and mature weight (kg) of perendale, dorper, suffolk and damara sheep were 1.43±0.50, 4.13±1.08 and 61.17±23.82; 1, 3.83±0.9 and 77.13±24.78; 1.40±0.45, 3.52±0.79 and 74.03±18.66; 1, 3.95±0.36 and 76.5±10.85, respectively. Birth weight had significance effect ($p<0.05$) among the breed. In case of F_2 generation crossbreds, litter size, body weight at 12 months and average daily gain at 12 months were found non-significant ($p>0.05$) while birth weight, body weight at 3, 6, 9 and average daily gain at 6 months were found significant ($p<0.05$ and $p<0.001$). The average birth weight, 6 months and 12 months body weight (kg) of Perendale, Dorper Suffolk and Damara crossbred sheep were 1.92±0.20, 10.67±1.82 and 19.29±2.08; 12.55±2.18 and 19.62±1.69; 1.82±0.36, 13.47±2.18 and 21.45±1.48, respectively. In case of Damara crossbred the values were 2.12±0.36 and 14.17±1.82 kg for birth weight and 6 months body weight, respectively. Among the crossbreds, highest birth weight was found in Dorper and Damara

crossbred genotype, respectively. In case of body weight at 6 months, highest value was found in Damara crossbred genotype. Highest body weight at 12 months was found in Suffolk crossbred genotype.

Table 1: Productive and reproductive performance of exotic sheep at BLRI (Mean±SD)-

Parameters	Exotic sheep genotype				Significance level
	Perendale	Dorper	Suffolk	Damara	
Litter size	1.43±0.50^{ab} (28)	1^{b} (7)	1.40±0.45^{a} (5)	1^{b} (9)	*
Birth weight (kg)	4.13±1.08 (28)	3.83±0.9 (7)	3.52±0.79 (5)	3.95±0.36 (9)	NS
Mature Body weight (kg)	61.17±23.82 (30)	77.13±24.78 (28)	74.03±18.66 (6)	76.5±10.85 (9)	NS

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

Table 2: Productive and reproductive performance of F_2 crossbred sheep (Mean±SD)-

Parameters	Crossbred sheep genotype				Significance level
	Perendale crossbred	Dorper crossbred	Suffolk crossbred	Damara crossbred	
Litter size	1.36±0.49 (22)	1.35±0.65 (34)	1.67±0.70 (5)	1.47±0.50 (36)	NS
Birth weight (kg)	1.92±0.20^{ab} (22)	2.11±0.41 ^{a} (34)	1.82±0.36 ^{b} (5)	2.12±0.36^{a} (36)	*
Body weight at 3 months (kg)	7.60±1.75^{b} (20)	8.93±2.24^{ab} (28)	7.3±1.82^{b} (4)	9.66±0.88^{b} (44)	*
Body weight at 6 months (kg)	10.67±1.82^{b} (20)	12.55±2.18^{ab} (28)	13.47±2.18^{a} (3)	14.17±1.82^{a} (22)	***
Body weight at 9 months (kg)	14.27±2.24^{b} (9)	15.71±2.11^{b} (16)	19.15±0.78^{a} (2)	-	*
Body weight at 12 months (kg)	19.29±2.08 (7)	19.62±1.69 (13)	21.45±1.48 (2)	-	NS
Average daily weight gain at 6 months (0-6 months, g/d)	47.97±9.99^{b} (20)	56.99±12.39^{ab} (28)	63.37±9.97^{a} (3)	66.43±10.41^{a} (22)	***
Average daily weight gain at 12 months (0-12 months, g/d)	47.39±5.65 (7)	47.84±4.76 (13)	52.88±4.26 (2)	-	NS

Figure in the parenthesis indicate the number of observations. ***= significant (p=0.000-0.001), *= significant (p=0.01-0.05), NS= Non significance (p>0.05)

In conclusion, superior rams and ewes should be selected on the basis of individual performance in every generation. The encouraging results also indicate that further research should be continued to produce a synthetic sheep breed suitable in local climatic conditions.

Production and adaptation of Bio-char as Soil amendment and C-sequestration for sustainable improvement of soil fertility in Sandy Soil.

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Executive summary

Bio-char is quite a novel approach having potential benefits to both environment and agriculture. It has the ability to aid in coping up with the greenhouse gases (GHG) and is helpful for carbon sequestration. Bio-char is made by pyrolysis, the thermochemical decomposition of organic materials at elevated temperatures (300-500 ^{0}C) under anaerobic conditions. Bio-char can be produced from animal manure, crop residue, bio-solids, paper mill waste and many other types of feed stocks. Recently, Bio-char has gained much attention as a soil amendment (Lehmann *et al*., 2006). Bio-char makes more reducing and oxidized soils. It lowers the Eh (electron activity) and increases the ph. The objectives of this research was to quantify the combined effect of Bio-char and mineral fertilizer on soil fertility, soil quality and soil organic carbon in char lands and another was to compare the production performance of BLRI Napier-3 variety using different types of Bio-char between on farm and on station level.

There were five treatments (T_1=control, T_2=Mineral fertilizer, T_3= Rice husk Bio-char, T_4=Cow dung Bio-char, T_5= Mineral fertilizer with cow dung) with three replications and each plot was 150m^2. To conduct this experiment, we were selected two farmers from Alokdea village and applied both type of Bio-char made from rice husk and cow dung. The production parameters of BLRI Napier-3 at 1st, 2nd and 3rd cutting were recorded. The data were analyzed using SPSS 20.0 statistical program and differences were determined by DMRT. Results revealed that biomass yield, number of tiller/hill, plant height, and leaf length in 1st, 2nd and 3rd cutting of BLRI Napier-3 fodder at both on-station and on-farm showed variation significantly ($P<0.05$). Group containing with cow dung Bio-char in both experimental sites showed higher biomass yield (kg/ha) comparatively to other treatment groups.

Table 1: Production performance of BLRI Napier-3 fodder at on-station

Parameter	Treatment group					P-value
	T_1	T_2	T_3	T_4	T_5	
1st cutting						
Leaf length (inch)	9.6±1.14	9.6±1.52	11.2±1.64	11±1.58	11.2±1.79	0.245
Plant height (inch)	11±1.58	11.4±1.14	12±1.58	12.4±2.41	11.4±1.52	0.712
No. of leaf/plant	6.0^{bc}±1.00	7.4^{b}±1.14	9.4^{a}±1.14	6.8^{b}±2.39	4.6^{c}±1.14	0.001
Tiller/hiller no.	3.6±0.89	3.4±1.14	3.4±1.14	1.14	3.4±0.55	0.461
Biomass yield (Kg/ha)	97.2^{d}±1.48	113.2^{c}±2.39	98.4^{d}±1.67	122.2^{a}±1.92	119.60^{b}±1.14	0.000
2nd cutting						
Leaf length (inch)	14.6^{a}±1.67	12.2^{b}±1.79	13.4^{ab}±1.14	12.8^{ab}±2.17	11.2^{b}±0.84	0.035
Plant height (inch)	12.2±0.84	12.2±1.64	13.4±1.14	12.6±2.30	11.4±1.14	0.355
No. of leaf/plant	7.4±1.14	7.8±0.84	8.2±0.84	6.8±1.79	7.8±1.92	0.583
Tiller/hiller no.	6.0^{a}±1.22	6.0^{a}±0.71	4.6^{ab}±0.89	6.0^{a}±1.22	3.8^{b}±0.84	0.005
Biomass yield (Kg/ha)	113.2^{d}±2.39	147.4^{c}±13.18	166.4^{b}±4.39	210.2^{a}±15.97	147.4^{c}±2.88	0.000
3rd cutting						
Leaf length (inch)	26.4^{c}±1.34	28.4^{bc}±1.67	32.0^{a}±1.58	28.8^{bc}±2.77	30.2^{ab}±1.48	0.002
Plant height (inch)	30.0^{c}±0.71	35.4^{b}±1.14	39.0^{a}±1.22	36.6^{ab}±5.03	40.0^{a}±1.58	0.000
No. of leaf/plant	11.0^{ab}±1.22	10.8^{ab}±1.30	10.2^{b}±0.84	12.4^{a}±0.89	10.0^{b}±1.58	0.039
Tiller/hiller no.	35.6^{d}±1.95	43.2^{c}±1.48	58.2^{a}±1.79	50.4^{b}±2.97	51.2^{b}±1.30	0.000

Biomass yield (Kg/ha)	236.8^{d}±5.12	304.8^{c}±8.35	329.8^{b}±13.44	586.2^{a}±27.33	341.2^{b}±10.47	0.000

^{a,b,c,d} means bearing uncommon superscripts in a row differ significantly. **= P<0.05 and value indicate-Mean ± Standard Deviation (SD)

Table 2: Production performance of BLRI Napier-3 fodder at on-farm

Parameter	Treatment group					p-value
	T_1	T_2	T_3	T_4	T_5	
1st cutting						
Leaf length (inch)	8.6±1.14	10.4±1.14	8.6±2.88	8.4±1.67	9±1.22	0.390
Plant height (inch)	9.2^{b}±1.30	11.2^{a}±0.84	12.6^{a}±1.14	11.0^{ab}±2.24	12.0^{a}±1.00	0.012
No.of leaf/plant	4.6^{c}±1.14	7.0^{ab}±1.87	7.8^{a}±0.84	7.4^{a}±1.52	5.6^{bc}±0.55	0.004
Tiller/hiller no.	3.8±0.84	4.0±1.00	4.0±1.00	4.0±1.00	3.6±0.89	0.947
Biomass yield (Kg/ha)	102.2^{c}±5.89	118.2^{b}±5.81	115.6^{b}±9.74	163.2^{a}±5.81	101.8^{c}±6.38	0.000
2nd cutting						
Leaf length (inch)	16.0^{a}±2.00	12.2^{b}±0.84	13.4^{b}±1.52	13.2^{b}±2.59	12.0^{b}±1.87	0.021
Plant height (inch)	10.6^{b}±1.14	14.2^{a}±0.84	14.0^{a}±1.58	14.6^{a}±1.95	11.6^{b}±2.07	0.002
No. of leaf/plant	6.0^{b}±1.00	9.4^{a}±1.14	10.8^{a}±1.48	10.6^{a}±1.14	7.4^{b}±1.14	0.000
Tiller/hiller no.	5.8±1.30	4.2±0.84	5.6±1.95	5±1.22	4.8±0.84	0.331
Biomass yield (Kg/ha)	119.6^{d}±2.97	191^{b}±7.52	171.2^{c}±4.60	261.2^{a}±4.38	116.6^{d}±10.45	0.000
3rd cutting						
Leaf length (inch)	27.2^{b}±1.48	30.4^{b}±2.51	34.8^{a}±3.35	36.4^{a}±4.22	30.8^{b}±1.92	0.000
Plant height (inch)	30.0±1.58	35.4±6.66	39.4±6.23	37.4±5.41	36.6±2.51	0.069
No. of leaf/plant	9.0^{c}±0.71	11.2^{bc}±1.92	13.6^{b}±1.67	18.2^{a}±4.60	10.6^{bc}±1.52	0.000
Tiller/hiller no.	35.0^{b}±6.93	39.6^{b}±7.99	58.2^{a}±2.39	42.4^{b}±5.46	41.0^{b}±6.52	0.000
Biomass yield (Kg/ha)	223.4^{e}±2.88	319.4^{d}±4.93	370.4^{b}±4.10	408.2^{a}±5.63	360^{c}±7.91	0.000

^{a,b,c,d,e} means bearing uncommon superscripts in a row differ significantly. **= P<0.05 and value indicate-Mean ± Standard Deviation (SD)

In conclusion, cow dung Bio-char in both on station and on-farm experimental site of BLRI Napier-3 fodder, at 1st, 2nd and 3rd cutting showed better production performance compared with other treatment groups.

Further study will continue to quantify the combined effect of Bio-char and mineral fertilizer on soil fertility, soil quality and soil organic carbon in char lands.

Comparative study on livestock structure at regional station of BLRI

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Executive summary

National priority on food security, poverty alleviation, employment creation and economic development through the improvement of livestock and poultry urges BLRI to develop technologies. Livestock farming varies from region to region due to variation in temperature, humidity, rainfall, solar radiation, air movement, agricultural pattern, of feeds and fodder etc. (Islam, 2013). BLRI has established five regional stations in different agro-ecological areas of the country. The study was taken into hand to strengthen the research activities of five regional stations of BLRI. To know the livestock population scenario and find out the opportunity of livestock technology intervention were the main objectives of this study. The data were collected from five regional stations through interviewing of 100 farmers in each station area and from five Upazila livestock office. All the data were collected through face to face Interview, focus group discussion (FGD) and Key information interview (KII).

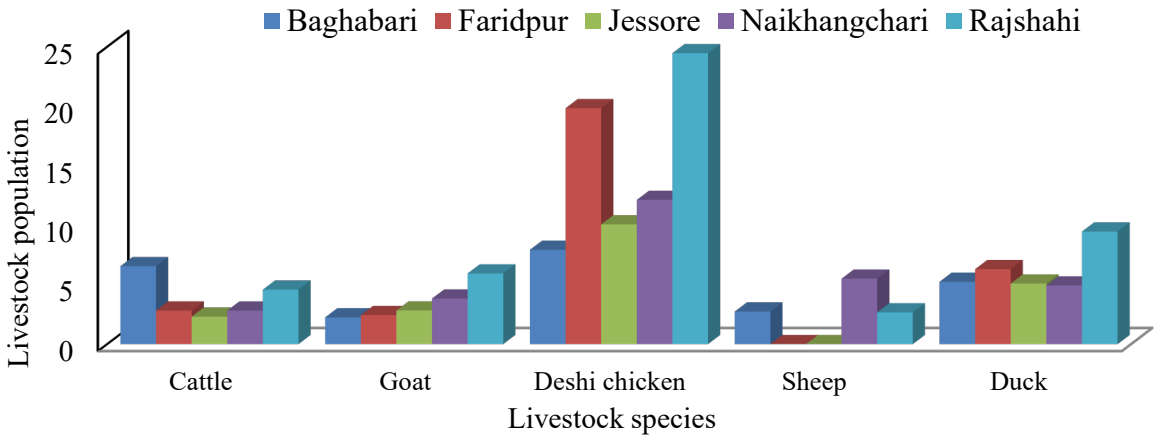

Figure 01: Livestock population per household

Table 01: Productive performance of livestock (five regional stations)

Regional Station	Milk prod. Cattle (L/D)	Lactation period (Days)	Annual Egg Production/bird		Adult body wt. (kg)		Fodder Prod.	
			Deshi chicken	Duck	Cattle	Goat	Farmer (%)	Ave. Land/farmer (Decimal)
Baghabari	13.74	265.23	81	120	286	24	98	65.21
Faridpur	5.28	232.15	87	109	230	23	4	13.25
Jessore	2.17	228.52	83.47	104.73	212	25	24	12
Naikhongchari	1.87	236.56	84.87	128	214	22.50	26	11.83
Rajshahi	1.20	245.16	78	116	195	20.2	0	0

The highest milk production in Baghabari (13.74 lit.) whereas lowest milk production in Rajshahi (1.20lit.) per cattle. There is no fodder cultivating farmer in Rajshahi. There is no fodder cultivating farmers in Rajshahi stations. *Matikalai* fodder is only cultivated at Baghabari station.

All the farmers of Baghabari vaccinate their animals and only 44% farmer of Naikhongchari vaccinate. In calf or kid stage most of the animal affected in diseases. Rainy season is mostly disease occurring season of animal. FMD in cattle highly occurred in Naikhongchari, PPR in goat highly occurred in Rajshahi and ND in poultry highly occurred at Jessore.

Table 02: Disease pattern of livestock and poultry

Regional Station	Preventive measure (%)		Affected Age (%)			Affected season (%)			Mostly occurring Disease (%)		
	Vaccine	Deworming	Kid/ calf	Growing	Adult	summer	rainy	winter	FMD for cattle	PPR for goat	ND for chicken
Baghabari	100	99	61	27	12	14.00	63.03	22.98	12.03	14.04	38.50
Faridpur	87	43	65	23	12	16.90	58.00	24.07	17.05	16.06	45.04
Jessore	79	85	68	21	11	15.09	66.45	18.46	21.45	17.20	62.33
Naikhongchari	44	57	63	27	10	18.88	59.68	21.44	24.00	19.02	55.05
Rajshahi	90	59	72	20	08	20.23	62.04	17.73	22.04	23.03	56.32

Table 03: Livestock dynamics of five Upazila where The RS of BLRI are situated

Parameters Farm (Population)	Locations				
	Naikhongchari	Baghabari	Jessore	Faridpur	Rajshahi
Cattle	74 (20510)	7720 (287273)	670 (101664)	13 (156)	603 (234625
Beef Fatting	105	2832	2174	194	250
Buffalo	30 (321)	- (2056)	27 (262)	- -	- 1344
Goat	115 (55000)	105 (63847)	435 (138825)	53 (31718)	165 (305909)
Sheep	12 (700)	85 (46609)	37 (530)	0 (50)	64 (17619)
Poultry	- (101840)	506 (1150710)	274 (6130232)	84 (346852)	428 (366159)
Duck	- (4500)	41 (123916)	34 (407289)	14 (102032)	161 (60274)
Special Fowl (Pigeon, Quail, Turkey, Goose)	- -	74 (28737)	98 (139343)	11 (30665)	32 (14725)
Fodder (Accor)	35 (120)	350 (700)	45 (50)	26 (18)	18 (22)

Source: DLS, 2021.

Data obtained from the Upazila livestock office and our survey results indicate that there are some opportunities of livestock technology intervention in that areas. In Naikhongcchari region feed processing & housing technology for cattle, goat, sheep and poultry rearing model are suitable for technology intervention. In Baghabari area feed and milk processing & fodder production technology for cattle; poultry rearing model and mastitis prevention model for cattle are satisfactory technology for intervention. In Jessore area feed processing & fodder production technology for cattle, goat, sheep, specialized water fowl rearing model with ND control model of poultry are appropriate for technology intervention. In Rajshahi and Faridpur region feed processing & fodder production technology for cattle, goat, sheep and special fowl rearing model fit best for technology intervention.

Most of the farmers interested in cattle farming, followed by poultry, sheep, goat and pigeon. It may be concluded that to set up some targets in selected agro-ecological areas such as awareness build-up; vaccination facility; make available of sustainable technologies; technical support of existing stock for ensuring increased livestock and poultry production as well as livelihood improvement of peoples.

COVID-19 Pandemic – Impact on Livestock Sector of Bangladesh

S Yasmin[1], M Ershaduzzaman[1], M J Alam[1], F A Huda[2] and M P Mostari[1]
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Executive Summary

Coronavirus or COVID-19 has made a devastating loss to the different sectors of the world. Of which, the livestock sector is the one of them, which is not directly affected by the virus, but indirectly has created an enormous economic loss to this sector mainly due to the lockdown. The lockdown has created several issues i.e., declining the demand as well supplying of animal products. In addition, there is a rumor that COVID-19 can be spread through the consumption of animal products. The coronavirus pandemic has been a public health emergency in Bangladesh, and the continuous phase of lockdown for a long period has created a major impact on the different sectors of the country. Various sectors have been affected drastically, and in the pre-Covid period, the livestock and poultry sector were the fastest growing sector in Bangladesh, which is tremendously affected by COVID-19. There is an enormous impact of COVID-19 and its associated lockdown on livestock and poultry sectors in Bangladesh that includes impact on dairy and associated value chain, poultry, nutrition, and health care and labor availability. In this context, the present study attempted to depict the economic analysis that indirectly reflects the impact of the COVID-19 outbreak in Bangladesh on the livestock sector.

The significant changes in the global consumption and demand for animal products, along with increasing pressures on resources, are having some important implications for the principal production systems. Increasing the supply of animal products can be achieved by combining an increase in the number of animals with the improvement of productivity, and processing marketing efficiency (Rifikin, 2002). In Bangladesh, land availability limits the expansion of livestock numbers in extensive production systems in most regions, and the bulk of the increase in livestock production will come from increased productivity through intensification and wider adoption of existing and new production and marketing technologies. Concerning structural changes in livestock production systems, the strongest trend has been the advent, and subsequent fast expansion, of industrial, vertically integrated, large-scale livestock production, particularly eggs and broiler production. The livestock sector in Bangladesh, which comprises 0.3 million dairy farms are compelled to shut down their production due to interrupting the supply chain of milk. The fresh milk price was 75% lowered compared to the pre-COVID pandemic situation. Animals will lack the provision of an adequate balanced ration when there is low input that will give rise to an output of these products due to the lockdown orders in most of the affected countries. Consequently, farmers will have reduced income due to low production and where there is statuesque maintaining of production output, there are low economic sales of these animal products which is forcing farmers to sell at very low prices forgetting profits due to lack or inadequate processing and storage facilities to make them available for a long period. Hence, there is a need for the use of existing and innovation for improving the shelf-life of products.

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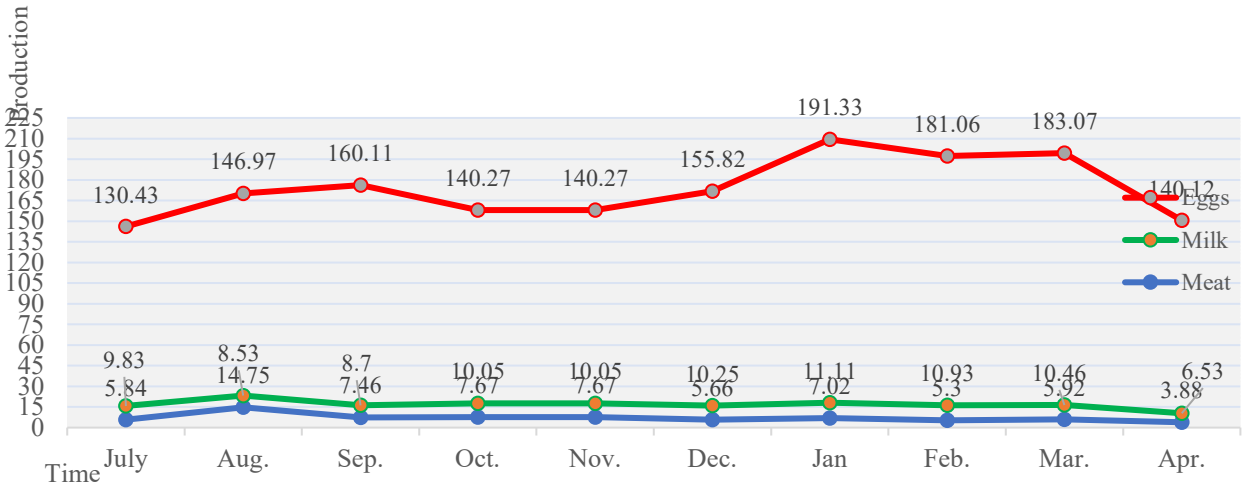

Fig. 1: Production trend of milk meat and eggs

Cattle and dairy farm's income was found highly vulnerable compared to the threshold situation in the pre-pandemic situation. The milk income drastically falls and the straw price was breaking its records of spiraling. The supply of raw materials is severely hampered by lockdown. The unavailability of roughage and straws compelled farmers to force the selling of animals. But the force selling animal price was also recorded lowest in the recent period. The pandemic associated lockdown drastically reduced live broiler price on one hand and higher feed cost on another side. The average cost of broiler falls from 130 tk/kg to 85 tk/kg in the first web. The income vulnerability of the farmer's income was estimated at 42% at the time of the first web of a pandemic. The broiler feed price was sharply rising over the pandemic period due to import restrictions of the main ingredients. In case of the layer farmers first web of pandemic similarly affects the farmer's income. But the vulnerability of income is higher compared to broiler farmers. The fattener was also affected by pandemic but their income vulnerability is low because they are operating for long run business compared to EID occasion.

Table 1: Income vulnerability of livestock farms

Category of farmers	National income threshold	Pre-pandemic income BDT	Vulnerability level
Milk producer	32,000 BDT/Month	14200	58%
Fattener		34000	23%
Broiler farms		28,000	43%
Layer farms		58,000	37%
Small ruminant rarer		4200	17%

Source: Field survey 2020-21

As the production decreases due to the Covid-19 pandemic and it may create possible hunger in most developing countries of the world, it is noteworthy to say animal products suffer consumption as an average individual just wants to survive without considering the nutritional requirement of the body system for functionality and productivity. Animals suffer a great deal due to restrictions on the movement of personnel, availability of feed ingredients/ materials, drugs, and vaccines which are very vital in animal production. Farmers are making a lesser profit due to reduced consumption of different animal products, the paying of farm- workers is paramount and important in farm growth and their income would susceptible

Impact of recent outbreaks of lumpy skin disease (LSD) on Northern dairy dominant areas in Bangladesh

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Executive Summary

Quantifying the economic impact of an animal disease outbreak is the most important in supporting ~~of~~ prevention and control decisions for improving animal health. While the direct disease costs are important, indirect costs are also of concern because the costs of disease do not stop at the farm-gate, within the agricultural sector, or after disease freedom is declared. The disease can affect a wide range of sectors of the economy. Lumpy Skin Disease (LSD) is a new, highly infectious and economically important transboundary disease of cattle in Bangladesh caused by LSD virus, characterized by fever and nodular lesions in the skin covering all parts of the body, which impacted severely in milk yields and as well as production of cattle. The study is an attempt to measure the losses of the farmers due to the outbreak of LSD with the objectives to measure the direct costs (economic costs) and indirect costs of LSD by livestock keepers and formulate the policy recommendations.

To accomplish the objectives, primary data were collected from 369 farmers of northern districts (Sirajganj, Nilphamari, Rangpur, and Dinajpur). Multistage and purposive sampling technique was followed for selecting the respondents who have only faced LSD in their livestock farms. In the case of cross-bred, we found, only two types: Holstein Friesian and Shahiwal. Holstein Friesian can give up to 20 liters of milk and Shahiwal can give maximum of 8-10 liters of milk. About 80% of our cross-breeds samples are Holstein Friesian and the rest~~s~~ are Shahiwal. Of the 369 samples, we interviewed 102, 88, 89, and 100 (you mentioning total number of samples is 369 but summation of 102+88+89+100=379, please correct the number of samples) farmers respectively from Dinajpur, Nilphamari, Rangpur, and Sirajganj Upazila, where 44 from local breed, 260 cross breed, 53 from mixed local and cross bred and 12 were from mixed farms, of which other than dairy cows were affected like fattening cows. In this study, the epidemiological model result was integrated with an economic model to enable estimation of the economic impacts of outbreaks of lumpy skin disease. Two types of cost were measured here, which are direct and indirect disease costs. Direct disease costs are the costs that include animal disease, including animal mortality, morbidity, and associated response costs. On the other hand, indirect costs were defined as the economic losses incurred in markets after disease freedom is declared.

From our survey, we found about 75% are above 40 years old, and most of them have more than a secondary level of education with a 21% of complete secondary or higher education. The sampled respondents' socioeconomic status or wealth index is nearly equally distributed among 5 categories from the lowest quantile to the highest quantile, like lowest (poor) - 20%, second (lower middle class) - 20%, middle (middle class) – 20%, fourth (upper-middle class) – 24% and highest (rich) – 16%. A good number of cross breed cows in all four districts, of which 72%, 15%, 15%, and 71% were affected in LSD among 613, 1158, 1504, 728 cows in Dinajpur, Nilphamari, Sirajganj and Rangpur, respectively. The average herd size of milking cows (local breed) before the outbreak, was 2.06 of which the average affected number of cows was 1.52 (Table 6), and for cross breed the values were 4.46 and 1.94. No farm animal has found to die in Nilphamari district. In Sirajganj, 4 claves and two young animals died. In Dinajpur, 20 calves had died while in Rangpur, 15 calves, 5 young and 3 adult animals found died due to LSD attack.

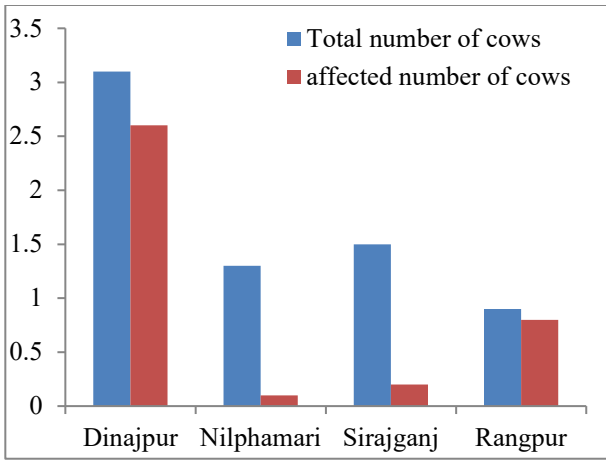

Figure 1: Average herd size and affected cows in local-breed

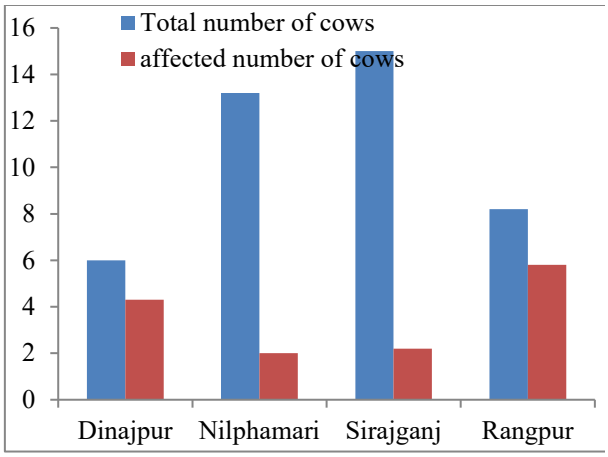

Figure 2: Average herd size and affected cows in cross-breed

The cross-breed farm has the highest lactation period but the highest and lowest lactation period has been noticed (considering the area) respectively, in the Nilphamari and Sirajganj districts (257 days), and Dinajpur district (212 days). The highest average milk production per day has been found in the Rangpur district (7.89 liter), while the lowest in the Nilphamari (5.16 liter).

The price of milk ranges from 36 to 60 taka per liter, across all four districts. The average milk loss have been estimated as 12%, and 13% respectively in local and cross-bred farms, while 31%, 7%, 30%, and 9% losses are in Dinajpur, Nilphamari, Rangpur and Sirajganj, respectively. The recovery cost due to weight loss were estimated as taka 1156 and 5446 for the local breed and cross-breed cows, respectively. The weight loss recovery cost was higher in Rangpur (taka 12199) and it was the lowest in Sirajganj (taka 2239). Treatment cost also followed the same trend with the highest in Rangpur (taka13379) and it was the lowest in Sirajganj (taka 2502). The recovery period of severely affected lactating cows were 7 days.

The per cow direct cost is the highest in Sirajganj (Taka 6389) and lowest in Dinajpur (Taka 1500). Per cow indirect cost is highest in Rangpur (Taka 2473) and the lowest in Nilphamari (taka 1304). The highest economic loss per cow is found in Sirajganj (taka 8622) and the lowest in Nilphamari (taka 3185). If the epidemic continues for longer from 20 days to 25, 30, 35 and 40 days, then the total economic loss can be increased by 100%.

Table 1: Direct costs, indirect costs and economic loss per cow (taka) for different regions and breeds

Total Sample	102	88	89	100	44	260
Districts/ breed types	Dinajpur	Nilphamari	Rangpur	Sirajganj	Local-breed	Cross-bred
Direct cost per cow	1500	1881	3626	6389	1246	2433
Indirect cost per cow	1838	1304	2473	2233	1079	1491
Economic loss per cow	3339	3185	6099	8622	2325	3924

The lowest and highest average economic loss is found respectively in local-breed and cross-breed farms. It is clear, economic losses is directly related to recovery period of affected cow. So, as the days of recovery increase, the costs of the disease increase. This trend remind us to increase the number of veterinarians as well as the number of trained para-vets in the region of dairy production.

Title: Conservation and Improvement of Black Bengal Goat in different community of Project locations in Bangladesh
Activity: Impact study of establishment of community based Buck park along with GSMS software at farmer's level

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Executive Summary

Bangladesh Livestock Research Institute (BLRI) has been attempted to improve Black Bengal Goat (BBG) through selective breeding since 1988. In goat rearing farmer's group, in case of unavailability of superior bucks, the project supplied the superior buck in all sites of project location from Goat Research farm, BLRI, Savar, Dhaka. Two superior Bucks were given to two buck rearing farmers of each project area. If any female goat shows the heat, the heated goat was brought to the respective buck rearing farmer and bred the heated doe. The buck rearing farmers kept all necessary information related breeding with service charge in the supplied recorded card given by the project. The scientific assistant visited in each buck rearing farmer and observed all the activities regularly. It was recommended to exchange the buck with neighbour farmer after certain period (1.5 year) to prevent inbreeding depression.

Table1. Selected farmer's performance (pre-& post study) on Black Bengal Buck park in selected areas

Project Area	Survey data regarding buck parks (from 60 goat rearing farmers in each site)									
	Knowledge on quality buck selection (%)		Uncontrolled breeding (%)		Service with payment (%)		Maintaining breeding record (%)		Buck Rotation (%)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Bhaluka	77	100	77	0	100	100	27	92	57	100
Muktagacha	23	100	100	8	100	100	0	68	0	100
Naikhongchari	18	100	100	12	100	100	0	93	0	100
Kustia	30	100	100	7	100	100	0	87	0	100
Chuadanga	45	100	100	10	100	100	10	83	0	100
Meherpur	30	100	100	13	100	100	0	80	0	100
Jashore	35	100	100	10	100	100	0	60	0	100
Rajshahi	27	100	100	15	100	100	0	65	0	100
Average	36	100	97	9	100	100	5	79	7	100

A little feed supplementation, routine vaccination and de-worming was provided to buck rearing farmers on regular basis to increase the productive farmers knowledge on quality buck selection (%) and controlled breeding practices (%) was established by 100% and 97% respectively. Maintaining breeding record was kept by 79%, where in pre-stage of buck park 5% farmer was found to keep the record. All buck farmers were agreed to rotate their bucks with neighbour bucks after the certain period.

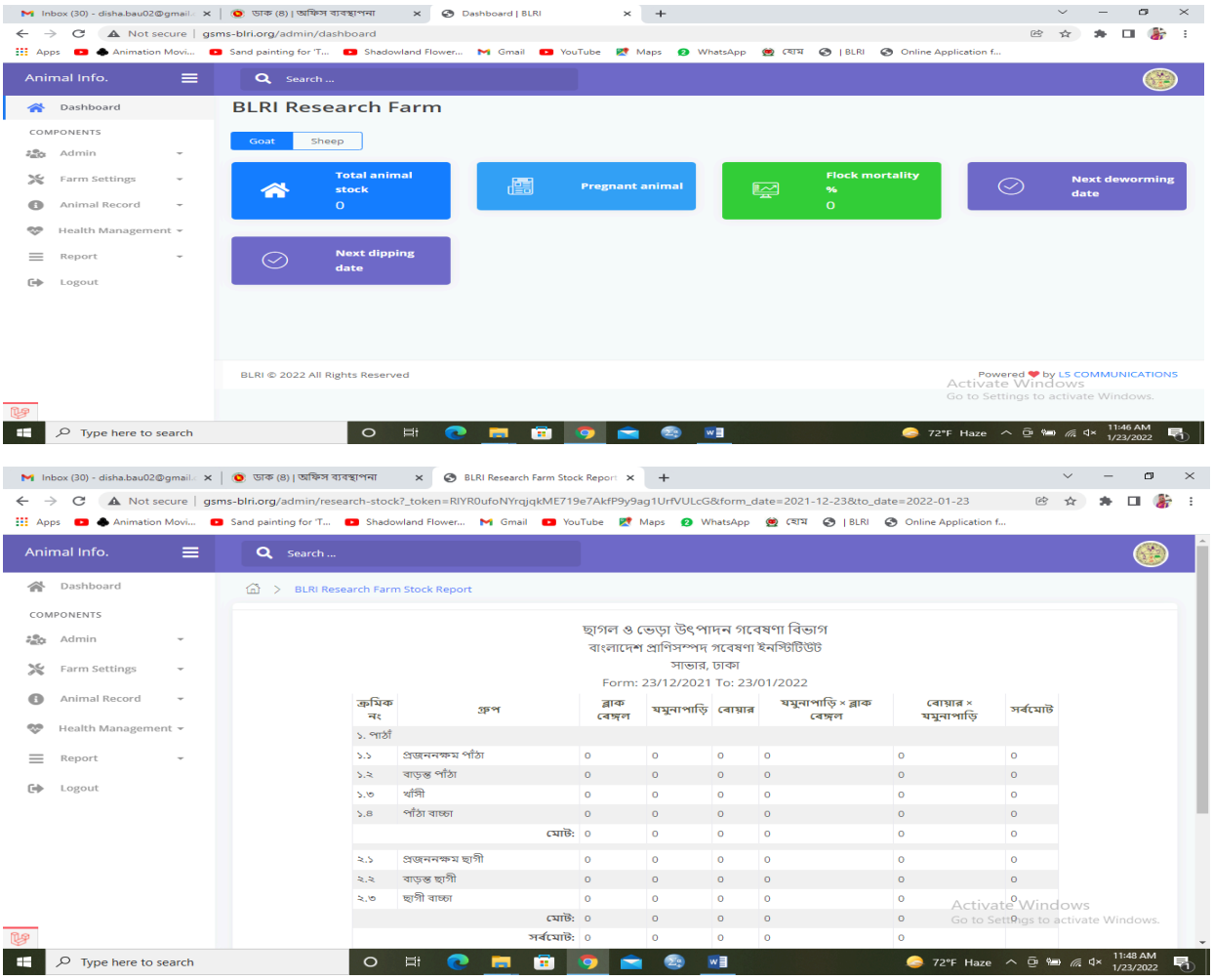

Fig. Screenshot of the dashboard of data recording software

A record keeping software was incorporated to manage all records from all the project sites at any time, in this regard, a software company was hired to develop a software according to our demands. It's so far, all the technical parts have completed and data (e.g. breeding management record, performance record, health management, feeding management record etc.) recording is going on with evaluation.

From the result so far, it was found that, the buck park activity has been reducing the crisis of quality bucks in the working areas. Quality buck was given to goat farmers and regular buck rotation program for breeding their does from buck park paying service charge system was introduced. Facilities is been introduced. Superior bucks in the park might increase the productive and reproductive performances of their progeny. Data based on socio-economic status of farmers and productive & reproductive performance of BB goats during this study might help in decision making on the evaluation of performance of BLRI improved BB goats at farmer's community. Therefore, the study will be continued until significantly change to build up a model for community-based goat production.

Project Title: Improvement of feeding system for Black Bengal Goat in Different selected areas of Bangladesh

Activity: Identification and evaluation of locally available fodders, leaves used for Black Bengal Goats in different selected areas in Bangladesh

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Bangladesh Livestock Research Institute, Savar, Dhaka

Executive Summary

The most popular breed for goat meat is Black Bengal (BB) goat in Bangladesh. BB goats are highly prolific and can kid twice in a year with at least twin kids. Feeding of goat in our country is based on traditional feeding system (mostly grazing) where, goats have to depend only on local fodders, which are insufficiently utilized by goats because of higher fiber contents, lower voluntary intakes and deficiency of high soluble carbohydrates and minerals as well as poor digestibility of the fibrous fractions. In Bangladesh, about 80% of the total arable land is used for cultivation of cereal crops and only 0.03% for cultivation of fodder crops and rest for other crops (BBS, 2009). Scarcity of animal feeds and fodder has been identified as a major constrain for the development of livestock in Bangladesh (Kanak *et al.,* 2012). So, livestock development in Bangladesh is mainly depending upon the improvement of animal nutrition through improved feeding and availability of fodder. Considering this fact, the present study was undertaken to identify and evaluate nutrient value of locally adapted available fodders. To achieve the objective, a questionnaire was prepared and tested to find out the feeding system, name of common local available grasses, tree leaves and other conventional and unconventional feeds used for their goats. The samples were collected for four topographical regions like Mymensingh (Bhaluka and Muktagasa) as plain land; Khulna (Khustia Sadar; Meherpur Sadar, Chuadanga Sadar) as saline land; Rajshahi (Rajshahi sadar, Jassore sadar) as drought and Bandorban (Naikhongchari sadar) as hilly land. Proximate analysis of different fodders and tree leaves were performed in Animal Nutrition Laboratory of Bangladesh Livestock Research Institute, Savar, Dhaka.

Table 1: Name of locally available fodders, tree leaves used for goats as roughages in the selective region of Bangladesh

Local/Common Name	% of local fodders/ tree leaves supplied by the farmers								Avg (%)
	Mymensingh		Khulna			Rajshahi		Bandarban	
	Valuka	Muktagasa	kustia	Cuadanga	Meherpur	Rajshahi	Jashore	Naikh'chari	
Maize (Fresh)	20	7	63	90	100	63	53	13	51.13
Napier	45	10	8	35	27	20	30	27	25.25
German	20	22	13	47	47	27	12	37	28.13
Pakchong	13	3	12	0	0	3	3	15	6.13
Jackfruit	100	100	100	100	100	63	100	30	86.63
Neem	5	0	3	7	3	7	7	0	4.00
Mehogoni	30	20	20	10	12	13	10	0	14.38
Sajna (moringa)	7	0	5	13	22	20	20	30	14.63
Ipil Ipil	7	0	0	0	0	0	3	0	1.25
Bamboo	27	0	3	0	0	0	7	0	4.63
Kheshari kalai	50	30	46	75	50	46	33	25	48.13
Mash kalai	56	32	78	92	47	66	41	18.5	55.06
Cauliflower	62	0	20	40	63	0	10	0	24.38
Cabbage	62	0	20	40	63	0	10	0	24.38
Silage (any)	0	0	0	0	0	0	0	13	1.63
Hay (any)	0	0	0	0	0	0	0	13	1.63
Natural grass	100	100	100	100	100	100	100	100	100

The available fodders/tree leaves used in surveyed area were shown in Table 1. It was observed that almost 51% farmers use fresh maize for their goat and the maximum use of maize was found in Khulna division followed by Rajshahi, Mymensingh and Hilly area. In case of tree leaves, almost 100% farmers use jackfruit leaf for their goats except in hilly area for lower production of jackfruit there . As leguminous fodder, kheshai and mash kalai was used by almost 50% farmers. There were no farmers found to use silage or hay as conserved feed during scarcity period. In Valuka and Khulna region, most farmers use winter vegetables (mostly cabbage and cauliflower as fodder for their goats. Very few farmers use sajna (*Moringa oleifera*) as fodder, which is high quality fodder with an excellent nutritive value. 100% farmers allowed their goats for browsing for more than 6 hours.

Table 2: The Nutritional facts of some available fodder/tree leave samples collected from different project sites

Local/Common Name	Production type	DM (%)	ME (MJ/kg)	Chemical Composition (%)			
				CP	Ash	ADF	NDF
Maize (Fresh)	Seasonal	18.61	9.5	8.8	10.2	51.68	82.3
Napier	Perennial	21.58	8.4	8.6	9.93	50.48	81.84
German	Perennial	19.91	19.91	9.01	9.41	51.22	80.45
Pakchong	Perennial	21.42	11.6	7.08	7.61	48.0	83.2
Jackfruit leaf	Perennial	26.2	6.3	12.0	13.2	38.2	52.4
Neem leaf	Perennial	21.8	7.4	16.9	12.3	66.5	77.2
Mehogoni	Perennial	18.4	13.6	4.7	14.2	52.8	74.2
Sajna	Perennial	20.4	20.1	18.1	71.6	29.3	38.1
Ipil Ipil	Perennial	22.4	12.5	23.1	6.1	31.4	77.65
Bamboo	Perennial	29.0	6.4	16.1	11.3	30.9	75.5
Kheshari kalai	Seasonal	15.8	7.75	17.3	14.6	41.9	78.44
Mash kalai	Seasonal	19.4	8.5	22.1	11.4	43.6	71.45
Cauliflower	Seasonal	8.6	4.3	14.3	12.2	16.9	18.9
Cabbage	Seasonal	8.7	5.2	13.8	11.5	19.5	22.3
Durba	Perennial	27.3	7.7	8.4	6.9	40.7	81.31
Dol	Perennial	26.8	7.5	7.9	7.4	41.69	82.93

Proximate composition was evaluated and depending on DM, CP and biomass yield of some fodders and tree leaves along with silage and hay are recommended for further research activity. Among the samples 11 samples were perennial and 5 samples were seasonal. As the part of improving the feeding system of Black Bengal goat in selected areas, the samples having higher DM, CP and biomass like, Sajna, Pakchong and Maize could be potential sources of roughages for specific regions and silage and hay could be established by the farmers as feed during scarcity period in all survey sites. As the rural farmers normally rear their goats without any concentrate supplementation that results poor productivity, so the further study will also be performed to know the effect of concentrate supplementation on productivity and economic return.

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

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Executive summary

The advanced techniques in molecular genetics have provided an opportunity to identify different candidate genes and their variants associated with different production, reproduction and disease related traits. Considering these opportunities, the present study was undertaken to explore and screen the candidate genes associated with the prolificacy in Black Bengal Goats (BBGs). Natural mutations in prolific sheep breeds have shown that the transforming growth factor beta (TGF-β) super family ligands such as growth differentiation factor 9 (GDF9), bone morphogenetic protein 15 (BMP15) and their type I receptor (bone morphogenetic protein receptor, BMPR1B) are crucial for ovulation and as well as for increasing litter size. Mutations in any of these genes increased prolificacy in sheep. Based on the known mutation information in sheep, the PCR primers were designed to amplify complete CDs sequences based on the reference sequence of the ovine genes to screen the mutations in BBGs. The NCBI primer blast was used to design the primers and OLIGO7 software (Molecular Biology Insights) was used for checking the right primers in accordance with the gene sequences. The genomic DNA was extracted from blood of each goats using genomic DNA kit (TianGen, Beijing, China) following the manufacturer's guidelines. The DNA concentration and quality were determined by NanoDrop 2000 (Thermo Fisher Scientific, Waltham, MA, USA) spectrophotometer and gel electrophoresis. A pooled DNA samples (50ng/µL/goat) made from the DNA of all selected animals were used for PCR. The PCR amplifications were performed in a final reaction volume of 50µl consisting of 1.5µl of each primer, 50ng genomic DNA, and 25µl premix (TaKaRa, Dalian, China). The amplifications environment in PCR was 5 min at 95ºC for initial denaturing followed by 30 cycles at 95ºC for 30s; annealing temperature at 59ºC for 30s; 72ºC for 40s; and a final extension at 72ºC for 5 min. From each PCR product 40µl of was sequenced using the ABI3730XL (Applied Bio-systems, Foster City, CA). The sequences were aligned with mega 6.0 program to determine the presence of any mutations. A total of three mutations (C/A, C/T and G/A) were detected by sequences analysis of BMPR1B gene in Black Bengal Goat breeds. Then the identified SNPs were genotyped following restriction fragment length polymorphism (RFLP).

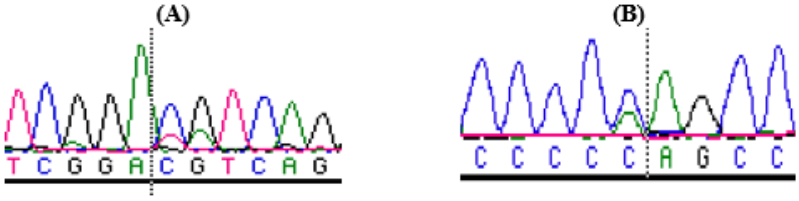

Figure 1. Sequence analysis, mutations detection and genotyping based on individual polymorphisms of BMPR1B gene in Black Bengal Goat breeds. (A) Detected two mutations after the dotted line, C/T and G/A. (B) Detected one mutation before the dotted line, C/A.

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

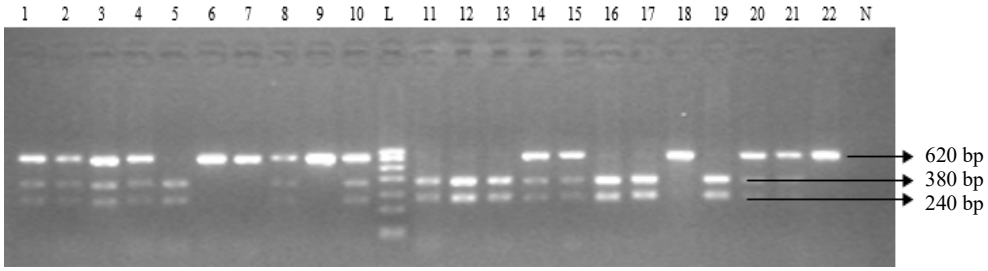

Figure 2. The agarose gel electrophoresis (2%) result of PCR-RFLP band patterns at C/A variant in BMPR1B gene. DNA was digested with the restriction enzyme Xho I and three types of genotype CC (620bp), CA (620bp/380bp/240bp) and AA (380bp/240bp) were found in the band patterns (Lane 1-22), L: Ladder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

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

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

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Executive Summary

Gastrointestinal nematodes (GINs) are one of the most economically important parasites of small ruminants. The resistance or susceptibility against this parasitic infection are related to the genetic factors and varies between and within breeds, even for individual to individual. The identification of candidate genes that influence the individual's production performance or diseases control would provide a better understanding of the physiological processes, like parasites susceptibility or resistant. One important marker-assisted selection is single nucleotide polymorphisms (SNPs), which are usually used to complex traits mapping by linkage disequilibrium (LD) when they are associated with the interested gene. One important differentially expressed gene (DEG) namely the low-density-lipoprotein receptor related protein-8 (LRP8) can be a functional candidate gene showing high fold change (log2) up-regulated expression in susceptible goat groups found by different RNA sequences data that were chosen for the identification marker-assisted selection. So the objective of this study is to identify SNPs in the low-density-lipoprotein receptor related protein-8 (LRP8) gene and investigate their association with GINs infection to know genetic resistance. One hundred and fifty animals are being under monitoring for parasitological (FEC) and hematological parameters (Hgb and PCV). Fecal egg count (FEC) was determined by using modified McMaster technique and blood parameters were determined using Mindray Auto Hematology Analyzer. To construct the evolutionary relationships of LRP8 gene of goat with other species, we also downloaded protein sequences of different species from NCBI. All collected sequences and their corresponding amino acids were aligned and a phylogenetic tree was constructed using MEGA version 6. The genomic DNA was extracted from blood using genomic DNA extraction kit following the manufacturer's guidelines. The DNA concentration and quality were determined by NanoDrop 2000 spectrophotometer and gel electrophoresis. We used goat re-sequencing data to detect possible SNPs in LRP8 gene. Caprine mRNA of LRP8 gene (XM_018044317.1) was downloaded from NCBI and was setup as a "reference genome" using Burrows-Wheeler Alignment (BWA) index. The identified SNPs were then genotyped in the 150 goats.

The average FEC values from the resistant group were 2.804 ± 0.164, while the susceptible group had average FEC values of 3.315 ± 0.136 at the end of the 16 times inspection in different months considering log-transformed data showed statistically significant ($P<0.01$). In both goat groups, there was an expected every times fluctuation in FEC (Figure 1) and the susceptible goats consistently demonstrated higher FEC than those of resistant goat groups throughout the period. The maximum likelihood phylogenetic tree showed that the caprine LRP8 gene was closely related to LRP8 gene of cattle and buffalo than that of other studied species (Figure 2). The protein sequences of LRP8 gene of goats also showed much closer amino acid similarity to the LRP8 gene of cattle (99%) and buffalo (99%) than that of sheep (98%), horse (94%), cat (93%), pig (93%), mouse (89%) and rat (88%). The nine novel polymorphisms were identified in the goat LRP8 gene, in where 5 mutations located in 3′ UTR and 3 synonymous and 1 non-synonymous mutation were located in the exon regions (Table 1). The non-synonymous mutation was encoded Threonine to Methionine.

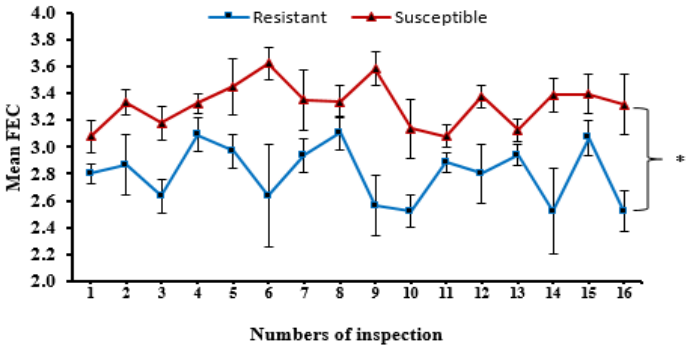

Figure 1.

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

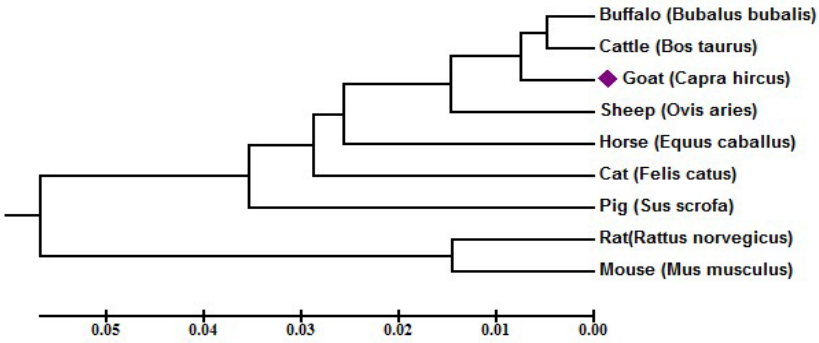

Figure 2: Maximum likelihood phylogenetic tree of LRP8 gene in goat

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

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

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

It's a partial result of our ongoing project but the results indicated that the LRP8 gene could be a good possible candidate gene either as a major gene or as an associated with another major gene in GINs infection in goat.

Problems and prospects of ostrich (*Struthio camelus*) production in Bangladesh

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Executive Summary

Agricultural land of Bangladesh has decreased on an average sixty six thousand acres each year which is 0.29 percent of total agricultural land. The research forecasting suggests that, if agricultural land decrease at the present trend and agricultural productivity and population also increase at the present trend, even in 2050, agricultural land decrease' hopefully will not be a threat to the agriculture sector of Bangladesh. But we need to have a pre-attention for balancing the agricultural production especially animal protein, against the decreasing of agricultural land. Among the options, ostrich farming is the most profitable agricultural projects and also offered a variety of possible valuable products like, meat, feather, fat and hide. Ostrich farming may be one of the best options for alternative protein source in Bangladesh due to its least cost for huge amount meat production. The study investigated the production status, problems and prospects of ostrich production in Bangladesh following survey and multistage sampling procedure. The exploratory research design was followed for this study. The data were collected taking representative samples from household survey, review of secondary data, individual interview, keen observation and Focus Group Discussion (FGD) from several districts in Bangladesh. The questionnaire was prepared with very carefully keeping in mind the objectives of this study. Average flock size, weight of a cock and hen were 116.67±8.82 and 92.50±7.50 kg, respectively. Poultry ready feed and forage, broiler starter ready feed, layer starter ready feed, mixed feed (L/S-50% + B/S-50%), broiler grower ready feed, vegetable and fodder as feed, fruit, egg and bakery food as feed, pieces of stone, and regular based different Vitamin were used by 100, 87.50, 12.50, 12.50, 25.00, 100.00, 25.00, 87.50 and 62.50% farmers, respectively. Both cock and hen attained puberty at 2.00±0.25 years, a hen laid 14 eggs in first laying year and weight of each egg was 1466.67±88.19g. Male and female ratio maintained 1.75±0.25. Fertility and hatchability of eggs were not measured. Main reasons of zero hatchability were infertile eggs due to unsuccessful mating and hazardous mating environment. None of the farmers used artificial insemination (AI) except natural breeding. Main advantages of ostrich rearing over other poultry species were disease resistant (adult), low production cost, high market price (end product), high dressing percentage and low cholesterol meat to 100, 85, 62.5, 37.5, and 37.5 farmers, respectively. While 37.5% farmers had encountered disease, 62.5% had not used vaccine. Price of ostrich chick and an adult ostrich were sold at (BDT, thousand) 13.29±1.04, and 137.50±12.50 respectively. In fact, ostrich production is still at very primitive stage which is characterized by poor adaptation to environment, feeding, breeding and healthcare practices, so vigorous public extension service, training, research and marketing strategies are immediately needed to improve this species in Bangladesh.

Table 1: General management data of ostrich farming in Bangladesh

Parameters	*Mean±SEM*
Age of farmers (Year)	45.75±1.98

Table 2: Productive and reproductive performance data of ostrich in Bangladesh

Parameters	*Mean±SEM*
Length of brooding in winter (day)	18.33±2.59

Table 3: Overall feed management data of ostrich in Bangladesh

Parameters (Fed different feed)	*Respondent (%)*
Poultry ready feed and forage	100.00

Experience of ostrich farming (Year)	4.38±0.94	Length of brooding in summer (day)	12.00±2.53	Broiler starter ready feed	87.50
Flock size (number)	18.29±5.07	Age of puberty(Year)	2.00±0.25	Layer starter ready feed	12.50
Weight of adult cock (kg)	116.67±8.82	Fertility of ostrich egg (%)	00	Mixed feed (L/S-50%+B/S-50%)	12.50
Weight of adult hen (kg)	92.50±7.50	Hatchability of ostrich egg (%)	00	Broiler pre starter ready feed	12.50
Weight of egg (g)	1466.67±88.19	Ratio of male : female (♂:♀)	1.75±0.25	Broiler grower ready feed	25.00
Egg laid each farm till date (No.)	37.33±3.93			Vegetable and fodder as feed	100.00
Price of adult ostrich (BDT, thousand)	137.5±12.5			Fruit, egg and bakery food as feed	25.00

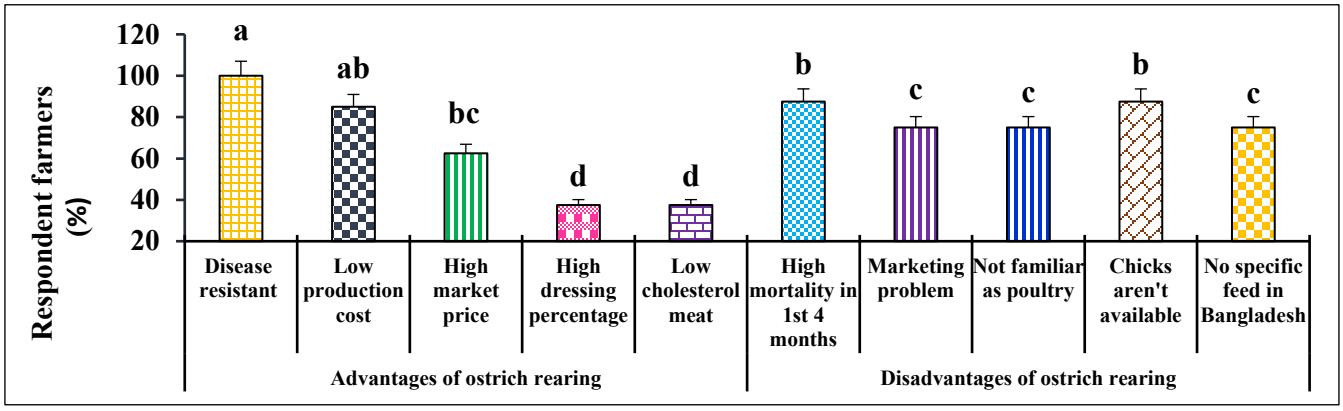

Figure1. Farmers' perception on advantages and disadvantages of ostrich

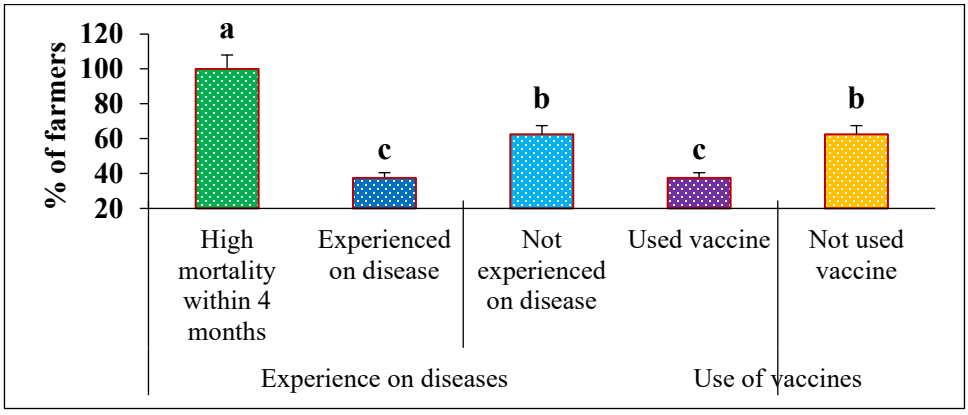

Figure 2. Farmers experience on diseases and vaccination of ostrich

The overall environment of Bangladesh actually seems in favor of ostrich production. But it is still at initial stage which is characterized by unskilled management, feeding, breeding and healthcare practices. Besides this ostrich farming success is facing inadequate availability of scientific information, recognized technical services, credit facilities, training and marketing opportunities. Finally, to increase the ostrich production, effective public extension service, training for farmers, opening of different avenues for research on ostrich and identifying marketing strategies, are immediately needed in Bangladesh.

Determination of essential minerals with heavy metals in feed, meat and eggs of different poultry species

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Executive Summary

Livestock and poultry originated nutrient enriched foods (milk, meat and egg) are essentially important for human consumption as well as required for proper growth and development. Inappropriate use of antibiotics or other foreign substances isundesirable. Human exposure to heavy metals may lead to several acute or chronic adverse effects. The present study was taken based on the following objectives: (i) To determine essential minerals from poultry feed, meat and eggs and (ii) To determine the toxic and safe level of heavy metals in feed, meat and egg of poultry.

In this experiment the samples were collected from different region of the country namely Dhaka division (Savar, Faridpur), Chattogram division (Nikhongchari, Bandarban), Rangpur division (Saidpur, Nilphamari), Khulna division (Jashore sadar), Rajshahi division (Godagari). A total of 45 samples (15 feed, 15 meat and 15 egg) were collected from each selected area by surveying with a structured questionnaire and these three samples were taken from the source of the same farmers. Essential minerals (Ca, P, Mg, Mn, Fe, Cu, Co, and Zn) and heavy metals (As, Cr, Se, Pb and Cd) were considered from the samples (feed, meat and egg) and analysed by using Atomic Absorption Spectrophotometer (AAS) machine.. All samples were processed and analyzed by the following the schedule of the laboratory. Experimentally about 9500 poultry birds (chicken, ducks and quail) were dressed, packaged, stored and supplied to the consumers at our processing plant at BLRI which indirectly reduced the live marketing practice at our locality. Heavy metals are part of Earth's crust, they do occur naturally in our environment.

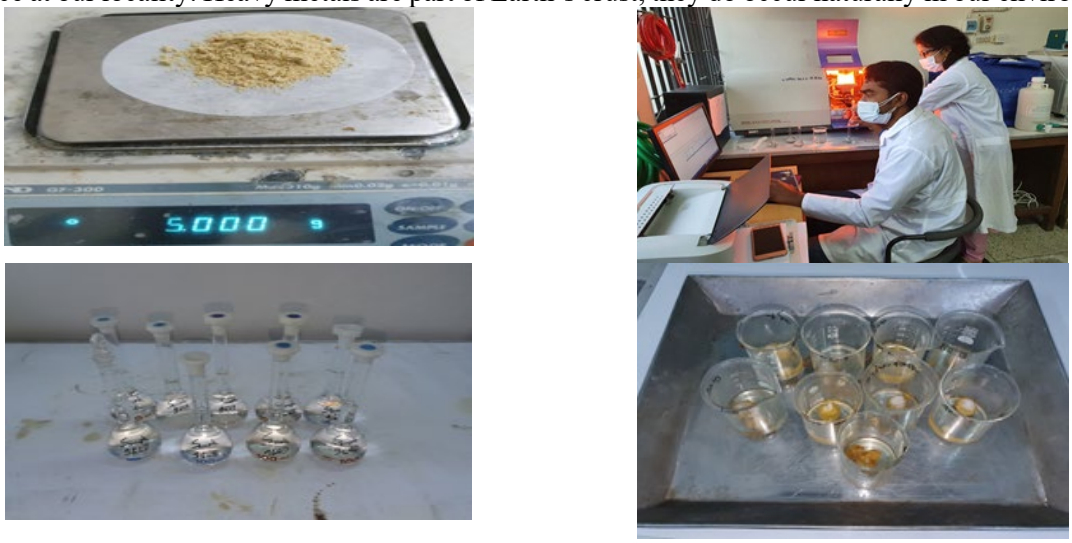

Figure 1: Some pictorial view of sample processing and analyzing

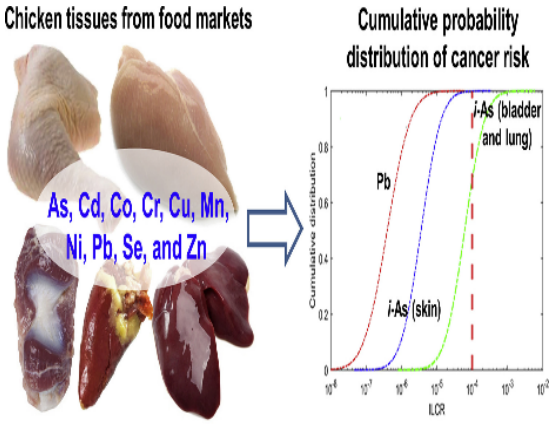

Fig. 3. Shimadzu AA-7000

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

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

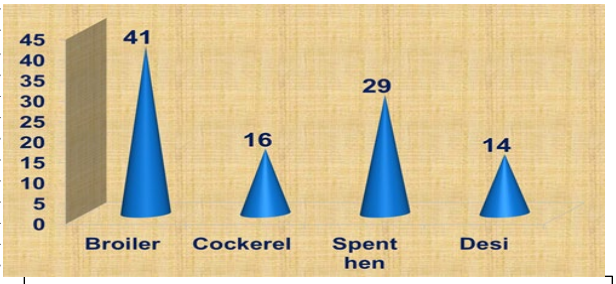

Fig 4. Poultry meat sample used for AAS analysis

** IAEA (International Atomic Energy Authority);
* Paulien

It can be concluded from the findings both poultry feed and meat are safe from the heavy metals. We are already analyzing essential minerals and heavy metals from poultry feed, meat and eggs and wished the values will found within acceptable range, especially the heavy metals concentration. So, in future we must consume poultry meat and egg without any confusion about heavy metals on to enhance immunity and safe human being.

Development of meat type chicken utilizing native and exotic genetic resources suitable for climatic condition of Bangladesh

(Study 1. Growth performance of Aseel chicken for developing meat type chicken)

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Executive Summary

The Aseel is important native chicken breed in India. In Bangladesh it is found mostly in Sarail Upazilla of Brahmanbaria district. This breed is characterized by its hardiness and ability to thrive under adverse climatic conditions and its meat is considered to have a desirable taste and flavor. Of late, there is renewed interest among consumers and farmers in native germplasm because of the unique hardiness of the breeds, their ability to thrive under adverse climatic conditions, and the desirable taste and flavor of eggs and meat. Hence, a significant demand exists for the Aseel native chicken. Therefore, Aseel need to be systematically evaluated for their various growth and production traits. Hence, the present study was conducted to evaluate various growth and production traits of Aseel chicken.

The study was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka with the objectives of (i) to introduce Aseel as a new germplasm at BLRI and make a foundation stock (ii) to know the (growth and reproductive) performances of Aseel and (iii) to know the behavioral pattern of Aseel. The data were analyzed in SPSS statistical analytical program.

About 45 Aseel eggs were collected and incubated properly and 21 chicks were hatched. Chicks were brooded properly for 8 weeks. Data on feed intake recorded daily and body weight weekly. All chicks were properly vaccinated and medicated. Broiler ration containing 18% CP and 2100 kcal ME/Kg were supplied to chicks during starter (0-21 days) and growing period (…). After 7 weeks the chicks were fed finisher diet. The feed supplied to the chicks started from 10 g per day and it increased up to 140 g/d in 12 weeks. The average feed intake of the chickens at the age of 4, 6, 8, 10 and 12 weeks were 36.58, 63.35, 77.09, 107.98 and 123.62 g respectively. The average body weight of 4, 6, 8, 10 and 12 weeks were 222.13, 392.39, 615.72, 872.59 and 1158.62 g respectively. The average body weight gain at the age of 4, 6, 8, 10 and 12 weeks were 1.94, 5.47, 7.22, 9.4 and 14.87g respectively. The mortality was about 4%. The FCR at the age of 4, 8 and 12 weeks were 2.09, 2.32 and 3.20 respectively.

Table 1: Feed intake and FCR of Aseel chicken at different weeks

Age(week)	Daily Feed Intake (g)	FCR
4	36.58±0.79	2.09±0.34
6	63.35±0.90	
8	77.09±1.30	2.32±0.45
10	107.98±1.40	
12	123.62±1.10	3.20±1.04

Table 2: Body weight and body weight gain of Aseel chicken at different ages

Age (week)	Body Weight (g)	Body Weight Gain (g)
4	222.13±7.89	1.94±0.12
6	392.39±8.95	5.47±0.98
8	615.72±12.75	7.22±1.54
10	872.59±10.86	9.40±0.67
12	1158.62±15.60	14.87±0.98

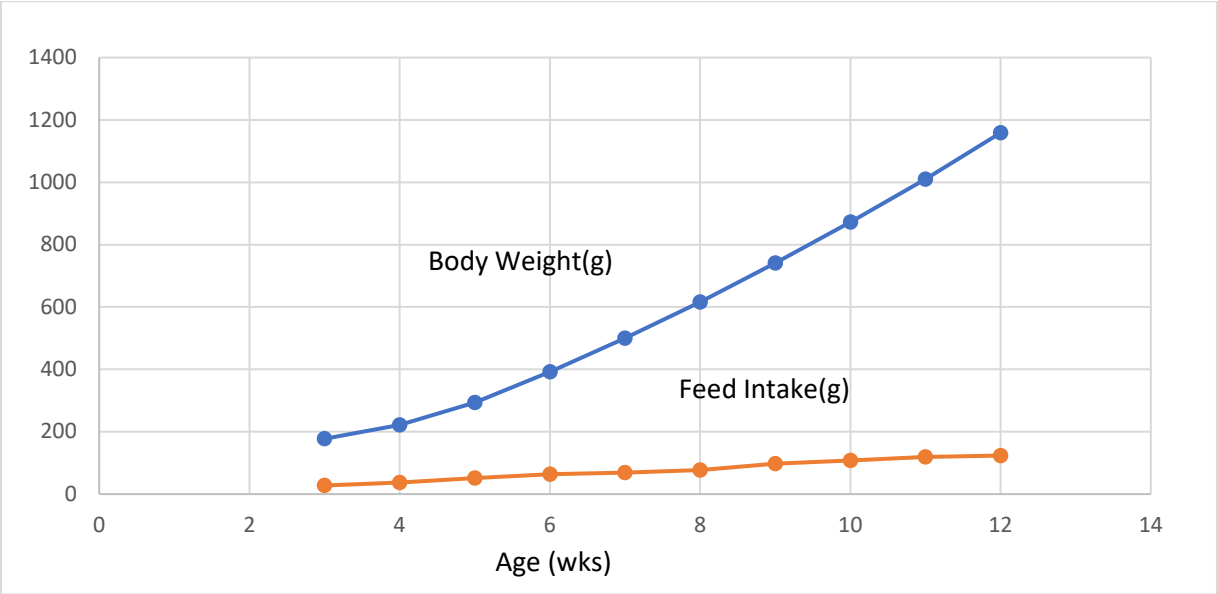

Figure: Feed intake and Body weight at different weeks of age

From this study, we concluded that the Aseel exhibited better growth performance and need to be more research for establishing as a potential bird as foundation stock for producing meat type chicken as well as other native chicken.

Study on mule duck production and assessment of its meat quality
Study 1. Performance of Pekin and Muscovy duck for meat type duck production

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Executive Summary

The poultry industry has been successful in becoming a leading industry of the country. The industry has immersed potentialities from point of view in economic growth of the country as well as fulfillment of protein for the human being. According to DLS (2018), there are about 55.2 million ducks in Bangladesh. Duck meat has a favorable profile of essential amino acids, unsaturated fatty acids among all poultry species. It is also a good source of vitamins (mainly A& E, B_1, B_2) & iron. It surpasses broiler chicken meat in tenderness & juiciness and also in taste and aroma (Kijowski, 2001). Sarker et. al. (2005) stated that increased duck production by exploiting scientific breeding techniques can contribute more to our animal protein requirement. Moreover, mule duck production especially for quality poultry meat has been realized in many other developing countries of the world especially in Asia and Africa (Nwachukwu, 2015). So, increased duck meat production can play a vital role to reduce prices of meat, different flavor, and also helps in poverty reduction. Pekin and Muscovy both are originated in China and widely used as a meat type bird. In many countries those breeds are used for mule duck production. Hence, the present study was conducted to evaluate various growth and production traits. The study was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka with the objectives of (i) To introduce Muscovy duck as a breeding stock at BLRI (ii) To know the growth performances of Pekin and Muscovy duck's germplasm and (iii) To produce a 3-way cross bred meat type mule duck. About 50 eggs of Pekin and 50 eggs of Muscovy were collected and incubated. After completion of incubation period 28 ducklings were hatched and they were brooded for 8 weeks. All the birds were reared in floor during brooding period. Temperature and humidity both were properly maintained. All vaccination and medication as per schedule were performed properly. A ration was supplied to ducklings during starter (0-21 days) and then grower feed supplied to the chicks. After 18 weeks the ducklings were fed layer diet. The feed supplied to the doc started from 10 g per day and it increased up to 160 g/d in 16 weeks. Data on feed intake recorded daily and body weight weekly. Data were analyzed by factorial arrangement in a CRD in SPSS statistical analytical program.

The body weight of Pekin was about 56, 98, 196, 350, 520,750,800, 1087,1289,1670,1890 gm at 0, 1, 2, 3, 4, 6, 8,12,16,32, 36 weeks of age (Table-1). Average feed intake was 8, 15, 21, 28, 38, 58, 78, 100, 117,135 and 155 g/b at 0, 1, 2, 3, 4, 5, 6, 7,8,12 and 16 weeks of age (Table-2). Egg weight was 52, 54.8, 58, 60 g at 20, 21, 22, 23 weeks of age. Egg production was 80, 75, 65, 55 at 24, 28, 32 and 36 weeks of age.

In white Muscovy body weight was 50, 78, 158, 312, 670, 970, 1200, 1560,1890, 2200 and 3500 gm at 0, 1, 2, 3, 4, 5, 6,7,8,12 and 16 weeks of age (Table-1). Average feed intake was 10, 15, 20, 30, 37, 55, 76, 92, 115,133 and 149 g/b at 0, 1, 2, 3, 4, 5, 6, 7,8,12 and 16 weeks of age (Table-2).

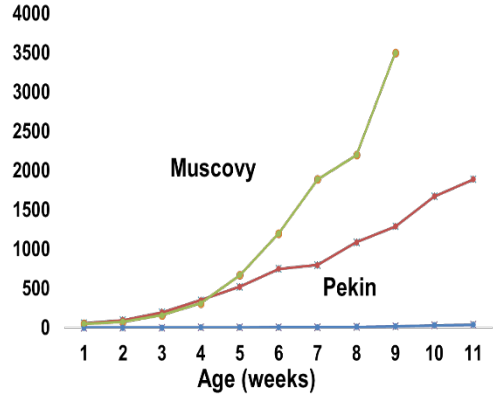
Table 1: Table 1. Body weight (gm) of Pekin and Muscovy ducks at different ages

Age (weeks)	Pekin	Muscovy
0	56.01±1.09	50±0.76
1	98±0.91	78±1.23
2	196±0.56	158±0.78
3	350±0.32	312±0.45
4	520±1.23	670±0.23
6	750±1.09	1200±1.20
8	800±1.02	1890±0.24
12	1087±0.98	2200±0.56
16	1289±0.56	3500±0.76

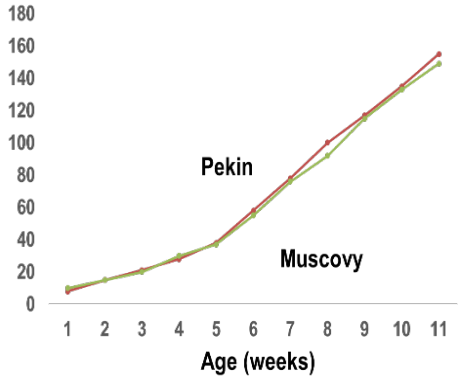
Values are Mean±SE

Table 2: Feed intake (g/b) of Pekin and Muscovy ducks at different ages

Age (weeks)	Pekin	Muscovy
0	8.0±0.1	10±0.34
1	15±0.1	15±0.23
2	21±0.54	20±1.9
3	28±0.23	30.23
4	38±0.43	37±0.45
5	58±0.13	55±0.21
6	78±0.01	76±0.45
7	100±0.34	92±0.34
8	117±1.1	115±0.76
12	135±0.76	133±0.13
16	155±0.34	149±0.23



Growth (g/d) curve Muscovy and Pekin duck



Feed intake (g/d) of Pekin and Muscovy duck

Figure1-2: Body weight and Feed Intake of Muscovy and Pekin duck

From this part of the study, it can be concluded that both Pekin and Muscovy ducks are well adopted in Bangladesh and further research is needed for establishing a representative flock to be used as parent line for producing meat type mule duck.

Collection, conservation and improvement of specialized fowl production

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Poultry Production Research Division, BLRI, Savar

Executive Summary

Bangladesh is rapidly moving towards a developed country. According to the statistical agency the per capita income increased to $ 2,554 in 2020-21, which was $ 2,024 in the 2019-20 Fiscal years (The Financial Express, 04 November 2021). As the increasing the buying capacity of the people increases the lifestyle as well as the consumer preferences also change. Therefore, the consumer nowadays is shifting to have other foods which are something new as well as value added. In Bangladesh, chicken consists of 90% of the poultry, followed by 8% duck and the remaining 2% include other species of specialized fowl such as quails, geese, pigeons, guinea fowls, Turkey etc. (Das *et al.,* 2008). Due to various socio-economic factors along with the consumer's preferences and improving purchasing capacity the demand for specialized fowls (Turkey, Guinea fowl and Pigeon) are increasing day by day and thus farming of specialized fowls has a lot of opportunity in our country. Owen *et al.,* 2008 reported that in order to maximize food production and meet protein requirements in developing countries, variable options need to be explored and evaluated. Therefore, the study was conducted to evaluate the performances of specialized fowls and to introduce new turkey, guinea fowl and pigeon varieties with the existing stock at BLRI research farm for improving their performance. A total of 605 and 590 hatching eggs of Turkey and Guinea fowls were collected and hatched at the Hatchery of BLRI and got 427 and 202 Poults and Kits, respectively and their performances were studied. The stocks were referred to as Foundation Stock. The breeding of pigeons was carried out traditionally. The chicks of turkey and guinea fowls were brooded up to 4 weeks of age. The formulated feed with required nutrients according to age was supplied to the birds at all ages. Pre-scheduled vaccination was followed; proper management and biosecurity measures were taken. Both the productive and reproductive record were kept.

Performances of Turkey

The maximum live weight of male and female birds at 20 weeks was found to be 3770 and 3346 g/bird for Bronze and Mixed variety, respectively mentioning Table 1 & 2. On the other hand, the maximum live weight of male and female birds at 60 weeks was found at 7863 and 3509 g/bird for White and Bronze variety, respectively.

Table 1. Live weight (g/bird) of male turkey up to 60 weeks of age

Age	Variety (Mean±SE)				
	Black	Bronze	Mixed	White	Bourbon Red
20	3290±131	3770±94	3524±157	3537±159	3598±115
25	5842±184	5732±248	5848±173	5654±263	5751±214
40	7634±344	7780±140	6789±420	7749±277	7757±188
60	7715±91	7405±170	6737±274	7863±248	7767±196

Table 2. Live weight (g/bird) of female turkey up to 60 weeks of age

Age	Variety (Mean±SE)				
	Black	Bronze	Mixed	White	Bourbon Red
20	2481.2 ± 53.9	3000.0±79.6	3346.0±140.5	2756.2±78.6	2958.4± 67.6
25	3212± 99	3054± 70	3071± 179	3372± 118	3187± 232
40	3401± 180	3984±156	3389± 230	3706± 249	3298± 113
60	3271± 292	3509± 235	3257± 54	3238± 164	3417± 134

The average feed intake found at 20 and 60 weeks of age was 217 and 235g/bird/day, respectively. The highest average hen day egg production is found in Bourbon Red (39%) and lowest for the Black variety of Turkey (22%). The mortality up to 60 weeks of age was 4.5%.

Table 3. Average feed intake (g/bird/day) and mortality (%) of Turkey up to 60 weeks of age

Age (Week)	Feed intake	Age (Week)	Feed intake	Mortality (%)
20	217	50	233	
30	222	60	235	4.5 (Up to 60 weeks of age)
40	230			

Table 4. Egg production performances of different varieties of turkey up to 60 weeks of age

Parameter	Variety (N=85)				
	Black	Bronze	Mixed	White	Bourbon Red
HDEP (%)	22.4	25.94	28	30.5	39
AFE (days)	173	165	188	183	180
Egg Weight (g)					
First Egg	40	46	50	50	44
60 Weeks	57	60.4	60.8	66.4	60.0

HDEP= Hen day Egg Production; AFE= Age at First Egg; N= No. of total female turkey.

Performances of Guinea fowl

The average fertility and hatchability of Guinea fowl were 55 and 67%, respectively. The highest fertility and hatchability were found in the White and Lavender varieties of Guinea fowl to be 72 and 79%, respectively. The highest live weight of male and female birds at 20 weeks was found 1408 and 1186g/bird for the Lavender and White variety, respectively. The highest average hen day egg production was found for Pearl variety. The overall mortality was found 6.5% up to 605 weeks that shown in table 5.

Table 5. Performances of Guinea fowl up to 60 weeks of age

Age (Week)	Sex	Live weight (g/bird) (Mean±SE) of different varieties				p
		Pearl	Mixed	White	Lavender	
20	Male	1305.80± 16.5	1267.60±15.6	1337.00± 25.7	1407.80±19.8	***
	Female	1177.40± 28.6	1103.40± 22.6	1186.40±25.8	1131.20± 13.0	
HDEP (%)	-	25	16	24	14	*
Mortality %)	Both	6.5				-
AFI (g/bird/day)	Both	98				-

*** = p< 0.001; * =p< 0.05; NS= p> 0.05; HDEP= Hen day egg production. AFI= Average Feed Intake at 20 weeks of age.

Performances of Pigeon

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

Table 6. performance of different pigeon varieties

Variety	Average adult live weight (g)		Average feed intake (g/bird/day)	Average squab weight (g/squab)
	Male	Female		
Moyurpankhi (Fancy)	414	402	26	-
King (Fancy)	729	704	29	-
Golla				
White	319	311	31.6	-
White-Reddish	346	331	29.8	126 (19 days of age)
Brown	340	331	28.7	-
White-Black	333	323	27.8	122 (27 days of age)

The Foundation stocks of Turkey and Guinea fowl were established. A good number of pigeon varieties were introduced. There was no major difficulties or diseases found except some wild nature of the Guinea fowls and adaptation with natural breeding systems of pigeons. The performances of the specialized fowls will be continued through planned breeding for improving their productivity.

Conservation and improvement of indigenous buffalo for milk production through open nucleus breeding program

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Executive Summary

Most of buffaloes of our country are indigenous river types that are reared by rural farmers with poor feeding, breeding and other management inputs. Despite, poor nutrition and management, the average lactation yield of indigenous buffalo is 620-1161 kg in a 270 to 330 days lactation period. So, there is an opportunity to improve the milk yield of indigenous buffalo through selective breeding. Considering the above facts, current study was undertaken to improve dairy performance of indigenous river buffalo through selective breeding using Open Nucleus Breeding System (ONBS) as well as to conserve indigenous buffalo for maintaining germplasm of indigenous stock as part of maintaining bio-diversity. For this purpose, 11 upazilas under 11 districts were selected for on-farm and BLRI Buffalo Research Herd for on-station study. Under the project area about 1000 indigenous buffalo cows producing above 3 liters of milk per day were selected. Selected buffaloes were identified by tagging and their productive, reproductive and health data were recorded. Moreover, milk quality was also analyzed using potable milk analyzer (FARM Eco, Milkotronic Ltd, Bulgaria).

Table 1. Distribution and milk yield performance scenarios of indigenous buffalo

Upazila	Total Farmers	Total Buffaloes	Total Buffaloes Cow	Daily milk yield per cow (Liter)	
				> 4	> 6L/day
Ramgati, Lakshmipur	164	4261	2890 (68%)	41 (1.42%)	4 (0.14%)
Madarganj, Jamalpur	84	1404	1098 (78%)	722 (65.75%)	120 (10.93%)
Anwara, Chattogram	240	1300	200 (15%)	40 (20%)	2 (1%)
Bauphal, Patuakhali	230	3509	2740 (78%)	121 (4.41%)	-
Fenchuganj, Sylhet	52	321	252 (78%)	4 (1.58%)	-
Charfasson, Bhola	342	23672	5600 (24%)	1725 (30.80%)	-
Kaliganj, Lalmonirhat	112	367	139 (38%)	39 (28.06%)	-
Gangachara, Rangpur	119	327	95 (29%)	60 (63.16%)	8 (8.42%)
Godagari, Rajshahi	142	1218	612 (50%)	162 (26.47%)	-
Iswardi, Pabna	107	1662	1082 (65%)	180 (16.64%)	-
Companiganj, Noakhali	172	4356	2689 (61%)	419 (15.58%)	0.78% (21)
Total	**1764**	**42397**	17397 **(**41.03%)	3513 **(**8.28**%)**	147 **(**0.34**%)**

In this year, field survey was conducted for identification of high yielding buffaloes in selected upazillas. Moreover, for proper recording a herd-book and a Software system were developed for data recording. On baseline survey in the study areas, 1764 buffalo rearing farmers were studied and 42397 head buffaloes were reared by them. On an average there are about 24 buffaloes in each farmer. Among the total buffaloes 41.03% were milking buffalo cows and considering milk production, 4 and 6 liters daily milk producing buffaloes were 8.28% and 0.34%, respectively (Table-1). Moreover, high milk producing buffaloes were found mainly in Madarganj and Gangachara upazillas and the percentages were 10.93% and 8.42%, respectively. Data recording activity is ongoing. After analyzing 1 year data of productive, reproductive and health performance, about 150 pure indigenous milking buffalo cows will be genotyped for collection

of 15 pure growing bulls and 50 buffalo cows. The collected 15 indigenous growing bulls with known milk yield performance of their dam will be prepared for semen collection. Considering semen quality and other parameters 5 bulls will be selected for artificial insemination among registered cows in on-station and on-farm. Present findings summarized that 8.62% buffalo cows produced more than 4 liters milk daily. Systematic selective breeding programme among these populations will ensure future genetic improvement of indigenous buffaloes.

"Greenway Business Apps" an Android Mobile Applications for the Farmers

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Executive Summary

Greenway Business Apps is an innovation idea of BLRI that were executed in the financial year 2020-21, responding the purpose, to sell the livestock and livestock products through online business Apps in short time with maximum benefits of the farmers. However, it is a farmer's friendly mobile application that is useful for farmers, traders and rural communities. The Apps may give farmers a easy way to use livestock technology by getting knowledge from the Apps immediately.

However they also get information about the daily market price of livestock commodities when they want and can sell them within very short time without facing any hazards immediately. Farmers also get the opportunity to discuss their problems with experts from different site. They can also share their problems with each other in need. Under the activities of Apps demonstration in selected areas (Dhamrai, Savar and Kushtia) apps instalment was done with farmers android mobile phone who are rearing cattle, buffalo, goat sheep and poultry. Data also collected regarding sell and buy of livestock products. Before Apps installment a data was generated with some previously prepared questionaries' that screen that a total of about 126 farmers was installed this Apps. About 77 farmers were eager to use these Apps whereas about 64 farmers use these Apps in their own way. The study from the survey showed that among the surveying 123 different livestock farmers 12.3% cattle farmers sold their animals in local market and 20.91% farmers sold their animals in other stakeholders. Among the 123 livestock farmers, 12.3%, 11.07%, 11.07% , 7.38% and 6.15% goat, sheep, poultry and layers farmers respectively were sold their products in local market respectively whereas 24.6% goats farmers, 14.76% sheep farmers, 12.3% poultry farmers, 9.84% layers farmers and 8.61% meat selling farmers sold their animals and products to others farmers.

Commercialization and digitization may change the world now days. Digitization is now a more powerful tool for all the sectors including livestock. This App helps to come to the farmers more digitized along with subsistence livestock rearing system and this might be solved the problems and encourage other farmers to become App oriented and adopted with this technology.

Marketing channels of different Livestock Farmers

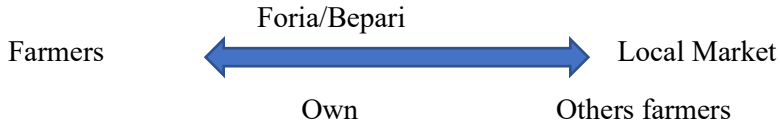

Table: Farmers perception about buy and sell their products

Farmers Type	Place of animals sell				Pattern of animal sell			
	Local market	Percent %	Farmers	Percent %	Own	Percent %	Foria/Bepari	Percent %
Cattle	10	12.3	17	20.91	16	19.68	12	14.76
Goat	10	12.3	20	24.6	15	18.45	9	11.07
Sheep	9	11.07	12	14.76	9	11.07	13	15.99
Poultry	9	11.07	10	12.3	15	18.45	8	9.84
Egg	6	7.38	8	9.84	12	14.76	8	9.84
Meat	5	6.15	7	8.61	5	6.15	3	3.69
Total	49	60.9	74	91.02%	72	88.56	53	65.19

Table 2: Uses of Greenway Apps by the Livestock Farmers

	Download				Users			
	77				64			
Farmers	Cattle	Goat	Sheep	Poultry	Cattle	Goat	Sheep	Poultry
	30	11	10	26	25	10	9	20