Proceedings

Annual Research Review Workshop 2022

Date: 13-14 December 2022

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

Annual Research Review Workshop 2022

Date: 13-14 December 2022

BLRI Conference Hall

3rd floor, Building 3

PROGRAMME

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh

BLRI ARRW-2022 Technical Committee

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01.	Dr. Nasrin Sultana	CSO & Director (Research)	Convener
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PREFACE

Bangladesh Livestock Research Institute (BLRI), state-run research institute at national level for livestock and poultry sector under The Ministry of Fisheries and Livestock, Bangladesh. BLRI has developed 93 Packages and Technologies, since its establishment for increasing livestock production. The mandate of the institute is to identify livestock and poultry production and their health constraints, develop solutions through a multi and interdisciplinary research approach and generate technologies compatible with other resources of the farmers to solve those constraints and problems. To address the mandates of the institute, BLRI conducting need base research activities in the five different disciplines namely Animal and Poultry Breeding and Genetics, Feeds, Fodder and Nutrition, Animal and Poultry Diseases and Health, Animal Biotechnology, Environment and Climate Resilience and Socio-Economics & Farming System Research. The Research Projects are implemented each year through a review process and finally approved by the Technical Committee to achieve the specific goal of the vision 2041 and as well as in the line of SDG's.

BLRI started formal ARRW in the financial year 1999-2000 and is still organizing 23th ARRW-2022. All the Executive Summary of those research works are published in the proceedings of Annual Research Review Workshop after thorough reviewing and editing by a group of panel reviewers. The Annual Research Review Workshop 2022 entitled the research activities in the financial year 2020-21 were 34 research projects from revenue budget and another 38 from developmental project budget. A total 72 executive summaries are presented where 28 for oral presentation and rest on 44 for poster presentation in the respective disciplines that will help student, scientists, academician and policy maker for developing future research programmes and taking the decisions of development policy in livestock and poultry sector. However, I am very much happy to share that BLRI has been handover two (2) new technologies to Department of Livestock Services (DLS) namely Salt Tolerant Fodder and Suborno meat type chicken strain through this ARRW-2022, that Fodder significantly brings revolution in fodder production in coastal areas which mitigate the adverse effect of climate change and ensure much more meat and milk production along with Suborno meat type chicken increases the white meat production with taste like native chicken.

The institute gratefully acknowledged the strong support Ministry of Fisheries and Livestock (MoFL) of the research endeavors and also very thankful for active participation of the all participates under the Department of Livestock Services (DLS), Bangladesh Agricultural University (BAU) and other Agricultural Universities, Bangladesh Agricultural Research Council (BARC), representative from NGO's, expertise of other Organizations who sharing their expertise during the workshop. Institute highly appreciates all the scientists and divisional heads for offering their utmost effort to publish their proceedings. Finally, BLRI believes that technological innovation through livestock research and development is contributing at all levels of national development, poverty reduction, employment generation, woman empowerment and safe animal protein production.

Dr. S. M. Jahangir Hossain
Director General
BLRI, Savar, Dhaka-1341

FOREWARD

Bangladesh Livestock Research Institute is the only one national research institute on livestock and poultry sector in Bangladesh under the Ministry of Fisheries and Livestock (MoFL). The Livestock and Poultry Sector has achieved increased heights and success over the last two and half decades where BLRI enormously gave technological support through developing 93 Technologies and Packages like beef fattening, high yielding fodder varieties, PPR vaccine etc since its establishment. BLRI has been performing in this activity through eight research divisions, three research centers and one support service division. The mandate of BLRI is to develop technology and knowledge through research for solving the existing problem of livestock and poultry production to ensure food and nutrition security of the country.

Through five research disciplines BLRI started a formal annual research review workshop in the fiscal year 1999-2000 and is still performing 23th ARRW-2022. The technical committee of ARRW is performing all technical activities related to the workshop. All the Executive Summary of those research works are published in the proceedings of Annual Research Review Workshop after thorough reviewing and editing by a group of subject matter expertise. The Annual Research Review Workshop 2022 delivers the research outcome in the financial year 2020-21, hence 34 research projects were from revenue budget and another 38 from developmental project budget. However, total 72 executive summaries will be presented where 28 for oral presentation and rest on 44 for poster presentation in the respective disciplines that obviously generate knowledge for student, scientists, academician and policy makers for the development of policy in livestock and poultry sector. However, I am very much happy to introducing that BLRI has been handover two (2) new technologies to Department of Livestock Services (DLS) namely Salt Tolerant Fodder and Suborno meat type chicken strain through this ARRW-2022, that Fodder that will be increased the fodder production in coastal areas and mitigate the adverse effect of climate change and ensure much more meat and milk production, thereafter the Suborno meat type chicken progressively support more chicken meat production with improved taste comparable as backyard poultry.

The organizing committee of BLRI ARRW grateful to thankful to BLRI administration, Ministry of Fisheries and Livestock (MoFL), all the research endeavors and also very thankful for active participation of the all participates of DLS, BAU, BARC and representatives from NGO's, and expertise of other organizations who will be shared sharing their expertise during the workshop. I believe that some of the research results and messages documented in this report will be adopted by the farmers and in the livestock industry and also create employment opportunities, generate income & food security and safety in the country.

Dr. Nasrin Sultana
Director (Research)
BLRI, Savar, Dhaka-1341

TECHNICAL SESSIONS

Day 1: Tuesday, 13 December, 2022

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

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

Co-Chairperson : **Dr. Md. Kabirul Islam Khan**
Professor, Dept. of Genetics and Animal Breeding, Chattogram Veterinary and Animal Sciences University, Chattogram

Rapporteurs : Dr. Md. Sirajul Islam, SSO, BLRI
Md. Panir Choudhury, SSO, BLRI

1.	11:30-11:40	Conservation and improvement of indigenous buffalo for milk production through open nucleus breeding program	GK Deb, PSO,BPRD
2.	11:40-11:50	Strategic development of beef cattle in Bangladesh	M. P. Mostari, PSO,APRD
3.	11:50-12:00	Upgrading indigenous cattle genetic resource through breeding, feeding and health managements at Baghabari and Jashore	YA Khan, SSO,Baghabari
4.	12:00-12:10	Red Chittagong Cattle Breeding and Revealing Their Genetic Architecture Using High Density Single Nucleotide Polymorphism Array	AKFH Bhuiyan, Professor, BAU
5.	12:10-12:20	Conservation and improvement of Munshiganj and North Bengal Grey Cattle	MF Afroz, SSO, APRD
6.	12:20-12:30	Conservation and improvement of native chicken: performance of tenth generation	S Faruque, PSO,PPRD
7.	12:30-12:40	Conservation and improvement of exotic germ plasms for the development of egg and meat type chicken	KN Monira, PSO,PPRD
8.	12:40-12:50	Laying performance of 7th generation of BLRI improved native duck and development of meat type duck by using native duck	H Khatun, SSO,PPRD
	12:50-01:10	**Discussion**	
	01:10-02.00	**Lunch and Prayer**	

Day 1: Tuesday, 13 December, 2022

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

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

Co-Chairperson : **Dr. Mohammad Shahedur Rahman,**
Professor, Dept. of Biotechnology and Genetic Engineering
Jahangirnagar University
Savar, Dhaka-1342

Rapporteurs : Farhana Afroz Mukta, SSO, BLRI
Shahrina Akter, SO, BLRI

1.	02:00-02:10	Development of cost effective semen cryopreservation technique for indigenous cattle of Bangladesh	SF Shejuty, SO, Biotechnology
2.	02:10-02:20	Comparative genomics and functional proteomics studies of Gayal to explore unique genomics features	GK Deb. PSO, BPRD
3.	02:20-02:30	Quality and safety assessments of milk and development of fortifying dairy products	AS Afsana, SO,DRTC
4.	02:30-02:40	Analysis of Candidate Gene for Growth and Morphometric Traits in Black Bengal Goat of Bangladesh	S Ahmed, PSO, GPRD
5.	02:30-02:40	Development of zinc-fortified meat product from broiler and spent hen	A Sultana, SPRDP
6.	02:40-02:50	Assessing the effect of lactic acid bacteria on improving quality and safety of broiler meat	M. A. Islam, SO, PRC
	02:50-03:00	**Discussion**	

Day 1: Tuesday, 13 December, 2022

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

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

Co-Chairperson : **Dr. Mohammad Saidur Rahman**
Professor, Dept. of Agricultural Economics
Bangladesh Agricultural University
Mymensingh-2202.

Rapporteurs : Sabina Yasmin, SSO, BLRI
DR. Md. Syidul Islam, SO, BLRI, Faridpur

1.	03:00-03:10	Baseline survey to evaluate the role of buffalo on economy of Bangladesh	MA Islam, Professor, BAU
2.	03:10-03:20	Dairy production and livelihood scenario in different regions in Bangladesh	E A, Pehan SO, DRTC
3.	03:20-03:30	Production and marketing of beef in some selected areas of Bangladesh	M.S Islam, SSO, Socio-economic
4.	03:30-03:40	Piloting of "BLRI Technology village" at Regional station of BLRI	MA Islam, SO, FSRD
	03:40-04:00	**Discussion**	
	04:00-5:00	**Poster presentation** **Tea and Snacks**	

Day 2: Wednesday, 13 December, 2022

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

Chairperson : **Prof. Dr. Nitish C. Debnath**
Former, Vice Chancellor
Chattogram Veterinary and Animal Sciences University, Chattogram

Co-Chairperson : **Dr. Amalendu Gosh**
Director, Livestock Research Institute
Mohakhali, Dhaka
Department Of Livestock Services

Rapporteurs : DR. Md. Hafizur Rahman, SSO, BLRI
DR. Bijoy Boruya, SO, BLRI, Naikhongchari

1.	09:30-09:40	Monitoring and evaluation of Peste des Petits Ruminants (PPR) virus isolates circulating in Bangladesh	MS Alam, SSO, AHRD
2.	09:40-09:50	Spatio-distribution of AMR in finisher livestock and poultry in Bangladesh	JB Bupasha, SO, AHRD
3.	09:50-10:00	Development of lumpy skin disease vaccine seed from circulating strain in Bangladesh	D Roy, SO, AHRD
4.	10:00-10:10	Development of Avian Influenza H9N2 vaccine from circulating strain	MMR Khan, SO, AHRD
5.	10:10-10:20	Development of Goat pox vaccine seed from circulating local strain	A Hossen, SSO, AHRD
6.	10:20-10:30	Project title: Identification of major goat health problems and their mitigation in different agro-ecological zones of Bangladesh **Activity 1:** Sero-prevalence of Caprine Arthritis and Encephalitis (CAE) in Bangladesh **Activity 2:** Isolation and molecular characterization of contagious ecthyma virus for the development of vaccine seed.	MS Alam, SSO, AHRD
7.	10:30-10:40	Isolation, molecular identification and antibiogram study of Pasteurellosis in pneumonic sheep from selected areas of Bangladesh	AH Zihadi, SO,SPRD
	10:40-10:50	**Discussion**	
	10:50-11:00	**Tea and Snacks**	

Day 2: Wednesday, 13 December, 2022

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

Chairperson : **Dr. Sharif Ahmed Choudhury**
General Manager, PKSF, Dhaka

Co-Chairperson : **Dr. Khan Md. Shaiful Islam**
Professor, Dept. of Animal Nutrition
Bangladesh Agricultural University
Mymensingh-2202.

Rapporteurs : Dr. Shabiha Sultana, SSO, BLRI
Md. Mustain Billah, SO, BLRI

1.	11:00-11:10	Effect of feeding BMP Napier grass as sole diet to local growing bulls on intake, nutrient utilization and growth performance	BK Roy, PSO,APRD
2.	11:10-11:20	Comparative study on existing buffalo feeding management practices and economic evaluation at four selected areas of Bangladesh	M. Miah, SO, BPRD
3.	11:20-11:30	Comparative Feeding Studies on Growth and Reproductive Performance of Black Bengal Buck	MZ Rahman, PSO,SPRD
4.	11:30-11:40	Effect of creep feeding during weaning period on the post weaning performances of growing Black Bengal goat	S Ahmed, PSO,GPRD
5.	11:40-11:50	Production of nutrient enriched designer eggs through dietary manipulation of *Moringa oleifera, Spirulina platensis* and *Linum usitatissimum* in laying hen	MSK Sarker, PSO,PRC
	11:50-12:00	**Discussion**	
	12:00-01:00	**Poster presentation**	
	01.00-02:00	**Lunch and Prayer**	

Day 2: Wednesday, 13 December, 2022

POSTER SESSION

Day 1: 4:00-5:00 pm
Day 2: 12:00-1:00 pm

Monitoring Committee :

1. Dr. Mohammad Shamsul Alam Bhuiyan, Convener
Professor, Animal Breeding and Genetics, BAU

2. Dr. Md. Abu Sufian Member
Director, Account Budget, & Audit Section, DLS

3. Dr. Gautam Kumar Deb, PSO, BLRI Member

4. Dr. Sardar Muhammad Amanullah, PSO, BLRI Member

5. Dr. Razia Khatun, PSO, BLRI Member- Secretary

SL No	Title	Presenter
01.	Epidemiological investigation of major buffalo diseases and evaluation of effectiveness of deworming against buffalo diseases in Bangladesh	OB Paul, SO, BDP
02.	Identification of common etiological agent of alopecia in Red Chittagong Cattle (RCC) calves in selected areas of Bangladesh	E Ahmed, SO (Research Farm), BLRI
03.	Seroprevalence and risk factors of brucellosis in sheep in Bangladesh	MAH. Zihadi, SO, SPRD
04.	Surveillance and molecular evolution of avian influenza virus and it's spatiotemporal distribution of outbreaks in Bangladesh	MMR Khan, SO,AHRD
05.	Development of vaccines for economically important bacterial diseases of poultry	JB Bupasha ,SO, AHRD
06.	Development of duck plague vaccine seed from circulating strain	MS Alam, SSO, AHRD
07.	Development of Multivalent Coccidial Vaccine for poultry	MZ Hassan, SSO, AHRD
08.	Isolation and identification of suitable lactic acid bacteria for the development of microbial silage inoculant	S Akter, SO, Biotec.
09.	Development of Animal Recording and Genetic Evaluation System to Foster Indigenous Buffalo Selection Program	AKFH Bhuiyan, Prof. BAU
10.	Performance evaluation of crossbred buffalo at on-station	MA Alam, SSO, BPRD

11.	Study on existing buffalo fattening scenario and development of community-based fattening program	GK Deb. PSO, BPRD
12.	Standardization of estrus synchronization techniques for improvement of reproductive efficiency of native buffaloes in Bangladesh	A Hakim, Prof. BAU
13.	SNP Analysis and Gene Expression Profiling for Milk Fat and Protein Related Traits in River Buffalo Populations of Bangladesh	MSA Bhuiyan, Prof. BAU
14.	Increasing efficiency of artificial insemination for improving conception rate in river buffalo	M Fakruzzaman, Prof. BAU
15.	Optimizing the process technology of manufacturing value added diversified buffalo milk Cheese and Rasomalai based on their nutritional and physicochemical profile	A. Yasmin, Prof. BAU
16.	Establishment of Milk Processing Facilities at BLRI – Fermented Milk (Dodhi, Yoghurt, Lassi & Laban) Production and Quality Control	AS Afsana, SO, DRTC
17.	Estimation of genetic parameters of growth performance at the pre-weaning period of RCC and their graded progeny	SF Shejuty, SO, Biotec.
18.	Development of low cost feeding system for Red Chittagong Cattle through the supplementation of locally available fodder	M Miah, SO, BPRD
19.	Optimizing the time and condition of RCC bulls for high quality semen production	D Das, SO, Biotech
20.	Conservation and improvement of farm animal and poultry genetic resources at the Hilly region, Naikhongchari	M S Hasan, SO, BLRI-RS, Naikhongchari
21.	Conservation and improvement of fodder crops and performance and nutritional quality evaluation of BRRI dhan -91	S. Ahmed, SSO, APRD
22.	Performance Study of Gamma radiated mutant lines of winter fodder “Oat” under on-farm condition	MM Billah, SO, APRD
23.	Conservation and Improvement of Black Bengal Goat at Bangladesh Livestock Research Institute	NH Desha, SO, SPRD
24.	Molecular identification of the Black Bengal Goat in Bangladesh using DNA barcoding	S Ahmed, PSO, GPRD
25.	Effect of establishment of community-based buck park on the performance of Black Bengal Goat at farmer’s level	S Ahmed, PSO, GPRD
26.	Identification of causative markers and their use in the conservation and improvement program of Jamunapari goat at BLRI	NH Desha, SO, SPRD
27.	Selection and Evaluation of Some Tree Leaves as Goat Feed Through In Vitro Gas Production Technique	JS Khanam, SSO, GPRD
28.	Ex-situ conservation and improvement of native sheep at Bangladesh Livestock Research Institute	S Afrin, SO, SPRD
29.	Exotic sheep adaptation and their crossbreds production for the development of a meat type synthetic sheep breed	MMH Pasha SO, SPRD
30.	Comparative Performances of Native Chickens Under ex-situ Production Environment for Selection as Parent Lines	F. Tabassum, SPRDP

31.	Quality and safety assessments for poultry meat products in Bangladesh	M R Amin, SPRDP
32.	Feeding effects of probiotic, synbiotic and organic acid as alternatives to antibiotic in broiler production	MU Ahmed, SPRDP
33.	Performance of exotic duck with their potentiality as parent line to produce meat type duck in Bangladesh condition	MA Hemayet, SPRDP
34.	Demonstration and validation of BLRI developed native duck through community level at Bhanga, Faridpur	S Islam, So, Faridpur
35.	Effect of feeding fresh azolla on the production performance and egg quality of native laying duck	H Khatun, SSO, PPRD
36.	Geese production and management practices in some selected regions of Bangladesh	MM Rana, SSO, BLRI-RS, Jessore
37.	Conservation and improvement of Quail: Performances of four quail genotypes in the eleventh generation	S Faruque, PSO, PPRD
38.	On-farm measurement of noxious greenhouse gases from poultry litter and their possible utilization	S Sultana, SSO, PPRD
39.	Recycling of poultry wastes for environment friendly low cost poultry production	M A Rashid, SSO, PPRD
40.	Measuring the effectiveness of different training methods and farm-level adoption of BLRI-developed technologies in different areas of Bangladesh	S Yasmin, SSO, FSRD
41.	Assessing baseline status, and knowledge, service and technology need of livestock farmers in selected flood affected areas	F Yasmin, SO, TPTD
42.	Impact of Training Given to Farmers on BLRI Technologies	M Khatun, STO, TPTD

CONTENTS

Technical Session I:

ANIMAL AND POULTRY BREEDING & GENETICS

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

GK Deb[1], SMJ Hossain[2], MP Mostari[3], MA Alam[1], KT Tahira[4], MKH Majumder[1], MK Alam[1] and S Akter[2]
[1]Buffalo Research and Development project, [2]Biotechnology Division, [3]Animal Production Research Division, [4]Buffalo Production Research Division, BLRI, Savar, Dhaka.

Executive summary

Buffalo is an integral component of livestock sub-sector in the country. They have higher capacity to convert low nutritional feed into high nutritional food (milk and meat) and higher adaptability in different harsh climates. Milk production varies according to genetic makeup and management practices in buffaloes. The reviewed literature revealed that indigenous river type buffalo in Bangladesh produces about 620-1161 kg milk in a 270 to 330 days lactation period. This indicates wide genetic variations among indigenous buffaloes for milk yield performance. So, there is a scope for genetic improvement of milk production efficiency of indigenous buffalo through selective breeding. Considering above facts, this study was undertaken to (i) improve the milk yield of indigenous river buffalo through selective breeding using open nucleus breeding system (ONBS) and (ii) conserve indigenous buffalo for maintaining bio-diversity. For this study, eleven (11) upazilas were selected along with BLRI buffalo research farm. A baseline survey was conducted in the selected project areas with the aim of developing a data base on available buffaloes and selection of 1000 high yielding buffalo cows considering daily milk production (over 3.0 liter per day) and parity (first and second). The selected buffalo cows were identified by tagging, dewormed and vaccinated against common diseases. Data on daily milk yield, lactation length, calving interval, and diseases were collected and recorded in herd-book. However, data on body weight at different age period, puberty, age at first calving, calving interval, number of services per conception were recorded at BLRI buffalo research farm. Milk samples from on-farm (n=179) and on-station (n=70) were analyzed for determination of milk composition using Lactoscan milk analyzer. A software was developed for recording productive, reproductive, and others data. Data were analyzed using CRD experimental design.

Table 1: Buffalo population and milk yield scenarios of indigenous buffalo in selected areas

Upazila	Total no. of buffalo found	Total no. of buffalo selected	Total no. of tagged buffalo	Buffalo cows in herd-book		Information of buffalo in software (No.)
				cows yield ≥ 4 litre milk	cows yield ≥ 6 litre milk	
Ishurdi	1662	1021	215	74	0	136
Ramgati	4277	849	352	40	3	244
Companiganj	4356	1358	530	128	8	314
Anwara	910	350	221	27	2	112
Fenchuganj	321	314	244	2	0	22
Kaliganj	550	231	164	32	6	116
Gangachara	361	190	113	32	0	29
Godagari	1607	722	407	39	6	253
Madarganj	1405	1081	266	151	10	161
Charfasson	29617	855	322	32	0	42
Bauphal	3485	1447	325	24	0	204
Total	**48551**	**8418**	**3159**	**581**	**35**	**1633**

A total of 1442 buffalo rearing farmers and 48551 buffaloes were identified in the study areas. Among them total 550 buffalo rearing farmers were selected and trained on buffalo rearing and data management. The number of buffaloes among the selected farmers was 8418 heads. About 37.52% of the selected buffaloes (3159) were marked using ear tagging or tattooing. Moreover, data on 1633

buffaloes were updated into the developed software (Table-1). About 41.03% of the total buffalo population were milking cows. Among them, about 20% and 0.89% cows were yielding 4-6 and above 6 liters milk daily, respectively (Table 1). The highest number of four and above liters daily milk producing buffalo cows (n=161) were recorded in the Madarganj upazilla of Jamalpur district. Buffalo cows/heifers attained in puberty and delivered their first calves in earlier age at on-station compared to on-farm condition (Table 2).

Table 2: Productive and reproductive performance of indigenous buffalo at on-farm and on station (Mean±SE)

Parameter	**On-station (25)**	**On-farm (274)**	**Level of sig.**
Age at puberty (months)	31.5±1.4	36.9±0.36	**
Age at 1st calving (months)	42.8±1.5	48.1±0.33	**
Calving interval (months)	14.5±0.9	14.8±0.18	NS
Service per conception	1.2±0.084	1.4±0.04	NS
Milk Composition			
Milk fat (%)	7.1±0.09	7.5±0.12	**
SNF (%)	10.01±0.3	9.98±0.11	NS
Protein (%)	4.1±0.2	3.9±0.1	NS
Lactose (%)	5.8±0.04	5.6±0.07	**

Figure in the parenthesis indicates the number of observations. **=significant ($p<0.05$), NS= non-significant

The fat content of milk was higher in case of on-farm (7.5±0.12) than on-station (7.1±0.09). Whereas, lactose percentage were higher in milk collected from cows reared in on-station (5.8±0.04) than on-farm (5.6±0.07).

Considering the above findings, indigenous buffaloes of Madarganj and Companiganj areas produced more milk than others areas.

Strategic development of beef cattle in Bangladesh

M. P. Mostari*, M.Y.A. Khan, M. F. Afroz, M. M. Billah and B. K. Roy
Animal Production Research Division, BLRI, Savar, DHAKA-1341
*Corresponding author: Parvin Mostari (adiba_blri@yahoo.com)

Executive summary

Bangladesh is a highly cattle dense country but the productivity of our cattle is still low and/not sufficient to meet the demand of beef in the country. Moreover, beef is the most preferred dietary meat item to the Bangladeshi consumers in history. But the price of beef is increasing tremendously especially in the last decades and now it is going beyond the purchasing power of the general consumers. In addition, we don't have any recognized high yield beef breed. Therefore, to meet the growing demand of this protein, uphold the nutritional status of the nation, earn foreign currency by exporting, beef production of the country must be increased many folds. Considering above facts, the present research program was undertaken to select the suitable exotic beef sire (s) for crossing with native cattle and evaluation of their growth and production performance and thus selection of suitable 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 98 F_1 and F_2 crossbred progeny were produced during 2015 to 2022 (Table 1). They were raised under similar feeding and management condition and their feed intake, body weight (at different physiological stages), average daily gains, disease incidence and mortality, meat yield & carcass characteristics, milk yield etc. were recorded and evaluated all over the year. After evaluation of F_1 progeny, Simmental×BCB-1 and Charolais×BCB-1 crossbred were selected as future beef producer (s) and used for production of F_2 crossbreds through *inter-se* mating. In the last year (2021-22), we compared the growth and production performance of F_1 and F_2 progeny of Simmental and Charolais crosses upto 2 years of age. We performed a feeding trail with F_2 progeny of Simmental and Charolais crosses for a period of 63 days. The *ad-libitum* green grass and concentrate mixture @1% body weight containing 18% CP were provided for this trial. In addition, we analyzed the meat sample of F_1 progeny at 2 years of age for total fat and lipid profile which were excluded in the previous year.
Table 2 showed that only at market age the live weight varied significantly between F_1 and F_2 progeny both in Simmental and Charolais crosses and about 100 to 150 kg higher live weight found in F_1 progeny that may be due to effect of heterosis and management.

Table 1: Present stock and total production of crossbred beef progeny

*; Total number of crossbred progeny produced over the year of 2015 to June-2022.

Genaratio ns	Genotypes								Total
	Simmental cross		Charolais cross		Limousin cross		Brahman cross		
	Male	Female	Male	Female	Male	Female	Male	Female	
At present									
F1	5	8	7	6	2	-	3	1	32
F2	6	9	5	3	-	-	-	-	23
Sub-total	**11**	**17**	**12**	**9**	**2**	**-**	**3**	**1**	**55**
*Total	13	24	19	15	8	7	7	5	98
	37		34		15		12		98

Table 3 indicated that there was no significant difference between Simmental and Charolais crosses in FCR in F_1 progeny but in the F_2, the FCR differed significantly and the higher feed conversion efficiency was found in Simmental cross compare to Charolais cross. The average daily gain did not vary significantly between Simmental and Charolais crosses (Table 3). There was no significant ($p>0.05$) difference in terms of total fat% among the beef breeds (Table 4) but Limousine cross showed the highest value (3.95 ± 0.74) and Simmental cross had the lowest value (2.40 ± 0.74**)**. In

case of lipid profile, there was a significant difference ($p<0.05$) in HDL and LDL values but TG and TC value were insignificant ($p>0.05$). The highest HDL value was found in Simmental cross (157.19 ± 19.80 ug/g) along with a lowest value of LDL (147.37 ± 4.13 ug/g).

Table 2: Comparative live weight of F_1 and F_2 male of Simmental and Charolais crosses

Live weight (kg)	Mean±SD(n)					
	Simmental			Charolais		
	F_1	F_2	Sig.	F_1	F_2	Sig.
At birth	23.35±2.54(4)	23.48±2.77(5)	NS	27.30±7.01(6)	25.70±7.01(4)	NS
Weaning	63.25±21.04(4)	58.20±10.63(5)	NS	67.18±18.70(6)	56.29±9.94(4)	NS
6 months	119.00±39.11(4)	99.80±7.58(5)	NS	127.16±39.28(6)	95.00±11.43(10)	NS
1 year	244.25±65.98(4)	216.65±19.23(5)	NS	260.66±69.52(6)	187.00±40.20(4)	NS
2 years	499.66±123.92(3)	367.05±30(5)	*	456.33±66.67(6)	345.00±34.15(4)	*

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

Table 3: Feed intake, growth and FCR of F_2 male of Simmental and Charolais crosses at 2 years of age

Parameters	Mean±SD		
	Simmental (n=3)	Charolais (n=2)	Sig.
DMI (kg/day)	5.74±0.13	8.58±0.02	***
Total Gain (Kg)	43.67±0.58	46.56±3.21	NS
ADG	0.68±0.01	0.73±0.05	NS
FCR of F_2	8.41±0.25	11.85±0.91	***
FCR of F_1	11.20±2.5(3)	11.30±3.4(5)	NS

FCR of F_1 of Simmental and Charolais crosses (Ref. Proceedings of Annual Research Review Workshop, 2019. BLRI, held in 26-27 January, 2020)

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

Table 4: Fat and lipid profile of F_1 male of different crossbreds and BCB-1 at 2 years of age

Parameters	Genotypes (Means±SEM)					
	BCB-1 (n=3)	Simmental cross(n=3)	Charolais cross(n=3)	Limousine cross (n=3)	Brahman cross(n=3)	Sig. level
a) Total fat %	2.44±0.50	2.40±0.74	2.85±0.55	3.95±0.74	3.30±0.29	NS
b) Lipid profile						
TG (ug/g)	2371.17±115.49	2344.03 ±161.87	2361.38 ±226.59	2466.27 ±233.25	2623.43 ±84.78	NS
TC(ug/g)	766.79 ±27.68	773.37 ±17.60	779.62 ±37.97	790.01 ±43.93	821.21 ±20.11	NS
LDL(ug/g)	179.33 ±12.06	147.37 ±4.13	194.42 ±6.77	185.61 ±8.78	189.16 ±4.74	**
HDL(ug/g)	113.22±2.87	157.19±19.80	112.92±3.33	111.14±3.40	108.22±3.71	*

*Significant ($p<0.05$); ** Significant ($p<0.01$); SEM=standard error of mean; NS= not significant; value in the parenthesis indicate the number of observation; TG=; TC=; LDL=; HDL=

A number of 2330 frozen semen straws were produced from selected F_1 crossbred bulls for future use in *inter-se*-mating and production of market beef cattle containing 25% exotic genetics.

Based on the present findings, it can be said that Simmental crossbred was better performer than Charolaise crossbred both in F_2 and F_1 in terms of production and meat quality. The growth performance was consequently transmitted from F_1 to F_2. More progeny of F_1 & F_2 of selected breeds yet to be produced. Production and evaluation of market beef cattle by using BLRI developed assorted beef bulls through field trial will be conducted. Thus, 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

Upgrading indigenous cattle genetic resource through breeding, feeding and health managements at Baghabari and Jashore

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Executive Summary

In Bangladesh daily per capita availability of meat and milk are 136.18 (gm/day/head) and 193.38 (ml/day/head) against the FAO recommendation of 120g/d/head and 250 ml/d/heads, respectively (DLS, 2020). Which indicate that we are surplus on meat production and a deficit in milk production by 56.62 ml/d/head. Although there is a little gap between supply and demand of milk production, but with this existing growth rate of milk production we may achieve our target very soon. Bangladesh has a target to reach developed country by 2041, thereby we have to increase our milk production many folds to meet the excess demand, as with the increase of purchasing capacity people will have higher tendency to consume more milk protein. There are about 24.5 million heads cattle (DLS, 2020) in Bangladesh, in which about 20-30% are crossbreds between different breeds and genotypes of Holstein Friesian (HF), Jersey, Sahiwal and Indigenous (Local) etc. Out of 24.5 about 7 million heads cattle are reproducible cows among which 24% are Holstein Friesian× Local (HF×L) crossbred types (Huque *et al.*, 2011). However, crossbred cows are more popular and suitable for commercial purpose due to potential milk production of 5 to 10 times more than local indigenous cows. Crossbreeding of local non-descript cattle with exotic breeds of high genetic potential could be considered as a rapid and effective method for the genetic improvement of indigenous cattle in Bangladesh (Usman *et al.*, 2012). We have already passed six decades in crossbreeding program through artificial insemination (AI) in our livestock population, but still now we have no exact information regarding genetic constituents of our crossbreed population. However, random crossbreeding may not be effective until and unless a distinct record keeping system could be established, where an individual animal should possess it's self-identity along with its pedigree records. Moreover, most of the crossbred genotypes are genetically admixture with several breeds, which is not justified for breed development program. Thus, it is necessary to establish a crossbred dairy herd by crossing a known purebred native with exotic cattle to determine the actual productive and reproductive performance of the crossbred and purebred. In this perspective, Bangladesh Livestock Research Institute (BLRI) has taken initiative to establish a Pabna cattle nucleus herd, two community herd and a crossbred cattle herd of HF ×Pabna cattle to investigate productive and reproductive performance of F_1 and F_2 progeny of Pabna, HF × Pabna and BCB-1 (Improved Pabna cattle)×indigenous. To implement the program, a total of 73 local Pabna cows and 7 pure Pabna bulls has were purchased through Dairy Development and Research Project (DDRP) to establish a pure Pabna nucleus breeding herd at Baghabari, Sirajganj. Community herd has been established at one char village in Bera, Pabna where, 50 cattle farmers have been surveyed and selected, a total of 251 cattle present in this community with an average 5.02±2.44 cattle per house hold. In Jashore community, 30 selected farmers having 116 indigenous cattle with an average of 3.87±1.68 cattle per house hold were surveyed and selected. In both community, farmers' training, deworming, vaccination, artificial insemination and health services were provided and each community have a livestock service provider for providing those services and data recording. In this financial year, a total of 47 AI and natural services has done using Pabna bulls' and BCB-1 frozen semen in Bera farmer's community and in BLRI Baghabari cattle research farm to produce pure Pabna progeny. A number of 26 AI has done in BLRI Baghabari cattle research farm using 100 % HF to produce Pabna ×HF and 19 AI has done in Jashore community to produce Pabna ×Indigenous graded progeny.

After establishment of nucleus herd at Baghabari at the year of 2017, a total of 37 HF crossbred F_1 progeny were produced, where, 17 males and 20 females. Purebred Pabna have increase to 87 cattle where, 30 males and 57 females (Table 1). All F_1 crossbred and Pabna calves were raised under similar feeding management system and productive and reproductive data were recorded all over the year. The recorded data were analyses using Microsoft Excel 2016. A very few number of crossbred males and females attain to maturity, however, body weight of crossbred HF male and female found 307 and 274 Kg where, purebred Pabna male and female showed 200 and 196 at 2 years of age (Table

2). Crossbred HF and Pabna cattle attained puberty at 19.7 and 25.7 months of age, respectively. Pabna Cattle showing average 86.8 days' post-partum heat period and 389.5 days calving interval (Table 3). Only one female of crossbred HF is in lactating stage with the lactation yield of 1979 Kg in 340 days and Pabna cattle showed average 1061 Kg lactation yield in 282 days (Table 4).

Table 1: Number of HF crossbred and purebred Pabna cattle in BLRI Baghabari.

Genotypes	Male	Female	Total
HF × Pabna	17	20	37
Purebred Pabna	30	57	87
Grand Total			124

Table 2: Body weight of HF crossbred and purebred Pabna cattle at different ages.

Age	Body weight (Kg) Mean±SD(n)			
	Pabna Male	Pabna Female	HF cross male	HF cross female
At Birth	19.5±2.9(28)	18.4±2.0(33)	22.2±2.7(16)	22.0±2.1(19)
3 Months	54.7±8.3(21)	51.0±6.6(29)	61.0±9.5(6)	72.3±9.1(10)
6 Months	84.1±17.3(15)	81.1±12.6(24)	114.4±25.5(6)	110.6±27.7(9)
12 Months	121.3±18.1(11)	116.0±17.1(21)	191.7±40.7(3)	207.0±38.7(4)
18 Months	162.2±25.2(11)	144.5±22.4(20)	264.4±28.3 (2)	245.5±47.7(4)
24 Months	200.4±30.5(5)	196.5±23.5(12)	307.5±31.8(2)	274.7±31.7(3)

SD=Standard Deviation, n= number of observation

Table 3: Reproductive performance of HF cross and purebred Pabna cattle.

Genotype	Age at 1st Heat (Months) Mean±SD(n)	Weight at 1st Heat (Kg) Mean±SD(n)	Post-partum heat period (Days) Mean±SD(n)	Calving Interval (Days) Mean±SD(n)
HF × Pabna	19.7±6.7(3)	251.5±38.7(3)	111(1)	
Pabna	25.7±4.1(15)	213.4±24.7(3)	86.8±9.4(4)	389.5±11.6(2)

Table 4: Milk production performance of HF cross and purebred Pabna cattle.

Genotype	Lactation Length (Days) Mean±SD(n)	Lactation Yield (Kg) Mean±SD(n)	Milk Yield/Day (Kg) Mean±SD(n)
HF × Pabna	340 (1)	1979.3 (1)	5.82 (1)
Pabna	282.5±64.5 (31)	1061.7±244.2 (31)	3.86±0.78(31)

This is a cattle breeding program which is time consuming and needs uninterrupted supply of adequate balance nutrition and management to get actual progeny performance and a large number of progeny performance data needs to determine a precise mean value of productive and reproductive traits. So, this program needs to extend and continue with a precise way.

Red Chittagong Cattle Breeding and Revealing Their Genetic Architecture Using High Density Single Nucleotide Polymorphism Array

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Executive Summary

The objectives of this research project were: (1) to assess the performance of pure and graded RCC with a view to make available pure young meritorious RCC bulls to national breeding service providers and (2) to investigate the genetic diversity and genomic architecture of RCC using high density SNP markers. Detailed data on a total of nearly 1000 pure RCC of different ages, stages and sexes available in the hands BAU, BLRI, DLS, BRAC, ADL, PKSF (IDF, Momota, Desha) Green Farming Cooperative, Nahar Dairy Ltd, private owners, etc. were collected. A standard database of the compiled pedigree and performance information has been developed and then uploaded to National RCC website. For molecular study, 281 blood samples from pure and unrelated RCC, Pabna, North Bengal Grey, Munshiganj, Sahiwal and Indigenous were collected from the institutional herds of BLRI, DLS, ADL, BAU as well as from the farmers' herds of Naogaon, Rajshahi, Sirajganj and Mymensingh. In total, 240 samples have already genotyped by Illumina 50K SNP bead chip (TNT Research Co. Ltd, South Korea). Our results provide insight information on genomic diversity and population structure of the aforesaid cattle genetic resources of Bangladesh. On the other hand, whole genome sequence of four RCC samples have already been completed using Illumina NGS technology and the NGS data analyses are about to be completed. In three batches a total of twenty-six potential pure young RCC bulls with known pedigree were identified, purchased and brought to BAU AI Centre for routine recording of their body weight, growth, testicular measurement and semen characteristics. Meanwhile, after test results a total of 16 (sixteen) Certified RCC Bulls have already been sold for use to American Dairy Ltd. (ADL), Lal Teer Ltd., ACI Genetics Ltd., IDF and Momota, Chottogram, Desha, Kushtia, a private owner of Dinajpur and Ejab Alliance Ltd., Thakurgaon. Growing RCC bulls found disqualified in the process of testing were culled. Alongside, Non-descript Local cows/heifers were bred with RCC semen produced at the BAU AI Centre and graded RCC progeny produced in the villages surrounding BAU were tracked using the developed RCC Herdbook and their growth performance recorded. Finally, with sufficient scientific evidence, population and breed descriptor data, application to the national body for breed registration was submitted and consequently government NTRC declared (24.5.2022) RCC as a dual-purpose breed of cattle of Bangladesh.

Conservation and improvement of Munshiganj and North Bengal Grey cattle

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Executive summary

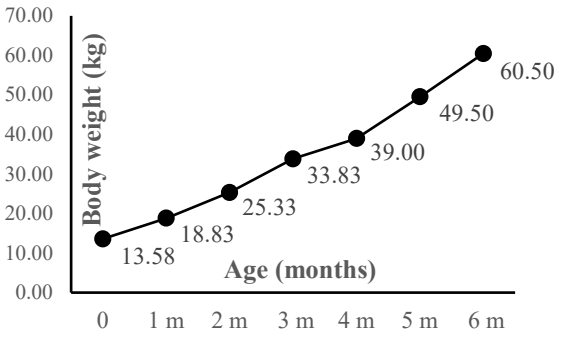
There are a number of pure/improved varieties of cattle localized in some areas of the country. Munshiganj Cattle (MC) is one of them found mainly in Munshiganj district and adjunct areas of the district. The MC is also locally known as "Mirkadim" or sometimes "Hasha". It is a typical milk type variety, mostly of creamy to white in coat colour. 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, subsequent improvement and breeding with pure MC are necessary. Considering the above facts, steps have been taken by BLRI since 2013. 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 39, which including 11 cows, 12 bulls, 7 heifers, 5 growing calves and 4 milking calves. Like as MC the North Bengal Grey (NBG) cattle may be a promising variety of domestic animal genetic resources. The actual breeding tract and history of this variety is still obscure but in the northern regions of Bangladesh it is found more frequently. The coat colour of these cattle is deep grey to white. The coat colour of the neck region in adult bulls was found to be generally ashy with a range of shades. Their phenotypic characterization and production potentials have not yet been well evaluated and documented. Therefore, in 2021-22 BLRI initiated a research program on NBG to know the probable distribution pattern, perform phenotypic characterization, collect, conserve, improve and multiply pure NBG both *in situ* and *ex situ*. A pre-tested structured questionnaire was followed to collect the field data. A total number of 207 respondents of 6 upazillas of 3 districts named as Rajshahi, Bogura and Naogan were surveyed this year.

For conservation of MC verity to regain its purity in the farmer's house, artificial insemination (AI) is going on with pure BLRI MC frozen semen. Some non-descript indigenous cattle are also selected for AI to increase the population of MC. In May, 2022, a number of 100 MC BLRI semen straws were supplied to the MC community through a focus group discussion.

Table 1: Statistics of AI (up to August-2022) by using BLRI MC semen in the community

Total doses	Name of MC community	No. of AI performed	Cattle type	No. animal conceived	Conception rate (%)
100	Bangla Bazar (#50)	11	MC	5	45.45
	Shiloy (#50)	19	MC (11)	4	36.36
			Others (8)	3	37.50
Total		30		12	39.99

Fig. 1 Growth curve of MC from birth to weaning age



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.

The Fig. 1 showed the growth curve of BLRI MC in where, at birth, the average body was found as 13.58 kg whereas, the weaning (6 months of age) weight was 60.50 kg. Table 2 showed the milk yield characteristics of MC which also indicated a big variation among the MC in terms of milk production criteria for selection and further improvement.

Table 2: MC milk production traits

Traits	No.	Minimum	Maximum	Mean	SD
Lactation Length (Days)	35	101	309	170	62.68
Lactation Yield (K)g	35	230.28	1545	612	233.55
Average daily milk yield (Kg)	35	2.28	5.0	3.6	0.71

Based on the previous primary studies, we selected the survey areas and farmers for our present study. Therefore, we found the NBG as maximum as possible in our present survey. Out of 715 cattle, a total number of 289 NBG were found in 3 districts (Table 3). Table 3 also showed the genetic diversity of cattle in the surveyed areas. Among the 6 upazillas, the highest number of NBG was found as Godagari, Rajshahi followed by Naogan>Tanor>Bogura Sadar>Sibgonj (Table 4). The highest number of cattle was found as Deshi with 55.66% and the lowest was MC with 0.28 %.

Table 3: Number of cattle by breed/genotype in the surveyed areas

Districts	Upazilla	Number of households surveyed	Total number of cattle	Breed/Genotype					
				NBG	Deshi	RCC	Pabna	MC	CB*
Rajshahi	Godagari	50	262	131	121	2	4	-	4
	Tanor	30	70	32	30	-	5	1	2
Bogra	Shibgonj	29	121	16	105	-	-	-	-
	Sadar	38	89	20	69	-	-	-	-
Naogan	Nagon Sadar	60	173	90	73	1	6	1	2
Total		207	715	289	398	3	15	2	8

*CB; Crossbreed

Table 4: NBG cattle distribution pattern by age in the surveyed areas

Type of cattle	Bogra sadar	Sibgonj	Godagari	Tanor	Naogon	Total
Milking cow	4	5	46	17	41	113
Dry Cow	6	2	17	3	1	29
Ox	6	7	29	1	9	52
Bullock	1	-	-	-	-	1
Growing bull calf (1-2 yrs)	-	1	5	1	9	16
Growing heifer (1-2 years)	1	1	6	6	9	23
Yearling male calf	-	-	15	2	8	25
Yearling female calf	2	-	13	2	13	30
Total	20	16	131	32	90	289

The findings of the survey on NBG cattle so far revealed that more systematic breed survey and details data bank development are needed to compare the production potentials with that of other indigenous cattle in Bangladesh. Before extinction and preventing the haphazard crossing of NBG, both *in situ* and *ex situ* conservation is compulsory for sustainable development. In addition to this, molecular characterization of NBG cattle is needed to determine their genetic constitution is essential.

Project title: Improvement of poultry species through appropriate selection and breeding and development of meat and egg type strains/crossbreds
Study 1: Conservation and improvement of native chicken: performance of tenth generation

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Executive Summary

The present study was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka with the objectives,(i) to assess the performances of three indigenous chicken genotypes under intensive management, (ii) to select parental birds (males and females) and breed them in an assortative plan for the production of tenth generation birds, and iii) to collect, evaluate and dilute of native chicken cock semen. A total of 8921-day-old chicks comprising of 3 types of chicken namely Naked Neck (NN-3261), Hilly (HI-2567) and Non-descript Deshi (ND-3093) were hatched in two batches to produce tenth generation (G_{10}). Progeny were wing banded and reared separately according to genotypes. The improvement target for egg production rate is to increase by 2% per generation, the improvement target for egg weight is to increase by 1 g, and the improvement target for growth rate is to increase by 20 g per generation. In the tenth generation (G_{10}), selection was practiced at two stages. Firstly, at 8th week of age according to 8th week's body weight and secondly, selection was practiced at 40th week of age on the basis of selection index to produce the next generation comprising the parameters of body weight (BW) at 40th week, egg production (EP) up to 40 week, egg weight (EW) at 40th week and age at maturity (ASM). 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 production from birds was recorded up to 72 weeks of age from hens of Non-descript Deshi, Hilly, Naked Neck. Chick weight (g), body weight at different stages of age, annual egg production, fertility (%), hatchability (%), feed intake (g/b/d) were recorded. All recorded data were analyzed in a CRD by a Generalized Linear Model (GLM) procedure using SPSS 20.0 for Windows. For mean comparison the Duncan Multiple Range Test (DMRT) was used. 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 weight was significantly ($p<0.001$) higher in NN and 8th week body weights of 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 ND (195.56), intermediate in NN(194.13) and lowest in HI (158.41). The percent hatchability of eggs obtained from HI hens was significantly ($p<0.001$) higher with the values of 71.26% and the fertility percentage was significantly higher in NN with the values of 84.94. Semen volume was significantly ($p<0.01$) affected by genotype (Table 1). Among the three genotypes, the semen volume of NN and ND (0.297ml) was significantly higher than HI (0.292ml). Mortality (%) was not affected by genotype. Table 2 showed the EP of ND, HI and NN birds were expected to increase by 1.872, 2.143 and 0.976%, respectively. The EW of ND, H and NN birds were expected to increase by 0.198, 0.225 and 0.166g, respectively. The number of effective population sizes (Ne) was 66.667- 100 (Table 3). The rate of inbreeding (ΔF) calculated for the native chicken considering the existing flock size and management practice ranged from 0.005 (0.5%) to 0.007 (.7%). The rate of inbreeding in *ex-situ* conservation system is found very negligible. This study

reveals that different genotypes have significant effect on 8th week body weight, egg production as well as semen volume.

Table 1: Performances of native chicken genotypes at 10th generation

Parameter	Genotype			Sig. level
	ND	HI	NN	
Day-old chick weight(g)	32.09^{b}±0.15	30.83^{c}±0.16	33.48^{a}±0.13	p<0.001
Male BW at 8th week (g)	691.31^{b}±4.59	774.73^{a}±5.72	631.76^{c}±5.45	P<0.001
Female BW at 8th week (g	584.09^{b}±4.66	629.62^{a}±4.62	502.27^{c}±4.66	p<0.001
Annual egg production (no.)	195.56^{a}±1.45	158.41^{b}±1.43	194.13^{a}±1.42	P<0.001
Annual egg production (%)	53.58^{a}±0.39	43.40^{b}±0.39	53.19^{a}±0.39	p<0.001
Fertility (%)	82.34^{ab}±1.27	80.05^{b}±1.34	84.94^{a}±1.40	p<0.05
Hatchability (%)	68.15^{a}±1.44	71.26^{a}±1.52	61.91^{b}±1.61	p<0.001
Semen Volume (ml)	0.292^{b}±0.010	0.297^{a}±0.010	0.297^{a}±0.011	p<0.01
Mortality (%) (0-4 week)	2.08	3.08	3.42	NS

BW=Body weight; ND-Non-descript Deshi, HI-Hilly, NN-Naked Neck, least squares mean without a common superscript along the row within a factor differed significantly (p<0.01), NS=Non-significance;.Values are (mean ± SE).

Table 2 : Expected response to selection for EP (up to 40 weeks) and EW (at 40 weeks) in the tenth generation (G_{10}) of native chicken

Genotype	Trait	Before selection	After selection	Selection differential(S)	Selection intensity(i)	Heritability (h2)	Expected response®
ND	EW(g)	46.5	47.31	0.81	0.2268	0.49	0.198
	EP(%)	58.14	65.63	7.49	0.5585	0.5	1.872
HI	EW(g)	44.47	45.45	0.98	0.2840	0.46	0.225
	EP(%)	45.46	54.21	8.75	0.5964	0.49	2.143
NN	EW(g)	44.47	45.15	0.68	0.2105	0.49	0.166
	EP(%)	57.61	63.19	5.58	0.5676	0.35	0.976

Table 3: Estimation of effective population size and rate of inbreeding of three indigenous chickens from nine to ten generations (G_9-G_{10})) of selection

Generation	Sires	Dams	Effective population size (N_e)	*Selection intensity(i)	Rate of inbreeding (ΔF)
Non-descript Deshi					
S_9	20	100	66.667	0.725	0.007
S_{10}	30	150	100.00	0.559	0.005
Hilly					
S_9	30	150	100.00	0.644	0.005
S_{10}	30	150	100.00	0.596	0.005
Naked Neck					
S_9	30	150	100.00	0.081	0.005
S_{10}	30	150	100.00	0.568	0.005

S_9- S_{10} indicate the generations of selection; *Selection intensity only for egg production (%)

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

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Executive Summary

Four genotypes of chicken White Leghorn (WLH), White Rock (WR), Rhode Island Red (RIR) and Barred Plymouth Rock (BPR) are being maintained at Bangladesh Livestock Research Institute (BLRI) research farm with the objectives; to conserve and strengthen production of four pure lines of chicken, to refine and optimize feeding and management standard of MCTC parent line. A total of 8000 pedigree hatched day old chicks (2000 for each line) were hatched as 19th generation and they were identified individually by wing band. Males and females were selected at the age of 8 and 16 weeks on the basis of pedigree records and phenotypic characteristics. Finally, 50 males and 200 females were selected at 38 weeks of age on the basis of selection index to produce next generation. The parent stock was reared in single cage open housed system. The experiment was carried out in 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 recorded monthly. Selection was done for 19th generation at 38 weeks of age by determining the selection index in each egg production record while males were selected based on family average. Selection index was calculated by using age at first egg (days), body weight (g) at 38 weeks of age, egg production (%) (168-280 days), egg weight (g) at 38 weeks of age parameters. The selection Index was calculated by the following equation; Selection Index (I) = $b_1x_1 + b_2x_2 + \ldots\ldots\ldots\ldots + b_nx_{n,}$ where, x_1, x_2,…….x_n represent the phenotypic value for the trait and b_1, b_2,…….b_n denote the relative weight given to each of the trait.

Table 2: Selection performances of four genotypes at19th generation (G19)

Parameter	Genotypes (Mean±SE)				Level of significance
	WLH	WR	RIR	BPR	
Egg production (EP %)	70.88^{bc}±3.12	72.82^{b}±1.61	75.02^{a}±2.4	64.28^{c}±2.7	p<0.001
Egg weight (EW g)	56.25^{b}±1.16	60.01^{a}±1.29	57.62^{ab}±2.02	56.40^{b}±1.78	NS
Age at first egg (days)	154.9825±3.17	159.48±0.61	162.64±12.78	160.9025±1.85	NS
Body weight (BW g)	1680.08^{c}±35.82	1418.23^{d}±28.98	1916.83^{a}±28.46	1791.04^{b}±33.83	p<0.01
Selection Index	20.07^{b}±0.34	28.37^{a}±0.33	20.73^{b}±0.38	15.34^{c}±0.56	p<0.01

P<0.001= highly significant, P<0.01=moderate significant, NS=non-significant

Egg production of WLH, WR, RIR and BPR were 70.88±3.12 (%), 72.82±1.61 (%), 75.02±2.4 (%), 64.28±2.7 (%) respectively (Table 1). The egg production percentage was significantly (P<0.001) higher in RIR (75.20%) compare to other three genotypes. Egg weight and age at first egg among four genotypes did not differ (p>0.05) but body weight was significantly (P<0.01) differed among all genotypes and was lower (1418.23 g) in WLH compare to other three genotypes.

Table 2: Selection response of four genotypes in 19th generation (G19)

Genotypes	Traits	Before selection	After selection	Selection Differential (S)	Selection Intensity (i)	Heritability (h^2)	Expected response ®
White Leghorn (WLH)	ASM (d)	159.36	158.62	-0.74	-0.092	0.46	-0.17
	BW (g)	1421.64	1414.58	-7.06	-0.045	0.49	-1.73
	EW (g)	60.34	61.66	1.32	0.275	0.49	0.32
	EP (%)	72.44	79.39	6.95	0.951	0.5	1.74
White Rock (WR)	ASM (d)	154.96	154.45	-0.51	-0.057	0.41	-0.10
	BW (g)	1677.44	1625.12	-52.32	-0.221	0.49	-12.82
	EW (g)	56.24	56.31	0.07	0.018	0.46	0.02
	EP (%)	70.74	77.22	6.48	0.668	0.49	1.59
Rhode Island Red (RIR)	ASM (d)	161.96	160.16	-1.80	-0.215	0.4	-0.36
	BW (g)	1912.77	1900.42	-12.35	-0.057	0.47	-2.90
	EW (g)	57.90	59.24	1.34	0.300	0.49	0.33
	EP (%)	75.16	83.73	8.57	1.007	0.35	1.50
Barred Plymouth Rock (BPR)	ASM (d)	160.86	158.19	-2.67	-0.400	0.41	-0.55
	BW (g)	1801.32	1775.96	-25.36	-0.147	0.49	-6.21
	EW (g)	56.30	57.37	1.07	0.172	0.46	0.25
	EP (%)	63.33	64.96	1.63	0.179	0.49	0.40

Table 2 shows that 38-week egg weight of WLH, WR, RIR and BPR were expected to increase by 0.32, 0.02, 0.33 and 0.25g respectively. Same as egg production percentage were expected to increase by 1.74%, 1.59%, 1.50% and 0.40% respectively

Table 3: Rate of Inbreeding of four genotypes in 19th generation (G19)

Generation	Sire	Dam	Effective population size (Ne)	Selection Intensity (i)	Rate of inbreeding (ΔF)
S19 (WLH)	25	125	83.33	0.951	0.006
S19 (WR)	20	100	66.67	0.668	0.008
S19 (RIR)	25	125	83.33	1.007	0.006
S19 (BPR)	15	75	50.00	0.179	0.010

The rate of inbreeding (ΔF) was 0.006, 0.008, 0.006 and 0.010 in WLH, WR, RIR and BPR respectively which was negligible. on the other hand, a standard feeding and management guidelines developed for the parent and commercial line. A total of 3500 number of male line hatching eggs & 37594 number of female line hatching eggs were distributed to Aftab Bhuhumuchi Farms Ltd and paragoan farms Ltd. From above findings suggested for continuing the chicken breeding research for producing more suitable egg & meat type genotypes.

Improvement of egg and meat producing duck through selection and breeding
Study: Laying performance of 7th generation of BLRI improved native duck and development of meat type duck by using native duck

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Executive Summary

Duck is threatened for existence due to lack of indiscriminate breeding and management practices. Therefore, efforts should be paid to implement breeding scheme for conservation especially in the duck rearing centers. 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 (BLRI) has been conserved two native duck genotypes since 2012. This study was undertaken to know the laying performance of 7th generation of BLRI 1 (rupali) and BLRI 2 (Nageswari) duck. In each generation selection were practiced on the basis of age at first lay (day), body weight at first lay (g), egg production % (168-280 days) and egg weight (g). Selected male and female were mated at the maximum ratio of 1: 5 using natural mating. Adult ducks were housed in an open sided shed with concrete floor and diet contained 17.5% CP and 2750 Kcal ME/kg DM during laying period. Drinking water was provided ad *libitum* throughout the day. Laying performance was individually recorded from the onset of lay. Egg production data of individual duck of 7th generation were recorded. Egg weight (EW) and feed intake (FI) data were recorded and egg mass (EM), egg production (EP) % and FCR were calculated. Total 20 eggs from each duck genotypes were randomly collected at the age 40 weeks and egg quality characteristics were evaluated by different formula. External and internal egg quality parameters were evaluated by methods described by Stadelman (1995) and Peebles and McDaniel (2004). Yolk color was measured by roche color scale. Currently, the demand for duck meat is increasing in rural and urban areas. But due to excess fat in duck meat many people do not eat this meat even though they like it. Some authors opined that crossbreeding of duck can reduce harmful fat in duck meat. Keeping that goal in mind, a few types of cross bred ducks were produced by using native duck. The body weight, feed consumption and carcass characteristics data were recorded. Besides a validation trial of BLRI 1 (Rupali) and BLRI 2 (Nageswari) duck is going on. A total of 10 farmers from Faridpur and Sathkhira areas have been selected. Rupali, Nageswari, local and Jendin ducks were distributed among 10 farmers. At morning and evening 60g supplementary feed were supplied. Other time they were scavenged. Vaccine and medication and other husbandry practices were followed. Body weight (g), Feed intake (g), egg production (no.), Age at Sexual maturity (day) data were recorded. All recorded data were analyzed by SAS and differences were determined by DMRT.

The egg production performances of Rupali and Nageswari ducks are present in Table1. EM was increased significantly ($p<0.01$) in Rupali (40.42g) than Nageswari (38.53g) duck per day whereas EP% (24-48 week) was not significantly differ in both genotypes. EP% in Rupali and Nagesswari duck was 51.08% and 50.17% respectively. Nagesswari ducks significantly ($p<0.001$) consumed less feed (137.80 g/d) than Rupali ducks (139.86 g/d). FCR was significantly ($p<0.05$) better in Rupali (3.42) than Nageswari (3.62) ducks. Mean values of external and internal egg quality traits of two genotypes are also given in Table 1. The eggs were found to have optimum weight, shape index and shell thickness of Rupali duck. Whereas, albumen index is better in Nageswari duck than Rupali. Higher values for albumen width (58.30) was also found in Rupali than Nageswari ($p<0.001$). Haugh unit were not found significantly different in both genotypes. Production performances of crossbred ducks at different ages are shown in Table 2. Live weight, feed intake, Body Weight Gain (BWG), FCR found significant difference at all crossbred duck at different ages. F_2 ducks have better performance in all parameters. At 8, 10 and 12 weeks of age there were found non-significant differences in carcass percentage in different crossbred and different age group. F_2 duck have less abdominal fat at all stages than other crossbred duck. F_2 duck have produced by three-way crossing, where Native, Pekin and Muscovy ducks were used. It is seen that there is no significant difference in egg production rate and haugh unit of Rupali and Nageswari ducks and F_2 (broiler duck) ducks produced by 3 way crossing have less abdominal fat, which is desirable for everyone.

Table1: Egg production performances and egg quality of Rupali and Nageswari ducks in seventh generation (G_7)

Parameters	Rupali	Nageswari	p value
	(Mean ± SE)	(Mean ± SE)	
Body weight, g	1602.60 ±7.5	1568.57 ± 6.80	0.001
EP% (24-48 week)	51.08 ±0.46	50.17 ± 0.59	0.239
EW at first lay (g)	50.70 ± 0.89	47.10± 0.74	0.002
EM (g/d)	40.42±0.72	38.53±0.75	0.042
Age at Sexual maturity (days)	151.73 ±0.12	148.63±1.01	0.067
FI(g/d)	137.80 ± 0.21	139.86 ± 0.19	0.000
FCR	3.42±0.09	3.62±0.08	0.053
Egg quality parameters			
Egg weight (g)	65.01±1.25	61.14±1.21	0.035
Egg Length (mm)	57.34±0.59	58.97±0.57	0.151
Egg Width (mm)	44.48±0.23	43.64±0.22	0.014
Shape Index (%)	77.66±0.65	74.60±0.63	0.002
Albumen Width(mm)	58.30±0.78	53.16±0.76	0.005
Albumen length(mm)	87.34±1.32	86.03±1.28	0.098
Albumen Index (%)	15.53 ±0.52	17.76±0.50	0.005
Haugh unit	93.33±1.44	96.22±1.39	0.163
Shell thickness (mm)	0.51±0.03	0.46±0.09	0.001

Table 2: Production performance of different crossbred duck at different ages

parameter		Crossbred duck (mean ± SE)			p value	
	Age (Week)	Pekin*Nageswari	Pekin*Rupali	F_2	Breed	Age (Week)
Live weight (g)	8	1337.58±31.10	1410.68±33.34	1717.47±41.10	0.000	0.000
	10	1536.55±28.77	1609.66±29.10	1844.01±30.71		
	12	1770.91±30.77	1916.44±36.10	2250.80±29.77		
BWG (g)	8	1303.19±31.00	1375.37±33.23	1675.40±31.00	0.000	0.000
	10	1503.08±30.67	1575.26±31	1874.30±30.70		
	12	1737.44±30.67	1809.61±31	2208.65±30.67		
CFI (g)	8	2211.62±58.23	2211.27±46.12	2241.06±59.10	0.000	0.000
	10	3854.74±76.90	3954.40±72.34	3984.18±40.09		
	12	6198.13±59.43	6198.28±39.40	6228.72±43.34		
FCR	8	1.76±0.06	1.68±0.05	1.23±0.04	0.000	0.000
	10	2.65±0.06	2.57±0.06	2.13±0.04		
	12	3.56±0.09	3.48±0.15	3.03±0.11		
Carcass (%)	8	47.74±1.9	47.97±0.6	52.13±1.7	0.053	0.126
	10	50.76±0.80	50.90±0.9	55.06±0.90		
	12	51.65±1.10	51.89±0.71	56.05±1.1		
Abdominal fat (%)	8	0.16±0.23	0.54±0.32	0.07±0.02	0.02	0.032
	10	0.53±0.32	0.92±0.11	0.20±0.17		
	12	0.93±0.22	1.30±0.19	0.60±0.23		

Pekin*Nageswari= F_1, Pekin*Rupali = F_1 and F_2= (Pekin*Rupali)*Muscovy (broiler duck); BWG=Body weight gain, FCR= Feed conversion Ratio, CFI= Cumulative Feed Intake

Technical Session II:

BIOTECHNOLOGY, ENVIRONMENT AND CLIMATE RESILIENCE

Establishment of semen bank for cryopreservation of BLRI improved germplasm

Sub title: Development of cost effective semen cryopreservation technique for indigenous cattle of Bangladesh

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Executive Summary

Semen cryopreservation is a technique for long-time semen preservation and this technique is used for the establishment of a semen bank. During semen cryopreservation, a large number of sperm suffer physiological damage which leads to the loss of fertility. In 2020-2021 year, 15 breeding bulls (3 BCB, 9 RCC and 3 Munshiganj cattle) were selected for semen collection and 16700 doses (BCB=1200, RCC=13000, Munshiganj Cattle= 2500) of semen were cryopreserved using Andromed semen extender. The average total motility of cryopreserved semen was found at 42% however; the conception rate of cryopreserved semen was only 15.41% on the BLRI farm. Hence, our cryopreservation system may have to modify for improving post-thaw viability and fertility of sperm considering indigenous cattle genetic resources. Various extenders and supplemented chemicals can reduce cryo-damage or oxidative stress. Considering the above fact, the objectives of our project were improvement of the post-thaw viability and fertility of cryopreserved sperm of indigenous cattle as well as conservation of BLRI improved indigenous germplasm through semen bank.

To fulfil this objective, at first the best semen cryopreservation technique for individual indigenous cattle varieties (RCC, BCB and Munshiganj) was developed. Subsequently, selection, management and training of breeding bulls were conducted. For developing the best semen cryopreservation technique 5 cattle from each variety were selected and semen was cryopreserved using different diluters (Triladyl, Steridyl, Andromed, Tris-egg yolk) and different steps of cryopreservation i.e- one Step (From +50C to −100 °C (10.50C/min) and transfer into liquid nitrogen at −196°C), two Step (+50C to -100C (-0.30C/min);-100C to -1300C (-250C/min)) and three step (+40C to -50C (200C/min); -50C to -1100C (550C/min); -1100C to -1400C (350C/min)). Semen was collected by Artificial Vagina (AV) method and semen quality was evaluated using CASA (Computer Assisted Semen Analyzer) after cryopreservation. For data analysis, a two-way Analysis of Variance (ANOVA) at 3×4 factorial model was used and results were expressed as Mean ± Standard error using the SPSS program (version 20.0, SPSS) and the difference between the mean was determined using the Duncan method. Finally, the efficacy of diluter of semen was determined by evaluating live sperm recovery rate using the following formula:

Sperm Recovery Rate (%) = (Observed motility/ Fresh semen motility) x100.

Moreover, heat shock and fertility of cryopreserved semen were evaluated by heat shock gene expression (HSP70 and HSP90) and fertility-related gene expression (CCDC174, PSMA6 & CRISP2) using qPCR. The qPCR expression data for each gene was extracted in the form of a quantification cycle (Ct), and data were subjected to subsequent analysis. The appropriate size of amplified products was ensured by 2% agarose gel electrophoresis and GLUT5 was used as an internal control gene. The relative expression was calculated using the $2^{-\Delta\Delta CT}$ method. Moreover, for determining microbial load of fresh semen and cryopreserved semen, serial dilution was performed on nutrient agar and the microbial load was counted using CFU/ml. Finally, artificial insemination (AI) was conducted using cryopreserved semen of different diluters and the conception rate was calculated by calculating the non-return rate 56 days after AI. Based on the previous experimental result the best semen cryopreservation technique for individual indigenous cattle species was determined. On the other hand, cattle selected for semen collection were conducted based on pedigree record (Milk production), disease condition (Brucellosis, Trichomoniasis, TB) and finally, based on the best semen cryopreservation technique 1000 doses of good quality cryopreserved semen were conserved in semen bank.

It was found that there was no significant effect in different steps and the interaction of step×diluter but a highly significant effect on different diluters. In case of RCC, the motility rate of diluted semen of Andromed, Tris-egg yolk, Steridyl and Triladyl were 32.35%, 60.66%, 53.50% and 52.93%, respectively. In case of MC semen, the motility rate of diluted semen of Andromed, Tris-egg yolk, Steridyl and Triladyl was 30.31%, 50.73%, 63.33% and 50.50%, respectively. In case of BCB semen, the motility rate of diluted semen of Andromed, Tris-egg yolk, Steridyl and Triladyl were 33.32%, 64.96%, 55.53% and 53.93%, respectively. The highest (66.46%) motile live sperm recovery rate of RCC semen was found from Tris-egg yolk diluted cryopreserved semen and the lowest (35.45%) motile live sperm recovery rate of RCC semen was found from Andromed diluted cryopreserved semen. In case of BCB cattle, the highest (85.93%) motile live sperm recovery rate was found from Tris-egg yolk diluted cryopreserved semen and the lowest (44.07%) motile live sperm recovery rate was found from Andromed diluted cryopreserved semen. In MC cattle, the highest motile live sperm recovery rate was 68.92%, recorded from Steridyl diluted cryopreserved semen and the lowest motile live sperm recovery rate was 32.98%, found from Andromed diluted cryopreserved semen. The microbial data analysis showed that before cryopreservation large number of microbes (84.33×10^3 CFU/ml) were found in fresh semen and after cryopreservation, only a few microbes (11 CFU/ml) were found in Andromed diluted semen and no microbes were found at Steridyl, Tris-egg yolk and Triladyl diluted semen, respectively. On the other hand, there was no significant difference in fresh semen quality within variety however, a significant difference was observed in semen morphology within the different varieties. After AI it was observed that the conception rate of Steridy and Tris-egg yolk diluted semen was higher than Andromed. BCB cattle sperm is larger than RCC and Munshiganj cattle sperm. The average head length of BCB, RCC and MC cattle's sperm is 13.31 µm, 11.53 µm and 10.39 µm, respectively and the average tail length of BCB, RCC and MC cattle's sperm is 37.89 µm, 32.01 µm and 21.59 µm, respectively. This morphological variation of indigenous cattle's sperm may affect different diluters, as a result, different variety's semen showed different performances in various diluters.

In conclusion, there was no significant difference among the cryopreservation steps in the indigenous cattle variety of Bangladesh. Besides this, there was a highly significant effect ($p\leq0.001$) among the diluters. Hence, alteration of diluter may increase post-thawing semen quality as well as semen motility. BLRI has developed cost-effective one-step portable semen cryopreserve machine (Figure) which can perform as a commercial machine i.e. Minitube semen handling and bio-freezing machine. As there was no significant impact on cryopreserve steps in indigenous cattle, so this cost-effective best semen cryopreserve technique developed by BLRI will play an important role in semen cryopreservation of livestock of Bangladesh and will be helpful to conserve semen in different research areas like-BLRI regional station, different Agri-universities and small scale commercial farm at low cost.

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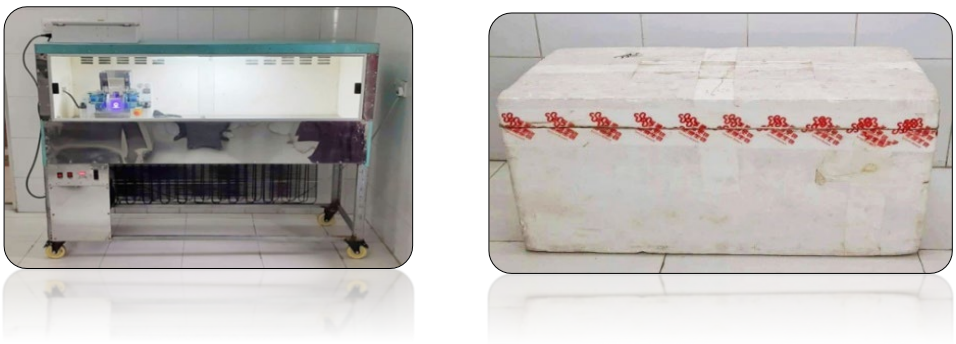

Figure-: BLRI semen cryopreserve machine

Comparative genomics and functional proteomics studies of Gayal to explore unique genomics features

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Executive Summary

The gayal is a large-sized endangered semi-domesticated bovine species belonging to the family Bovidae, genus Bos, and species *Bos frontalis*. It is also called as the *mitha*n or *mithun*. Bangladesh Livestock Research Institute (BLRI) has been conserving gayal at its regional station located in Naikhochori, Bandarban. During the first phase of the project, a total of 450 GB raw reads were generated (from four gayals) and subsequently two assemblers generated 5344 scaffolds along with 702,160 contigs in Platanus (Assembly software) and 823,556 contigs in Abyss (Assembly software). All four SRA (Sequence Read Archive) datasets of *Bos frontalis* submitted on NCBI were sequenced with Illumina HiSeq X Ten from genomic source (Blood DNA) and Whole Genome Sequencing (WGS) was accomplished with paired layout and 150 base pair nucleotide size. The present research was conducted to foster comparative genomics to identify gene(s) associated with different important traits of gayal (eg. muscle strength, adaptation). We attempted to employ RNAseq datasets to explore comparative proteomics and transcriptomes of different gayals with specific traits and to visualize the complete genome and proteome of Gayal through a genome browser (Fig. 1). For a complete proteome map, we have arranged complete chromosome-level orientation. After chromosome orientation, we ran annotation pipeline again to get the dataset which is accepted by globally accessible UCSC Genome Browser (Fig.1). The sequence of events or pipeline for this data visualization is: Step 1. Formatting the data set: converting the data as a tab-separated file using one of the formats supported by the Genome Browser. Step 2. Defining the Genome Browser display characteristics: adding one or more optional browser lines at the beginning of the data file to configure the overall display of the Genome Browser. Step 3. Defining the annotation track display characteristics: Following the browser lines--and immediately preceding the formatted data-- a track line will be added. Track lines are useful to define annotation track characteristics such as the name, description, colors, initial display mode, use score, etc.

(a) Datasets for comparative genomics analyses submitted at NCBI:

Table 1: Raw data details from four samples as submitted in NCBI SRA

Data name	SRA accession number	Spots (in million)	Bases (in Giga base pair)	Total data size (in gigabyte)	GC content (%)
CVASU_Gayal_001	SRR12436427	133.5	40.0	122	43.8%
CVASU_Gayal_002	SRR12795798	132.7	39.8	120	43.7%
CVASU_Gayal_003	SRR12782937	104.4	31.3	96	44.2%
CVASU_Gayal_004	SRR12806943	120.8	36.2	110	43.8%

(b) *Development of UCSC Genome browser for gayal genomics and proteomics datasets:*

For a complete proteome map, we have completed chromosome orientation. After chromosome orientation, we ran annotation again to get the dataset which is supported by global UCSC Genome Browser (https://genome.ucsc.edu/). A snapshot of the gayal UCSC browser is below-

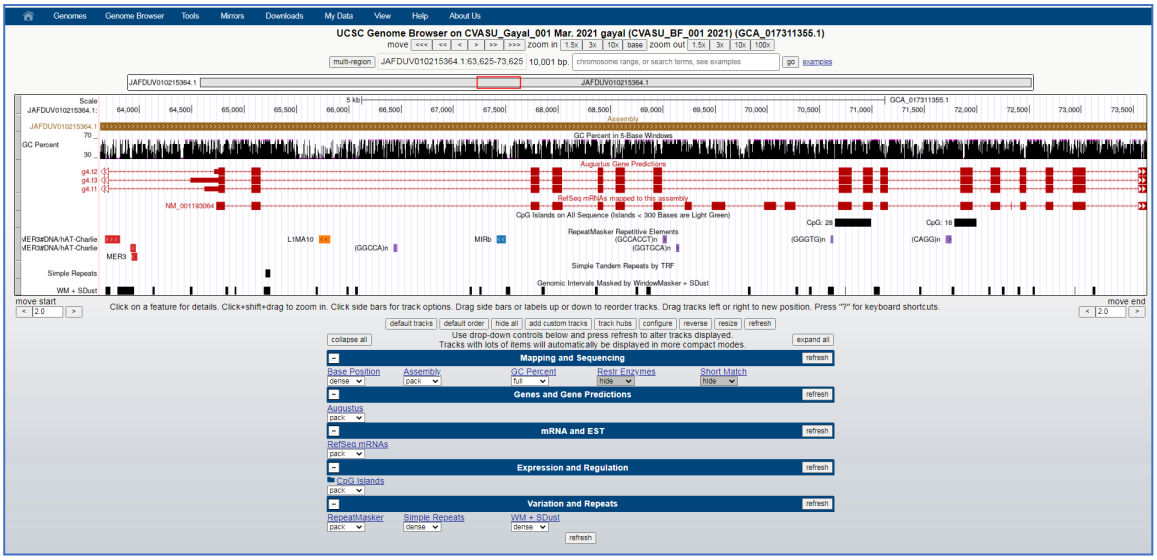

Fig. 1. Snapshot of UCSC genome browser proteome map of gayal generated from current project

(c) Comparative proteomics and transcriptomes of different gayals with specific traits

Gayal is a species that is well adapted to their local hilly environment in Southern Bangladesh and few transcriptomic studies focusing on regulation analysis of gayal in adaptation to the local high-altitude environment are reported till date. A number of genes associated with different traits (eg. Muscle growth, adaptation) have been identified based on available WGS data and are used for further comparative analyses at transcriptomes level. The RNAseq data from different studies have been explored to find differentially expressed genes and their quantitation. Earlier, the muscle transcriptome analysis of gayal showed that hub genes including *MTMR3, CUX1, LONRF3, PLXNB2, KMT2C, ZRSR2Y, PRR14, USP9Y, SLMAP,* and *KANSL2* might contribute to muscle growth. We have validated these findings along with identifying novel transcriptomes through using various computational biology tools such as principal component analysis (PCA), Gene Ontology (GO) function annotation and KEGG pathway enrichment analysis for differentially expressed genes (DEGs). In addition, to better understand the adaptation of species, we also collected a set of known or potential adaptation candidate genes (not shown here) from previously published literatures.

The comparative RNASeq analysis of gayal tissues based on WGS datasets is the first study of its kind in the country. The UCSC genome browser will be an addition of existing scientific database which will be used by future researchers around the globe. Comparative genome/ transcriptome analysis will also contribute to rapid production of animals with desired characteristics. The genetic tools and experiences from this current project may offer a new frontier to disease management, the ability to more accurately select animals for specific purposes. We can also use DNA markers, the flags for identifying particular regions of a chromosome and can introduce marker assisted selection (MAS). In addition, rapid rate of genetic gains can be produced for a particular trait. The post-genomic analyses of gayal will provide valuable information on genome organization, evolutionary divergence, conservation and overall endemic diversity. It also will identify some important genes related to a particular trait such as those associated with adaptation, muscle strength or prolificacy.

Quality and safety assessments of milk and development of fortifying dairy products

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Executive Summary

Milk is a highly nutritious food, ideal for microbial growth and the fresh milk easily deteriorates to become unsuitable for processing and human consumption. Milk quality assurance begins with the microbial quality of the farm and ends in the hands of the consumers. In Bangladesh, adulteration of milk is pretty common. Therefore, a baseline survey was conducted in 12 different parts of Bangladesh with a pre-structured questionnaire about 28 management issues related to quality and safety measures taken by the farmers. This study was also aimed to assess the organoleptic, physicochemical and microbial load and to detect the adulterants and composition in different raw, pasteurized, powder and condensed milk samples. For this purpose, 05 brands of pasteurized milk, 06 brands of powder milk, 04 brands of condensed milk and 200 raw milk samples from different areas were used for quality test. The samples were procured from house hold farmer, milkman, local markets, super-shop and subjected to laboratory analysis using different standard methods. Clot on-boiling (COB), alcohol perception and methylene blue tests, Hydrogen–per-oxide, hypoclorites, formaldehyde, neutralizer, maltodextin, detergent, urea, starch, sugar tests were used for the determination of adulterants in raw milk. Other parameters were determined by Lactoscan machine (Ultrasonic milk analyzer, EN ISO 0001:2008, Bugaria). Acidity was measured by titration with 0.1 N sodium hydroxide solution and using 1% ethanol solution of phenolphthalein as indicator (Lampert 1947). Presence of the other adulterants was tested by specific qualitative tests. The microbiological test viz, Total viable count (TVC), Total Coliform Count (TCC), Yeast and mould count in raw, pasteurized, powder and condensed milk were tested following the standards protocol. All the data were arranged by ANOVA and differences were determined by Duncan Multiple Range Test (DMRT) using SPSS, 25 computer software packages.

Table 1: Chemical analysis of raw milk in different areas of Bangladesh

Area	Fat %	SNF %	Protein %	Conductivity %	Water %	Lactose	% Acidity %
Chattogram	3.54^{b}	8.11^{a}	2.97	3.74	8.02^{bc}	4.46	0.15
Mymensingh	2.94^{c}	7.29^{ab}	2.67	3.59	14.79^{a}	4.01	0.16
Narayanganj	3.52^{b}	5.68^{c}	2.05	4.12	11.22^{b}	3.57	0.14
Manikganj	4.56^{a}	8.37^{a}	3.06	4.49	0.34^{e}	4.59	0.15
Savar	3.87^{ab}	7.85^{ab}	2.86	4.44	5.49^{cd}	4.31	0.15
Pabna	2.67^{c}	6.52^{bc}	2.42	4.42	14.67^{a}	3.57	0.13
Rajshahi	3.29^{bc}	7.49^{ab}	2.74	4.62	10.77^{b}	4.11	0.14
Sunamganj	3.41^{bc}	7.25^{ab}	2.56	3.72	10.60^{b}	4.07	0.15
Kushtia	3.87^{ab}	6.89^{b}	2.90	3.78	6.78^{c}	4.09	0.16
Sirajganj	3.68^{b}	8.61^{a}	2.99	3.71	3.98^{d}	3.98	0.14
Satkhira	3.94^{ab}	7.05^{ab}	2.59	3.85	14.44^{a}	3.89	0.13
Kurigram	3.99^{ab}	7.59^{ab}	2.76	4.44	8.04^{bc}	4.15	0.16
SEM	0.43	0.67	0.51	0.75	1.73	0.92	0.93
P value	0.034	0.026	0.087	0.661	0.0001	0.691	0.487

*different superscript in the same column differ significantly, $p<0.05$.

From the survey, the majority of the respondents (98%) in Satkhira stated that they washed their hands regularly but 15% irregularly washed their hands in Sirajgang and Pubna districts. Majority (95%) farmers in Mymensingh maintained hygienic condition during milking. Respondents in Sunamganj (90%) waited 0.5-1 hr before milk selling but in Mymensingh and Manikganj (15%) waited 2-4 hours before milk transfer. 98% farmers did not use footbath in their farm in the surveyed area. Most of the farmers opined that (70%-90%), they did not have any information about food safety. Most of the

organoleptic properties of raw and commercial pasteurized milk were found satisfactory and varied based on sensory evaluation (creamy white and slightly sweet). In the laboratory analysis, raw milk collected from different regions found that fat% and SNF% were significantly ($p<0.05$) higher in Manikganj but lower in Pubna districts. The highest % acidity (0.16%; $p>0.05$) was found in Mymensingh, Kushtia and Kurigram districts indicating high bacterial activity and the lowest were 0.13% in Pabna and Satkhira districts indicating the relatively best quality with regards to freshness. In powder milk, brand-5 had higher (%) of fat, SNF and protein than others. In condensed milk, fat% almost same in all brands but protein% was lower in brand-2. On the other hand, in pasteurized milk, brand-3 had shown higher (%) of fat (6.1), SNF (9.4) and lactose (5.16) than other brands. Lower level of salt (0.46%) and lactose (3.57%) were found in Narayanganj and Mymensingh. All adulteration tests responded negatively for raw and pasteurized samples except added water, salt, sugar where as commercial milk samples (powder and condensed) showed positive response only on added sugar test.

Table 2: Microbiological analysis of raw milk samples collected from different districts

Area name	Total viable bacteria (CFU/ml)	Coliform count CFU/ml	Yeast/Mold (cfu/ml)
Chattogram	1.92×10^5	2.3×10^2	Nil
Mymensingh	2.24×10^6	1.6×10^2	Nil
Narayanganj	2.77×10^4	2.1×10^2	Nil
Manikganj	1.82×10^5	1.4×10^2	Nil
Savar	1.91×10^5	2.5×10^2	Nil
Pabna	3.15×10^5	2.1×10^2	Nil
Rajshahi	3.78×10^6	2.2×10^2	Nil
Sunamganj	2.43×10^6	1.7×10^2	Nil
Kushtia	2.15×10^5	1.4×10^2	Nil
Sirajganj	1.57×10^4	2.4×10^2	Nil
Satkhira	2.12×10^5	2.0×10^2	Nil

In case of bacteriological analysis, all the raw milks had bacterial load which ranged from 1.57×10^4 to 3.78×10^6 cfu/ml. The TVBC (total viable bacterial count) of the pasteurized milk samples ranged from 1.4×10^2 to 1.1×10^4 cfu/ml. Coliform count in the raw milks ranged from 1.4×10^2 to 2.5×10^2 cfu/ml. Pasteurized milk of Brand-2 & Brand-3 didn't contain any coliform, whereas TCC of the other three pasteurized milks were 123, 178 and 243 cfu/ml. In terms of powder and condensed milk didn't found any types of coliform bacteria but TVBC of the powder milk samples ranged from 3100 -9165 cfu/g and condensed milk sample ranged from 11.7×10^2-13.8×10^2.

On the basis of these findings, it can be concluded that the quality of raw, powder, pasteurized and condensed milk were satisfactory and safe for consumption. Further study is needed to carry out the quantitative analysis for better clarification of the results which may help to develop the fortified dairy products.

Analysis of Candidate Gene for Growth and Morphometric Traits in Black Bengal Goat of Bangladesh

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Executive Summary

Black Bengal goat (BBG) is an important livestock genetic resource after cattle in Bangladesh that has worldwide reputation for their early sexual maturity, higher fertility rate, adaptability and superior meat and skin quality. Candidate gene-based approach has been widely used to select better performed animals with known genetic make-up even at earlier age and thereby, selection of animals would be possible within shortest possible time. Despite the potential impacts of candidate genes on genetic improvement of various livestock species including goat, limited studies so far conducted involving goat genetic resource of Bangladesh. Hippocampus abundant transcript 1 (HIAT1) gene, also known as MFSD14A gene (rs665862918) had significant association to the growth and morphometric traits in different goat breeds worldwide and was used as candidate gene to evaluate the growth trait of BBG. Considering the above stated scenarios, the project has designed to quantify and evaluate data on growth and morphometric traits of BBG goat in order to detect genetic polymorphisms (SNPs) in the selected fragment of candidate gene and to investigate the possible association between identified SNPs and aforementioned traits for development of molecular marker(s) with commercial impacts in BBG. A total of 271 selected adult goats blood samples from different location were used for the study. After that, DNA extraction, PCR amplification and sequencing of gene fragments of samples were performed. All sorts of descriptive statistics, mean separation and single marker association were performed using R platform. Genotype had significant association between BBG and Black Bengal cross (Table 1) as well as different color variants of BBG (Table 2). A 15-bp indel polymorphism was detected in the studied goat populations. PCR amplification detected three genotypes II, ID and DD. The II, ID and DD genotype frequencies were 0.16, 0.44 and 0.40, respectively (Table 3). Overall, both the individuals of DD and ID genotype were predominant than II individuals in BBG and its crossbred populations in Bangladesh. In BBG populations, rump width ($P<0.001$) and rump length ($P<0.01$) were significantly associated with 15-bp indel genotypes (Table 4) whereas wither height and rump height were significantly ($P<0.01$) associated in Black Bengal cross. In conclusion, this study revealed that the 15-bp indel polymorphism was detected in the studied goat populations. The identified 15-bp indel of the HIAT1 gene could be used as a molecular marker for morphometric traits improvement in BBG of Bangladesh upon validation with large number of samples.

Table 1: Effect of genotypes on different morphometric traits

Traits[1]	Genotypes (mean ± SE)		Level of Significance
	Black Bengal	Black Bengal Cross	
BW	19.87 ± 0.28 (165)	23.76 ± 0.54 (68)	***
WH	49.67 ± 0.25 (173)	59.45 ± 0.54 (69)	***
RH	51.81 ± 0.24 (174)	61.80 ± 0.55 (70)	***
BL	52.97[c] ± 0.35 (176)	56.32[b] ± 0.46 (66)	***
HG	62.03 ± 0.35 (174)	67.92 ± 0.41 (64)	***
RW	12.16 ± 0.12 (176)	12.59 ± 0.15 (71)	***
RL	11.78 ± 0.11(167)	12.76 ± 0.14 (71)	***
CC	7.01 ± 0.04 (172)	7.36 ± 0.07 (70)	***
CW	13.04 ± 0.16 (171)	12.99 ± 0.17 (68)	***
EL	12.08 ± 0.08 (171)	15.52 ± 0.22 (65)	***

[1]BW: mature body weight; WH: wither height; RH: rump height; BL: body length; HG: heart girth; RW: rump width; RL: rump length; CC: cannon circumference, CW: chest width, EL: ear length: [2]Values in the parentheses represent the number of samples under respective breed/population. [3]The different superscripts in the same row differ significantly at $P<0.001$.

Table 2: Morphometric traits of Black Bengal goat in different coat color variant

Traits	Coat Color Variant of BBG (LSM ± SE (n))					Sig.
	Solid Black	Toggenburg	Brown	Dutch Belt	White	
BW	19.86 ±0.46(70)	19.28±0.55(40)	20.14±0.54(41)	21.92±1.54(5)	20.16±1.1(9)	NS
WH	49.69^{b}±0.35(74)	50.29^{ab}±0.45(41)	48.10^{b}±0.54(42)	51.00^{ab}±1.55(6)	52.80^{a}±1.08(10)	***
RH	52.41^{a}±0.33(76)	52.50^{a}±0.44(41)	49.33^{b}±0.43(42)	53.17^{a}±1.17(6)	54.28^{a}±0.9(9)	***
BL	51.36^{b}±0.46(76)	51.79^{b}±0.73(43)	56.80^{a}±0.47(40)	54.43^{ab}±1.73(7)	54.0^{ab}±1.66(10)	***
HG	61.88±0.56(75)	60.93±0.62(41)	62.37±0.72(41)	65.14±2.06 (7)	64.10±1.20(10)	NS
RW	12.31^{bc}±.19(78)	11.91^{cd}±0.23(41)	11.69^{d}±0.19(42)	13.33^{ab}±0.84(6)	13.50^{a}±.29(9)	***
RL	11.88^{ab}±.17(76)	11.66^{ab}±0.2(40)	11.50^{b}±0.18(42)	12.83^{a}±0.65(6)	12.67^{ab}±.88(3)	*
CC	6.86^{b}±0.06(75)	7.05^{ab}±0.10(42)	7.29^{a}±0.07(39)	6.93^{ab}±0.07(7)	6.94^{ab}±.15(9)	***
CW	13.26^{b}±0.24(73)	12.86^{bc}±0.34(42)	12.21^{cd}±.28(42)	14.60^{ab}±0.93(5)	15.11^{a}±.35(9)	***
EL	12.11^{ab}±.12(75)	12.24^{ab}±0.15(41)	11.62^{b}±0.11(42)	12.66^{ab}±0.52(5)	13.00^{a}±.19(8)	***

Least-squares means (LSM), standard errors (SE), number of samples (n). Superscript in the same row differ significantly at P<0.001 or P<0.05. NS: P>0.05; ***:** P<0.05; *****:** P<0.001.

Table 3: Genotypic and allelic frequencies for the 15-bp InDel of *HIAT1* gene in BBG goat breeds of Bangladesh

Breed	Sample Size	Genotype Frequency (n)			Gene Frequency	
		II	ID	DD	I	D
BBG	199	0.16 (32)	0.44 (87)	0.40 (80)	0.38	0.62
BBG Cross	72	0.11 (8)	0.40 (29)	0.49 (35)	0.31	0.69

n= number of samples.

Table 4: Association of the 15-bp InDel of *HIAT1* gene with morphometric traits of BBG

Breed	Traits	Genotypes, LSM ± SE (n)			Sig.
		DD	ID	II	
BBG	BW	19.87 ± 0.52 (64)	19.34 ± 0.39 (71)	19.98 ± 0.61 (27)	NS
	WH	49.48 ± 0.37 (69)	49.99 ± 0.41 (74)	49.26 ± 0.68 (27)	NS
	RH	51.99 ± 0.35 (69)	51.86 ± 0.40 (74)	51.30 ± 0.60 (28)	NS
	BL	52.62 ± 0.56 (71)	53.05 ± 0.53 (74)	53.21 ± 0.90 (28)	NS
	HG	62.39 ± 0.61 (70)	61.80 ± 0.53 (73)	61.71 ± 0.79 (28)	NS
	RW	12.45^{a} ± 0.21 (72)	12.12^{ab} ± 0.16 (73)	11.57^{b} ± 0.27 (28)	***
	RL	12.03^{a} ± 0.18 (67)	11.74^{ab} ± 0.16 (70)	11.22^{b} ± 0.23 (27)	**
	CC	6.95 ± 0.07 (71)	7.00 ± 0.06(72)	7.13 ± 0.10 (26)	NS
	CW	13.18 ± 0.26 (68)	12.97 ± 0.25 (72)	12.86 ± 0.40 (28)	NS
	EL	12.10 ± 0.11(69)	12.13 ± 0.12 (71)	12.00 ± 0.20 (28)	NS
	BW	19.87 ± 0.52 (64)	19.34 ± 0.39 (71)	19.98 ± 0.61 (27)	NS
Black Bengal cross	BW	24.36 ± 0.74 (33)	23.91 ± 0.91 (28)	20.31 ± 1.02 (7)	NS
	WH	60.24^{a} ± 0.81 (33)	54.75^{a} ± 0.70 (28)	59.86^{b} ± 1.39 (8)	**
	RH	62.65^{a} ± 0.87 (34)	61.96^{a} ± 0.72 (28)	57.63^{b} ± 1.15 (8)	**
	BL	56.30 ± 0.72 (33)	56.96 ± 0.60 (26)	54.00 ± 1.33 (7)	NS
	HG	68.40 ± 0.57 (30)	67.67 ± 0.66 (27)	66.86 ± 1.16 (7)	NS
	RW	12.71 ± 0.24 (35)	12.61 ± 0.21 (28)	12.00 ± 0.46 (8)	NS
	RL	12.84 ± 0.23 (35)	12.77 ± 0.35 (28)	12.38 ± 0.28 (8)	NS
	CC	7.44 ± 0.11 (34)	7.32 ± 0.19 (28)	7.13 ± 0.12 (8)	NS
	CW	13.04 ± 0.24 (34)	12.81 ± 0.26 (26)	13.31 ± 0.62 (8)	NS
	EL	15.77^{a} ± 0.33 (31)	15.59^{a} ± 0.30 (27)	14.07^{b} ± 0.64 (7)	*

Least-squares means (LSM), standard errors (SE), number of samples (n). The different superscripts in the same column differ significantly at P<0.001 or P<0.01. NS: P>0.05; ****:** P<0.01; *****:** P<0.001.

Development of zinc-fortified meat product from broiler and spent hen

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Executive Summary

Zn is the most important nutrient that plays a major role in food intake regulation, nutrient metabolism, protein synthesis, growth and development. According to the National Micronutrient Survey in 2011-12, the prevalence of zinc deficiency in preschool children is 44.6 per cent in Bangladesh. Low intake of animal protein, unavailability of zinc-enriched foods and weak planning of several common food fortification programs are the important factors for zinc malnutrition in Bangladesh. However, animal protein source such as the poultry sector is constantly striving to meet the growing domestic demand significantly. Presently, animal scientists are paying attention to producing targeted nutrient-rich fortified and functional poultry products to benefit human health. At the same time, businesses are trying to reach out to new groups of clients through product development and value addition of poultry products. Connecting with this present situation, the objective of the study was to determine if zinc sulfate could be incorporated into meat products to manufacture zinc-fortified chicken meatballs without affecting their quality and sensory attributes of it.

For conducting the research, 20 broilers and 20 spent hens (76 weeks of age) were collected from the local market. The carcasses were deboned, breast meats were collected, weighed, minced and blended with spices. Different levels of elemental zinc of food-grade zinc sulfate were added to meat for producing zinc fortified meatball. The varying levels of zinc sulfate were considered as different treatment (T0- 0mg/kg, T1-10mg/kg, T2-20mg/kg, T3- 30mg/kg and T4- 40mg/kg) groups. After cooking, the meatball samples were preserved at -20^{0}C for analysis. The proximate composition (Table 1), quality parameters (Table 1), storage quality (Figure 1), texture (Table2) and sensory properties (Figure 2) were studied for knowing the possibilities of using zinc sulfate in meatballs. The spent hen meatballs showed no significant ($P>0.05$) differences in these parameters compared to the control (0mg/kg zinc sulfate) group. Though T4 broiler meatball showed significantly higher crude protein ($P<0.01$), cook yield ($P<0.01$) and water holding capacity ($P<0.05$) compared to the other treated groups. Besides, throughout the storage period, the quantity of MDA (malondialdehyde) of all samples was in quite an acceptable range (0.11±0.02 to 0.22±0.02) and with the increase in storage time, the values did not show any significant difference among them. In addition, the hardness of broiler and spent hen meatballs were not altered significantly by adding different levels of zinc sulfate. The instrumental result of hardness was also confirmed by the sensory panelist (figure 2). About 41.8% and 49.35% zinc was recovered by the broiler and spent hen's T4 meatball, respectively. The total amount of zinc (19.74mg/kg) in the final product proved that the application of 40mg/ kg of zinc in the product can produce zinc-enriched meatballs required by the human body. Finally, except for some results of broiler meatball, it can be said that zinc sulfate cannot alter product composition, quality and texture and can be used for fortification of poultry products as a source of zinc in the human diet. However, a continuation of this study, utilizing animal models and human trials, is required to better understand the absorption of zinc used in the fortified product.

Table 1: Changes in proximate composition, quality parameters and amount of zinc in broiler and spent hen's meatballs treated with different levels of zinc sulfate

	Treatment						
Parameters	T0	T1	T2	T3	T4	SEM	p-value
Broiler							
Proximate composition							
Moisture (%)	72.68	72.00	71.28	71.97	74.53	0.929	0.881
Crude protein (%)	13.21c	13.09bc	12.31bc	14.93b	18.18a	0.603	0.00
Ether extract (%)	2.10	1.20	1.80	1.80	1.60	0.111	0.102
Quality parameters							
pH	5.81	5.89	6.08	5.88	5.86	0.039	0.231
Cook yield (%)	103.21b	103.20b	103.63b	107.76a	109.35a	0.60	0.00
Water holding capacity (%)	48.16ab	43.50b	49.92ab	48.00ab	52.58a	1.127	0.029
Zinc amount(mg/kg)	ND	ND	7.00	14.62	16.72	1.491	
Spent hen							
Proximate composition							
Moisture (%)	74.09	72.02	74.00	74.82	73.30	0.441	0.36
Crude protein (%)	14.19	17.02	17.06	15.36	18.06	0.607	0.28
Ether extract (%)	1.60	1.00	1.33	1.40	0.80	0.089	0.57
Quality parameters							
pH	7.40	8.04	7.74	7.74	7.72	0.80	0.168
Cook yield (%)	109.42	108.43	104.28	110.74	112.98	1.360	0.361
Water holding capacity (%)	48.44	48.32	46.10	46.68	45.44	0.778	0.160
Zinc amount(mg/kg)	ND	4.80	7.20	14.59	19.74	1.95	

P<0.01 = Significant at 1% level, P<0.05 = Significant at 5% level, P>0.05 = Non-significant. ND= Not Detected. In a column figures with same letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT)

Table 2: Changes in the texture of meatballs treated with different levels of zinc sulfate

	Treatment						
	T0	T1	T2	T3	T4	SEM	p-value
Broiler's meatball hardness(N)	7.48	8.79	8.22	9.30	8.62	0.350	0.588
Spent hen's meatball hardness(N)	9.22	8.24	8.24	8.16	9.86	0.286	0.225

P<0.01 = Significant at 1% level, P<0.05 = Significant at 5% level, P>0.05 = Non-significant. In a column figures with same letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT)

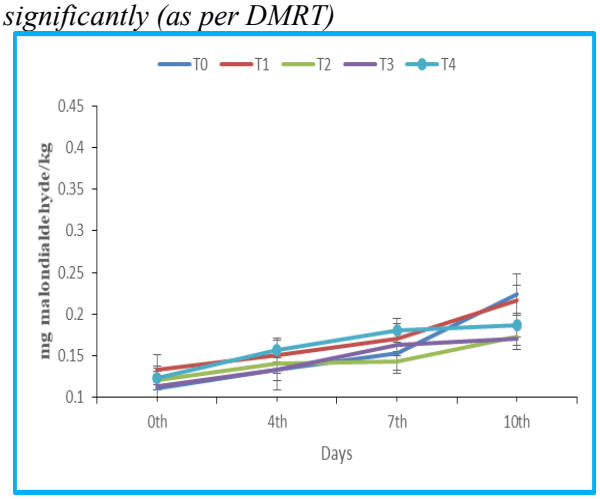

Figure 1: Effect of zinc fortification on storage quality

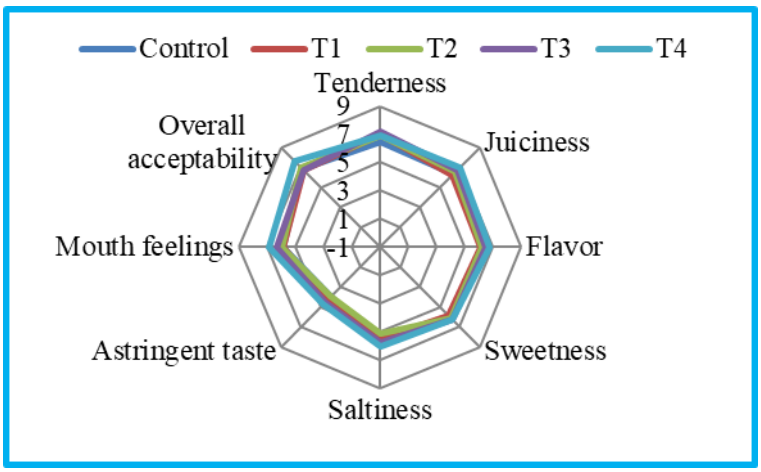

Figure 2: Sensory quality of zinc-fortified meatballs

Assessing the effect of lactic acid bacteria on improving quality and safety of broiler meat

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Executive summary

Last year, a sub-project of the mentioned title was taken under the developmental project entitled "Strengthening of Poultry Research and Development" to accelerate research facilities to a scientist holding a PhD fellowship (Sandwich type) in Universiti Putra Malaysia (UPM). The general aim of the study was to isolation, identification and molecular characterization of lactic acid bacteria (LAB) from poultry meat and to evaluate the effect of this LAB isolates on the physicochemical properties of broiler meat and its safe production. In terms of human food safety question, the effectiveness of LAB isolates as bio-preservative marinades on the meat spoilage bacteria will be evaluated in different incubation time, stored at chilling temperature (4°C). For this purpose, initially four poultry meat sources (deshi, broiler, sonali and layer) from wet market and an online shopping poultry meat source were selected for meat sample collection. Ten (10) of about 500 g meat samples were collected from each sources in the market area of Savar, Dhaka. Samples were blended into mash, and three replicates of the same sample sources were used for microbiological analysis. Samples (20g) were shaken well for 60 sec. by hand with 180 ml of sterilized distilled water, and 10^{-1} to 10^{-8} serial dilutions were made in 0.85% sodium chloride solution. Bacterial colonies were grown from diluted meat samples spreading on MRS agar media by incubating at 37^0C for 24h. Twenty six (26) large colonies (diameter, 20-25mm), growing on the agar plate, were isolated randomly from the different sources and were subjected to purify and multiplied by two times streaking on MRS agar. Purified colonies were exposed to physiological and morphological analysis. Based colony and cell morphology and gram staining and catalase activity, eight (8) LAB isolates were purified and send third party company for species level identification by using 16s rRNA gene sequencing, where PCR products will be determined directly with a sequencing kit using the prokaryotic 16S ribosomal DNA universal primers 27F (5′- AGA GTT TGA TCM TGG CTC AG -3′) and 1492R (5′- CGG TTA CCT TGT TAC GAC TT -3′). The 16s rRNA gene sequencing analysis are being studied. The same experiment will be carried out in the Microbiology Laboratory, Department of Animal Science, Faculty of Agriculture by the PhD fellow studied presently in UPM, Malaysia.

Table 1. The physiological and morphological characteristics of representative LAB isolates of different meat samples

SL no.	LAB Isolates							
Isolates ID	D-3	D-5	D-6	B-11	B-16	S-22	S-23	L-25
Cell morphology	Thin, short rod	Long Rod	Long Rod	Long Rod	short rod	Cocci	Cocci	short rod
Colony morphology	Smooth, round, cream white	Smooth, round, white	Smooth, round, white	Smooth, round, white	Smooth, round, cream white	Small, circular, gray white	Small, circular, gray white	Small, circular cream white
Gram stain	+	+	+	+	+	+	+	+
Catalase activity	-	-	-	-	-	-	-	-

(+) denotes for positive result and (–) denotes for negative result.

Out of eight colonies, a total of six isolated colonies were considered to be *Lactobacillus spp.* based on their grams positive, catalase negative and short to long rod shaped cell morphology with white and creamy white colony morphology, whereas, two isolates were determined to be *Lactobacillus spp.* by gram positive, catalase negative and cocci shaped cell with small, circular and gray white colony

morphology. Out of eight isolates three colonies (D-3, D-5 and D-6) identified as *Lactobacillus spp.* were screened from Deshi poultry meat, when each of two predominant colonies from broiler (B-11 and B-16) and sonali (S-22 and S-23) chicken meat, respectively. Whereas, out of six colonies grown on agar plate only one colony was screened as promising *Lactobacillus spp.* The samples collected and representative isolates with identified LAB strains are stated in the table 1. The isolated LAB colonies will be further identified in the species level by analyzing chromatogram obtained after 16s rRNA gene sequencing. To conclude that, based on morphological and physiological analysis, total eight colonies from local wet market poultry meat sources were isolated as *Lactobacillus spp.* which are being subjected to identify species level after 16s rRNA gene sequencing. Thought, the experiment was conducted by the PhD fellow during his pre-departure tenure to UPM, again the title was changed by "Assessing the effect of lactic acid bacteria postbiotics on improving quality and safety of broiler meat" and the research work will be conducted accordingly.

Technical Session III:

SOCIOECONOMICS AND FARMING SYSTEM RESEARCH

Baseline survey to evaluate the role of buffalo on economy of Bangladesh

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Executive Summary

Buffalo is a versatile domestic animal useful in agricultural production system and helps the human livelihood by providing milk, meat and value-added products in Bangladesh. According to the Agriculture Census 2019, buffalo population in Bangladesh is 378411 and buffalo is the 2nd highest milk producing animal in Bangladesh. The objectives of this study were to assess the current status, socio-economic condition of the farmers, profitability, economic efficiency, accessibility of buffalo products in Bangladeshi market, know the status of the gender involvement, and identify the constraints and opportunities for long-term sustainability of buffalo farming in Bangladesh. The primary data of sample size 1013 of buffalo farmers and 150 of cattle farmers (as control) has been collected from sixteen (16) districts (Bhola, Patuakhali, Chattagram, Coxs Bazar, Lakshmipur, Noakhali, Dhaka, Gazipur, Kushtia, Jamalpur, Pabna, Rajshahi, Rangpur, Lalmonirhat, Sylhet, and Moulavibazar) of eight (8) divisions based on restricted multistage stratified random sampling into three size classes, namely Large, Medium, and Small by using pretested structured questionnaires. Ten (10) Key Informant Interviews (KIIs) and five (05) Focus Group Discussions (FGDs) have been conducted. Secondary data were collected from the Bangladesh Bureau of Statistics (BBS) and Ministry of Fisheries and Livestock (MoFL) to find out the policy options for improving economic potentiality of buffalo farming in Bangladesh. Descriptive (frequency table, percentage, arithmetic mean, standard deviation, bar diagram and pie chart), and inferential statistics, profitability ratio namely net profit margin, operating profit margin, gross profit margin, basic earning power (BEP) ratio, return of total assets, return on common equity and profitability index, Stochastic Frontier Production Function and strength, weakness, opportunity and threat (SWOT) analysis have been used to achieve the study objectives.

The study reveals that the percentage of Large (>10), Medium (6 to 10), and Small (<6) buffalo farms are 26.65, 25.47 and 47.88, respectively. About 88% percent of existing buffaloes are of indigenous type throughout the country, while rest of them are cross breed type. Most of the farmers follow the extensive to semi-intensive farming methods. Natural breeding is the major method of breeding (above 96.4%) and only few percentages used artificial insemination. About 77.2% farmers reported that artificial breeding method is unavailable. Most of the farmers opined that the success rate of artificial insemination is very low due to the nature of breeding time of buffalos. Therefore, the development of natural bull can be a good option for breed development. The study found different categories of buffalos, namely milking (64.9%), heifer (14.22%), bull calf (10.23%) and bull (10.65%) in the study areas. The study found that buffalo farming is profitable. The average yearly rearing cost per farm was around BDT 151297, which includes feed cost, medicine cost, labor cost and others. The average yearly profit for small, medium and large farm was around BDT 141661, BDT 331204 and BDT 368169, respectively. Average yearly milk production per farm was 3175 Kg. Furthermore, average farming experiences of the farmers was 16.84 years. Almost 23.4% buffalo farmer took loan from different sources where 13.2% for solely buffalo farming. Around 58-72% consumers' perception is that the buffalo meat, milk and milk products are tasty and of high nutritional value. Farmers opined that 28-34% consumers are willing to pay more than 6% for buffalo meat, milk and its related value-added products. Women are not so empowered to take decision in buffalo farming but they play role to purchase cloth, household and agricultural assets and manage education expenses. Results from FGDs and KIIs reveal that by increasing the production of curd, ghee, butter and other value-added products made from milk, farmers including the women and youth may gain advantages in market competition and through which the problem of unemployment can be reduced to some extent. Though most of the farmers opined that buffalo farming is profitable, the average farm size is decreasing due to the lack of improved breed, quality feed, grazing land, water scarcity, lack of financial capital, lack of fair price of the product, scarcity and high wage of labour, insufficient fodder, access to technical knowledge, scarcity of vaccine, high price of medicine, scarcity of milk

storage facility, and unavailability of livestock extension service providers in due time. The epidemiological risk of buffalo farming is low except the existence of few regular diseases, namely foot-and-mouth disease (FMD), diarrhea, hoof-and-mouth disease (HMD). KII and FGD focused that Bangladesh Livestock Research Institute (BLRI), Department of Livestock and other related organizations are providing continuous training in different districts on buffalo rearing so that the farmers can gather more knowledge about buffalo rearing for increasing profitability of their buffalo rearing.

The demand of buffalo meat, milk and milk products are increasing day by day in national and international markets. By increasing buffalo rearing and ensuring the quality of buffalo milk and meat, Bangladesh can reduce the additional pressure on cow milk and meat and can earn significant amount of foreign currency. This implies that buffalo farming has good opportunities to increase farmers' income and livelihood considering environmental and climate change issues. Therefore, policy should focus on the development of breed, vaccination and technical assistance and future interventions for increasing buffalo farming.

Dairy production and livelihood scenario in different regions in Bangladesh

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Executive summary

In recent years, the structure of the dairy farm industry has been changing rapidly. Therefore, dairy has been turned into a profitable business. But farmers are not aware of the key factors affecting dairy productivity and farm profitability. To identify the scenario, a total of 450 farms from 5 regions (90 farm in each region including; Plane area, Hilly area, Coastal, River basin and Barind) were selected. Primary data were collected through dairy farm survey using pre tested questionnaires. Secondary data (111) were collected in each region from DLS and dairy experts from BLRI, BAU, Milk Vita and other officials from private dairy farms. This study defines dairy farm size based on the numbers of cows and classified the farms as small (2-5 cows), medium (6-9 cows) and large (more than 10 cows) category respectively. At the end of the study, all data were analyzed according to two-way ANOVA (both parametric and non-parametric data) using PROC GLM procedure of SAS (2005) and the difference among treatments were determined by DMRT and significance was declare when the probability was less than 5% ($P<0.05$). Milk yield of dairy cattle in different climatic region were found in (Table 1), which indicates the improvement of milk production of different cross breed dairy cattle in Bangladesh.

Table 1: Production scenario of dairy cattle in different climatic region

Location	Farm Size	Lactating cow (%)	Lactation Length (m)	Average Milk Yield (lit/d)	Average Lactation Yield (lit)	Post-partum Heat period (d)	Calving Interval/ (d)
Hilly	L	41.63	10.00	9.17	2751.00	103.20	442.59
	M	33.42	8.79	7.67	2022.58	148.30	481.30
	S	40.64	7.91	4.67	1108.19	127.60	449.86
Plain	L	33.41	11.25	11.33	3823.87	112.90	481.50
	M	35.40	9.03	8.69	2354.12	102.00	478.60
	S	38.09	7.86	9.71	2289.61	117.15	482.20
Barind	L	41.44	9.73	8.33	2431.52	95.00	507.70
	M	50.37	9.43	8.57	2424.45	90.00	516.20
	S	43.57	7.14	6.85	1467.27	92.92	430.40
Costal	L	44.38	10.72	8.09	2601.75	109.10	408.60
	M	37.54	9.61	6.72	1937.37	101.70	378.13
	S	36.23	9.71	4.26	1240.93	121.10	394.17
River basin	L	44.18	8.33	10	2499.00	130.06	437.80
	M	40.90	8.00	11	2640.00	110.00	457.88
	S	37.50	7.75	10.75	2499.37	91.00	481.30

The highest percentage of lactating cow/farm (50.37%) were found in medium category in Coastal region and the lowest were found in large farm of Plain (33.41%) region and medium farm of Hilly (33.42%) region. The percentage of lactating cows of all farms was below the recommended standard (60%) which is the first prerequisite for farm profitability. Average milk yield/d (11.33 L) and average lactation yield (3823.87 L) were highest in large farm of Plain region and were lowest in small farm of Hilly (4.67L) and Costal (4.26L) region. There was no significant difference on calving interval and post-partum heat period.

Cultivation of fodder (Napier packchong 50.58%, Napier 27.77%, German 18.60%, Maize 8.64% etc.) was getting more popularity day by day. Average roughage to concentrate ratio was (53:47) in all region which was responsible for the lower production and higher feed cost. In case of maximum farm the common feeding practice was (Straw+concentrate+grass). On season based feeding practices there

was a significant differences. During rainy season in all the regions the most practiced (more than 90%) feeding system was mixture of straw, concentrate and green grass, but this differs in the large farms of Costal region (63.64%).

Diseases were the main constrain for profitable dairy farming. The result demonstrated that, frequencies of mastitis were very high in large farm of Hilly region (75.76%) and low in small farm of Coastal region (28.57%). FMD was high in large farm of Plain region (60.71%) and low in small farm of Coastal region (28.57%). Calf diarrhea was also very high in Costal region (above 80%). Frequencies of other diseases were Bloat (26.04%), Acidosis (22.34%), Lumpy Skin Diseases (17.81%), Retained Placenta (15.07%), Milk Fever (14.68%), Early Abortion (9.89%), Ketosis (8.85%) and Anthrax (2.90%). Along with these diseases Repeat Breeding was also a common reproductive problem (36.48%) in all the regions.

In case of manure management bio-gas plant was very popular among the large farmers of Plain region (42.42%) and compost was mostly found in small holder farmers of Coastal region (66.67%). Average 16.67% people use cow dung as a direct source of fuel just after sun dry. Milk price was found higher in Coastal region (average 72.86 taka) and lower in River basin region (average 38.32 taka). The average price of milk in other regions ranges from (45-65) taka.

Table 2: Knowledge of technology practices by dairy farmers in different climatic region.

Region	Farm Size	AI (%)	Ration Balancing (%)	Fodder Production (%)	Silage Making (%)	Manure Management (%)	Routine Deworming (%)	Routine Vaccination (%)
Plain	S	81.33	10.11	58.54	14.21	51.22	51.22	53.66
	M	87.56	12.23	58.54	12.77	51.22	51.22	66.67
	L	91.56	10.71	63.89	21.21	63.89	55.55	81.82
Hilly	S	83.45	10.57	42.42	11.21	48.79	71.82	51.51
	M	86.89	33.03	60.61	17.93	52.42	59.39	80.00
	L	93.89	47.00	40.00	21.22	55.73	75.00	87.50
Barind	S	90.16	28.12	33.12	23.11	58.00	70.62	75.93
	M	91.56	37.14	47.91	18.23	61.99	73.56	81.13
	L	94.45	42.86	53.51	23.29	75.56	77.34	77.23
Costal	S	78.11	12.17	12.13	09.71	33.37	12.78	23.75
	M	87.56	13.56	17.51	11.13	23.88	17.91	21.29
	L	91.61	21.66	15.18	15.07	25.41	15.43	33.17
River basin	S	87.87	58.01	73.34	19.34	31.33	82.88	70.12
	M	91.63	57.89	56.78	17.56	48.56	78.46	72.23
	L	95.23	63.18	78.18	22.25	45.64	83.11	78.71

The farmers were well adopted with different technologies which were the striking reason for improvement of dairy production scenario. Artificial Insemination (AI) was well practiced (average more than 88%) in the entire region. The use and knowledge of other technologies like; ration balancing, fodder production, manure management, routine deworming and vaccination etc. were also increasing over time other than in River basin region. The farmers of Plain area had more knowledge about newly adopted technologies than the other regions. The silage making rate was slowly increasing to meet the demand of scarcity period and River basin region. Lack of high yielding breed, high feed cost, low milk price, less farming and technological knowledge, less government subsidy, difficulties in milk storage facilities and product diversification were the major challenges for the dairy farmers.

This research has identified the area based scenario for dairy cattle breeding; farm management practices, marketing channels, feeding and technologies practices, diseases frequencies and climatic risk analysis for small, medium and large scale dairy farm which would be an asset for further research work and policy making.

Production and marketing of beef in some selected areas of Bangladesh

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Executive summary

Beef has a high nutrient content which is very essential for a healthy life. It's a vital source of protein, iron (Fe), zinc, vitamins, and other micronutrients (omega-3 fatty acids, and selenium). According to the US department of agriculture, on average 56 gm of beef is required for a person based on a 2,000-calorie diet. Moreover, beef is the most preferred dietary item by Bangladeshi consumers in history. But the fact is that the price of beef is now going beyond the purchasing power of the general consumers despiting its high growth performance which is a matter of rigorous concern. Considering this view as a research problem, the present study wants to review the national and international beef prices in the major producing and exporting countries; measure the profitability of beef production under different farming categories, and identify the factors influencing beef prices. For this, we have taken 7 administrative divisions namely Dhaka, Mymensingh, Rangpur, Rajshahi, Khulna, Chattogram and Barishal and from each division, we have selected one district purposively on the basis of cattle population density, beef fattening and marketing. In this case, we studied published articles in peer-reviewed journals and use cost-benefit analysis to meet the objectives. From the results, we observed that beef prices increased globally (fig. 1) as well as in the domestic market of Bangladesh (fig. 2). Though the beef price is going upward globally, the price is higher in Bangladesh compared to neighboring countries-Pakistan, India and Malaysia. In the case of beef cattle rearing, the cost items are as follows- the initial price of cattle, feed cost (straw, green grass, rice/wheat bran, oil cake, processed feed, minerals and vitamins), treatment, labor and housing cost. From the break of cost items, we found that the initial price (purchase price or the price expected by the farmers before going to additional care of the cattle) of cattle holds the highest share i. e., about 55% followed by feed cost (37%). We found total cost (TC) was highest in the Khulna division is BDT 142678/ cattle followed by the Dhaka division is BDT 123618/ cattle (Table 1). In the Khulna division, the initial investment cost for cattle was found higher compared to other divisions. It will be the main cause of higher total costs.

Fig. 1 Global average beef price
Source: Statista, 2022

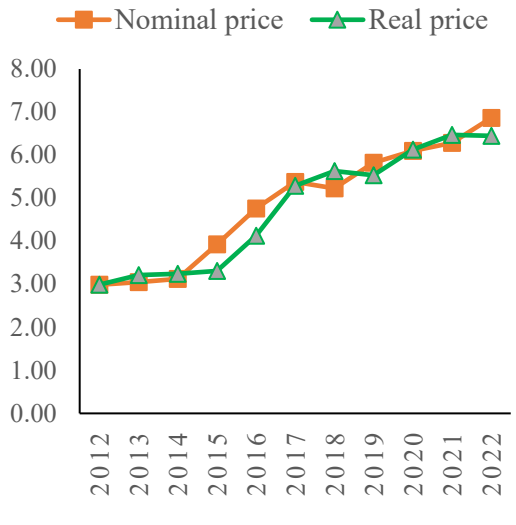

Fig. 2 Beef price (national average) in Bangladesh

Source: DAM, 2022. (Accessed on 26th May 2022)
1 US$ = 87.9 BDT (As of 26th May 2022)

From the viewpoint of profitability analysis, the net return is higher in Dhaka, i. e. BDT 33974 per cattle followed by Rajshahi and Barishal. The reason for higher net return in Dhaka region is farmers

selected crossbred cattle for beef production and locational facilities such as Gabtoli Cattle Market and the Capital city Dhaka has the highest number of consumers. On the other hand, based on the benefit-cost ratio (BCR) (full cost basis) the farmers of the Rajshahi division earned a higher profit (BCR = 1.29) followed by Dhaka and Barishal (BCR = 1.27) (Table 2). The average BC ratio was found 1.22 that indicating beef cattle farming is a profitable enterprise in Bangladesh though animal feed cost has gone up at the apex of recorded history.

Table 1. Cost of beef cattle rearing (BDT\Cattle)

Items	Dhaka	Mymen	Rangpur	Khulna	Rajshahi	Chatto	Barishal	Average	(%)
Variable cost									
Initial price of cattle	56233	61783	58382	73666	59944	54688	59945	60663	54.74
Feed cost total	50688	44374	30460	52557	39721	28188	40817	40972	36.97
Treatment	280	265	270	300	310	315	285	289	0.26
Transport	1575	974	900	832	1000	1066	1050	1056	0.95
Labor	8400	7500	7250	8100	7900	7600	8200	7850	7.08
A. Total variable cost	**117176**	**114896**	**97262**	**135455**	**108875**	**91857**	**110297**	**110830**	**100**
Fixed cost									
Housing	223	283	233	174	495	115	495	288	-
Equipment	361	115	224	276	243	203	365	255	-
B. Total fixed cost	**584**	**398**	**457**	**450**	**738**	**318**	**860**	**543**	-
C. IOC@5%	**5858**	**5744**	**4863**	**6773**	**5443**	**4592**	**5515**	**5541**	-
D. Total cost (A+B+C)	**123618**	**121038**	**102582**	**142678**	**115056**	**96767**	**116672**	**116914**	-

(IOC refers to interest on operating capital, Mymen = Mymensingh, and Chatto = Chattogram)

Table 2. Return from beef cattle rearing (BDT\Cattle)

Items	Dhaka	Mymen	Rangpur	Khulna	Rajshahi	Chatto	Barishal	Average	(%)
Cattle sold	156500	139422	120662	165133	147533	112000	147534	141255	99.16
Cow dung	992	943	907	1237	817	794	819	930	0.75
Feed sack	100	120	130	90	85	75	120	103	0.08
E. Total return	**157592**	**140485**	**121699**	**166460**	**148435**	**112869**	**148473**	**142288**	**100**
F. Gross return (E-A)	**40416**	**25589**	**24437**	**31005**	**39560**	**21012**	**38176**	**31458**	**-**
G. Net return (E-D)	**33974**	**19447**	**19117**	**23782**	**33379**	**16102**	**31801**	**25374**	**-**
H. BCR (E/D)	**1.27**	**1.16**	**1.19**	**1.17**	**1.29**	**1.17**	**1.27**	**1.22**	**-**

Based on farmers` opinions, we can say that in the study areas feed cost is the first and foremost reason for increasing the price of beef in the country. In the conclusion, it can be said that still Bangladesh has the comparative advantage of producing beef cattle to meet the increasing demand for meat. Therefore, our recommendation is the government should give subsidy on animal feed production and import as well.

Piloting of "BLRI Technology village" at Regional station of BLRI

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Executive Summary

The Technology Villages have been established with the goal of bringing technology services to the doorsteps of people and creating fields or platforms for field research. In this context, BLRI Technology Village has already been established in Dhamrai and its piloting work is underway in 5 regional stations (RS) where 1st year is preliminary phase, at 2nd to 3rd year is in intervention phase and 4th year is impact phase. The objective of the study is to disseminate BLRI developed region based livestock technologies for increasing productivity; to identify the region based problems and level of adoption of BLRI developed technologies and to get acquainted with the "BLRI technology villages" and its adaptation at farm community. Therefore, BLRI has taken up the process of forming BLRI Technology village in five regional stations (RS). On this journey, the research team visited three surrounding villages and conducted a participatory meeting (50 members) with farmers and local authority of respective villages and DLS personnel of each regional station. A total 15 village's visit and five participatory meetings were conducted. During the visit time, the research team was considering related factors such as genetic diversity, livestock population density, Govt. and Non-Govt. activities scenarios, natural barriers, homestead area, location of the area, electricity facilities, socio-economic and environment condition of the farmers etc. A structured questionnaire was developed by the research team with the help of the Department of Agricultural Economics, BAU. A baseline survey was carried out in different parts of the selected areas where three villages under one Upazila of regional stations. A total of 750 farm households in five regional stations (50 households/village/RS) were surveyed to know the existing scenario of the selected villages. One village as a "BLRI technology village" was selected based on field visit, participatory meeting, survey report and comment on regional station In-charge. We considered the nine criteria for village selection such as village area, distance from regional station, natural barriers, livestock farming households, other organizational interventions on livestock, farmer's interest on livestock technology, land holding capacity, problem vs. prospective intensity and genetic diversity of livestock. The villages achieving high scores have been considered as technology villages based on village selection characteristics. We found that the selected villages fulfilling a maximum six to seven among nine required criteria.

After getting the survey report, we analysed the farmers profile, existing production system, livestock population, feeds and feeding system, cultivation pattern, disease pattern, socioeconomic condition and set the appropriate technology for the relevant farmer's. The major constraints of adapting the technology have also been identified. All activities have been done based on group discussion of each regional station.

Technology demonstration materials were developed for Hands on Training and then the training and technology demonstration at Naikhongchari, Sirajganj, Faridpur, Jessore, Rajshahi Regional station and Dhamrai areas were completed. A total of 300 farmers (50 farmers per village of regional station) were selected for Hands on Training. One Society as a "BLRI projukti polli somobay somity" is being formulated with holistic approach per regional station. Two LSPs (Local Service provider) per regional station were developed. A team of Green helpline mobile service providers were formulated and they are monitoring field level activities at all regional stations.

Before the technology intervention we analysed the critical existing situation like dissemination process elements. In this process, we selected disseminators who would disseminated the technology to the different regional station (RS); the recipients as a technology based group of farmers; the message what type of technology are suitable for each RS; the media and feedback as a technology dissemination pathway; what type of research inputs were supplied to the farmers etc. A format was developed to get the feedback of farmers.

Shorifbag Dhamrai village has been officially declared as "BLRI Technology village". Now in Community business model and entrepreneur development aspect, we were started "Green Way Apps" for products marketing; one hatchery has been established in community level and they produce chick

commercially; three superior qualities back has been supplied to community and they provided service to the goat farmers at Shorifbag Dhamrai. About 10 meetings of "BLRI projukti polli somobay somity" have been held and all activities are being carried out through this association. Technical support and management inputs are being provided to 103 improve native chicken farmers of Gangadhorodi village of Faridpur RS. Six High Yielding Fodder (HYF) Germplasm Bank has been established at Faridpur (HYF variety-07), Naikhongchari (HYF variety-15), Rajshahi (HYF variety-07), Sirajganj (HYF variety-19) Jashore (HYF variety-11) and Dhamrai (HYF variety-06) RS to serve the respective community. Consequently, we supplied a total 123000 fodder cutting to ACDI-VOCA from Vanga, Faridpur RS to develop 83 fodder nurseries at Jhalokati, Barisal, Bhola, Patuakhali districts. Data from RS and survey found some opportunities of livestock technology intervention. In Naikhongcchari area, feed processing & housing technology for cattle, goat, sheep and poultry rearing model may introduced. In Baghabari, feed and milk processing & fodder production technology for cattle; poultry rearing model and mastitis prevention and disease control model for cattle may introduced. In Jashore, feed processing & fodder production technology for beef and dairy cattle, goat, specialized water fowl rearing model with ND control model of poultry, PPR control model of goat may introduced. In Rajshahi and Faridpur feed processing & fodder production technology for cattle, goat, sheep and special fowl rearing model may introduced. Those villages have a good border area which will help to maintain biosecurity and disease outbreak control.

It may be concluded that to set up some targets in selected agro-ecological areas such as awareness build-up; vaccination facility; make sustainable technologies available; technical support of existing stock for ensuring increased livestock and poultry production as well as livelihood improvement of peoples. Finally a Hub of improved animal, poultry and fodder germplasm will be developed to start a new farm through a community business model.

Table.1: Selected parameter dynamics of five villages in RS of BLRI as a technology village

Sl no	Selected Village (RS /name/ union)	Village area (Sqkm)	Distance from RS (km)	Farmer interest on technology (%)	Problem Vs Prospect (%)	Livestock household (No)	Human population density	Livestock household (%)	Genetic diversity (%)	Natural barrier (%)	Achieved criteria score for selection (%)
01.	Baghabari RS Khamarshanila Rupbati	1.30	3.8	44.05	92.90	301	1154	89.8	85.71	75	66.60
02.	Rajshahi RS Kamlapur Gogram	1.10	8.2	38.95	73.15	175	1427	85.3	85.71	75	66.60
03.	Jashore RS Madhugram, Noapara	2.42	4.0	44.00	76.06	320	523	91.4	71,42	50	77.70
04	Naikhongchari RS Masjidghona (Leker Par), Sadar	1.74	0.5	41.67	63.8	225	689	90.0	85.71	100	77.70
05	Faridpur RS Jandi,Bhanga	8.00	2.5	33.6	68.00	450	750	75.0	71,42	100	77.70

Technical Session IV:
ANIMAL AND POULTRY DISEASES AND HEALTH

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

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Executive summery

Peste des Petits Ruminants (PPR) is popularly known as goat/ sheep plague, an important OIE listed transboundary animal disease (TAD) of small ruminants (goat and sheep). In Bangladesh, PPR cause huge economic losses in village goat farmers due to high morbidity (100%) and mortality with heavy production losses. PPR was first detected in 1993 in Meherpur District of Bangladesh. Since then, the disease has spread all over the country, resulting in severe socioeconomic consequences affecting food security and livelihoods. The disease causes major constraints in improving the productivity of small ruminants in enzootic countries, and it significantly affects the livestock sector economy. Because of the vast socio-economic impacts of PPR, the global scientific community emphasized the requirement to eradicate PPR, with the adoption of the PPR global control and eradication strategy (GCES) by 2030. In this connection, the Food and Agriculture Organization and World Animal Health (OIE) jointly initiated the strategic plan, PPR-Global Eradication Program, for the control and eradication of PPR. Studying seroprevalence of PPR from different geographical locations may help in formulating effective and appropriate disease control strategies under the ongoing national PPR control and eradication program. The present study was executed, to monitor the sero-prevalence of PPR disease in goat and sheep in the selected areas of Bangladesh and to detect and characterize PPR virus from PPR disease outbreaks areas in Bangladesh and maintain PPR virus repository at SAARC PPR laboratory, BLRI.

In sero-monitoring, a total of 356 (vaccinated: 220 and unvaccinated: 136) and 167 (vaccinated: 133 and unvaccinated: 34) serum samples were collected respectively from goat and sheep. In addition, a total of 50 and 30 serum samples were collected respectively from the unvaccinated kid (< 2 months) and lamb (< 6 months). The collected sera were labeled and transported in an ice-cool container to the SAARC PPR laboratory, and the samples were stored at −20°C until further use. All the sera were tested by competitive ELISA (ID vet, France), which is being employed for the serosurveillance or seromonitoring of PPR for the detection of PPRV specific antibodies, which were measured in terms of percentage inhibition (PI) according to the kit protocol and samples with a PI of ≥50% were considered as a positive. Furthermore, for the outbreak investigation of PPR disease in goat, a total of 76 nasal swabs (suspected to PPR) were collected, labeled and transported to the SAARC PPR laboratory from the different outbreak areas of Bangladesh and stored at −20°C until use. All the samples were processed and RNA was extracted using the protocol of RNA extraction kit (Invitrogen, Thermo Fisher scientific®, USA) and performed RT-PCR targeting on N gene and F gene of PPR virus. Inoculum was prepared from fresh swab samples and treated with equal volume of antibiotic-antimycotic solution (OIE, 2012) and, then inoculated into primary lamb testicular cell (LTC) for the isolation of PPRV.

In sero-monitoring of goat, results show 84.54% (186/220) and 30.88% (42/136) samples were antibody positive to PPR disease, but in sheep it was 77.44% (103/133) and 32.35% (11/34) respectively, at vaccinated and unvaccinated serum samples. In the case of an unvaccinated kid (< 2 months) and lamb (< 6 months), we found 44% (22/50) and 36% (11/30) samples were antibody positive to PPR, respectively. In the outbreak investigation of PPR disease, 60.52% (46/76) of the field samples were positive for PPRV by RT-PCR targeting the N gene and F gene of PPRV. The expected PCR amplicon appeared at 352-bp and 448-bp respectively for the N gene and F gene (Figure 1).

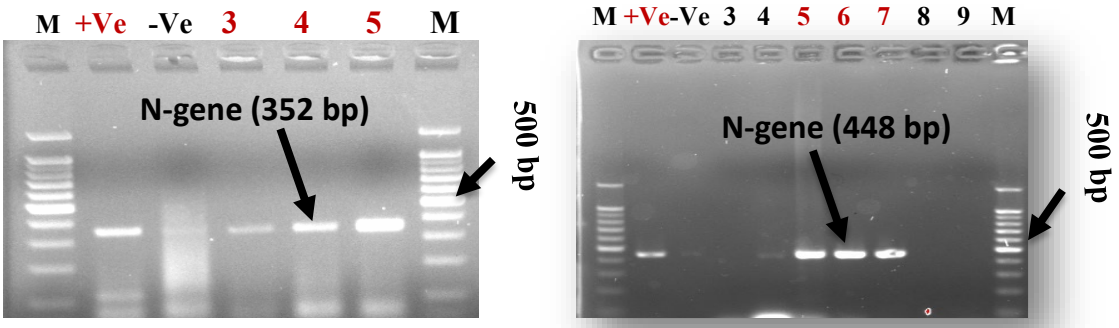

Figure 1: Amplification of the portion of N gene (352 bp) and F gene (448 bp) of PPR virus.

For the isolation and propagation of PPRV, at least three serial blind passages were conducted on primary LTC and observed cell cytopathic effect (CPE) regularly, when more than 70% CPE (Figure-2) was observed, subsequently harvested virus containing cell culture fluid, labelled and stored at -80˚C. At each blind passage, reconfirmed PPRV from harvested samples by RT-PCR. Three RT-PCR positive samples were further confirmed as PPRV by gene sequencing (partial N gene) and performed phylogenetic analysis.

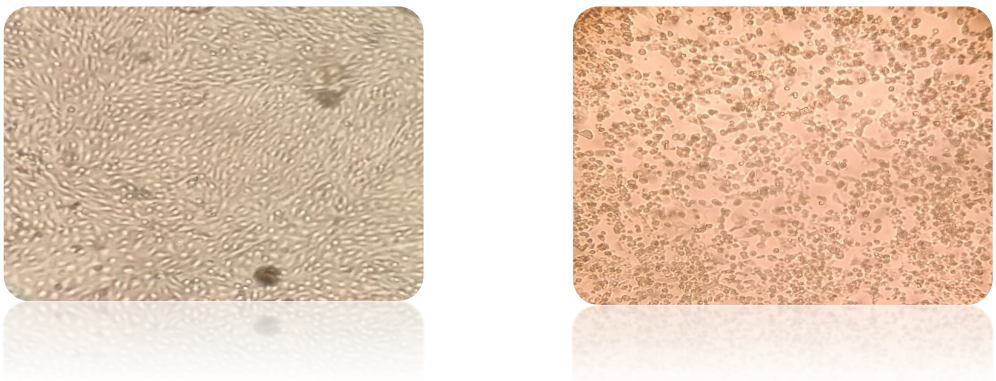

Figure 2: Confluent cell monolayer of LTC (left) and cytopathic effect on LTC at 7 days of post inoculation (right).

The overall seroprevalence of PPR after vaccination in goats and sheep was 84.54% and 77.44%, respectively, which indicates our PPR vaccine is effective against PPR disease in goats and sheep. The outbreak investigation study indicates a high prevalence rate of PPR in different parts of Bangladesh and justifies regular vaccination of small ruminants to develop better immunity to prevent the infection. In phylogenetic analysis, we found three PPRV isolates have 100% identical to each other's and also high homology (98%) with viruses from China/Tibet, India and Israel variants of PPRV. So, it is assumed that Bangladeshi, Chinese and Indian isolates of PPRV may have a common ancestor. In conclusion, it can say that the current study will be helpful for the eradication program of PPR disease by 2030 to achieve the SDG goal 2.

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

Running Title: Spatio-distribution of AMR in finisher livestock and poultry in Bangladesh

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Antimicrobial resistance (AMR) is a worldwide global health problem. AMR in livestock and poultry food value chain is a growing concern in Bangladesh. Resistance of microorganism to different antimicrobial drugs is increasing day-by-day due to the indiscriminate use, low dose and over dose of antibiotics for the treatment of bacterial diseases of domestic animals in Bangladesh. Bacteria become resistant to specific antibiotics due to repeated exposure of the same antibiotics through different mechanisms (gene transfer, induction, mutation, etc.) (Cosgrove et al., 2006; Da Costa et al., 2013) and eventually dissemination of the ABR genes to the environment through the farm waste and possibly to human resulting of direct contact with animals, intake of animal originate contaminated food, and water (Aarestrup, 2004). The first and second lines of antibiotics that are commonly used for the treatment of human and veterinary medicine are growing resistance gradually. Antibiotic resistance like oxytetracycline (80-85%), ampicillin (85-90%), chlortetracycline (70-80%), ciprofloxacin (40-50%), amoxicillin (50-60%), sulphar drugs (40-70%) and erythromycin (70-80%) is very common in poultry in Bangladesh (Siddiky et al., 2021, 2022) Due to the emergence of resistance to these access and watch group of antibiotics, farmers are using reserve group of antibiotics.This is dangerous for human for getting chance to acquire resistance genes from animals.The main objectives of this study were to assess spatio-temporal variation along with flock to flock variation in AMR phenotypes and associated antimicrobial resistance genes (ARGs) in fecal commensal enteric bacteria in poultry farm and live bird markets.

A total of 189 samples including 81 cloacal swabs and 81 drinking water from different poultry farms and 27 caecal contents from live bird markets (LBMs) were collected from different areas of Gazipur, Narsinghdi, Bogura, Joypurhat, Barishal, Sylhet, Chattogram, Cox's Bazar and Jessore district. Samples were collected from different districts of Bangladesh to assess the AMR patterns regarding the areas. Next three successive years, samples will be collected from same geographical location to determine the temporal patterns of AMR. Immediately after collection, the samples were transferred to the National Reference Laboratory for AMR (Research) and all the samples were processed for bacterial culture and further confirmatory test.

The overall prevalence of *E. coli* and *Salmonella* was 71.96% and 14.81%, respectively. After that antimicrobial susceptibility testing (AST) using disk diffusion method was done for all positive isolates of *E. coli* and *Salmonella*. The results were interpreted by Clinical and Laboratory Standards Institute (CLSI, 2021). From the AST results, we found that tetracycline (84.56%), ampicillin (80.88%), ciprofloxacin (72.06%), nalidixic acid (75.74%), and sulphamethoxazole (62.5%) were the most resistance antibiotics in *E. coli* whereas almost same resistance patterns were observed in *Salmonella* isolates. Ceftazidime, ceftriaxone, meropenem, amikacin and azithromycin showed the highest sensitivity against both *E. coli* and *Salmonella* isolates. A total of four ARGs were detected by PCR in both phenotypically resistant isolates whereas *bla*TEM (81.82%, 86.96%), *tet*A (91.30%, 86.67%), sul1 (96.47%, 91.84%), and sul2 (41.18%, 37.76%) were detected in E. coli followed by Salmonella isolates. The findings of this study anticipate that resistant *E. coli* and *Salmonella* are roaming in the poultry farms and live bird markets which can easily anchor to the farmers, vendors, consumers and ultimately in the food chain.

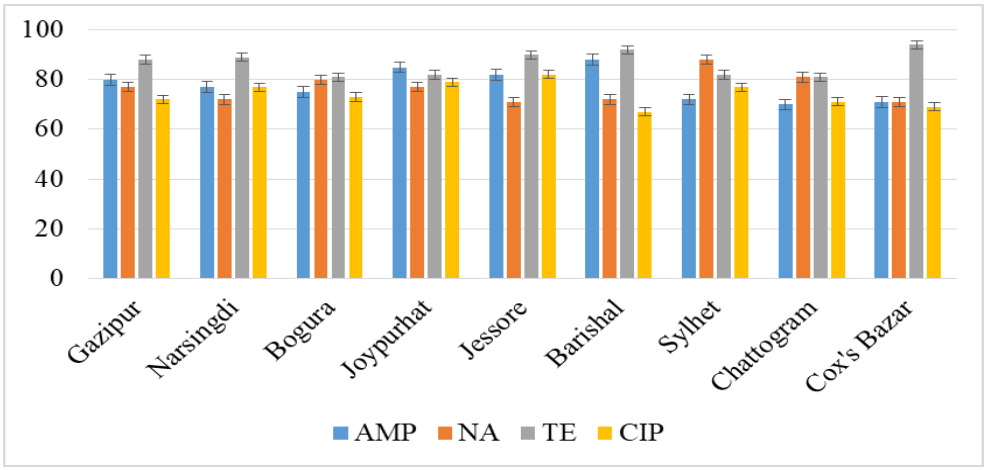

Figure 1. Patterns of top antibiotic resistance in different sampling area of *E. coli* isolates

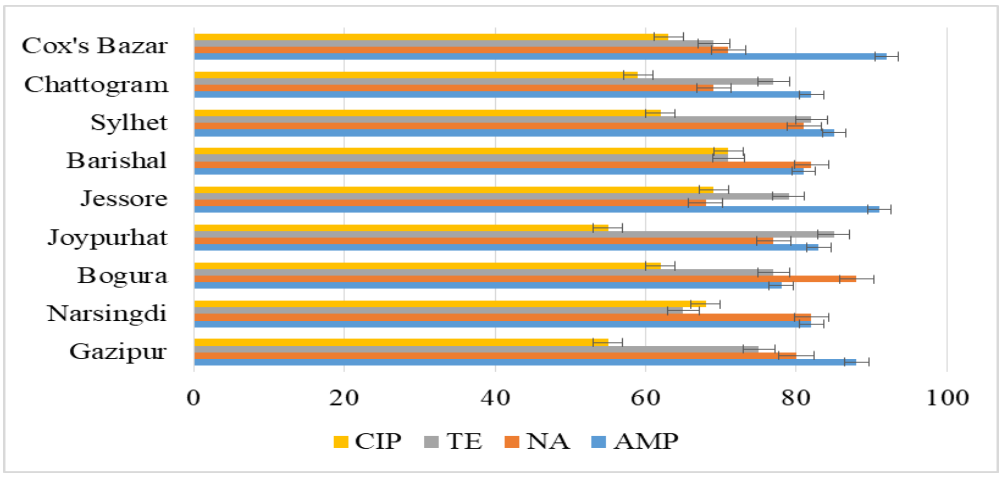

Figure 2. Top antibiotic resistance patterns in different sampling area of *Salmonella* isolates

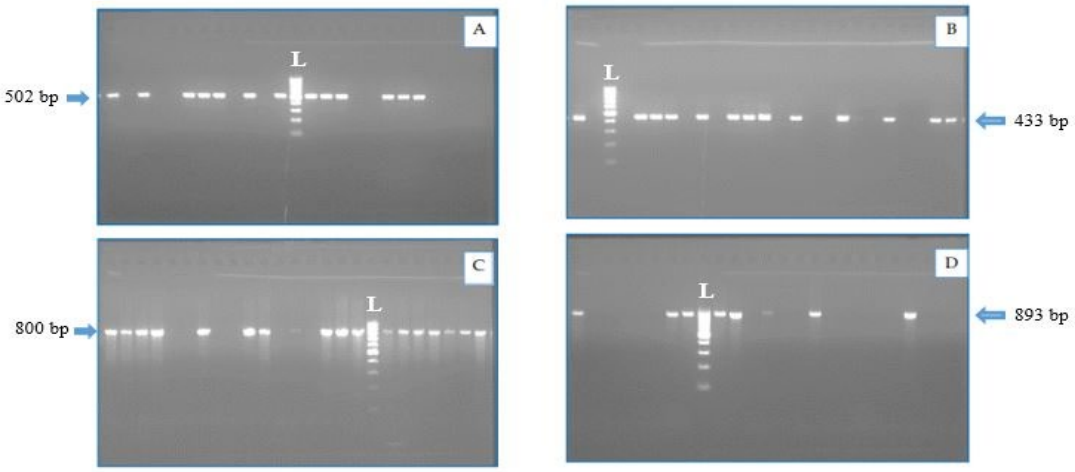

Figure 3. PCR result of resistance genes, (A) *tet*A gene (502bp), (B) *sul*1 (433bp), (C) *bla*TEM (800bp) and (D) *sul*2 (893bp)

Development of lumpy skin disease vaccine seed from circulating strain in Bangladesh

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Executive Summery

Lumpy skin disease (LSD) is a viral disease caused by LSD virus (LSDV) that belongs to the family Poxviridae and genus Capripoxvirus. The disease affects a wide range of domestic animals, mainly cattle. The clinical signs are fever and nodular lesions on the skin, mucous membranes of the respiratory and digestive tracts. Transmission occurs mainly by biting arthropods such as mosquitoes, flies and ticks. The World Organization for Animal Health (WOAH) included the disease in the notifiable transboundary disease list due to its substantial economic losses in terms of reduced productivity, poor hide quality, poor growth rate, infertility and even death. In Bangladesh, the first outbreak of the LSD occurred in mid-2019 in the Chattogram district, then rapidly spread throughout the entire country. Still, our cattle population have been affected by LSD, and thus farmers are paying huge for the treatment purpose as well as facing production loss after recovery from the disease. To overcome the present situation, mass vaccination is essential for the prevention of LSD outbreak in our country. In Bangladesh, yet there has not been developed any lumpy skin disease vaccine seed using local strain**.** Considering this national issue, the project is under taken with the objectives of molecular characterization of the circulating lumpy skin disease virus in Bangladesh and development of its live attenuated vaccine seed from the circulating strain.

In this study, from August, 2021 to September, 2022, a total of 75 clinically suspected LSD samples (skin nodules) were collected from 12 different field outbreaks in Jhenaidaha, Chattogram, Gazipur, Noakhali, Dhaka (Dhamrai and Manikgonj), Tangail, Mymensingh, Netrokona, Rajshahi, Bogura, Joypurhat and Gaibandha. For identification of LSDV, the tissue samples were grinded with mortar and pastel, and 10 % tissue suspension (w/v) was made with PBS (phosphate buffer saline). The tissue suspension was centrifuged at 3000 rpm for 10 mins and the supernatant was collected. For molecular confirmation, the genomic DNA was extracted from the supernatant of the samples by -PureLink™ Viral RNA/DNA Mini Kit, Thermo Fisher Scientific, USA, according to manufacturer protocols. Molecular identification was done with the LSD virus specific primers targeted at the envelope protein P32 gene recommended by OIE. For virus isolation, primary lamb testicular cells (LTC) were prepared from one-week old lamb testis according the method described by Ferris and Plowright, 1958 with minor modification. After molecular confirmation of each suspected LSD samples, 500 microliters of the positive sample's supernatant were treated with an antibiotic and filtered with a 0.45 microliter filter for inoculum preparation. The inoculum was inoculated into a flask containing a confluent monolayer of primary LTC . The cytopathic effects (CPE) were observed regularly under microscope until 14 days of post inoculation (dpi). The growth of the isolates was further confirmed by PCR as well as cultured in Vero cell line for adaptation and attenuation of LSDV targeting to develop live attenuated vaccine seed.

Out of 75 samples, 41.33% (31/75) were found PCR positive and we have successfully isolated 05 LSDV isolates from different field outbreaks in Jhenaidaha, Chattogram, Gazipur, Tangail and Mymensingh. In LTC, infected cells developed a characteristic CPE consisting of retraction of the cell membrane from surrounding cells, and eventually rounding and aggregation of cell (at 10 dpi). In Vero cell line, CPE was observed as a clustering of cells (at 6 dpi). As a part of the development of live attenuated LSD vaccine seed, our first batch isolates have reached the 40^{th} passage in Vero cell line and CPE was started at 3-4 dpi but total harvesting time required 7-8 dpi to obtain 80% CPE. Our target passages for the attenuation of LSDV will be 60^{th}.

LSD has become a major headache in the cattle farming sector in Bangladesh. Farmers are facing a huge problem due to production loss and the cost of treatment. Available vaccines are not produced from the local LSDV strain of our country. As a result, the production of LSDV live attenuated

vaccine seed using our local strain will provide the best protection against LSD to cattle population and mitigate economic loss of farmers.

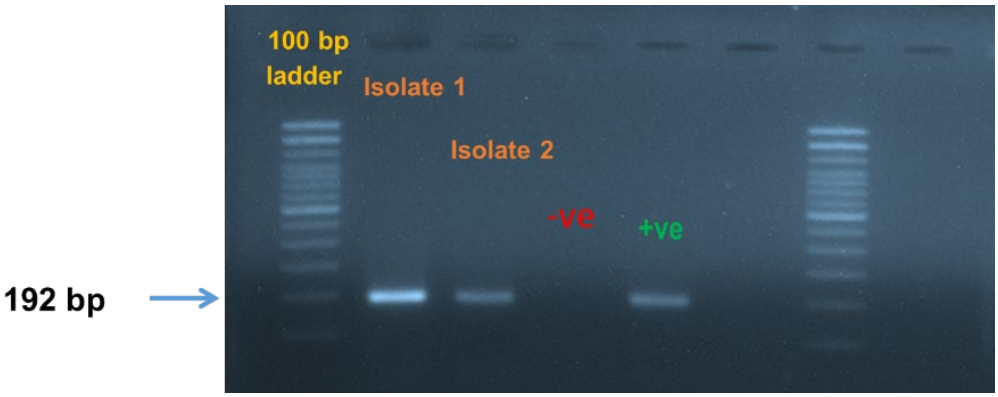
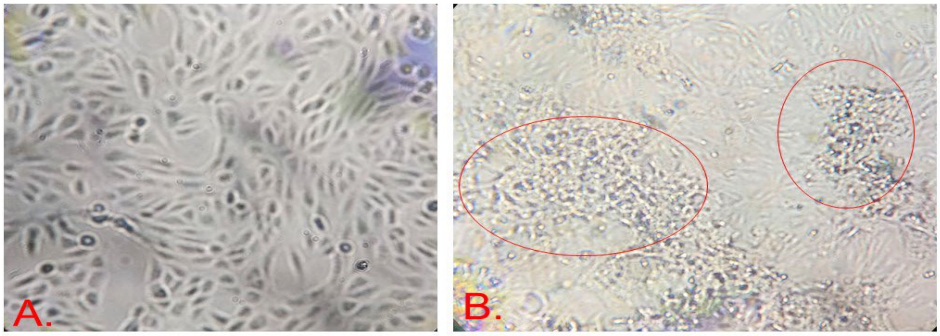


Fig. Molecular confirmation of LSDV targeting the P32 gene (192 bp)



A. Monolayer Vero cell line B. Cytopathic effect of LSD virus in Vero cell line along with cytopathic effect characterize by aggregations of the cell

Development of Avian Influenza H9N2 vaccine from circulating strain

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Executive Summery

Influenza in birds is caused by infection with viruses of the family Orthomyxoviridae placed in the genus Alpha influenza. Influenza A viruses are the only orthomyxoviruses known to naturally infect birds. Some avian influenza virus strains have caused sporadic zoonotic infections principally of H5, H7 and H9 subtypes and these three subtypes have been highlighted as potential pandemic risks when additional mutations occur that support sustained human-to-human transmission. While avian influenza remains a threat to birds, the H1N1 and H3N2 influenza virus subtypes still infect humans. Worldwide spread among birds of the H5 and H7 subtypes, with sporadic and ineffective transmission to humans. Results from recent research on the H9N2 subtype has demonstrated an increased threat to humans due to the potential emergence of novel subtypes of avian influenza by genetic evolution. In contrast, low pathogenic avian influenza (LPAI) H9N2 remains endemic across Asia, and its outbreaks are limited in domestic land-based poultry. There is evidence of interspecies transmission of H9N2 from land-based poultry to mammals, such as pigs and swine. LPAI viruses that normally cause disease with showing only a mild or no clinical symptoms, but in certain circumstances it can produce a spectrum of clinical signs, and the severity of infection may approach that of HPAI, particularly if exacerbating infections and/or adverse environmental conditions are present. Various subtypes of LPAIV have been identified in poultry in Bangladesh, including H9N2 belonging to G1 lineage which is endemic in chickens. Previous studies indicated that live bird markets (LBM) in Bangladesh have a high incidence of A/H5N1 and A/H9N2 viruses and these LBMs could be a major contact point between humans and infected birds. From the above discussion it can say vaccine production can be one of the ways to curtail the lethal effect of avian influenza virus for birds. Therefore, the research was under taken to develop an inactivated AIV H9N2 vaccine seed from circulating strain for the prevention of AIV H9N2.
The proposed research activities in the financial year 2021-22 were the collection of samples from commercial farm and outbreak investigation, subtype determination with RT-qPCR test, isolation of AIV H9N2 and screening of co-infections. A total of 325 samples were collected from different geographical locations considering poultry populations including Gazipur, Dhaka, Bogura, Joypurhar, Rangpur, Comilla, and Chattogram district of Bangladesh (Figure 1). All types of poultry species specially chickens, duck, goose and turkey were considered for sampling. Cloacal and oropharyngeal swabs samples were collected from health live birds and morbid materials such as trachea was collected from succumbed birds, and used virus transfer media to transfer the samples to laboratory immediately maintaining proper cooling temperature. Then the samples were processed individually and magnetic bead-based RNA isolation technology was applied for RNA extraction from collected samples individually using MagMAX™-96 AI/ND Viral RNA Isolation Kit (Applied Biosystems™, San Francisco, CA) in KingFisher™ Flex 96-well robot (Thermo Scientific™, Waltham, MA) according to the manufacturer's protocol. The samples were screened first for the presence of M gene by rRT-PCR test using reference primers and probes, and found 45 (13.84%) positive.

Then, 45 M gene positive samples were further assessed for H5, H9, N1, N2, N6, and N8 sub-typing using primers and probes by rRT-PCR test, and found 30 samples are AIV H9N2 positive. Further screening of the 30 AIV H9N2 positive samples were done to determine the co-infection of Mycoplasma, Infectious bronchitis disease virus, Newcastle disease virus, Infectious laryngotracheitis as well as other bacterial contaminations through molecular techniques. The confirmed 15 AIV H9N2 samples were processed individually and treated for 45 minutes by appropriate antibiotics and antimitotic solution (Gibco® Antibiotic-Antimitotic, USA) and inoculated into 9th day old SPF embryonated chicken egg through allantoic cavity (100µl/egg) route and incubated at 37^{0}C for up to 72 hrs. The infected eggs were chilled at 4°C before being harvested and allantoic fluids were

collected by suction. Allantoic fluids were subjected to a haemagglutination (HA) test and 11 AIV H9N2 isolates finally shown HA positive results that has considered for further analysis. The presence of AIV H9N2 in the cultured fluid samples were reconfirmed by qRT-PCR test according to method described before.

In conclusion, the isolates were confirmed for AIV H9N2 and further genetic characterization and antigenic properties of the isolates will help to select the potential vaccine candidate.

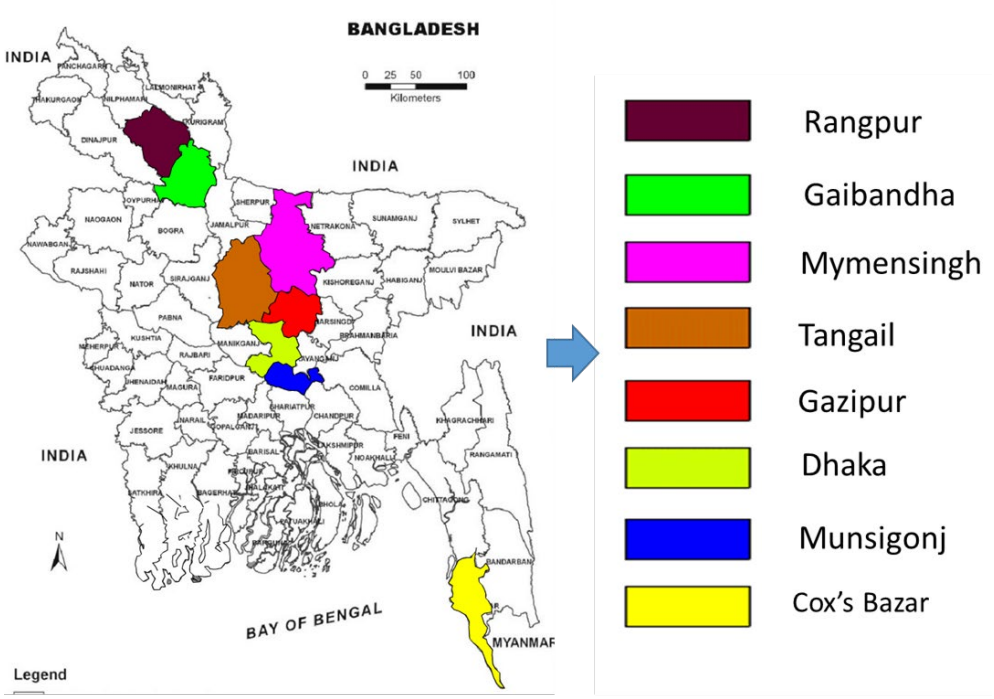

Figure 1. Samples collection map from commercial farm and outbreak investigation areas.

Development of Goat pox vaccine seed from circulating local strain

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Executive summary

Goat pox (GP) is a highly infectious disease of goats caused by the enveloped double stranded DNA virus of the family Poxviridae. This disease may be mild in indigenous breeds in endemic areas, but it is often fatal in newly introduced exotic breeds as well as crossbred and hybrids. The disease causes huge economic losses. Theeconomic losses result from decreased milk production, damage skin quality, abortion of a fetus, weight loss, and other production losses. It also limits trade and inhibits the development of intensive goat farming in Bangladesh. Although GP has been prevalent in Bangladesh for more than decades, the property of the prevalent goat pox virus (GPV) has not yet been characterized. Besides, the Goat pox vaccine can be used for controlling the lumpy skin disease. Hence, the government has prioritized developing GP vaccine seed from circulating local strain along with other vaccines. Therefore, the present study was executed to detect, isolate and characterize the circulating field strains of GPV and to adapt the virulent GPV strain in the vero cell line for the development of attenuated live GP vaccine seed.

A total of 68 clinically suspected GP samples (cutaneous papules, nodules, skin) were collected aseptically from Meherpur, Jhenaidah, Chuadanga, Dinajpur and Rangamati districts.Out of 68 samples 64samples were collected from Meherpur (35), Jhenaidah (14), Chuadanga (9) and Dinajpur (6) districts respectively and 4 samples from Rangamati were supplied by DLS.A structured and validated questionnaire was developed and administered to the farmers during sample collection to record farmer's demographic information, farm information and management practices. After collection, the samples were labeled and immediately transported to the SAARC regional leading diagnostics Laboratory for PPR, BLRI in an ice-cool container. Subsequently, the genomic DNA was extracted by DNA extraction Kit (Invitrogen, Thermofisher Scientific, USA) according to the manufacturer protocols. Samples were tested by PCR with the specific primers and protocol (OIE-2017) targeting DNA polymerase gene of GPV.Inoculum was prepared from fresh PCR positive samples and treated with equal volume of antibiotic-antimycotic solution (OIE, 2012) and, then inoculated into primary lamb testicular cell (LTC) for the isolation of GPV.

Out of 68 samples, 42 (61.76%) samples were found PCR positive.Of which 62.85% (22/35),64.28% (9/14), 55.55% (5/9), 50% (3/6), and 75% (3/4) samples were PCR positive from Meherpur, Jhenaidah, Chuadanga, Dinajpur and Rangamati districts respectively.The expected PCR amplicon size was 289 bp (Fig.1& 2).

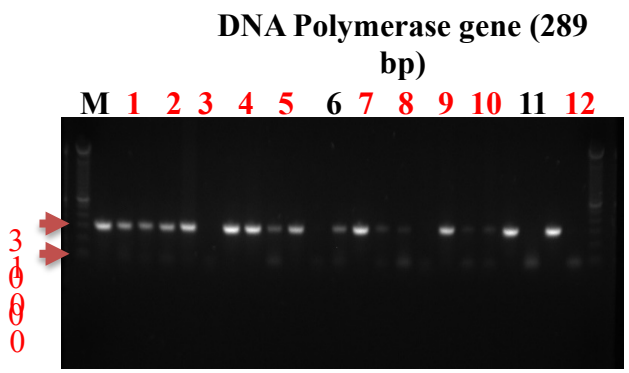

Fig. 1: Amplification of DNA poly gene of GPV from sample. Here, Lane-M: 100 bp DNA marker; Lane (1-21): field samples; lane-22: +ve control & lane-23: -ve control.

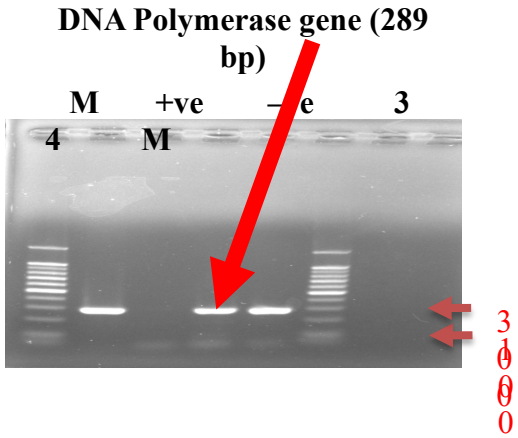

Fig. 2: Amplification of DNA poly gene of isolated GPV from LTC.Here, Lane-M: 100 bp DNA marker; Lane 1: +ve control & lane-2: -ve control, Lane(3-4): isolated GPV from LTC.

For the isolation of GPV from fresh PCR positive samples, three to five serial blind passages were conducted in primary lamb testicular cells (LTC) and observed daily until 7-8 days of post inoculation to see the Cytopathic Effects (CPE) produced by GPV (Fig.:3) and harvested and stored at -80^{0}C. CPE produced by GPV in the cell is also reconfirmed by PCR. So far 8 goat pox virus isolates were isolated from field strain. In addition, 5 PCR positive samples from five outbreaks were sent for partial gene sequencing.

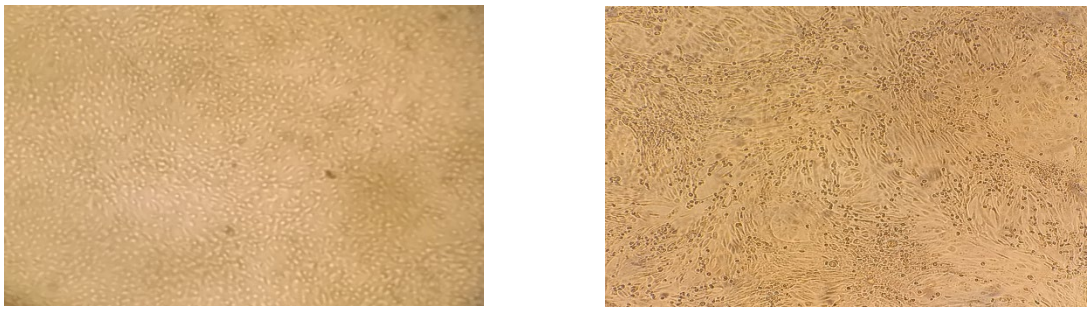

Fig.3: Confluent monolayer cell of LTC (left) and cytopathic effects of GPV on LTC at 7 days of post inoculation (right)

Adaptation and attenuation of representative two GPV isolates in vero cell line is also going on (8th passage) for the development of live attenuated GP vaccine seed (Fig.:4). After each passage, CPE produced by GPV in the vero cell line reconfirmed by PCR and harvested and stored at -80^{0}C.

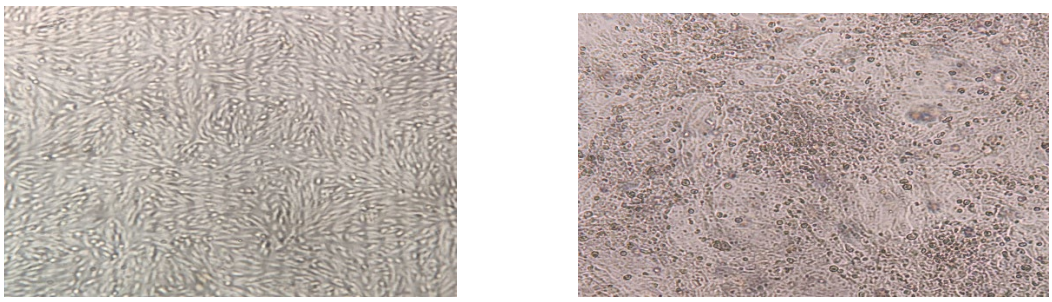

Fig. 4: Confluent monolayer cell of vero cell (left) and cytopathic effects of GPV of 8th passage on vero cell at 7 days of post inoculation (right)

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

Activity 1: Sero-prevalence of Caprine Arthritis and Encephalitis (CAE) in Bangladesh

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Executive Summary

Caprine Arthritis and Encephalitis (CAE) is a multi-systemic persistent newly viral disease of goat caused by caprine arthritis-encephalitis virus (CAEV), a lentivirus of family retroviridae. Although most infections are subclinical, a few numbers of animals develop progressive, untreatable disease syndromes including polyarthritis, indurative mastitis and progressive weight loss in adults and encephalomyelitis in kid. Hence, most infected animals do not show any clinical signs, major losses from these infected animals are due to retarded growth, emaciation and suboptimal production. There is however no data about the Caprine Arthritis Encephalitis Virus (CAEV) in this country. So, this study was designed to determine the sero-prevalence of CAE virus (CAEV) among goat population in selected goat prone areas in Bangladesh and the risk factors associated with the occurrence of the disease. For achieving the objective, a total of 446 blood samples were collected from goats in our study area i.e. Jashore (n=42), Jhenidah (n=36), Chuadanga (n=52), Meherpur (n=48), Kustia (n=47), Gaibandha (n=58), Rajshahi (n=47), Mymensingh (n=43), Savar (n=41), Bandarban (n=32) during the period of July, 2021 to June, 2022 and some information's were recorded by using a questionnaire from the goat owners by direct interview to know the possible risk factors. Keeping the animal in standing position, all blood samples were collected aseptically from jugular vein by using disposable syringe. The syringes were kept in an upright position at 25 ºC for about 2 hours. Then separated serum was collected in a 1.5 ml Eppendorf tube and stored at -20^{0}C until laboratory testing. In small ruminant's research laboratory, BLRI, all collected sera were screened for anti-CAEV antibodies using a commercial ELISA kit (ID Screen® CAEV/MVV Indirect, ID vet, France) as per the manufacturer's instructions and read the O.D value at 450 nm by a Microplate reader (Thermo Scientific™ Multiskan™ FC Microplate Photometer, Thermo Fisher Scientific, USA).

In our study, we found 4.26% (19/446) goats were seropositive towards CAEV (Table 1). We noticed highest prevalence in Chuadanga (7.69%) and lowest prevalence in Rajshahi (2.13%) but no positive sample found in Bandarban. In addition, sex, and age of animals were observed to be important risk factors associated with the occurrence of CAE in goats (Table 2).

Table 1: Area wise seroprevalence of CAEV in goats tested by ELISA

Sampling Location	Number of sera tested	Positive	Prevalence	OR	95% CI
Jashore	42	2	4.76%	4.01	0.18-86.54
Jhenidah	36	2	5.55%	4.71	0.21-101.87
Chuadanga	52	4	7.69%	6.03	0.31-115.84
Meherpur	48	3	6.25%	5	0.24-100.15
Kustia	47	2	4.25%	3.57	0.16-76.9
Gaibandha	58	2	3.45%	3.91	0.18-84.42
Rajshahi	47	1	2.13%	2.87	0.13-61.76
Mymensingh	43	2	4.65%	2.4	0.09-61.08

Savar	41	1	2.44%	2.09	0.08-53.1
Bandarban	32	0	0	Ref.	
Total	**446**	**19**	**4.26%**		

OR- Odds ratio; CI-Confidence interval; Ref.- Reference value

Table 2: Results of univariable analysis showing association between serological status of individual goat and different risk factors.
*P value statistically significant, CI-Confidence interval

Category	**Variable**	**No. of tested**	**No. of sample positive (%)**	**Odds ratio (OR)**	**95% CI**	**p value**
Breed	BBG	143	6 (4.20)	1.62	0.32-8.23	0.56
	Cross	216	11 (4.85)	1.88	0.40-8.69	0.41
	JP	76	2 (2.63)	Ref		
Age	below 12	106	2 (1.89)	1.26	0.11-14.27	0.84
	12 to 48	273	16 (5.86)	4.1	0.53-31.54	0.17
	over 48	67	1 (1.49)	Ref		
Sex	Male	179	3 (1.68)	Ref		
	Female	267	16 (5.99)	3.7397	1.07- 13.02	0.003*
Rearing System	Free	349	16 (4.58)	1.5	0.42-5.27	0.63
	Semi intensive	97	3 (3.09)	Ref		
Farm size	Small	316	14 (4.43)	1.31	0.36-4.67	0.7
	Medium	42	2 (4.76)	1.41	0.22-8.81	0.67
	Large	88	3 (3.40)	Ref		
Biosecurity	Yes	97	3 (3.09)	Ref		
	No	349	16 (4.58)	1.5	0.42-5.27	0.522
Housing System	Floor	349	16 (4.58)	1.5	0.42-5.27	0.522
	Slat	97	3 (3.09)	Ref		

The findings of this study affirmed that the sero-prevalence of CAEV infection among goat population in some selected areas in Bangladesh, is low. However, there is need to establish strict control measures such as testing and culling positive animals or separation of infected animals from those that tested negative to the disease for effective eradication of the disease.

Activity 2: Isolation and molecular characterization of contagious ecthyma virus for the development of vaccine seed.

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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 and goats, caused by contagious ecthyma virus (CEV) under the family Poxviridae. CE is a highly contagious, zoonotic viral skin disease that affects mainly goats and sheep. All breed and age groups of goat and sheep are susceptible to this disease, although young animals are highly susceptible and more commonly affected. The lesions of this disease are most commonly seen on the lips and mouth of infected animals, but may also occur on the udder and between the toes. Infected animals become sick, fail to thrive and are more susceptible to adventitious bacterial infections. The disease has been reported from many countries of the world. In 2011, the existence of CE virus in the country is confirmed by PCR and partial gene sequencing. Now the disease is prevalent in the country. Vaccination is the eminent tools for the control of CE in goats and sheep, but still, we are not using vaccine due to lack of availability of vaccine. Additionally, there are very limited study on molecular characterization, isolation, and adaptation of CEV in Vero cell line. Therefore, the present study was aimed at isolation, identification and molecular characterization of the CEV circulating in Bangladesh that possesses the suitable characteristics for an effective vaccine, and adaptation of the CEV isolates in Vero cell line for the development of live attenuated vaccine seed.

The study was conducted during the period of July 2021 to June 2022, and a total of 43 clinically suspected CE samples were collected, labeled and transported in an ice-cool container to Animal Health Research Laboratory, BLRI. Out of 43 samples 37 were from young goat of less than 6 months and in region wise 12, 8, 9, 8 and 6 were respectively collected from BLRI goat farm, Rajshahi, Nikhongchari, Meherpur and Mymensing. Subsequently, all samples were processed and DNA was extracted using the DNA extraction kit (Monarch®, USA) according to manufacturer's instruction. Polymerase chain reaction (PCR) was performed (OIE, 2012) for the detection and amplification of two different genes of CE virus using two sets of primers.

Table 1. Sequence and source of primers used in the research study

Sl No.	Sequence (**5′-3′**)	Source	Target base pair (bp)
1.	GIF5 : GCT CTA GGA AAG ATG GCG TG GIF6: GTA CTC CTG GCT GAA GAG CG	Klein and Tryland, 2005	400 bp
2.	vIL-10-3: ATG CTA CTC ACA CAG TCG CTC C vIL-10-4: TAT GTC GAA CTC GCT CAT GGC C	Klein and Tryland, 2005	300 bp

Inoculum was prepared from PCR positive samples (OIE, 2012) and then treated with antibiotic-antimycotic solution for one hour. Afterward, 0.5 ml of treated inoculum were inoculated into primary lamb testicular cell (LTC) for the isolation of CEV. The cells were observed twice daily and cytopathic effect (CPE) was recorded up to 10 days post inoculation (dpi). Negative control was run along with test sample. PCR was used to confirm the virus from culture supernatant. Three blind passages of each isolate were conducted in LTC. Harvested of CEV infected LTC and reconfirmed by PCR at each time. Subsequently, inoculation of confirmed isolates into Vero cell line for the adaptation and attenuation of CE virus. Three PCR positive samples were used for partial gene sequencing. The primer used for PCR was used in sequencing reaction.

Out of 43 CE suspected field samples, 27.90% (12/43) were found positive for CEV by PCR (Fig. 1) using two different sets of primers. Among the two sets of primers 66.67% (8/12) and 33.33% (4/12)

samples were found positive respectively in GIF and vIL. PCR positive samples for CEV at different location were shown in Table 1. Positive isolates produced cytopathic effect (CPE) in LTC at 6-7 dpi and CPE characterized by rounding and detachment of cells (Fig. 2).

Table 2. Collection of CE suspected field samples at different location and identification of them by PCR.

Name of the location	Number of samples	No of positive samples	Percentage positive
BLRI goat farm	12	4	33.33%
Rajshahi	8	2	25%
Nichongchari	9	2	22.22%
Meherpur	8	3	37.5%
Mymensing	6	1	16.66%
Total	43	12	27.90%

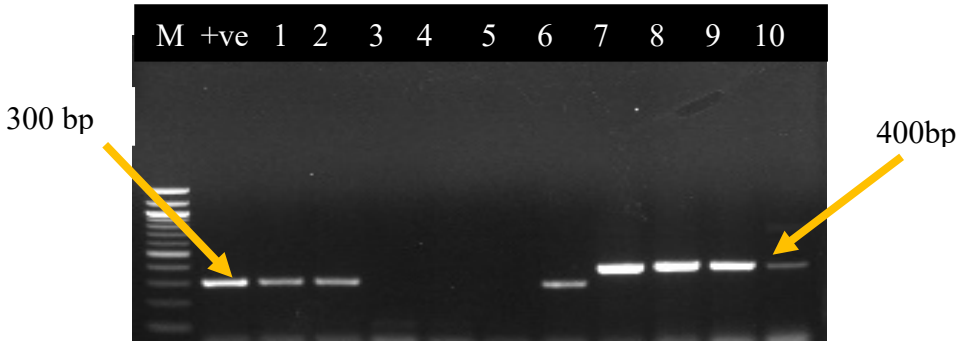

Fig.1 Detection of contagious ecthyma virus from field samples by PCR. Lane M: Marker (100 bp), Lane 1: positive control, Lane 2- 10: Test sample. (Samples 1-6: vIL primer and 7-10: GIF primer.

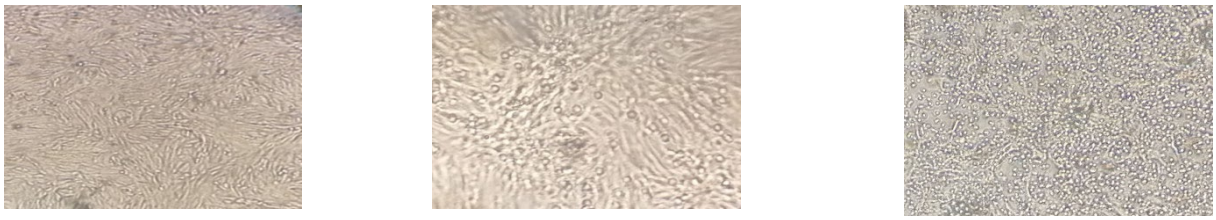

Fig. 2 Vero cell normal (left) and cytopathic effect induced by CEV (right)

It is concluded that CEV is circulating in Bangladesh. Young goats and sheep were found more susceptible to infection.

Project title: Investigation of Pneumonic Pasteurellosis and PPR in sheep and their mitigation to develop a model sheep health management package for ideal farming

Subtitle: Isolation, molecular identification and antibiogram study of Pasteurellosis in pneumonic sheep from selected areas of Bangladesh

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Executive summary

Sheep suffer from many diseases and some of these are common with other livestock species, while some of these are specific to sheep only, with a few of zoonotic nature also. Pneumonic Pasteurellosis is one of them that causes about acute outbreaks in sheep associated with huge mortality in the world. The current research was carried out to identify the Pneumonic Pasteurella species in sheep in selected areas of Bangladesh. A total of 140 samples (120 nasal swab and 20 lungs tissues from dead sheep) of sheep suspected to pneumonic Pasteurellosis were collected aseptically and transported to the small ruminant research laboratory of Bangladesh Livestock Research Institute. A total of 30 samples from Rajshahi, 15 from Nikhongchari, 20 from Tangail , 20 from Faridpur, 30 from Savar and 25 from Noakhali were collected with Brain heart infusion (BHI) Broth. Subsequently, collected samples were incubated overnight on Brain heart infusion (BHI) broth and plate culture methods on Blood agar was used to isolate the Pasteurella spp. The colonies with white-grayish medium-sized round and non-mucoid colony on blood agar were subjected to identify by biochemical features (catalase, oxidase, indole, lactose, fermentation, grams staining and growth on MacConkey lactose agar) was performed as described by Klima CL, et. al. 2011(Fig.1). Bacterial colonies were than confirmed by polymerase chain reaction (PCR) using 0.8% agarose gel electrophoresis. Antibiotic susceptibility testing was performed with oxytetracycline (30mcg), gentamicin (10mcg), tetracycline (30mcg), streptomycin (10mcg) and ceftriaxone (30mcg) with the isolates of Pasteurella using Kirby-Bauer disk diffusion method on Muller Hinton Agar as per Clinical and Laboratory Standard Institute (CLSI) with *Escherichia coli* ATCC 25922 as control.

Out of 140 suspected samples, 47 (33.57%) were identified as *M. haemolytica* and *P. multocida* by biochemical test. Among positive isolates, 13 were from Rajshahi, 4 from Nikhongchari, 6 from Tangail, 8 isolates from Faridpur, 9 from savar and 7 from Noakhali (Table-1). Among confirmed samples, 74.46 %(35/140) *M. haemolytica* was found with PCR amplifications with species specific primers targeting gene was 304 bp, 143 bp and *P. multocida* was 25.53 % (12/140) targeting 460 bp respectively (Fig.2). Antibiotic susceptibility testing with five antibiotic *M. haemolytica* showed highest resistance to tetracycline (83.33%), oxytetracycline (72.22%) and streptomycine (72.22%) whereas *P. multocida* isolates showed resistance to tetracycline (81.82%) and oxytetracycline (72.23%) (Table 2). Both the isolates showed highest resistance towards tetracycline and lowest resistance to gentamycin and ceftriaxone. The study revealed that Pasteurella organisms' causes pneumonia in sheep and the identified bacteria become resistant towards common antimicrobials frequently used in the field that warrants more robust prevention and control measures to tackle this disease in Bangladesh.

Table -1: Prevalence percentage of Pasreurella positive samples collected from different regions of Bangladesh

Sample collection area	No of Sample	Positive	Percentage (%)
Rajshahi	30	13	43.3%
Nikhongchori	15	4	26.66
Tangail	20	6	30%
Faridpur	20	8	40%

Savar	30	9	30%
Noakhali	25	7	28%
Total	140	47	33.57%

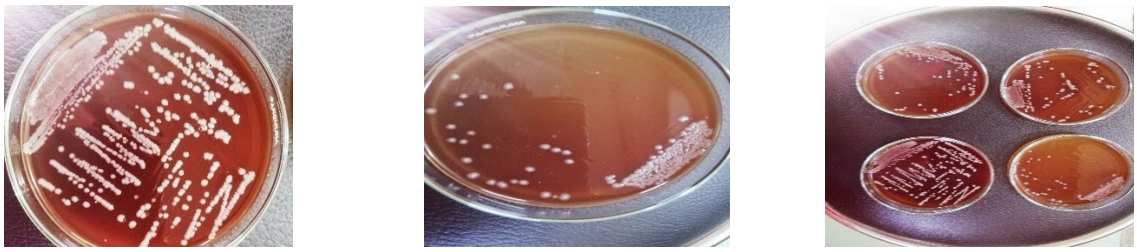

Fig.1: Pasteurella spp. on Blood agar after 24 hours of incubation at 37^0C

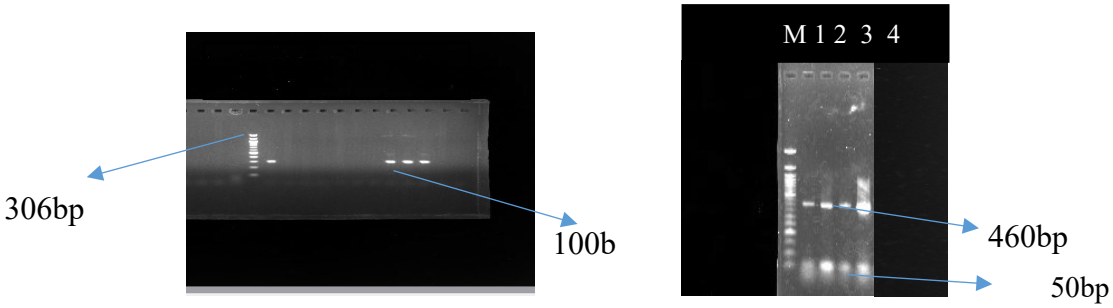

Figure 2: PCR amplication for *Mannhaimia hemolytica*. Lane 1, 7-9: DNA extracted from pure culture with 100bp ladder marker;Lane-1 positive control. PCR amplification for *Pasteurella multocida*.Lane 1-4 with 50bp ladder marker.

Table. 2: Antibiotic susceptibility testing of 18 *M. haemolytica* and 11 *P.multocida* isolates from sheep

Sl.No.	Antibiotics (Conc./disc)	*M. haemolytica* (18) (%)			*P. multocida* (11) (%)		
		S	I	R	S	I	R
1.	Gentamicin (10mcg)	44.44	5.56	50	36.36	9	54.54
2.	Tetracycline (30 mcg)	16.67	-	83.33	18.18	-	81.81
3.	Cetriaxone (30 mcg)	44.44	-	55.56	5	18.18	36.36
4.	Streptomycin (10 mcg)	16.67	11.11	72.22	45.45	-	54.55
5.	Oxytetracycline (30 mcg)	22.22	5.56	72.22	27.27	-	72.73

M. haemolytica= Mannheimia haemolytica; P. multocida= Pasteurella multocida. S=Susceptible; I=Intermediate, R=Resistance

Technical Session V:
FEEDS, FODDER AND NUTRITION

Effect of feeding BMP Napier grass as sole diet to local growing bulls on intake, nutrient utilization and growth performance

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Executive summary

Sustainable livestock production is highly dependent on the availability of quality feed and forage resources. Livestock production is mainly constrained by lack of continuity in the supply of good quality feed, either grazing or conserved forage in developing countries like Bangladesh. Napier (*Pennisetum purpureum* Schumach) is a perennial grass widely used for ruminants particularly for dairy & beef production in Bangladesh. Generally, this grass is used to feed the livestock as cut and carry system when it reaches~200-300 cm height and harvested at a severity of 5-6 cm above ground mainly to achieve greater biomass. Quality of this grass is often compromised to achieve high biomass yield which led to low level of protein and energy content of this grass and resulting in low levels of cattle of milk/beef production and/or reduced development. With appropriate or best management practices (intervention of defoliation or severity height, plant density etc.), Napier grass could play an important role in providing a significant amount of quality forage, both for the smallholder farmer as well as intensive livestock production systems (Tessema and Halima, 1998; Alemayehu, 2004). This study was conducted to assess the effect of feeding Pakchong grass harvested at different defoliation height on intake, nutrient utilization, FCR and growth performance in local growing bulls.

The present study was conducted at fodder research field and Cattle research farm of Bangladesh Livestock Research Institute, Savar, Dhaka. Under this study, we used sole Pakchong (*Pennisetum perpureum*) grass for feeding of local growing bull. The grasses were grown from stem cuttings having 2 nodes. Harvests were made when the plant height reached approximately 50 cm, 100 cm and 200 cm, respectively. However, for all treatments the cutting height was considered 10 cm above the ground. The BMP grass-1, BMP grass-2 and grass harvested at existing/current management practice were used to feed solely by local bulls in cut and carry feeding systems. The three different defoliation heights or plant heights of Pakchong grass were randomly fed to 18 local growing bulls (*Bos indicus*; RCC) of average 181.9±18.3 (Mean ±SD) Kg initial live weight and their age ranged between 18 and 22 months dividing them into three equal dietary groups as denoted by T_1 (50 cm defoliation height or BMP grass-1), T_2 (100 cm defoliation height or BMP grass-2) and T_3 (200 cm defoliation height or existing/current management practice). The animals under the three dietary groups were housed individually and fed the experimental diets *ad libitum* (at least 10% in excess of requirement) for a period of 106 days including a 7 days digestibility trial after 106 days of feeding. No concentrate or supplementation was provided during the whole feeding trial. The animals were weighed at an interval of 10 days, and their feed intake, digestibility of nutrients, FCR, growth performance and cost-net profit calculation were analyzed statistically in an ANOVA of a completely randomized design (CRD) using the compare means with SPSS, 20 computer software packages.

Table 1: Chemical composition of BMP Napier grass offered to growing local bulls

Diets	DM, % fresh	Chemical composition (% DM)				
		OM	CP	ADF	NDF	Ash
BMP grass-1	12.46^{c}	87.65^{b}	15.58^{a}	40.65	70.53^{c}	12.35^{a}
BMP grass-2	14.45^{b}	87.80^{b}	11.31^{b}	41.24	71.78^{b}	12.20^{a}
Current practice	17.42^{a}	89.45^{a}	8.37^{c}	41.06	73.96^{a}	10.55^{b}
SED	0.25	0.13	0.10	0.20	0.30	0.13
Sig. level	***	***	***	NS	***	***

The chemical composition of diets used in this experiment is shown in Table 1. It shows that, the defoliation height had a significant effect on the percentage content of dry matter, organic matter & NDF

in Pakchong grass ($p<0.001$), with DM percent and OM percent increasing as the defoliation height increased from 50 to 200 cm. By comparison, crude protein showed a decrease as the defoliation height increased. Pakchong harvested at 50 cm height contained significantly ($p<0.001$) crude protein content than Pakchong harvested at 100 cm or 200 cm height.

The total per head daily fresh ($p<0.001$), DM ($p<0.01$), CP ($p<0.001$), OM ($p<0.001$), ADF ($p<0.01$) and NDF ($p<0.001$) intake of bulls vary significantly among the three different dietary treatment groups. Per day DM (4.30 Kg), OM (3.84 Kg), ADF (1.77 Kg), NDF (3.19 Kg) intake and the DM intake based on percent live weight of bulls fed Pakchong grass with 200 cm defoliation height was significantly higher followed by bulls those fed 100 cm and 50 cm defoliation height Pakchong grass. However, per day CP (0.65 Kg) of bulls fed 50 cm defoliation height based diet was significantly ($p<0.001$) higher than that of 100 cm defoliation height (0.47 Kg) and 200 cm defoliation height (0.37 Kg) based dietary groups (Table 2). The ADF digestibility did not vary significantly ($p>0.05$) among the three dietary treatment groups (data now shown). However, the DM ($p<0.01$), CP ($p<0.01$) and OM ($p<0.001$) digestibility appear to be greatest for 50 cm defoliation height based diet (62.98, 68.42 & 65.66%, respectively), intermediate for 100 cm defoliation height based diet (59.53, 62.51 & 62.39%, respectively) and lowest for 200 cm defoliation height based dietary group (56.74, 59.25 & 58.13%, respectively; Table 2). Similarly, Pakchong grass with 50 cm defoliation height had the highest ($p<0.001$) intake of digestible crude protein (DCP) followed by DCP intake of 100 cm defoliation height and 200 cm defoliation height based diets. However, the intake of DDM and DOM did not vary significantly ($p>0.05$) among the dietary groups (Table 2). Feeding Pakchong grass with 50 cm defoliation height based diet had higher ($p>0.001$) average daily gain of 0.61 Kg compared to 0.35 Kg of 100 cm defoliation height or 0.27 Kg of 200 cm defoliation height based diet with an average feed conversion efficiency of 6.44, 11.31 and 16.21, respectively ($p<0.05$; Table 2) indicating that the FCR of bulls fed 50 cm defoliation based diet found better ($p<0.001$) than bulls those fed 100 cm & 200 cm defoliation based diets. The total DM yield per hectare land per year for Pakchong harvested at 50 cm, 100 cm and 200 cm height were 35.53, 31.18 & 35.59 ton, respectively. The feed cost involvement for kg DM yield of Pakchong harvested at 50 cm, 100 cm and 200 cm height were Tk. 11.45, 8.85 and 6.85, respectively. However, the total feed cost for kg live weight gain were lower for bulls fed 50 cm defoliation height based diet (Tk. 73.73) than those fed with 100 cm defoliation height (Tk. 100.10) and 200 cm defoliation height based diet (Tk. 111.03). The results so far obtained, it may be concluded that considering the overall beef production performances 50 cm defoliation height based diet may be ranked on top, followed by100 cm and 200 cm defoliation height based diets. Similarly, considering the results of FCR and feed cost analysis, the bulls fed 50 cm defoliation height based diet performed better than that of 100 cm and 200 cm defoliation based diet.

Table 2: Intake, digestibility, growth, feed conversion efficiency & cost-benefit of bulls fed solely Pakchong

Parameters	Experimental diets			SED	Sig. level
	BMP-1 (T_1)	BMP-2 (T_2)	Current (T_3)		
Fresh Intake (Kg/d)	31.66^a	27.54^b	24.92^c	0.44	***
DMI (Kg/d)	3.92^b	3.97^b	4.30^a	0.07	**
CPI (Kg/d)	0.65^a	0.47^b	0.37^c	0.01	***
OMI (Kg/d)	3.43^b	3.47^b	3.84^a	0.06	***
ADFI (Kg/d)	1.60^b	1.65^b	1.77^a	0.03	**
NDFI (Kg/d)	2.76^b	2.85^b	3.19^a	0.05	***
DMI (Kg; % LW)	1.85^c	1.99^b	2.12^a	0.03	***
DM dig.	62.98^a	59.53^b	56.74^b	0.90	**
CP dig.	68.42^a	62.51^b	59.25^b	1.34	**
OM dig.	65.66^a	62.39^b	58.13^c	0.88	***
DDMI (Kg/d)	2.47	2.36	2.44	0.04	NS
DOMI (Kg/d)	2.25	2.17	2.22	0.03	NS
DCPI (Kg/d)	0.44^a	0.29^b	0.22^c	0.006	***
Initial LW (Kg)	181.0	181.0	183.8	6.47	NS
Final LW (Kg)	246.1^a	218.4^b	212.9^b	7.14	*
ADG (Kg)	0.61^a	0.35^b	0.27^c	0.02	***
FCR	6.44^a	11.31^b	16.21^c	0.62	***
DM yield (t/ha/y)	35.53	31.18	35.59	-	-
Feed cost (Kg,DM)	11.45	8.85	6.85	-	-
Feed cost/kg LW gain, Tk.	73.73	100.1	111.03	-	-

Project Title: Development of Feeding and Nutritional Management Practices for Optimization of Dairy Performances in Buffalo

Running Title: Study on existing buffalo feeding management practices at selected areas of Bangladesh and establishment of rotational grazing research plot at BLRI

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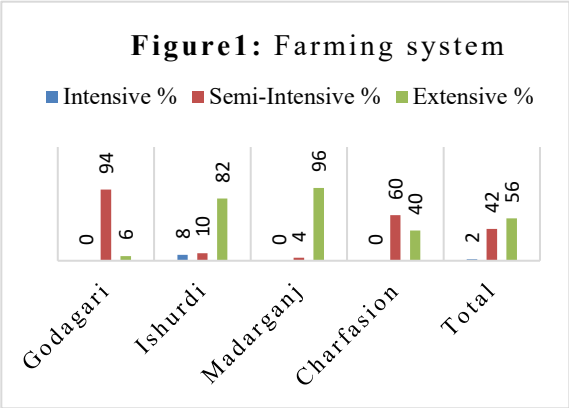
Executive Summary

Buffalo plays significant role in the national economy and nutritional security through providing milk, meat and draught power. The buffaloes can utilize poor-quality roughages, survive in environmental extremes and less prone to common bovine diseases. The majority of the buffaloes are found in the coastal char, riverine char and haor areas in Bangladesh. Green grass availability is the major limitation for buffalo rearing in these areas. The production and reproduction performance of buffalo in Bangladesh is very poor. Their average daily milk production varies from 2 to 4 liters and produces 2 calves in 3 years following first calving at around 4 years of age. The poor nutritional management and genetic merit are resulting low performance. Considering the above facts, the current study was designed to (i) know the existing feeding management practices in different buffalo-concentrated areas and (ii) evaluate the suitable age & height of pakchong fodder for rotational grazing in buffalo. To fulfill the first objective, a purposive survey with pretested questionnaire was conducted in geographically different locations in Bangladesh (Godagari, Ishwardi, Charfashion, and Madarganj Upazila). Data on current farming system, and productive and reproductive performances of buffalo were collected from 200 farmers during January to March, 2022. The productive traits considered for this study were age at first heat, estrous cycle, gestation length, lactation length, milk production, dry period and birth weight of buffaloes. A rotational grazing research plot on 5.0 acres land was established at BLRI. The biomass yield and height of pakchong fodder at different cutting ages (25, 30, 40 and 50 days) were recorded. Proximate composition (DM, CP, Ash, ADF, NDF) of pakchong fodder at different stage of production were also analyzed following the procedure of AOAC, 2005.

Results showed that three different buffalo farming systems were available in the studied areas. About 56% farmers were rearing their buffalo in an extensive farming system followed by semi-intensive (42%) and intensive (2%) farming systems (**Figure 1**). Among the four study areas, extensive buffalo farming was practiced mainly in Madargonj, Ishurdi and Charfasion Upazilas. Whereas, semi-intensive farming system is practiced mainly at Godagari Upazila under Rajshahi district and intensive buffalo farming system was found only in Ishurdi upazila. On the other hand, the productive and reproductive performance of buffalo in the intensive, semi-intensive and extensive farming systems were shown in **Table 1**. The larger herd size was found in the extensive (19.67±14.43) farming system followed by semi-intensive (14.58±6.27) and intensive (10.25±5.77) farming systems. It was observed that buffalo reared in the intensive systems show their first heat in earlier age (38.75±2.22 months) compared to extensive (39.36±3.58 months) and semi-intensive (42.86±3.83 months) farming system. Higher calf birth weight (28.33±3.79 kg) was found in the intensive management system and lowest birth weight was found in extensive and semi-intensive farming systems. A short dry period (71.6±13.20 days) was found in intensive system (Table 1). Similarly, lactation length was higher in intensive (225.83±19.16 days) and



the lowest in extensive (218.14±16.01 days) farming systems. The average milk production was highest in the intensive system (3.64±0.61 kg) followed by semi-intensive (3.19±0.60 kg) and extensive (3.02±0.70 kg) farming system. It was also revealed that the highest average feed cost per kg of milk production was found in intensive farming systems (42.07±4.90 BDT) followed by semi-intensive (37.87±8.79 BDT) and extensive farming systems (33.14±9.15 BDT).

Table 1: Productive and Reproductive performances of Buffalo in four selected areas (Mean±SD)

Parameter	Intensive	Semi-intensive	Extensive
Herd Size (No)	10.25±5.77	14.58±6.27	19.67±14.43
Age at 1st heat (Month)	38.75±2.22	42.86±3.83	39.36±3.58
Estrous Cycle (Days)	21.91±.79	21.83±10	22.35±1.22
Gestation Length (Days)	309±4.98	311.71±3.32	311.88±3.58
Calf Birth weight (Kg)	28.33±3.79	23.66±3.06	25.43±5.18
Dry Period (Days)	71.6±13.20	81.60±12.11	80.99±15.43
Lactation Length (Days)	225.83±19.16	220±18.66	218.14±16.01
Avg. Milk Production (Kg/d/buffalo)	3.64±0.61	3.19±0.60	3.02±0.70
Feed cost (BDT/kg) milk production	42.07±4.90	37.87±8.79	33.14±9.15

Results at different ages of pakchong fodder from rotational grazing research plots showed that dry matter content was higher ($P<0.05$) at 50 days, followed by 40, 30 and 25 days respectively. Whereas, crude protein content was higher ($P<0.05$) at 25 days of age followed by 30, 40 and 50 days, respectively (Table 2). There was no significant variations among ADF, NDF, and ash content at different ages of fodder.
The average height and biomass yield of pakchong fodder was higher at 50 days of age, followed by 40, 30 and 25 days, respectively

Table 2: Nutrients composition and biomass yield of pakchong fodder at different age (Mean±SD)

Parameter (%)	25 days	30 days	40 days	50 days	Sig. Level
Dry matter	11.87^{d}±0.12	14.31^{c}±0.47	16.73^{b}±0.97	18.35^{a}±0.976	**
Crude protein	16.36^{a}±1.30	15.55^{a}±0.30	11.41^{bc}±0.72	10.52^{bc}±0.38	**
Acid detergent fibre	36.52±1.12	38.52±5.77	39.30±1.21	38.77±2.98	NS
Neutral detergent fibre	71.17±0.06	70.69±2.22	71.33±2.40	70.24±1.60	NS
Ash	**10.4±0.20**	**11.0±0.04**	**11.25±0.23**	**11.13±0.063**	**NS**
Avg. height (cm/cutting)	65.75±4.57	78.75±6.13	93.75±4.11	139.5±5.19	**NS**
Biomass production (Ton/cutting/hectare)	4.82±0.85	5.62±0.78	7.92±1.84	10.4±2.07	**NS**

Considering the above findings, the existing herd size of buffalo at the farmer's level in the study areas was 20 and they were mainly reared in an extensive system. From the rotational grazing research plot, pakchong fodder at 25 days of age had a lower dry matter and biomass yield but higher crude protein content. Further experiment to identify optimum age and height of fodder for grazing buffaloes at rotational fodder plot should be conducted.

Comparative Feeding Studies on Growth and Reproductive Performance of Black Bengal Buck

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Executive Summary

Black Bengal goat is a dwarf breed and famous for high fertility, prolificacy, superior chevon quality, best quality skin, early sexual maturity, resistance against common diseases, seasonality, low kidding interval and very good adaptability. For orderly breeding of these high quality goats, the first step is to produce good quality buck and their proper management. Due to the lack of quality buck and following haphazard mating policy, in one hand this goat is decreasing in number and on another hand the growth and reproductive efficiency of kid and doe is reducing due to the resultant of inbreeding depression from repeated use of single buck. Reluctance of farmers to rear buck, some related superstitions and lack of proper feeding management are the main reasons for buck insufficiency. Ensuring the supply of nutrient rich feed in adequate amount is essential for the production of quality buck and to improve its genetic makeup. In this circumstance, an experiment was conducted to quantify actual intake of feed and nutrient, and to test the effect of different forms of roughage source on growth and reproductive performance of Black Bengal Goat (BBG) buck. The study was conducted in Goat Research Farm of BLRI, Savar, Dhaka. An animal feeding trial with 20 lambs aged 4-5 months was set up in a Complete Randomized Design (CRD) where four types of basal diets (Urea Molasses Straw, Maize Silage, Khesari Hay and Fresh German Grass) provided as treatments on *ad libitum* basis. Each group had an equal number of replication (5). All the animals were fed with equal amount (90-150gm) of concentrate comprising 88.84% DM and 17.88%CP. The chemical composition of experimental diet is presented in Table -1. Sample of feed, feces and urine was collected and analyzed at Animal nutrition Laboratory of BLRI to quantify the nutrient intake and outgo of the animal. From six months of age, data on reproductive parameters of goats such as length, diameter and shape of scrotum, daily mountings frequency etc. were collected regularly. Training to artificially collect semen from goats is started from eight months of their age and collection began from 9 months of age. Trial was continued up to one year age of buck. Finally, all data related to growth and reproduction were recorded in an Excel spreadsheet and were analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0.

Table-1: Nutritional Composition of Experimental Diet

	DM%	Chemical Composition (% DM)			
		Ash	CP	ADF	NDF
UMS	64.2	4.8	7.75	42.5	60.3
Silage	22.0	6.0	8.4	38.6	71.4
Hay	87.1	9.6	10.7	56.2	81.6
German	14.20	9.7	10.47	41.8	72.8
Concentrate Mixture	90.0	5.0	18.3	40.6	79.3

Table-2: Nutritional and growth response of different roughage

Parameters	Diet (Mean±SEM)				p value
	UMS	Silage	Hay	Grass	
Dry matter intake (gm)	248.34±19.53^{a}	248.34±19.53^{a}	199.45±18.72^{b}	228.63±18.85^{a}	.001
CP intake (gm)	46.36±3.60^{c}	51.28±5.07^{b}	52.87±6.0^{a}	52.77±4.02^{a}	.001
Initial live weight (kg)	6.58±0.47	6.52±0.68	6.54±0.94	6.60±0.95	1.00
Final live weight (kg)	12.42±0.95	12.66±.07	14.18±0.74	13.54±0.91	0.533
Daily gain (gm)	45.20±3.70^{b}	53.12±1.67^{ab}	56.02±2.29^{a}	56.16±1.48^{a}	0.001
FCR	4.91±0.62^{b}	6.11±1.18^{b}	4.89±0.27^{b}	10.00±1.11^{a}	0.000
Cost (TK) per kg weight gain	98.2	73.3	34.23	60	-

Data on individual DM intake reveals that, per head daily intake of UMS and silage was 248 gm whereas hay was 199gm and green grass was 228 gm (Table 2). Amount of hay intake was significantly lower following UMS, silage and green grass. But CP intake from green grass (52.77gm) and hay (52.87gm) was significantly higher comparing silage (51.28 gm) and UMS (46.36 gm). No significant difference was observed in initial and final live weight of animal irrespective of feeding group. But the average daily gain was significantly higher in hay (56.02 gm) and grass (56.16 gm) and lower in UMS (45.20 gm). The FCR of bucks fed hay (4.89) and UMS (4.91) found better ($p<0.000$) compared to Grass (10.00) and silage (6.11). The overall cost of one kg gain was lower in hay (34tk) and grass (60tk) compared to silage (73tk) and UMS (98tk). It can be seen from the reproductive data of Buck shown in Table 3 that, the scrotum shape was oval irrespective of treatments. Average daily mounting frequency was equal (4) in UMS, hay and green grass group and low in silage (3), however, no significant difference ($p>0.05$) was observed there.

Table 3: Reproductive characteristics of different feeding system

Parameter	Diet (Mean±SD)				
	UMS	Silage	Hay	Grass	p value
Scrotum length (cm)	9.3±0.55^{ab}	9.6±0.73^{ab}	10.6±1.24^{a}	10.1±0.57^{a}	0.078
Scrotum diameter (cm)	17.31±0.51	17.21±1.91	18.04±0.99	17.64±0.73	0.676
Mounting frequency	4.0±0.47	3.0±1.0	4.0±1.00	4.0±0.76	0.360
Scrotum shape	Oval	Oval	Oval	Oval	-

Table 4: Semen quality characteristics of different feeding group

Feed	Physical Characteristics		Motility (%)			
	Volume (ml)	Colour	Motile	Progreesive	Static	Slow
UMS	0.30	Creamy	77.2	57.9	12.3	0.3
Silage	0.35	Milky	83.46	50.7	16.5	0.1
Hay	0.45	Milky	88.88	60.3	22.8	0.1
German	0.40	Creamy	90.43	64.38	9.58	0.3

In reproductive case, only scrotum length differed significantly ($p<0.05$) and was higher in buck fed hay (10.6 cm) and fresh grass (10.1 cm). No significant difference was observed in scrotum diameter. In case of semen quality, the physical characteristics of buck semen were satisfactory irrespective of group. Maximum motile sperm was found from buck fed green grass and hay followed by silage and UMS and the value was 90 and 88% of which about 60% were progressive. The earliest semen ejaculation was obtained from grass and hay fed group at 11 month of age.

In conclusion, it can be said that, green grass or hay based diet may play potential role to obtain satisfactory growth and reproductive performance. But more research need be conducted to define age based energy and protein requirement and their supplementary source for getting maximum output with minimum input.

Effect of creep feeding during weaning period on the post weaning performances of growing Black Bengal goat

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Executive Summary

Black Bengal goat is a high prolific breed but due to low milk production often can't support the milk requirement of all the kids. As a result, malnutrition, disease incidence and mortality of kids' increases during weaning period and farmers are not able to get optimum profit from 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. In the previous study, it was observed that supplementation with creep feed (creep Feed-1 and creep feed-2; Table-1) during weaning period enhances growth performance of the kids although not significant but enhances considerable profit per kid until weaning (BDT. 358.82 vs BDT.147.43, respectively). Creep feeding also reduces the disease incidences and kid mortality until weaning (50%). Thus, the objective of the present study was to know the effect of creep feeding during weaning period on the post weaning performances of growing goat. An initial trial was conducted with a total of 24 Black Bengal kids (Average birth weight-1.00kg, age-7 to 10 days, sex- Male). They were assigned into three treatment groups (A, B and C), where group A was supplemented with creep feed-1(concentrate based) along with dam's milk, group B was supplemented creep feed-2 (moringa based) along with dam's milk and group C was only allowed for sucking during weaning period (control group). At this stage the pre-weaning groups are considered as the treatment groups. Each group comprised of kids having similar group average weight. After weaning, growing goats in all 3 groups were fed Ad libitum green grass (German grass) + Concentrate feed (@1.5% of body weight) + Water for another 90 days. The composition of concentrate feed is shown in Table2.

The chemical composition of creep feed was shown in Table-1 which was provided during weaning period. 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 (2025) 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 previously

Sample name	DM	Ash	CP	ADF	Fat	GE (MJ/Kg DM)
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

Table2. Composition of the concentrate feed

Name of the ingredients	Wheat bran	Broken maize	Soybean meal	Kheshari bran	Protein concentrate	Vitamin min. pre	DCP	Salt
Percentage	30	27	23	16	1.5	0.5	1.0	1.0

Performances of different groups of growing goats are presented in Table 3. The DM intake among the treatment group differs significantly ($p<0.05$). The average daily weight gain was significantly ($p<0.01$) higher in group B. Similarly, FCR and cost per kg weight gain were also significantly ($p<0.01$, $p<0.05$) lower in the treatment group B.

Group B (previously fed creep feed-2) performed better than other two groups (Group A: previously fed creep feed-1 and Group C: control) in terms of total weight gain, daily weight gain, FCR and cost per kg weight gain (2.63kg, 29.21gm/day, 5.01 and 230.32tk, respectively).

Table3. Performances of different groups of growing goats

Parameters	Treatment groups			SEM	Level of Significance
	A	B	C		
Total Weight gain, kg	3.08^{a}	4.13^{b}	2.63^{a}	0.15028	**
Daily weight gain, g	34.19^{a}	45.88^{b}	29.18^{a}	1.66980	**
Dry matter intake, kg	19.13^{ab}	20.38^{b}	17.98^{a}	0.36649	*
FCR	6.29^{a}	5.01^{b}	7.08^{a}	0.28757	**
Cost per kg weight gain, tk	331.27^{ab}	230.32^{b}	384.08^{a}	23.59415	*

****= significant (p=0.001-0.01), *=significant (p=0.02-0.05)**

On the other hand, the common diseases or health problems observed during the experimental period (Table 4) were Pneumonia, Coccidiosis/Diarrhoea and Lameness. During the post-weaning period 37.5%, 25.00%, 50.00% of growing goats faced different diseases or health related problems for the group A, B and C, respectively. The kid mortality rate was 0.0%, 0.0% and 12.5% for the group A, B and C, respectively.

Table4. 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.)	1	1	2
Coccidiosis/Diarrhoea (no.)	2	1	2
Lameness (no.)	0	0	1
Total (no. of kids)	3	2	4
Incidences of diseases or health problems, (%)	37.5	25.00	50.00
Death (no.)	0	0	1
Kid mortality (%)	0	0	12.5

The result suggested that creep feeding during pre-weaning period enhances post-weaning growth performance of growing goats whereas moringa foliage-based creep feed performed better although the average initial weight of the animals of different Groups were similar. Creep feeding also reduces the disease incidences and mortality that should have a positive impact on farm profitability.

Production of nutrient enriched designer eggs through dietary manipulation of *Moringa oleifera, Spirulina platensis* and *Linum usitatissimum* in laying hen

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Executive summary

Eggs are considered as complete food because of all the nutrients available in required proportion. They are enriched an excellent quality of protein, a moderate calorie source (about 150 kcal/100 g), great culinary versatility and low economic cost. Eggs are also relatively rich in fat-soluble compounds for people of all ages and at different stages of life. In particular, eggs may play a particularly useful role in the diets of those at risk of low-nutrient intakes such as the elderly, pregnant women and children. Additionally, eggs can be consumed throughout the world, having no use restrictions on religious grounds. It is an ongoing research program to increase omega-3 fatty acids in egg by supplementing natural diets to laying hen. Therefore, the objectives of the present study were to evaluate the feeding effect of *Moringa oleifera, Spirulina platensis* and *Linum usitatissimum* on their performance, egg quality, and fatty acid profiles of laying hen egg. One hundred and eighty-nine (189) RIR 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 with the basal feed as follow T_1-Control Diet; T_2-*Moringa oleifera* 1.0%; T_3- *Spirulina platensis* 1.5%; T_4- Flaxseed 1.5% (*Linum usitatissimum*); T_5- *M. oleifera* 1.0% + Flaxseed 1.5%; T_6- *S. platensis* 1.5% + Flaxseed 1.5%; T_7- *M. oleifera* 1.0%+ *S. platensis* 1.5%. Proximate composition of Moringa, Spirulina and flaxseed are shown in Fig.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 determined 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 qualities such as egg length (cm), eggshell thickness, egg width (cm), shape index (%), shell thickness (mm) shell weight (g) or internal qualities of eggs such as albumen height (cm), albumen width (cm), albumen index (%), yolk height (cm), yolk width (cm), Yolk index (%) and yolk color. The results also showed that the shape index, albumen width and albumen index were not significantly difference compared to control group. Moreover, slightly higher yolk colour value (8) was observed in the T_3 group compared to the control group (7) (Table-1). A numerical reduction in total cholesterol levels was noted upon feeding with additives to the diet, which may be due to hypocholesterolemic effect (Table 1). Yolk cholesterol was significantly ($p < 0.05$) reduced in all additive's groups. The hypolipidemic effect is might be due to the high saponin content in moringa, spirulina and flaxseed. Some researcher found saponin to be the most active anti-nutritional substance in these components. Since plant saponin binds with cholesterol, as mentioned above, it can be expected that saponin reduces the level of cholesterol in the body. It was also reported that some saponins can prevent hypercholesterolaemia, a phenomenon that results from complex formation with cholesterol. Total PUFA content was also higher in the T_2, T_4 and T_5 groups compared to the control (Fig. 2). Fatty acid composition, especially ω-3 fatty acid content was improved due to presence of phenolic components and egg cholesterol concentration was reduced at the lower levels i.e., PUFA was improved, in T_2, T_4, and T_5 groups.

Table 1 Serum, yolk cholesterol and internal egg quality traits of laying hens fed with Moringa, Flaxseed and Spirulina

Parameter	T_1	T_2	T_3	T_4	T_5	T_6	T_7	SME	*p*-value
TC (mg/dL)	204.67	146.00	232.00	218.33	238.83	182.33	160.80	12.19	0.30
HDL (mg/dL)	46.21	46.33	46.93	49.33	40.33	42.33	39.91	1.34	0.44
LDL (mg/dL)	82.33	53.00	85.00	87.33	66.67	71.17	59.67	5.35	0.56
Triglyceride (mg/dL)	1042.00	1099.00	1141.67	1122.33	1116.67	1111.00	1107.33	19.02	0.92
Yolk cholesterol (mg/100g)	310.50^{a}	247.41^{c}	255.37^{c}	290.03^{b}	270.81^{bc}	301.81^{ab}	305.69^{ab}	5.31	0.00
[1]Shape index (%)	78.41	82.80	77.51	80.34	80.86	74.43	80.25	2.39	0.46
[2]Albumen index (%)	8.14	10.35	9.57	10.65	9.52	7.58	7.34	0.85	0.94
[3]Yolk index (%)	43.43	42.85	41.30	40.74	41.57	40.91	43.80	1.05	0.99
Yolk color	7.00	7.33	8.00	7.00	7.00	7.67	7.33	0.22	0.36

T_1-Control Diet; T_2- Moringa 1%; T_3- Spirulina 1.5%; T_4-Flaxseed 1.5%; T_5- Moringa 1.0% + Flaxseed 1.5%; T_6- Spirulina 1.5% + Flaxseed 1.5%; T_7- Moringa 1.0%+ Spirulina 1.5%. Values are expressed as mean ± standard error of means. Means represent four replicates, three egg per replicate.
[1]Shape index = Egg Width / Egg length x 100
[2]Albumen index = Height of albumen/ Width of albumen x 100
[3]Yolk index = Height of the yolk/ Width of yolk x 100

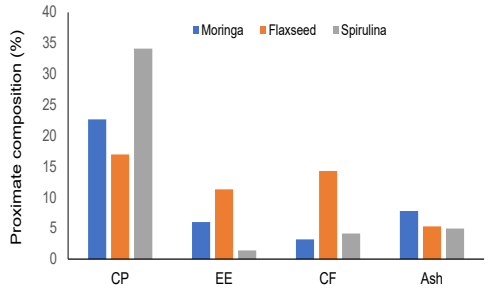

Fig.1 Proximate composition of feed additives

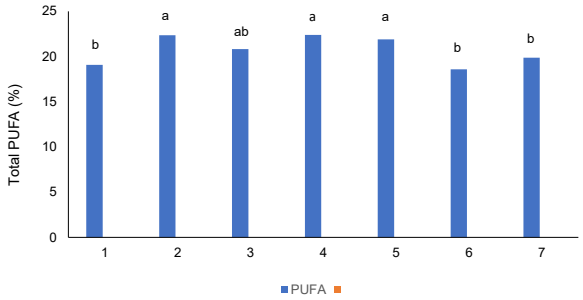

Fig. 2 PUFA in egg yolk (g/100g) of different dietary treatments

Addition of different levels of feed additives in diets had no effect on production performance in terms of egg nutritional composition and external quality parameters of egg. 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. 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.

POSTER SESSION

Epidemiological investigation of major buffalo diseases and evaluation of effectiveness of deworming against buffalo diseases in Bangladesh

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Executive Summary

Buffalo is providing milk, meat and draught power for agriculture. This species is known for its' higher capacity to convert course roughage based poor nutritious feed into high nutritious human food (milk and meat) and high adaptation in harsh climatic conditions. They are more resistant to several tropical diseases. However, several diseases were reported in buffalo. The majority of buffalo diseases are infectious and parasitic in origin. Diseases results substantial risks to the productivity. The present study aimed to conduct an epidemiological investigation for knowing the prevalence of buffalo diseases and determine the effectiveness of deworming at on-farm for developing a strategic deworming calendar. A passive surveillance with a pretested questionnaire was conducted in 6 buffalo pocket areas among 300 buffalo farmers. During survey data were collected on buffalo health care practices, disease incidences and risk factors associated with buffalo health. A total of 200 fecal samples from buffaloes (n=118) of 4 different age groups (<1 year; 1-3 years; 3-6 Years; >6 years) were collected after 4 and 5 months of post deworming with combined Ivermectin and Chlorsulon. Deworming effectiveness was determined through evaluation of eggs/oocysts per gram faeces (EPG/OPG) following modified McMaster technique. The flotation technique was used for demonstrating gastrointestinal nematode (GIN) and cestode eggs, as well as oocysts of coccidian. The sedimentation technique was used for detecting the trematodes eggs. The collected data were processed using MS Excel and then transferred to STATA 14 for performing one-way ANOVA.

About 93% (279 out of 300) farmers were not familiar with proper deworming and vaccination practices. The prevalence of infectious diseases was higher than non-infectious diseases in the study areas. About 25% and 21% farmers were reported occurrence of the foot and mouth disease (FMD) and Hemorrhagic Septicemia (HS), respectively in most buffalo concentrated riverine pockets. Other infectious diseases like gastroenteritis (19.4%), calf scour (12.6%) and mastitis (4.2%) were also reported in studied areas. The prevalence of *Trichuris* spp. was higher (n=90) (76.3%; CI: 0.68–0.83) than all other parasites at 4 months of post deworming (n=118), whereas *Trichostrongylus* spp. (n=16) was higher (13.6%) (CI: 0.08–0.21) among the nematodes. The prevalence of *Coccidia* spp. and *Fasciola* spp. were observed at 23.7% (CI: 0.17-0.32) and 5.1% (CI: 0.02-0.11) samples, respectively. FEC was significantly higher at 5 months post-deworming (P = 0.01, CI: 0.02-0.24) than at 4 months. Calves (<1year) had a higher parasitic infestation than the adults (<6 years) (P = 0.02; CI: -0.35 to -0.03).The geometric (G) mean of FEC in buffaloes reared in extensive/free ranging systems was higher than in semi-intensive rearing systems. Conversely, among the age groups lower parasitic infection rate was observed at 3-6 year old buffaloes at the 4 months than 5 months of post deworming, which could be attributed to the intensive rearing system of male and pregnant buffaloes rather than a free-ranging or semi-intensive system.

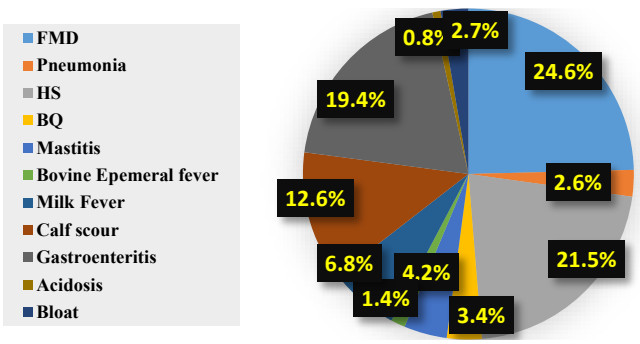

Figure 1: Disease prevalence in buffalo in different project areas

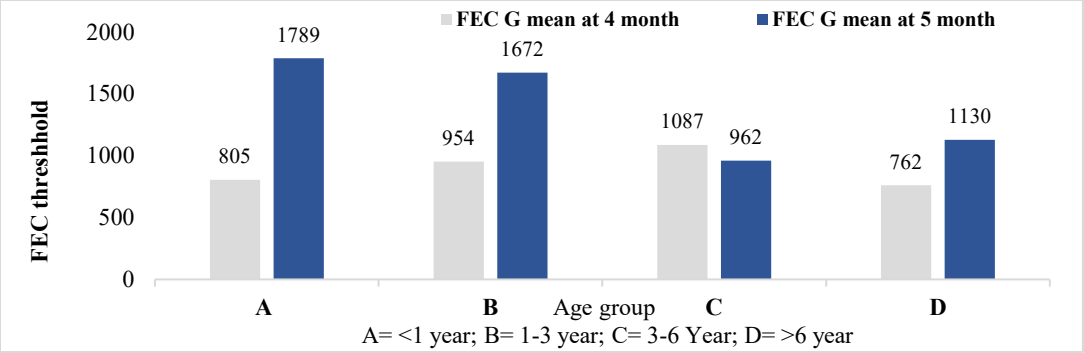

Figure 2: Mean difference of four age group at semi- intensive and semi-bathan rearing system

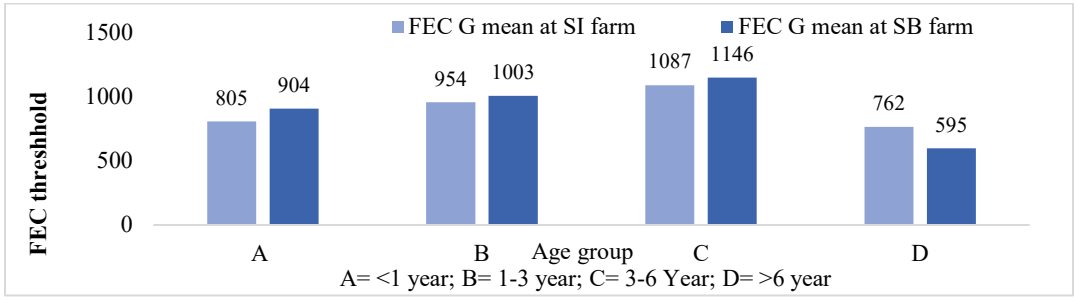

Figure 3: Fecal egg count between 4 and 5 months after deworming in four age groups of buffalo.

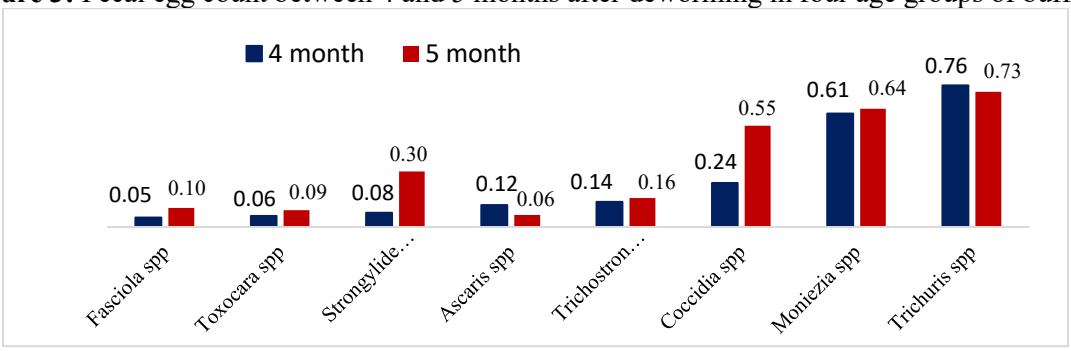

Figure 4: Prevalence of parasite eggs in the intestine at 4 and 5 months after deworming

From these findings, it may be concluded that the effectiveness of deworming or control of parasitic infestation was higher in the case of an intensive rearing system of buffaloes than a free-ranging rearing system. Therefore, a proper deworming and vaccination calendar is crucial to control infectious and parasitic diseases for intensive, household, and riverine buffalo rearing systems.

Identification of common etiological agent of alopecia in Red Chittagong Cattle (RCC) calves in selected areas of Bangladesh

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Executive Summary

Alopecia is usually defined as the partial or complete absence of hair in the skin where it normally grows. It can be caused by abnormality or malfunction of the hair follicles (primary alopecia) or can be associated with inflammation and hypertrophy of the skin and subsequent involvement of the hair follicles (secondary alopecia). Alopecia can be differentiated as congenital or acquired that depends on the etiology. Congenital alopecia has been described in different breeds and is caused by genetic defects and sometimes associated with additional malformations. However, alopecia is commonly caused by parasitic infestation, or secondary infectious disease and metabolic causes. Alopecia is a big problem in the hide and skin of cattle industry in tropical and subtropical countries specially in Bangladesh. The RCC is one of the potential genetic varieties in Bangladesh-specially in hilly areas and breeding farms characterized by special red color occupying in horn, hoof, udder, ears, eyeball, eyebrow, vulva, and tail switch. Comparing the other diseases, alopecia is considered as a big problem in cattle industry specially in calf including RCC calf that affects their hair follicles and aggressively damage the hide and skin quality. This problem is most frequently found in young calves within one month of age and this scenario is common in winter season despite these calves are born with normal hair coat. Although this problem creates huge havoc in cattle industry and leads massive economical losses, however what common organisms associated with this disease occurrence has not been properly addressed. To do this, one-year research program was carried out in the RCC calf located in Nikhongchari and BLRI research farm in the FY 2021-22, where, 50 blood samples and 30 skin scrapings were collected from the clinic-suspected calves of 2 to 6 months age, where 21 skin samples and 38 blood samples from savar and 9 skin samples and 12 blood samples from Nikhongchari respectively. The blood samples were subjected to chemistry profiling where glucose, total protein, vitamin B2, electrolyte (Zinc and Calcium), and SGOT was estimated using commercial biochemical analyzer. The skin scrapings samples were subjected to ecto-parasitic and fungal tests where histological changes were categorized. The result showed that among the 30 skin samples the overall prevalence of alopecia was 73.33% (n=22). Moreover, out of 30 skin scrapings, 50% (n=15), 13% (n=4), and 12% (n=3) cases were ectoparasitic (tick mite infestation), bacterial (pus forming bacteria), and fungal cases, respectively (Figure 1). On the other hand, the biochemical analysis of blood samples showed that the glucose level was 60-65±0.5 mg/dl (Normal 68-70±0.5 mg/dl), calcium 4-6±0.5 mg/dl (7-8 ±0.5 mg/dl), Zn 2-2.5±0.5 mg/dl (4-5 ±0.5 mg/dl), TP 10-11±0.5 mg/dl (10-12±0.5 mg/dl), vitamin B2 0.7-0.8 ±0.01 mg/dl (0.8-1.1 ±0.01 mg/dl), SGOT 90-95±0.5 mg/dl (100-101 ±0.5 mg/dl). This blood parameter was measured because healthy calf without the sign and symptoms shown the normal blood profile instead of alopecia in calf. Interestingly, when we compared the results, it showed that no alopecia cases (0.0%) were detected in BLRI research farm, whereas 100% cases were found in hilly areas from the clinically affected RCC calf. However, it is speculated that proper nutritional supplement, management strategy and regular vaccination against common infectious diseases with good livestock farming practices might be the factors for having this variable cases. It is interesting that animal reared in top or middle level of soil in hilly areas suffered more nutritional problem than the animal reared in low land. It might be due to rain or water flow from the top soil portion of hilly areas leaches the soil nutrition to the low land areas. Because grasses of fodder uptake the nutrients from soil to fodder plants. However, soil health is important for nutritive growth of the fodder. It also a probable causes of alopecia in hilly areas. Finally, it can be concluded that parasitic infestation is the main causes of alopecia in calf followed

by vitamin, mineral and fungal causes that can be decreased by proper supplementation of nutrition and practicing good livestock farming strategy.

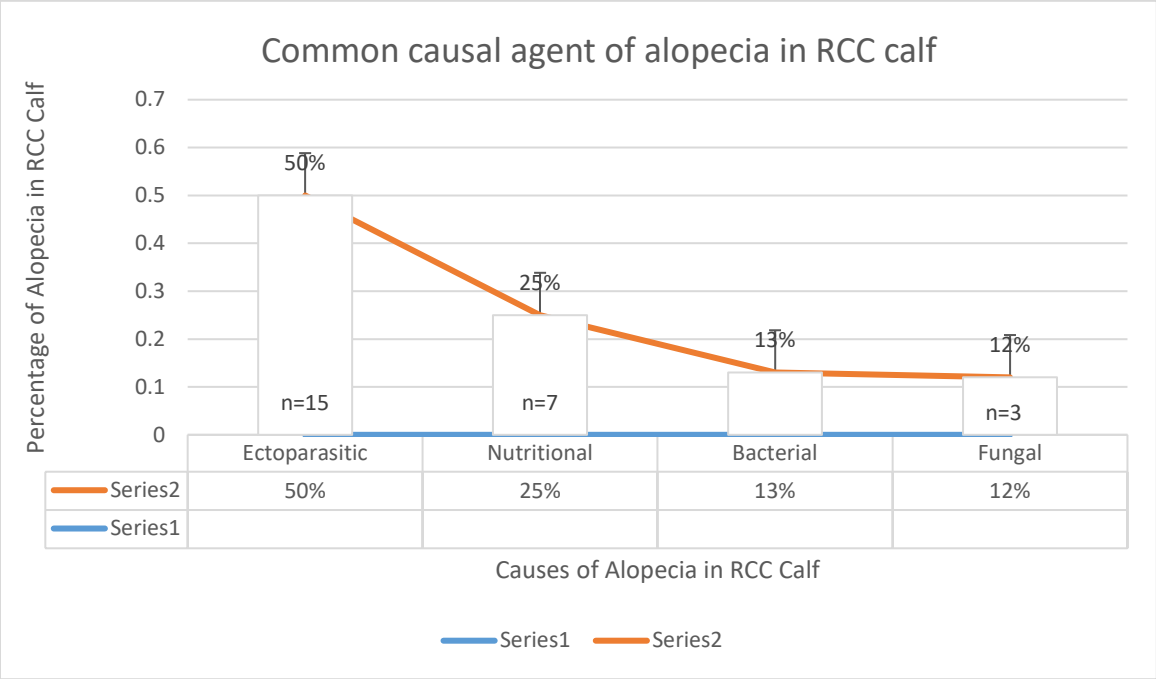

Fig 01: Showing the percentage of common etiological agent of alopecia in RCC calf

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

Subtitle: Seroprevalence and risk factors of brucellosis in sheep in Bangladesh

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Executive Summary

Brucellosis is a zoonotic disease globally, associated with significant morbidity that can lead to an increased rate of spontaneous abortion and infertility in livestock. The disease is widely distributed throughout the developing world, including Bangladesh, and considered to be a serious problem in at least 86 countries. The disease is caused by a small, facultative, non-motile, gram-negative coccobacillae bacteria which belongs to the genus Brucella. In sheep and goats, brucellosis is mainly caused by *Brucella melitensis.* and rarely by *Brucella abortus or Brucella ovis.* In sheep, brucellosis causes severe economic losses as a result of stormy abortions or reproductive failure, sterility and reduced milk production rates. Besides that, it adds to the burden shouldered by the farmers by the costs of control and management. Therefore, the present study was carried out to investigate the seroprevalence of brucellosis in sheep and to explore the risk factors associated with it. A cross-sectional study was conducted in ~~various~~ several selected sheep-prone areas of Bangladesh from July 2021 to June 2022 to determine the sero-prevalence of brucellosis in sheep. A total of 394 serum samples were collected randomly from sheep in different selected areas of Bangladesh, including Faridpur (52), Noakhali (60), Rajshahi (46), Tangail (48), Savar (46), Thakurgoan (50), Bandarban (44), and Meherpur (48) to determine the ~~S~~ seroprevalence of brucellosis and its associated risk factors. Information related to age, sex, parity, herd size, rearing system, and biosecurity was collected through a structured questionnaire by direct interview to find out the possible risk factors. Two different types of serological tests, like the Rose Bengal Plate Test (RBT) and the Enzyme Linked Immuno Sorbent Assay (ELISA), were performed at the Small Ruminant Research Laboratory in Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. The RBT was performed as per standard procedure and before using the Rose Bengal colored antigen, the bottle was shaken well to ensure homogenous suspension. After that, 30 µl of each serum sample was taken on a glass plate by micropipette and then added 30 µl of the Rose Bengal-colored antigen. Subsequently, the antigen and serum were mixed thoroughly by the rotation of the glass plate gently using hand and contact for a period of 5 min. Agglutination/ clumping was considered as positive reaction, whereas no agglutination/no clumping was regarded as negative but slightly agglutination is also considered as a positive result. Then ELISA was performed using a commercial ELISA kit (ID Screen® Brucellosis Serum Indirect Multi-species, ID vet, France) according to the manufacturer's instructions.

On the basis of the Rose Bengal Plate Test (RBT) and ELISA (Table-01), we found the overall sero-prevalence of brucellosis in sheep was 5.84% (23/394) and 3.55% (14/394) respectively. We noticed the highest prevalence of brucellosis in Meherpur (8.33%) and the lowest in Tangail (4.17%) in RBPT, but in ELISA, the highest prevalence was observed in Rajshahi (6.52%) and the lowest in Savar (0%). In addition, age, sex, parity, biosecurity and rearing system of animals were considered as important risk factors associated with the occurrence of brucellosis in sheep (Table 2).

It can be concluded that sheep brucellosis according to serological diagnosis is prevailing in Bangladesh at a low rate. The prevalence and severity of the infection may differ with the breed, geographical location, type of diagnostic test, husbandry and environmental factors. Serological tests might be a means for the identification of brucellosis in sheep across the country, and measures could have been taken to initiate and establish a program for the control and prevention of brucellosis through vaccination, testing and slaughtering the infected animal from the flock and also by maintaining proper biosecurity.

Table 1: Seroprevalence of brucellosis in sheep based on RBPT and ELISA

Location	Total no. of sera tested	Positive in RBPT (%)	Positive in ELISA (%)
Faridpur	52	3 (5.77%)	3 (5.77%)
Noakhali	60	4 (6.67%)	2 (3.33%)
Rajshahi	46	3 (6.52%)	3 (6.52%)
Tangail	48	2 (4.17%)	1 (2.08%)
Savar	46	2 (4.35%)	0
Thakurgaon	50	3 (6.00%)	2 (4.00%)
Bandarban	44	2 (4.55%)	1 (2.27)
Meherpur	48	4 (8.33%)	2 (4.17%)
Total	**394**	**23 (5.84%)**	**14 (3.55%)**

Table 2: Association between the prevalence of brucellosis in sheep and its various risk factors

Risk Factor	Group	No. of Animal	RBPT Positive Samples	ELISA Positive Samples
Age	Below 1 yr	97	2 (2.06%)	1 (1.03%)
	1 to 3 yrs	189	12 (6.35%)	8 (4.23%)
	over 3 yrs	108	9 (8.33%)	5 (4.63%)
Sex	Male	82	4 (4.88%)	2 (2.44%)
	Female	312	19 (6.09%)	12 (3.85%)
Parity	0	97	2 (2.06%)	1 (1.03%)
	1 to 3	137	8 (5.84%)	5 (3.65%)
	Over 3	160	13 (8.13%)	8 (5.00%)
Herd Size	Small	221	13 (5.88%)	7 (3.17%
	Medium	61	3 (4.92%)	2 (3.28%)
	Large	112	7 (6.25%)	5 (4.46%)
Rearing System	Free	239	16 (6.69%)	9 (3.77%)
	Semi-intensive	155	7 (4.52%)	5 (3.23%)
Biosecurity	Yes	129	6 (4.65%)	3 (2.33%)
	No	265	17 (6.41%)	11 (4.15%)

Sureillance and molecular evolution of avian influenza virus and it's spatiotemporal distribution of outbreaks in Bangladesh

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Executive Summary

Avian influenza, known informally as avian flu or bird flu, is a variety of influenza caused by viruses adapted to birds. It is a highly contagious viral disease and it is causing tremendous economic losses to the poultry industries over the last decade. It is very difficult to control this disease because of its huge number of serotypes and mutation nature. The virus is zoonotic in nature that easily mutates from LPAI to HPAI. Formation of the International Partnership on Avian and Pandemic Influenza was announced in order to elevate the importance of avian flu, coordinated efforts, and improve disease reporting and surveillance for the better respond to future pandemics. As of June 2022, a total of 548 outbreaks of HPAI H5N1 have been reported; these outbreaks have resulted in serious economic losses in the poultry sector in this country. Furthermore, 7 cases of human infection with HPAI H5N1 were confirmed emphasizing the public health aspect of the ongoing HPAIV H5N1 outbreaks. Following the initial spread of clade 2.2 H5N1 HPAI virus in Bangladesh in 2007, there have been new introductions of clade 2.3.2.1 and clade 2.3.4 virus in 2011. In addition to the HPAI H5N1 virus, the H9N2 subtype is widely circulating in poultry in Bangladesh, and co-circulation with other infectious respiratory pathogens also reported. This is an on-going research project and last financial year 2021-22 we found overall 8.6% (66/355) of oropharyngeal swabs samples were found positive for avian influenza (AIV) M gene.

The research was conducted under two objectives- detection, isolation and molecular evolution of avian influenza viruses circulating in Bangladesh; and development of reference antisera from circulating A/H5N1 Clade 2.3.2.1a. The activity of research project in the financial year 2021-22 was collection of samples from commercial farm and outbreak investigation, subtype determination by RT-qPCR, isolation of AIV, preparation of AIV antigen (A/H5N1) and inoculation to experiment chickens.

The samples were collected from 11 districts of Bangladesh including Rangpur, Gainbandha, Dhaka, Manikgonj, Munshigonj, Mymensingh, Tangail, Gazipur, Bogura, Joypurhat and Cox'sbazar districts during 2021 to 2022 (Figure 1). Total 355 oropharyngeal swabs and post-mortem specimens were collected from commercial chicken (286), duck (35), turkey (20), ostrich (4) and zoo birds (10) in virus transfer media. 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. Samples were tested for and evaluated for the presence of AIV and its subtypes by RT-qPCR assays. The samples were screened first for the presence of M gene by RT-PCR test using reference primers. Then M gene positive samples were further assessed for H5 and H9 sub-typing using primers and probes by RT-PCR test. Totals of 8.6% (66/355) of samples oropharyngeal swabs were found positive for avian influenza (AIV) M gene. Whereas total of 30 samples were identified for H5N1 subtype and H5N1positive samples were inoculated into specific pathogen-free (SPF) chicken embryos through CAM route and isolated 20 H5N1 samples finally. The isolates were stored for the further molecular characterization and genomic evolution study. For the development of reference antisera from circulating H5N1 Clade 2.3.2.1a (NRL-AI archived isolates), a total of 10 AIV seronegative chickens were selected and infected by formalin killed

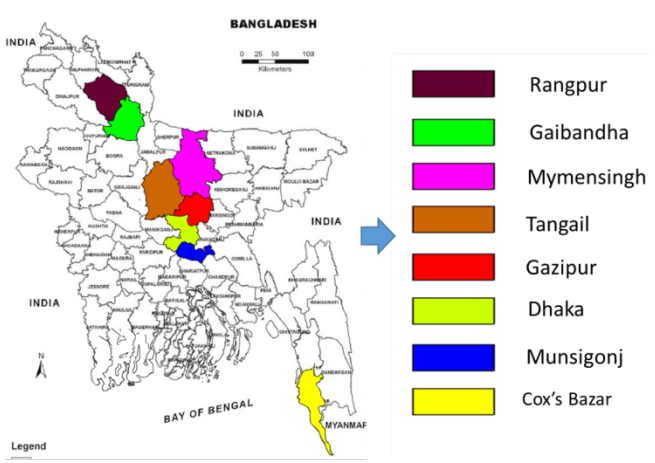

Figure 1. Graphical Presentation of sampling area

A/Chicken/Bangladesh/NRL-AI-8323/2017 virus. Finally, prime sera and boosted sera (30 days of 1st infection) were collected for further antigenic cartography study.

In conclusion, the results demonstrated that H5N1are circulating in wider range of poultry species of selected areas. Strict farm biosecurity practices and proper vaccination against H5N1 are recommended to prevent AIV spread.

Development of vaccines for economically important bacterial diseases of poultry

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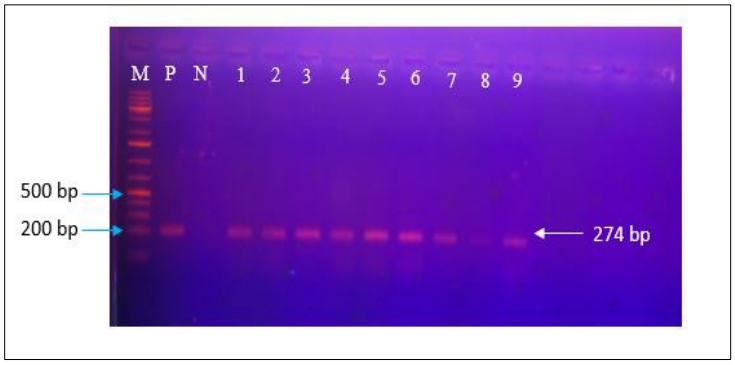
Salmonellosis, a zoonotic bacterial disease caused by 2610 different *Salmonella* serovars has been reported worldwide in 2018. Being a prevalent reason for mortality and/or reduced production of the poultry population in Bangladesh, it demands extensive research and preventive measures against *Salmonella*. Fowl typhoid and pullorum disease, caused by *Salmonella enterica subspecies enterica serovars* Gallinarum *biovars* Gallinarum and Pullorum, respectively, are widely distributed throughout the world, especially in developing countries. *Salmonella enterica serovar* Gallinarum *biovars* Pullorum (*S. Pullorum*) and *Gallinarum* (*S. Gallinarum*) are predominantly being abundant in Bangladesh. In poultry, which represent important sources of cheap protein, fowl typhoid and pullorum disease continue to cause economic losses where the poultry industries are continuing to intensify and where open sided housing is common. The costs or impracticality of improvements in hygiene and management together with the increasing problems of antibiotic resistance suggest that vaccination in poultry will become more attractive as an adjunct to existing control measures. Thus, we will be constructing a bivalent vaccine fighting against *S. Gallinarum and S. Pullorum* to impact on our poultry industry as per standard protocol developed by the World Organisation for Animal Health (WOAH, 2004). Therefore, we formulate this research project for developing a bivalent *salmonella* vaccine from circulating local strains.

Till now, a total of 100 clinically suspected postmortem *Salmonella* samples (liver and intestine) have been collected from different chicken farms and private veterinary hospitals of Gazipur and Bogura districts since June 2022. Immediately after collection, the samples were transferred to the National Reference Laboratory for AMR (Research) and all the samples were processed for bacterial isolation, identification and molecular identification to confirm *Salmonella* at genus level and *S. Gallinarum* and *S. Pullorum* at species level. Initially, *Salomella* was isolated based on the colony morphology on selective solid media (XLD, Oxoid). 17 isolates were presumptively *Salmonella* positive out of 100 samples. For the PCR, total DNA was extracted from the isolated samples using boiling method. *Salmonella* was confirmed by targeting the *sdi*A gene by a uniplex PCR (F: AATATCGCTTCGTACCAC, R: GTAGGTAAACGAGGAGCAG). PCR conditions were: 95°C for 5 min for initial denaturation, followed by 35 cycles of denaturation at 95°C for 30 sec, annealing at 50°C for 1 min, elongation at 72°C for 1 min and final extension at 72°C for 10 min. Among the 17 presumptively *Salmonella* isolates, 15 isolates (15/100, 15%) were confirmed for *Salmonella* by PCR at genus level (mentioned the percentage or number of samples was positive in PCR.)



After detection of *Salmonella* at genus level, PCR was carried out to confirm *S. Gallinarum* and *S. Pullorum* of the 15 PCR positive samples.We have used primers F- GTA TGG TTA TTA GAC GTT GTT, R- TAT TCA CGA ATT GAATA CTC and F- GAT CGA AAA AAT AGT AGA ATT, R- GCA TCA AGT GAT GAG ATA ATC for detection of *S. Gallinarum* and *S. Pullorum*, respectively. The *S.* Gallinarum cycling conditions were at 94°C for 5 min, followed by 30 cycles of denaturation at 94°C for 1 min, annealing at 60°C for 1 min, extension at 72°C for 1 min followed by final extension at 72°C for 5 min. For *S.* Pullorum, thermal cycler with initial denaturation at 94°C for 5 min followed by 30 cycles of

denaturation at 94°C for 1 min, annealing at 62°C for 1 min and extension at 72°C for 30 sec. The final extension step was at 72°C for 5 min. Though, out of 15 Salmonella isolates none of the isolates were found positive to S. *Gallinarum* and S. *Pullorum.*

Clinically suspected samples are collected continuously for the isolation of both *S.* Gallinarum and *S.* Pullorum strains circulating in the poultry population. After isolation and confirmation of *S.* G*allinarum* and *S. Pullorum*, it will be characterized by Whole genome sequencing (WGS), and later on, a vaccine seed will be developed.

Development of duck plague vaccine seed from circulating strain

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Executive summery

Duck plague (DP), also called Duck virus enteritis (DVE), is one of the major contagious and fatal diseases of ducks, geese and swan. The disease is characterized by sudden death, high mortality (particularly among older ducks), vascular damage, and subsequent internal hemorrhage, lesions in lymphoid organs and severe diarrhea. It is caused by a duck enteritis virus (DEV) /Anatid herpesvirus-1 of the genus *Mardivirus*, family *Herpesviridae*. Of note, DVE has distributed throughout the world, wherein migratory waterfowl plays a vital role in its transmission within and between continents. DPV is mainly transmitted by direct contact from infected ducks or by indirect contact with contaminated environment. Additionally, horizontal and/or vertical transmission plays a significant role in spreading the DP disease through oral-fecal discharges. Either of sexes from varying age groups of ducks are susceptible to DP virus. Huge economic losses are connected with the acute nature of the disease, increased morbidity and mortality (5%–100%), decreased egg production and hatchability. In Bangladesh, DP was first confirmed in 1980 and a significant number of ducks died each year mainly in Haor areas. Livestock officials in Bangladesh have expressed great concern over the outbreaks of DP, especially prevalent in Haor areas. It poses a serious threat to the growth of duck farming in the Haor (wetland) areas of Bangladesh. Vaccination is only the eminent method for the control of DP, but in Bangladesh, the vaccination program is not widely exposed because of the limited volume of DP vaccine. To efficiently combat this threat, mass production of quality DP vaccine is required. Therefore, the current study was performed, to isolate and characterize the circulating DPV from field samples and to adapt the DPV isolates (last year and this year) in specific pathogen free (SPF) developing duck/chicken embryo or their primary duck or chicken embryo fibroblast cell (CEF) for the development of live attenuated vaccine seed.

A total of 48 DP suspected samples (liver, spleen, kidney, esophagus, and intestine) were collected, labeled and transported to the Animal Health Research Laboratory (AHRL), Bangladesh Livestock Research Institute (BLRI), Savar. Out of 48 samples, 18, 12, 9 and 9 were respectively, from the Rajbari, Netrokona, Sylhet and BLRI farm. All tissue samples were processed and made 10% suspension in PBS and subsequently DNA was extracted using the DNA extraction kit (Monarch®, UK) accordingly manufacturer protocol, and performed PCR for targeting the amplification of the DNA polymerase gene according to the methods described in the OIE, 2012. Concurrently, the inoculum was prepared from fresh PCR positive samples as well as last year's PCR positive samples after treating with an equal volume of 100X antibiotic-antimycotic solution for one hour. Afterwards, 200 µl inoculum was inoculated into a SPF 10-day-old embryonated chicken egg (ECE) through the Chorioallantoic Membrane (CAM) route and observed daily until 6 days post inoculation (dpi). Then, CAM and allantoic fluid (AF) were harvested; DPV was confirmed from the harvested samples by PCR and stored at -80˚C. For the isolation and propagation of the DPV, three serial blind passages were continued on 10-day-old SPF ECE, and harvested AF and CAMs each time (reconfirmed by PCR), and then labeled and stored at -80ºC.

Of the 48 samples, 35.4% (17/48) were positive for DPV by PCR targeting the DNA polymerase gene of DPV, and the highest positive sample was noticed in Rajbari (10/18). The expected PCR amplicon appeared at 446-bp for the DNA polymerase gene (Figure 1).

A total of four DPV isolates were isolated in SPF ECE and reconfirmed by PCR (Figure 2) on the 4th passage. Adaptation and attenuation of these four DPV isolates in SPF ECE or primary CEF is also going on for the development of live attenuated DP vaccine seed.

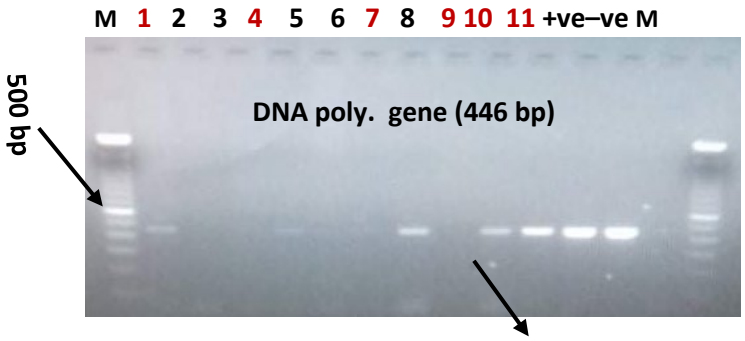

Figure 1. Amplification of the portion of DNA polymerase gene of DPV (field samples). Lane M: 100 bp Marker; Lane 1-11: field samples; Lane 12 & 13: +ve & –ve control.

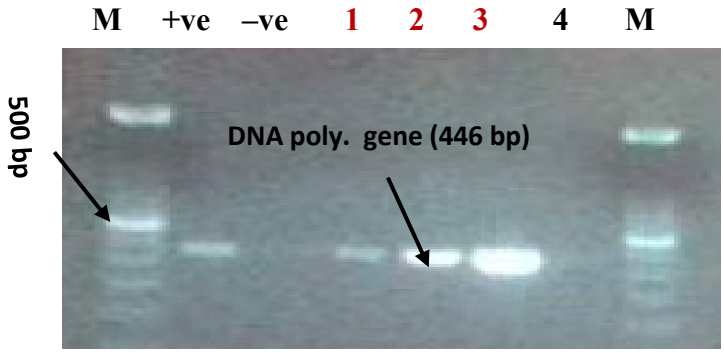

Figure 2. Reconfirmation DNA polymerase gene of DPV after 4th passage in SPF ECE. Here, Lane M: 100 bp Marker; Lane 1 &2: +ve & –ve control, Lane 1-4: hervested CAM and allantoic fliud.

Development of Multivalent Coccidial Vaccine for poultry

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Executive Summary (2021-22)

Coccidiosis is one of the oldest immunosuppressive parasitic diseases of livestock and poultry. This self-limiting protozoan disease is caused by Apicomplexan parasites of the genus *Eimeria*, known to have seven important species in poultry, namely *E. tenella, E. necatrix*, *E. maxima, E. brunetti, E. acervulina, E. praecox* and *E. mitis* that affect different parts of the intestinal tract of chickens. Among them, *E. necatrix, E. tenella, E. acervuline, E. brunetti* and *E. maxima* are considered to be the most pathogenic for chickens of poultry species. In Bangladesh, approximately 80%, 20% and 13% of economic losses have occurred due to coccidiosis respectively in broiler, sonali and layer flocks. So, it appears that coccidiosis is a major constraint in poultry farming in Bangladesh. In the poultry sector of Bangladesh, about 13.6 billion USD is lost annually due to coccidiosis. Immunity of coccidiosis is species-specific, sometimes strain-specific and is observed frequently. The usefulness of prophylactic and therapeutic anticoccidial compounds has decreased in recent years due to the emergence of drug resistance in *Eimeria*. Despite that, biosecurity and disinfection measures are the cornerstones for controlling the emergence of the pathogen. The immunization methods proved to be more practical and promising to prevent outbreaks due to coccidia. The genetic diversity of the pathogen influences epidemiology, virulence, and their implications for treatment and immunization, as well as coccidiosis control. Therefore, it is essential to identify the *Eimeria* species and their genotyping for the prevention of coccidiosis. Conventional diagnosis based on oocyst morphology, site-specificity, and the lesion result. Moreover, diagnostic laboratories are increasingly relying on DNA-based techniques (PCR) for the identification of *Eimeria* species. Use of coccidiostat in poultry feed, higher treatment costs due to secondary bacterial infection, drug resistance in *Eimeria*, together with their possible toxic effects on human consumers, and importation of coccidial vaccine, prioritize the development of a multivalent *Eimeria* vaccine from circulating local strains. Therefore, the present study was performed for the molecular detection of *Eimeria spp.* in chicken from field samples.

A total of 200 fresh fecal samples were collected from large and small scale broiler and layer farm of clinically dead birds in different regions of Bangladesh. Out of 200 samples, 50, 60, 70 and 20 were respectively collected from Mymensingh (Valuka), Tangail (Sokhipur), Dhaka (Savar) and Rajshahi (Godagari). Then all the samples were shifted to the Parasitology Laboratory, AHRD, BLRI in an ice-cool container, and subsequently oocyst of *Eimeria* spp was isolated by the flotation technique and the McMaster method. The oocysts were proceed for sporulation, and it was performed using 2.5% potassium dichromate at room temperature within 48 hours. Afterward, the DNA was extracted from sporulated and unsporulated oocysts using the QIAamp DNA stool mini kit (Qiagen, Germany) according to the manufacturer's protocol. Later, the DNA concentration was measured using a Nano-drop spectrophotometer (Thermofisher Scientific) and stored at -20^{0}C until further use. The species-specific primer sequences (oligonucleotides) were used in PCR targeting the amplification of the ITS-1 sequences of genomic DNA was carried out in 25 µL reaction volumes containing 5 µL of DNA template ITS1 gene of *Eimeria* spp*. and* visualized in 1.5% agarose gel electrophoresis.However, Collected data were coded, recorded, and analyzed in a Microsoft Excel spreadsheet. Descriptive statistical analysis (mean and percentage) was used to summarize and present the data, and t-test: Two-Sample Assuming Equal Variances was used to evaluate the prevalence association of each Eimeria species among broiler farms and study sites. P-value<0.05 was considered significant.

In this study, it was found that 81% (n=162/200) of the samples were positive for *Emeria* spp. based on microscopic analysis. Of the 162 positive samples, 24.07% (n=39), 31.48% (n= 51), 37.65% (n=61) and 6.8% (n=11) were positive to *Emeria* spp. respectively in Mymensingh, Tangail, Dhaka and Rajshahi. Then, all positive samples were pooled into 32 (at least 5 samples in each pooled sample) and subjected to PCR for the final confirmation of different *Emeria* spp. and in the PCR results, it was found that *E. tenella* (19 %, P<0.04), *E. brunetti* (23 %, P<0.005), *E. necatrix* (26 %, P<o.4), *E. mitis* (15 %,P<0.06), and *E. maxima* (17%,P<0.006). Then, these selected samples will be used for the purification of each *Eimeria* spp. and subjected to Whole Genome Sequencing for molecular characterization. Furthermore, the selected sporulated oocysts of *Eimeria* spp. will be purified and sporozoites was inoculated into 11-day old specific pathogens free (SPF) embryonated chicken eggs (ECE) via the CAM route for the propagation and attenuation of *Eimeria* oocysts. Then, the attenuated oocysts will be used as vaccine seed for field trials. However, the intracellular *Eimeria* parasites show economic significance in the poultry industry due to their high percentage of morbidity and mortality along with high treatment costs. Effective vaccination against multiple species of *Eimeria* with a good poultry rearing system could mitigate these losses. It can be concluded that, *Eimeria* is a parasitic organism causing coccidiosis, an enteric disease of major economic importance in poultry. The conventional methods for species identification of *Eimeria* have major limitations and the study identified the five Eimeria species and revealed that multiple infections of Eimeria species per sample are common in most of the evaluated farms. The current findings might be useful for future anticoccidial vaccine development and for effective chemoprophylactic and control strategies.

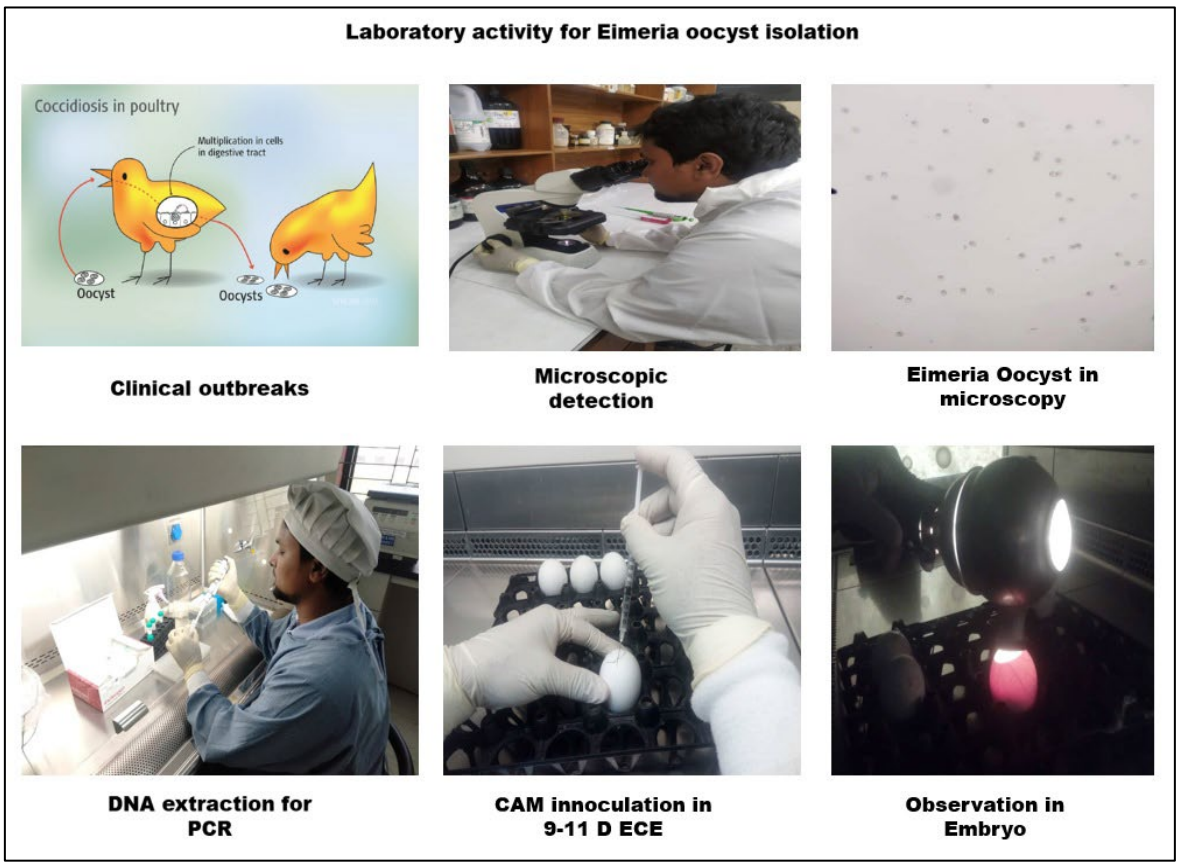

Figure-01. Laboratory activity on *Eimeria* spp.

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

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Executive summary

Generally, silage fermentation occurs naturally under anaerobic conditions but the speed and efficacy of fermentation depends on the numbers and types of lactic acid bacteria (LAB) presence in the fodder. Selective bacterial inoculant was found very effective for quick fermentation with minimum nutrient losses and increased aerobic stability of silage. Therefore, some such type of bacteria isolation and identification is necessary. This current study was undertaken to isolate and identify suitable bacteria for development of silage inoculant which can maintain both quality and aerobic stability of silage. For that purpose, in previous year isolation, identification and characterization (Biochemical & molecular) of potential bacterial inoculum were done. The experiment showed that previous isolated bacteria and its combination (*L. fermentum* and *B. subtilis)* solely were effective to lower yeast and mold growth in silage, but aerobic stability of silage is similar to control. To overcome this problem further suitable lactic acid bacteria (*L. buchneri*) isolation was started which maintain aerobic stability as well as control yeast and mold growth. Several subsequent studies have confirmed that *Lactobacillus buchneri* application improves the aerobic stability of silages. Possible natural source of *L. buchneri* were reviewed and trying to mark out. For this purpose, 30 samples (Silage:5, Napier:5, Pakchong:3, Maize:6, fermented cucumber:3, fermented grapes:3, fermented tomato:3, cheese:2) were collected and bacteria were isolated from these sample using MRS agar media according to previous experiment. Based on Catalase negative and Gram' staining positive test, bacterial colony was selected. In biochemical test growth at different temperatures (5, 10, 15, 30, 40, 43, 54, and 50^{o}c), different NaCl concentrations (2, 3, 4, 5, 6, 7, 8, 9 and 10%), different P^{H} (3.0, 3.5, 4.0, 4.5, 5.0,6.5, 7.0, 6.0, 8.5, 9.0, and 9.5) were conducted. Then DNA was extracted from purified isolates using purifying kit. After DNA extraction PCR was conducted for identification of genus (*Lactobacillu. sp* and *Bacillus sp)* of selected isolates and finally 16s rDNA sequencing was conducted for identifying at species level.

After catalase and grams staining test 20 colonies ware initially selected as lactic acid bacteria. Among them 20 % bacteria were coccus in shape and 80% bacteria were rode shape. All the isolated LAB strains could not grow normally at 5 and 50°C, while they grew well in the temperatures ranging from 15 to 43°C and all strains were able to tolerate the salt concentrations (NaCl) levels in MRS at 2.0, 3.0, 4.0, 6.5 and 7.0%, where not grew in the level of 10.0%. Only rod-shaped isolates were able to grow at pH level from 4.0 to 9.5 while other coccus isolates were could grow normally at pH level from 4.5 to 9.0. After PCR identification 7 colonies were identified as Lactobacillus *sp* and 2 colonies were identified as *Bacillus sp.* 16s rDNA sequencing activity was ongoing.

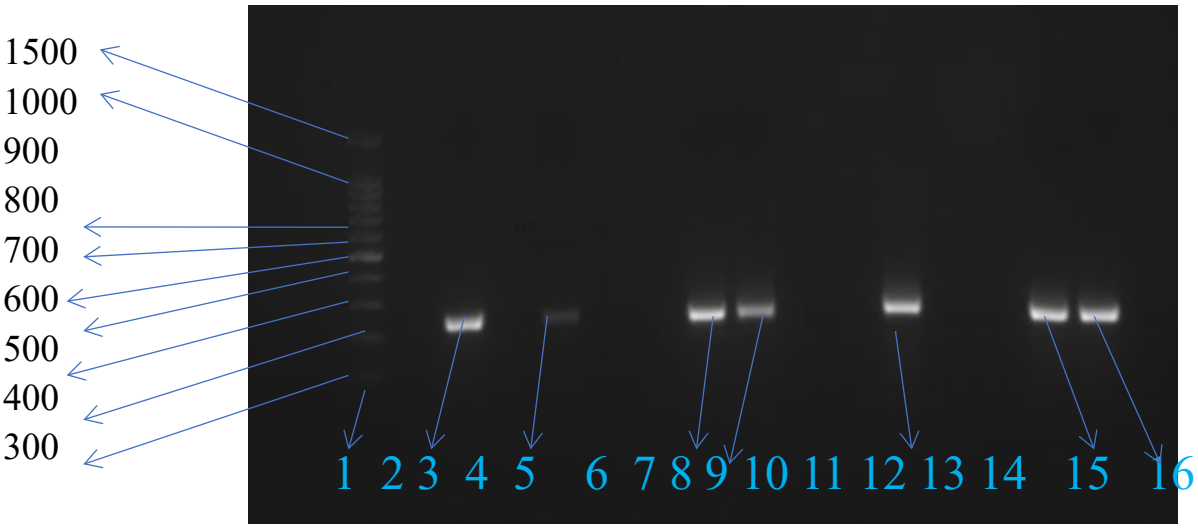

Fig 1: DNA amplification by *Lactobacillus* sp primer

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Development of animal recording and genetic evaluation system to foster indigenous buffalo selection programme

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Executive Summary

Sound and sustainable breed improvement through both pure breeding (selective breeding) of indigenous types/varieties and upgradation of high yielding buffalo breeds in collaboration with buffalo keepers, the government and private sector in all buffalo concentrated areas of the country to enhance the milk and meat production would be keys for buffalo development in Bangladesh. Development of on-farm animal recording system, continuous use of thus generated data to estimate genetic parameters and development of a dynamic genetic evaluation system to facilitate buffalo selection and breeding are considered keys to accrue the said development. The objectives of this research project were: (a) to investigate on-farm buffalo recording system both off-line and on-line (digital devices) with regards to evaluate growth, reproduction, milk yield, milk composition and disease incidence in indigenous buffaloes under the prevailing systems of their management; (b) to estimate (co)variance components and genetic parameters of economic traits of indigenous buffaloes, and (c) to develop a dynamic genetic evaluation system for indigenous buffaloes for use in replacement animal selection (mainly breeding bulls) in on-going buffalo improvement programs throughout Bangladesh. This research project started in January 2022.

The farmers and their indigenous river type mature female buffaloes have been identified in four buffalo-pocket areas of the country viz. (1) Ishwardi, Pabna, (2) Madergonj, Jamalpur, (3) Government Buffalo Breeding Farm, Fakirhat, Bagerhat, and (4) Milk Vita Buffalo Herd, Raipur, Lakshmipur. Four Animal Recorders have been selected in aforesaid four areas and they have already been trained on the systems of collection and keeping of data on individual buffaloes. Each and every mature female has been identified using tattoo and coloured marks. Animals have individually been registered in Herdbooks developed by the project. Therefore, data collection in four areas of the country is in progress.

Both off-line (Herdbook) and on-line (Digital Device) Animal Data Recording and acquisition processes are underway. The gathered data will be used for genetic parameter estimation followed by genetic evaluation of indigenous river type buffaloes for growth, milk production and important functional traits with a view to identify superior indigenous river type buffalo breeding bulls to aid buffalo selection and breeding program in Bangladesh.

Performance evaluation of crossbred buffalo at on-station

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Executive Summary

Buffalo is increasingly become popular in several parts of the world because of its quality milk and meat, better adaptability in different climatic conditions and utilization of poor quality fibrous crop residues. Bangladesh possesses about 1.5 million head buffaloes. They are mainly indigenous type concentrated in the costal and riverine charlands. Productive (daily milk yield 3 to 4 litters) and reproductive (age at first heat 30.30±1.43 months at on-station and 39.4 to 54.45 months at on-farm) performances of the indigenous buffaloes are poor. Therefore, crossbreeding programme has been taken to improve milk yield performance of indigenous buffalo since 2013 in Bangladesh. A number of crossbred buffalo calves have born in the country. However, the adaptability of these crossbred buffaloes at existing management practices are yet to characterize. Considering above facts, the main objectives of the research programme was to i) evaluate the productive and reproductive performance of crossbred buffaloes and ii) develop feeding regime for attaining puberty between 24 to 28 months of age. Body weight largely determines age of puberty in ruminants. Many genetic and non-genetic factors are responsible for body weight gain in animals. Genetic factors along with nutrition, hormones, individuality and many other factors determine the growth of animals. Feeding high energy or protein diets reduce the age of puberty and first calving age through lowering time of attaining mature body weight. The research was conducted at BLRI Buffalo Research Farm, Savar, Dhaka to prepare frozen semen from pure Murrah and Nili-Ravi breeding bulls for artificial insemination of indigenous buffalo cows and produce F_1 crossbred buffalo calves (50% Murrah x 50% Local and 50% Nili-Ravi x 50% local). Moreover, a feeding trial was conducted so that the buffalo heifers will attain puberty between 24 to 28 months of their age following completely randomized experimental design. Indigenous cows were bred with pure Nili-Ravi or Murrah buffalo bulls using artificial insemination on natural estrus or artificially induced estrus. A total of eight crossbred heifer were divided into group A (n=4) and group B (n=4) respectively based on their body weight (173.75±7.5 vs 215.25±7.5 kg) and age (16 vs 19 months). The experimental rations were formulated with 10% above the ME requirement compare to the standard ration. The CP content of experimental and standard rations were same (15-16%). The heifers were supplied pakchong napier fodder with concentrate mixture of soybean meal, wheat bran, til oil cake, Kheshari bran, di-calcium phosphate (DCP) and common salt. Data were summarized from 120 days feeding trial, and the feeding trial will be continued until all heifers become pregnant. Data on body weight at different interval, age at first heat, age at first calving, calving interval and disease incidence were recorded for the evaluation of adaptability of crossbred buffalo calves.

Result showed that average body weight, daily dry matter intake and daily body weight gain were 240.75±3.3 kg, 5.71±0.47kg and 0.56±0.04kg, respectively in group A. On the other hand, average body weight, daily dry matter intake and daily body weight gain were 293.25±12.31kg, 6.57±0.70kg and 0.65±0.04kg, respectively in group B. Overall calf mortality were 4.4% at BLRI Buffalo Research Farm. 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.

Considering above finding, this study summarized that target body weight may be attained at these supplemented ration but yet puberty or age at first heat was not shown of the heifer buffaloes.

Project Title: Development of buffalo fattening model for quality meat production
Runing title: Study on existing buffalo fattening scenario and development of community-based fattening program

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Executive Summary

The indigenous type is dominating total buffalo population in Bangladesh. Both swamp and river types buffaloes are found in the country. About 60-70% of buffaloes in Bangladesh are raised in coastal, river basin and haor areas which are highly adapted to extreme climate. Buffalo meat is regarded as a healthy red meat because of its lower fat and cholesterol content in comparison to other red meat. In Bangladesh, generally buffaloes are slaughtered after end of their productive life. Therefore, most of the buffalo meat is produced from aged and emaciated buffaloes. As a result, the meat is generally of poor quality (course fibers), unattractive in appearance and higher bone to meat ratio. However, rearing of buffalo (2 to 4 years age) in plane of nutrition results quality meat production. The male buffalo and aged female buffalo may be a good source of quality red meat in Bangladesh. Recent study of BLRI showed that buffalo fattening improves meat production and its quality. Therefore, buffalo fattening programme will be a good source of income generating activities in the country as well as good source of meat. Considering above facts, the present research project was designed with two specific objectives (i) to know the current buffalo fattening status (hard structure, level of fattening, buffalo sale and slaughtering scenario) at community level, and (ii) to determine appropriate feeding system, optimum duration of fattening & proper management practices for buffalo fattening. To fulfill the first objective of this study, a baseline survey (house hold of 416 buffalo farmers) was conducted in geographically different locations of Bangladesh (Godagari, Ishwardi, Gangachara, Kaligonj, Madarganj, Fenchuganj, Ramgoti, Companigonj, Anowara, Bauphal and Charfashion Upazila). Both quantitative and qualitative approaches were followed for the baseline survey. A questionnaire was developed by using both open and close-ended questions. To fulfill the second objective of this study, focused Group Discussion (FGD) were arranged to select farmers for community based buffalo fattening research. Bulls were selected based on farmer's interest and marked by tagging. High yielding fodder was cultivated on rented land and prepared a tin shaded house for conducting a feeding trial.

From the survey, it was revealed that the herd size of buffalo was 16.11±18.45 heads. The average number of milking buffalo cows, dry buffalo cows, up to 6 months age calf, 7 to 12 months age calf, 18 to 24 months age bull, 25 to 36 months age bull, above 36 months age bull, 18 to 24 months age heifer and 25 to 36 months age heifer were 4.52±5.08, 4.02±4.57, 3.31±5.16, 2.59±2.69, 1.60±1.69, 1.20±1.58, 1.51±1.58, 2.89±2.83, 3.20±3.02 heads, respectively (Table 1).

Table 1. Herd structure of buffalo at community

Sl	Herd structure	Mean±SD
1.	Average herd size	16.11±18.45
2.	Milking buffalo cow	4.52±5.08
3.	Dry buffalo cow	4.02±4.57
4.	0-6 months aged calf	3.31±5.16
5.	7-12 months aged calf	2.59±2.69
6.	18-24 months aged bull	1.60±1.69
7.	25-36 months aged bull	1.20±1.58
8.	Above 36 months aged bull	1.51±1.58
9.	18-24 months aged heifer	2.89±2.83

10.	25-36 months aged heifer	3.20±3.02

The average number of live cattle, buffalo, goats and sheep sold in the local market per week were 243.19±21.75, 72.50±7.80, 151.0±19.50 and 43.32±5.50 heads, respectively. The average number of buffalo and buffalo bull were 2.72±1.12 and 1.79±0.95. However, the average age of buffalo bull sold by farmers was 2.83±1.22 in the study areas.

Table 2. Buffalo fattening-related information

Sl	Variable/Parameter	Measurement unit	Value
1.	Farmers bought buffalo bull for rearing	% said 'yes'	49.04
2.	Year-round buffalo bull rearing	% said 'yes'	73.04
3.	Buffalo fattening	% said 'yes'	26.96
4.	Frequency of fattening per year	Times	1.26
5.	Total bull fattening per year	Number	3.71

About 49.04% farmers were found who bought buffalo bull for rearing. However, 73.04% of farmers were rearing buffalo on a year-round basis. Among buffalo-rearing farmers, 26.96% were found fattening buffaloes and the frequency of fattening per year was 1.26 times. Moreover, the average bull fattening per year was 3.71 (Table 2).

Table 3. Livestock slaughtering-related information in the local market

Sl	Species	Measurement unit	Slaughterer	Slaughter per week
1.	Cattle	Number	565 (11)	1875±3.35
2.	Buffalo	Number	57 (11)	68±1.19
3.	Goat	Number	376 (11)	790±2.65
4.	Sheep	Number	13 (11)	35±2.69

Figure in the parenthesis indicates the number of upazillas.

The average number of cattle, buffalo, goats and sheep slaughtered per week in the local market were 1875, 68, 790 and 35 heads, respectively. Among the weekly animal slaughter count, buffalo represented 2.46% in the study areas (Table 3).

Considering the above findings, it may be concluded that herd structure of buffalo at community level was 16, consisting of 5, 4 and 7 number of milking cow, dry cow and other ages group, respectively.
The average age of buffalo bulls sold by farmers was 2.83 years and of the number of weekly animal slaughters, buffalo represented 2.46% in the study areas. However, feeds and nutritional study of buffalo fattening is not documented which will be studied in the future.

Standardization of estrus synchronization techniques for improvement of reproductive efficiency of native buffaloes in Bangladesh

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Executive Summary

This study was aimed to standardize estrus synchronization protocols applicable for native buffaloes, to know the effect of vitamin mineral supplementation on synchronizing estrus in native buffaloes, to increase reproductive efficiencies of native buffalo cows using estrus synchronization technique and to popularize estrus synchronization protocol among buffalo farmers. A number of 20 farmers were selected and their buffaloes were identified with ear tags and tattoo marks. The buffalo cows (n=26) of second to fifth parity having good body condition score were selected for estrus synchronization at Madarganj Upazilla, Jamalpur. Concentrate supplement with vitamin mineral premix was supplied to a number of 13 buffalo cows while only concentrate mixture was supplied to other 13 buffaloes. Estrus of buffalo cows were synchronized with Ovsynch protocol. In this protocol, buffaloes received 5 ml Gonadorelin (GnRH) on day 0, 5 ml Reprolyse ($PGF_{2\alpha}$) on day 7 and the second Gonadorelin injection was given on day 9, and artificial insemination (AI) was performed with frozen semen prepared by Bangladesh Livestock Research Institute (BLRI) at 16 hrs and 24 hrs after final dose of Gonadorelin injection. At 60 days after AI pregnancy of buffaloes were diagnosed through rectal palpation. In mineral supplemented group, among 13 mineral supplemented buffaloes, 11cows (84.6%) showed estrus and inseminated (AI).The remaining 2 buffaloes showed estrus in 3 weeks after AI. In control group, one buffalo was died due food poisoning. Among a number of remaining 12 buffaloes, 8 (66.6%) cows showed estrus and inseminated. Conception rate has not been examined in all buffaloes yet. At the beginning of the experiment blood samples were collected from jugular vein of the experimental buffaloes. After treatment of minerals for 1 month blood samples were again collected during estrus synchronization for analysis of total protein, albumin, globuline, cholesterol, glucose, triglyceride, calcium, zinc, iron, alanine amino trasnferase (ALT), alkaline phosphatase (ALP), estrogen and progesterone to know the nutritional and hormonal status of buffaloes.The experiment is being conducted and the results are not obtained completely yet.

SNP Analysis and Gene Expression Profiling for Milk Fat and Protein Related Traits in River Buffalo Populations of Bangladesh

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Executive Summary

Buffalo milk is well known for its high qualities which contains higher fat, protein, lactose, vitamins and minerals as compared to cow milk. The thicker consistency and white color make it suitable as one of the best raw materials for the manufacturing of various fat-based dairy products such as butter, ghee, yogurt, cheese and ice cream. The aim of this study is to establish genome-wide polymorphisms (SNPs) association with milk fat and protein related traits in river buffalo of Bangladesh. In order to establish phenotypic database, riverine buffalo from six different locations were selected for this study. Accordingly, a two pages Herdbook was developed for collection of objective data. Herdbook based record keeping is ongoing in four different locations namely Madarganj, Jamalpur; Ishwardi, Pabna, and Buffalo Breeding and Development Farm, Bagerhat and BLRI Buffalo Research herd and the remaining two locations at Milk Vita Buffalo Farm, Raipur, Laxmipur; Godagari, Rajshahi will be started soon. A total of 105 blood samples were collected from the aforementioned three locations. Genomic DNA extraction was performed using commercial kit (AddBio Inc., South Korea). The concentration of the extracted DNA ranged between 27.3 and 206.0 ng/µl while the purity of those samples varied from 1.70 to 2.00. Besides, fragments of five well annotated candidate genes (STAT1, PPARGC1A, PRL, FASN and DGAT1) were selected for milk fat and protein related association studies and accordingly, seven primer pairs were synthesized from a commercial service provider (Macrogen, Korea). The Herdbook based accumulated information will help to establish database on riverine buffaloes' milk production profiles along with other productive and reproductive performances.

Increasing efficiency of artificial insemination for improving conception rate in river buffalo

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Executive Summary

Poor reproductive performance is a major constraint for increased production of buffaloes all around the world indicating that the profitability of buffalo farming is more or less directly related to the reproductive performance of the animals. To have a breakthrough in changing the present scenario, improved reproductive management practices are necessary for developing buffalo production to a satisfactory level. This study was conducted to find out the problems that affect artificial insemination (AI) and conception rate in river buffalo and how to improve the conception rate using nutritional supplements in certain coastal areas covering Bauphal Upazila of Patuakhali and Charfassion Upazila of Bhola district. Data on buffalo breeds, health management, reproductive parameters and management practices were collected by personal interviewing of 200 farmers (100 from each Upazila) using pre-tested questionnaires. The results showed that 100% of farmers rearing buffaloes to generate income by selling milk and meat without providing any nutritious feed and feed supplements. For breeding purposes they bred their buffalo cows by natural mating. Taking into account this survey, initially, we selected ten non-pregnant buffalo cows over 4 years of age from each Upazila. The outcomes regarding various breeding practices followed by the buffalo owners are presented in Table 1. For heat detection, bellowing and vaginal discharge were the most common symptoms observed by the majority of respondents. In addition to these, frequent urination and mounting on other animals were also considered. This means that the dairy farmers had bred their animals with the locally available bulls. During heat, the time of insemination is a very crucial aspect of conception. The buffalo owners of the survey areas inseminated their buffalo cows mainly within 12-18 hours (65.44%) of heat manifestation. On the other hand, 23.22% of farmers inseminated their animals after 18 hours of heat. It was very remarkable that 17.78% of farmers kept breeding records.

Table 1: Breeding management practices followed by buffalo owners

Practices	Particulars	Percent
Heat Detection methods	Vaginal discharge	73.11
	Bellowing	86.89
	Vulva swelling	37.56
	Frequent urination	24.67
	Mounting on other animals	41.22
	Allow other animals to mount	11.11
Methods of breeding	Natural service	100.00
	Artificial insemination	0.00
Time of breed (Natural/AI)	Before 12hrs	13.33
	Between 12~18hrs	65.44
	After 18 hrs	23.22
Drying off	Yes	15.56
	No	84.44
Record Keeping	Yes	14.78
	No	85.22

After selection, all the experimental buffaloes were marked by tagging. Nutritional variation might be a good factor to increase the efficiency of AI. For trials, selected buffaloes were vaccinated and dewormed and divided into four (04) treatment groups as T_0= control; T1= supplemented with urea molasses straw; T2= supplemented with DCP and administrated AD3E and T3= supplemented with T1 and T2. For the availability of green grass, 3 acres of land were cultivated for high-yielding fodder production. The experiment has already been started and data collection has been ongoing (Not shown).

It is concluded that the reproductive performances of dairy buffaloes were relatively poor. The overall scenario of the existing breeding management practices followed by the buffalo farmers was not satisfactory and this situation might influence adversely on productive and reproductive performance of animals. However, this research tried to supplement with various feeds and nutrition which can be an alternative to enhance the efficiency of AI as well as pregnancy establishment and overall reproductive performance of buffalo cows.

Optimizing the process technology of manufacturing value added diversified buffalo milk Cheese and Rasomalai based on their nutritional and physicochemical profile

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Executive Summary

Milk and milk products are known for their nutritional profile, however, lack in dietary fiber and very poor source of omega-3 fatty acids. Dietary manipulation of cow and buffalo has very lesser to do with the omega-3 fatty acid content of the milk. Now-a-days, consumers make their choice not only based of their taste but also consider the nutrient he/she going to have thorough a particular food item. Therefore, dietary fiber and omega-3 fatty acid enrichment of milk and milk products could be better value addition considering the consumers health conscious perspective. In addition, this type of value addition may also help the buffalo milk producer to get fair milk price, increase the availability of diversified dairy products in the market and thus improves the sustainability of the dairy industry in general. In Bangladesh, the demand for Cheese is increasing continuously and Rasomalai among the traditional dairy products are preferred by almost everybody. Keeping these in consideration the present study was designed to develop the manufacturing technology/SOP of diversified value added Cheese from buffalo milk with improved texture, flavor and nutritional profile; cultivate the suitable manufacturing technology/SOP of fiber and healthy fat fortified value added buffalo milk Rasomalai; monitor the shelf-life of diversified value added buffalo milk Cheese and Rasomalai and record the cost of production of different value added buffalo milk Cheese and Rasomalai. The project duration is March 2022 to June 2025 and conducting site is Laboratory of Dairy Chemistry and Technology, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh-2202. Under this project, already the laboratory renovation work has been done. Now it is ready for the laboratory instruments and consumables and analytical purpose. The inception workshop covering different stakeholders has also been completed. The participants put their suggestions which were recorded properly and some of them will incorporated in the research work. The purchase of few of the laboratory instruments has been completed. One pre-experiment primary trial has been conducted on Rasomalai fortification by dietary fiber from Carrot, Dates and Chia seed. Morning composite milk from BAU dairy farm was collected for this purpose. Half of the collected milk was used to obtain cchana curd to be used in the preparation of cchana ball and rest half was desiccated to 50% of its original volume to get the malai portion. During the preparation of malai, different levels of Carrot, Dates and Chia seed were added and the products were evaluated for their sensory attributes. With regards to Cheese fortification with fiber, first we turned the method for process Cheese manufacturing in general. Then we did the dietary fiber enrichment. For tuning the process cheese manufacturing, cheese mixed with Na-citrate and Na-alginate was heated at 90 ℃ for 8 minutes. The tuning has not finished yet. After that, dietary fiber added with the processed cheese.

Based on the color, mouth feel and taste, the levels of Dates, Carrot and Chia seed will be selected for final product manufacturing. The final product with different selected levels of dates, carrot and chia seed will be compared for its nutritional (dietary fiber, fat, protein, minerals etc.), descriptive sensorial (appearance, color, flavor, texture etc.), consumer liking hedonic test (neither pleasant nor unpleasant, extremely pleasant, extremely unpleasant) consumption fitness and textural characteristics (hardness, chewiness, gumminess, springiness, adhesiveness). Similar will be done with the process cheese as well. At the end of the project we will be able to suggest SOP for the cost effective manufacturing of dietary fiber and omega-3 fatty acid enriched Cheese and Rasomalai from buffalo milk with pleasant flavor, texture and reasonable shelf-life.

Establishment of Milk Processing Facilities at BLRI – Fermented Milk (Dodhi, Yoghurt, Lassi & Laban) Production and Quality Control

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Executive Summary

The mandate of Bangladesh livestock research institute (BLRI) is to identify livestock and poultry production constraints at the national and farm level, solve those problems through multi and inter disciplinary and international research and to develop technologies to help food and nutrition security for the increasing population, poverty alleviation, employment opportunities, income generation and control of environment pollution.The existing research facilities of BLRI for catering biotechnological, genetic engineering or nutritional research rank as top in the country. Unfortunately, research capacity building on milk processing and quality control related issues are still lacking, which restricts breakthrough research and technology generation to feed the dairy industry of the country. However, BLRI lacks the research facility and program to overstep in dairy processing related issues. The development and refinement of technology for making fermented milk products like yoghurt, dodhi, lassi, laban, etc. were thus a key focus to excel in dairy processing research at the BLRI.Fermented milk and fermented milk beverages are preferred as an ideal food items for the people of Bangladesh. It is naturally good source of high-quality protein, rich in calcium, vitamins, and many minerals. In addition to milk, several dairy products such as sweets, yoghurt, ghee, cream, butter, ice-cream, cheese and other fermented milk products are also often fortified with others nutrients, making it very nutritious food for both children and adults. Dairy industry in Bangladesh has been transforming from traditional substances to more market oriented which would open the opportunity for dairy farmers to exploit the rising demand of milk products at national level. The consumption of milk and milk products in Bangladesh is very low even when compared to neighbouring countries. It may be reasonably assumed that demand for milk and milk products will continue to increase rapidly but the consumption level of cheese is still low in Bangladesh. Currently, around 10% of the total milk production goes to brands produce pasteurized milk and dairy products whereas 90% milk sale in the local market. Dairy Industry of the country is poised to become globally competitive and it aims to capture the international dairy market by improving the quality of milk and milk products. Cosidering above circumstances, the following objectives of the project were (a) To establish a modern pilot plant to process milk for making fermented milk products; (b) To commission a quality control laboratory to judge the products; and (c) To provide a guideline on the cost-benefit issues in establishing a pilot scale milk processing operation for small scale producers.

Building place for the pilot plant was allocated followed by proper renovation at the Dairy Research Center of BLRI, Savar, Dhaka. Necessary civil works has been carried out following existing guideline and rules. Detailed list of machineries, equipment, utensils and chemicals was purchased and prepared. All the machineries, ingredients and chemicals was procured following the PPR rules, 2008. These included milk vat, refrigerator, homogenizer, pasteurizer, laboratory instruments/utensils, analytical grade chemicals, ingredients (starter, sugar, spices, etc.) and so on. Reception, commissioning and installation of machineries was done precisely under the supervision of experts and suppliers.

Pilot scale production of fermented milks and realted products are yet to be done neverthless protocols of fermented milk products like dodhi, yoghurt, lassi, labang, etc have prepred. Among of the protocol of *yoghurt* preparation includes heating of milk (1 liter) to 80-90ºC followed by addition of refined cane sugar at the rate of 10-12% by volume of milk. The milk is to cooled at 45-50ºC. Yogurt starter culture (an equal mixture of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgaricus*) is added to milk at the rate of 1-2%. The yogurt starter culture is mixed with the rest of the milk by gentle stirring. The mix is then poured in a suitable container and incubated at 38-42ºC for 5-6 hours until a

coagulum develops and the pH is dropped to 4.6. The container is finally placed at 4ºC in a refrigerator for at least 4 hours for setting.

The proposed protocol for *dodhi* preparation includes boiling of fresh milk (1 liter) and sugar (12-14% by volume of milk) in a karahi on medium flame until the volume of mix is reduced by 30%. The mix is cooled to 50°C. A mixed lactic starter culture is added at the rate of 2-3%. The mix is poured in a suitable container. The container is put in the incubator at 32-37°C for 6-8 hours until a coagulation is achieved. The container is put in the refrigerator for at least 4 hours at 4°C for setting.

The proposed protocol for *lassi* preparation includes blending of sweet dodhi (1 kg), sugar (10-12% by weight of dodhi) and chilled (2-4°C) water (1 kg) for 1-2 minutes. Lassi is then packaged in suitable container and stored at 4°C until consumption. The proposed protocol for Laban preparation includes heating of milk (1 liter) to boiling point followed by cooling to 45-50ºC. Around 60 mL of the warm milk is then mixed to 15-20 g sour yogurt and stirred. The yogurt is poured over the rest of the milk and mixed thoroughly.The milk is covered with a lid and the container is put in an incubator at 25-30°C for 12-24 hours. The coagulated milk is cooled at 4°C for 4- 6 hours. The coagulum is broken by gentle agitation. Laban is packaged in suitable container and stored at 4°C until consumption.

BLRI has already established a pilot plant and research laboratory for the pilot scale production of fermented milks like dodhi, yogurt, laban, lassi. In addition, state of the quality control facilities for the development of premium quality dairy products have already been developed. The results presented here are the results of one year's study. Further studies of this project will integrate research into value added dairy products such as fermented milk for further development. Ultimately, this research will advance the revolutionary milk processing research towards producing fermented milk that meets the needs of milk producers, processors and consumers across the country.

Estimation of genetic parameters of growth performance at the pre-weaning period of RCC and their graded progeny

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Executive summary

Red Chittagong Cattle (RCC) is one of the most promising indigenous cattle genetic resources of Bangladesh with some potential attributes evidenced earlier. It has unique characteristics which can be easily differentiated from other available cattle genetic resources in Bangladesh. But, due to indiscriminate crossbreeding with Sahiwal, Sindhi and Holstein Friesian, the population of pure RCC genetic groups has been declining with the rapid expansion of countrywide artificial insemination (AI). For the sake of cultural heritage and to save their lives, Bangladesh Livestock Research Institute (BLRI) has been conducting research on RCC for their genetic improvement by conserving a small herd *ex-situ* since 2006. In the breeding policy of Bangladesh, it is strongly prohibited to dilute RCC crossed with other genetic groups. However, this research was carried out to compare pre-weaning growth performance between RCC and their graded calves with local indigenous genotypes and to estimate genetic parameters of growth traits of RCC and their graded calves. Breeding activity of RCC cattle was ongoing since 2018. In 2020, a total of 2995 AI were performed in selected areas and a total of 665 calves were born (Table 1). Among them, 179 calves were pure RCC and 386 calves were graded RCC. However, frozen semen, vaccination, treatment and several training programs were provided to RCC rearing farmers in selected Upazilas in the present year. Phenotypic data (color, calving difficulty, shape and size, growth performance, age at puberty, adaptability to different environments) of RCC and their graded progeny were collected from selected Upazila through a prestructured questionnaire. The collected data of 400 RCC rearing farmers' were analyzed using SPSS (version 17.0) and mean comparisons were estimated by Duncan's multiple range test (DMRT) method. After data analysis, it was observed that the birth weight of pure RCC calf was 15.77±0.13kg whereas that of graded RCC calf was 13.63±0.30kg. Besides, 6-month weight, 12-month weight and 18-month weight of pure RCC calf were found to be 53.23±1.45kg, 86.54±4.24kg and 154.50±0.50kg, respectively, whereas those of graded RCC calf were recorded 44.73±2.37kg, 79.58±9.79kg and 165.00±0.00kg, respectively (Figure 2). There was no significant difference between the growth performance of F_1 RCC cross calves. The mortality rate of graded RCC calves was 1.8. Almost 78% of the phenotypic characteristics (Figure 1) of F_1 RCC cross calves were similar and general appearances was also found to be similar (about 68% similar). Therefore, it can be concluded that F_1 RCC cross calves had similar performance and characteristic to pure RCC and F_2 RCC cross calves is hypothesized to be as like as pure RCC.

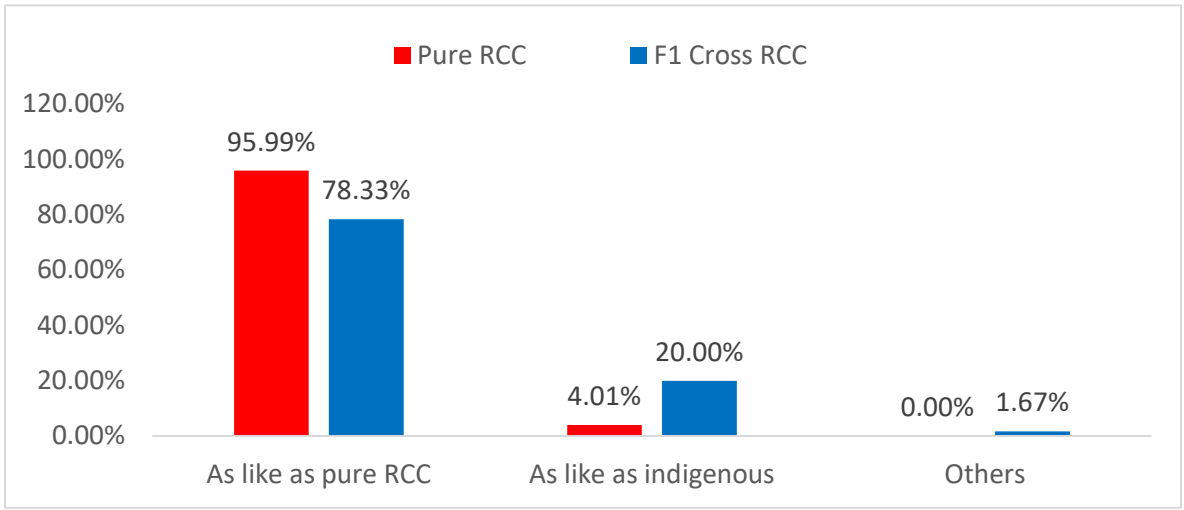

Figure 1: Color phenotype of F_1 RCC Cross Calves

Table 1: Number of AI and calves born in different project areas.

	Project Area	No of AI	Total AI	No of Calves born			
				Male	Female	Total	
Pure RCC	Patiya	143	**704**	28	20	48	**279**
	Chandanaish	115		32	17	49	
	Anowara	126		22	30	52	
	Satkania	120		32	15	47	
	Bashkhali	87		22	18	40	
	Hathazari	113		28	15	43	
Crossbred RCC	Swandip	64	**2291**	7	6	13	**386**
	Sylhet	83		13	19	32	
	Keshobpur	60		14	12	26	
	Naikhongchari	18		5	4	9	
	Rajshahi	1800		130	117	247	
	Sakhipur	196		26	17	43	
	Kurigram	70		8	8	16	
	Total	**2995**		367	298	**665**	

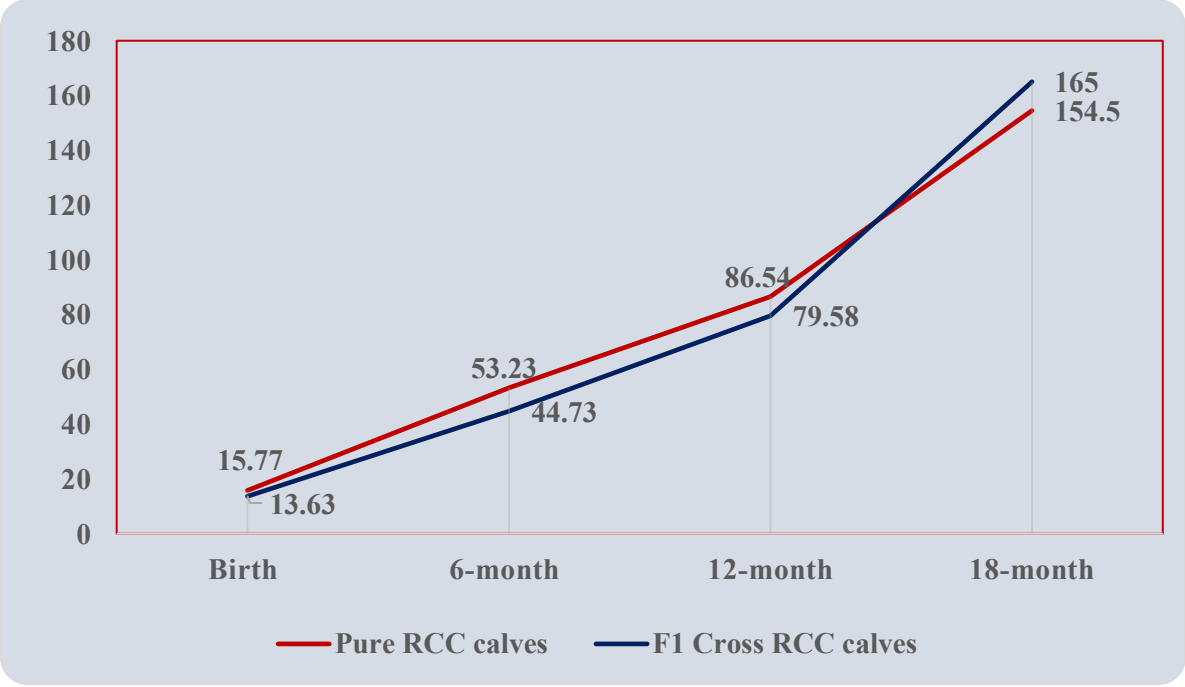

Figure 2: Growth curve of Pure RCC &F_1 Cross RCC calves

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

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Executive Summary

Red Chittagong Cattle (RCC) is recognized as a potential type or variety; it has its own distinct phenotypic characteristics with physical fitness and superiority of productive and reproductive performances aspects. It is well adopted in southern part of Bangladesh with prevailing feeding and management systems and resistant to several diseases and parasitic infestation. But improvement of feeding management practices through high cost involvement can restrict in RCC production. Thus development of low cost feeding system is a growing interest day by day with the concern of farmers on the benefits of RCC rearing. Hence this research work was carried out for acquainting low-cost feeding schemes in subsistence RCC growing farming and assessment the profitability of RCC growing farming with the consideration of productive and reproductive performances against feed cost. Therefore, to assess the low cost feeding practice on the RCC raring areas based on straw with green forages or locally available fodders, a baseline survey was completed about the existing feeding management practices for RCC farming system. This survey was conducted on 28 RCC farmers at Satkania, Anowara, Potia and Chandanaish under formerly selected research location of "Conservation and Improvement of Red Chittagong Cattle Project (Phase-II)" was executed and funded by BLRI, Savar, Dhaka. Direct interview method was used for collection of data from the selected farmers with well-developed, pre-tested objective-based questionnaire contained existing feeding management practices and farming systems of RCC, feeds availability and fodder cultivation. On the other hand a feeding trial was conducted at 'BLRI Cattle Research Farm' to assess the profitability of rearing RCC at different feeding management practices. Feeding trial on growing RCC bull was carried out with four treatment groups with four replication in each group where existing feeding (50:50 ratio of Roughage and Concentrate) system was considered as control (group-1) and concentrate feed was replaced by 45 days aged german grass in remaining three groups (60:40, 70:30 & 80:20 ratio) conducted for 90 days with 15 days adjustment period. Data were analyzed by using MS Excel and SPSS 22 software with descriptive statistics.

Results described that among four rearing systems maximum farmers in Satkania (34.99%), Potia (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. At present most popularly stall feeding was found 29.40% and grazing system was 45.97% respectively. Normally farmers provided broken rice, broken wheat, maize kernel, and ready feed etc. as concentrate and straw as dry roughage and Napier, Para, German, Shorghum etc. as fodders for RCC in these four locations.

Table-1: Effect of different stage of production of RCC on their feed intake

Types of cow	Feed Supply *(Mean±SD)*		
	Fodder (kg/d/h)	Straw (kg/d/h)	Concentrate (kg/d/h)
Milking Cattle	13.07^{b}±1.26	3.23^{ab}±0.18	1.35^{b}±0.11
Pregnant Cattle	12.02^{c}±0.57	2.94^{ab}±0.28	1.79^{a} ±0.16
Dry cow	9.10^{d}±0.84	2.78^{b}±0.47	0.82^{c}±0.1
Adult Cattle	15.10^{a}±0.99	3.08^{a}±0.45	1.88^{a}±0.12

Sig. Level	***	NS	***

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).

Feed intake differs at study areas (Chandanaish) with the farmer capability and stage of production of RCC. At different study areas farmers supplied grass, straw and concentrate as 9.10-15.10 kg, 2.78-3.23 kg and 0.82-1.88 kg daily per cow (Table-1).

Table-2: Weekly body weight gain of growing RCC

Parameter	Roughage- Concentrate Ratio				
	Group-1 (50:50)	Group-2 (40:60)	Group-3 (30:70)	Group-4 (20:80)	Level of Sig.
Growth Rate (kg/wk)	5.808^{b}±1.38	6.343^{b}±1.45	8.250^{a}±0.969	5.194^{b}±1.001	***

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).

Results from four groups indicate that group-3 showed significant differences between others group, weekly live body weight gain was 8.25±0.969 kg and lowest at group-4 was 5.194±1.001 kg/wk (Table-2).

Table-3: Economic return evaluation of RCC against feed cost

Costing parameter	Group-1 (50:50)	Group-2 (40:60)	Group-3 (30:70)	Group-4 (20:80)
Total Feed cost (BDT)	9276.63	8640.27	7820.37	6154.40
Total BW gain (kg)	69.7	76.12	99	62.33
Approx. dressed meat at DP (kg)	43.911	47.9556	62.37	39.27
Approx. dressed meat price (680tk/kg)	29859.48	32609.81	42411.6	26703.6
Return against feed cost (BDT.)	20582.85	23969.54	34591.23	20549.20
Ratio of return against feed cost	1:2.2	1:2.7	1:4.4	1:3.3

From 3 month feeding trial of RCC profitability was calculated considering feed cost as direct input for RCC rearing. Finally based on profitability and cost of production group-3 (Con:Rou=30:70) performed well (Table-3), it is recommended for profitable RCC farming, with ranking as- group-3 > group-2 > group-1 > group-4 on the basis of live body weight gain and return (Table-3).

Optimizing the time and condition of RCC bulls for high quality semen production

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Executive Summary

Red Chittagong Cattle (RCC) is small red-colored cattle which are more prolific, resistant to common parasites and diseases, ideal for small-holder farmers in the tropics. Moreover, it is one of the potential native genotypes that has been recommended as a breed of Bangladesh by NTRC recently. Cattle semen quality is affected by many genetic and environmental factors such as type of animal, age, body condition, temperature and humidity etc. To harvest the best quality semen from RCC, genetic and environmental factors regulating semen have to be properly addressed. Hence, the present research was designed to determine the best harvesting time for good quality semen and to evaluate the genetic & environmental factors.

A total of 30 RCC bulls were selected from Pachutia Research Farm and grouped according to age (G I: 2.5 to 3.5 yrs, G II: >3.5 to 4.5 yrs, G III: >4.5 yrs), weight (G I: 150-300kg, G II: 300-450 kg, and G III: 450-600kg) and scrotal circumference (G I: 27-30 cm, G II: 30-33 cm, G III: 33.1 cm-above). In each group, there were five replications. Moreover, semen was collected once a week throughout the year and the whole year was divided into three groups (G I: March - June, G II: July -October, G III: November - February). After semen collection, volume (ml) and creamy white color of semen was observed and semen quality was evaluated using CASA (Computer Assisted Semen Analyzer). Microbial load on fresh semen was determined according to age group by serial dilution and plated on nutrient agar and the microbial load was counted in CFU/ml. Moreover, the fertility level of the different groups was determined by fertility-related gene expression (CCDC174, CRISP2 and TSSK6) using Rt-PCR. The qPCR expression data for each gene was extracted in the form of a quantification cycle (Ct), and data were subjected to subsequent analysis. The appropriate size of amplified products was ensured by 2% agarose gel electrophoresis on PCR and GLUT5 was used as an internal control gene. The relative expression was calculated using the $2^{-\Delta\Delta CT}$ method. Finally, One Way Analysis of Variance (ANOVA) was used for data analysis and results were expressed as Mean ± Standard Deviation using the SPSS program (version 20.0, SPSS) and the difference between the mean was determined using the LSD and Duncan method.

After data analysis, it was observed that there was significant variation ($P < 0.01$) in semen volume, semen motility (overall motility & progressive motility, slow and static) and Semen abnormality (bent tail) considering the weather, age, weight and scrotal circumference. The mean volume of semen was positively correlated with age and scrotal circumference with the exception in weight. Therefore, the highest volume of semen was found in age group III: >4.5 yrs, scrotum group G III: 33.1 cm-above and weight group G II: 300-450 kg and the value is 4.43±0.09 ml, 4.87±0.18 ml and 4.61±1.35 ml respectively. The highest percentage of overall motility (84.92±12.15) and progressive motility (66.84±14.17) was found in July- Oct followed by Nov-Feb (57.73±2.45) and March-June (55.22±1.24) whereas, lowest percentage (2.82±0.29) of sperm abnormality (bent tail) was found in July-Oct. Moreover, the highest volume of semen (4.43±0.09) was recorded in the>4.5yrs age group. On the other hand, the younger age group I (2.5-3.5yrs) had the lowest percentage of static motility (9.51±1.43), whereas, the same age group had the highest percentage of progressive motility (71.50a±1.43) and overall motility (90.49±1.43). Besides, in case of semen abnormality, the lowest percentage of bent tail (2.07±0.51) and coiled tail (0.12±0.034) was found in age group I (2.5-3.5yrs). Furthermore, it was observed that less weighing bulls ranging from 150-300kg had the highest percentage of progressive

motility (69.17±4.03) and overall motility (86.71±13.43) along with the lowest percentage of bent tail (2.39±1.79). Moreover, results showed a positive correlation between scrotal circumference and semen volume as well as semen quality. The highest semen volume (4.87±0.18) was recorded in larger scrotal circumference group (33cm-above) with highest percentage of progressive motility (71.33±2.09) and overall motility (84.19±2.12) and lowest percentage of bent tail (3.06±0.56), coiled tail (0.45±0.09) than other groups. The microbial data analysis showed that microbial load was highest at 2.5-3.5 yrs. age group and the microbial load was decreased during the increasing age group.

From the above findings it can be concluded that, considering age, weight and scrotal circumference, 2.5-3.5 year age group, 150-300kg body weight and >33.1 cm scrotal circumferences can be selected for producing the best quality semen for semen cryopreservation. Moreover, July and October was the best time for harvesting good quality semen and during other time extra management have to be provided for harvesting quality semen.

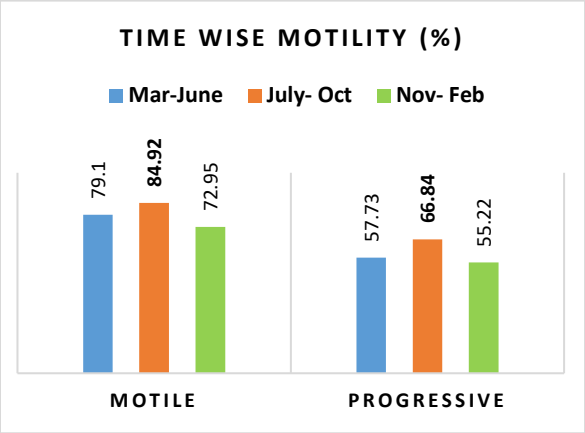

Fig 1. Motility percentage considering time period

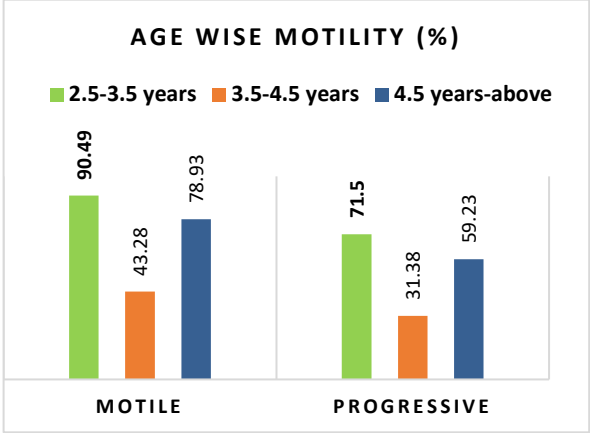

Fig 2. Motility percentage considering age

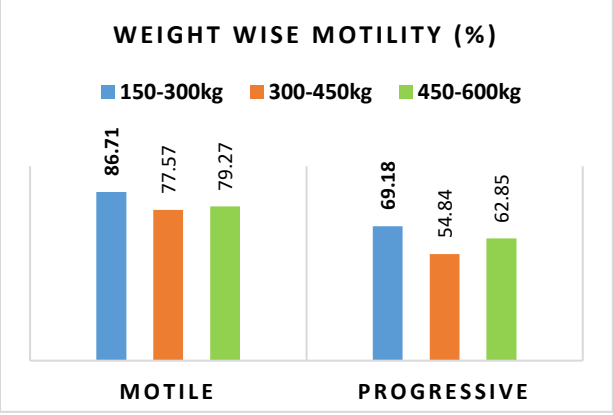

Fig 3. Motility percentage considering body weight

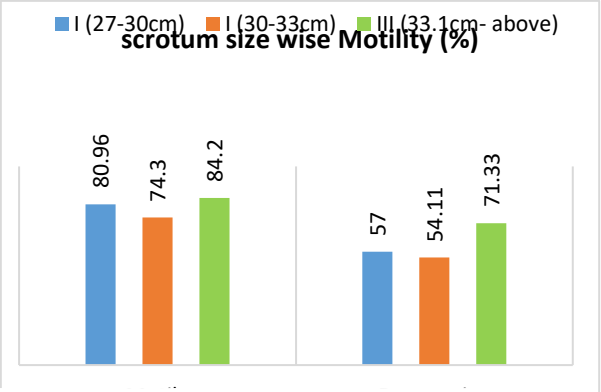

Fig 4. Motility percentage considering scrotal circumference

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

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Executive Summary

The present study was undertaken for the conservation and improvement of farm animal and poultry genetic resources at the Hilly region, Naikhongchari. The objectives were to conserve and improve of different livestock and poultry germplasm suitable for hilly region, to select parental animal and birds and breed them in an assortative design for the production of next generation and to develop of animal and poultry health package at hilly region, Naikhongchari. First activity was selection and improvement of Hilly Brown Bengal goat (HBG). For that purpose, bucks were kept separately from does to avoid unplanned mating. A total of 30 goats and 10 bucks were selected based on birth weight, 3 and 6 month body weight, prolificacy, milk yield and kid survivability. The breeding program was conducted through Open Nucleus Breeding System (ONBS) at the research farm Naikhongchari. To avoid inbreeding depression, mating between full-sibs and half-sibs were not practiced. The productive and reproductive performance of foundation stock's (G_0) is shown in Table 1. For producing next generation, both independent culling level and selection index will be continued. The experiment is on-going.

Table 1: Productive and reproductive performance of foundation stock's (G_0) Brown Bengal Goat

Productive parameters	Mean±SE	Reproductive parameters	Mean±SE
Birth wt. of male kid (kg)	1.24±0.05	Age at first heat (d)	300.22±11.58
Birth wt. of female kid (kg)	1.07±0.03	Wt. at first heat (kg)	11.70±0.28
Weaning wt. of male (kg)	3.80±0.25	Age at first conception (d)	319.05±11.69
Weaning wt. of female (kg)	3.67±0.13	Wt. at first conception (kg)	11.80±0.29
3 months body wt. of male (kg)	4.35±0.25	No. of service per conception	1.17±0.06
3 months body wt. of female (kg)	3.95±0.12	Days open (d)	43.68±0.41
6 months body wt. of male (kg)	7.49±0.32	Conception rate (%)	91.46±2.97
6 months body wt. of female (kg)	6.40±0.15	Litter size	2.17±0.06
Mature buck wt. (kg)	24.07±0.57	Kidding interval (d)	213.59±3.45
Mature doe wt. (kg)	18.60±0.53	Post-partum heat period (d)	26.27±0.95
Growth rate of male (g/d)	34.76±1.70	Kid survivability (%)	91.57±1.25
Growth rate of female (g/d)	29.60±0.82		

Second activity was comparison of productive and reproductive performance of native sheep under farm and community level. In this experiment, animals were allowed to graze for 6-7 hours both farm and community and concentrate (17% CP, 11 MJ/kg DM) were offered twice (morning & evening) daily at the rate of 250 g in farm and farmers provided concentrate according to their capability. Some training program and uthan Boithok regarding sheep rearing and management were provided to the farmer in community. The routine vaccination and deworming program were practiced in both farm and community. Most of the productive and some reproductive performance of native sheep at research farm level was better than the community (Table 2, Table 3).

Table 2: Productive Performance of sheep at farm and community level

Parameters	Research Farm	Community	Level of significance
Birth wt. of male kid (kg)	1.27±0.58	1.09±0.54	.037
Birth wt. of female kid (kg)	1.23±0.06	1.08±0.03	.035
Weaning wt. of male (kg)	5.09±0.36	4.15±0.19	.032
Weaning wt. of female (kg)	4.74±0.18	4.32±0.19	.114
3 months body wt. of male (kg)	5.14±0.25	3.79±0.13	.000
3 months body wt. of female (kg)	4.86±0.17	3.98±0.16	.001
6 months body wt. of male (kg)	8.69±0.13	8.12±0.12	.005
6 months body wt. of female (kg)	8.19±0.14	7.58±0.15	.005
Mature ram wt. (kg)	25.67±0.93	22.72±0.47	.011
Mature doe wt. (kg)	18.72±0.35	16.69±0.36	.000
Growth rate of male (g/d)	41.22±0.77	39.08±0.69	.053
Growth rate of female (g/d)	38.67±0.91	36.11±0.79	.041

Table 3: Reproductive Performance of sheep at farm and community level

Parameters	Research Farm	Community	Level of significance
Age at first heat (d)	238.11±8.62	261.00±14.39	.190
Wt. at first heat (kg)	12.94±0.19	13.08±0.24	.654
Age at first conception (d)	259.81±8.05	286.00±13.89	.119
Wt. at first conception (kg)	13.19±0.20	13.28±0.23	.765
No. of service per conception	1.22±0.08	1.90±0.14	.000
Days open (d)	40.56±0.85	54.67±3.16	.000
Conception rate (%)	88.89±4.08	62.78±5.03	.000
Litter size	1.81±0.10	1.57±0.11	.121
Lambing interval (d)	215.93±3.30	210.33±5.99	.431
Post-partum heat period (d)	27.96±0.83	41.63±2.29	.000
Lamb survivability (%)	94.03±1.89	87.02±2.16	.019

Proper nutritional management, vaccination and deworming may improve the health status and productivity of native sheep at community level.

Third activity was collection, conservation, selection and improvement of Hilly chicken. For that purpose, the day old hilly chicks were identified individually by wing band and the chick were brooded up to 5 weeks. The initial DOC wt. was found 26.93±0.64 g. After completion of brooding period, body weight of male and female was 165.33±13.55 g and 141.75±8.80 g respectively. Selection of bird was performed at 8 weeks and 16 weeks and we observed the body weight of male was 625.83±49.30 g and 1692.67±90.38 g and in female counterpart was 459.08±30.64 g and1163.42±42.99 g respectively. The mature male and female body weight at 30 weeks of age was 2779.40±50.06 g and 2198.29±104.28 g respectively, age at first egg was 171.16±3.96 day, weight of first egg was 31.11±0.85 g. For the selection of superior male and female at 40 weeks of age we are keeping data on body weight, egg production % (168-280 days) and also egg weight. The experiment is ongoing.

Fourth activity was establishment of fodder germplasm bank and determination biomass yield, morphological characteristics and botanical fractions of BLRI Napier-3, Red Napier and Napier Pakchong at plain land and hill slopes of hilly areas. For this, the lands both plain and hill slopes were cultivated followed by proper fertilization, irrigation and other intercultural operations. The highest biomass yield obtained in Napier Pakchong (72.96±1.19 ton/ha) followed by BLRI Napier 3 (68.62±0.44 ton/ha) and Red Napier (60.28±0.84 ton/ha) in plain land at first cutting. While considering hill slopes, the highest biomass yield was observed in BLRI Napier 3 (69.68±1.44 ton/ha) followed by Napier Pakchong (61.68±1.34ton/ha) and Red Napier (54.99±0.81ton/ha).

Fifth activity was prevalence and morphological identification of tick species infestation in goat, sheep & cattle in Naikhonchari. For that reason, a total of 870 tick samples were collected from tick infested goat, sheep and cattle in BLRI, regional station research farm. After microscopic examination, the four genus (*Haemaphyalis*, *Boophilus Rhipicephalus* and *Hyalomma)* were found. The highest prevalence (%) of tick was *Haemaphyalis* followed by *Boophilus*, *Rhipicephalus* and *Hyalomma* in goat, sheep and cattle (Figure 1).

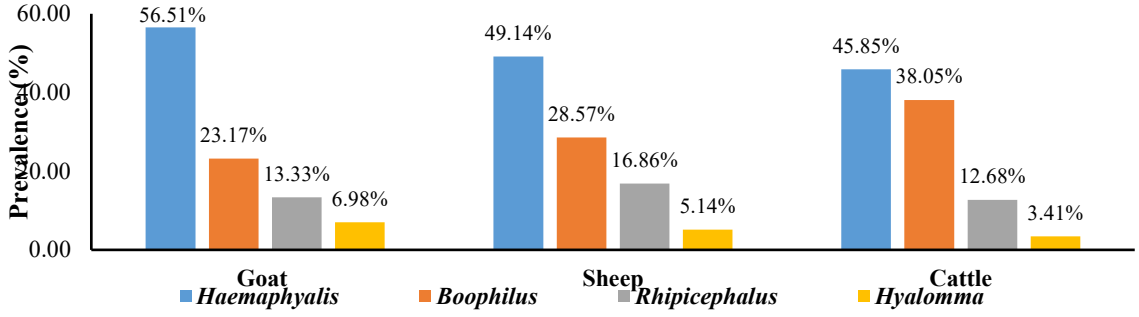

Figure 1: Prevalence (%) of tick infestation in goat, sheep and cattle

Conservation and improvement of fodder crops and performance and nutritional quality evaluation of BRRI dhan -91

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Executive Summary

Conservation of different fodder germplasm is very much important for future research as well as distribution of fodder cuttings among livestock keepers round the year. BLRI had been conserving different fodder germplasm for that purpose. A huge scarcity of green fodder is existing in Bangladesh which is one of the utmost constraints for increasing productivity (meat and milk) of livestock. To meet up the increasing demand of green fodder in rice-based cropping system, it is essential to find out a rice variety having potential growth and nutritive values as like as HYV fodder. In that regard, BRRI achieved success in developing a deep-water rice (DWR) variety, a superior tall variety named BRRI dhan 91 which could be grown in low-lying areas and could also produce ratoon crop having better fodder and paddy yield as like as main crop. This versatile genotype is suitable as fodder crop having robustness, fast growth, tallness (190 cm tall) and bamboo like strong stem as like as Napier grass. However, quality of fodder is important for higher production from livestock. To increase yield and quality of fodder, intercropping high yielding fodders with legumes may be a good option for livestock production. Maize (*Zea mays*) is an ideal forage crop possessing quick growth habit, high yielding ability, palatability and widely known as "ready-made fodder crop". Even though, maize provides adequate fodder, there is need to improve its quality by mixing suitable legume fodder without reduction in forage yields. Alfalfa (*Medicago sativa*), also known as Lucerne, is a perennial legume plant used for grazing, hay, and silage, as well as a green manure and cover crop. Therefore, this research project has been developed with a view to conserve fodder germplasm, introducing new varieties of fodder and producing higher nutrient yields by mixed cropping system.

To conserve different varieties of fodder germplasm, a total of 19 hectares lands had been utilizing at BLRI campus peripheries. Standard agronomical management practices (cultivation, weeding, fertilizing and irrigation) had been maintaining to conserve different germplasm. For cultivation of BRRI-91 and BRRI-28 paddy crops, a total of 6 plots (each of 25 sqm) having 3 replications per variety had been prepared. Two seedlings were transplanted with spacing of 20 cm between plants and 30cm between rows. Adequate irrigation and proper time of water management and fertilization doses were maintained as per recommendation. At the time of harvest (156 days for BRRI-91 and 146 for BRRI-28), all straw based productive parameters were recorded and analyzed following Completely Random Design (CRD). For intercropping experiment, a total of 25 plots (each of 25 sqm) were laid out in a Randomized Block Design (RBD) with 5 treatments (sole maize, sole alfalfa, 75% maize+25% alfalfa, 50% maize+50% alfalfa, 25% maize+75% alfalfa) in five blocks. All plots were prepared properly by removing stubbles, ploughing, manuring and leveling. Maize and alfalfa seeds were planted in line sowing at the rate of 40 and 15 Kg ha^{-1}, respectively with a line spacing of 25 cm. Fodder maize was harvested at 75 days after plantation (DAP), while alfalfa was first harvested at 45 DAP followed by second harvest at 75 DAP. All data were analyzed statistically by SPSS 20.

A total of 9.5 lacs cuttings, 1.5 tons oat seeds and 0.3 ton triticale seeds were produced from germplasm bank and distributed among livestock keepers in different areas of Bangladesh. In addition, a total of 300 tones silage and required amounts of green forages were supplied for self-consumption of BLRI cattle and buffalo research farm. The productive and nutritional performance of BRRI-91 and BRRI-28 shown in Table 1 reveals that plant height, number of tiller, per panicle, straw yield, straw-grain ratio and CP content varied significantly between varieties. Table 2 shows the production and nutritional performance of maize fodder intercropped with alfalfa. There were no significant differences of plant morphological features among treatment groups,while total green and dry biomass and CP yields differed significantly

among treatment groups. Highest total fresh and dry biomass yields were obtained in sole maize (M100), followed by M75A25, M50A50, M25A75, sole alfalfa (A100). The highest CP yields were obtained in M75A25 followed by M100, M50A50, M25A75 and A100.

Table-1 Production and nutritional comparison between BRRI 91 and BRRI 28 paddy

Parameters	BRRI 91	BRRI 28	SE	P value
Tiller, number/hill	17	14	0.600	0.025*
Straw yield (green), t/ha	10.77	6.43	0.973	0.000***
Harvest index	0.31	0.47	0.034	0.000***
Straw grain ratio	2.20	1.13	0.241	0.000***
Dry matter (%)	82.37	81.65	0.43	0.500NS
Gross Energy (MJ/kgDM)	13.74	12.35	0.45	0.123NS
Crude Protein (%)	7.22	5.42	0.44	0.013*
Acid Detergent Fiber (ADF)	42.37	42.00	0.61	0.803NS
Neutral Detergent Fiber (NDF)	74.12	69.62	1.13	0.017*
Ash (%)	13.59	13.75	0.26	0.797NS
Organic Matter (%)	82.62	83.59	0.50	0.508NS

*-significant at 5% level (P<0.05), ** significant at 1% level (P<0.01), ***-significant at 0.1 level (P<0.001), NS-not significant (P>0.05).

Table-2 Production and nutritional evaluation of intercropped maize and Alfalfa fodder

Parameters	M100	M75A25	M50A50	M25A75	A100	SE	P value
Alfalfa height, cm	-	52.4	53.6	53.5	52.8	1.24	0.988NS
Alfalfa leaf, number/plant	-	155	177	186	233	12.66	0.154 NS
Alfalfa leaf weight, g/plant	-	2.40	2.63	2.46	2.66	0.15	0.934 NS
Alfalfa stem weight, g/plant	-	2.7	3.23	3.56	4.16	0.19	0.172 NS
Maize height, cm	276	273	261	285	-	3.46	0.158 NS
Maize leaf number	16	16	16	15	-	0.15	0.507 NS
Maize leaf weight, g/plant	0.31	0.31	0.28	0.27	-	0.34	0.559 NS
Maize stem weight, g/plant	0.68	0.82	0.86	0.91	-	0.92	0.154 NS
Alfalfa biomass, t/ha	-	1.88	2.13	2.23	4.3	0.31	0.325 NS
Maize biomass, t/ha	43.3	37.6	34.6	21.8	-	4.15	0.534 NS
Total biomass, t/ha	43.30[a]	39.48[b]	36.72[c]	23.99[d]	4.30[e]	3.88	0.000***
Total DM yield (t/ha)	7.72[a]	6.81[b]	5.93[c]	4.51[d]	0.72[e]	0.66	0.000***
Total CP Yield (t/ha)	0.81[b]	1.31[a]	0.77[b]	0.56[b]	0.13[c]	0.11	0.000***

***-significant at 0.1 level (P<0.001), NS-not significant (P>0.05).

The results reveal that BRRI-91 could be an alternative source of fodder crop which is comparatively superior than BRRI-28 in terms of green straw yields and CP contents. On the other hand, maize fodder intercropped with alfalfa in combination of 75% maize+25% alfalfa could be cultivated for obtaining higher CP yields.

Performance Study of Gamma radiated mutant lines of winter fodder "Oat" under on-farm condition

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Executive Summary

The shortage of natural feed and high price of processed feed are major challenges for small holder's rearing livestock. In recent times, due to salinity, the scarcity of grasses started in coastal region, resulting in a decline in cattle production (Bangladesh Planning Commission, 2020). Improvement or development of new stress tolerant fodder germplasm will help to increase production and productivity of farm animals in the country. As for the reason the present study was taken to validate some mutant lines of winter fodder "Oat" at saline areas of Bangladesh. For study, the winter fodder seed 'Oat' were initially irradiated with seven (7) different doses of Gamma rays as 100 Gy, 150 Gy, 200 Gy, 250Gy, 300 Gy, 350 Gy, and 400 Gy from ^{60}Co source from Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh in 2018. The irradiated seeds were cultivated and screened on the basis of both qualitative and quantitative performance under on-station conditions. Based on results from the on-station research, we improved 3 different irradiated mutant lines such as 300 Gy, 350 Gy and 400 Gy. These three mutant lines were selected for field validation trials under farmer's conditions in different AEZ particularly saline (Sathkhira) and plain (Savar) region of the country. All the mutant lines (0Gy, 300Gy, 350Gy and 400Gy) were planted in Completely Randomized Design (CRD) with 5 replications each. The total plot number was 40 and each plot having a size of 2mx2m and similar agronomic practices such as irrigation, fertilization, weeding etc. were followed for all treatments. During harvesting different production, nutritional and morphological parameters were recorded. In salinity stress experiments, selected best mutants were exposed to salinity stress of 0dSm^{-1}, 8dSm^{-1}, 10 dSm^{-1} and 12 dSm^{-1} of EC (Electric Conductivity). The effect of Gamma radiation doses and different salt levels on biomass yield and chemical composition of Oat grass under pot experiment has been presented in Table 1. It was observed that salt had an effect of Gamma radiation doses on biomass yield, DM content and CP content of Oat grass. Irrespective of Gamma radiation, salt doses ($p<0.001$) and their interactions ($p<0.01$) had a significant effect on fresh biomass yield per plant during the pot experiment. However, irrespective of salt doses, Gamma radiation had no effects ($p>0.05$) on fresh biomass yield per plant during the pot experiment. The higher ($p>0.05$) fresh biomass per plant was recorded at 300 Gy (0.144 kg per plant) followed by 0.138 Kg of 350 Gy. It was showed that, salts dose influenced the biomass yield directly. The value for average fresh biomass was found 0.156, 0.145, 0.144 and 0.124 kg/plant in 12 dSm^{-1}, 8 dSm^{-1}, 10 dSm^{-1}, and 0 dSm^{-1} respectively. The biomass yield and nutritional composition of Oat grass at different gamma radiation doses under saline prone areas is presented in Table 3. The results showed that there was no significant effect ($p>0.05$) of different gamma radiation doses on fresh biomass yield, DM yield, CP yield, DM and CP content. But irrespective of control (0 Gy), 300 Gy attained 42.73% increased fresh biomass yield, 49.13% DM yield and 46% CP yield followed by 400 Gy had increased 34.19% fresh biomass yield, 38.86% DM yield and 32% CP yield and 350 Gy had increased 23.37% fresh biomass yield, 30.80% DM yield and 24% CP yield. The biomass yield and nutritional composition of Oat grass at different gamma radiation doses under plain area is presented in Table 2. The results showed that there was no significant effect ($P>0.05$) of different gamma radiation doses on fresh biomass yield, DM yield, CP yield, DM and CP content. But irrespective of control (0 Gy) , 400 Gy attained 51.76% increased fresh biomass yield, 58.03% DM yield and 77.26% CP yield followed by 300 Gy had increased 41.20% fresh biomass yield, 44.12% DM yield and 45.28% CP yield and 350 Gy had increased 26.56% fresh biomass yield, 18.96% DM yield and 15.09% CP yield. There was no significant effect ($p>0.05$) of different gamma radiation doses on morphological characteristics like plant height (cm), No. of leaf/plant, No. of node/plant, leaf wide (cm), Leaf length (cm), stem diameter (cm), stem ratio, leaf ratio of Oat grass both in Saline area, plaun area and pot experiment. The production cost involvement for kg DM yield of Oat grass cultivated with 0 Gy, 300 Gy, 350 Gy and 400 Gy were Tk. 8.49, 5.89, 7.13 and 5.37, respectively at plain area and 10.61, 7.12, 8.11 and 7.64, respectively at saline area.

Table 1: Effect of salt and gamma radiation doses on biomass yield and chemical composition of Oat grass in pot experiment (On-station: Cutting duration 104 days)

Salt and Radiation :Interaction		Biomass (kg/plant)	%DM	%CP	%ADF	%NDF
Salt	0	0.118^{b}	23.59^{b}	8.98^{c}	34.69^{a}	55.09^{a}
	8	0.136^{ab}	25.15^{a}	8.52^{b}	32.33^{ab}	58.58^{b}
	10	0.143^{ab}	24.46^{c}	9.39^{a}	29.94^{b}	57.42^{c}
	12	0.146^{a}	25.31^{a}	9.00^{c}	30.43^{b}	56.97^{c}
Radiation	0	0.133	24.15^{a}	8.99^{c}	31.72	56.53^{b}
	300	0.144	25.04^{b}	9.37^{a}	32.13	57.28^{b}
	350	0.130	24.74^{b}	8.80^{b}	31.79	58.39^{a}
	400	0.136	24.60^{ab}	8.72^{b}	31.74	55.87^{b}
SED		0.008	0.14	0.29	0.61	0.22
Sig	Salt	*	***	***	*	***
	Radiation	NS	*	***	NS	***
	Salt×Radiation	NS	**	***	NS	*

Table 2: Effect Gamma radiation doses on biomass yield and chemical composition of Oat grass under on-farm conditions (Savar-Plain Area: Cutting duration 109 days)

Parameters	Gamma Radiation				SED	Level of sig.
	0	300	350	400		
Fresh Biomass yield (Ton/hac)	41.19	58.16	52.13	62.51	8.81	NS
Fresh BMY increase (%)	-	41.20	26.56	51.76	-	-
DM yield (Ton/hac)	7.91	11.40	9.41	12.50	1.95	NS
DM yield increase (%)	-	44.12	18.96	58.03	-	-
CP yield (Ton/hac)	0.53	0.77	0.61	0.94	0.16	NS
CP yield increase (%)	-	45.28	15.09	77.26	-	-
% DM	19.46	19.26	17.83	19.30	0.88	NS
% CP	6.17	6.46	6.35	7.14	0.43	NS
Feed cost (BDT/Kg/DM)	8.49	5.89	7.13	5.37	-	-

Table 3: Effect Gamma radiation doses on biomass yield and chemical composition of Oat grass under on-farm conditions (Sathkhira-Saline Area: Cutting duration 104 days)

Parameters	**Gamma Radiation**				**SED**	**Level of sig.**
	0	**300**	**350**	**400**		
Fresh Biomass yield (Ton/hac)	32.90	46.96	40.59	44.15	0.23	NS
Fresh BMY increase (%)	-	42.73	23.37	34.19	-	--
DM yield (Ton/hac)	6.33	9.44	8.28	8.79	0.30	NS
DM yield increase (%)	-	49.13	30.80	38.86	-	-
CP yield (Ton/hac)	0.50	0.73	0.62	0.66	0.10	NS
CP yield increase (%)	-	46.00	24.00	32.00	-	--
% DM	19.95	20.63	20.71	20.49	0.06	NS
% CP	7.50	7.58	7.34	7.21	0.53	NS
Feed cost (BDT/Kg/DM)	10.61	7.12	8.11	7.64	-	-

On the basis of these findings, it is concluded that, Oat 300 Gy had highest fresh biomass yield, DM yield and CP yield in saline area and Oat 400 Gy had highest fresh biomass yield, DM yield and CP yield in plain area. Based on these facts, it can be recommended that, Oat 300 Gy can be cultivated as winter fodder at saline area and Oat 400 Gy can be cultivated as winter fodder at plain area. Further genetic diversity analysis will be required for complete conclusion.

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

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Executive Summary

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. The objectives were to conserve and improve Black Bengal goat through selective breeding, to evaluate the performance of different coat color variants of Black Bengal goat (Solid Black, White Bengal, Dutch Belt and Toggenburg) and to produce frozen semen for Artificial Insemination (AI) in Black Bengal goats under on-station condition. The study was conducted in Goat Research Farm of BLRI, Savar, Dhaka through Open Nucleus Breeding System (ONBS) avoiding inbreeding. 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/doe/day and 12 kg, respectively. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0.

The average litter size, dam milk production, birth weight, 3 months and 6 months weight of Solid black genotype were 2.16±0.07, 335.76±13.99 ml/doe, 1.16±0.02, 5.70±0.08 and 9.84±0.10 kg, respectively; in case of White Bengal genotype, the values were 2.25±0.13, 510.67±24.03 ml/d, 1.11±0.03, 6.30±0.18 and 11.58±0.22 kg; in case of Dutch Belt genotype the values were 2.30±0.12, 467.78±32.9, 1.07±0.02, 6.12±0.16 and 13.53±0.13 kg and for Toggenburg genotype, the values were 1.88±0.11, 398.82±24.01, 1.11±0.03, 5.97±0.12 and 10.50±0.20 kg, respectively (table 1). 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. Total motility of the sperm was decreased over the time after cryopreservation. Single dose AI at 24 and 36 hours after showing heat was found more effective to achieve higher conception rate in goat (table 3).

Table 1: Productive and reproductive performance of Black Bengal goat and it's coat color variants (Mean± SE)

Parameters	Solid Black	White Bengal	Dutch Belt	Toggenburg	Level of sig.
Litter size	2.16^{ab}±0.07 (100)	2.25^{ab}±0.13 (43)	2.30^{a}±0.12 (35)	1.88^{b}±0.11 (31)	*
Milk production (ml/doe)	335.76^{c}±13.99 (34)	510.67^{a}± 4.03 (15)	467.78^{a}±32.9 (09)	398.82^{b}±24.01 (11)	***
Birth weight (kg/kid)	1.16^{a}±0.02 (100)	1.11^{ab}±0.03 (15)	1.07^{b}±0.02 (31)	1.11^{ab}±0.03 (31)	*
3 months body weight (kg)	5.70^{b}±0.08 (57)	6.30^{b}±0.18 (34)	6.12^{b}±0.16 (27)	5.97^{a}±0.12 (22)	*
6 months body weight (kg)	9.84^{b}±0.10 (69)	11.58^{a}±0.22 (25)	13.53^{a}±0.13 (09)	10.50^{b}±0.20 (22)	*

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

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

Motility Parameter (%)	Fresh	Freezing stage		
		3 months	6 months	12 months
Total motility	66.27±3.85	63.33±5.79	44.5±1.6	37.4±1.97
Progressive motility	52.93±4.29	44.58±5.42	35.4±4	27.8±2.89
Static motility	33.73±3.85	32.5±5.70	55.5±1.6	72.8±1.95
Slow motility	0.32±0.09	1.37±0.43	1.7±1.6	0.25±0.06

Table 3: Conception rate of Artificial Insemination (AI)

Dose	Treatment	Conception rate (%)	Repeat heat (%)
Single dose	1 (24 hours after standing heat)	90.32 (28)	9.68 (3)
	2 (36 hours after standing heat)	90.91 (10)	9.09 (1)
Double dose	3 (12 and 24 hours after standing heat)	78.95 (15)	21.05 (4)
	4 (24 and 36 hours after standing heat)	87.5 (14)	12.5 (2)

Superior bucks and does will be selected from every genotype by the individual performance score. Therefore, the research program should continue for the coming years to achieve the targeted goal. Regarding AI, it could be concluded that single dose of AI between 24 and 36 hours after standing heat showed higher conception rate than other doses. So, more research regarding on-station and on farm with large sample size needed to conclude a concrete result on frozen semen production and AI in Black Bengal goat.

Molecular identification of the Black Bengal Goat in Bangladesh using DNA barcoding

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Executive Summery

DNA barcoding technology has been used for identification and classification of different taxa and has successfully identified new species and varieties (Hebert et al. 2004; Hajibabaei et al. 2006; Lane et al. 2007). Mitochondrial DNA sequences, including mitochondrial DNA control D-loop region, have many advantages as molecular markers. The examination of variations in the mitochondrial DNA (mtDNA) control region sequences has been shown to be very useful in elucidating the origin and diversification of domestic animals (Jeon et al., 2005; Sasazaki et al., 2006; Odahara et al., 2006) that can quickly identify species as a DNA barcode, and have been widely used in species identification, genetic diversity, and molecular evolutionary studies. A DNA barcode based on the D-loop region has been used for species identification in goat varieties (Ruo-Yu et al., 2006, Liu, R. Y., 2006). The goal of this study was to look into the genetic diversity of Bangladeshi (BD) native goat and their likely origins. About 70 blood samples has been collected from 7 different project locations out of 8 locations representing Kustia, Meherpur, Bandarban, Savar, Rajshahi, Chuadanga and Bhaluka. The mtDNA has been extracted from blood of each goats using phenol chloroform method. The DNA concentration and quality were determined by NanoDrop 2000 (Thermo Fisher Scientific, Waltham, MA, USA) spectrophotometer and gel electrophoresis. Six hundred and six base pairs (606bp) of the mtDNA D-loop region (HVI segment of the control region) were amplified using the primers CAP-F (5′ -CGTGTATGCAAGTACATTAC-3′) and CAP-R (3′ - CTGATTAGTCATTAGTCCATC-5′). The primer was synthesized from Invitrogen (Invitrogen Life technologies, Beijing, China). PCR amplifications for each sample was performed in a final reaction volume of 50 µl consisting of 2 µl containing 100 ng genomic DNA, 25 µl premix, 1.5 µl of each primer (20 pM) and 20 µl ddH2O using reagents from Invitrogen. The PCR protocol was 5 min at 94ºC for initial denaturing followed by 34 cycles at 94ºC for 30 s; 56ºC for 30 s; 72ºC for 30 s; and final extension at 72ºC for 7 min. The PCR product was used for electrophoresis on a 2.0% agarose gel and visualized by staining with ethidium bromide via ultraviolet transilluminator to confirm the amplification. Then PCR product was purified using PCR product purification kit and 40 µl of each PCR purified product was sent to the Molecular Biotechnology Division, National Institute of Biotechnology, Bangladesh for sequencing. We get already 17 sequencing result (Table-1) and rests of the samples are under the process of sequencing. After getting all the sequencing data results will be interpreted for population history and demographic dynamics, mtDNA (D-loop) haplogroups analysis to assess the maternal origin, diversity analysis, istance analysis, analysis of molecular variance (AMOVA) and phylogeny analysis.

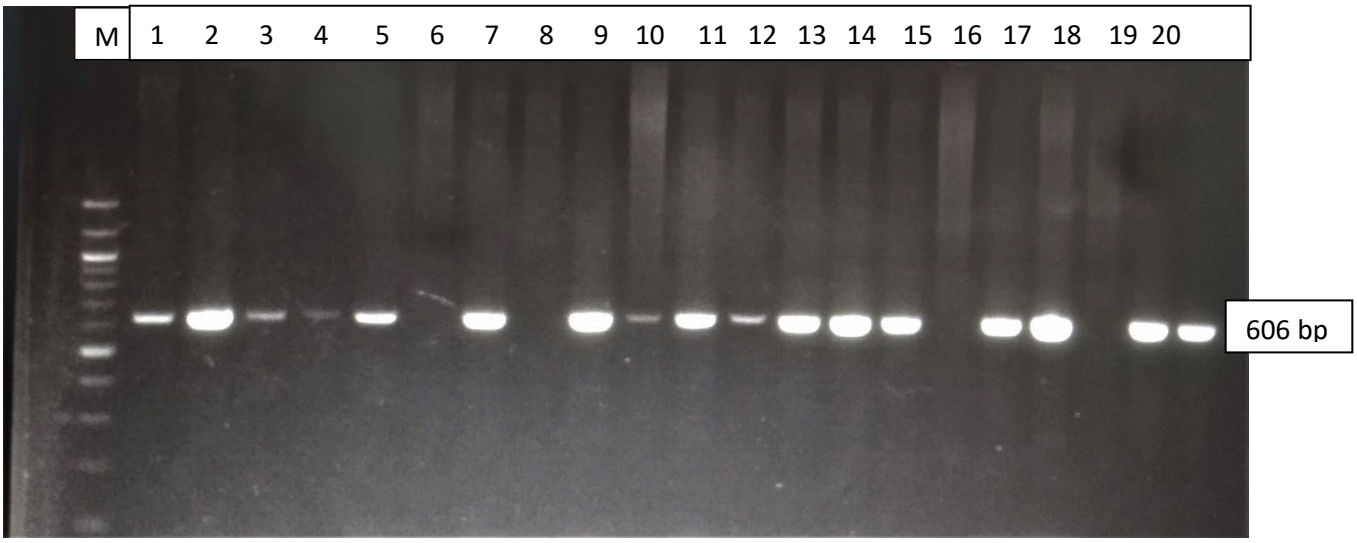

Figure 1: Amplification of mtDNA D-loop gene. Test samples of black Bengal goat showed band at 606 bp. M= 100bp Marker, Number = Sample number.

Table 1: Total Sequencing Result

Already done (Region)	Number of sequence	Already Sent (Region)	Number of sequence
Chuadanga	7	Savar	10
Bandarban	6	Bandarban	4
Meherpur	4	Meherpur	6

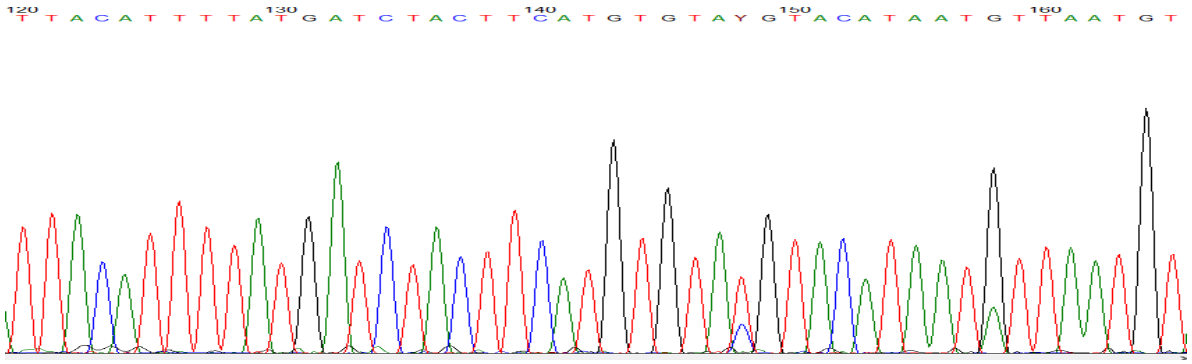

Figure 2: Result of electropherogram for mtDNA D-loop gene after sequencing

Title: Conservation and improvement of Black Bengal Goat in different community of project locations in Bangladesh

Activity: *Effect of establishment of community-based buck park on the performance of Black Bengal Goat 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, BLRI supplied the superior buck (collected from pure Black Bengal Goat flock of Goat Research farm, Bangladesh Livestock Research Institute, Savar, Dhaka) in eight different project locations namely Rajshahi, Bhaluka, Naikhangchari, Jashore, Kustia, Chuadanga, Meherpur and Muktagacha through "Black Bengal Goat Conservation and Development Research" project. Two superior Bucks were given to two buck-rearing farmers of each project area. When any doe showed the heat, the standing heated doe was brought to the respective buck rearing farmer and bred the doe. The buck rearing farmers kept the record of all the necessary information related breeding with service charge in the supplied recorded card given by the project. As per recommendation, almost all the buck-rearing farmers exchanged their buck with neighbour farmer to prevent inbreeding depression. This study was aimed to evaluate the effect of the established Black Bengal buck park on the performance of the progeny of those 'does' serviced in the respective buck park. The traits considered were gestation length (days), birth weight (g), litter size (no.), post-partum heat period (PPHP)(days), kidding interval (KI) kid mortality (%), income of buck owner of pre and post condition of establishment of Black Bengal Goat (BBG) buck park.

Table1. Changes of productive and reproductive performances of Black Bengal Goat due to establishment of community-based buck park (before and after)

Project sites	Parameter	Before	After	*t* value	*p* value	Level of significant
		Mean ± SD	Mean ± SD			
Rajshahi	Gestation length(days)	158.63±8.87	155.17±6.6	1.51	0.141	NS
	Birth weight (g)	1116.33±97.23	1204.33±106.4	-3.09	0.004	**
	LS (No.)	1.47±0.51	2.2±0.41	-6.88	<0.001	**
	PPHP (days)	75.73±4.4	66.37±4.11	7.99	<0.001	**
	KI (days)	251.53±31.69	234.07±7.9	2.67	0.012	**
Bhaluka	Gestation length(days)	157.73±8.33	155±7.32	1.18	0.247	NS
	Birth weight (g)	1138.33±80.82	1089.83±120.21	2.02	0.052	NS
	LS (No.)	1.77±0.63	1.83±0.53	-.38	0.701	NS
	PPHP (days)	75.13±3.38	65.83±3.3	9.44	<0.001	**
	KI (days)	249.97±35.09	234.27±6.92	2.180	.037	**
Naikhangchari	Gestation length (days)	159.37±8.13	157.73±8.04	0.69	0.495	NS
	Birth weight (g)	1116.67±106.89	1125.83±139.25	-.294	.770	NS
	LS (No.)	1.33±0.48	1.8±0.55	-3.500	0.001	**

	PPHP (days)	75.13±2.66	65.87±2.9	12.915	<0.001	**
	KI (days)	251.87±36.92	233.97±5.82	2.358	.025	**

LS=Litter size, PPHP=post-partum heat period, KI=kidding interval

Among the eight different locations, data from three selected locations i.e. Rajshahi, Bhaluka and Naikhangchari were considered to evaluate the results. Data were collected on a regular basis from July 2021 to May 2022. Paired sample t-test using the SPSS 20.0 statistical program was used for analysing of data.

Table-1 shows the changes of productive and reproductive performances of Black Bengal Goat due to establishment of community-based buck park (before and after). In case of Rajshahi, the average birth weight and litter size enhance significantly ($p< 0.05$) and also post-partum heat period (PPHP) and kidding interval (KI) reduced significantly ($p< 0.05$) after establishment of buck park. In Bhaluka, after establishment of buck park the average post-partum heat period (PPHP) and kidding interval (KI) reduced significantly after providing superior buck to the buck park. Although the average birth weight didn't differ significantly but litter size enhances ($p< 0.05$) and post-partum heat period (PPHP) and kidding interval (KI) reduces significantly ($p< 0.05$) compared to previously established buck park. The results suggest that higher productive and reproductive performance were observed due to establishment of buck park.

The service charge was found higher in all the rural areas of all three sites due to high scarcity of breeding buck. BDT 266, 150 and 236 with some other input like concentrated feed, green grass was received against per service in Rajshahi, Bhaluka and Muktagasa respectively. Whereas, from the buck station the farmers can get buck service with minimum cost (taka 50 for BBG community farmers and taka 150 for other farmers). However, the misconceptions of rearing buck (those who rears buck are lowest class of society, daughters not getting marry, deprivation from social opportunities and so on), after counselling by project personnel, Islamic Scholar, through field day workshop and advertisement in electronic media these attitudes are being reduced gradually.

The study indicated acute shortage of Black Bengal breeding bucks was the overall situation in the rural areas of Bangladesh. From the result so far, it was found that, the buck park activity has been reducing the crisis of quality bucks in the working places. The productive and reproductive performances of the progenies were found increasing through matting superior bucks through Buck Park. Therefore, system for the establishment of Black Bengal breeding "Buck Park" and their distribution in the rural areas of Bangladesh may urgently be developed and this study will be continued until the significant change to build up a model for community-based BBG production.

Identification of causative markers and their use in the conservation and improvement program of Jamunapari goat at BLRI

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Executive Summary

Goat is a multi-functional animal and plays a significant role in the economy and nutrition of landless, small and marginal farmers in the country. Mostly Black Bengal goat breed along with some Jamunapari and their crosses with Black Bengal constitutes the goat population in Bangladesh. The number of this breed in Bangladesh is not known but the breed is preferred by local farmers in some areas of the country. Combined with traditional selection techniques, marker-assisted selection (MAS) has become a valuable tool in selecting animals for desirable traits. The MAS is expected to increase genetic gain compared to traditional breeding programs and reduce the cost of progeny testing by early selection of the potential animals. Considering the above facts and circumstances the project has designed to study on the productive and reproductive performance of Jamunapari goat, to identify candidate genes or mutations as the causal markers associated with productive and reproductive traits, i.e., prolificacy, milk production and body weight and to conserve and improve Jamunapari goat through selective breeding using identified causal markers as a molecular tool. The study was conducted in Goat Research Farm of BLRI, Savar, Dhaka. The breeding program was conducted through Open Nucleus Breeding System (ONBS) avoiding inbreeding. The selection objectives of the study were to improve the prolificacy, milk production and growth rate of the breed. The selection targets were minimum 2 kids per kidding, 1.0 litter/day milk and 16 kg body weight at 6 months. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0. Hippocampus abundant transcript 1 (HIAT1) gene, also known as MFSD14A (major facilitator superfamily domain containing 14A) gene belongs to the major Facilitator superfamily (MFS) used as candidate gene to evaluate the growth trait of Jamunapari goat. A total of 15 selected adult goats blood samples from BLRI farm were used for the study. After that, DNA extraction, PCR amplification and sequencing of gene fragments and SNP genotyping of samples have done. Genotypic and allelic frequencies were calculated according to Falconer and Mackay (1997). One pair of specific primer (rs665862918 primer reported by Gao et al., 2020) was used to amplify HIAT1 gene fragment that harbored 15-bp insertion/deletion (indel).

Table 1 describes the average litter size (number), milk production (ml/d), birth weight (kg), 3-month weight (kg) and 6-month weight (kg) of Jamunapari goat were 1.67 ± 0.07, 506.15 ± 0.03, 2.12 ± 0.06, 8.33 ± 0.29 and 12.57 ± 0.51, respectively. Values of different morphometric traits for growth were described in table 2. The gene frequency and genotype frequency based on 15-bp Indel polymorphism of HIAT1 gene associated with morphometric traits in the Jamunapari goat was shown in Table 3. PCR amplification showed a size of 183/198 bp fragments that indicated the primer specific amplification. Three different genotypes were observed based on the amplified fragments of 15-bp indel of HIAT1 gene. 47% of heterozygous ID (heterozygous genotype) and 53% of homozygous DD (deletion type) individuals were identified in Jamunapari goat breed with no homozygous II (insertion type) goat. After analysis, the 15-bp indel polymorphism was detected in the studied goat populations and could be used as a molecular marker for growth trait improvement in Jamunapari goat.

Table 1: Productive and reproductive performance of Jamunapari goat (Mean ± SE)

Parameters	Mean ± SE
Litter size (number)	1.67 ± 0.07 (67)
Milk production (ml/d)	506.15 ± 0.03 (45)

Birth weight (kg)	2.12 ± 0.06 (67)
3 months body weight (kg)	8.33 ± 0.29 (41)
6 months body weight (kg)	12.57 ± 0.51 (35)

Table 2: Least-squares means (LSM) with standard errors (SE) of morphometric traits of Jamunapari goat

Trait	BW (kg)	WH (cm)	RH (cm)	BL (cm)	HG (cm)	RW (cm)	RL (cm)	CC (cm)	CW (cm)	EL (cm)
(mean ± SE)	31.72 ± 1.45	69.29 ± 0.95	69.67 ± 1.24	63.79 ± 1.02	72.57 ± 1.06	15.83 ± 0.24	11.78 ± 0.11	8.17 ± 0.25	19.50 ± 0.31	23.46± 0.46

BW= Body weight, WH= wither height, RH= rump height, BL= body length, HG= heart girth, RW= rump width, RL= rump length, CC= cannon circumference, CW= chest width and EL= ear length.

Table 3: Genotypic and allelic frequencies for the 15-bp indel of *HIAT1* gene in Jamunapari goat at BLRI

Breed	Sample Size	Genotype Frequency*, **			Gene Frequency	
		II	ID	DD	I	D
Jamunapari	15	0.00 (0)	0.47 (7)	0.53 (8)	0.23	0.77

Homozygous insertion= II, homozygous deletion= DD and heterozygous genotypes= ID.
**Homozygous II genotype, heterozygous ID genotype, homozygous DD genotype.
*Values in the parentheses represent the number of samples under respective genotype.

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Gao, J., Song, X., Wu, H., Tang, Q., Wei, Z., Wang, X., Lan, X. and Zhang, B. 2020. Detection of rs665862918 (15-bp indel) of the HIAT1 gene and its strong genetic effects on growth traits in goats. Animals: 10 (2).

Selection and Evaluation of Some Tree Leaves as Goat Feed Through In Vitro Gas Production Technique

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Executive Summary

Small ruminants, especially goats, are the integral part of the livestock sector, economy and the mainstay of livelihood of the majority of rural people in Bangladesh. Currently 26.77 million goats are being reared in Bangladesh (source). To rear this vast population the annual DM requirement is 606903.75 ton/year where roughage contributes 424832.6 ton and concentrate is 182071.13 ton/year. But at present, the country faces a net deficit of 35% roughage and 82% concentrate compared to its demand. In this crisis context of feed, introducing suitable tree leaves as fodder may contribute a potential role to meet the growing demand. Literature reveals that, at present, different tree leaves are globally used as goat feed having more productivity rather than any loss. Considering all these contexts, present study was undertaken to identify and evaluate the available tree fodder mostly used for goat feeding at some selected areas of Bangladesh. Another study was designed to develop concentrated supplemented feeding strategies for goats with the aim of increasing production efficiency at field level. A baseline survey was conducted at eight different areas (Vhaluka, Muktagacha, Rajsahi sadar, Kustia, Meherpur, Chuadanga, Jashore sadar and Naikhongchori) for defining the frequently used tree as a nutritional potential fodders for goat feeding. Personal interview method with 30 individual farmer of each target area following a previously prepared and pre-tested questionnaire was used during this survey. Representative amount of tree leaf sample was collected to analyse at the laboratory for both nutritional (proximate) and anti-nutritional value (tannin) which are associated with reduced digestibility and intake due to reduced protein digestibility by rumen microflora.The in vitro gas production technique was used to evaluate the digestibility of frequently used tree leaves. Proximate Analysis and In vitro gas production technique was done at Animal Nutrition Laboratory, BLRI and the analysis of tannin was at the Bangladesh Reference Institute for Chemical Measurement (BRICM) laboratory. A 45 days feeding trial at farmers' level using concentrate supplementation was done with 20 growing male animals of 6 months age at Bhaluka upazila, Mymensingh. Concentrate supplementation rate was 0, 1, 1.5 and 2% of their body weight. All the collected data were inserted in a Microsoft Excel sheet and analyzed using (SPSS) version 20.0.
Results presented in table 1 shows that, mango, jackfruit, banana, mahogany and ipil-ipil are mostly used tree fodder by farmers' at field. Its utilization pattern varies according to the variation of regional area.

Table-1: Tree fodder used by farmers of different areas (% of total respondents)

Areas	Mango	Jackfruit	Banana	Mahogany	Ipil-ipil	Cultivated Fodder	No Tree Fodder
Bhaluka	25	35	15	2	5	5	13
Muktagacha	32	18	17	-	7	8	18
Rajshahi	47	25	12	-	3	8	5
Kushtia	10	25	14	35	1	12	3
Meherpur	10	23	8	30	18	5	6
Chuadanga	10	18	7	39	5	12	9
Naikhongchori	-	60	20	-	-	5	15

Among the eight selected areas farmer of Bhaluka (35%) and Naikhongchori (60%) prefers jackfruit leaf most to fed their goat. The tendency to feed mango leaves is acute in Muktagacha (32%) and Rajshahi (47%) areas. Whereas farmers of Kushtia, Meherpur and Chuadanga are very enthusiastic about feeding Mahogany leaves to their goats and they believe that production efficiency of goat is enhanced by feeding mahogany leaves. The chemical composition of aforementioned tree leaves are shown in Table 2 where is that, the CP content of all the tree leaves are promising to meet the protein requirement of goat but at the

Table-2: Nutritional composition (%) of Selected Tree Leaves for Goat Feeding

Tree leaves	Proximate composition (% of DM)					Anti-nutritional factor (% of DM)
	DM	CP	ADF	NDF	Ash	Tannin
Mango	36.21	14.06	58.56	64.81	14.86	0.43
Jackfruit	38.30	12.90	28.50	34.90	16.00	0.39
Banana	18.00	13.62	34.04	65.18	16.20	0.10
Mahogany	41.45	11.08	34.31	47.11	8.80	0.47
Ipil-ipil	37.48	22.21	17.44	35.68	12.91	0.46

same time their tannin content is also slightly higher than reference value (32gm/kg DM) except banana leaf. To evaluate the maximum used tree leaves at farmers' field in terms of digestibility (%) in vitro gas production method was followed where gas production up to 72 hours was observed and recorded. Maximum gas was produced from jackfruit leaves in three consecutive days. Results of digestibility is shown in Figure-1 where maximum digestibility (68.87%) is also found from the same tree. Despite of having higher protein, ipil-ipil shows the lowest digetibility (47.1%) which may be attributed to its higher tanin content (0.46% of DM). Feeding trial regarding concentrate supplemented diet is going on. Samples of feed used in the trial and initial blood profile are already analyzed.

In conclusion, it may be recommended that tree fodder has much more potentiality to meet the growing feed scarcity of goats. But a complete feeding package system needs to be developed in a cost effective and farmers friendly way through further research. De-taninification of tree leaves should be prioritized in research to avoid any kind of negative effect of using tree leaves on goat health and productivity. Supplementation of concentrate with conventional farmers' practice of goat rearing may help to produce quality meat in addition to achieving maximum market weight within minimum time.

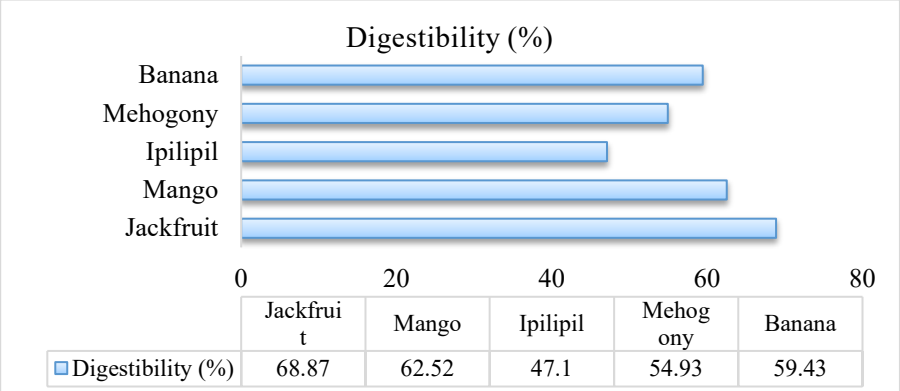

FIGURE-1: DIGESTIBILITY (%) OF SOME SELECTED TREE LEAVES

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

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Executive Summary

The project has designed to develop superior native sheep germplasm and their improvement at BLRI and to study the productive and reproductive performance of native sheep. The breeding program was conducted at sheep research farm, BLRI, Savar, Dhaka with four different types of sheep viz. Coastal, Jamuna River basin, Barind and Garole. 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. Open Nucleus Breeding System was adopted in order to improve the genetic and phenotypic traits of existing breeding sheep stock avoiding inbreeding. The selection targets of the study were to improve litter size, birth weight and 6 months body weight. The targeted litter size, birth weight and 6 months body weight were minimum 2 lambs per lambing, 1.5 kg and 14 kg. Data on productive and reproductive performances were recorded regularly. 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, 3 months and 6 months body weight of Coastal sheep were 1.73±0.05, 1.56±0.02, 6.99±0.17 and 11.13±0.34 kg, respectively; in case of Jamuna River basin sheep, the values were 1.57±0.10, 1.30±0.03, 6.84±0.29 and 10.47±0.52 kg, respectively; the values for Barind sheep were 1.73±0.07, 1.40±0.04, 6.87±0.27, 10.46±0.29 kg, respectively and in case of Garole sheep, the values were 1.76±0.08, 1.31±0.03, 6.09±0.19, 9.64±0.31 kg, respectively. There was no significant difference in litter size but in case of birth weight and 6 months body weight, there were significance difference ($p<0.001$ and $p<0.05$) among genotypes. Highest birth weight, 3 months and 6 months body weight were found in Coastal sheep while the highest litter size was found in Garole sheep.

Phenotypic observation in association of BMPR1B gene polymorphism with litter size was not significant. The heterozygous AG genotype had the highest litter size (1.52± 0.11; n=14) and homozygous AA genotype had the lowest litter size (1.00; n=04).

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

Parameters	Native sheep genotype				Significance level
	Coastal sheep	Jamuna river basin sheep	Barind sheep	Garole sheep	
Litter size	1.73±0.05 (129)	1.57±0.10 (42)	1.73±0.07 (60)	1.76±0.08 (58)	NS
Birth weight (kg)	1.56^{a}±0.02(129)	1.30^{c}±0.03(42)	1.40^{b}±0.04(60)	1.31^{c}±0.03(58)	***
3 months body weight (kg)	6.99±0.17 (75)	6.84±0.29 (27)	6.87±0.27 (36)	6.09±0.19 (22)	NS
6 months body weight (kg)	11.13^{a}±0.34 (39)	10.47^{ab}±0.52 (15)	10.46^{ab}±0.29 (29)	9.64^{b}±0.31 (19)	*

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)

Table 2. Average litter size (Mean ± SE) of different BMPR1B genotypes in selected sheep populations of BLRI

Gene	Genotype of selected animal	Expected Prolificacy	N	Observed Litter size	Level of significance
BMPR1B	AA	Low	4	1.00	NS
	AG	Moderate	14	1.52± 0.11	
	GG	High	3	1.17± 0.17	

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

Exotic sheep adaptation and their crossbreds production for the development of a meat type synthetic sheep breed

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Executive Summary

There is no established sheep breed in Bangladesh, but only the native sheep. Moreover, the growth rate of native sheep is low. Therefore, crossbred or synthetic sheep might be emphasized for meat production 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. However, very limited research work has done on synthetic sheep breed development in Bangladesh. Thus, the present study was undertaken to adapt high yielding exotic sheep breeds in our climatic condition and production of their crossbreds; to evaluate the productive and reproductive performance 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. The crossbreeding program was conducted with native sheep (Coastal and Jamuna River Basin) as dam and Dorper, Perendale, Suffolk and Damara sheep as sire. The breeding program was designed in such a way that resists inbreeding and maintain 50% foreign blood. Then, *inter-se* mating within all the crossbred genotype was practiced. The selection targets of the study were to improve the birth weight, 6 and 12 months body weight. Subsequent data on productive and reproductive performance were recorded regularly. The experimental design was CRD and the collected data were analyzed by SPSS 20.0 Statistical computer programme.

The production performance of exotic sheep is presented in Table 1. The average litter size, birth weight (kg), 3-month and 6-month weight (kg) of Dorper, Perendale & Suffolk sheep were 2.0±0.27, 2.90±0.56, 18.75±2.18 & 23.75±1.30; 1.40±0.17, 3.12±0.35, 16.34±1.38 and 24.75±1.30; 2.0±0.19, 2.58±0.39 & 13.83±1.54, respectively. Whereas the world standard value of litter size, birth weight and 3 months body weight of Dorper are 1.45-1.60, 4-4.75 and 25-30 kg; in case of, Perendale the values are 1.61-1.75, 3.9-4.4 and 20-22 kg; and in case of Suffolk the values are 1.6-1.95, 5-5.9 and 40-45 kg, respectively. Table 2 shows that in case of crossbred genotype, litter size, birth weight & 12 months body weight were found non-significant ($p>0.05$) while body weight at 6-month was found as significant ($p<0.05$). Among the crossbreds, in case of body weight at 6 months, the highest value was found in Suffolk crossbred genotype.

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

Genotype	Parameters (Mean ± SE)			
	Litter size	Birth weight (kg)	3 months body weight (kg)	6 months body weight (kg)
Dorper	2.0 ± 0.27 (02)	2.90 ± 0.56 (02)	18.75 ± 2.18 (02)	23.75 ± 1.30 (02)
Perendale	1.40 ± 0.17 (05)	3.12 ± 0.35 (05)	16.34 ± 1.38 (05)	24.75 ± 1.30 (02)
Suffolk	2.0 ± 0.19 (04)	2.58 ± 0.39 (04)	13.83 ± 1.54 (04)	-
Level of significance	NS	NS	NS	NS

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

Table 2: Productive and reproductive performance of crossbred sheep (Mean ± SE)

Crossbred Genotype	Parameters (Mean ± SE)			
	Litter size	Birth weight (kg)	6 months body weight (kg)	12 months body weight (kg)
Dorper Crossbred	1.23 ± 0.17 (49)	2.22 ± 0.14 (49)	13.51[b] ± 0.80 (16)	23.75 ± 1.30 (02)
Perendale Crossbred	1.33 ± 0.10 (25)	1.88 ± 0.08 (25)	13.10[b] ± 0.78 (13)	24.75 ± 1.30 (02)
Suffolk Crossbred	1.42 ± 0.14 (14)	2.13 ± 0.11 (14)	17.17[a] ± 1.06 (07)	-
Damara Crossbred	1.58 ± 0.15 (27)	1.83 ± 0.12 (27)	12.94[b] ± 1.45 (12)	20.11 ± 1.22 (09)
Level of significance	NS	NS	*	NS

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

Table 3: Productive and reproductive performance of crossbred sheep according to generation (Mean ± SE)

Crossbred Genotype	Generation	Parameters (Mean ± SE)			
		Litter size	Birth weight (kg)	6 months body weight (kg)	12 months body weight (kg)
Dorper Crossbred	1	1.29 ± 0.09 (28)	2.14 ± 0.08 (28)	11.43 ± 0.80 (12)	18.69 ± 1.29 (08)
	2	1.40 ± 0.11 (20)	1.93 ± 0.09 (20)	15.60 ± 1.39 (04)	25.35 ± 2.58 (02)
	3	1.00 ± 0.49 (01)	2.60 ± 0.41 (01)	-	-
Perendale Crossbred	1	1.50 ± 0.14 (12)	1.88 ± 0.12 (12)	14.07 ± 1.05 (07)	20.70 ± 1.49 (06)
	2	1.15 ± 0.14 (13)	1.88 ± 0.11 (13)	12.13 ± 1.14 (06)	15.90 ± 2.11 (03)
	3	1.00 (05)	2.02 ± 0.14 (05)	-	-
Suffolk Crossbred	1	1.40 ± 0.22 (05)	2.18 ± 0.18 (05)	17.47 ± 1.61 (03)	21.45±1.48 (02)
	2	1.44 ± 0.16 (09)	2.09 ± 0.14 (09)	16.88 ± 1.39 (04)	-
Damara Crossbred	1	1.64 ± 0.11 (132)	1.96±0.05 (132)	12.98±0.46 (71)	21.88±0.99 (02)
	2	1.50 ± 0.10 (24)	1.83 ± 0.08 (24)	14.79 ± 0.84 (11)	20.11 ± 1.22 (09)
	3	1.67 ± 0.28 (03)	1.83 ± 0.23 (03)	11.10 ± 2.79 (01)	-

Figure in the parenthesis indicate the number of observations.

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

Comparative Performances of Native Chickens Under ex-situ Production Environment for Selection as Parent Lines

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Executive summary

Poultry sector is an integral part of farming systems and has created both direct and indirect employment opportunity, improved food security and enhanced supply of quality protein to people's meals, contributing country's economic growth and reducing poverty level in rural and urban areas of Bangladesh. As now we are fulfilling our protein requirements 136 g meat and 147.10 nos of egg (DLS, 2021) as developed country, to achieve the goals of SDG's and also Vision-2021 by the year of 2041 we will be turned into a developed country. In many developed countries in the world peoples consume comparatively almost double number of eggs and meat every year. So, to be a developed country we should increase our minimum protein requirement level to compete with them. In this view this research has been undertaken.The objectives of the research were to select best performing native chicken lines based on growth, productive, reproductive performance and meat quality parameters. Four native chicken genotypes were selected namely Common Deshi, Hilly, Naked Neck and Aseel. About 250 birds of above first three genotypes and only 40 birds of Aseel were selected for this experiment. The birds were reared in an open sided house with semi gable type roof and concrete floor at BLRI regional station Godagari, Rajshahi and BLRI, Savar, Dhaka (only for Aseel chicken). After receiving birds were brooded properly for 6-8 weeks. All the requirements like bedding material, temperature, humidity and others during brooding period were maintained properly. The birds were then shifted to grower and after 20 weeks in laying shed and all managemental procedures will be maintained properly for different stages. All the birds were reared in a natural-ventilated poultry house and a 16h photoperiod. The experimental birds were fed three types of diets; starter (0-7weeks), grower (8-20 weeks), layer (20-above weeks) during brooding, growing and laying respectively. Ad-libitum feeding was practiced for first four weeks. Thereafter restricted feeding was practiced during growing period. *Ad libitum* fresh water was supplied twice daily in the morning and evening. Refusals of the feed were measured every day in the morning. After selection of superior birds, they were identified individually by using leg and wing bands. All types of data were recorded to maintain proper breeding. All growth and reproductive traits of individual birds from birth to the end of their productive life will be recorded. In addition, survivability and disease resistant traits were recorded on flock basis. All chicks were vaccinated and dewormed properly as per standard schedule. All data on feed intake of different chicken genotypes at different ages are shown in Table 1. Data show that lowest feed intake found in CD (7.45 g) whereas highest in Hilly (9.22 g) at 1 day of age. Lowest feed intake (36.65 g) found in Aseel and highest in NN (37.83 g) at the age of 4th week. Lowest feed intake was also found in Aseel at the age of 8th (61.28 g), 12th (85.71g), 16th (105.33 g) and 20th (115.52g) weeks whereas highest in NN (63.86g), Hilly (89.16g), NN (109.41 g) and NN (119.33) in consecutive weeks. There are significant differences in feed intake of different chicken genotypes at different weeks of ages.

Table 1: Feed intake of different native chicken genotypes at different ages

Age	CD (g)	Hilly (g)	NN (g)	Aseel (g)
DOC	7.45±0.043	9.22±0.008	7.96±0.033	9.16±0.089
4th Week	37.21±0.041	37.43±0.004	37.83±0.032	36.65±0.279
8th Week	62.21±0.041	63.86±0.139	62.76±0.033	61.28±0.103
12th Week	87.17±0.042	89.16±0.00	87.76±0.033	85.71±0.135
16th Week	109.30±0.157	108.73±0.127	109.41±0.132	105.33±0.206

20th Week	119.20±0.072	118.88±0.00	119.33±0.061	115.52±0.190
Sig. Level	***	***	***	***

Table 2 shows body weight of different chicken genotypes at different ages. This Table reveals that lowest body weight found in Aseel (26.47 g) in 1 day old and highest in Hilly (29.56 g). Lowest body weight was also found in Aseel (151.23 g) in 4th week whereas highest in CD (338.44 g). Lowest body weight was found in Hilly (331.99 g) whereas highest in CD (536.67g) at 8th week. Lowest body weight found in CD (862.95 g and 1208.23g) and whereas highest in Aseel (1127.13 g and 1305.67 g) at consecutively 12th and 16th weeks of age. At the age of 20 weeks' lowest body weight found in Aseel (1477.40 g) and highest in Hilly (1612.63g). There are significant differences in body weight among all genotypes of chicken at all ages.

Table 2: Body weight of different native chicken genotypes at different ages

Age	CD (g)	Hilly (g)	NN (g)	Aseel (g)
DOC	29.20±0.27	29.56±0.24	28.96±0.18	26.47±0.68
4th Week	338.44±2.26	332.24±2.51	278.75±3.17	151.23±6.19
8th Week	536.67±5.13	331.99±2.73	535.65±4.10	414.23±12.33
12th Week	862.95±9.91	929.92±14.29	876.51±11.45	1127.13±16.07
16th Week	1208.23±12.60	1210.33±17.70	1259.36±15.00	1305.67±20.81
20th Week	1561.07±11.22	1612.63±15.93	1483.24±13.62	1477.40±20.00
Sig. Level	***	***	***	***

From this study it was observed that Hilly and Aseel performed better at marketing age (12th week). However, Hilly and CD occupied top positions at 20th week of age. This finding corroborates with the previous findings conducted at BLRI, Savar, Dhaka. We need more egg production data for making a valid conclusion.

Quality and safety assessments for poultry meat products in Bangladesh

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Executive summary

The lifestyle is gradually changing towards a positive trend due to increase the level of income. For this reason, peoples are changing their food habits too. Now everybody wants to eat something ready-made due to the shortage of time and workloads. The fast food what's getting our surroundings in fast food shop and departmental store, most of these are chicken meat products. Companies are marketing chicken meat products like chicken nugget, chicken sausage, chicken meatball, chicken burger patty, chicken drumstick, chicken salami, chicken popcorn, chicken hot wings, chicken strips, chicken kebab, chicken cutlet, smoked breast and chicken lollipop by varieties of brand name. The aim of the study was to evaluate the proximate components of most consuming chicken meat products of reputed companies of Bangladesh. For this study, sample was collected from the five reputed companies of Bangladesh on the basis of that's companies market share. Five chicken meat products from each company, finally, total 25 samples were selected for nutritional analysis. The chicken meatball, chicken nuggets, chicken sausage, fried chicken and chicken burger were selected. Sample was collected from the outlet of company (single outlet for each company). The sample collection area was Mohammadpur and Dhanmondi of Dhaka city. Moisture, crude protein, crude fat, ash and ether extract of chicken meat products was determined as per the standard procedures of Association of Official Analytical Chemists (AOAC, 1995).The same sample has been placed in the central laboratory of Bangladesh Agricultural University, Mymensingh for detection of heavy metals likeLead (Pb), Chromium (Cr), Cadmium (Cd), Arsenic (As), Cobalt (Co) and spoilage microorganisms like E. Coli, Salmonella, Clostridium.
The data was analyzed through SPSS. 16 Versions

Table-01: Comparison into different meat products for proximate component of five companies of Bangladesh

Product Name	Proximate Component (%)				
	Moisture	Ash	Crude Fiber	Ether Extract	Crude Protein
Chicken Fry	73.06 ± 1.09^{a}	2.14 ± 0.18	2.08 ± 0.06	2.56 ± 0.23^{b}	19.10 ± 1.23^{a}
Chicken Nugget	58.94 ± 2.89^{c}	2.18 ± 0.18	2.85 ± 0.74	7.04 ± 1.45^{a}	15.16 ± 1.03^{b}
Chicken Sausage	67.45 ± 1.77^{ab}	1.72 ± 0.12	3.51 ± 0.61	3.00 ± 0.58^{b}	14.96 ± 1.31^{b}
Chicken Burger	63.41 ± 3.50^{bc}	2.30 ± 0.17	2.40 ± 0.46	5.28 ± 1.42^{ab}	16.88 ± 0.90^{ab}
Chicken Meatball	65.89 ± 1.92^{abc}	2.66 ± 0.37	2.67 ± 0.47	2.80 ± 0.30^{b}	13.68 ± 1.57^{b}
P-value	0.008	0.099	0.408	0.013	0.049

Mean ± SE; Compare mean- One way anova

It was found significant difference in case for moisture content (highly significant), ether extract and crude protein. The highest moisture content was found in Chicken fry and the lowest result was found in Chicken nugget. The ether extract was higher in Chicken nugget and lower in Chicken fry. Crude protein was higher in Chicken fry and lower in Chicken meatball and that was low level of significance.

Table-02: Average value of proximate component (%) of different chicken meat products into these five companies

Product Name	Proximate Component				
	Average				
	Moisture	Ash	Crude Fiber	Ether Extract	Crude Protein
Chicken Fry	73.06	2.14	2.09	2.56	19.10
Chicken Nugget	58.94	2.18	2.86	7.04	15.16
Chicken Sausage	67.45	1.72	3.51	3.00	14.96
Chicken Burger	63.41	2.30	2.40	5.28	16.88
Chicken Meatball	65.89	2.46	2.67	2.80	13.68

The proximate component of five chicken meat products sample was analyzed and the sample was collected from company's outlet. The result showed significant difference for moisture content, ether extract and crude protein. Moisture content was higher in Chicken fry, ether extract was higher in Chicken nugget and crude protein was higher in Chicken fry.On the basis of analysis, the proximate result was in normal range for different products of different companies. There was somewhat compositional difference for different products; this might be for different processing technique (such as frying, mixing, and marinating). Finally, we can conclude that proximate components of the products are in normal value in the nutritional aspects.

Feeding effects of probiotic, synbiotic and organic acid as alternatives to antibiotic in broiler production

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Executive summary

Poultry industry plays a vital role for income generation in rural people. Enormous demand for animal protein has caused an increasing of broiler farming in Bangladesh. However, to maximum production, feeding and good management practices are not properly maintained (Alkhalf et.al. 2010), Modern feeding practice involves the use of phytobiotics, probiotics, antibiotic growth promoters, balanced diet, and so many new concepts. Several animal husbandry practices have been reported to be important risk factors in transmitting antimicrobial zoonotic drug resistance in rural Bangladesh (Paulina and Katarzyna 2018). Therefore, the aim of the experiment was to investigate the effects of dietary supplementations of prebiotic, synbiotic and organic acid as alternative to antibiotic on growth performance and carcass characteristics of broiler chickens.
A total of 240 day-old Arbor Acres broiler chickens of either sex were randomly assigne to five dietary treatments each consisting of four replication and each replicate having 12 birds for 5 weeks. The dietary treatments were (T_1) control group with basal diet, (T_2) Basal diet supplemented with antibiotic (at 250 gm/100 kg of starter as well as finisher ration), (T_3) Basal diet supplemented with probiotic (at 10 gm/100 kg of starter as well as finisher ration), (T_4) Basal diet supplemented with synbiotic (at 25 gm/100 kg of starter ration as well as finisher ration), and (T_5) Basal diet supplemented with organic acid (at 150 gm/100 kg of starter as well as finisher ration). The birds were provided with ad-libitum feed and drinking water during the entire experimental period.

The highest body weight observed in a probiotic group, which was non-significantly ($p>0.05$) higher than the control group. Antibiotic, synbiotic and organic acid groups showed lower body weight than probiotic group. A total feed intake did not show any significant ($p>0.05$) difference between experimental groups. There were no significant ($p>0.05$) differences in feed conversion ratio of broiler chickens in antibiotic, prebiotic, synbiotic and organic acid groups as compared with control group. There was no significant ($p>0.05$) difference in the carcass traits with respect to dressing percentage, carcass percentage, heart weight, liver weight and gizzard weight, wing percentage, breast percentage, back percentage, thigh percentage, and drumstick percentage in Arbor Acres broilers under study. The growth performance and percentage of carcass yield did not show any significant difference by the dietary inclusion of antibiotic, probiotic, synbiotic, and organic acid compared with un-supplemented control in a commercial broiler chicken. So that it is easily conclude that, probiotic, synbiotic, and organic acid can be use as alternatives to antibiotic.

Table 1. Growth performance of broiler at 5th week

	T1	T2	T3	T4	T5	SED	Sig.
Initial wt	38.75^{b}±0.06	39.02^{a}±0.20	38.76^{b}±0.16	38.67^{bc}±0.08	38.53^{c}±.0.09	0.04	**
BW	1700.75^{b}±7.49	1671.10^{c}±13.29	1777.75^{a}±6.44	1697.65^{b}±6.18	1703.70^{b}±5.61	2.62	***
FI	2433.4±188.8	2420.1±206.6	2518.3±224.5	2380.1±147.4	2432.3±222.0	63.22	NS
FCR	1.46±0.06	1.48±0.06	1.44±0.06	1.43±0.04	1.46±0.06	0.10	.985

T_1-Control Diet; T_2- antibiotic at 250 gm/100 kg; T_3- probiotic at 10 gm/100 kg; T_4- synbiotic at 25 gm/100 kg; T_5- organic acid at 150 gm/100 kg. Values are expressed as mean and standard error of means. Means represent four replicates, four bird per replicate. $^{a, b, c}$ Mean with different superscripts within same rows are significantly different (p <.05) by Tukey HSD test, SEM= Standard Error of Mean.

Table -2: Effect of carcass characteristics of broiler at different stage of ages

	T1	T2	T3	T4	T5	SED	Sig.
Live weight	2050.62±254.23	2013.00±215.47	1935.12±283.41	1955.50±187.43	1850.25±198.11	51.55	NS
Carcass	1303.62±182.83	1291.75±122.80	1232.12±179.17	1267.87±135.11	1181.25±123.90	33.79	NS
Breast	380.00±74.36	357.37±44.58	346.87±56.97	375.00±46.34	330.50±44.77	12.21	NS
Thigh	212.25±30.72	218.87±25.02	218.87±25.02	204.37±28.04	200.62±26.72	6.27	NS
Drumstick	191.75±29.82	179.87±21.14	181.87±24.96	187.25±21.06	169.75±15.12	5.13	NS
Wing	119.50±15.69	113.62±9.006	119.37±11.89	122.75±11.79	116.75±9.11	2.63	NS
Ab. fat	21.75^{ac}±7.57	20.00^{ac}±2.92	17.37^{cb}±8.01	13.50^{b}±4.44	20.00^{ac}±5.31	1.33	*

T_1-Control Diet; T_2- antibiotic at 250 gm/100 kg; T_3- probiotic at 10 gm/100 kg; T_4- synbiotic at 25 gm/100 kg; T_5- organic acid at 150 gm/100 kg. Values are expressed as mean and standard error of means. Means represent four replicates, four bird per replicate. $^{a, b, c}$ Mean with different superscripts within same rows are significantly different (p <.05) by Tukey HSD test, SEM= Standard Error of Mean.

Study on mule duck production and assessment of meat quality traits in Bangladesh

Sub title: Performance of exotic duck with their potentiality as parent line to produce meat type duck in Bangladesh condition

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Executive summary

Among domesticated avian species, Muscovy duck is ranked third after chicken and guinea fowl. Muscovy duck (*Cairina moschata*) and common duck (*Anas platyrhynchos*) are the most common genera of domesticated ducks. Muscovy duck is commonly found all over the world constituting 74% of all duck species. Muscovy duck is an integral part of local poultry sector on a small scale in the rural areas. The demand of duck meat is mostly fulfilled by the culled laying duck. A part of duck meat demand is being fulfilled by pekin duck (*Anas platyrhynchos*). Pekin ducks are adaptable in wider climatic conditions. These are also known to possess a strong and resilient immune system. The body shape of a Pekin duck is long, fairly wide and full breasted. The meat of the laying ducks either male or female was relatively little, because its weight was only about 1.2-1.3 kg/duck at the age of 10-12 weeks, so that the resulting meat was only about 0.6-0.7 kg/duck/10-12 weeks of age. However, the hybrid duck generated by the community were still vary, both coat color and productivity. Therefore, recently in the Bangladesh Livestock Research Institute (BLRI) have been pioneered the establishment of meat type duck stocks that were expected to have a uniform of color feather (preferably white) and meat production. During this study, BLRI improved Local Deshi (Rupali) was crossed with Muscovy and Pekin males to produce F1 hybrid ducks. Muscovy and pekin have the potentiality to be developed into a source of meat that can provide permanent impact, due to the improving of production levels would be inherited to their offspring. In rural areas, male muscovy commonly crosses with layer ducks for the production of mule ducks to be sold as meat type ducks. However, their population is very few with various plumage colors (black, chocolate, lavender, white and silver) and with very low egg production. Therefore, Muscovy can be used as the male parent stock in a commercial production for mule ducks, but it was preferable if they have white plumage for better carcass performance. The aim of the study was to evaluate the characteristics of a muscovy and pekin population whether they were suitable as the parent stock for meat type duck production through intercrossing. This study was conducted at the Duck Research Farm, Bangladesh Livestock Research Institute, Savar, Dhaka. This study investigated the morphological features and growth performance of muscovy duck (M), pekin duck (P) and BLRI improved local common white (Rupali). A total of 50 females and 10 males of local white muscovy and pekin ducks were collected from Khulna district as DOD (day old ducklings) were used in this study. The body weight (gm) of Rupali was collected from BLRI Duck farm germplasm flock. They were kept under close confinements and fed according their nutrition requirements. Measurements were taken on body weight at DOD, 2, 4, 5, 8, 10, 12 weeks of age and morphological characteristics. Commercial concentrated feed (recommended) was fed to ducks daily and allowed to scavenge during the day within the fenced farm. Means and standard deviations of all measured traits were computed.

Results showed that the average body weight of Muscovy duck, Pekin duck at DOD, 2, 4, 5, 8, 10, 12 weeks of age were 47.56±0.64, 294.66±27.03, 818.75±45.75, 1186.45±119.36, 1708.12±153.18, 2122.86±234.54, 2509.35±129.74 and 42.47±0.58, 283.78±63.1, 704.12±67.09, 1100.27±94.85, 1324.83±229.62, 1627.57±175.82, 1806.97±129.36 grams respectively, whereas the average body weight of Rupali (BLRI improved common white) at DOD, 2, 4, 5, 8, 10, 12 weeks of age were 40.47±0.60, 156.78±23.9, 378.95±61.89, 674.44±84.05, 846.71±127.62, 1058.85±225.12, 1399.91±233.61 grams with a variation of 30%, 145%, 92%, 49%, 51%, 51%, 52% respectively of more weight of Muscovy and

16%, 135%, 66%, 38%, 17%, 16%, 14% respectively of more weight of Pekin than Rupali. With such large variations, the population was appropriate to be used as the foundation stock for a selection to improve meat production through intercrossing breeding scheme.

Table 1. Performances of Muscovy duck, pekin and rupali at at different age

Age (wk)	Live weight (Mean ± SD)			LS
	Muscovy	Pekin	Rupali	
DOD	47.56±0.64 (50)[1]	42.47±0.58 (45)	36.16±0.60 (102)	
2nd	294.66±27.03 (42)	283.78±63.1 (40)	120.48±23.9 (80)	
4th	818.75±45.75 (35)	704.12±67.09 (38)	424.87±61.89 (72)	
6th	1186.45±119.36 (35)	1100.27±94.85 (35)	792.48±84.05 (61)	***[2]
8th	1708.12±153.18 (30)	1324.83±229.62 (30)	1126.11±127.62 (60)	
10th	2122.86±234.54 (30)	1627.57±175.82 (30)	1401.48±225.12 (60	
12th	2409.35±129.74 (30)	1806.97±129.36 (30)	1580.47±233.61 (56)	

*[1] values in the parentheses indicate the number of observations. [2]different superscripts in the same row within a trait differ significantly at ***= P<0.001*

Based on the productivity characteristics, the white Muscovy and Pekin have potentiality as parent stock for meat type hybrid duck, due to large body size and uniformity. Coefficient of variation in weight gain for 12 weeks was characterized high, therefore the selection program on body weight gain compared to native, Muscovy and Pekin was expected to give a positive response, so at the end the growth of native duck could be increased and followed by the intercrossing with Muscovy and Pekin to get meat type duck.

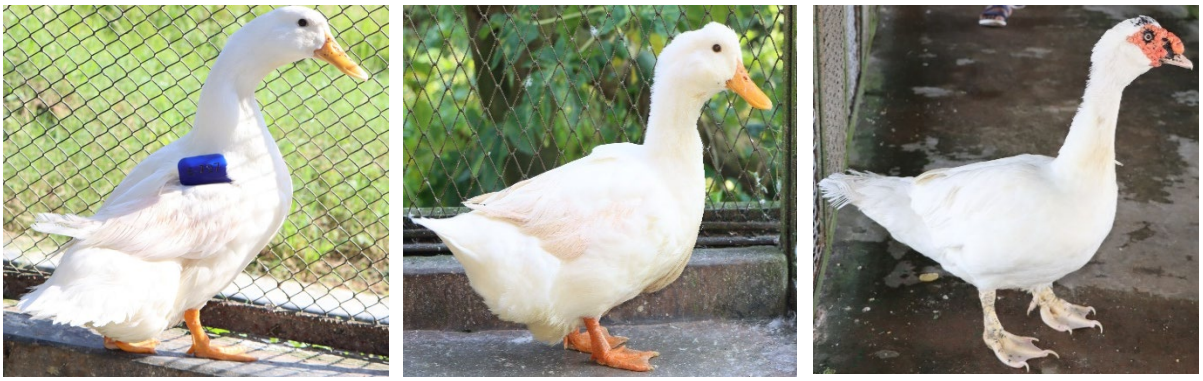

Figure. Pictures of Rupali, Pekin and Muscovy ducks rearing at BLRI Duck Farm

Demonstration and validation of BLRI developed native duck through community level at Bhanga, Faridpur

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Executive summary

Bangladesh is the biggest delta landscape in the world with a large human and natural resources. Duck is the important poultry species which are mostly reared in southern part and haor area of Bangladesh. Duck farming appears to be a profitable business for the rural farmer of Bangladesh. The climate and environmental condition of Bangladesh are suitable for duck habitation. Duck are more productive and resistant to the harsh climatic condition than chicken (Islam et al. 2003a). BLRI developed native ducks named as Rupali and Nageswari. Several studies were conducted to evaluate productive, reproductive and phenotypic characteristics of Rupali and Nageswary duck. All those studies were conducted on station under intensive management system. Presumptuous that both Rupali and Nageswary ducks will perform better under scavenging system of rearing in rural condition, a field trial was conducted to validate the production ability of Rupali and Nageswary ducks compared to locally rear native ducks under farmer's condition. Demonstration and validation of BLRI developed native duck through community level at Bhanga, Faridpur was introduced to know the productive performance and compare the productive and reproductive performance at field level. BLRI demonstration farm had 180 duck in which Rupali were 98 and Nageswari were 82. These duck were reared in Semi-intensive system. Their production performance and weight at different age were recorded. From this duck shed egg of Rupali and Nageswari were distributed to the rural women for hatching and trial the BLRI native duck at community level at Bhanga Faridpur. The Experiment was designed in 4 treatment group having 10 replications. Each replications consists of BLRI native duck either Rupali or Nageswari or both. The farmer reared duck in their house in backyard farming system and in local management and feeding. Data on egg hatchability rate, egg weight, duckling weight, weight at 8 & 16week of age, weight at laying , age at egg production, Weight at culling, dressing weight and egg production per year were recorded.

Production Performance of BLRI native duck at on Station and on farm level.

SL NO.	Parameter	On Station (BLRI Regional station, Bhanga, Faridpur)		On farm level (In rural area of Bhanga, Faridpur)	
		Rupali	Nageshori	Rupali	Nageshori
1	Egg hatchability rate:	68%	65%	65%	60%
2	Day old Duckling weight	40gm	38gm	40gm	36gm
3	weight at 8 week of age	700gm	600gm	650gm	600gm
4	weight at 16 week of age	1.40kg	1.20kg	1.25kg	1.05kg
5	weight at egg production	1.50kg	1.30kg	1.45kg	1.20kg
6	Age at egg production	160day	163day	180	175day
7	weight at culling	1.90kg	1.70kg	2.20kg	1.80kg

8	Dressing weight	1.140kg	952gm	1.34kg	1.0kg
9	Dressing %	60%	56%	62%	55.56%
10	Weight of Egg	66g	57g	65g	54g
11	Egg production per year	170	180	150	160

From this findings Rupali duck had better body weight gain and egg weight than Nageswari duck. But Nageswari duck had high egg production in compared to Rupali duck. The production performance of BLRI native duck on Station is higher than on community farm level.

Improvement of egg production and egg quality through nutritional manipulation (Effect of feeding fresh azolla on the production performance and egg quality of native laying duck)

H Khatun, MMR Manu, S Faruque and MRA Sumon

Executive Summary

Poultry farming is the most profitable enterprise responsible for employment of rural peoples. In Bangladesh duck population of around 638.45 in lakh according to the Department of livestock services (2021-22). Duck products in the form of meat and egg have demand in local market. The increased price of feed ingredients the production cost is high. Therefore, use of alternate feed ingredients needs to be explored to sustain the poultry production. In this situation, Azolla can be used as an alternate feed ingredient to sustain livestock and poultry production. Generally duck consumed more feed for their production. For minimizing the cost of production azolla can be an alternate feed ingredient for duck ration. Azolla biomass doubled in a week. Azolla yielded approximately 700-800 gms/m^2. The proximate composition of Azolla pinnata was: dry matter-6.6, crude protein-24.53, ether extract-4.40, crude fibre-14.6 and total ash 14.45 % respectively. The calcium contain was generally high. Regarding this nutrient composition a study was conducted to examine the effect of feeding of fresh *azolla pinnata* in the diet of native laying ducks on their production performance and egg quality. Sixty native laying ducks (38 weeks) were divided into four groups (each group had three replicates with five laying ducks per replicate) and were randomly fed four experimental diets: Control diet (duck layer diet (DLD), no azolla), T_1 (DLD reduced by 10% + fresh azolla @ 100g/duck/day, T_2 (DLD reduced by 15% + fresh azolla @ 150g/duck/day) and T_3 (DLD reduced by 20% + fresh azolla @ 200g/duck/day) for a period of 84 days. All the diets were made iso-nitrogenous and iso-caloric. The egg production, feed intake, egg weight and egg quality data were recorded. Duck day egg production percent, feed conversion ratio, performance efficiency index and cost of feed/egg (Tk.) were calculated. The design of the experiment was RCBD. The data were analyzed by SPSS, version 20.0. The means were tested for significant differences by Duncan's Multiple Range Test (Duncan, 1955). Effect of feeding fresh azolla on the performance of native laying duck are presenting in table 1. Significant ($p<0.001$) decrease in feed consumption was observed in laying duck fed diet given fresh azolla @ 200g/duck/day (T3). Significant ($p<0.001$) improvement in feed conversion ratio was observed in laying ducks fed fresh azolla at all levels. Egg weight was not found any difference in all treatment groups. Duck day egg production (DDEP) numerically increased due to supplementation of fresh azolla at all levels (100g, 150g and 200g/duck/day) than control. There was a saving of about tk. 3/- each egg production on ducks fed 20% azolla diet. The performance efficiency index increased significantly ($p<0.001$) due to fed of fresh azolla in native laying ducks at all levels which might be due to better FCR, egg production and egg weight in azolla fed ducks.

Table 1: Effect of feeding fresh azolla on the performance of native laying duck (Mean ± SE)

Treatment	Egg weight, g	Feed consumption, g	Egg production %	FCR	Feed cost/ egg	Performance efficiency index
TI	66.91±0.63	10565^{b}±109.12	53.57±1.92	3.51^{b}± 0.08	11.28±1.06	33.40^{b}±0.90
T2	65.53±0.55	9972^{c}± 90.12	56.74±1.80	3.19^{c}± 0.02	10.13±1.24	36.95^{a}±0.89
T3	67.43±0.61	9408^{d}± 86.12	53.96±1.10	3.09^{c}± 0.03	9.96±1.12	39.98^{a}±0.80
Control	65.28±0.63	11784^{a}± 103.12	51.43±2.09	4.18^{a}± 0.08	13.06±1.11	28.42^{c}±0.98
P value	0.091	0.000	0.342	0.000	0.353	0.000

Effect of fresh azolla on egg quality characteristics of native laying duck are presenting in table 2. The shape index increased significantly in ducks kept on T2 (150g fresh azolla/duck/day) and egg quality parameters such as albumen index, yolk index, haugh unit, albumen %, yolk %, shell % in ducks fed fresh

Table 2: Effect of fresh azolla on egg quality characteristics of native laying duck (Mean ±SE)

Treatment	Shape Index	Albumen Index	Yolk Index	Haugh Unit	Albumen (%)	Yolk (%)	Shell (%)	Yolk Color
TI	72.10^{ab}±1.23	19.96±1.55	45.78±1.94	94.85±3.09	48.94±2.69	33.64±1.63	10.88±0.36	11.28±0.32
T2	74.39^{a}±1.23	20.68±1.55	45.75±1.90	97.23±3.09	51.86±2.69	32.81±1.63	10.97±0.36	11±0.32
T3	72.30^{ab}±1.33	18.17±1.68	46.04±2.09	96.39±3.34	48.26±2.91	34.75±1.76	11.26±0.39	10.58±0.34
Control	68.95^{b}±1.46	18.23±1.84	47.55±2.29	94.39±3.66	46.91±3.18	35.02±1.92	11.63±0.43	9.6±0.37
P value	0.057	0.631	0..834	0.670	0.342	0.791	0.551	0.01

azolla were similar in all groups. The egg yolk of the laying ducks fed azolla was deep orange in color compared to the yellow color of the egg yolk in the control ducks. It can be concluded that supplementation of fresh azolla @ 200g/duck/day by substituting 20% of standard duck layer diet improve the egg weight, feed conversion ratio, feed cost/egg and performance efficiency index with enrichment of yolk color.

Parameter	Nutrient (%)	T1	T2	T3	Control	Level of significance	
yolk						para	treat
	Moisture	46.37±	46.53±	43.67±	43.26±	0.000	0.000
	Crude Protein	13.05±	13.73±	12.35±	12.87±	0.000	0.583
	Fat	20.92±	23.72±	25.42±	23.82±	0.000	0.039
Albumen	Moisture	87.80±	87.96±	85.10±	84.68±	0.000	0.000
	Crude Protein	9.46±	10.15±	8.77±	9.28±	0.000	0.583
	Fat	0.03±	1.47±	3.17±	1.57±	0.000	0.039

Geese production and management practices in some selected regions of Bangladesh

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Executive Summary

The goose is a multi-purpose winged animal reared for meat production. It is both popular in backyard companions as well as commercially produced in specialized farms in few countries in Asia and Central Europe for economical impotency. It has numerous interesting biological characteristics such as a high juvenile growth rate, good adaptation to extensive management and more disease resistance. Besides, supplying nutritious meat, large eggs, rich fat for cooking as well as soft down, and feathers for bedding and clothing, which makes particularly supplementary income of farmers and animal protein requirement for family. They are grass foragers and play a key role as guard control, even do not compete directly with humans for grains like chicken. Based on all these factors, geese production is of considerable importance and widespread interest. However, it is remained a neglected specialized poultry species in Bangladesh to be extended in spite of having ample advantages. Even, till now no primary statistics are available in the literature. Lack of proper technical knowledge regarding all aspects of geese production and management, which are some of the major obstacles for development of geese production in our country. Therefore, based on the above discussion, the study was conducted to know the overview of various characteristics of geese production and management in some selected areas of Bangladesh. The study was conducted in purposively three locations of Bangladesh viz. Godhagari, Rajshahi, Monirampur, Jashore and Koyra, Khulna. A survey was carried out in these areas to document rearing practices using a pre-tested questionnaire by conducting direct interviews to the farmer's house. Forty (40) geese farmers from each area, a total of 120 in all, were selected by simple random sampling technique, on the basis of flock size having at least three geese in each farmer's house. The selected farmers were interviewed in easy and understandable language for obtaining information on geese rearing and other details. Socio-economic status of the geese rearers was also documented. Descriptive statistics were performed using Microsoft excel 2013 to represent the data.

It was observed that, the farmers had practiced different occupations in the study areas. None of the farmers had engaged in goose rearing as their sole occupation. It was only kept in house either as a sideline, hobby, and ornamental or as a subsidiary source of income (Table 1). An average geese flock size in the surveyed areas of Rajshahi, Jashore and Khulna was 9.45, 5.85 and 7.02 number, respectively (Table 2). Semi-intensive production system was being followed by the farmers in all areas. Different types of houses included for keeping geese and majority of the farmers kept in separate pen (95.83%) and floor of the house (3.33%) with 58.33% farmers use litter as a bedding material. Feed was given in a large bowl/bucket and small bucket by 90% and 10% farmers. About 99.17% farmers used bucket or box type incubation nest and straw nest on the floor less than 1%. Gosling production was followed naturally by broody geese and eggs were mainly kept for hatching. Average number of eggs was set for incubation 9.64±0.29 and eggs were kept for storage 18.16±9.47 days of age. After 10 days of hatching, gosling was usually allowed to go into water. An adult goose was being marketed at the farmer's door-step and in city as well as consumed by family in the special occasion or festival. Average price of gosling and an adult goose was 150 Tk and 1500 Tk.

Table 1. Housing, feeding and incubation practices of geese in the survey areas

Parameter	Percentage of the farmers (%)			
	Rajshahi (Godagari)	**Jashore** (Monirampur)	**Khulna** (Koyra)	**Overall**
Type of house				
Separate shed	90 (36)	97.5 (39)	100 (40)	95.83
With other duck	2.5(1)	-	-	-
With duck and chicken together	-	-	-	-
Floor of the house	7.5(3)	2.5 (1)	-	3.33
Others	-	-	-	-
Use of bedding material/litter				
Litter used	22.5	95.00	57.5	58.33
Litter not used	77.5	5.00	42.5	41.67
Feeding system				
In a big bowl	77.5	92.5	100.0	90.00
On floor	-	-	-	-
In circular plain sheet	-	-	-	-
Small bucket	22.5	7.50	-	10.00
Over polythene sheet	-	-	-	-
Types of incubation nest				
Nest in a bucket or box	97.5	100.00	100.00	99.17
Straw nest on floor	2.5	0.00	-	<1.00

Table 2. Egg storage, incubation and price of gosling and adult goose

Parameter	**Overall** (Mean±SD)
Egg storage for hatching (days)	18.16±9.47
No. of eggs set for incubation	9.64±0.29
Price of each gosling (Tk.)	150.00
Price of adult goose (Tk.)	1500.00

Thus, it can be summarized that geese rearing in some selected areas could be a profitable farming practice with minimal feed suppliment.

Project title: Improvement of poultry species through appropriate selection and breeding and development of meat and egg type strains/crossbreds
Study 3: Development of meat type quail through appropriate breeding
Sub-title: Conservation and Improvement of Quail: Performances of four quail genotypes in the eleventh generation

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Executive Summary

Four genotypes of quail such as Dhakai (D), White (W), Brown (Br) and Black (Bl) quail are being maintained at thePoultry Production Research Division, BLRI. In this study, 6th week body weight (BW) is using as a selection criterion and maintaining the precise pedigree records in each generation for developing meat- type quail genotypes. Single pair mating through selective breeding is also practicing to produce the chicks of the subsequent generation. Therefore, the present study was undertaken to evaluate growth performance at the sixth week BW of D, W, Bl, and Br quail genotypes in the 11thgeneration (G_{11}). The commercial poultry feed was provided to all birds twice a day, in the morning and the evening, from 0 to 4 weeks (starter feed: 24% CP, ME 3000 Kcal/kg DM), 4 to 5 weeks (grower feed: 21% CP, ME 2800 Kcal/kg DM), and 6 to 30 weeks (layer feed: 18% CP, ME 2600 Kcal/kg DM) of age, respectively.The water was supplied ad-libitum. A total of 1206 day-old quail chicks comprising of Bl-398, Br-171, D-257 and W-380 were hatched in three successive batches to produce chicks of the G_{11}. Progeny were leg and wing banded and reared separately according to genotypes. Expected genetic progress due to selection for the 6th week BW was estimated for the G_{11} using the following equation (*Falconer, 1981),* $R= h^2 \times S$ where, R= Expected response, h^2 = heritability for 6th week body weight, S= Selection differential for the selected males and females. Data were analyzed by CRD using Statistical Package for the Social Sciences (SPSS) version 20.0.

Table 1 showed that higher day old chick weight was found in the D genotype (6.87±0.07g) followed by the Bl genotype (6.81±0.06g), W (6.59±0.06g), and Br (6.28±0.08g). The 6th week BW was higher in the D (136.67± 4.76g) than W (131.73±3.47g), Br (130.42±6.58g), and Bl (120.21±4.14g). Both the egg production percentage (EP %) and hen day egg production percentage (HDEP %) from 16 to 30 weeks of age were significantly ($p<0.001$) higher in W genotypes (70.23±0.79, and 67.47±0.41) followed by Bl, D and Br genotypes, respectively. The feed intake (g/d/b) from 0 to 4 weeks of age was significantly higher ($p<0.001$) in Bl among the genotypes. The amount of feed intake per bird was 11.55±0.78, 10.85±0.78, 10.53±0.78, and 9.16±0.78g, for the Bl, D, W, and Br quail genotypes; respectively. On the other hand, feed conversion ratio (FCR) from 0 to 4 weeks of age was significantly lower in D (2.79) than Br (2.94), W (2.950), and Bl (3.46). Selection differential varied from 4.17g BW in Br quail female to 10.96g BW in W quail female. The selection differentials for the males were 8.90, 5.66, 5.63, and 8.27 g for Bl, Br, D, and W quail genotypes, respectively. For the females, the corresponding values of the selection differentials were 7.62, 4.17, 5.66, and 10.96g (Table 2). Table 2 also showed that the 6th week BW of male quails of Bl, Br, D and W were expected to increase by 3.57, 2.55, 2.43 and 3.99; respectively. While in female quails of Bl, Br, D and W; the expected responses were 3.47, 1.89, 2.21 and 5.22; respectively. Table 3 shows the mortality percentage (0-4weeks) was non- significantly higher in Bl (7.05%) followed by W (5.41%), Br (4.90%), and D (4.35%). Finally, based on the production performance among four types of genotypes, the Dhakai genotype was superior for body weight and white quail for egg production. The present findings suggested for further study to produce standard population size of four quail genotypes in the twelve generation (G_{12}) for improving their target body weight at BLRI

Table 1. Body weight and egg production performances of four quail genotypes at the eleventh generation

Traits	Genotype				Level of Sig.
	Black (Mean±SE)	Brown (Mean±SE)	Dhakai (Mean±SE)	White (Mean±SE)	
Day old chick weight (g)	6.81[a]±0.06	6.28[c]±0.08	6.87 [a] ±0.07	6.59[b]±0.06	p<0.001
BW at 5th weeks(g)	116.19±1.51	116.36±1.98	131.566±1.50	15.78±1.50	p<0.001
BW at 6th weeks(g)	120.21±4.14	130.42±6.58	136.67±4.76	131.73±3.47	p<0.001
EP (16-30 weeks) (%.)	69.20±0.73	66.61±.95	69.10±79	70.23±.79	p<0.001
HDEP (15-30 weeks) (%)	65.96±0.41	64.91±0.78	67.13±0.41	67.47±0.41	p<0.001
FI (0-4 weeks) (g/d/b	11.55±0.78	9.16±0.78	10.85±0.78	10.53±0.78	p<0.001
FI (5 -8 weeks) (g/d/b)	17.07±0.73	17.16±0.73	18.48±0.73	19.03±0.73	p<0.001
FCR (up to 4 weeks)	3.46±0.05	2.94±0.04	2.79±0.03	2.95±0.03	p<0.001
FCR (up to 5 weeks)	3.72±0.04	3.17±0.05	3.23±0.04	3.23±0.04	p<0.001

BW=Body weight; EP=Egg production; HDEP=Hen-day egg production; FI=Feed intake; FCR=Feed conversion ratio*Least squares mean without a common superscript along the row within a factor differedsignificantly (p<0.001).

Table 2. Selection responses for 6th week body weight (g) of four quail genotypes in eleventh generation

Genotypes	Sex	Before selection		After selection		Selection Differential(S) (g)	Selection Intensity (i)	Heritability (h^2)	Expected response to selection (R)
		No.	Average	No.	Average				
Black	M	184	111.66	84	120.56	8.90	0.648	0.401	3.57
	F	159	135.42	84	143.04	7.62	0.611	0.455	3.47
Brown	M	83	107.39	60	113.05	5.66	0.363	0.451	2.55
	F	70	130.37	60	134.54	4.17	0.255	0.454	1.89
Dhakai	M	114	125.08	84	130.71	5.63	0.421	0.432	2.43
	F	107	150.63	84	156.29	5.66	0.378	0.391	2.21
White	M	181	119.85	84	128.12	8.27	0.839	0.482	3.99
	F	159	140.57	84	151.53	10.96	0.627	0.476	5.22

Table 3: Effect of four genotypes of quail on mortality at 0-4 & 5-8 weeks of age

Parameter	Week	Genotype				χ^2(df=3)	p- value
		Black	Brown	Dhakai	White		
Mortality(%)	0- 4 wk	7.05	4.92	4.35	5.41	1.023	p>0.05
	5-8 wk	1.38	3.45	0.0	1.9	3.34	p>0.05

On-farm measurement of noxious greenhouse gases from poultry litter and their possible utilization

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Executive Summary

The present experiment was conducted to determine the effective strategies to reduce odor emissions from poultry litter. Therefore, a low-protein diet with a particular amino acid (glutamine) was supplied to the BLRI meat chicken-1 to reduce the excretion of nitrogen for mitigating the environmental impacts. A total of 640 day old BLRI developed meat chicken-1 were equalized and allocated to 8 dietary treatments (4 replicated per treatment and 20 birds per replicated pen). The experimental design was completely randomized with a 4×2 factorial arrangement of treatments where 4 levels of glutamine% (0.00, 0.10, 0.15, and 0.20) and 2 levels of CP % (22, 19) were supplied to the experimental birds. Therefore, in the starter period of 0–21 days, (T_1, 22×0; T_2, 22×0.10; T_3, 22×0.15; T_4, 22×0.20; T_5, 19×0; T_6, 19×0.10; T_7, 19×0.15; T_8, 19×0.20) % CP and % glutamine were supplied in the diet. Dietary CP levels were reduced by 3% in each treatment during the growing period of 22–56 days. Body weight, weight gain and feed intake were measured and feed conversion ratio (FCR) was calculatedweekly. At the end of the experiment, 10 chickens in each treatmentwere slaughtered, and meat samples were collected to analyze the proximate and carcass characteristics of chickens.On the other hand, after 3 days adaptation period, fresh excreta from BLRI meat chicken-1were collected to determine excreta noxious gas emission. Excreta samples (1000g) were collected and stored in 10 L plastic bucket and allowed 24 hours for fermentation at room temperature. After the fermentation period, the gases(NH_3, CO_2, O_2, H_2S, CH_4 and CH_4S) that formed were determined using a Geotech (Biogas 5000, USA) from approximately 5cm above the excreta samples. All the data were arranged by 2-way ANOVA with interaction of a completely randomized design (CRD) and differences were determined by Duncan Multiple Range Test (DMRT) using SPSS, 25 computer software packages.

Results showed that, no significant difference were found among the treatments but numerically higher body weight (1020.24g) were gained in T_4 (22% CP x 0.20% Glu) and lower was found in T_5 (19% CP x 0.0% Glu) andT_1 (22% CP x 0.0% Glu). Weight gain was also numerically higher in T_4(984.44g) and in T_8 (976.30g) treatments. Among the treatments, significantlyhigher feed was consumed in T_1 (22% CP x 0.0% Glu) but lower in T_8 (19x0.20) treatment. Therefore, FCR (2.29) was found significantly better in the T_8 than the other treatments.

Table: Effect of dietary protein and glutamine on growth performance of BLRI meat chicken-1

Traits	Treatments								SEM	p-value (CPxGlu)
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8		
BW(g)	984.4	1001.3	1016.3	1020.2	981.3	991.1	1004.3	1012.1	0.39	0.14
WG(g)	949.1	965.8	980.9	984.4	945.8	955.3	968.7	976.3	0.28	0.13
FI(g)	2458.6^{a}	2289.6^{ab}	2252.4^{b}	2303.0^{ab}	2359.4^{ab}	2302.5^{ab}	2297.9^{ab}	2237.7^{b}	4.27	0.03
FCR	2.59^{a}	2.37^{bc}	2.30^{c}	2.34^{bc}	2.49^{ab}	2.41^{ab}	2.37^{bc}	2.29^{bc}	0.003	0.02

BW=Body weight, WG=Weight gain, FI=Feed intake, Glu=Glutamin, CP=Crude protein; SEM= Standard error of mean, different superscript in the same column differ significantly, $p<0.05$.

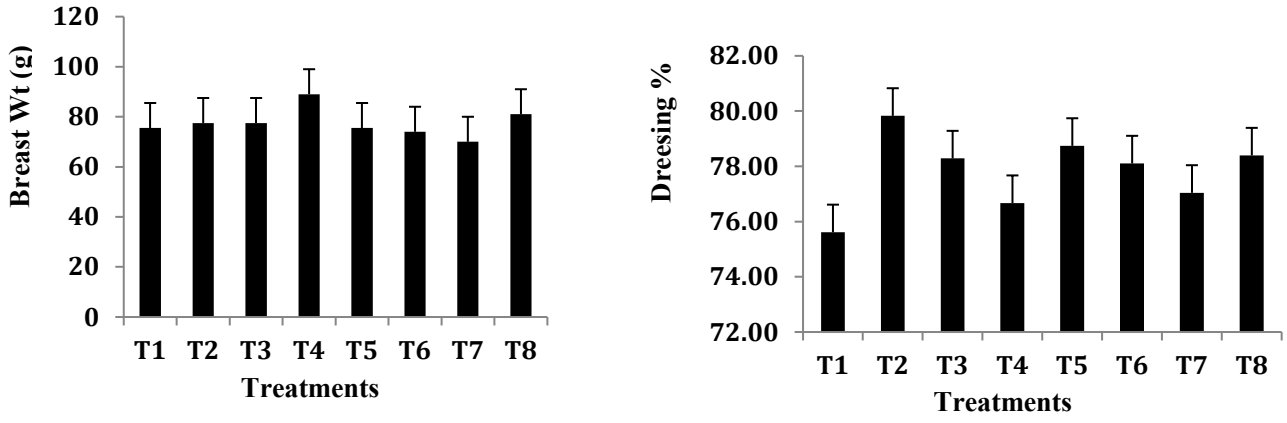

Figure 1: Effect of dietary protein and glutamine on Carcass characteristics of BLRI meat chicken-1

In carcass characteristics, higher amounts of breast meat (89g), thigh meat (115g) andwing weight (76g) were obtained in T_4 than in other treatments but higher dressing% was shown in T_2 treatments.All proximate compositions of meat were significantly different among the treatments.

Table 2: Effect of dietary protein and glutamine on noxious gas emission from the litter of BLRI meat chicken-1

Traits	Treatments								SEM	p-value
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8		
O_2 (%)	20.8	21.66	21.66	22.64	18.7	20.5	21.64	22.4	0.17	0.21
CH_4 (%)	12.60^{a}	12.48^{a}	10.0^{ab}	9.78^{b}	11.40^{a}	10.76^{ab}	8.56^{bc}	7.20^{c}	0.84	0.04
H_2S (ppm)	65.8^{a}	56.9^{ab}	50.40^{ab}	53.1^{ab}	55.6^{ab}	37.40^{b}	32.5^{bc}	26.09^{c}	4.89	0.03
NH_3(ppm)	80.20^{a}	74.20^{a}	70.39^{ab}	67.20^{ab}	52.40^{b}	54.61^{b}	37.80^{bc}	27.40^{c}	5.15	0.04
CH_4S (ppm)	73.3^{a}	70.9^{a}	49.7^{bc}	$46.9b^{c}$	66.9^{ab}	63.9^{ab}	54.8^{b}	42.7^{c}	5.19	0.02
CO_2 (%)	17.74^{b}	25.14^{b}	25.1^{b}	22.06^{b}	20.80^{b}	20.80^{b}	24.06^{b}	17.2^{b}	1.33	0.02

0_2=oxygen, CH_4=Methane, H_2S=Hydrogensulfide, NH_3=Ammonia, CH_4S=Methylmercaptan, CO_2=Carbon dioxide; different superscript in the same column differ significantly, $p<0.05$.

After measurement of gas emission from poultry litter, a significantly lower level of NH_3, H_2S, and CH_4S were found in T_8 treatments as compared to T_1 treatments but CO_2% was higher in T_2 and T_3treatments. But no significant different was observed in O_2 level.

In conclusion, reduction of CP with glutamine in diet, there was no impact on growth performances of BLRI meat chicken-1and also gas emission from poultry litter was decreased. Therefore, a 3% reduction in protein with a supplement of 0.20% glutamine in the diet of BLRI meat chicken-1may reduce gas emissions without affecting growth performance.

Recycling of poultry wastes for environment friendly low cost poultry production

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Strengthening of Poultry Research and Development Project
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Executive Summary

Worldwide, the commercial poultry industry is growing rapidly. The total poultry population in Bangladesh is 365.85 million (DLS, 2020-21) and the total number of commercial poultry farms is 65-70 thousand (WPSA-BB, 2021). Wastes from poultry processing and hatchery industry is an unavoidable by products. Wastes of a poultry farm includes litters from broiler and layers, hatchery debris, dead birds and much other debris. On the other hand, the poultry industry mainly the hatchery unit produces large amounts of hatchery wastes. 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. Poultry waste can have serious ramifications for the environment like odor and nuisance issues, the attraction of insects and pests, groundwater pollution, surface water spillover, weakening of organic design of the earth, and disastrous spills. The actual database regarding the amount of processing and hatchery wastes produced in the country is almost absent. Poultry processing and hatchery wastes is becoming a great concern for the growing industry. Therefore, there is urgent need to give a high attention by the scientists to develop scientific way of disposal of those wastes. The efficient utilization of any by-products has direct impact on the economy and environmental pollution. Considering those facts the present study was conducted to estimate the amount of poultry dressing and hatchery wastes produced in Bangladesh and assessment their nutritive and qualitative evaluation. The processing and hatchery wastes were estimated as per the weekly Day-old-chicks production of commercial broiler, layer, Sonali and colour broiler in Bangladesh. The back and forward calculation was done to get the estimated hatchery and processing wastes produced yearly. The information was collected from the Bangladesh Poultry Industries Association. To analyze the nutritive and qualitative assessment the poultry offal and hatchery wastes was collected from Poultry Research Centre of BLRI. The offal was washed with clean water and then cooked in water for 5 minutes and sun dried. After drying the sample was grinded in fine power. 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 as fine powder. A total of 4 samples of hatchery wastes and offal meals were tested for heavy metals (As, Pd, Cr and Cd) from the Interdisciplinary Institute for Food Security laboratory at the Bangladesh Agricultural University, Mymensingh. The spoilage microorganism (*Salmonella spp. And E. coli*) was tested from the food safety laboratory of BLRI and proximate analysis was done at PRC of BLRI.

It was estimated that approximately 6 lakh MT poultry processing and 37,000 MT hatchery wastes produced at the against of 123,76,00000 DOC produced yearly in Bangladesh. On the other hand, the yearly estimated poultry processing and hatchery wastes produced at PRC, BLRI was 2.7 and 1.5MT, respectively.

Table 1 Heavy metals test results

Name of sample	Heavy metals (ppm)			
	As	Pd	Cr	Cd
Hatchery waste-1	ND	Trace	25	ND
Hatchery waste-2	ND	Trace	12	ND
Infertile eggs	ND	Trace	16	ND
Offal's meal	ND	Trace	ND	ND

ND- Not detectable

Table shows the results of heavy metal tests. All tested samples were not detected any of heavy metal or trace amount except for Cr it was detected as negligible amount.

Table 2: Microbial tests results

Name of sample	Salmonella Spp.	E. coli	TVC (CFU/ml)
Hatchery waste-1	(-)ve	(+)ve	1480
Hatchery waste-2	(-)ve	(+)ve	1300
Infertile eggs	(-)ve	(+)ve	750
Offal's meal	(-)ve	(+)ve	970

Table 2 represents the results of microbial tests. All tested samples were found negative for *Salmonella Spp*.**.** But**,** there was found *E. Coli* with varying quantity from 750 -1480 CFU/ml.

Table 3: Proximate value (%) of Poultry offal meal and hatchery wastes meal

Parameters	Poultry offal meal		Hatchery wastes meal	
	Mean	±SD	Mean	±SD
Dry Matter (DM)	87.48	0.88	93.79	1.20
Moisture	12.52	0.88	6.20	1.20
Crude Protein (CP)	62.67	2.09	55.82	2.09
Crude Fiber (CF)	0.90	0.27	2.62	0.55
Ether Extract (EE)	7.04	0.99	2.58	3.73
Ash	8.46	1.36	18.3	0.75

Table 3 represents the results of Proximate value (%) of poultry offal meal and hatchery wastes meal. Mean (%) of dry matter (DM), moisture, crude protein (CP), crude fiber (CF), ether extract (EE) and ash content of offal meal was 87.48, 12.52, 62.67, 0.90, 7.04 and 8.46, respectively. The (%) of dry matter (DM), moisture, crude protein (CP), crude fiber (CF), ether extract (EE) and ash of hatchery wastes was 93.79, 6.20, 55.82, 2.62, 2.58 and 18.3 respectively.

In conclusion, poultry processing and hatchery wastes could be used as protein feedstuffs or other value-added products after appropriate treatment. Therefore, further study is suggested specially, with the proper treatment to remove the E. Coli content.

Measuring the effectiveness of different training methods and farm-level adoption of BLRI-developed technologies for different farming systems in different areas of Bangladesh

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Executive Summary

Adoption of new technologies is a challenge for any organization, in which training plays a very important role in technology dissemination when implementing a new system. But ineffectiveness in training can be an immense barrier to technology adoption. Therefore, the study was conducted to measure the effectiveness of different technology dissemination methods (lecture, audiovisual and demonstration) and to identify the factors affecting farm-level technology adoption. Trainings were conducted on beef fattening, dairy cow rearing, and chicken rearing at 5 different stations of BLRI, like main station (Savar), Dhamrai, Naikhangchari, Sirajganj and Rajshahi. Nearly 1000 trainees have been trained. To measure the Effectiveness of different technology dissemination methods, memory recall data were collected 3 times with an interval on the last day of training, after 7 days of training, and 15 days of training. A number of 10 questions (Q) were asked just at the end of the training (0 day), 20 questions were asked after 7 days and 30 were asked after 15 days. After that, multinomial regression model was applied for 5 areas using SPSS-25, where the knowledge scores were taken as dependent variables; and different socioeconomic characteristics of participants were taken as independent variables. Among the trainees, 60% of them were technology adopters and the rest were the non-adopters. To measure the factors affecting farm level technologies adoption, logistic regression model was applied, where the dependent variables were given a value of 1 if a farmer was a technology adopter and 0, if a non-adopter. The independent variables were different continuous variables (age, education level, family size, membership in social institutions, experience, amount of farm ownership, etc.) and dummy variables (gender, participation in extension activities, member (community group), insurance policy, technology adoption status, contact with extension workers, etc.)

The study found that audio-visual methods were a more effective method of training followed by lecture and demonstration. In cases of lecture and audio-visual methods, trainees' level of knowledge decreases after 15 days, but in the case of demonstration methods, level of knowledge increases. In case of the lecture method, the knowledge levels were low, medium and high for 18, 62 and 20 percent trainees respectively. In the case of audio-visual methods, 96% achieved a high level of knowledge, while in the case of demonstration method, 7, 40 and 53 percent participants achieved low, medium and high level of knowledge. The study found that participants' age, communication with Upazila livestock /District livestock Office, and experience negatively affect training effectiveness of lecture methods for beef fattening participants, while decisions taken by participants and farm size affect positively. The result may mean that any kind of training is more effective for the young aged participants than their elderly counterparts (Table 2).

Table 1: knowledge score of trainees in accordance with training methods, technology and region

Training methods	Technology	Region	Average number of answers (Knowledge score)		Range of scores (% of trainees)		
			Last day of training_ 10Q	After 15 days_30Q	0-10 (Low)	11-20 (Medium)	21-30 (High)
Lecture	Beef fattening	BLRI	8.62	26.52	18	62	20
Audio visual	Cow rearing	Dhamrai	8.84	17.66	22	32	46
Audio visual	Chicken rearing	Rajshahi	8.62	26.52	0	4	96
Demonstration	Cow rearing	Naikhangchari	6.96	19.48	10	40	50
Demonstration	Chicken rearing	Sirajganj	7.87	20.07	7	40	53

Audio visual method was effective for the dairy farmer participants who were more aged, educated, did not have insurance policy and with less number of livestock. It was also effective for female farmers. The

method was also applied for chicken rearing farmers, which showed that it was effective for those who were less aged, had been rearing chicken since before, and had less number of birds,. The demonstration method was useful for the dairy cow rearing farmers, those who already adopted respective technologies, and who are members of any community group. In the case of chicken rearing, the method is useful for educated farmers with small farm size. Age shows a mixed reflection in the case of demonstration, as elderly cow rearers can follow the demonstration method, while young-aged chicken rearers can follow the method effectively. The sign was always negative for the number of livestock which may mean that any method of training is more effective for small farmers than their large counterparts (Table 2).

Table 2 Factors affecting knowledge score and effectiveness of different training methods

Independent variables	Coefficient (Standard Error); (Training methods, Technology, Region)				
	Lecture, Beef fattening, BLRI	Audio visual, Cow rearing, Dhamrai	Audio visual, Chicken rearing, Rajshahi	Demonstration, cow rearing, Naikhangchari	Demonstration, Chicken rearing, Sirajganj
Constant	35.728*** (8.364)	5.924** (2.673)	7.944*** (2.369)	15.865** (8.195)	50.875 (44.203)
Age	-.322***(.097)	.277*(.153)	-.270**(.109)		.425***(.126)
Distance of market (km)		-.488(.373)		4.598***(1.121)	
decisions taken by participants	1.935**(.951)				
Educational qualification	1.935(.951)	3.863**(1.614)			3.090**(1.387)
Farm size (land area)	.015(.008)		.021(.015)		-.046***(.017)
Gender		-7.803**(3.134)			
Member (community group)		-2.989(1.824)	5.856**(3.041)		
Insurance policy		5.727**(2.928)			
Livestock number	-3.209(2.479)	-.256**(.101)		-.201**(.103)	
Contact with extension workers	-1.050 (-2.271)				
Engage in respective farming	2.071(2.168)		4.672**(2.460)	-7.399***(2.181)	-4.246(3.475)
Year of experience	-.416**(.214)		.212(.199)		
R Square	.423	.425	.420	.417	.415
F Value	2.858***	2.810**	2.318**	6.309***	2.725**

Note: *** p<.01, ** p<.05, * p<.1

The study found that trainees' educational qualifications always play a positive role in technology adoption. In case of lecture method for beef fattening farmers, experience and credit positively affect technology adoption, while crop farm size affects negatively.

Table 3 Factors affecting technology adoption in regards to training methods, technology &region

Independent variables	Coefficient (Standard Error); (Training methods, Technology, Region)			
	Lecture, Beef fattening, BLRI	Audio visual, Cow rearing, Dhamrai	Audio visual, Chicken rearing, Rajshahi	Demonstration, cow rearing, Naikhangchari
% of adopters	78	74	50	54
Constant	-6.442* (3.911)	-.172 (2.003)	28.948***(9.513)	2.970***(.998)
Age		.048 (.046)		-.039 (.037)
Gender		5.248** (2.089)	-1.805*(1.002)	
Distance of market (km)			-3.992***(1.214)	-2.098*(1.211)
Educational qualification	1.078**(.532)	1.330***(.673)		.915*(.506)

Farm size (land area)	-.008**(.004)	.023*(.014)	-1.060(1.078)	
Member (community group)	-1.638(1.157)			1.449(1.095)
Number of livestock	0.042(.036)		0.198**(.086)	.320(.412)
Loan taken	2.074*(1.286)			-.985(.862)
Year of experience	.255*(.126)	-.048(.050)		
Log likelihood	28.234	16.259	33.350	54.853
Nagelkerke R Square	.652	.524	.684	.329

Note: *** p<.01, ** p<.05, * p<.1

Farm size (land area) plays a positive role in the case of dairy cow rearing while it shows a negative role in case of beef fattening. The reasons still need to be explored. Again, distance of market plays a negative role in technology adoption which may indicate the development of improved communication systems.

In a nutshell, it can be said that different socioeconomic characteristics like gender, experience, educational qualification, farm size, number of livestock, access to credit, distance of market play a significant role in the effectiveness of different methods of training as well as technology adoption.

Assessing baseline status, and knowledge, service and technology need of livestock farmers in selected flood affected areas

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Executive summary

Bangladesh is one of the most climate change (CC) vulnerable countries in the world. About 135 million people in Bangladesh are at risk of declining living standards as a result of rising temperature and erratic rainfall due to CC according to a recent World Bank report. Livelihood of marginal people in Bangladesh is heavily dependent on livestock. This sector provides full time employment for 20% and part-time employment for another 50% of the total population. Livestock is being affected directly and indirectly with CC factors. Flash flood in Haor in 2017 accounted a loss of 420 million BDT, while in 2008 cyclone SIDR caused a loss of 1300 million BDT in livestock sector. Direct effects also include reduced production of milk, meat and egg; hampered reproduction, increased disease outbreaks and decreased supply of feeds and fodder those are potential to be happened due to CC effects. Farmers needs different kinds of support to increase their resilience against flood and other extreme climatic event. Those supports may be of knowledge, technology, health services, advisory services, training etc. However, it is necessary to know the region-specific problems of farmers during extreme climatic events and assess their appropriate needs to be resilient against disaster. Therefore, the present research was designed to assess the baseline status, and knowledge, service and technology need of flood-affected livestock farmers in selected regions. A total of 153 farmers were interviewed directly from Shariakandi, Bogura; Saghata, Gaibandha; and Islampur, Jamalapur. A pretested, structured questionnaire was used to collect data. Collected data were inserted into the MS Excel software, organized and analyzed for mean, standard deviation, range etc.

Table 1: Mostly affected livestock species by flood in different regions

Species	Bogura (n=50)		Gaibandha (n=53)		Jamalpur (n=50)		Overall (n=153)	
	% Resp.	Intensity* (0-4)	% Resp.	Intensity (0-4)	% Resp.	Intensity (0-4)	% Resp.	Intensity (0-4)
Dairy cattle	73 (n=34)	4	83.3 (n= 48)	4	58.8 (n= 34)	3	71.7 (n=116)	3.6
Beef cattle	76 (n=26)	3	70 (n= 31)	3	88 (n= 28)	4	78 (n=85)	3.33
Buffalo	82 (n= 16)	4	0 (n=1)	0	0 (n=1)	0	27.3 (n=18)	1.3
Goat	66 (n=33)	1	52 (n= 21)	2	13 (n= 15)	1	43.7 (n= 69)	1.3
Sheep	0 (n=3)	1	40 (n=10)	1	0 n=1)	1	13.3 (n= 14)	1
Duck	0 (n=2)	1	28 (n= 7)	1	0 (n=4)	1	9.3 (n= 13)	1
Chicken	54 (n=27)	1	30 (n=33)	1	30 (n=33)	1	38 (n= 93)	1

Resp., Respondents. *Intensity scale: 0, not affected; 1, slightly affected; 2, medium; 3, high & 4, very highly affected

The interviewed farmers were mostly illiterate (62.7%), dependent on livestock (100%) and crops (86%), small farmers (86%) based on land holdings and 48% of them were female. On an average, 84% of interviewed farmers reported economic loss due to flood and the average amount was 39958 Taka/year (data are not shown in table). It was found that cattle enterprise is the most severely affected enterprise due to flood, while buffalo and other animal/poultry enterprise have some sort of resilience to cope with the situation (Table 1). Among the livestock and poultry diseases, lumpy skin disease (LSD), foot and mouth disease (FMD), black quarter (BQ), fowl pox and para-TB were reported to affect livestock after flood with variable intensity. LSD and FMD were reported as most intense post-flood disease outbreak in the study area. Farmers used rice straw and green grass mainly as feed, while few farmers supply wheat bran and broken rice as concentrate. During flood they were dependent mainly on straw and a 15-20% rise in price during flood was also found. Farmers also used unconventional feed sources like tree foliage and water hyacinth to meet feed crises during the flood.

Table 2: Kinds of supports needed by the farmers during flood in different regions

Sl. No.	Support/Need	Bogura (n= 50)		Gaibandha (n=53)		Jamalpur (n=50)		Overall (n=153)	
		%Resp.	Need (0-4)*	%Resp.	Need (0-4)	%Resp.	Need (0-4)	%Resp.	Need (0-4)
1	Suitable technology to tackle disaster	80	2	60	2	75	2	71.66	2
2	Training to acquire relevant knowledge and use of technology	89	2	90	3	80	3	86.33	2.6
3	Sufficient veterinary services, vaccine and treatment	50	2	20	1	95	4	55	2.33
4	Market access for selling products at reasonable price	20	1.5	40	2	35	2	31.66	1.5
5	Feeds as relief material	90	3.4	100	4	40	1	43.33	2.8
6	Cash support	30	1	40	2	45	1	38.33	1.33
7	Sufficient livestock shelter	100	3.8	100	4	20	1	73.33	2.93
8	Livestock-keeping facilities in existing shelters for human	50	2.4	85	3	5	1	46.66	2.13

Resp., Respondents. *Need level: 0, no need; 1, slightly needed; 2, medium; 3, highly needed & 4, extremely needed

To increase resilience against flood farmers thought they intensely needed livestock shelter, feed as relief material, training on resilient technology and veterinary services (Table 2). Results revealed that in study areas economic loss in livestock enterprise is extreme and they need to provide livestock shelter, feed supply, and health services, provision of resilient technology and training are necessary interventions.

Impact of Training Given to Farmers on BLRI Technologies

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Executive Summary

Training and education would help to farmers and stakeholders to develop skillness that are more readily and accurately assessable. Adoption of superior technologies have profound effects to change their livelihood and socioeconomic status. Training is a planned activity intended to enhance the knowledge, skill and competencies of the farmers for refining them. BLRI has developed 91 technologies and among them Beef Fattening, PPR Vaccine, Poultry farm Biosecurity, Silage preparation, Dairy Farming, Goat Rearing Silage preparation, goat rearing technology etc. are the most popular technology that has been using for the development of farmers through adopting those technologies by providing training. In the financial year 2020-21, the average cattle population of dairy cows, fattening farmers was 5.87 and 4.04 before getting the training which is increased up to 10 cows and 10.83 respectively after getting the training. However the objective of this study was, to determine the impact of farmers training on adoption of BLRI technologies. The trained farmers of BLRI headquarter and five farmers from BLRI regional station were considered. Before conducting the training, the base line data were collected and analyzed. The farmers were selected randomly and special emphasis was given to select the farmers, for example, need-based affinity to the BLRI technologies, their availability in the training duration according to BLRI training calendar. A total of 210 farmers took part in the training program on BLRI developed livestock rearing & management technologies [Improved cattle fattening training (n=60), Dairy Cattle Rearing and Management (n=120) and Goat rearing and Management (n=30)]. A questionnaire was developed and field survey method was used to collect the data before and after providing the training to evaluate the improvement of the farmer's socio-economic status. Both the primary and secondary data were used in this study. The statistical analysis was done using 'SPSS-11.5' statistical program. From the base line survey, it showed that 25%, 27% and 30% farmers were associated with beef fattening, dairy farm rearing and goat rearing, respectively. The education level of the farmers was primary level (35%), SSC (35%), HSC (20%) and graduates/masters' level (10%). The male family members in each family were 2 and they were below 18 years of age and 2.8 number who were over 18 years old. The female's members were 1.98 who were below 18 years and 2 number who were over 18 years. The land availability such as housing area were 0.90 acre, cultivated area 2.90 acre, uncultivated area 0.50 acre and fodder land area 0.25acre per family. The Agriculture was the highest (60%) occupation followed by business (30%), services (2%) and others (8%). The number of the cattle was 5.62 per family. In case of small ruminants, average number of goat and sheep were 7.66 and 1.81 per family, respectively that was the previous data before getting the training. Most of the dairy cows were indigenous/local; however, some farmers had crossbred cattle. The average milk production (l/d), birth wt. (kg), calf mortality (%) and lactation period (d) of cattle were, 4.86, 25.00±1.37, 9.80 and 180, respectively. The average litter size (no. per year), kid birth wt. (kg) and kid mortality (%) were 1.53, 0.76 and 25%, respectively. Their annual income (BDT/year) came from livestock farming before getting the training on BLRI technologies through selling of livestock products and by-products such as milk, selling of cattle, cow dung, compost and goat and their average grand total income was 72853.60±32.32, 92919.10±18.33, 9352.60±19.62, 18100.00±12.89, 68000.00±37.67 and

261224.30±38.76, respectively (Table 1). The average livestock rearing (cattle & goat, the average number of cattle and goat per farm was 6 and 8 respectively.) cost (BDT/year) was 195500.00. Compared to the total cost, their average profit was 65724 BDT/year. However, From the above result it will be concluded that livestock related technology trainings brings the net financial profit that above fifty thousand take per technology benefits that brings comfort livelihood of the farmer.

Table 1. Annual income from livestock products or by-products of farm families (Tk./year) before getting the training.

Source of income	Mean±SE
Milk	72853.60±32.32
Cattle sale	92919.10±18.33
Cow dung	9352.60±19.62
Compost	18100.00 (3) ±12.89
Goat sale (live)	68000.00±37.67
Total	261224.30±38.76

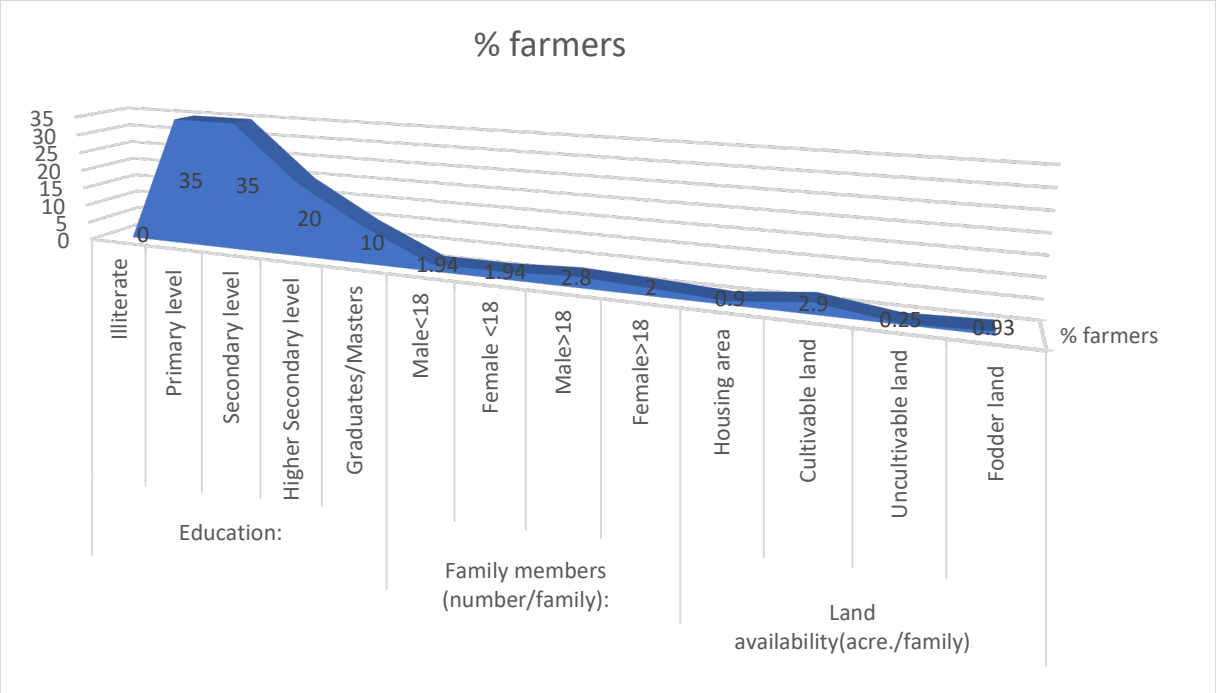

Fig 1. General Information of the farmers.