Annual Research Review Workshop-2016

Date: 02-04 November 2016

BLRI Conference Hall

3rd floor, Building 3

PROGRAMME

Bangladesh Livestock Research Institute
Savar, Dhaka-1341, Bangladesh

TECHNICAL SESSIONS

Day 1: Wednesday, 02 November, 2016

Technical Session I : **GENETICS AND BREEDING**

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

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

Rapporteurs : **Kamrun Nahar Monira**, SSO, BLRI
Md. Yousuf Ali Khan, SO, BLRI

09:30-09:42	Strategic development of beef cattle and their qualities	MP Mostari
09:42-09:54	Propagation, improvement and conservation of Munshiganj Cattle through planned breeding and their performance study ex-situ	SMJ Hossain
09:54-10:06	Identification of repeat breeding problems and measures in dairy cows at Baghabari milk shed areas	MS Islam
10:06-10:18	Performances of Hilly Brown Bengal goat at farm level	MM Rahman
10:18-10:30	Evaluation of genetic potentials of BLRI developed indigenous chicken varieties under farmers' condition	MA Rashid
10:30-10:42	Productive and Reproductive performance of selected native duck genotype	MSK Sarker
10:42-10:54	**Tea Break**	
10:54-11:06	Maintenance and improvement of chicken pure lines and performance of BLRI developed layer hybrids	MR Hassan
11:06-11:18	Conservation and improvement of native chicken: Performance of fifth generation	S Faruque
11:18-11:30	Conservation and improvement of Quail: Performance of fifth generation	S Faruque
11:30-12:00	**Discussion**	
12:00-01:00	**Opening of Modernized Buffalo Research Farm & Technology Handover**	
01:00-2:00	**Lunch and Prayer**	
02:00-03:00	**Poster Presentation**	

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

Chairperson : **Dr. Matiar Rahman Howlader**
Professor, Dept. of Physiology
Sylhet Agricultural University, Sylhet

Co-Chairperson : **DR. Ainul Haque**
DD, Department of Livestock Services (DLS)

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

03:00-03:12	Immune escape and genetic evolution of highly pathogenic avian influenza virus H5N1 with the advent of vaccination in poultry in Bangladesh	MA Samad
03:12-03:24	Prevalence of emerging and re-emerging food borne pathogenes and drug resistant gene in poultry value chain	MA Samad
03:24-03:36	Prevalence and molecular characterization of duck plague virus in selected areas of Bangladesh	A Hossen
03:36-03:48	Development of Peste des Petis Ruminants (PPR) free zone in selected areas of Bangladesh to meet global strategy	MA Yousuf
03:48-04:00	*In vivo* evaluation of anthelmintic properties of certain medicinal plants against internal parasites-GI nematodes of sheep	MN Munsi
04:00-04.15	Tea Break	
04:15-04:27	Study on prevalence and molecular diagnosis of subclinical mastitis in dairy cows at Baghabari milk shed area, Sirajgonj	MH Kabir
04:27-04:39	Descriptive epidemiology of Foot and Mouth Disease in Bangladesh	MG Osmani
04:39-04:51	Persistence of infection induced antibody against Foot and Mouth Disease in naturally infected cattle	L Akhter
04:51-05:20	**Discussion**	

Day 2: Thursday, 03 November, 2016

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

Chairperson : **Dr. M. Saadullah**
Professor (Rtd.), Dept. of Animal Science
Bangladesh Agricultural University, Mymensingh

Co-Chairperson : **Dr. Mohammad Mujaffar Hossain**
Professor, Dept. of Animal Science
Bangladesh Agricultural University, Mymensingh

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

09:30-09:42	Feeding effect of densified total Mixed Ration (TMR) on the milk yield, milk composition and digestibility of RCC milking cows	NR Sarker
09:42-09:54	Comparative feed intake and growth performances of buffalo and cattle of different ages	BK Roy
09:54-10:06	Study of Moringa plant fodder agronomy and its feeding to ruminants	MK Bashar
10:06-10:18	Study on the adaptability of HYV fodder cultivars in Barind areas	MA Habib
10:18-10:30	Upgrading and validation of FeedMaster Application	MA Kabir
10:30-10:42	Identification and documentation of locally available forages in some selected regions of Bangladesh	MA Kabir
10:42-11:00	**Tea Break**	
11:00-11:12	Effect of pre and post-natal nutrition of dams on the post weaning growth performances of lambs	S Ahmed
11:12-11:24	Evaluation of lamb production potentiality of the Barind, Jamuna river basin and Coastal region sheep of Bangladesh under intensive management	S Ahmed
11:24-11:36	Effect of dietary energy and protein levels on growth and productivity of straight run Hilly chicken up to eight weeks of age	H Khatun
11:36-12:00	**Discussion**	
12:00-01:00	**Poster Session**	
01:00-02:00	**Lunch and Prayer Break**	

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

Chairperson : **Dr. Syed Sakhawat Husain**
Professor, Dept. of Animal Breeding and Genetics
Bangladesh Agricultural University, Mymensingh

Co-Chairperson : **Dr. Md. Ruhul Amin**
Professor, Dept. of Animal Breeding and Genetics
Bangladesh Agricultural University, Mymensingh

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

02:00-02:12	Production of calves through transfer of *in vitro* produced cattle embryos at farmers level and BLRI Research Farm	GK Deb
02:12-02:24	*In vitro p*roduction of buffalo embryo	MFH Miraz
02:24-02:36	Establishment of bovine fibroblast cell line for somatic cell nuclear transfer: Protocol adaptation and development of primary culture of cell lines	MF Afroz
02:36-02:48	Enhancing methanogenesis in biogas digester through hybridization of feedstock biomass	SM Amanullah
02:48-03:00	Study of livestock manure management and clean air production	JS Khanam
03:00-03.12	System modeling for food waste to feed production	NG Das
03:12-03:30	**Tea Break**	
03:30-03:42	Taxonomical and molecular characterization and micro-propagation of selected Moringa cultivars using tissue culture	S Ahmed
03:42-03:54	In vitro regeneration of Napier grass for genetic transformation and Identification of gene and local gene sources as donors for salt tolerant trait	MK Alam
03:54-04:45	**Discussion**	

Day 3: Friday, 04 November, 2016

Technical Session II : **SOCIOECONOMIC AND FARMING SYSTEM RESEARCH**

Chairperson : **Dr. Md. Jahangir Alam Khan**
Ex-Director General
Bangladesh Livestock Research Institute

Co-Chairperson : **Dr. Md. Taj Uddin**
Professor, Dept. of Agricultural Economics
Bangladesh Agricultural University, Mymensingh

Rapporteurs : **Md. Sirajul Islam**, SSO, BLRI
Most. Mahfuja Khatun, SO, BLRI

09:30-09:42	Development of livestock community through intervention of BLRI developed suitable technologies some selected areas of Sylhet region	R Khatun
09:42-09:54	Livelihood Improvement of Rural Farmers through Suitable Livestock and Poultry Technology Dissemination in Selected Hilly Areas of Bangladesh	R Khatun
09:54-10:06	Value Chain Analysis of Milk and Comparative Advantage of Milk Production in Bangladesh	MS Islam
10:06-10:18	Economic Evaluation of Buffalo Production in selected regions of Bangladesh	MS Islam
10:18-10:40	**Discussion**	
10:40-11.00	**Tea Break**	
11:00-01.00	**Closing Session**	

Poster Session

Day 1: 02:00-03:00 pm
Day 2: 12:00-01:00 pm

01	Modification of grain feeding by Hydroponic grass for increasing production	MA Kabir
02	Performance evaluation of Murrah x Local F_1 crossbred and production of Nili-Ravi x Local F_1 crossbred buffaloes in Bangladesh	MF Afroz
03	Phenotypic and Molecular Characterization of buffalo genetic resources in selected regions of Bangladesh	MN Yeasmin
04	Developing the fodder production model in coastal and river basin regions of Bangladesh	M Rahman
05	Development of existing feed resources based feeding system in Haor areas to increase milk production of smallholder dairy farmers	MR Amin
06	Feed intake, growth performance and nutrient utilization by local growing bulls fed different fodders as sole diet and their biometrical ranking	BK Roy
07	Effect of different soil types on growth and production of Napier-4 at the Regional Station	MS Islam
08	Field application of the technology of preservation of green forage as *DOL* in different locations in Bangladesh	MZ Rahman
09	Effect of formulated vitamin mineral premix on the growth performance, meat yield traits and internal organ development of multi-colour table chicken	MSK Sarker
10	Modulation of antiviral activity against Infectious bursal disease virus through activation of Toll-Like Receptor (TLR) signaling pathway	MA Samad
11	Development of polyclonal antibody based PPRV detection system	MA Yousuf
12	Development of blended yarns and fabrics from jute, cotton and native sheep wool	M Ershaduzzaman
13	Community based sheep production in hilly area at Naikhongchari	MAI Talukdar
14	Screening and development of different coat color variants' goat stock at BLRI	SMJ Hossain
15	Evaluation of performances of Boer and Jamunapari goat at BLRI	MP Chowdhury
16	Improvement of Black Bengal Goat through community breeding	MP Chowdhury

INAUGURAL SESSION

(2 November, 2016)

Chief Guest : **Mr. Muhammed Sayedul Hoque, MP**
Hon'ble Minister
Ministry of Fisheries and Livestock

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

Guest of Honor : **Mr. Ajay Kumar Roy**
Director General
Department of Livestock Services

Chairperson : **Mr. Md. Maksudul Hasan Khan**
Secretary
Ministry of Fisheries and Livestock

12:00-12:05	Guests take their seats
12:05-12:15	Recitation from the Holy Quran & Holy Gita
12:15-12:20	Opening remarks and welcome address **Dr. Talukder Nurun Nahar** Director General Bangladesh Livestock Research Institute
12:20-12.25	Opening of Modernized Buffalo Research Farm & Technology Handover
11:25-11:35	Address by the Guest of Honor **Mr. Ajay Kumar Ray** Director General Department of Livestock Services
11:35-11:45	Address by the Special Guest **Dr. Md. Enamur Rahaman**, **MP** Dhaka-19
	Address by the Chairperson **Mr. Md. Maksudul Hasan Khan** Secretary Ministry of Fisheries and Livestock
11:45-12:30	Address by the Chief Guest **Mr. Muhammed Sayedul Hoque**, **MP** Hon'ble Minister, Ministry of Fisheries and Livestock
12:30	Refreshment

CLOSING SESSION
(4 November, 2016)

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

Special Guest : **Dr. Abul Kalam Azad**
Executive Chairman
Bangladesh Agricultural Research Council

Chairperson : **Dr. Talukder Nurun Nahar**
Director General
Bangladesh Livestock Research Institute

11:00-11:05	Guests take their seats
11:05-11:10	Recitation from the Holy Quran & Holy Gita
11:10-11:20	Presentation of workshop recommendation
11:20-11.40	Open discussion
11:40-11:55	Address by the Special Guest **Dr. Abul Kalam Azad** Executive Chairman Bangladesh Agricultural Research Council
11:55-12:15	Address by the Chief Guest **Mr. Narayon Chandra Chanda, MP** Hon'ble State Minister Ministry of Fisheries and Livestock
12:15-12:30	Vote of thanks by the Chairperson **Dr. Talukder Nurun Nahar** Director General Bangladesh Livestock Research Institute
12:30-01:00	**Refreshment**

CONTENTS

Production performances, feed efficiency and disease incidence of F_1 progeny

MP Mostari, MYA Khan[1], BK Roy[1], SMJ Hossain[2] and KS Huque[1]
[1]Animal Production Research Division and [2]Biotechnology Division, Bangladesh Livestock Research Institute, Savar, Dhaka, Dhaka, Bangladesh

Executive Summary

Bangladesh has been facing cattle demand and supply mismatches due to insufficient production and supply of beef, low carcass yield of native cattle and recent no-cattle export policy of a long bordered neighboring country. Thus, Bangladesh must take an opportunity for boosting its bovine industry through not only on-going program like, cattle fattening or crossbreeding for dairy and beef cattle production but also increasing the productivity (vertical development) instead of population increase (horizontal development). Vertical development should be keys for unlocking potentials of beef cattle in a country like Bangladesh, one of the habitats of highest cattle density (19.7-361.7 heads/ Sq Km) in the world. At the same time we must not disqualify our native cattle; as they are much more potentials and are even more efficient beef producers, if fed with diets of similar nutritional values to that of exotic cattle and managed scientifically (Huque *et al*. 2014). Thus, the present work was undertaken with an objective to develop market beef cattle of at least average 200 Kg carcass weight by 24 months at an average FCR of <6.50 under on farm feeding and management conditions. Aiming at developing breeding bulls the cows of BLRI Cattle Breed 1 (BCB-1) were inseminated with the imported frozen semen of Brahman, Simmental, Charolais or Limousine. The crossbred bulls of different assorted F_1 genotypes are being selected and their production and breeding performances are being evaluated and compared with BCB-1 (Control).The selected assorted F_1 genotypes will be developed through *inter se* mating into breeding bulls for mating with local cows for producing market beef cattle of desired production performances. Artificial insemination (AI) was performed following standard procedure for the production of crossbred progeny. Not more than 2 AI services were allowed for single conception and subsequent calculation of service per conception. All pregnant (> 6 months of gestation period) cows were in pre-natal care, and all calves were raised in a single plane of nutrition and management. Total milk and feed intake, FCR, disease incidence and calf mortality of BCB-1 and its assorted genotypes were recorded. The effects of sex, season and genotype×season interactions were also determined under the study.

Table 1. Number of crossbred F_1progeny

Genotype of calves	Sex		Total
	Male	Female	
BCB-1×BCB-1	5	5	10
Limousine×BCB-1	5	2	7
Simmental×BCB-1	2	5	7
Charolais×BCB-1	3	2	5
Brahman×BCB-1	4	3	7
Total	19	17	36

The economic traits (birth, weaning, 6th month, 9th month, and yearling weight, ADGs at different ages) were compared statistically in an ANOVA of a Completely Randomized Design (CRD) using General Linear Model Procedure of SPSS (17.0). Table 1 showed the number of crossbred and purebred progeny produced under this breeding program so far. Table 2 revealed that all crossbred progeny performed better than BCB-1 in terms of live weights and ADGs. Among the crossbreds, Charolais×BCB-1 had the highest birth weight (27.5±1.52 kg) followed by Brahman×BCB-1 (24.1±1.23), Simmental×BCB-1 (21.9±1.78), Limousine×BCB-1 (19.8±1.39) and BCB-1×BCB-1 (18.4±1.09), and the genotype differences were highly significant ($p<0.001$). But the weaning, 6th month, 9th month and 12th month cumulative weights were the highest in Simmental×BCB-1 and the lowest in purebred BCB-1, and the genotype differences were also highly significant ($p<0.001$). Production performances of Brahman crosses are yet to be evaluated. In average daily weight gain, Simmental cross was found as the highest up to 9th month of age but in 9 to 12 m, Charolais cross performed the best (Table 2). Male and female calves of crossbred and BCB-1 did not differ significantly ($p>0.05$) on live weights and ADGs. Maximum calves born in rainy season and their birth weights differed significantly ($p<0.001$) among the seasons. The highest birth weight was observed in the winter that may be due to genotype of exotic sires (Table 2). Season had significant effect on birth ($p<0.001$) and weaning ($p<0.05$) weight. Only daily gains of 3 to 6 months of age affected by the season ($p<0.05$). The genotype×environment interaction was only observed in

birth weight (Table 2) and after birth calves were adjusted gradually with the environment. Simmental and Charolais crosses daily took the similar amount of DM in 6 to 9 m of age but Simmental cross gained more than Charolais cross at the same period of age (Table 2). Purebred BCB-1 had the lowest daily DM intake and FCR in all ages compare to other crosses (Table 3). Calf scour and alopecia occurred in all genotypes. Coccidiosis and fever occurred in Limousine, Simmental, Charolais crosses and BCB-1. A total of 38 calves were born and out of that 2 died of coccidiosis and premature delivery. In this breeding program, calf mortality was found as 5.26 %.

Table 2. Effects of genotypes and seasons on body weights and average daily body weight gains (ADG) at different ages

Parameters	Body weights (kg)					ADGs (kg)			
	Birth wt	Weaning wt (3 M)	6 M wt	9 M wt	12 M wt	0 to Weaning	3 to 6 M	6 to 9 M	9 to12 M
Genotypes	Mean±SEM (n)								
BCB-1×BCB-1	18.4 (10)	50.1 (10)	91.6 (8)	139.4 (3)	194.7 (1)	0.40 (10)	0.47 (8)	0.47 (3)	0.54(1)
Limousine×BCB-1	19.8 (7)	72.8 (7)	134.2 (7)	196.9 (5)	270.2 (2)	0.59 (7)	0.68 (7)	0.66 (5)	0.74(2)
Simmental×BCB-1	21.9 (7)	80.5 (7)	156.1 (7)	227.6 (7)	297.3 (1)	0.65 (7)	0.84 (7)	0.79 (7)	0.67(1)
Charolais×BCB-1	27.5 (5)	79.4 (4)	138.1 (3)	199.2 (1)	279.9 (1)	0.60 (4)	0.76 (3)	0.60 (1)	0.78(1)
Brahman×BCB-1	24.1 (7)	64.2 (5)	-	-	-	0.45 (5)	-	-	-
Sig.	***	***	***	***	-	***	***	**	-
Seasons									
Summer (March to June)	21.99 (10)	71.21 (7)	140.26 (6)	193.02	262.5 (5)	0.56 (7)	0.76 (6)	0.59 (6)	0.68 (5)
Rainy (July to October)	19.34 (18)	63.67(18)	121.16 (18)	184.96	-	0.49 (18)	0.64 (18)	0.69 (10)	-
Winter (November to February)	27.40 (8)	70.88(8)	85.86 (1)	-	-	0.48 (8)	0.40 (1)	-	-
Sig.	***	*	NS	NS	-	NS	*	NS	-
Genotype×Season									
Sig.	*	NS	NS	NS	-	NS	NS	NS	-
Grand Mean	22.46±0.63 (36)	68.62±1.93 (33)	125.72±3.36 (25)	189.57±4.96 (16)	-	0.52±0.02 (33)	0.66±0.018 (25)	0.63±0.022 (16)	0.68 (5)

NS=Non-significant; *=P<0.05; **=P<0.01; ***=P<0.001

Table 3. FCR of different genotypes at different ages

Genotypes	At 6 M			At 9 M		
	Live weights (kg)	ADGs (kg)	FCR	Live weights (kg)	ADGs (kg)	FCR
BCB-1×BCB-1	91.6	0.47	4.89(1)	139.4	0.47	5.84±2.42(4)
Limousine×BCB-1	134.2	0.68	6.06±0.82(3)	196.9	0.66	5.96±1.76(7)
Simmental×BCB-1	156.1	0.84	5.17±0.72(2)	227.6	0.79	6.93±1.12(7)
Charolais×BCB-1	-	-	-	199.2	0.60	5.98±2.74(2)
Brahman×BCB-1	-	-	-	-	-	-

In conclusion, so far Simmental×BCB-1 is performing as the best among the five crosses in terms of growth, FCR and disease resistance up to 12 month of age. More F_1 progeny is yet to be produced to evaluate their performances up to 24 months of age for selection of suitable beef genotype for the production of market beef cattle. Therefore, this breeding program should be continuing for the coming years to achieve its goal.

Propagation, improvement and conservation of Munshiganj Cattle through planned breeding and their performance study *ex-situ*

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Executive Summary

Despite of highest cattle density per km^2in Bangladesh compared with some large cattle population countries like India, Ethiopia, Brazil, etc., production of milk, meat are far belowthan the expectation due to large number of poor qualities indigenous cattle populations having lower milk and/or meat production. Although they posses some beneficial characteristics such as heat tolerance, adapted to hot and humid climate, high rainfall, flood and swampy condition, ability to survive with low quality feedstuffs, good degree of resistance to diseases and giving more calves. However, there are some promising varieties of indigenous cattle genetic resources in Bangladesh. Munshiganj cattle (MC) are one of them. Evidences are available for the inclusion of foreign bloods in different types of crossbred cattle in Bangladesh. On the other hand, there are no evidences of foreign blood in indigenous cattle. Although, some sporadic works had so far been done for some indigenous cattle but information are scanty in case of MC. The numbers of MC are declining gradually day by day; hence they are under the threat of extinction. Therefore, under this project initiative was taken to conserve and to improve MC to fulfill the following objectives: 1)to develop a pure nucleus herd by screening from their original habitat, 2)to propagate, improve and conserve it through planned breeding and their *ex-situ* performance study, and 3)to develop a rearing community at their habitat and exchange of proven semen/bull. To achieve the aforesaid objectives of the project a mini nucleus herd including eight adult female cows, 4 heifers and two ready to mate bulls were collected from different parts of their own habitats. Having establishment of nucleus all animals are being observed for their performance evaluation keeping records from birth up to end. For the establishment of community herd, a survey was conducted to know the population of MC cows in the households in Munshiganj, the home tract of the genotype. Based on the survey, a total number of 104 households having a single MC cow were registered under the MC cattle rearing community. Various data so far collected were analyzed by SPSS.

Table 1. Structure of registered MC cattle rearing community farmers from different selected regions in Munshiganj district

Upazilas	Unions	No. of MC keeper	MC Herd Structure						Total	Herd size
			Cows	Bull	Heifer	G. bull	H. calf	B. calf		
Mushigang Sadar	Bangla Bazar	26	26	-	-	01	04	01	32	1.23
	Adhara	10	10	-	-	-	03	01	14	1.40
Sirjdikhan	Chitrokot	14	14	-	-	01	01	01	17	1.21
	Rajanagar	07	07	-	-	-	01	-	08	1.14
	Kewan	04	04	01	-	-	-	-	05	1.25
	Bashail	03	03	-	-	-	-	-	03	1.00
Gojaria	Baushia	06	06	-	-	-	01	-	07	1.17
	Guagaicha	04	04	-	-	-	02	-	06	1.50
	Luter char	07	07	-	-	-	-	-	07	1.00
Tungibari	Betka	03	03	-	01	-	02	-	06	2.00
	Baligaon	02	02	-	-	-	-	-	02	1.00
	Sonarong	03	03	-	-	-	-	-	03	1.00
Srinagar	Baghra	08	08	01	-	-	-	-	09	1.13
Louhaganj	Konokshar	07	07	-	01	-	01	-	09	1.29
Total		104	104	02	02	02	15	03	128	1.23

The structure of registered MC cattle rearing farmers from different upazillas in Munshiganj district is presented in Table 1.A total of 104 households from 14 unions in 6 upazillas of Munshiganj district were selected for formation of the MC cattle rearing community (Table 1).

Table 2 shows that the calves so far born at BLRI nucleus herd were 3 males and 5 females with the sex ratio of 37.5: 62.5. The average birth weights of male calves (19.47±0.79 kg) were significantly ($p<0.05$) higher than average of those of female calves (16.14±0.52 kg). The survivability of both sexes was 100% in the herd (Table 2).

Table 2. Birth weight and survivability (%) of MC calves

Values	Sex of calves		Survivality (%)
	Male	Female	
Min.	18.4	15.2	100
Max.	21.0	18.0	100
Overall (Mean±SE)	19.47^{a}±0.79	16.14^{b}±0.52	100
Significance level	*		

Mean with uncommon superscript differ significantly ($p<0.05$); *-$p<0.05$

Table 3 illustrates the milk production and reproductive potential of MC cows in the nucleus herd which shows average lactation length, lactation milk yield, daily milk yield, postpartum heat period and number of services for per conception to be 187.5±9.54 days, 728.46±88.80 kg, 3.84±0.31 kg, 65.5±5.25 days and 1.14±0.14, respectively.

Table 3. Milk production and reproductive potential of Munshiganj cows

Values	Milk production parameters			Reproductive parameters	
	LL (d)	LMY (kg)	DMY (kg)	PPHP (d)	NSPC
Min.	164	478.00	2.91	45	1
Max.	210	889.65	4.23	78	2
Overall (Mean±SE)	187.5±9.54	728.46±88.80	3.84±0.31	65.5±5.25	1.14±0.14

LL-lactation length; LMY-lactation milk yield; DMY-daily milk yield; PPHP-postpartum heat period; NSPC-number of services per conception; SE-standard error

Table 4 illustrates the composition of milk samples of MCC taken from morning and evening milking. Milk fat, protein, lactose and SNF in morning and evening milk were 4.89 and 6.34%, 4.23 and 4.38%, 6.11 and 6.28% and 11.25 and 11.60%, respectively. The overall mean were 5.61, 4.31, 6.19 and 11.43%, respectively (Table 4). Fat and protein contained in evening milk were significantly higher than morning milk, while non significantly differed for lactose and SNF content.

Table 4. Milk composition of Munshiganj cows

Values	%Fat		%Protein		%Lactose		%SNF	
	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
Min.	4.08	4.91	4.10	4.24	5.96	6.14	10.95	11.29
Max.	6.39	7.66	4.40	4.59	6.37	6.59	11.49	12.16
Mean	4.89^{b}±0.28	6.34^{a}±0.35	4.23^{b}±0.04	4.38^{a}±0.05	6.11±0.06	6.28±0.07	11.25±0.11	11.60±0.13
Overall	5.61±0.29		4.31±0.04		6.19±0.05		11.43±0.09	
Sig.	**		*		NS		NS	

*-significant at 5% level ($p<0.05$); **-significant at 1% level ($p<0.01$); NS-non significant ($p>0.05$)

The preliminary results showed that MC may be valuable indigenous cattle genetic resources of Bangladesh. As MC cows are now under the threat of extinction, it is necessary to develop Munshiganj cattle rearing community at their own habitat and need to exchange the pure elite bull/semen.

Identification of possible causes of repeat breeding in dairy cows at Baghabari milk shed areas

MS Islam[1], GK Deb[2], M Ershaduzzaman[2], M Giasuddin[2], MA Habib[2], MY Ali[1], MH Kabir[1], MOA Rahman[2], MA Yosuf[2], MF Afroz[2], MR Karim[2]

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Executive Summary

Baghabari is one of the most important and the largest milk producing area of Bangladesh. Farmers rear about 98% crossbred dairy cattle for milk production contributing two-third milk production of the country. Normally cow's conception rate is 50 to 60 percent within 1-3 consequent insemination. Repeating breeding (RB) means a cow not to conceive after three regular artificial insemination (AI) services by an inseminator or natural services by a breeding bull. It always causes a great economic loss increasing the cost of production like AI, treatment, feed, labour and other management cost. It reduces milk production while increases days open of a cow. As a result, repeat breeding has been made a major concern to dairy farmers of milk vita areas. However, repeat breeding is a multi-factorial problem in dairy cows. Very few works have so far been done on repeat breeding of dairy cows in Bangladesh. So, scope of in-depth works associated with the repeat breeding problem in dairy cows to identify real causes is still there. Hence, this study was undertaken with the objective to identify the causal factors associated with repeat breeding in dairy cows. To achieve the said objective, the present study was conducted at milk pocket areas named as Sahjadpur upazilla under Sirajgonj district and Shathia and Bera upazillas under Pabna district. A purposive survey among one hundred and ninety (190) randomly chosen dairy farmers was conducted with a semi-structure questionnaire. In addition, to identify the root causes of RB, concentrate mixed feed and frozen semen samples were tested from different sources. Rectal palpation was also done in 46 repeat breeder cows to identify reproductive disorders. All data collected from different events were statistically analyzed with SPSS 17.0. Farmer's opinions on different causal factors of repeat breeding are shown in Table 1. Most of the farmers claimed about the main causes of RB to be balanced feed (60%), quality of semen (52%) and reproductive disease (44%).

Table 1. Farmer's opinion on causal factors in repeat breeding (N=190)

SN	Causal factors	No. of farmers	Percent (%)	SN	Causal factors	No. of farmers	Percent (%)
1	Balanced feed	113	59.47	7	High milk production	38	20.00
2	Semen quality	98	51.58	8	Timely AI	36	18.95
3	Reproductive diseases	83	43.68	9	Seasons	35	18.42
4	Unskilled AI worker	59	31.05	10	Anthelmentics	18	9.47
5	Maltreatment of RBC	43	22.63	11	General diseases	14	7.37
6	Genotype	39	20.53	12	No comments	29	15.26

Table 2 shows the incidence of repeat breeding for different genotypes. The highest RB incidence was obtained in Local×Holstein Friesian crosses (69%) and lowest in Local×Sahiwal crosses (8%).

Table 2. Incidence of RB in different genotypes

Types of genotypes	No. of RB cows	Incidence (%)
Local×Holstein Friesian (L×HF)	209	68.52
Local ×Jersey (L×J)	35	11.48
Local ×Sahiwal	24	7.87
Local ×Jersey×Holstein Friesian (L×J×HF)	37	12.13
Total	305	100

Table 3. Quality of frozen semen samples taken from different sources using in the studied areas

Sample Source	Concentr. (million/ml)	Type of motility (%)						
		Progr.	Circle	Fast	Slow	Local	Motile sperm	Immotile sperm
		Mean ±SE (N=6)						
A	33.90± 15.45	17.38± 9.75	0.00	15.16 ±8.59	2.18± 1.25	3.14 ±1.66	20.42± 11.41	79.61± 11.39
B	63.75±21.87	14.76±4.03	0.78±0.06	9.23±2.55	4.8±1.44	5.9±1.67	20.65 ±5.69	79.35±5.69
C	52.44±11.15	41.14±6.94	0,25±0.02	31.37±4.90	9.47±2.21	7.57±0.65	48.43±7.26	51.17±7.26
D	34.06±9.71	23.10±2.71	0.03±0.01	17.00±2.53	5.04±0.45	5.84±0.70	27.95± 1.77	72.39±1.85
E	12.56 ±6.39	25.57±6.55	0.11±0.11	15.98±5.38	9.49±1.38	10.36±1.34	35.90± 7.82	64.09±7.81
F	46.95±9.18	40.99±8.31	0.16±0.08	31.72±6.03	9.12±2.30	9.00±1.97	50.02±10.22	50.13±10.14
G	60.78±20.67	12.47±5.07	0.03±0.02	8.98±3.68	3.47±1.42	4.54±1.82	17.03± 6.77	82.97±6.77
Min.	5.44	0	0	0	0	0	0	28.67
Max.	116.77	58.3	0.4	43.7	15.9	14.03	71.46	100
Overall mean	46.50±6.18	25.40±3.17	0.10±0.02	18.87±2.48	6.22±0.80	6.54±0.68	31.86± 3.73	68.20±3.72
CV (%)	72.80	68.42	132.0	72.03	70.65	57.12	64.08	29.87
Sig.	NS	*	*	**	*	NS	*	*

**p<0.001, *P<0.05, NS= Non significant, SE=Standard Error, Sig.= Significant, CV=Coefficient of variation, Min.=Minimum, Max.=Maximum.

Table 4. Reproductive disorders observed in rectal palpation of RBC in different genotypes

Reproductive organs	Condition	Genotype				Sig.
		L×HF	L×J	L×J×HF	Overall	
Cervix	Normal	100 (30)	100 (09)	83.3 (05)	97.80 (45)	*
	Thin	0	0	16.7 (01)	02.20 (01)	
Ovary	Normal	90.00 (27)	88.90 (08)	100 (06)	91.10 (41)	NS
	Cystic	10.00 (03)	11.1 (01)	0	08.90 (04)	
Uterus	Normal	70.00 (21)	77.80 (07)	100 (06)	75.60 (34)	NS
	Metritis	23.30 (07)	22.20 (02)	0	20.00 (09)	
	Pyometra	6.70 (02)	0	0	04.40 (02)	
Overall	Normal	60.00 (18)	66.60 (06)	83.30 (05)	70.00 (29)	**
	Problem	40.00 (12)	33.40 (03)	16.70 (01)	30.00 (16)	

*P<0.01, NS= Non significant, SE=Standard Error, Sig.= Significant, L=Local, J=Jersey, HF=Holstein Friesian

Table 5. Frequency of AI services given to RB cows in the studied areas

Frequency of AI services	No. of RB cows	Percent (%)
4-8	137	44.94
9-12	95	31.01
above 12	73	24.05
Overall	305	100

Table 6. Chemical composition of concentrate mixture feed used in farmers filed

DM	Ash	ADF	CP	EE	Ca	P
91.23	8.23	28.91	10.51	4.27	1.06	1.67

Table 3 shows the quality of frozen semen of different sources taken from the farmer's field. Total motile sperm in frozen semen were significantly difference among different sources. About 30% RB cows had reproductive problems in which highest about 40% of the RB cows were Local×Holstein Friesian crosses (Table 4). More than twelve times of AI services were given in about 25% of RB cows (Table 5). Table 6 shows the nutrient composition of concentrate mix feed which seem to be less crude protein (about 10.5% CP) in diet. From the findings so far obtained in this study, it can be concluded that genotype, nutrient of feed, quality of semen, frequency of insemination and reproductive problems are the main possible causes for RB in the studied areas.

Performances of Hilly Brown Bengal goat at farm level

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Executive Summary

The main aim of this study is to characterize hilly goats by qualitative and quantitative measurement in ultimate production profile. So, it seems essential to identify and quantify the parameters by which hilly goats can be described distinctively from others. The hilly goats no doubt a promising treasure of Bangladesh but is going to be extinct. The government of Bangladesh is now realizing the importance of its conservation and development. The objective of the research work is to determine the phenotypic and productive performances of hilly goats at Naikhongchari hilly area. The breeding program was conducted initially through Open Nucleus Breeding System (ONBS) at hilly areas at Naikhonchari. Animals were maintained in a semi-intensive rearing system. Initially goats were kept in the wooden floor and tin shed houses with the wooden wall. Then in second year of the project, goats were housed in permanent house with slated platform of 1m above from the ground. All goats were kept separately according to sex and age groups to avoid random mating and collect data easily. Goats were allowed to graze for 6-7 hours per day and concentrate was offered twice daily during morning and evening at the rate of 1% of their body weight per head per day. Data on productive and growth performance were recorded and calculated in the year of 2014 and 2015. All the information about production and reproduction were recorded in an individual data sheet for each of the animal. Then all data were stored in computer for analyses. The statistical analysis of the data was performed using compare mean with one way ANOVA and univariate analysis of variance procedure of SPSS package. The difference between treatments means were examined by using Duncan Multiple Range Test. Following results were found in the present experiment.

***Effect of season on growth performance*:** The seasonal effect on growth performance is shown Table 1. The body weight gain of Brown Bengal Goat during pre-weaning period, 3-month and 9-month age were influenced by seasonal variation. The experiment showed that pre-weaning and post-weaning gain had higher value in summer followed by winter and rainy season. Similar higher body weight gains during summer season followed by winter and rainy seasons also found for 3-month, 6-month and 9-month age period. The seasonal variation on growth performances of goat due to several factors such as higher feed intake, higher water intake, frequent movement in hilly areas etc. These factors may be influenced on the body weight changes of goat over summer to winter and rainy season. The average adult body weights of brown Bengal male and female were 25.58 kg and 20.92 kg, respectively.

Table 1 Effect of season on growth performance of Brown Bengal goats

Parameters		Seasons			SEM	Sig.
		Summer	Rainy	Winter		
Pre-weaning (0-90d) gain (Kg)		4.48^{a}	3.51^{b}	3.56^{b}	0.11	**
Pre-weaning (0-90d) gain (g/d)		49.86^{a}	39.00^{b}	39.55^{b}	1.16	**
Post-weaning (91-180d) gain (g/d)		39.90^{a}	36.32^{ab}	28.57^{b}	1.68	*
3-month body weight (kg)		5.73^{a}	4.62^{b}	4.79^{b}	0.11	**
6-month body weight (Kg)		6.93^{b}	7.89^{a}	7.88^{a}	0.15	*
9- month body weight (Kg)		9.34^{b}	11.31^{a}	9.21^{b}	0.22	**
Adult body weight (Kg)	Male	25.58				
	Female	20.92				

** = significant P< 0.01), * =significant (p<0.05).

Frequency of kidding: During the experimental period (2014 to 2015) a total of 257 kids were born from 163 does. The percentages of male and female kid were 48.25 % and 51.75 % respectively (Table 2). Seasonal effects on the frequency of kidding were also observed during the study. In summer season, the percent of total kidding was higher (39.69%) than rainy (34.63%) and winter season (25.68%). However, higher percentage of total kidding was found in September (24.51%) followed by December (17.90%) and April (16.34%).

Table 2. Frequency of kidding during different months of 2014 and 2015

Season	Months	Total does kidded	Total kids born	Male	Female	% of male kids	% of female kids	% of total kidding
Summer	March	20	29	16	13	55.17	44.83	11.28
	April	26	42	21	21	50.00	50.00	16.34
	May	6	9	4	5	44.44	55.56	3.50
	June	15	22	9	13	40.91	59.09	8.56
Total								**39.69**
Rainy	July	2	2	1	1	50.00	50.00	0.78
	August	2	4	3	1	75.00	25.00	1.56
	September	40	63	24	39	38.10	61.90	24.51
	October	11	20	10	10	50.00	50.00	7.78
Total								**34.63**
Winter	November	2	4	0	4	0.00	100.00	1.56
	December	29	46	24	22	52.17	47.83	17.90
	January	9	13	9	4	69.23	30.77	5.06
	February	3	3	3	0	100.00	0.00	1.17
Total								**25.68**
Grand Total		163	257	124	133	48.25	51.75	100.00

***Effect of parity on birth type*:** Effect of parity on birth type was shown in Table 3. At first parity, 79.17% of the kidding was single and that of 20.83% were twin in Brown Bengal goats. However, with the advancement of the parity, the trends of multiple births (twin and triplet) were increased and at the 5th parity 68.18% of kidding were twin and 18.18% were triplet (Table 3).

Table 3. Effect of parity on birth type of Brown Bengal goat

Birth type	1st Parity	2nd Parity	3rd Parity	4th Parity	5th Parity
Single	79.17	41.67	28.57	18.52	13.64
Twine	20.83	52.08	65.71	70.37	68.18
Triplet	0.00	6.25	5.71	11.11	18.18

Body weight changes of dam: Live weight at kidding and live weight just after kidding was tented to be higher ($p<0.01$) in triplet kidded does than twin and single kidded does (Table 4). The average live weight at kidding and live weight just after kidding was 25.02 kg and 21.98 kg respectively and the average loss of live weight just after kidding was 3.04 kg. The loss of live weight just after kidding was also tended to be higher ($p<0.01$) in triplet kidded (4.80 kg) does than twin (2.56 kg) and single (1.75 kg) kidded does. The placental weights (without fluid), were higher ($p<0.01$) in triplet kidded (331 g) does than twin (273 g) and single (253 g) kidded does.

Table 4. Effect of birth type (LS) on body weight changes (Kg) and placental weight (g)

Reproductive Parameters	Birth type			SEM	Sig.
	Single	Twin	Triplet		
Live wt. at kidding (Kg)	22.38^{b}	23.79^{b}	28.90^{a}	0.62	**
Live wt. just after kidding (Kg)	20.63^{b}	21.20^{b}	24.09^{a}	0.57	*
Lose of Live wt. after Kidding (kg)	1.75^{c}	2.59^{b}	4.80^{a}	0.16	**
Placental wt. (without fluid), g	253^{b}	273^{b}	331^{a}	5.90	**

** = Significant at 1% level (P< 0.01), * = Significant at 5% level (P< 0.05).

This study summarized that seasonal variations has significant influences on body weight and daily body weight gain in different age groups of Brown Bengal goat. Body weight, daily body weight gains and kidding percentage were higher during summer seasons. However, higher total kidding percentage was observed in summer season than any other seasons but higher percentage of total kidding was experienced in the month of September. Followed by first kidding, a leanier trend was observed on multiple kidding until 5th parity. Birth type had significant effect on body weight changes and placental weight.

Evaluation of genetic potentials of BLRI developed indigenous chicken varieties under farmers' condition

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Executive Summary

Scavenging chicken provide the lion's share of eggs and meat for domestic consumption. Majority of the consumers have fascination for egg and meat produced from scavenging condition. They are even ready to pay about two times more prices for the produces than that of hybrid broilers and layers. Indigenous chickens are low in productivity but are well adapted to adverse tropical climate and nutritional conditions compared to exotic chicken. Bhuiyan *et al.* (2013) reported that about 90 % of the rural households keep chicken with an average flock size of 5.73 per holding under backyard scavenging system which mirrored the significance of indigenous chicken for Bangladesh perspective. All stakeholders have been realizing for an indigenous chicken varieties with improved productivity to fulfill the demand. Bangladesh Livestock Research Institute (BLRI) conducted decade long breeding experiment on indigenous chicken varieties under intensive management condition and their productivity has remarkably increased (annual egg production of Common Deshi, Hilly and Naked neck increased up to 150-160, 130-140 and 175-190 respectively' age at sexual maturity decreased to 154 days from 168 days and egg weight increased by 2-3 gm). However, their performance has yet to be tested in farmers' conditions. Therefore, the improved genetic potentialities should be judged and explored by validating the performance under farmer's condition. With those ideas in mind the current study was undertaken to evaluate the performances of BLRI improved indigenous chicken varieties (Common Deshi, Hilly and Naked Neck) under farmers' condition. To conduct the study a total of 12 farmers were selected from each of the 3 project sites (Nakla, Sherpur; Dinajpur Sadar and Dumuria, Khulna) of Scavenging Poultry Conservation and Development Project (SPCDP). The farmers were imparted 3 days training on rearing of scavenging chicken. Among the 12, a total of 9 farmers were provided 2 male and 6 female birds of BLRI improved varieties replicating 3 for each of the variety (e.g. Common Deshi, Hilly and Naked Neck) in each location. The rest 3 farmers were provided existing indigenous birds as control in each location. A total of 800 eggs of BLRI improved 3 varieties e.g. Common Deshi (CD), Hilly and Naked Neck (NN) were collected from BLRI improved stocks; The eggs were hatched at the hatchery of BLRI and a total of 580 day-old-chick (DOC) distributed to the selected farmers. On the other hand, a total of 300 eggs of existing local variety (e.g.CD) were collected from different parts of the country and a total of 180 DOC were distributed to the selected farmers. The housing, feeding and management were same for both the treatment and control groups. The birds were reared following the management practices of BLRI developed native chicken rearing model. Data on daily feed intake (g/bird), weekly live weight (g), age (days) and weight (g) at sexual maturity, egg weight (g), egg production (no./day) and mortality were recorded for productive performances. The data on fertility, hatchability, age and live weight at first lay were recorded for reproductive performances. The average feed intake of BLRI improved birds at 4^{th}, 8^{th} and 12^{th} week of age were 25.0, 51.4 and 60.3 g/bird/day; while the values were 24.0, 49.0 and 58.8 g/bird/day respectively for local indigenous chicken. On the other hand, the cumulative average live weight of BLRI improved Common Deshi at 4^{th}, 8^{th} and 12^{th}week of age were 213, 536 and 852 g /bird while it was 200, 429 and 706 g/bird for local Common Deshi birds. The live weight of BLRI improved Naked Neck and Hilly chicken at 4^{th}, 8^{th} and 12^{th} week of age were 203, 509 and 819 g/bird, and 233, 600 and 1033 g/bird respectively. The average mortality of BLRI improved varieties and local Common Deshi variety at 1^{st}, 4^{th} and 8^{th} week of age were 2.0, 4.0, 0.68% and 2.35, 3.93 and 0.2% respectively. However, mortality at 12^{th} week of age was nil in both the groups.

Considering the above results, it may be concluded that till now the growth performances of BLRI improved indigenous chicken varieties seems to be better in comparison to the existing local indigenous chicken varieties. The birds already started laying and the study will be continued to assess the one year laying performances.

Table1. Feed intake (g/bird/day) of BLRI improved varieties and local Common Deshi in 3 locations

BLRI					Common Deshi(Local)			
Week	Nakla	Dinajpur	Khulna	Mean± SD	Nakla	Dinajpur	Khulna	Mean ± SD
1st	4.7	8.3	7.2	6.77 ± 1.8	8.53	9.01	5.85	7.80 ± 1.70
4th	26.7	21.3	27	25.00 ±3.1	27.14	25	24	25.4 ±1.60
8th	47	56.2	51	51.4 ± 4.6	47.14	47.45	49	47.9 ± 1.00
12th	48.7	57	75	60.3 ±13.4	48.41	55.92	72	8.8 ± 12.05

Table 2.Live weight of Common Deshi (g/bird) in 3 locations

Common Deshi (BLRI)					Common Deshi (Local)			
Week	Nakla	Dinajpur	Khulna	Mean ±SD	Nakla	Dinajpur	Khulna	Mean ±SD
DOC	30	31.16	30.5	30.55±0.58	28	21.63	23.9	24.51±3.23
1st	47.5	50.84	54.5	50.95±3.50	47	41.53	54.3	47.61±6.41
4th	189.54	189.36	260.48	213.13±41.01	169.77	172.68	257.56	200.00±49.87
8th	548	495	564	535.67±36.12	461	395	432	429.33±33.08
12th	904	781	871	852.00±63.66	738	652	728	706.00±47.03

Table 3. Live weight (g/bird) of BLRI naked neck and Hilly birds in 3 locations

Naked neck (BLRI)					Hilly (BLRI)			
Week	Nakla	Dinajpur	Khulna	Mean ±SD	Nakla	Dinajpur	Khulna	Mean ±SD
DOC	30	30	29	29.67 ± 0.5	28.8	31.56	31.1	30.49 ± 1.4
1st	46.54	50.6	52.4	49.85± 3.0	50.4	51.5	51.7	51.20 ± 0.7
4th	174.58	179.16	256.26	203.33±45.8	205.7	211.46	281.58	232.94 ±42.2
8th	475	496.2	555	508.73±41.4	632	589	578	599.67±28.5
12th	835	757	865	819.00±55.7	1109	1006	985	1033.3±66.3

Table 4. Mortality (%) of BLRI improved varieties and local Common Deshi in 3 locations

BLRI					Common Deshi (Local)			
Week	Nakla	Dinajpur	Khulna	Mean±SD	Nakla	Dinajpur	Khulna	Mean±SD
1st	3	1.63	1.6	2.08±0.8	3	2.56	1.5	2.35 ±0.7
4th	5	2.44	4.7	4.05±1.4	4	5.88	1.91	3.93 ±1.9
8th	1.5	0.5	0.03	0.68±0.7	0	0.3	0.3	0.2±0.1
12th	0	0	0	0	0	0	0	0

Productive and reproductive performance of selected native duck genotype

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Executive Summary

The study was conducted to evaluate the productive and reproductive potentialities of BLRI developed selected native duck genotypes from generation G2 to G3. At least five generations of pedigree hatching will be done to homogenize their genetic characters. Individual pedigree records are being kept by using commercially available leg bands to identify the ducks of all ages. A total of 550 day-old ducklings comprising of two selected native ducks namely Rupali and Nageswari were hatched in one batch. Ducklings were brooded in brooder house until 4th weeks of age and then they were reared in floor house under intensive management condition. The ducks and drakes were separated after 10th weeks of age. Nutrient content of the diets were provided 19.50%, 16.00%, 17.00% crude protein and 2900, 2950, 2800 ME Kcal/kg in starter, grower and layer breeder respectively. The desirable sex ratio for good fertility and hatchability was 1:5 for intensive rearing in a pen. Data on egg weight, hatchability, body weight at first day, 2nd, 4th , 6th ,8th and 10th week of age, feed intake, mortality, individual egg production were recorded to assess the productive and reproductive performances. The selection was practiced in third generation (G3) at 10th week of age according to 10th week body weight and at 40-week of age on the basis of an index comprising the parameters of age at sexual maturity (ASM), body weight (BW), egg production (EP) and egg weight (EW).The basis of selection process were rate of egg production that has to increase generation to generation. The data were analyzed by factorial arrangement in a CRD by General Linear Model (GLM) Univariate Procedure in SPSS Computer Program. Expected genetic progress was estimated for selection at 10th week body weight in third generation (G3) by using the following equation (Falconer, 1981).R = h2 ×S where, R = Expected response, h2 = heritability for 8 week body weight and S = Selection differential for the selected males and females.

Table 1. Productive and reproductive performance of selected naïve duck genotypes (G_2)

Parameter	Genotype (Mean ± SE)		F Value	Level of Significance
	Rupali	Nageswari		
Age at sexual maturity (ASM)/d	157.23±1.77	152.63±2.47	2.27	0.138^{NS}
Onset of egg wt.(g)	54.02±1.20	51.37±1.68	1.66	0.203^{NS}
BW at onset of lay (g)	1662.73±22.53	1467.58±31.45	25.45	0.000^{**}
Egg production $(24\text{-}48)^{th}$ weeks	158.68±2.49	148.42±3.47	5.72	0.020^{**}

NS: Non-significant; $p>0.05$; **; $p<0.01$

Age at first laid and onset of egg weight of Rupali duck were found 157 d and 54 g which were comparatively higher than Nageswari duck 152 d and 51 g respectively. The Body weight at onset of lay and egg production at 24 to 48^{th} weeks were found significantly different 1662g, 158 numbers and 1467g, 148 numbers in Rupali and Nageswari duck respectively (Table 1). Highly significant different in egg weight was observed between the genotypes Rupali and Nageswari duck at the age of 30, 36 and 40 weeks (Table 2). Body weight of Rupali and Nageswari duck at 10^{th} week of age 1515g and 1398g respectively were significantly ($p<0.05$) influenced by the genotype (Table 3). As shown in Table 4 that 10^{th} week body weight of males Rupali and Nageswari ducks were expected to increase by 62.54 and 46.30g respectively while in females Rupali and Nageswari duck., the expected responses were 20.56 and 16.71g respectively.

Table 2. Egg weight at 30, 36 and 40 weeks of age on selected native duck genotypes (G_2)

Parameter	Genotype (Mean ± SE)		F Value	Level of Significance
	Rupali	Nageswari		
Egg wt. at 30th week	63.14±0.91	58.21±1.27	10.00	0.003**
Egg wt. at 36th week	67.95±0.92	64.63±1.28	4.40	0.041**
Egg wt. at 40th week	66.16±0.89	62.53±1.25	5.96	0.022**

NS: Non-significant; P>0.05; **; P<0.01

Table 3. Effect of selected native duck genotype (G_3) on growth performance at different ages

Parameter	Genotype (Mean ± SE)		F Value	Level of Significance
	Rupali	Nageswari		
IBW	39.30±0.23	40.88±0.75	3.99	0.047**
BW at 2nd week	229.85±3.56	211.08±11.47	2.44	0.119NS
BW at 4th week	577.98±9.85	607.36±31.73	0.78	0.377NS
BW at 6th week	912.75±8.92	940.83±28.73	0.87	0.351NS
BW at 8th week	1262.53±10.11	1247.29±32.55	0.20	0.655NS
BW at 10th week	1515.68±9.99	1398.21±32.09	12.21	0.01**

NS: Non-significant; P>0.05; **; P<0.01

Table 4. Selection differential at 10th week's body (g) of selected native duck genotype (G_3)

Genotype	Sex	Before Selection		After Selection		Selection Differential (S) in gram	Expected Response to Selection
		No.	Avg.	No.	Avg.		
Rupali	M	87	1565.05	42	1704.02	138.98	62.54
	F	121	1471.47	101	1517.16	45.69	20.56
Nageswari	M	21	1432.24	15	1535.13	102.90	46.30
	F	25	1294.96	22	1332.09	37.13	16.71

The response to selection at 10th week body weight in male and female for two genotypes (Rupali and Nageswari) were expected to be positive in next generations. These finding will be helpful for further program formulation to carry on the duck breeding activities at BLRI.

Maintenance and improvement of chicken pure lines and performance of BLRI developed layer hybrids

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Executive Summary

Activity 1. Improvement of pure lines of chicken through selective breeding

Poultry breeding programs have been developed for many years and most of the commercial chickens are produced through line mating. The line building composed of a series of processes such as formation of base population (foundation stock) through gathering of individuals from the mass population. Therefore, this breeding program was undertaken to maintain and improvement of pure lines of chicken and to measure response to selection. These breeding lines have been rearing up and each generation reproduced from the best performers on the basis of their production performance. Individual culling and selection index methods are used as breeding tools. After hatch, a total of 500 day old chicks from each line were marked individually by wing band. After brooding, males and females were selected at the age of 8 weeks (85 males and 220 females) and 16 weeks (65 males & 200 females) based on the uniformity and phenotypic performances. Finally, 17 males and 85 females were selected at 38 weeks of age on the basis of selection index (composed of age at first egg, body weight, egg production and egg weight) to produce next generation. Hatching eggs are collecting based on the assortative mating design. After selection in generation 14, egg production percentages were increased 7, 6, 10 and 8 % in White Leghorn (L_1), White Rock (L_2), Rhode Island Red (L_3) and Barred Plymouth Rock(L_4) lines, respectively. Egg weight was increased 1-2 g in all lines. Similarly age at sexual maturity was decreased about 1 day in $L_1$and L_2, 4 days in L_3 and 5 days in L_4. On the other hand, body weight was reduced 15 g in L_1, 11 g in L_2, 40 g in L_3 and 4 g in L_4, respectively. Therefore, in the present generation of WR, egg production was highest and matures earlier than the lines of chicken. For efficient selection, and breeding, population per line should be increased.

Table 1. Result of selection of different lines and traits

Lines	Traits	Before selection Av/sd	After selection Av/sd	Selection difference	Selection intensity	Culling level
Line 1	ASM (d)	148.58/11.0	147.88/9.08	-0.71	-0.064	134<x<172
	BW (g)	1441.97/153.1	1426.11/150.5	-15.86	-0.103	1106<x
	EW (g)	59.76/3.90	61.58/3.60	1.82	0.467	54<x
	EP (%)	75.03/12.60	82.34/5.29	7.31	0.58	64.75<x
Line 2	ASM (d)	146.29/9.68	145.70/7.49	-0.59	-0.061	133<x<165
	BW (g)	1746.51/163.6	1735.61/138.29	-10.90	-0.067	1394<x
	EW (g)	57.79/4.02	60.25/3.42	2.46	0.612	51<x<67
	EP (%)	80.56/13.0	86.08/4.44	5.52	0.425	75<x
Line 3	ASM (d)	157.87/17.24	153.78/12.28	-4.09	-0.237	135<x<198
	BW (g)	1901.25/217.3	1861.50/144.51	-39.75	-0.183	1546<x
	EW (g)	60.38/4.85	62.38/4.18	2.0	0.412	54<x
	EP (%)	70.37/17.57	80.79/7.99	10.42	0.593	54.92<x
Line 4	ASM (d)	167.78/19.33	162.46/14.35	-5.32	-0.275	137<x<199
	BW (g)	1907.96/222.5	1903.86/213.9	-4.10	-0.018	1210<x
	EW (g)	59.72/3.66	60.89/3.75	1.17	0.319	52.67<x
	EP (%)	65.22/14.0	73.33/8.65	8.11	0.579	54.10<x

ASM, age at sexual maturity; BW, body weight; EW, egg weight; EP, egg production

During the last 15 years selection program, egg production was increased 12% in L_1, 8% in L_2, 4% in L_3 and 5% in L_4 respectively. Egg weight was increased 1.5 g in L_1, 6 g in L_2, 5 g in L_3 and 4 g in L_4 lines. On the other hand, age at sexual maturity was reduced 15 d in L_1, 8 d in L_2, 10 d in L_3 and 5 d in L_4 respectively.

Activity2. Performance evaluation of BLRI developed layer hybrid-2

Bangladesh imports parent and grandparent chicks from abroad to meet it's internal demand for day old commercial chicks. But, most of the world's leading companies are located in temperate region; while their developed chicken strains are marketed all over the world in varietal environmental condition which may not adapt in tropical environments. Therefore, the development of layer hybrid/variety/strain considering the existing environment is a long desire in the country. Keeping this view in mind, BLRI has developed color sexed layer hybrid named "Shorna". To measure the sexing accuracy, a total of 1022 day old Shorna chicks were hatched and sexed based on the feather color and found about 96% accuracy under farmer's condition in first batch. In second batch, a total of 1500 chicks were hatched (750 Shorna, and 750 ISA brown) and was found about 98 % sexing accuracy in ISA brown strain and about 96 % in Shorna strain. Thus no significant effect between the layer strains. The performance of laying hens is summarized in Table 2. Though the rate egg production of ISA brown hen was significantly increased but egg weight was decreased than that of Shorna ($P<0.05$). Therefore, higher egg mass production was found in Shorna. On the other hand, body weight and feed intake were higher in Shorna than that of ISA brown but differences were not significant ($P>0.05$). Therefore, FCR were not influenced between Shorna and ISA brown layer chicken. Therefore, BLRI developed Shorna is comparable with ISA brown laying hen.

Table 2. Comparative performances between Shorna and ISA brown layer strain

Parameter	Shorna	ISA Brown	SEM	P value
Hatching egg weight(g)	60.23	59.98	1.84	0.768
Hatchability (%)	88.16	89.79	0.92	0.097
Sound chicks (%)	98.95	98.49	0.21	0.961
Sexing accuracy (%)	95.02	97.73	6.45	0.321
DOC weight (g)	37.36	37.19	0.56	0.496
Body weight (g)	1896.64	1815.67	39.99	0.401
ASM (d)	139.87	143.42	0.98	0.341
Egg production (%)	79.43^{b}	82.47^{a}	0.612	0.020
Egg weight (g)	65.30^{a}	60.36^{b}	0.491	0.001
Egg mass (g)	51.87^{a}	49.78^{b}	0.487	0.005
Feed intake (g)	113.23	110.01	0.694	0.140
FCR	2.195	2.211	0.027	0.315

To determine and optimize the feed requirements, a total of 200 ready to lay Shorna pullets were randomly assigned into 5 treatment groups (T_o *ad lib*; T_1, 105 g feed/d; T_2, 110g feed/d; T_3, 115 g feed/d and T_4, 120g feed/d) and each treatment was replicated 4 times with 10 birds per replication. Birds were reared (20-72 weeks) in conventional individual layer cages. The birds were reared as per guidelines and were given access to feed and water throughout the study. In each lot of commercial feeds used in the experiment (16.97% CP and 2725 Kcal/Kg ME), the nutritional analysis was conducted to maintain CP and ME levels recommended by NRC (1994) standard. Egg production (EP) and feed intake (FI) of individual birds in each treatment group were recorded daily, and body weight (BW) and egg weight (EW) were weighed once in a week. At 72 weeks of age, 6 birds in each treatment group were sacrificed and meat quality and abdominal fat contents were measured according to Hassan *et al.* (2014). All data were analyzed by one-way analysis of variance using the GLM procedure in SAS (9.1., Cary, NC, 2005) and difference were determined by DMRT (Steel and Torrie, 1980). A *P*-value < 0.05 was considered significant. The results showed that annual egg production (no. of eggs) in T_3 was significantly higher than that of *ad lib* (T_0) and T_1 groups. Higher egg production was found under the T_3 treatment, and heavier eggs were laid by the *ad lib* and T_4 treatments ($P<0.05$). Consequently, better feed conversion ($P>0.05$) ratio was attained in T_3. On the other hand, hens received *ad lib* feeds in T_0 gained significantly more body weight and abdominal fat content than hens of other groups. Regarding egg qualities, neither eggshell breaking strength, albumin and yolk index, yolk color, nor Haugh unit was affected by treatment. Thus, these results suggest that daily 110-115 g feed may optimize the performance and enhance egg production of Shorna laying hen.

Conservation and improvement of Quail: Performance of fifth generation

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Executive Summary

Four genotypes of quail like Japanese (J), White (W), Black (Bl) and Brown (Br) quail are being maintained at BLRI with the objective to develop a suitable meat type quail genotype for our existing farming. The parent males and females were being maintained in cages for single pair mating through close breeding system for producing each generation. At least five generations of pedigree hatching will be done to homogenize their genetic characters. Pedigree records are being kept by using commercially available leg bands to identify quail of all ages. For producing fifth generation (G_5), parent quails of each genotype were selected from the 4thgeneration (G_4) on the basis of breeding value according to their 5th week body weight. Hatching eggs were collected from every single pen of the selected parent quails. A total of 1750-day-old chicks comprising of 4 types of quail namely J, W, Br, and Bl were hatched in one batch. Diet containing 24% crude protein and 3000kcal ME/kg were provided to the birds. Data on egg weight, hatchability, body weight of chick at first day, 2nd week, 4th week, 5th week and 6th week of age, feed intake, mortality, egg production were recorded to study their productive and reproductive performances. Collected data were analyzed in a CRD by General Linear Model (GLM) Univariate Procedure in SPSS Computer Program. The following general linear statistical model was used to analyze the different parameters: $Y_{ik}= \mu + g_i + e_{ik,}$; Where, $Y_{ik}$is the dependent variable of the experiment; μ is the overall mean; g_i is the effect of ithgenotype (i=1-4); e_{ik} is the error term specific to each record.

Body weight of quails at 3rd, 4th, and 6th week of age were significantly ($p<0.001$) influenced by genotype (Table 1). The 6th week body weight was 126.51 ± 1.23, 133.19 ± 0.99, 130.80 ±1.11 and 115.40± 1.21 g , respectively for J, W, Br and Bl genotypes. Significantly higher body weight was found in W and Br followed by Bl and J quail genotypes at different period of age.The productive and reproductive traits of quail genotypes are presented in table 2. The hatchability rate were significantly ($p<0.001$) higher in J (58.38%) compared to other three genotypes of W (50.30%), Br (47.79%) and Bl (46.45 %), respectively. Feed intake was not affected by genotype but hen day egg production (HDEP%) was significantly ($p<0.001$) influenced by genotype. Black genotype (8.78%) had non-significantly ($\chi^2 = 2.19$; $p>0.05$) higher chick mortality than J (6.66%), Br (6.31%) and W (5.36%) genotypes at 0-5 weeks which is shown in table 3. Selection differential varied from 4.3g body weight in White quail male to 8.7g body weight in Japanese quail female (Table 4). Phenotypic standard deviation varied from 7.4g in Japanese male to 11.3g in White female. The intensity of selection varied from 0.47 to 0.93 in this population. Based on the performances, W quail was superior for body weight and Bl quail for egg production. These findings give us more attention for continuing the quail breeding research for producing a suitable meat type quail genotype in our country.

Table 1. Least squares means (LSM) and standard error of means (SEM) of different weight traits as affected by genotype

Genotype	3rdwk body weight	4thwk body weight	6thwk body weight
Japanese	66.82^{c} ± 0.63 (756)	91.09^{b} ± 0.80 (742)	126.51^{b} ± 1.23(728)
White	77.03^{a} ± 0.69 (400)	103.01^{a} ± 0.55 (394)	133.19^{a} ± 0.99(388)
Brown	72.67^{b} ± 0.65 (398)	90.90^{b} ± 0.84 (391)	130.80^{a} ± 1.11(386)
Black	66.21^{c} ± 0.59 (141)	87.45^{c} ± 0.74 (138)	115.40^{c} ±1.21(135)
Level of significance	p<0.001	p<0.001	p<0.001

Figure in the parenthesis indicate the number of observations. Least squares means without a common superscript along the column differed significantly ((p<0.05)

Table 2. Productive and reproductive performance of four quail genotypes

Parameter	Quail varieties(Mean ±SE)				Level of Significance
	Japanese	Brown	Black	White	
Hatchability on setting eggs (%)	58.38^{a} ±3.21	47.79^{b}±2.56	46.45^{b}±3.54	50.30^{b}±2.67	p<0.001
Feed Intake(g/b/d)	11.32±0.84	10.68±0.84	10.21±0.84	10.66±0.84	NS
HDEP (%)	57.38^{b}±3.5	48.14^{b}±3.3	69.15^{a}±3.4	54.80^{b}±3.5	p<0.001

Least squares means without a common superscript along the row differed significantly ((p<0.05)

Table 3. Effect of genotype on chick mortality (%) during 0-5 weeks of age

Parameter	Genotype				χ^2 (df=3)	P- value
	Japanese	White	Black	Brown		
Mortality (%)	6.66	5.36	8.78	6.31	2.19	p>0.05

Table 4. Selection differential, selection intensity for 5 weeks body weight (g) in fifth generation (G_5) of quail

Genotype	Sex	Before selection		After selection		Selection Differential (S) (g)	Selection Intensity (i)	Phenotypic standard deviation (sd)
		No.	Aver.	No.	Aver.			
Japanese	M	328	103.2	150	109.3	6.1	0.83	7.4
	F	352	109.9	150	118.6	8.7	0.93	9.4
White	M	171	119.4	120	123.7	4.3	0.47	9.1
	F	208	125.4	120	133.0	7.6	0.67	11.3
Brown	M	185	110.8	120	115.4	4.6	0.57	8.1
	F	186	111.6	120	118.1	6.5	0.58	11.2
Black	M	68	99.9	30	107.2	7.3	0.92	7.9
	F	62	103.2	30	111.0	7.8	0.82	9.4

Conservation and improvement of native chicken: Performance of fifth generation

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Executive Summary

The 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 design for the production of fifth generation birds, and (iii) to estimate inbreeding coefficient to improve 3 Indigenous Chicken genotypes. A total of 1128-day-old chicks comprising of 3 types of chicken namely Naked Neck (NN), Hilly (H) and Non-descript Deshi (ND) were hatched in one batch for this study. In fifth generation (G4), selection was practiced at 8 week of age according to 8 week body weight and at 40-week of age on the basis of an index comprising the parameters of age first egg (AFE), body weight (BW), egg production (EP) and egg weight (EW). Improvement target of egg weight and egg production rate was increasing by 1g and 2 % respectively with per generation. The data were analyzed by factorial arrangement in a CRD by General Linear Model (GLM) Univariate Procedure in SPSS Computer Program. Expected genetic progress due to selection in a generation for 8 week body weight was estimated for fifth generation (G5) using the following equation (Falconer, 1981). R = h2 × S where, R = Expected response, h2 = heritability for 8 week body weight and S = Selection differential for the selected males and females.

Significant ($p<0.001$) body weight differences among the genotypes were observed at 12^{th} and 16^{th} weeks of age , with the highest body weight observed for H genotype (1250.71±27.71, and 1502.54±36.81g) than other two genotypes (Table 1) in all stages of age. NN genotype (2.85 %) had significantly ($\chi^2 = 9.023$; $p < 0.05$) higher chick mortality than ND (0.68 %) and NN (2.05 %) genotypes respectively at 0-8 weeks of age which is shown in table 2.The age at first egg laid was significantly ($p<0.001$) affected by genotype (Table 3). The age at which Indigenous Chickens start laying eggs ranged from 152.79 to 161.95 days. The birds of H genotype started laying eggs at higher age as compared to NN genotype. Feed consumption from hatching to 8 weeks (Table 3) showed that there was significant ($p<0.001$) variation in feed intake among the Indigenous Chickens genotypes. At the age of eight weeks, the lowest (62.96g) and highest (83.46g) daily feed intake were recorded for ND and H genotypes, respectively. The effects of genotype on hen -day egg production (HDEP %) of Indigenous Chicken is presented in Table 3. Hen-day egg production (HDEP %) observed in the present study were affected significantly ($p<0.001$) by genotype. In this study the average HDEP% of ND, H and NN were found to be 38.44±2.18, 30.43±2.10 and 41.95±2.11respectively.

Table 1. Body weight of Indigenous Chicken up to 16 weeks of age

Parameter	Genotype			Level of sig.
	ND (Mean±SE)	H (Mean±SE)	NN (Mean±SE)	
12^{th} week weight (g)	979.4^{b}±11.6 (315)	1250.7^{a}±27.7(155)	940.1^{b}±17.4 (139)	p<0.001
16^{th} week weight (g)	1300.4^{b}±20.3(208)	1502.5^{a}±36.81 (140)	1213.4^{c}±24.9 (137)	p<0.001

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

As shown in Table 4 that 8^{th} week body weight of males ND, H and NN birds were expected to increase by 64.7, 46.1 and 43.9g, respectively. While in females ND, H and NN birds, the expected responses were 21.5, 27.9 and 10.7g, respectively. The response to selection for 8 weeks body weight in male and female for three genotypes (ND, H and NN) were expected to be positive (increase).

Table 2. Effect of genotype on chick mortality (%) during 0-8 weeks of age

Genotype	ND	H	NN	χ^2 (df=2)	P-Value
Mortality (%)	0.68	2.08	2.85	9.023	p <0.05

Table 3. Productive and reproductive performance of native chicken genotypes

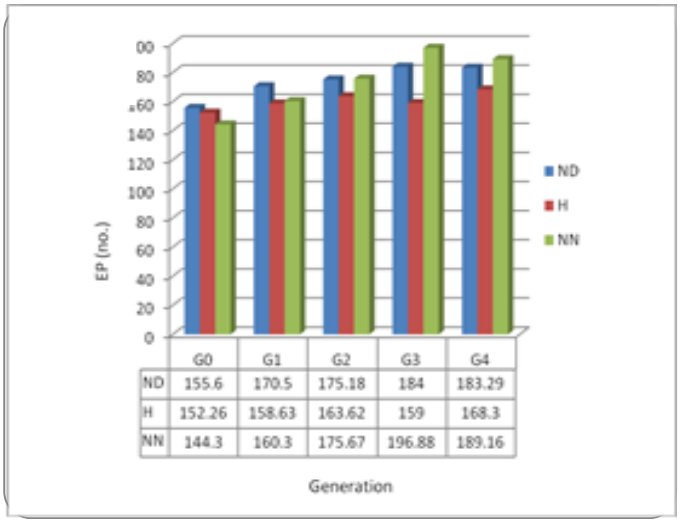
Parameter	Genotype (Mean ±SE)			Level of Significance
	ND	H	NN	
Age at first egg (d)	159.95^{b} ±0.49	161.95^{a}±0.62	152.79^{c}±0.77	p<0.001
Feed Intake(g/b/d)	62.96^{b}±1.48	83.46^{a}±1.43	66.94^{b}±1.41	p<0.001
HDEP (%)	38.44^{a}±2.18	30.43^{b}±2.10	41.95^{a}±2.11	p<0.001

Least squares means without a common superscript along the row differed significantly ((p<0.05)

Table 4. Selection differential, selection intensity for 5 weeks body weight (g) in fifth generation (G_5) of Native Chicken

Genotype	Sex	Before selection		After selection		Selection Differential (S) (g)	Selection Intensity (i)	Phenotypic Standard Deviation (SD)	Expected Response to Selection ®
		No.	Aver.	No.	Aver.				
ND	M	281	650.2	85	780.0	129.8	1.13	114.7	64.7
	F	302	525.4	230	568.5	43.1	0.42	102.5	21.5
H	M	62	844.5	30	938.9	94.4	0.88	106.8	46.1
	F	135	677.4	100	734.5	57.1	0.48	118.5	27.9
NN	M	121	661.5	45	753.4	91.9	0.99	92.8	43.9
	F	121	540.2	100	562.6	22.4	0.29	78.0	10.7

Figure 1. Generation wise annual egg production of indigenous chicken



Generation wise annual egg production of indigenous chicken is shown in Figure 1. In initial generation, egg production of ND was better than H and NN genotype respectively but in later generation, egg production of NN genotype was better. It is concluded that H genotype may be chosen for meat production and NN genotype for egg production. For further improvement selection should be continued.

Immune escape and genetic evolution of highly pathogenic avian influenza virus H5N1 with the advent of vaccination in poultry in Bangladesh

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Executive Summary

HPAI H5N1 virus has spread globally and has become endemic in several parts of the world, which is unique for an HPAI strain. Twenty-nine distinct HPAI epizootics have occurred since 1959. The current H5N1 HPAI panzootic affecting Asia, Africa and Eastern Europe which now also extends to the North American continent. Till today at least 63 countries poultry/ or wild birds have been affected with HPAI. Moreover, transmission to humans occurs sporadically with most of the incidents involving poultry workers and handlers and their immediate family members as well as visitors of live bird markets. In order to control HPAI outbreaks and thus prevent potential transmission to humans, culling of infected animals as well as pre-emptive culling is the most common method of choice. This would have a devastating effect on the economy in endemically infected countries. Instead, a number of countries (i.e. People's Republic of China, Hong Kong SAR, Vietnam, Indonesia, South Korea, Mexico, Pakistan and Egypt) are implementing nation-wide vaccination programs against avian influenza especially of the H5N1 subtype due to its implications for humans. However, field outbreaks have occurred in vaccinating countries, primarily because of inadequate coverage in the target species, but vaccine failures have also occurred following antigenic drift in field viruses. Bangladesh has also taken several measures including OIE classical methods to control this disease since 2007, but these methods have had limited impact on spread of HPAI virus. In this regard, government has decided to use vaccine as an additional tool to reduce the disease outbreaks to a level that can be responded effectively through conventional stamping out procedures.

Antigenic drift at the epitope regions is among the strategies the influenza virus uses to escape adaptive humoral immunity. Vaccination confounds one of the most effective selection forces fostering the generation of antigenic variants escaping vaccination induced immunity. Thus, the unpredictability of antigenic drift represents the most important hindrance to vaccine development. Therefore, an effective vaccination is possible only when the epidemic strain matches with the vaccine strain. In addition, high vaccine coverage exceeding 85% of individual birds of a population is required. Nonetheless, lack of screening for emerging variants as well as cutting vaccine dose or coverage for economical reasons could result in enhanced antigenic drift. This can even be accelerated by the immune pressure due to prior immunizations. Clinically silent though continuous inter- and intraspecies transmission may occur in populations where vaccination is used. However, it is generally accepted that the highly error-prone replication of influenza viruses and viral genome re-assortment enhance the robustness of an efficient evolutionary capacity of the virus. Given the zoonotic potential of the AIV circulating in Bangladesh risks of increased pandemic propensities of these viruses need to be taken into account as well. In the light of these facts, the present study aims to examine the following objectives-

i. Enhanced virological supervision of commercial chicken farms receiving AI vaccination: Detection and isolation of HPAIVs (focusing on H5N1 and H9N2) in circulation on the farm
ii. Characterization of genetic and antigenic properties of these viruses to verify the vigor of the mutational events with the advent of vaccination
iii. Efficacy evaluation of commercial vaccines (GOB recommended) against infection from most prevalent virus strains

We have supervised 50 farms vaccinated against HPAI H5N1 in each of three divisions (50 x 3) of the country and samples have collected thrice yearly. Cloacal and oropharyngeal swabs, fecal sample in case of live birds and morbid materials such as trachea have collected from healthy and succumbed birds from chicken flocks with a vaccination history (only H5N1 vaccination permitted in Bangladesh). Virus isolation has done from the cloacal and tracheal swab samples. We have isolated 52 isolates of type A influenza virus from the vaccinated farms and characterize for subtypes through rRT-PCR. Sequencing is ongoing for analysis the genetic variation and antigenic drift.

Prevalence of emerging and re-emerging foodborne pathogens and drug resistant gene in poultry value chain

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Executive Summary

Food safety is a global health concern which describes hygienic handling, preparation, and storage of food in ways that prevent foodborne illness. Foodborne diseases are widespread and becoming a growing public health concern not only for the developing countries but also for the developed nations. Food can transmit disease from person to person as well as serve as a growth medium for bacteria that can cause food poisoning. Although the incidence of food borne diseases at global level is difficult to estimate but they pose a significant economic burden by straining health care systems and have immense impact on international food trade, tourism and development. *Campylobacter* spp, *Salmonella* spp and *Escherichia coli* are the major zoonotic pathogens those can disseminate across borders and spread far distances via the food trade and international travel, and transmit to humans through the food chain. Antimicrobials or antibiotics revolutionized medicine in the 20th century and are probably one of the most successful forms of chemotherapy in the history of medicine. Their effectiveness and easy access led to overuse, especially in livestock raising, prompting bacteria to develop resistance. Furthermore, long-term exposure to sub-therapeutic antimicrobial agents provides selective pressure, which might change the sensitivity of bacteria to antimicrobial agents. This has led to widespread problems with antimicrobial and antibiotic resistance.

To fulfill the international requirements, the Bangladesh government already amended the fish and fish products regulations in-corporation HACCP system to increase the export. Nevertheless, there is no regulatory act against the drug residues in animal and poultry origin food in Bangladesh. The general public is becoming aware of food safety issues potential for chemical and antimicrobial drug hazards in foods. Livestock and poultry origin food viz. meat, milk, egg etc have antimicrobial drug residue, may play an important role in producing drug resistance gene of microorganisms. So, time will come when public will not purchase animal origin food having history of recent use of drug. The government has already taken drastic action to control adulteration in food, drugs, etc necessary for living. But still awareness has not developed about residual effect of drug and drug resistance gene. Considering these facts the study is under taken with the following objectives-

i. Isolation and Identification of emerging and re-emerging foodborne pathogens in poultry products
ii. Determination of antimicrobial drug residue in poultry products and byproducts
iii. Detection of antibiotic resistant gene in poultry value chain

Emergence of antimicrobial resistance foodborne bacteria due to easy access and indiscriminate use of antibiotic has become a serious problem in Bangladesh. However, the prevalence of foodborne pathogens and its potential risk to public health has not been well determined and evaluated. A total of 630 (26%) *salmonella* along with 97 (4%) *E.coli* O157 isolates were recovered from 2420 samples taken in 6 categories representing 22 types during 2015-2016. Among the *Salmonella* isolates, the predominant serotypes were *S. Enteritidis* (n=195), followed by *S. Typhimurium* (n=136), *S. Infanti s*(n=65), *S. Dublin* (n=45), *S. Indiana* (n=42), *S. Gueuletapee* (n=36) and *S. Derby* (n =15). In disk diffusion assay, high rates of antimicrobial resistance were observed for tetracycline (73.8%; 66.8%), gentamicin (72.4%; 69.2%), ampicillin (70.3%; 68.9%), amoxicillin (54.5%; 67.9%) and ciprofloxacin (50.3%; 45.9%) in *Salmonella* and *E. coli* O157, respectively (CLSI standard). About 78.2% salmonella and 75.1% *E. coli* O157 isolates showed a multidrug resistance (MDR) phenotype (resistance to ≥ 2 antibiotics). On-going study provided prevalence of foodborne pathogens in food,

which may be for poor hygiene and farming-to-slaughter practice. MDR highlights the need for immediate action on regulation and monitoring antimicrobial use to reduce healthcare cost and risk to public health.

Prevalence and molecular characterization of duck plague virus in selected areas of Bangladesh

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Executive Summary

Duck plague (DP) is an acute, sometimes chronic, contagious virus infection that occurs naturally in ducks, geese and swans. The disease is a potential threat to commercially reared, domestic and wild waterfowl. It often causes sudden, high and persistent mortality (90-100%) with a significant drop in egg production in laying ducks. In Bangladesh, major portion of the ducks are reared in semi intensive methods in the Haor areas where lands are remain under water for 4-5 months of the year. These huge water bodies in these areas are very convenient for duck rearing. In these low laying areas poor and ultra-poor people depend on ducks for their livelihoods as well as meats and eggs. But literature showed that DP is the most devastating among duck diseases in which causes huge economic losses of the poor and ultra-poor duck farmers. For minimizing the loss of framers as well as the sustainable development of duck industries in Bangladesh, it should be necessary to conduct research on duck plague virus (DPV) to know the status of this disease with proper control strategies in Bangladesh. In the light of above circumstances, the present study has been undertaken with the objectives to determine prevalence of DPV in selected areas of Bangladesh and, to isolate and identify DPV for molecular characterization.

For the above purposes, the study was conducted in the selected Haor areas of Bangladesh. A total of 155 samples (cloacal swab & clinical) were collected from duck species of different haor areas of Bangladesh including 45 samples from Mohanganj, Netrokona; 42 samples from Itna, Kishoregonj; 30 samples from Nasirnagar, Brahmanbaria and 38 samples from Taherpur, Sunamganj. The samples were processed and pooled (1:5 ratio) for initial screening of target *polymerase gene* (446 bp) of DPV by polymerase chain reaction (PCR) method. All samples of a positive pool were then tested individually for identifying the individual positive samples. The results showing that out of 155 samples 41 (26.45%) were found positive in which 17 (36.58%) were from Mohongonj, Netrokona; 16 (35%) from Itna, Kishoregonj; 2 (6.0%) from Nasirnagar, Brahmanbaria and 5 (14.28%) from Taherpur, Sunamganj (Table 1).

Table 1. Prevalence of Duck plague virus in selected areas of Bangladesh

Source of sample	Sample type	Sample No.	PCR test result		Virus isolation
			Positive	% Prevalence	
Mohanganj, Netrokona	Cloacal	41	15	36.58	11
	Clinical	4	2	50	2
Itna, Kishoreganj	Cloacal	40	14	35	9
	Clinical	2	2	100	2
Nasirnagar, Brahmanbaria	Cloacal	30	2	6.0	1
Taherpur, Sunamganj	Cloacal	35	5	14.28	2
Total		155	41	26.45	26

Positive samples were inoculated into 9-14 days embryonated duck eggs (EDEs) through chorioallantoic membrane (CAM) route for isolation of virus. Each of inoculated embryos was monitored daily for 6 days. After 6 days of post-infection (PI), all live EDEs were chilled overnight and CAM were collected separately from embryos. The EDE died earlier was also chilled, and in similar way, the CAMs were collected and again performed PCR for identification of virus. Subsequently isolation of DPV in primary duck embryo fibroblasts cell culture was done by observing cytopathic effect (CPE). CPE is characterized by the appearance of rounded clumped cells that enlarge and become necrotic 2–4 days later. Out of 41 samples, 26 isolated samples were confirmed by PCR. Representative four samples each one from four studied areas was selected for sequencing. Now sequence work is under process.

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

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Executive summary

Peste des Petits Ruminants (PPR) is a highly fatal viral disease of goat and sheep which is characterized by high fever, depression, oro-nasal secretion, respiratory distress, diarrhoea, high morbidity and mortality in small ruminants. In Bangladesh, this disease was first identified in the year 1993. Since then PPR is endemic all over the country causing huge economic loss. To control PPR in Bangladesh, a live attenuated conventional PPR vaccine was developed by Animal Health Research Division of Bangladesh Livestock Research Institute (BLRI) in 2000 and successfully used in the country. Currently many PPR prevalent countries with development partner like FAO has developed strategic control plan, so that PPR can be controlled and eradicated effectively. Until now no such strategic plan has been developed in our country. So a small scale pilot project implementation with objective of PPR control has been undertaken and its findings can be used as a basis to formulate a nationwide strategic control and eradication program based on global control program. The objectives of the project involve determination of goat and sheep population in the selected areas, conduct sero-surveillance and epidemiological studies of PPR, awareness campaigns on PPR recognition, prevention and control, development of control strategy, undertake phased vaccination program and assessment of conferred immunity and vaccine efficacy.

Goat population was determined in 21 selected villages under Jicorgachaupazila of Jessore district by door to door baseline survey with pre-tested questionnaire. Sixteen villages of Maguraunionand 2 villages of Paneasaraunionunder Jicorgacha upazila of Jessore district were treated as treatment villages. Bejeatola village of Paneasara union, Hariadira of Jicorgacha union and Sreerampur of Simulia union under Jicorgacha upazila of Jessore district were treated as control villages. Collection of epidemiological data was done by regular visit and communication with farmers of study areas. Awareness building campaigns with villagers have been conducted involving both men and women through meeting, regular visit of household, postering and distribution of leaflet. One training was conducted for paravet for proper vaccination of goat. A colour poster about the PPR disease control was printed and distributed to villagers and pasted on strategic public places in the villages. Campaigns were included different aspects of PPR disease, how to identify PPR disease, PPR situation in the villages, aim and goal of pilot project. A mass vaccination program was carried in all goats (3+ months) of 18 treatment villages (where around 8223 goats were vaccinated) after initial sero-surveillance; subsequently regular vaccination is being carried out for kids and newly purchased goats of treatment villages. Three hundred and seventy one sera samples have been collected (according OIE guidelines, based on the study population and considering age groups) for conducting sero-surveillance from the control and treatment villages and 827 sera samples were collected from vaccinated goats for post-vaccination (after 60 days) sero monitoring. All sera samples were tested by cELISA following the instruction of the manufacturer of the kit (BDSL and the Pirbright Institute World Reference Laboratory for PPR, United Kingdom)**.**

Baseline study showed that a total of 1013household rear goats in selected 21 villages where number of goats per household ranges from 3.50-3.55. Predominating Black Bengal breed is reared by the different catagories goat farmers, and native goat (Black Bengal) was 8 times higher than cross breed in this study areas. Black Bengal comes in first estrous at the age of 6 to 7 months and gives first kid at the age of 12 to 13 months, usually give births two kids at first parturition. Highest kidding is found in the winter season. Conventional and mixed type goat farming systems are practiced by the farmers.44.13% farmers practiced deworming and 29.71% farmers vaccinated their goats in surveyed areas.

Pre-vaccination sera analysis showed that in eight treatment village seropositive goats were 86.49%, 82.13%,64.44%, 76.92%,61.22%, 25.80%, 61.90%,and 40% in Rugonathnagar, Ghoradah, Nayemgali, Dohormagura, Borokhuli, Monohorpur, Amitobazar and kayemkhola, respectively, whereas in the control villages seropositive goats were 29.41%, 13.79% and 23.81% inSreerampur, Bejeatola and Hariadiara, respectively. Overall 60.89% goats were seropositive in treated villages before vaccination. Sera analysis from 60 days post-vaccinated goat from the treatment 18 villages showed60 days post-vaccination herd immunity rose to 87.85% (Figure 1) whereas in the control villages seropositive goats that 31.58%, 20.69% and 37.93% are positive in Hariadiara, Bejeatola and Sreerampur, respectively. After 30 months of post vaccination, the long life immunity level was found in 86% and 94.11% in Modhukali and Misridiara village (Table-1).From the results of persistence of maternal antibody, it can be said that first vaccination in kid or lamb should be given around 3 months of age.

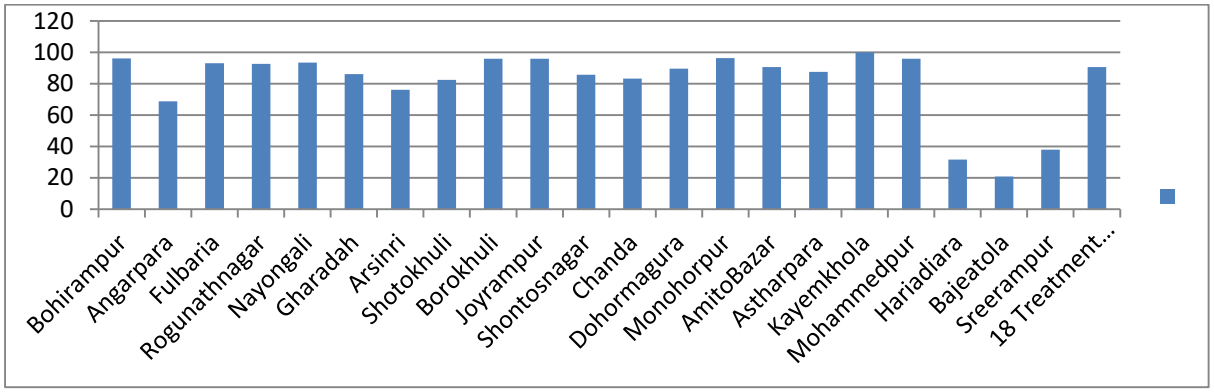

Figure 1. Sero-monitoring 60 days post vaccinated sera samples tested by cELISA

Table 1: The long life immunity level in two villages (30 months after first vaccination)

District	Upazila	Village	Level of immunity (%)			
			Total sera sample	Positive	Negative	Average
Jessore	Jikorgacha	Misridhiara	51	48	3	94.11%
		Modukhali	50	43	7	86%

Epidemiologically, PPR, FMD and some other non-specific diseases were recorded in the study areas. New entry of goats in the household or village is one of the most important risk factors for PPR virus circulation and found in several outbreaks surrounding the treatment villages. Morbidity and case fatality rate recorded were 14% and 70.55%, respectively during outbreaks. There was no outbreak of PPR in the treatment villages only one goat was died that purchased from local market due to lack of sufficient immunity. In case of sick goat, about 85% goats were received treatment, 10% goats were sold and 5% goats were slaughtered. The 99% dead goats were buried under soil.

Comparatively sero-positive goats are more in the treatment villages as compare to the control villages. It is reflected that locally produced PPR vaccine confers sufficient herd immunity that can protect PPR disease in goat and helps to meet global PPR control programme.

In vivo evaluation of anthelmintic properties of certain medicinal plants against internal parasites-GI nematodes of sheep

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Executive Summary

Parasitic infection especially gastrointestinal (GI) nematodiasis is a major burden for small ruminants particularly sheep and goats in Bangladesh. It causes reduced production and impaired animal health. GI nematodiasis is commonly treated by using synthetic anthelmintic. Thus GI nematodes are becoming increasingly resistant to the synthetic drugs. The cost of routine synthetic anthelmintic applications on herds and the problem of residues in animal products have prompted research on the anthelmintic activity of plant extracts. So, the present study was undertaken to develop herbal anthelmintic as an alternative to synthetic anthelmintic. The experiment was conducted at the sheep research farm of Bangladesh Livestock Research Institute, Savar, Dhaka from July 2015 to June 2016. The faecal samples were collected directly from the rectum of the animals with the help of poly bags and brought to the laboratory by using cool box. The GI nematodes egg per gram (EPG) of faeces was determined by MacMaster technique. A total of 105 sheep having EPG counts ranging from 550 to 7000was used in this experiment. About 35 sheep of different ages, sexes and body weights were included in each trial. The average age and body weight of the animals were 6 months and 15 kg, respectively. The animals were divided into five groups including control, where each group contained 7 individuals. Four herbal extracts were used in this experiment namely, mahogany, papaya, night-flowering jasmine and hill glory bower leaves. The control group was marked as T_0 and the treatment groups were marked as T_1, T_2, T_3, and T_4 for mahogany (*Swieteniamahagoni*), papaya (*Carica papaya*), night-flowering jasmine (*Nyctanthes arbor-tristis*) and hill glory bower (*Clerodendrum viscosum*) leaves, respectively. The mahogany, papaya, night-flowering jasmine and hill glory bowerleaves were collected from different locations to prepare the aqueous extracts with the help of a blender, while 300ml of clean drinking water was added to each 50gm. The pH of the fresh herbal preparations were 6.31, 6.92, 6.39, and 6.46 for mahogany leaves, papaya leaves, night-flowering jasmine leaves, and hill glory bower leaves, successively. The prepared extracts were administered orally once in the morning. The doses used were 10ml, 15ml and 20ml per kg body weight for all types of extracts. After treatment, the EPG of faeces was determined on day 5, day 7 and day 14 to compare the EPG counts before and after treatment. In case of herbal drugs administered @ 20ml/kg, live body weights of the animals on specific days were measured by digital balance, and certain haematological, biochemical parameters were tested as well. In addition, phytochemical analysis of the herbal plants was done to confirm the presence of anthelmintic phytoconstituents. The data were recorded properly and all data were analyzed by one way ANOVA using GLM procedure of SAS (9.1, Cary, NC, 2005). DMRT was performed to identify differences (Steel and Torrie, 1980). A p-value<0.05 was considered significant.

Table1. Effects of herbal plants/drugs on EPG counts

Treat-ment	No. of sheep	GI nematodes EPG counts (mean±SE)			
		Day 0	Day 5	Day 7	Day 14
T_0	21	1766.67±184.69	1747.62±183.24	1752.38^{a}±177.67	1816.67^{a}±183.23
T_1	21	1835.71±290.30	1428.57±229.33	879.76^{bc}±122.23	910.71^{bc}±118.58
T_2	21	1840.48±198.55	1530.95±159.67	1066.67^{bc}±102.37	1107.14^{bc}±100.85
T_3	21	1776.19±179.93	1526.19±156.66	1207.14^{b}±115.85	1235.71^{b}±116.45
T_4	21	1959.52±222.53	1392.86±117.07	733.81^{c}±74.08	772.14^{c}±76.60
Significance		NS	NS	***	***

NS=Non Significant;[abc]Data having different superscripts at the same column differ significantly; [**]Significant at 0.1% level (p<0.001).

The EPG counts were significantly ($p<0.01$) reduced on day 7 and day 14 while the best result was found in case of hill glory bower (Table 1). In respect of different doses, no significant difference was observed (Table 2). There was a significant difference in case of live body weight gain on day 14 (Table 3) but there was no noticeable change in haematological and biochemical parameters (Hb, PCV, ESR, AST, ALT) values that remained within normal range. Regarding phytochemical analysis, alkaloid, saponin, steroid, tannin and glycoside were strongly present in hill glory bower than mahogany, papaya and night-flowering jasmine (Table 4).

Table 2. Effects of doses of herbal drugs on EPG counts

Treat-ment	No. of sheep	GI nematodes EPG counts (mean±SE)			
		Day 0	Day 5	Day 7	Day 14
10ml	35	1555.71±98.94	1412.86±94.03	1752.38±177.67	1175.71±97.00
15ml	35	1690.00±118.05	1447.14±105.78	1058.57±99.57	1100.00±100.86
20ml	35	2261.43±230.29	1715.71±180.58	1199.57±136.90	1229.71±137.60
Significance		NS	NS	NS	NS

NS=Non Significant

Table 3. Effects of herbal drugs on body weight gain (@ 20ml/kg)

Treat-ment	No. of sheep	Live body weight(mean±SE)		
		Day 0	Day 7	Day 14
T_0	21	9.15±0.56	9.38±0.50	9.55^{b}±0.48
T_1	21	10.30±0.47	10.65±0.44	11.05^{ab}±0.45
T_2	21	9.65±0.57	9.96±0.52	10.29^{ab}±0.48
T_3	21	9.80±0.85	10.02±0.92	10.13^{ab}±1.04
T_4	21	11.00±0.71	11.04±0.79	11.85^{a}±0.58
Significance		NS	NS	*

NS=Non Significant;[ab]Data having different superscripts at the same column differ significantly; [**]Significant at 5% level ($p<0.05$).

Table 4. Phytochemical analysis of herbal plants used

Test		Hill glory bower	Mahogany	Papaya	Night-flowering jasmine
Alkaloid	Mayer's test	++	-	+	+
	Hager's test	++	++	++	++
	Wagner's test	++	-	+	+
	Dragendorff's test	++	+	++	+
Flavonoid		-	+	+	+
Glycoside		+	-	+	+
Saponin		++	++	+	+
Steroid		++	++	+	+
Tannin		+	+	+	+

++ = Strongly Present, + = Present, - = Absent

It can be concluded that among all four herbal drugs, hill glory bower revealed better anthelmintic properties *in vivo* against GI nematodes of sheep. Again, any of the doses (10ml, 15ml, and 20ml per kg body weight) can be used for the purpose of treatment.

Study on prevalence and molecular diagnosis of subclinical mastitis in dairy cows at Baghabari milk shed area of Sirajganj

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Executive Summary

Mastitis is an inflammation of mammary gland which together with physical, chemical, microbiological changes is characterized by increase in number of somatic cells in the milk and by pathological changes in the mammary tissue but subclinical mastitis are which no changes in the milk apparent, may both reduce milk production. The reduction in milk production attributed to subclinical mastitis may account for 70%-80% of the total losses. The subclinical mastitis in dairy cows is important because it reduces the milk yield, usually proceeds to clinical form, persist for long time, difficult to detect and it adversely affects milk quality. Several causative agents and predisposing factors have been implicated mastitis i.e. viral, bacterial, mycoplasmal and yeast pathogen and there is no gross changes occur in udder or glandular tissues. So it has needed to laboratory examination. infected animal acts as a continuous source of infection to herd mates. As it is a persisting problem in dairy industries and causes huge loss. So it is important to study the prevalence of subclinical mastitis and identify the causal agents that will be helpful to control the Subclinical Mastitis of dairy cows and hence increasing dairy production to meet up the growing demand of milk in Bangladesh. Dairy farmers will get maximum profit with minimum production cost and it will be a supporting tool to ensure the Vision-20121 of the Government. Therefore, the present research work was undertaken with the objectives-to investigate the prevalence of Subclinical Mastitis of cows in milk shed areas and Dissemination of Mastitis control package to the dairy farmers. A questionnaire was prepared and pre-tested in the respective field for questionnaire finalization. It was prepared and surveyed with direct interviewed of farmers to collect both herd and animal level data including herd size, no. of parity, age, milk yield, history of diseases specially mastitis, type of breed, deworming, vaccination, hygienic status etc. A total of 1200 milk samples from 300 crossbred dairy cows of 60 dairy farmers at thirteen villages of Shahjadpur upazilla of Sirajganj district and Sathiaupazila of Pabna district were tested to CMT, WST and SFMS for sub clinical mastitis during September 2015 to May 2016. In this study, overall prevalence of subclinical mastitis was 51 % by CMT. Strong positive samples were taken to laboratory for screening tests, culture, antibiotic sensitivity test and PCR to detect strains. In this study, we found that farmers were practiced deworming of their animals in different ways such as every 3 months, 6 months, 9 months, 1 year, 1 year above and the percentage of it practicing farmers were 15 %, 50 %, 3.33 %, 26.67 % and 5 % respectively. About 98 % farmers did not practice hand wash and udder wash with antiseptic solution or water. About 93 % farmers were not practicing of bathing of their dairy cows before milking and there were no certain hygienic place of milking. In this study, we also found that 98 % cows shed were tin shed and 76.67 % floors were made up of brick though hygienic status of housing and floor was not satisfactory. Only 6.67% farmers use antiseptic in the cleaning of their farms. They have no isolation shed for sick animals in their farms. Only 3.34% farmers adopted manure management system such as biogas plant. Over 54 % dairy farmers assumed that 30 % to 60 % milk production decrease due to mastitis in lactating cows. About 56.67 % dairy farmers had previous record of culling of cows due to mastitis. Out of 1200 milk samples, 49% were CMT negative and in case of positive: Trace- 13 %, Weak 11 %, Distinct 18.67%, Strong 8.33%. Among them 400 samples were again screenings with WST where 45% samples were negative and positive: Mild- 22 %, Moderate 27%, Strong 6 %. Same 400 samples were tested with SFMT where negative 45 %, and positive: Mild- 20 %, Moderate 29%, Strong 6 %. Strong positive samples were cultured in different agar media such as Xylose Lysine Dextrose agar (XLD), Nutrient agar, EMB agar, Mannitol salt agar for isolation of *Salmonella spp., E. coli, Staphylococcus spp., Pseudomonas spp.* respectively. Biochemical test & Gram's staining were performed for more confirmation. After then culture sensitivity tests were performed against Gentamycin, Amoxicillin, Ceftriaxone, Penicillin, Ciprofloxacin and Colistinsulphate. It was observed that most of the

microorganisms were sensitive to Gentamycin, Amoxicillin, Ceftriaxone and show resistant to Penicillin, Ciprofloxacin and Colistinsulphate.

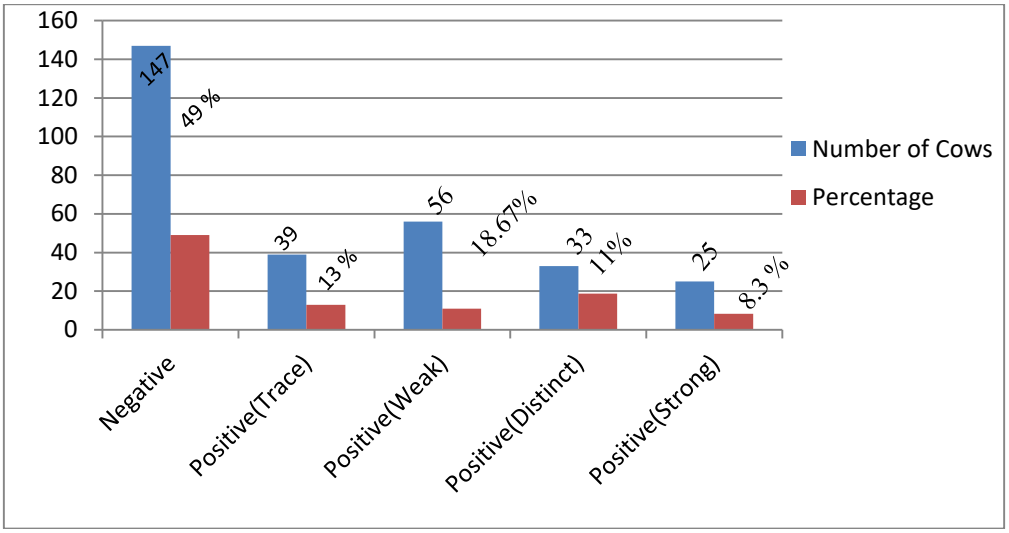

Figure 1. Showing 51 % Prevalence of Subclinical Mastitis in dairy cows by CMT

From the investigation, it will be said that, Gentamycin and Ceftriaxone are more sensitive to the organisms causing mastitis in cows. It was also observed that among three tests, SFMT is most cost effective and easy for farmers which could regularly use in farm level for early detection of subclinical mastitis to take preventive measures to control the disease successfully.

Descriptive epidemiology of Foot and Mouth Disease in Bangladesh

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Executive Summary

Foot and Mouth Disease (FMD) is endemic in Bangladesh. FMD is a highly contagious OIE listed important viral disease that causes huge economic losses due to drastic reduction of production. FMD affects all cloven hoofed domestic animals such as cattle, swine, sheep, goats as well as more than 70 species of wild life. There are 7 serotypes and around 60 subtypes of FMD virus, which produce similar clinical symptoms but may not be cross protective. Epidemiology of FMD has been extensively studied in developed countries but limited works have been done in endemic situation like in Bangladesh. Vaccination against FMD is practiced in Bangladesh, though a number of outbreaks are occurring in the country every year. In the present study, the epidemiology of FMD in Bangladesh was explored. The objectives were undertaken to study the descriptive epidemiology of FMD in endemic setting in Bangladesh.

Three regions of Bangladesh having different husbandry practices were selected. These were Savar upazilla of Dhaka district, Shahjadpur upazilla of Sirajgonj district and Ghatailupazila of Tangail district. A cross-sectional study was conducted to identify the risk factors for FMD incursion and spread. Cluster sampling technique was applied and data were collected from 458 households/farms of 50 clusters during the period from June 2013 to May 2014 with pretested questionnaire having 43 variables. Simultaneously, an active surveillance based on clinical observations followed by virological confirmation was carried out in the study areas during the period from April 2013 to June 2015. Data were analyzed by using MS excel, STATA, R and GIS software.

During June 2013 to May 2014, a total of 103 farms/households were found to have been affected by FMD. The prevalence rate among 5,663 cattle was found to be 18 per 100 cattle. Type of farms of the study areas were categorized broadly into 2 groups of which intensive farms where animal having no access to grazing were 57.2% (262), extensive farms where animal having access to grazing were 43.8% (196) . About 68% households/farms reared cross bred cattle, 26% indigenous cattle and only 6% reared both types of cattle. Nearly 50% of total cattle were milking cows, 25% were male and rests were heifer. FMD vaccine coverage was 49% in the study areas. Among the affected households/farms, 69% did not receive any FMD vaccine. Out of 458 households/farms 400 farms/households were within <1 kilometer distance from long road, and the remaining 58 households/farms were >1 kilometer away from the long road. From the study it was found that 93% of outbreak farms/households were in regular contact with feed seller, which would suggest that the disease might have transmitted through contaminated feed or movement of vehicle or human. History of introducing new animals were found in 38% of the households/farms affected with FMD.

During the active surveillance, 21 epidemiologically distinct outbreaks of FMD, involving 64 households/farms were found. There were 5 outbreaks at Shahjadpur, 12 outbreaks at Ghatail and Madhupur and 4 outbreaks at Gazipur, Savar and Keraniganj during the period from April 2013 to June 2015. It was found that 34%-75% (overall 49%) animals of affected herds developed clinical disease during an outbreak. Among the affected farms, 52% and 38% were small household farms having 1-3 and 4-7 animals, respectively and only 10% were larger farms having >20 animals.

From the study it was found that vaccination has positive impact in reducing FMD outbreaks. Frequent contact with feed seller and introduction of new animal may enhance the spread of FMD. Small scale farms/households were more prone to FMD than large scale farms/households.

Persistence of infection induced antibody against Foot and Mouth Disease in naturally infected cattle

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Executive Summary

Bangladesh is a densely populated country of south Asia with most of the people (80%) dependent on agriculture, mainly on livestock rearing for food and occupation. But there are many diseases of livestock hindering its production. Among these Foot and Mouth disease (FMD) is the most detrimental, mainly to cattle. FMDV is endemic in Bangladesh and causes huge loss declining productivity of cattle. Three serotypes of FMD virus O, A and Asia 1 are now circulating in this country. To efficiently control the disease in developing countries like Bangladesh, vaccination of animals is the most conventional and efficient way. Naturally infected animals develop some innate antibody against the disease and it persists for a temporary period. For effective vaccination program it is essential to know how long the natural immunity persists and protect the animals against circulating FMD serotypes. The proposed study was conducted for identification and serotyping of Foot and Mouth Disease virus from clinically infected cattle and detection of persistence of antibody induced by infection in their serum.

Clinical samples were collected aseptically from live FMD suspected cattle showing characteristic signs and lesions of Foot and Mouth Disease from different outbreak areas of Savar upazilla of Dhaka district of Bangladesh during the period from January/2014 to June/2015. Firstly uniplex one-step RT-PCR was performed with clinical samples using universal primer pair 1F and 1R to identify whether the virus belonged to FMD group or not. After initial confirmation of FMD virus, multiplex RT-PCR (mRT-PCR) was employed using serotype specific primers (P38:P40:P74-77:P110) to confirm the FMD virus serotypes. During collection of clinical samples for PCR, blood samples were also collected from FMD affected cattle for measuring antibody titer in serum by Liquid Phase Blocking (LPB) ELISA. Further blood samplings were done for more than five consecutive occasions at five weeks interval from the survived cattle in which infection was confirmed by RT PCR. The serological responses of cattle to natural FMD infection were measured with collected sera samples by performing the LPB ELISA.

RT-PCR result of clinical samples with universal primer pair (1F, 1R) revealed sixteen samples positive for FMDV out of twenty five samples. Among these positive samples; 7 samples (43.75%) were positive for FMDV O type followed by 5 samples (31.25%) positive for A type, and 2 samples (12.5%) were positive for Asia-1 type. There were 2 cases (12.5%) of mixed infection with synchronized presence of O and Asia-1 serotype. The antibody evoked by natural FMD infection was evaluated by LPB ELISA. The antibody titers arose at high level (PI value>80) at the first week of infection and reached at its peak (PI value >90) on the 70-75 days post infection (dpi) for serotypes A, O and Asia 1. After that a steep fall was observed for all serotypes. But the antibodies remained above the protective level (PI value >50) up to 140 -145 dpi for all three serotypes. No protective antibody (PI value<50) was detected in the serum samples collected after 365 days from the onset of FMD clinical signs (Table 1 & Figure 1). The protective antibody titer was recorded only against that serotype with which the animal was infected. Antibody against other serotypes develops slightly but those were much below the cut off value of test for protection (Figure 2).

Table 1. Mean PI values with std. deviation of naturally infected cattle

Vaccine name		1-5 dpi	35-40 dpi	70-75 dpi	105-110 dpi	140-145 dpi	175-180dpi	365 dpi
O type		87.8+3.9	90.4+2.4	92.1+5.1	78.0+8.3	66.7+8.6	49.8+10.5	18.7+29.1
A type		84.4+3.5	88.5+3.5	91.6+3.0	71.7+6.0	55.0+11.0	46.5+6.2	20.3+0.0
Asia 1 type		83.8+5.1	86.1+5.4	89.9+2.3	78.9+.67	51.0+2.6	37.7+0.5	0.0
Mixed infection	O type	83.9+2.1	88.9+0.1	92.7+2.9	84.2+4.4	63.4+1.6	55.9+3.1	14.9+21.0
	Asia 1	80.4+2.0	84.8+0.7	90.1+4.8	72.1+3.7	57.7+2.6	42.6+1.3	24.8+0.0

*dpi= days post infection

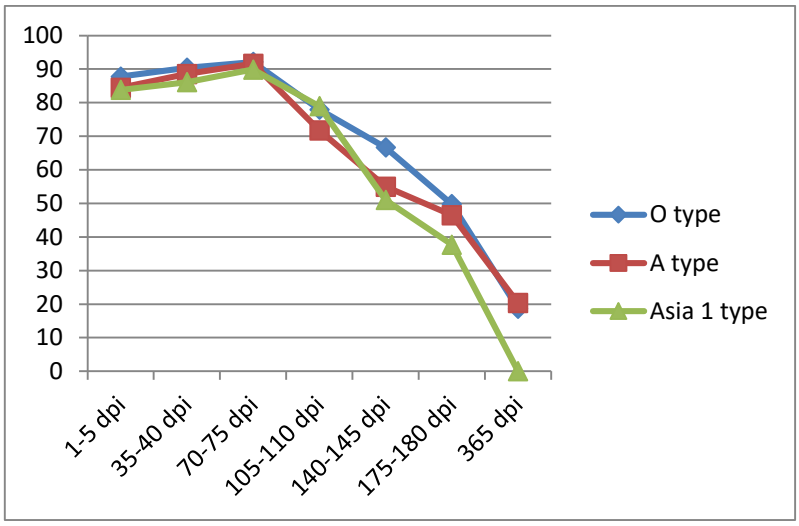

Figure 1. Antibody titer at different post infection period

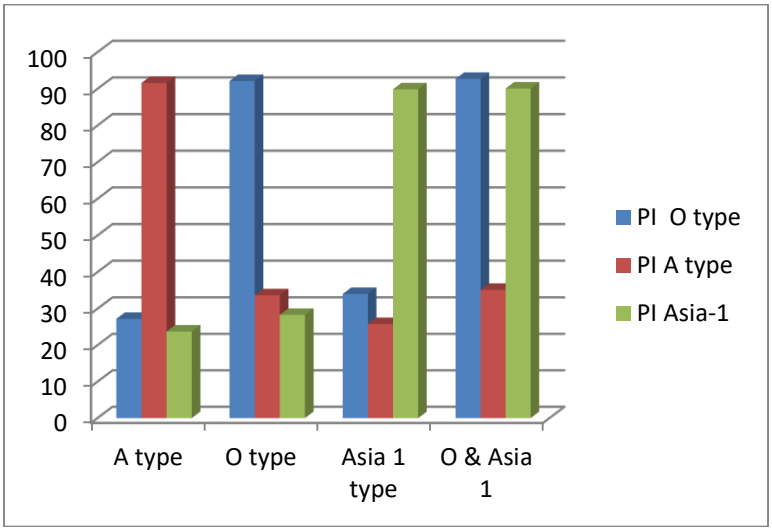

Figure 2. Rise of antibody was corresponding to the type of infection

It could be concluded that three serotypes of FMD virus O, A and Asia 1 were circulating in the study area and type O was dominating among these serotypes followed by A and Asia 1. There were also occurrence of mixed infection with serotype O and Asia 1. Antibody induced by natural infection remains at protective level (according to test interpretation, PI value >50) up to 145 days post infection (dpi). The protective antibody titer was recorded against only that serotype with which the animal was infected (serotype specific).

Feeding effect of densified total Mixed Ration (TMR) on the milk yield, milk composition and digestibility of RCC milking cows

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Executive Summary

Crop residues are the major roughage source available for ruminant feeding in Bangladesh. Improving the management of crop residues as animal feed and restricting its wastage through burning should be the priority area for livestock researchers. In this respect, the technology of "Total Mixed Ration (TMR) Block" is a novel approach, which provides a good opportunity to feed manufacturers and entrepreneurs to remove regional disparities in available feed and supplying balanced feed to the dairy and other ruminant stock farmers on a large scale, especially in areas with shortage of green fodder. Straw based densified TMR is a new concept in the feeding of dairy animals and is a novel system of delivering nutrients to bovines as a complete balanced ration. This study was conducted to formulate, process, and development of TMR for RCC milking animal by using locally available agro-industrial by-products. To determine the feeding effect of TMR, an experiment was conducted at Pachutia Research farm of Bangladesh Livestock Research Institute (BLRI), Savar Dhaka. A total of 15 milking cows were selected and equally divided into 3 treatment groups having 5 cows in each group considering their milk yield. One group was considered as control and fed regular feed supplied to the animal at the farm (T_0). In another two were treatment groups, animals fed TMR (60% roughages: 40% concentrate, contained 16% CP), where, one group fed as block (T_2) and another group fed as mash form (T_3). For making TMR, rice straw was used as crop residue. Before preparation of TMR, rice straw was chopped through the chopper machine and then mixed with other concentrate ingredients.TMR blocks were prepared manually contained 5 kg materials with the dimension of 9cm×9cm×9cm. The dietary composition of TMR is shown in Table 1 and 2. Animals of each group offered TMR twice daily as *adlibitum* at 8.00 am and at 4.00 pm. Data of Feed intake, milk yield, milk composition, body weight gain and nutrient utilization were recorded. The feeding trial was continued for a period 70 days. In the middle of the feeding trial, a digestibility trial was conducted (Respective samples of feed, refusal and faeces samples were subjected to chemical analysis for determination of crude protein (CP), organic matter (OM),dry matter (DM), ash and Neutral detergent fibre (NDF), Acid detergent fibre (ADF) following the methods of AOAC (2005) and Van Soest *et al*., (1991), respectively. In the TMR for blocks antifungal agent were mixed at the rate of 0.15% to improve their shelf life. The shelf life of the blocks was observed daily up to 7 days and continued for 1.5 month by opening the wrapping poly pack to test the physical quality (colour, smell, rottenness),and yeast and moulds were visually observed as per methods of integrated evaluation (BAPH, 1996). The data were analyzed using the "SPSS" statistical program with one way ANOVA in Completely Randomized Design (CRD) and Duncan's Multiple Range Test (DMRT) used to compare the significance of treatment means among the different parameters.

The feed intake of animals supplied different form shown in Table 3. The study revealed that feed intake was significantly higher in T_1 group than other treatment groups. DM intake, CP intake, DM intake % live weights were significantly higher in T_1 group and the lowest observed in T_0 group. Crude protein (CP) intake was differed due to the variation of DM intake among different treatment groups. Milk production and composition of different treatment groups were shown in Table 4 .There were significant differences observed in milk yield among different treatment groups. The highest milk yield was observed in T_1 group and lowest milk yield werein T_0 group. There were significant difference observed in fat, protein, lactose content in milk and but no significant difference was in SNF content. The body weight gain is shown in Table 5. Nutrient utilization of different treatment groups are shown in Table 6. The highest DM, CP, OM, Ash, ADF, NDF digestibility were higher in T_1 group and lowest in T_0 group.

Table 1: Dietary Composition

Feed Ingredients	Amount in kg	
	T_0	T_1 & T_2
Rice straw	-	40.51
Napier silage-3	82	-
Wheat bran	5.85	0.65
Kheshari bran	1.8	0.65
Soybean meal	2.6	18.55
Molasses	-	5.25
Salt	0.09	0.35
DCP	2.7	1.75
Water	-	32.29
Wheat broken	1.44	-
Maize crushed	1.8	-
TOC	2.16	-
DM(%Fresh basis)	34.18	62.24
CP(%)	9.01	16

Table 2: Nutrient composition of different feed ingredients used in different treatment group

Ingredients	DM (%)	CP (%)
Wheat bran	87.91	16.77
Khesari bran	89.58	13.69
Soybean meal	87.68	40.05
Wheat broken	89.11	12.16
Maize crushed	90.01	8.5
TOC	88.55	30.03
Rice straw	88.96	4.61
Napier-3 silage	20.39	10.25

Table 3. Feeding effect of TMR on intake

Parameter	Control(T_0)	TMR Block(T_1)	TMR mash(T_2)	Significance level
Fresh feed intake (kg/day)	16.82^{c}±.18	14.66^{b} ± .24	14.12^{a} ±.45 .08	p<0.001
DM intake (kg/day)	5.1^{a}±.05	9.1^{b}±.06	8.9^{b}±.12	p<0.001
CP intake (kg/day)	0.46^{a}±.004	1.36^{c}±.01	1.31^{b}±.01	p<0.001
DM intake% live wt	2.67^{a}±.19	4.28^{b}±.21	3.82^{b}±.19	p<0.001

Table 4. Milk production and composition of different treatment groups

Parameter	Control(T_0)	TMR Block(T_1)	TMR mash(T_2)	Significance level
Initial milk yield	2.74±0.31	2.74 ±.21	2.75± .21	p>0.05
Current milk yield	2.75^{a}±.02	3.02^{b}±.02	2.93^{b}±.03	p<0.001
Fat	4.52^{a}±.18	4.91^{ab}± ..12	5.03^{b} ± .15	p<0.05
Protein	3.82^{a}±.1	4.17^{b}±.03	4.07^{b}±.03	p<0.001
lactose	5.78^{a} ±.1	6.01^{b}±.05	5.87^{ab}±.04	p<0.05
SNF	10.92±.08	11.09±.1	10.9±.05	p>0.05

Table 5. Changes of live weight of different treatment groups

Parameter	Control(T_1)	TMR Block(T_2)	TMR mash(T_3)	Significance level
Weight gain(kg)	12.28±3.55	16.34±1.32	33.72±18.9	p>0.05
Live weight gain(kg/d)	0.175±.05	0.233±.01	0.481±.27	p>0.05

Table 6. Nutrient utilization of different treatment groups

Nutrients digestibility (%)	Control(T_0)	TMR Block(T_1)	TMR mash(T_2)	Significance level
DM	55.71^{a}±1.23	72.09^{b} ± .93	70.4^{b} ±1.61	p<0.001
CP	50.28^{a}±1.74	75.55c±.43	71.27^{b}±1.49	p<0.001
OM	58.11^{a}±1.16	74.38^{b}±.85	72.55^{b}±.1.36	p<0.001
Ash	39.12^{a}±2.45	62.06^{b}±1.33	61.85^{b}±2.68	p<0.001
ADF	59.33^{a}±.53	69.85^{b}±1.3	68.29^{b}±1.43	p<0.001
NDF	60.76^{a}±.99	70.14^{b}±1.43	67.47^{b}±1.57	p<0.001

Based on the results of the experiment, it can be concluded that densified TMR block (T_1) can be used in regards to higher milk yield, higher nutrient digestibility and more profit. Further, validation research on developed TMR will be carried out under farmers' condition for commercialization of the technology.

Comparative feed intake and growth performances of buffalo and cattle of different ages

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Executive Summary

The public sector development plan identified beef production as the potential income generating and poverty reduction good practices, and targeted to promote sustainable improvements in animal productivity including product processing and value additions (7th Five-year plan). On the backdrop of a slower growth of beef meat (Statistical Yearbook, 2014) but, the hiking of its market prices (Statistical Yearbook, 2014), fattening of buffaloes of the south and river deltas and the evaluation of their meat quality comparing with cattle may help the strategic improvement of beef productions of the country. Thus, the present study was undertaken with the objectives of determining differences in the i) intake and digestibility, ii) growth performances and iii) feed cost of the two species at different slaughter ages fed a common diet.

Eighteen native buffalo and 18 BLRI Cattle Breed-1 bulls of three age groups (18 months, 24 months & 30 months) were distributed in 6 (2 species*3 ages) treatment groups having an equal number (6) of animals in each. All animals were reared on a single plane of nutrition of a 50:50 mixed diet (DM basis) of maize silage and a concentrate mixtureof crushed wheat (20%), wheat bran (40%), khesari bran (20%), soybean meal (15%), common salt (1%), dicalcium phosphate (3%) & limestone (1%). The chemical composition of the silage and the concentrate is presented in Table 1. Any difference at the initial plane of nutrition of the animals collected from two different major sources was minimized through an initial rearing phase of 15 days. The animals were dewormed with anthelmentics before the start of a growth trial of at least for 120 days. The initial live weights of animals were taken before the distribution of animals randomly and subsequent weights were taken at an interval of 10 days. A digestibility trial period of eight (8) days was completed after an initial period of 40 days to determine the intake and digestibility of the diet in two species. The growth of the animals during the first 60 days of the trial and feed conversion ratio (FCR) including intake and nutrient digestibility are presented in Table 2 & 3. A least squares regression approach in SPSS, 17 computer software packages was used to describe statistical relations between the treatment responses of a 2*3 factorial experiment. The ad lib intake of Maize DM of each 10 days feeding period was considered as the ex post facto amount of concentrate to be fed in subsequent 10 days feeding periods and thus, the desired roughage to concentrate ratio was adjusted by changing the per head intake of animals stalled individually. Their daily feed was offered in two equal meals at 9:00 h and 16:00 h.

Table 1. Chemical composition of experimental diets

Diets	DM % fresh	Chemical composition (%DM)				
		OM	CP	ADF	NDF	Ash
Maize silage	22.63	93.9	8.09	53.3	72.4	6.06
Concentrates	88.83	85.5	18.3	24.8	28.2	14.6

During the initial period of 60 days, the Buffalo bulls had a significantly ($p<0.001$) higher total DM intake expressed both in terms of daily total intake per head (7.52 kg) or % live weight (2.60%) or total daily CP (1.01 kg/head) intake than cattle (5.90 kg/head, 2.26% and 0.80 kg/head, respectively). With the increase of age, the total daily DM or CP intake of both the animal increased significantly ($p<0.001$) but, the DM intake as % of live weight decreased linearly ($p<0.001$) with the increase of age or cumulative live weight (Table 2 & Table 3).

The buffalo bulls had significantly higher digestibility of DM (68.0%), ADF (59.8%) or NDF (59.6%, $p<0.001$) or CP (66.3%, $p<0.05$) than cattle (63.0%, 52.4%, 49.6% & 63.6%, respectively; Table 2). However, the digestibility of DM, CP, ADF or NDF was not affected significantly ($p>0.05$)

Table 2. Effect of species and age of buffalo and cattle on the intake and digestibility of nutrients

Species, age & their interactions			Nutrient intake			Nutrient digestibility			
			DMI (kg/d)	DMI (kg% LW)	CPI (kg/d)	DM dig.%	CP dig.%	ADF dig.%	NDF dig.%
BCB-1	Age	18M	4.72	2.39	0.65	61.8	62.5	50.8	45.6
		24M	6.43	2.29	0.86	62.5	63.5	50.9	49.1
		30M	6.54	2.11	0.88	64.6	64.7	55.4	54.1
Buffalo	Age	18M	6.30	2.71	0.85	68.6	65.3	60.1	61.0
		24M	7.46	2.67	0.99	67.6	66.6	59.9	60.1
		30M	8.79	2.41	1.19	67.8	66.9	59.4	57.8
Species	BCB-1		5.90	2.26	0.80	63.0	63.6	52.4	49.6
	Buffalo		7.52	2.60	1.01	68.0	66.3	59.8	59.6
Age	18M		5.51^{a}	2.55^{a}	0.75^{a}	65.2	63.9	55.4	53.3
	24M		6.94^{b}	2.48^{a}	0.93^{b}	65.1	65.0	55.5	54.6
	30M		7.67^{c}	2.26^{b}	1.04^{c}	66.2	65.8	57.4	55.9
SED			0.21	0.03	0.03	0.71	0.85	1.17	1.35
Sig.lev.	s		***	***	***	***	*	***	***
	a		***	***	***	NS	NS	NS	NS
	s×a		NS	NS	NS	NS	NS	NS	NS

by the age of the bulls. No significant interaction effects of the two ($p>0.05$) was found. The initial (250.9 kg) and final live weight (317.7 kg) or daily live weight gain of buffalo bulls (1.11 kg), irrespective of their age, were significantly ($p<0.01$) higher than that of cattle (219.8 kg, 279.0 kg and 0.99 kg, respectively). The average initial (182.5 kg, 234.0 kg & 289.5 kg, respectively) and final weight (234.4 kg, 300.8 kg & 359.8 kg, respectively) or daily growth (0.86 kg, 1.11 kg & 1.17 kg, respectively) of both the animal at different ages (18, 24 & 30 months, respectively) differed significantly ($p<0.001$), and all of them increased linearly with the increase of their age (Table 3) till 60 days of the trial. Buffalo bulls, being a poor internal body heat regulator that tolls on productivity, were significantly ($p<0.05$) less efficient in feed conversion to growth (FCR) than cattle (6.32 vs 6.00, respectively) resulting in a higher feed cost per kg gain (US$ 1.69 vs US$ 1.53) of the former. The effect of age or its interactions with the species on FCR or cost of gain, however, were non-significant ($p>0.05$; Table 3).

Table 3. Effect of species and age of buffalo and cattle on growth, FCR and feed cost

Species, age & their interactions			Initial LW (kg)	Final LW (kg)	ADG (kg)	FCR	Feed cost (Tk, kg gain)
BCB-1	Age	18M	164.3	213.3	0.82	5.85	118
		24M	230.3	297.8	1.12	5.67	112
		30M	264.7	325.8	1.00	6.46	130
Buffalo	Age	18M	200.7	255.5	0.91	6.43	136
		24M	237.6	303.8	1.10	6.37	131
		30M	314.3	393.8	1.33	6.15	132
Species	BCB-1		219.8	279.0	0.99	6.00	120
	Buffalo		250.9	317.7	1.11	6.32	133
Age	18M		182.5^{a}	234.4^{a}	0.86^{a}	6.14	127
	24M		234.0^{b}	300.8^{b}	1.11^{b}	6.02	122
	30M		289.5^{c}	359.8^{c}	1.17^{b}	6.31	131
SED			7.99	8.66	0.53	0.21	4.07
Sig.lev.	s		**	**	**	*	*
	a		***	***	***	NS	NS
	s×a		NS	NS	*	NS	NS

Considering the data so far obtained, it may be stated that the buffalo bulls, irrespective of their age, being low efficient in feed utilization produced a higher average daily weight gain than cattle. The weight gain of both the species increased with the increase of age. Both of them were more efficient in feed conversion at their average age of 24 months. The growth trial is being continued further to reach a decisive conclusion quantifying any possible initial compensation to growth of the animals, and to determine the species and age effects on carcass and meat quality.

Study of Moringa plant fodder agronomy and its feeding to ruminants

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Executive Summary

The gradual transformation of traditional subsistence livestock farming into input supported dairy or beef farming has been demanding more protein rich quality feeds and fodders. Moringa (*Moringa oleifera),* a plant fodder being researched and found responsive to increasing production and productivity of ruminant animals, was identified as one of the best options for Bangladesh (Huque and Sarker, 2014) to support increasing livestock production and productivity. Keeping the above factors in consideration the present research work was undertaken to (i) determine feeding impacts of Moringa feed (M_f) on dairy cattle, (ii) identify suitable cultivar(s) of Moringa for year round feed production and (iii) test on farm production performance of selected Moringa cultivar. For testing the Moringa feed (processed Moringa tops containing CP:ADF ratio of 1:2) on milk production, fifteen BCB-1 cows of third or fourth parity after 3 to 4 weeks of calving were selected and divided into three dietary groups having five animals in each considering their live weight and ex-post factor of milk yield . A group of cows fed a control diet consisting of 50:50 ratio (DM basis) of Napier silage anda concentrate mixture (Table1) of rice bran-38%, wheat bran-23%, Soybean meal-23% Crushed wheat 12%, Mineral mixture-3% and Salt-1%.The concentrate of the control diet was replaced by Moringa feed at 50% maintaining a ratio of 50:25:25 respectively; in diet $T_1$and at 100% maintaining a ratio of 50:0:50 respectively in diet T_2, and the diets were fed for 60 days. All the three concentrate mixture was iso-nitrogenous, and the daily energy and CP requirement of the cows were calculated according to BSTI (2008). Feeding response of different diets on different parameters was analyzed in an ANOVA of a Completely Randomized Design (CRD).

Table 1. Chemical composition of different feeds

Experimental diet	%, Chemical composition (DM basis)			
	DM	CP	ADF	NDF
Napier Silage	92.95	8.26	62.76	67.14
Con. mixture	88.45	16.44	35.36	51.04
Moringa feed	88.80	16.59	32.89	40.73

Table 2. Effect of supplementation of moringa feed on the nutrient intake and production of BCB-1 cows

Parameters	Experimental rations			Significance	
	T_0	T_1	T_2	Overall SE	Level
Total dry matter intake(kg/day)	5.8±0.3	5.9±0.4	5.6±0.4	0.2	NS
Total CP intake(g/day)	796.5±28.5	793.9±34.8	778.2±43.2	19.3	NS
Total ME intake(MJ/day)	52.1±2.1	52.9±4.6	49.9±3.7	1.9	NS
Ave.daily milk production(kg)	3.30±0.4	3.31±0.6	3.40±0.8	0.34	NS
Daily weight gain	206.8^{c}±27.6	246.0^{b}±30.8	300.6^{a}±4.2	20.7	*
Daily wt gain(g) of calves	321.4^{b}±84.4	370.8^{a}±96.4	369.9^{a}±25.0	40.7	*

Table 3. Impacts on biomass and quality of different cultivars

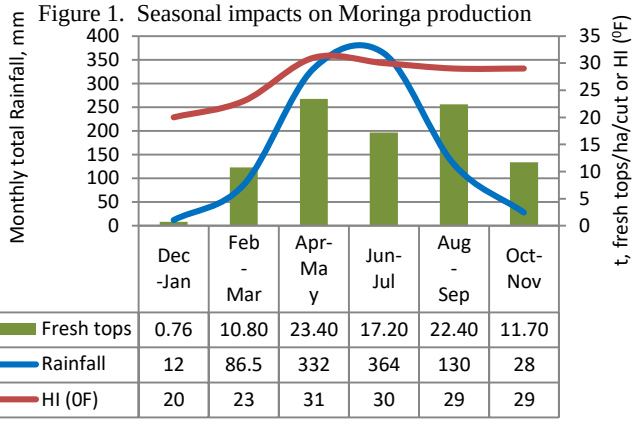
Parameters	Moringa cultivars			Significance	
	BSM-T	WSM	BSM-L	SE	Level
Survival rate (%)	55.5^{b}	25.0^{c}	97.2^{a}	9.6	P<0.00
No. of Prunes/plant	3.1^{a}	2.3^{b}	3.5^{a}	0.2	P<0.01
DM yield (ton $ha^{-1}yr^{-1}$)	16.0^{b}	5.8^{c}	22.7^{a}	2.3	P<0.00
Defoliation rate (%)	2.6	3.7	3.1	0.4	P<0.46
Stem: Leaf	0.58	0.56	0.45	0.04	P<0.42
Effective degradability (%)	63.6	64.2	62.8	0.5	P<0.14
% CP (DM basis)	22.3	22.2	22.4	1.1	P<0.68

The replacement of concentrate mixture by Moringa feed had no effect on daily DM, CP or ME intake or daily milk yield of the cows (Table 2). But, the daily live weight gain of cows and their calves increased significantly (P<0.05) when Moringa feed was added to the control diet. It decreased

blood cholesterol from 204.5 mg/dl in the control to 111.5 mg/dl in the cows fed T_2 diet, without showing any significant ($p>0.05$) change in fat, SNF, Lactose or CP content of milk.

Two local varieties namely Black Seed (BSM-L) and White Seed (WSM) Moringa, and one Black Seed Moringa collected from FAO regional office, Bangkok (BSM-T) were planted in a seedbed andthe saplings were transplanted in the fodder research land of Bangladesh Livestock Research Institute (BLRI), Savar, Bangladesh to compare their production and productivity of biomass. The cultivars were raised in 12 plots each of 1x1 sq meter having four replications for each variety following a Complete Randomized Design (CRD). Table 3 shows that the survivability of BSM-L was the highest (97.2 %) followed by BSM-T (55.6 %) and WSM (25.0 %) and their differences were significant ($P<0.001$). Both the black seed cultivars had significantly ($P<0.01$) higher average number of prunes (3.5 vs. 3.1 prunes/plant) than WSM. The average defoliation rate of all the cultivars varied from 2.4% to 4.0% and it did not differ significantly ($p<0.46$). The annual dry matter (22.73 ton/ha) yield of BSM-L tops was significantly ($p<0.001$) higher than that of BSM-T (16.03 ton/ha) or WSM (5.79 ton/ha) respectively. The average stem to leaf ratio of BSM-L was 0.45 and it reflects that almost a half of the whole tops dry matter was shared by leaves. The ratio varied from 0.56 to 0.58 in WSM and BSM-T. There is no significant difference in the effective DM degradability (%) of Moringa tops of different cultivars. Fresh tops yield (ton/ha/cut) varied according to the season of a year (Fig1). The yield was the lowest (average 0.76 ton/ha/harvest) during the dry (monthly total rainfall 12.0 mm) and cool (Heat Index; HI 20^0F) months (December to January). Its peak attained during the dry and hot months (April to May, average 23.4 ton/ha/harvest) with the rise of HI (31^0F) and rainfall (332 mm). A further rise in rainfall affected peak productions (17.2 to 22.4 ton/ha/cut) during the hot and humid months of the year. For evaluating cost effective on farm production of Moringa fodder, a 100 decimal cultivable land in Gaibandha district was leased in and a farmer was allowed to cultivate BSM-L following the agronomy being practiced on-station. The on-farm biomass production of BSM-L shows that the yield of the first two harvests was even better than that was found on station (26.67 ton vs. 19 ton). The land is being maintained for the production of Moringa feed and its cost effectiveness will be compared with the existing cash crops of the area.

Figure 1. Seasonal impacts on Moringa production



	Dec -Jan	Feb - Mar	Apr- May	Jun- Jul	Aug - Sep	Oct- Nov
Fresh tops	0.76	10.80	23.40	17.20	22.40	11.70
Rainfall	12	86.5	332	364	130	28
HI (0F)	20	23	31	30	29	29

The result so far generated shows that Moringa may be cultivated as a fodder crop and the feed produced from it may increase daily live weight gain of cows and calves with a significant reduction in milk cholesterol. The HI above 23^0F, with an average range of rainfall 130 mm to 330 mm per month may be suitable for Moringa feed production. However, the effect of Moringa feed on milk yield and quality needs to be determined through further research. The seasonal impacts on Moringa production on station and on farm needs to be determined through continuation of its cultivation in subsequent years.

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

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Executive Summary

Drought is one of the main problems for many nations, and the severity of such issue goes big when it comes as obstacle to ensure an optimum agricultural production for a country like Bangladesh. Between 1960 and 1991, drought events occurred 19 times in Bangladesh. Very strong droughts hit the country in 1961, 1975, 1981, 1982, 1984, 1989, 1994, and 2000. Over the last few decades drought is being considered as the main cause which hampers the estimated agricultural production in Bangladesh. Every five years, Bangladesh is affected by the major country-wide droughts. However, local droughts occur regularly and affect crop production. The agricultural drought, linked to soil moisture scarcity, occurs at different stages of crop growth, development and reproduction. Apart from the agricultural loss, drought has important effect on livestock population, land degradation, health and employment. Past droughts have naturally affected about 53% of the population and 47% of the country. In the drought prone areas the scarcity of feeds and fodder are one of the important problems in Bangladesh for rearing dairy cows. Among the drought prone areas of Bangladesh, the Barind region, the majority of households involved in farming have livestock. Therefore, the aim of this study was to increase the availability of green grasses in the Barind regions of Bangladesh. To achieve the goal of the study, an adaptability and performance trial with BLRI developed high yielding fodders (selected five fodder cultivars as treatment namely: BLRI –Napier 1, BLRI –Napier 2, BLRI-Napier 3, BLRI-Napier-4 and Napier dwarf. was conducted as pilot basis in two drought prone locations, namely; Sadar and Nachol upazillas in Chapainawabgonj. Numbers of farmers in each location were five (05) as disperse replications. (2.5x3.0) m plots were segregated for each cultivar for each farmer of two locations. Thus, the design of the experiment was RCBD with 2×5 factorial experiment. Prior to cultivation of fodder, soils were ploughed, added fertilizer and leveled properly. During the time of first transplanting of stem cuttings, line to line and plant to plant distance were 70 and 30 cm, respectively maintained. Conventional agronomical practices were followed for all of the experimental plots during the experimental periods. Fodder yield was harvested at a regular interval at 40-45 days after each cutting, whilst first cut was made after 60 days transplanting of stem cuttings. After each cutting, the soil of each plot was loosen with spade and urea was applied as top dressed. The irrigation was applied in each experimental plot if required when there was no rain. During the time of harvest, records of plant height, stem length, leaf length, number of leaf per stem, number of tillers per hill, yield per hill and total biomass yield per plot were taken from each of the plot. The parameters studied were biomass yield, number of tillers per hill, plant height, stem weight, sheath weight and botanical fractions (stem: leaf ratio). The experimental data analyzed for the said parameters were collected from two locations with four cuttings (harvest yield) for each of the cultivar. All data were compiled in Excel spread sheet, transport to SPSS 17.0 and thus analyzed statistically by GLM procedure to find out mean, mean comparison and test of significance for main effect as well as interaction effect between cultivar and location.

Table 1, illustrates the comparative performances of Napier as affected by cultivar, locations and cutting frequency. The results showed that biomass yield was affected by cultivar ($P<0.05$) and frequency of cuttings ($P<0.001$), while not for location. The highest biomass yield was found from BLRI Napier-3 (18.28±1.14 MT/ha) and from 3rd cutting (20.73±0.89 MT/ha) with an overall mean yield of 16.18±0.43 MT/ha. Cultivars and locations have no interaction effect on biomass yield. Number of tillers per hill differed significantly ($P<0.001$) among different cuttings, while not among cultivars and locations. The highest number of tillers per hill was found in 3rd cut (23.66±1.19) with an overall mean number of 18.61±0.57. There was no interaction effect on number of tillers per hill between cultivars and locations. Plant height differed significantly ($P<0.001$) among cuttings, but had no effect on cultivar and location. The highest plant height was obtained from 3rd cut (55.8±1.66 inch.) with an overall height of 43.1±0.80inch. Cultivar and location did not interact for plant height.

Stem weight had no effect for cultivar, but had significant effect (P<0.001) for locations and frequency of cuttings. The highest stem weight was yielded in Chapainawabganj (225.4±10.15 g) from 4th cut (253.5±11.56 g) with an overall mean weight of 196.6±6.86g. There was no interaction effect between cultivars and locations for stem weight. Sheath weight differed significantly (p<0.05) among locations and frequency of cutting while not differed among cultivars. The highest sheath weight was obtained in Chapainawabganj (142.9±11.07 g) from 3rd cutting (164.0±13.56 g) with an overall sheath weight of 123.4±07.48g. Interaction effect between cultivar and location was not found for sheath weight. Any of the effect for cultivar, location and cutting frequency was not found for botanical fraction (stem:leaf) which averaged to 1.28±0.05.

Table 1. Performance of Napier as affected by cultivar and location

Factors	Mean (±SEM) for different parameters					
	Biomass yield (MY/ha)	Tiller per hill (no)	Plant height (inch)	Stem weight (g)	Sheath weight (g)	Stem:leaf
Cultivar	*	NS	NS	NS	NS	NS
Napier-1	14.35^{b}±0.78	19.24^{ab}±1.22	42.8^{ab}±1.94	228.6±22.51	136.6±19.34	1.19±0.10
Napier-2	17.17^{ab}±1.16	21.51^{a}±1.74	43.4^{ab}±1.82	197.8±21.87	146.9±22.64	1.19±0.09
Napier-3	18.28^{a}±1.14	17.50^{b}±1.39	46.6^{a}±2.10	198.0±16.94	107.1±15.29	1.44±0.11
Napier-4	16.63^{ab}±0.94	18.18^{ab}±1.01	41.9^{ab}±2.06	193.7±19.95	101.1±13.86	1.31±0.14
Dwarf	14.48^{b}±0.91	16.64^{b}±1.11	40.6^{b}±1.92	164.9±15.92	125.1±14.54	1.27±0.10
Location	NS	NS	NS	***	*	NS
Nachol	16.10±0.59	18.39±0.78	41.6±1.10	167.9^{b}±09.23	103.8^{b}±10.06	1.21±0.07
Chapai. Sadar	16.26±0.63	18.84±0.84	44.5±1.17	225.4^{a}±10.15	142.9^{a}±11.07	1.34±0.08
Cutting freq.	***	***	***	***	*	NS
1st cut	13.89^{b}±0.83	16.09^{bc}±1.10	36.9^{c}±1.54	136.8^{c}±11.56	096.8^{b}±12.60	1.15±0.09
2nd cut	14.81^{b}±0.89	15.47^{c}±1.19	42.1^{b}±1.66	199.6^{b}±12.44	147.0^{ab}±13.56	1.39±0.09
3rd cut	20.73^{a}±0.89	23.66^{a}±1.19	55.8^{a}±1.66	240.6^{a}±12.44	164.0^{a}±13.56	1.41±0.09
4th cut	15.30^{b}±0.83	19.24^{b}±1.10	37.5^{c}±1.54	253.5^{a}±11.56	126.3^{ab}±12.60	1.29±0.09
Overall mean	16.18±0.43	18.61±0.57	43.1±0.80	196.6±6.86	123.4±07.48	1.28±0.05
C×L	NS	NS	NS	NS	NS	NS

Means with uncommon superscript along the same column differed significantly (p<0.05); *-p<0.05; **-p<0.01; ***-p<0.001; NS- p>0.05; C×L- Interaction between cultivar and location.

Considering the results, so far obtained from this study in two locations of drought prone areas of Bangladesh, all cultivars are likely to be adapted in drought prone barind areas. However, there were no significant interaction effects between cultivars and locations for all of the parameters estimated in this study. But, in term of total biomass yield, BLRI Napier- 3 performed better and for most of the parameters 3rd cut yielded better. Further in depth study needs will be carried considering physiological parameters of plant growth and biomass yield and identification of drought tolerant genes through molecular experiment with covering one more upazilla in drought prone areas.

Upgrading and Validation of FeedMaster Application

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Executive Summary

Profitable animal production depends on several factors and feeding is most important among them as feed cost is responsible for minimum 60% of total animal production cost. In order to provide balanced feed, FeedMaster mobile application was developed which guide the farmer for proper ration formulation. Along with proper animal feeding disease control is also essential for profitable animal production. Farmers are not concern about common diseases of their animals, as well as their prevention, proper vaccination and deworming procedure. Concerning above fact, FeedMaster android application was enriched with proper vaccination schedule and a brief description of common diseases of livestock. In FeedMaster application average Dry Matter Intake (DMI) for all groups of bovine was initially fixed at 2.5 % of the body weight on thumb rule basis. But in new version, the DMI for bull, growing and fattening animal was fixed at 3% of body weight and that of for dry, pregnant and milking animal was fixed at 2.5% of the body weight. Among total DM requirement 1/3 portion is fulfilled by concentrate and 2/3 portion by roughages. The ration of bull, growing and fattening animals (Ration A) consists of maize crush, wheat bran, rice polish, khesary bran, soybean meal, salt and di-calcium phosphate (DCP) in a ratio of 25, 20, 15, 20, 17, 1 and 2 percent respectively. The dry, pregnant and milking animal ration (Ration B) contain same ingredient in a ratio of 30, 20, 20, 15, 12, 1 and 2 percent respectively. Milk producing animals were grouped into 5 categories according to their milk production and supplemented concentrate was calculated on the basis of their extend of production by using formulas: Concentrate for less than 5 litters milk production = 0.5+0.7 X milk production (L), Concentrate for less than 8 litters milk production = 0.7+0.4 X milk production (L), Concentrate for less than 12 litters milk production = 2.0+0.4 X milk production (L), Concentrate for less than 15 litters milk production = 3.0+0.3 X milk production (L), Concentrate for less than 20 litters milk production = 0.3 X milk production (L). In case of pregnant (over 6 months) animal, 1.5 kg concentrate/animal was supplemented. In this new version along with ration formulation farmer can easily calculate the feed requirements for weekly, monthly and annually with the cost of ration formulation. In Bangladesh, Anthrax, Black Quarter, Hemorrhagic Septicemia, Foot and Mouth Diseases are common in cattle and buffalo. Outbreak of all the diseases is related with the seasonal variation. To prevent incidences of aforesaid diseases, animal should be vaccinated seasonally. For this reason, vaccination alarming system was added to FeedMaster. This application will inform farmer for proper vaccination before the disease outbreak by alarming and giving massage according to vaccination and deworming (DW) schedule (Table 1).

Table1. Vaccination and deworming schedule

Disease	January	April	May	June	September	December
Foot and mouth diseases				√		√
Black quarter		√				
Hemorrhagic septicemia					√	
Anthrax			√			
DW	√		√		√	

E-book was also added to FeedMaster which contains information about high yielding grass cultivation technique, animal rearing technique, common animal disease and disease prevention technique, animal feed processing technique. This application was evaluated by a) field testing and b) comparing it with other apps. Trial version of this application was copy right by proper authority and uploaded in play store of Google and BLRI website. This application was given to 10 farmers for evaluation of its impacts at farmers' level. It was also compared with ICER- National Institute of

Animal Nutrition and Physiology developed Feed Chart apps and the following differences were found.

Parameter	Feed Chart apps	FeedMaster apps
Ingredient Use	Not fixed. Ration contain 30 parts of grain (Combination of Maize, broken rice, bajra, sorghum or minor millets) 36 parts of brans and chunnis (Combination of wheat bran, rice bran, gram chunnies) 30 parts of oil cake (Combination of cotton seed meal, soybean meal, ground nut cake, coconut cake, sunflower oil cake, Til oil cake), 1.5 part salt, 1.5 part calcium, 1 part mineral mixture.	Fixed. Maize crush, wheat bran, rice polish, khesary bran, soybean meal, salt and di-calcium phosphate were used in different ratio.
Ration formulation	Can calculate total concentrate and roughs requirement only for a fixed body weight (400 kg) with fixed milk production 5, 7.5, 10, 12.5, 15 and 20 litter/day.	Can calculate individual concentrate and roughs ingredient and formulate ration according to age, sex and stage of production.
Total concentrate estimation		In Feed Master total concentrate is over calculated 12, 3.96, 11.36 and 9.51 percent for 5, 10, 12.5 and 15 litter milk productions respectively.
Internet connection	Online	Offline
Other properties	No other facility.	Facility of • Feed ingredients requirement calculation and budgeting for daily, weekly, monthly and yearly. • Year round fodder production planning and cultivated land calculation, • Housing instruction and designing, • Weight calculation with pictorial view. • Vaccination reminder • E-books • Emergency contract with scientist.

FeedMaster android application is a digital consultant that can easily solve the answer of farmers and stakeholder how to fed, how much to fed, how to cultivate, how much to cultivate, when to cultivate and what will be the cost of feeding of their animals. Efficient use of this software package will encourage the entrepreneurs to invest in livestock sector to achieve optimum profit from this sector.

Identification and documentation of locally available forages in some selected regions of Bangladesh

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Executive Summary

In Bangladesh, about 80% of the total arable land is used for cultivation of cereal crops and only 0.03% for cultivation of fodder crops and the rest for other crops (BBS 2009). Scarcity of animal feeds and fodder has been identified as a major constraint for the development of livestock in Bangladesh (Kanak*et al.,* 2012). So livestock development in Bangladesh is mainly depending upon the improvement of animal nutrition through improved feeding and availability of fodder. To meet up the increasing need of green fodder, it is essential to find out some potential existing fodder and recommend it for extensive cultivation by the farmers for feeding their productive animals. Considering this fact, the present study was undertaken to identify (Taxonomically) and evaluate nutrient value of locally adapted available forages. To achieve the objective, a structured questionnaire was prepared and pretested to find out name of common local available grasses, percentages of farmers fed that local grasses, feeding system. Two buffalo grazing char from each of the three Upazillas of Bhola, Jamalpur and Moulovibazar district were selected for forage sample and data collection. For taxonomic identification, documentation and nutritional composition samples were collected at flowering stage and for biomass yield samples were collected randomly from 3.5ft x 3.5ft quadrate and location was documented by using My GPS Altitude and My GPS Coordinates software. For final identification sample were examined and identified in Plant Systematics Laboratory of Botany Department, Jahangirnagar University and Bangladesh National Herbarium (BNH). Proximate analysis of different forage specimens were done in Animal Nutrition Laboratory of Bangladesh Livestock Research Institute, Savar, Dhaka.

In Bhola, Jamalpur and Moulovibazar, farmers fed about 29 types of forages to their local buffalo. Among them name of 10 forages which are mostly fed to buffalo are shown in Table 1. A total no of 26 samples were collected from above three areas. Taxonomic identification and proximate composition was evaluated. Depending on DM, CP and biomass yield 10 forage samples are recommended here for further research activity. Among those forages 1 was leguminous and 9 were non-leguminous (Table 2).

Table 1: Name of Locally available forages fed to the buffalo in the selective region of Bangladesh

Local name	Percent (%) of local forages supplied by the farmers		
	Bhola	Jamalpur	Maulvibazar
Hale	17.6	-	5.6
Kaila lata	5.6	-	3.8
Arali	4.2	-	6.2
Kaisa	-	20	-
Futi	-	-	7.1
Hone	-	5	-
Bogra	28	-	-
Kalimoina	-	25	-
Durba	24	22	25
Parua	-	-	14.3

Table 2. Taxonomic and nutritional facts of some valuable forage samples collected from different regions

Name of grass	DM (%)	Chemical composition (DM basis)				Biomass yield (MT/hac)		Family	Fodder type
		CP	Ash	(Ton/hac) ADF	NDF	Fresh	DM		
Bhola									
Leersiahexendra (Ajali/ Arali)	18.4	4.7	14.2	52.8	74.2	12.8	2.4	Poaceae	Non-Leguminous
Cyperusexaltatus (Bogra)	17.4	7.2	12.9	56.9	63.2	12.1	2.1	Cyperaceae	Non-Leguminous
Jamalpur									
Paspalumdisticum (Kalemoina)	27.5	10.2	12.5	38.2	52.4	11.6	3.2	Poaceae	Non-Leguminous
Crotalaria juncea(Hone)	24.5	15.0	6.3	66.5	75.5	40.9	10.0	Fabaceae	Leguminous
Moulovibazar									
Pennisetumpolystachyon(Swati)	35.58	6.91	5.74	33.61	76.58	29.72	10.57	Poaceae	Non-Leguminous
Panicumbrevifolium (Baspata)	34.53	7.66	13.19	40.70	81.31	16.05	5.70	Poaceae	Non-Leguminous
Panicumpaludosum(Borali/ Barti)	26.43	9.30	9.15	39.91	76.99	14.26	3.77	Poaceae	Non-Leguminous
Echinochloastagnina (Parua)	23.55	10.17	18.09	39.25	78.39	20.33	4.79	Poaceae	Non-Leguminous
Schoenoplectusjunciodes (Bulrush)	28.63	10.57	7.36	46.83	71.31	19.26	5.51	Cyperaceae	Non-Leguminous
Sporobolusdiander (Binajoni)	23.60	12.60	15.70	41.92	82.93	18.72	4.42	Poaceae	Non-Leguminous

From above discussion, it can be concluded that, forage sample having higher DM, CP and biomass yield would be potential sources of green fodder for specific regions. Further research is required to recommend them as fodder for large scale cultivation by the farmer.

Effect of pre and post-natal nutrition of dams on the post weaning growth performances of lambs

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Executive Summary

Bangladesh produces only 30.18% of the total requirement of meat and its per capita intake of meat is 8.6 kg compare to average 42.1 kg and 32.2 kgof the world and developing countries, respectively (Huque, 2012). To meet this gap, the meat production of the country must be increased many folds.Therefore, different non-popular animals,likethat of sheep occupy third position with a population of 3.16 million among ruminants, may be brought under market oriented productions through developing good practices. Nutrition, one of the major limiting factors, especially ewe's nutrition in the last six to eight weeks of pregnancy is critical as the foetus grows very rapidly and accordingly, the ewe's nutrient requirement increases. This affects the health and productivity of offspring. Ewe's nutrition during the last period of pregnancy is the major factor that affects milk yield, birth weight and pre-weaning lamb's growth rate as well as post weaning performances. However, the data of the effect of maternal nutrition during the period of late pregnancy to lactation on the post weaning performances of native Bengal lambs is scarce. Thus, the aims of this study was to determine the effect of different level of maternal nutrition during the period of late pregnancy to lactation on the post weaning performances of lambs and also to define suitable lambing age for marketing considering FCR and feed cost. Thirty-six native ewes of last 7 weeks pregnancy at 2 to 5 parity were randomly allocated to four different treatment groups (T_0, T_1, T_2, T_3). Ewes of all the treatment group were supplied *ad libitum* German grass (*Echinochloa polystachya*). The ewes of T_1, T_2 and T_3 group were supplemented with a concentrated mixture (Crushed Maize 40%, Soybean meal 26 %, Wheat bran 22%, Rice polish 10%, Salt 1%, Vitamin-mineral premix 0.5% and DCP 0.5%), at 1.0, 1.5 and 2.0% of their body weight, respectively while that of $T_0$was fed control diet (*ad lib* German grass).After parturition, lambs were supplemented with a creep feed (Crushed maize 68%, Soybean meal 30 %, Vitamin-mineral premix 1%, Salt 1%) at the age of 2 weeks @ 20g/lamb/day withan weekly increment of 10g /lamb. After weaning, the 5, 5, 6 and 6 male lambs of T_0, T_1, T_2, T_3groups, respectively were continued to fed with ad libitum German grass and a concentrate mixture (Crushed Maize 68%, Soybean meal 30 %, Salt 1%, Vitamin-mineral premix 0.5% and DCP 0.5%) at 1.5% of their body weight until they reached at one year of age. The chemical compositions of the experimental diets are presented in the table 1. Parameters like, weekly weight change, live weight at 06 months, 09 months and 01 year of age, feed intake, FCR and feed cost per kg gain were recorded. The data were statistical elaborated in an ANOVA of Completely Randomized Design (CRD) using SPSS v. 20. The data of different parameters of all lambs from weaning age to 01 year of age were also evaluated considering age (6 months, 9 months and 1 year) as a fixed factor. The treatment response differences were compared by DMRT at a probability level of $P<0.05$. The correlations among different parameters with different ages were also performed.

Table1. Chemical composition of the experimental diets

Diets	DM (% fresh)	Chemical composition (% DM)					
		Ash	OM	CP	NDF	ADF	EE
German Grass	19.91	9.41	90.6	9.01	80.45	51.22	0.54
Concentrate Mixture	87.6	11.63	88.37	18.42	45.95	8.59	2.32

The effect of maternal nutrition during pre and post-natal period on the performances of lambs is presented in table 2. Although, birth weight not differ significantly among the groups but weaning weight differ significantly ($P<0.05$). The correlation among lambs weaning weight with different post weaning growth performances are presented in fig. 1. The results showed a strong positive leaner relationship with lambs weaning weight and different post weaning growth

performances. Higher weaning weight of lamb significantly depends on pre and post-natal nutrition of ewes. Thus, maternal nutrition strongly influenced the post weaning growth of lambs.

Table 2. Effect of maternal nutrition during pre and post-natal period on the performances of lambs

Parameters	Ewe's diet				Overall mean	SEM	Sig.
	T0	T1	T2	T3			
Birth wt. (kg)	2.03	1.99	2.26	1.77	2.01	0.11	NS
Litter size	1.38	1.44	1.44	1.86	1.52	0.10	NS
Weaning Wt. (kg)	9.04^{a}	10.47^{ab}	13.28^{b}	10.20^{a}	10.84	0.56	*
Milk yield (g/day)	339.21^{a}	450.87^{ab}	525.2^{b}	561.07^{b}	467.49	30.71	*

NS= Non significant, * p<0.05,**p<0.01; ^{a,b,}values within the same raw with different superscripts differsignificantly,

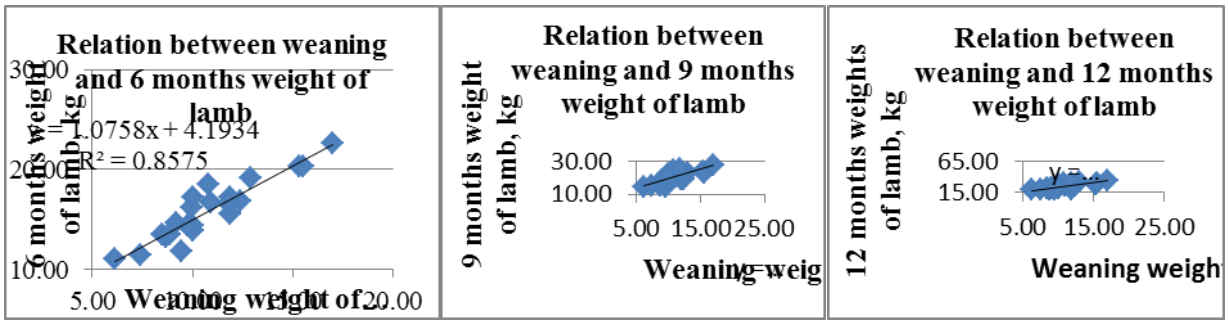

Figure 1. Relation between lambs weaning weight with different post weaning growth performances

Table 3. Effect of age of lambs (months) on the live weight (kg), LWG (g/day), Correlation among weaning weight and ages, FCR and cost per kg gain (BDT**)**

Parameters	Lamb age			SEM	Sig.
	6 months	9 months	12 months		
Live Weight of lamb (kg)	15.85^{a}	20.36^{b}	24.53^{c}	0.6468	**
LWG (g/day)	55.72	52.92	50.71	1.5432	NS
Correlation among WWT & ages (r)	0.926	0.785	0.813	-	**
FCR	6.82^{a}	8.06^{b}	8.94^{b}	0.2593	**
Cost/kg gain (BDT)	108.76^{a}	137.78^{b}	159.24^{b}	5.2206	**

*NS= Non significant, * p<0.05,**p<0.01; $^{a, b}$ values within the same raw with different superscripts differsignificantly, WWT=Weaning weight, r=correlation coefficient, LWG= Daily live weight gain*

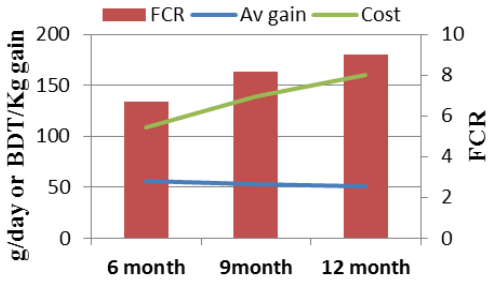

Fig. 2. Effect of age on daily gain, FCR and cost/kg gain

The effect of age of lambs on the live weight, LWG, correlation among weaning weight and ages, FCR and cost per kg gain are presented in table 3. The live weight, FCR, cost per kg gain significantly increases (P<0.01) with increasing age.The lowest FCR, cost per kg gain and higher daily gain found at 6 months of age. The fig. 4 shows the relationship among the lambs age, daily gain and FCR. The daily weight gain although not differ among different age of lambs but started decline slightly from 6 months of age to until 12 months of age. Thus, results suggest that 6 months of age could be more profitable slaughter age for native Bengal lambs.

Finally, post weaning growth performances of native Bengal lambs highly influences by pre and post-natal nutrition of ewes and native Bengal lamb production could be more profitable when marketed at 6 months of age.

Evaluation of lamb production potentiality of the Barind, Jamuna river basin and Coastal region sheep of Bangladesh under intensive management

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Executive Summary

Sheep in Bangladesh are mostly indigenous non-descript type, with few crossbreds (Bhuiyan, 2006) and are capable of bi-annual lambing and multiple births. Bangladesh has 3.16 million sheep which secure 3rd position in number among the ruminant species of Bangladesh (DLS, 2014). They are sparsely distributed throughout the country but relatively higher concentration are found in three different ecological zones like, Barind, Jamuna river basin and Coastal areas, where farmers maintain larger commercial (meat) flocks (Rahman, 1989). Native Bengal sheep found in these three different ecological zones also vary phenotypically. Bangladesh only produced 30.18% requirement of meat (Huque, 2012) and need to increase meet production in many folds. Therefore, sheep might be emphasized as a meat animal. Nowadays, farmer's aware about sheep farming for the production of lamb. But, data regarding comparative lamb production potentiality of three different regional sheep is scarce or not found in systematic way. Therefore, the study was undertaken with the objective to evaluate the lamb production potentialityof three regional native Bengal sheep under intensive management. Hence, twenty four growing lambwith 4 to 6 months of age were randomly allocated in three different groups having eight lambs per treatment. Diet containing 40% urea molasses straw (UMS) and 60% concentrate mixture (broken maize-42%, soybean meal-38%, wheat bran-17%, vitamin-1%, DCP-1% and salt-1%). Chemical compositions of the experimental diets are presented in the table 1.Different parameters like, live weight gain (LWG), DMI, FCR, feed digestibility, carcass characteristics and meat quality of lambs wererecorded.The duration ofthe trial was 90 days. At the end of the feeding trial, animals were transferred into metabolic cages and collect faeces and urine for 07 days to evaluate feed digestibility with allowing 07 days asadaptation period. Four lambs from each treatment group were randomly selected for slaughtering to evaluate the carcass characteristics and meat quality.The experiment was arranged in a completely randomized design (CRD) and thedata were analyzed using the GLM procedure of the SAS (1994). The differences were tested by DMRT using GLM of SAS. Significant differences were declared when $P<0.05$.

Table 1. Chemical composition of the experimental diets

Diet	DM (%fresh)	Chemical composition (%DM)					Estimated ME (MJ/Kg DM)
		Ash	OM	CP	ADF	NDF	
UMS	54.71	17.08	82.92	10.74	48.74	78.07	7.93
Concentrate mixture	88.76	7.07	92.93	19.02	8.95	45.74	12.04

The Growth responses, FCR and cost per kg gain by different regional growing native Bengal lambsare shown in Table 2. The DMI was significantly ($P<0.01$) lower in Jamuna river basin group compared to other groups. Lower FCR was also found in Jamuna river basin group but not differ significantly with Coastal group. Nevertheless, daily gain and total live weight gain (LWG) were significantly ($P<0.01$) higher in Costal sheep (Table 2). However, cost per kg gain not differs significantly among the groups. Besides that dressing percent and nutritive composition of meat did not differ among the groups (Table 3). The digestibility of DM, OM and CP and nitrogen balance (NB, $g/kg^{w0.75}/d$) were significantly ($P<0.01$) higher in Jamuna river basin group (Table 4).

Table 2. Growth responses, FCR and cost per kg gain by different regional growing lambs

Parameters	Barind	Jamuna river basin	Coastal	SEM	Sig. Level
Initial LW	11.54	10.53	12.88	1.02	NS
Final LW	18.87^{ab}	17.11^{a}	21.01^{b}	1.27	*
Total LWG	7.33^{b}	6.58^{a}	8.13^{b}	0.41	**
DMI (kg)	0.68^{b}	0.50^{a}	0.64^{b}	0.05	**
DMI % Body weight	4.43^{b}	3.64^{b}	3.77^{b}	0.15	**
FCR	8.38^{b}	6.75^{a}	7.06^{a}	0.55	*
Daily gain (g/day)	82.37^{ab}	73.88^{a}	91.29^{b}	4.66	**
Feed cost per kg gain (Tk.)	147.70	146.89	150.29	12.19	NS

NS= Non significant, * p<0.05,**p<0.01; $^{a, b}$ values within the same raw with different superscripts differs significantly,

Table 3. Carcass weight, dressing yield and nutritive value of meat of different regional growing lambs

Parameters	Barind	Jamuna river basin	Coastal	SEM	Sig. Level
Live weight (kg)	21.21^{b}	17.60^{a}	23.35^{c}	0.85	**
Hot carcass wt(kg)	10.36^{b}	8.59^{a}	11.79^{c}	0.42	**
Dressing %	48.86	48.93	50.44	0.98	NS
DM (%fresh)	25.89	26.55	27.18	1.26	NS
Ash (%DM)	4.18	4.45	4.57	0.34	NS
CP (%DM)	17.69	17.26	17.41	0.61	NS
EE (%DM)	4.28	5.00	4.54	1.18	NS

NS= Non significant, * p<0.05,**p<0.01; $^{a, b}$ values within the same raw with different superscripts differs significantly,

Table 4. Nutritional responses of different regional growing native Bengal lambs

Parameters	Barind	Jamuna river basin	Coastal	SEM	Sig. Level
DM Dig%	73.35^{a}	76.00^{b}	72.33^{a}	1.07	**
OM Dig%	77.51^{a}	79.47^{b}	76.27^{a}	0.93	**
CP Dig%	78.09^{b}	79.06^{b}	75.81^{a}	0.89	**
NDF Dig%	74.72	75.90	73.30	1.07	NS
ADF Dig%	46.21^{a}	53.69^{b}	43.13^{a}	2.77	**
NB (g/d)	12.5^{7b}	11.01a	11.94^{b}	0.32	**
NB ($g/kg^{w0.75}$/d)	1.31^{b}	1.33^{b}	1.13^{a}	0.03	**

NS= Non significant, * p<0.05,**p<0.01; $^{a, b}$ values within the same raw with different superscripts differs significantly,

In conclusion the result revealed that Jamuna River basin sheep and Coastal sheep both could be the suitable native sheep for the lamb production in Bangladesh. More research with large sample size considering details economic analysis is needed for more concrete results.

Effect of dietary energy and protein levels on growth and carcass characteristics of hilly chicken up to eight weeks of age

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Executive Summary

The relationship between protein and energy requirements has been reported by many researchers. It is clear that protein requirements have little meaning unless energy requirements are considered. Several scientists have chosen to express these nutrient requirements in terms of energy and protein ratios. But there is a little information on the effects of a varying dietary energy and protein level on native chicken. The experiment was undertaken to determine the effect of varying energy and protein levels on growth performance of hilly chicks at starting period (up to eight weeks of age). Three hundred twenty four straight run day-old chicks were randomly allocated to three dietary treatments of varying energy and protein levels as 2850, 2950 and 3050 ME Kcal/Kg and 200, 210 and 220 g CP/kg DM for starting period. Each treatment was replicated three times in a completely randomized design and the diets were assigned in a 3×3 factorial arrangement. Each replication of 12 chicks was accommodated in 2.5 m^2 floor space. The birds were raised under standard husbandry practices; feed and water were supplied *ad libitum* throughout the experimental period. Feed intake, live weight gain, feed conversion, digestibility and dressing percentage were measured during the experimental period. Performance characteristics of hilly chicken, fed on different level of energy and protein in the diets are presented in table 1. Final body weight and body weight gain were not significantly affected ($P>0.05$) by the dietary regimes and its interaction. Birds consumed least amount of feed on the diet containing 2850 kcal/kg energy $P<0.05$) and convert feed comparatively with better efficiency ($P<0.05$). However, protein efficiency was better ($P<0.05$) at the lower level of dietary protein (20% CP) and energy (2850 ME Kcal/kg). At 20% of CP level, increasing dietary energy from 2850 to 3050 kcal/kg ME resulted into a 29g decreases in weight gain. Conversely, at 2850 kcal/kg ME an increase in dietary protein from 20% to 22% CP resulted into a 27 g decrease in weight gain. Maximum weight gain was achieved at an ME: CP ratio of 142.5 which corresponded with the 2850 kcal/kg ME and 20% CP diet. The carcass yields and other carcass portions of hilly chicken fed varying dietary energy and protein levels is shown in table 2. Birds fed with 2850 kcal/kg energy diet had higher carcass weight ($P<0.001$) compared to other energy level. Fed on the diets with the lower energy level (2850 kcal/kg ME) yielded the heaviest breast meat ($p<0.01$) and thigh meat ($p<0.05$). The findings of present study therefore indicate that the 2850 kcal/kg ME and 20% CP dietary level, with ME: CP ratio of 142.5 could meet the growth performance of the indigenous hilly chicken up to eight weeks of age.

Table 1. Performance characteristics of hilly chicken, fed on different level of energy and protein in the diets

Parameter	**Protein (%)**	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
Final body weight (g/bird)	20	785.3	688.5	750.9	741.4±15	NS	NS	NS
	21	736.6	725.2	741.3	734.8±15			
	22	752.9	725.2	715.7	730.6±15			
Mean ± SE		758.3±15	718.60±16.5	735.3±15				
Parameter	Protein **(%)**	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
Body weight gain (g/b)	20	752.3	661.5	723.2	713.7±15	NS	NS	NS
	21	704.7	698.4	687.2	696.5±15			
	22	725.0	699.2	710.0	703.8±15			
Mean ± SE		727±15	686.4±15	706.8±15				
Parameter	Protein **(%)**	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
Total feed intake (g/b)	20	2045.9	2111.8	2072.7	2076±27	NS	*	NS
	21	1922.6	2090.7	2110.9	2041±27			
	22	2067.5	2084.2	2161.9	2104±27			

Mean ± SE		2012[a]±27	2095[b]±27	2115[b]±27				
Parameter	Protein	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
FCR (Feed: Gain)	20	2.71	3.2	2.8	2.9±.07	NS	*	NS
	21	2.73	2.9	2.95	2.89±.07			
	22	2.85	2.9	3.01	2.94±.07			
Mean ± SE		2.77[a]±.07	3.06[c]±.07	2.92[b]±.07				
Parameter	Protein	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
PER[1]	20	1.8	1.5	1.8	1.7[a]±.07	*	*	NS
	21	1.7	1.5	1.5	1.6[a]±.07			
	22	1.5	1.5	1.5	1.5[ab]±.07			
Mean ± SE		1.7[a]±.07	1.5[ab]±.07	1.6[a]±.07				
Parameter	Protein	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
EER[2]	20	9.2	7.6	8.0	8.2±.17	NS	***	NS
	21	8.5	8.0	7.6	8.1±.17			
	22	8.9	8.0	7.7	8.2±.17			
Mean ± SE		8.9[a]±.17	7.8[b]±.17	7.8[b]±.17				

[a,b,c]means on the same row and column with different superscripts differ significantly ; NS= Non significant, ***(P<0.001), **(P<0.01) .*(P<0.05)

[1]PER=Protein efficiency ratio calculated as weight gain per protein intake

[2]EER=Energy efficiency ratio calculated as weight gain ×100/total metabolizable energy intake

Table 2. Effect of diet on carcass characteristics of hilly chicken

Parameters	**Protein (%)**	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
Carcass yield (g)	20	518.85	439.86	435.31	464.67±9.3	NS	***	NS
	21	541.38	494.73	443.18	493.10±9.3			
	22	498.75	436.43	415.10	450.09±9.3			
Mean ± SE		519.6[a]±9.3	457[b]±9.3	431[b]±9.3				
Parameter	**Protein (%)**	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
Breast meat weight (g)	**20**	107.80	102.63	102.51	104.31±2.1	NS	**	NS
	21	105.23	106.36	97.30	102.96±2.1			
	22	112.48	106.70	97.10	105.42±2.1			
Mean ± SE		108.5[a]±2.1	105.2[a]±2.1	98.96[b]±2.1				
Parameter	**Protein (%)**	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
Drumstick weight (g)	**20**	73.33	67.40	72.30	71.01±1.8	NS	NS	NS
	21	75.28	72.06	67.88	71.74±1.8			
	22	76.03	70.18	69.63	71.95±1.8			
Mean ± SE		74.88±33	69.88±1.8	69.93±1.8				
Parameter	**Protein (%)**	**Energy (Kcal)**			**Average**	**Level of significance**		
		2850	2950	3050		p	ME	P*ME
Thai weight (g)	**20**	75.33	69.28	71.58	72.06±1.7	NS	*	NS
	21	74.67	71.45	66.36	70.86±1.7			
	22	74.03	65.88	66.18	68.70±1.7			
Mean ± SE		74.71[a]±1.7	68.87[b]±1.7	68.04[b]±1.7				

[a,b,c]means on the same row with different superscripts differ significantly ; NS= Non significant, ***(P<0.001), **(P<0.01) .*(P<0.05)

Production of calves through transfer of *in vitro* produced cattle embryos at farmers' level and BLRI Research Farm

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Executive Summary

In vitro embryo production (IVEP) technology is used to exploit genetic superiority of both female and male lines. The IVEP enhance genetic changes in desired direction through maternal lineage. The IVEP technology has been using in many developed and developing countries for assisting genetic progress in conventional cattle breeding programme. Oocytes of IVEP may come from i) slaughterhouse ovary, the genetic status are unknown and ii) live elite cows. Ultrasound-guided transvaginal ovum pick-up (OPU) technique is routinely used for collection of oocytes from live elite cows for their multiplication. The OPU in combination with conventional IVEP (OPU-IVEP) has enabled repeated production of large number of IVEP calves from donors of high genetic merit without altering their genetic make-up. Application of the said technology requires consistency as well as efficient embryo culture, storage and transfer system to recipient. Considering above facts, BLRI is working with OPU-IVEP technology for multiplication of elite cows possessing high genetic merit since last four years. Meanwhile, the oocyte aspiration protocol from slaughtered cow ovary, ovarian follicular dynamics of slaughtered and live animal, IVEP protocol for large and small number of oocytes collected from slaughtered cow ovary, estrus synchronization and embryo transfer protocol were adopted at BLRI. The present research project was designed i) to produce calves through transfer of IVEP embryos into the recipient cows and ii) to adopt OPU protocol. The cumulus-oocyte-complexes (COC) were aspirated from 3 to 8 mm diameter secondary follicles using a 10-mL disposable syringe attached with a 21G needle and searched under a stereomicroscope. The COC possessing an even cytoplasm and covered with minimum 3 layers of compact cumulus cells were selected for *in vitro* maturation (IVM). The selected COC were washed 2-3 times in TL-HEPES medium (washing medium) and 2-3 times in IVM medium before placing them into a well of a 4-well culture dish containing IVM medium. The matured COC were fertilized *in vitro* (IVF) using frozen/fresh bull semen capacitated through incubation with heparin sodium salt (20 μg/mL) dissolved in the IVF medium for 15 min. The capacitated sperms were diluted at approximately 12.5×10^6 spermatozoa/mL with IVF medium. The matured COC were co-cultured with capacitated spermatozoa for 18 to 20 hr. After IVF, cumulus cells were removed by gentle pipetting into TL-HEPES. The denuded zygotes were washed 3 times in *in vitro* culture (IVC) I medium and placed them into the culture droplet for 3 days. After 3 days, the 8 to 32 cell embryos were transferred into IVC-II medium for remaining culture period (until Day 8). The incubation environment during IVM, IVF, and IVC were 5% CO_2 in air at 38.5°C with maximum humidity. At day 8, embryos were transferred into the uterus of selected recipients those came into heat treated with single dose of prostaglandin $F_2\alpha$ ($PGF_2\alpha$) upon detection of functional corpus luteum (CL) through rectum palpation followed by single dose of Gonadotrophin Releasing Hormone (GnRH) on observed estrus to synchronize ovulation of the recipient in due time to develop new CL for embryo transfer (ET). The treated recipients came into estrus within 60 to 72 hr following PGF2α administration. Estrus was confirmed by close observation of behavioral symptoms, teaser bull exposure and rectal palpation. Embryos produced in two different batches were transferred into 5 cows in two batches (2 cows in first batch and 3 cows in second batch). On day 7 or 8, depending on the morphological

Figure 1. First twin IVEP calves (Falguni and Chaitali) of Bangladesh was born in BLRI on March 5, 2016.

development stage of IVEP embryo, two embryos (late morulae to early blastocyst) were transferred to each recipient. Embryos were transferred in the horn of the uterus ipsilaterally. Pregnancy was first diagnosed by rectal palpation on day 60 after ET. Pregnancy was confirmed by ultrasonography on day 90 following ET. Results showed that one of the recipient cows conceived and delivered twin heifer calves. The newborn twin calf first delivered was named as Falguni and the next co-twin was named as Chaitali. The gestation length was 277 days. Birth weight of Falguni was 12.87 kg and that of Chaitali was 18.59 kg. Body weights of Falguni and Chaitaliat at 30, 60 and 111 days were 23.45 and 33.38 kg, 41.15 and 47.40 kg and 56.00 and 70.00 kg, respectively. A daily body weight gain up to 111 days in Falguni was 388.56 gm and that of Chaitali was 463.15 gm. About 12 attempts were taken to collect oocytes from live donors. However, none of the attempts were able to collect oocytes from donor's ovary. The OPU protocol is under way of customization for successful ovum collection. This study concluded that IVEP calves can be produced by collecting oocytes from slaughterhouse cow’s ovary.

In vitro production of buffalo embryo

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Buffalo is a highly potential animal species in terms of milk and meat production but traditionally they are regarded as a poor breeder. This is manifested mainly as late maturity, long postpartum anestrous intervals, poor expression of estrus, poor conception rates (CR) and long calving intervals. In order to improve reproductive efficiency of buffalo, assisted reproductive technologies such as artificial insemination (AI), multiple ovulation and embryo transfer (MOET) and *in vitro* production of embryos have been introduced (Nandi *et al.* 2002). Application of these technologies in assisted reproduction of buffalo is necessary to rescue the precious germplasm. In addition, female buffaloes have few primordial follicles and a high rate of follicular atresia. These limiting factors also limit the embryo transfer technology in buffalo. Therefore, the emphasis has now shifted to *in vitro* embryo production (IVEP). From this point of view, the present study was undertaken aiming to produce *in vitro* buffalo embryo in the laboratory under Buffalo Development Project (Component-A). Ovaries of slaughtered buffaloes were collected from abattoir located at Kaptan Bazar, City Corporation Slaughterhouse, Gulistan, Dhaka in physiological saline at ambient temperature and transported to the laboratory within 4 to 5 hr of slaughter. The cumulus-oocyte-complexes (COCs) were aspirated and COCs possessing an even cytoplasm and covered with minimum 3 layers of compact cumulus cells was selected for *in vitro* maturation. The selected COCs (50 to 70 per well) was washed 2-3 times in TL-HEPES and 2-3 times in IVM medium (TCM199 + 10% FBS, 1 μg/mL β-estradiol, 10 μg/mL FSH, 0.6-mM cystein, and 0.2-mM sodium pyruvate) before placing them into a well of 4-well dish containing 700 μL IVM medium for 22 to 24 hr.The matured COCs was fertilized *in vitro* by frozen semen (Nili Ravi and Murrah). After thawing, semen was centrifuged with 1800 rpm for 5 min. The sperm was washed for 2 times and capacitated through incubation with 500 μL IVF medium (Tyrode's lactate solution supplemented with 6 mg/mL BSA, 22 μg/mL sodium pyruvate, 100 IU/mL penicillin, and 0.1 mg/mL streptomycin) containing heparin sodium salt (20 μg/mL) for 15 min. After capacitation, the spermatozoa were diluted at approximately 1×10^6 spermatozoa/mL with IVF medium.

Table 1. Effects of CL on follicular statistics and COCs in buffalo ovaries

Types of ovary	Total no of follicles	Follicles per ovary (Mean ± SE)	Aspirated follicles per ovary (Mean ± SE)	Collected COCs per ovary(Mean ± SE)		Total COCs per ovary (Mean ± SE)
				Normal	Abnormal	
CL absent ovary	43	7.4^{a}± 0.21 (319)	5^{a}± 0.00 (215)	1.98^{a} ±0.77 (85)	1 ± 0.53 (43)	2.98^{a}± 0.16 (128)
CL present ovary	25	4.80^{b} ± 0.17 (120)	3.92^{b} ± 0.95 (98)	0.88^{b}± 0.60 (22)	1 ± 0.5 (25)	1.88^{b} ±0.16 (47)
Total	68	6.46 ± 0.21 (439)	4.60 ± 0.9 (313)	1.57±0.10 (107)	1 ± 0.06 (68)	2.57± 0.13 (175)

The matured COC were co-cultured with capacitated spermatozoa for 18 to 20 h through placing them into a well of 4-well dish (700 μL). A total of 68 buffalo ovaries were obtained from the slaughterhouse and categorized into 2 groups based on presence (n=25) or absence (n=43) of corpus luteum (CL). A total of 439 follicles were counted at the ovarian surface, 319 being from CL absent and 120 from CL-containing ovaries. Not all these follicles were suitable for aspiration. The total number of aspirated follicles was 313, from which 215 were aspirated from CL-absent ovaries, while 98were aspirated from ovaries presenting CL. A significantly higher ($P<0.01$) number of follicles was observed in CL-absent ovaries than in CL-containing types (Table 1). Consequently, the number of

aspirated follicles from CL-absent ovaries was significantly higher (P<0.01) than those aspirated from CL-containing ovaries (Table 1). Significantly higher (P<0.01) number of normal COCs was found in CL-absent ovaries compared to CL-containing ovaries. The mean retrieved COCs per ovary was higher in CL-absent ovaries than in CL-present ovaries (2.98 *vs.* 1.88 COCs). The cause for the low number of oocytes in ovaries presenting a CL is likely because of the restricted follicular development, as lutein cells occupy a great portion of the ovary; furthermore, CL may inhibit the follicular growth and foster their atresia.

Collected total 107 normal COCs were allowed for *in vitro* maturation (5% CO_2 in air at 38.5°C with maximum humidity) in which 55 oocytes showed cumulus expansion at the rate of 52%. Examination of the level of nuclear maturation of the expanded COCs is under processing. All the expanded COCs were allowed for *in vitro* fertilization using frozen semen (Niliravi and Murrah) and they were cultured subsequently (IVC 1 and IVC 2) for 8 days, but no cleavage were found.The poor cleavage rate of the COCs may be due to the poor quality of the frozen semen. Considering the above limitations liquid semen was aimed to use for IVF and semen collection from buffalo bull is under process.

Table 2. Cumulus cell expansion following *in vitro* maturation of buffalo COCs

No. of COCS for in vitro maturation	No. of COCS with cumulus expansion	Rate of cumulus expansion (%)	No of COCs for in vitro fertilization	Cleavage (%)
107	55	51.40	55	0

This could be concluded that follicular statistics and oocyte yield were found to be higher in ovaries without corpus luteum and that normal grade oocyte undergoes *in vitro* maturation at a considerable rate. The ongoing experiments on *in vitro* fertilization of buffalo oocytes with fresh semen may give the results of acceptable cleavage rate.

Protocol adaptation and development of primary culture of bovine fibroblast cell line

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Executive Summary

Cell culture is the process by which prokaryotic, eukaryotic or plant cells are grown under controlled conditions. But in practice, it refers to the culturing of cells derived from animal cells. In cell culture, the cells are no longer organized into tissues. When cells are surgically removed from an organism and placed into a suitable culture environment; they will attach, divide and grow. This is called as primary culture. The genetic diversity of livestock and poultry plays an important part in overall biological diversity, as well as form the basis for the survival and sustainable development of the human beings. Therefore, the preservation of genetic resources from endangered species has scientific significance. At present, the preservation of individual animals, semen, embryos, genomic libraries and cDNA libraries are all practical approaches. Nevertheless, the establishment of cell line using cryopreservation technique is another effective approach. Most cell banks emphasize conservation and utilization of animal resources, especially animal generative cells and embryos. In addition to these methods, modern somatic cell cloning technique has made somatic cells become attractive resource in the conservation of animal genetic materials. Cell culture is a general idiom used for the removal of cells or tissues from an animal and their next placement into an artificial environment conductive to growth. It is also known as techniques of keeping tissues alive and growing in an appropriate culture medium. Growing tissues of living organism outside the body is made possible in an appropriate culture medium, containing mixture of nutrient either in solid or liquid form. At present remarkable association in the field of animal cell culture done by researchers. Cell culture was first successfully undertaken by Ross Harrison in 1907. Earle developed permanent cell for the first time from subcutaneous mouse tissue. Development of use of trypsin to allow subculture of attached cells from one flask to another, development in cell culture vessels and bioreactors, cell cryopreservation methods and different media formulations were taken places during 1950s to 1960s. Vaccine production from cultured cell was also developed by this time. The technology for the production of different antibiotics from cultured cell lines was established by the continuous effort of researchers during the period of 1970 to 1980.The technology for the production of cloned calf from bovine fibroblast cell line was successfully adopted. A bovine fetal fibroblast culture was established and used as nucleus donor, slaughterhouse oocytes were matured and enucleated oocytes were fused with fibroblast. Reconstructed embryos were cultured and developed blastocysts were transferred to recipient cows which eventually produced a cloned calf. There have been a number of recent publications on the development of fibroblast cell lines from various animals, including the Debao pony, Beijing fatty chicken, sheep, Taihu pig, Luxi cattle, and white ear lobe chicken. A Texel sheep ear marginal tissue fibroblast cell line (named TSF19) was successfully established by using a primary explant technique and cell cryo-conservation technology. This newly established cell line will not only preserve the genetic resources of the important Texel sheep at the cell level, but will also provide a valuable resource for genomic, post-genomic and somatic cloning research. Establishment and characterization of the fibroblast cell line from Silkie Bantam was successfully adopted. At 2010, the developmental rates of bovine nuclear transfer embryos derived from different fetal non transfected and transfected cells was successfully adopted by Ricardo Felmer and his team. Hai-Yan Wu and his team developed an improved method for highly efficient isolation of primary mouse embryonic

fibroblasts. The objective of the project is to adaption of fibroblast cell line protocol for reproductive cloning. Development of primary culture of cell lines using ovarian tissue and ear tissue of buffalo to establish fibroblast cell line. Cells are growing *in vitro*. A piece of ear tissue cultured in the medium to develop primary fibroblast cell line. At first, tissue sample was washed with PBS followed by clipped, saved and washed again with PBS. After washing, the tissue samples were sliced with scalpel and blade. The sliced samples were washed again with PBS and incubated in PBS containing trypsin- EDTA (~3-4ml) for 5 min. After 5 min, DMEM working solution was added to inactivate enzymatic activity and then centrifuged at 800 rpm for 5 min. The supernatant was discarded and tissue slice was washed in PBS before seedling in Petridish and flask. The media was poured so that the slice was not completely submerged into the media. Then the culture petridishies were placed into a CO_2 incubator (5% Co_2 with 37°C temperature) for 24 hr. After attachment of seeded tissues in dish, DMEM working media was added to submerge the tissue slice into media. The culture was continuing until 80-90% confluent. Culture a medium was replaced after two days and then replaces it three times a week. The fibroblast were started to grow from 2 to 3 days following seedling. At day five of culture, the cell in dishes were treated with trypsin, poured into a 15-ml tube and centrifuged at 1800 rpm for 5 min. The supernatant was discarded and working medium was added to the tube. The cells were mixed by gentle pipetting and passaged into new dish or cryopreserved for future use. The general morphology and growth of cell population and presence of any microbial contaminants should be checked regularly under an inverted microscope in phase contrast. The medium were changed 3 times in a week to maintain proper proliferation and growth of cells. Cells were counts using hemocytometers. Viable cells were detected following staining cells with Trypan Blue. Total 15 times tissue sliced were cultured for development of primary and subculture. Out of 15 times, cells were grown in 6 times. Confluence of cells ranged from 70 to 90%. Subculture was performed 3 times. Confluences of cells in first passage were ranged from 75 to 90% and numbers of cell per milliliter suspension were $2.64x10^5$ during first passage. About 92.29% of the total cells grown during first passaging were viable. Further researches may be conducted to characterize cells produced through established primary and sub-culture protocols.

Enhancing methanogenesis in biogas digester through hybridization of feedstock biomass

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Executive Summary

Biogas production from livestock manure could be a promising source of renewable energy that has given considerable importance while formulating the Renewable Energy Policy of Bangladesh. The draft National Integrated Livestock Manure Management (ILMM) Policy earges research and development and technology adoption for improving biogas for ensuring its diversified use. It is estimated that the available livestock manure in the country can annually produce 77.4 million m^3 of biogas, 170188.8 MWH/year of power and 121.8 million tons of bio-slurry (Bangladesh Biogas Development Foundation, BBDF; personal communication). Considering the total estimated manure production in the country, the potential biogas production is calculated to be 5765 million m^3 (Draft ILMM Policy, 2015), which is equivalent to 2.95 million tons of kerosene or 5.9 million tons of coal. The use of biogas in automobiles, industry and electricity generation is limited by its carbon di-oxide (CO_2) and hydrogen sullfide (H_2S) contents. Usually biogas consisted of 55-65% methane and 30-35% CO_2 and trace amount of nitrogen, hydrogen sulfide, hydrogen, oxygen and water vapour. Generally methane is needed to be purified from biogas for further value added use. Increasing proportionate production of methane during fermentation of feedstock in the digester could be good option to increase energy efficiency and broadened-up the potential of biogas for industrial use. At field level, each ton of cow dung, poultry litter and vegetable waste can produce around 45, 80 and 90 m^3 of biogas, respectively of variable methane concentration. Therefore, the objective of the present research was to increase gas production and methane concentration in biogas digester through hybridization of different feedstock biomass.

For this purpose, cowdung (CD) and layer dropings (LD) were used as feedstock biomass either solely (100%) or in different combinations (25:75, 50:50 and 75:25) in 25 laboratory simulated biogas digester each of 3.5 litter capacity according to the following experimental layout. The digeter was connected to a 60 ml disposable syringe through collection tube by which gas production was measured and gas sample was collected. Another additional pipeline was placed to provide expulsion of slurry incase of excess gas pressure. Water was mixed at a rate of 0.75 and 1.0 kg for each kg of cowdung and layer droppings, respectively to faciliate hydrolysis. Fresh substrate sample before fermentation was collected and stored at -70^{0}C for laboratory analysis. In each digester 2.0 litters of substrate (water+biomass) is poured, pH was recorded immediately, sealed to provide anaerobic condition and allowed to be fermented in room temperature (at about 30^{0}C). Gas production was measured from syringe and pressure was released periodically. Gas sample was collected at day 22 days.

Experimental Layout

Substrate %	Treatments				
	Control (T_0)	T_1	T_2	T_3	T_4
CD	100	75	50	25	0
LD	0	25	50	75	100
Replication	5	5	5	5	5

At the end of experiment, pH of slurry was recorded and slurry sample was collected for chemical analysis. Results are illustrated in Table 1.Total gas production was found highest (P=0.001) in T3 and lowest in the control (T_0) (100% cow dung), while the control has the highest (P=0.007) percentage of methane concentration compared to others. Overall, treatments having layer litter showed higher gas productions compared to cow dung alone. Previous studies also suggest that poultry manure produce more biogas but less proportion of methane compared to cow dung (Alfa et

al., 2014). After 22 days of anaerobic fermentation, pH, ash and N concentration of bioslury was found to be differed among the treatments. They were increased (P<0.001) linearly with the increasing proportion of layer litter in the substrate. Increased pH and concentrations of ash and N in substrate from poultry droppings were also observed by Alfa et al. (2014) and Adelekan and Bamgboye (2009).

Table 1. Effect of feedstock biomass hybridization on biogas and bio-slurry in laboratory simulated biogas digester at 22 days.

	Control (T_0) (100:0)*	T_1 (75:25)	T_2 (50:50)	T_3 (25:75)	T_4 (0:100)	SEM	p-value
Total Gas (L)	1.8^{c}	5.9^{abc}	8.3^{ab}	10.4^{a}	5.1^{bc}	2.56	0.001
Gas (ml/d)	83.8^{b}	270.5^{abc}	378.1^{ab}	476.5^{a}	236.2^{bc}	114.85	0.001
CH_4 (%)	37.4^{a}	27.8^{ab}	22.95^{ab}	12.0^{b}	24.6^{ab}	6.39	0.007
Total CH_4 (L)	0.7^{b}	1.6^{ab}	1.9^{a}	1.3^{ab}	1.3^{ab}	0.60	0.071
Fresh Substrate							
pH	7.04	7.03	7.05	7.15	7.02		
Ash, %DM	2.3	3.0	4.3	4.4	7.6		
N, %DM	15.9	16.9	24.1	34.3	38.7		
Bioslurry							
pH	5.9^{d}	6.3^{c}	6.5^{b}	6.6^{ab}	6.7^{a}	0.06	<0.001
Ash, %DM	15.1^{e}	26.3^{d}	34.7^{c}	40.9^{b}	47.9^{a}	2.36	<0.001
N, %DM	1.4^{c}	3.1^{c}	6.4^{bc}	10.4^{b}	19.2^{a}	3.51	<0.001

*Cow dung (CD); Layer droppings (LD)

Considering the total gas and proportion of methane concentration, it was observed that a 50:50 mixture of cow dung and layer litter (T_2) produced maximum methane (1.9 L) in biogas after 22 days of anaerobic digestion of biomass. This indicated that hybridization of biomass feedstock could be an important tool to increase methane production in biogas plant. However, extensive research is needed for deriving comprehensive results and recommending for using the technique at farm level.

Study of livestock manure management and clean air production

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Executive Summary

Livestock manure, up to 55% of feeds fed to ruminant animals that pass through digestive tract undigested, pollutes the environment through conventional managements. It is being considered a waste may turn into wealth through improved management. Anaerobic digestion; a gateway to biogas, organic fertilizer/soil conditioner, vermicompost, condensed methane, bio-power and bio-pesticide; spouts bio-slurries, nutritionally rich semi-solid biomass, containing >90.0% water may be turned into organic fertilizers/soil conditioners. This may make livestock production more sustainable, compensating at least a part of feed cost of livestock farming, and climate cleaner. Some organic-fertilizers in various physical forms, moisture contents and nutritional integrities are available in the market. They required being evaluated with respect to their response to crop production and conformity with national organic fertilizer standards. Development of cost effective safe value addition system of bio-slurry based organic fertilizers , a most profit earning value added product of livestock manure (Draft National Integrated Livestock Manure Management Policy 2016), is essential and may contribute importantly to crop productions. Farmers know how organic fertilizers enrich soil health; average fertility of which in some areas eroded to ≤0.5% than a required level of ≥3.0% over time through repeated uses of different chemical fertilizers for higher crop intensities. Thus, initially, the present study was undertaken with the objectives to develop livestock manure based safe and cost effective organic-fertilizer(s) and determine its impact on rice production and soil health.

Evaporation of high moisture in bio-slurries (average 91.8%) to a level that allows its considerable shelf-life and safe handling during marketing, and determination of its/their soil nutrient and heavy metal contents, standard dosages and effects on crop production on-station &/or on-farm and of residual impacts on soil health are major activities undertaken in the initial phase of the present work. Sun drying with or without the use of different levels (0, 10, 20, 30 & 40%) of Sawdust (SD) or Cook Stove Ash (CSA) was tested for production of organic-fertilizer of variable moisture levels. All the organic-fertilizers, thus, produced on sun drying were preserved in polythene bags closed tightly to minimize air leaking for a period of at least 6 months and nitrogen contents were analyzed at different moisture levels. Representative samples of organic-fertilizers of different physical compositions were digested in the nutrition lab of the BLRI for determining major soil nutrients eg, organic carbon (OC), nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Zinc (Z) and Copper (C); and heavy metals such as, Cadmium (Cd), Lead (Pb), Nickel (Ni) and Chromium (Cr) in the lab of the Soil Resource Development Institute (SRDI). Considering nutrient content the control organic fertilizer (without absorbent) containing 30% to 40% moisture was selected to test its effect on rice production on-station and on-farm with the technical assistance of the Bangladesh Rice Research Institute (BRRI). On station greenhouse rice production without any chemical and organic fertilizer (Control) was compared with 100% chemical fertilizer (T_1), 100% chemical fertilizer with 0.5 ton/ha organic fertilizer (T_2), 50:50 chemical fertilizer and organic fertilizer (T_3) or 100% organic fertilizer (T_4). P^H, OC, N, available P and exchangeable K of initial soil and post-harvest soil were analyzed. Treatment responses were analyzed in an ANOVA of simple design using SPSS 17.0 statistical software.

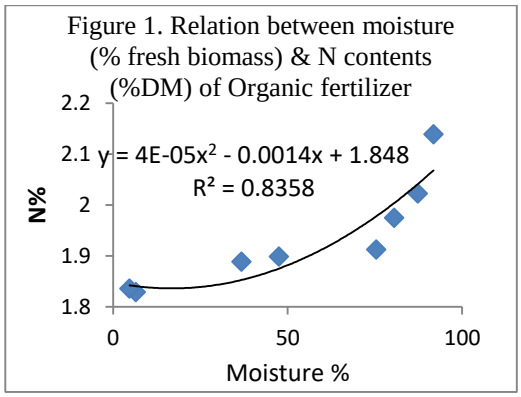

Figure 1. Relation between moisture (% fresh biomass) & N contents (%DM) of Organic fertilizer

Table 1. Nutritional composition and heavy metal content of Organic-fertilizer of bioslurry origin

Nutrients (%)	Control 0 SD/CSA	Sawdust (SD, %)				Cooke Stove Ash (CSA, %)				Standard organic fertilizer
		10	20	30	40	10	20	30	40	
OC	18.9	16.84	12.22	18.91	18.47	16.13	15.16	15.20	14.67	≥10.0
N	1.06	0.90	0.76	0.65	0.58	0.85	0.79	0.62	0.59	≥0.50
P	0.44	0.34	0.27	0.24	0.18	0.30	0.31	0.31	0.27	≥0.50
K	0.25	0.20	0.33	0.09	0.08	0.23	0.20	0.20	0.17	≥0.25
S	0.49	0.58	0.30	0.14	0.08	0.29	0.05	0.01	0.08	≥0.10
Zn	0.02	0.055	0.007	0.13	0.07	0.01	0.004	0.001	0.004	≥0.01
Cu	0.06	0.002	3.55	3.69	5.33	0.001	0.14	0.20	1.17	≥0.05
Heavy Metals, ppm										
Cd	1.25	2.94	1.14	4.58	1.46	0.35	6.14	7.55	3.3	5.00
Pb	6.06	3.95	3.89	3.50	5.38	8.14	4.27	4.34	9.7	30.0
Ni	2.05	3.09	2.51	3.20	2.08	4.28	3.60	5.58	6.7	30.0
Cr	2.46	2.00	0.27	22.0	22.50	6.56	8.33	9.00	21.9	50.0

Moisture evaporation has a strong relation ($p<0.05$) withthe reduction of N inorganic fertilizer (Fig1) and it justifies to have processing system, other than drying. The organic fertilizer produced without using SD or CSA was superior in terms of nutrient contents and with the increase of SD or CSA level, the nutritional values of organic fertilizer were reduced with the increased cost of absorbents (Table1). All the organic fertilizer had a higher content of nutrients and a lower content of heavy metals than the national organic fertilizer standard (Table 1), and no off flavor or fungal infestation developed during six months storage period in the absence or presence of SD or CSA.

Table 2 shows that the highest plant height (111cm), grain yield (5.87 t/ha) and straw yield (6.08 t/ha) was found when chemical fertilizer and organic fertilizer at a ratio of 50:50 was applied. Organic fertilizer had similar responses to the yield of grain (3.99 vs 3.48 t/ha)& straw (4.22 vs 4.03 t/ha), plant height (102cm vs 105 cm) or tiller number per hill (12 vs 14) to that of chemical fertilizer or the latter with 0.5 t/ha organic fertilizer (T_2;4.36 t/ha, 5.38 t/ha, 111cm & 18/hill, respectively).

Table 2. Effect of chemical fertilizer or Organic fertilizer on BRRIdhan29 production characteristics at harvesting

Constants	Yields (t/ha)		Plant characteristics	
	Grain	Straw	Height, cm	Tiller no/hill
Control	2.07D	2.85C	81C	8D
T_1	3.48C	4.03BC	105AB	14BC
T_2	4.36B	5.38AB	111A	18A
T_3	5.87A	6.08A	111A	17AB
T_4	3.99BC	4.22BC	102B	12C
$LSD_{0.05}$	0.794	1.43	8.93	3.59
CV(%)	13.79	21.85	6.0	18.21

It may be concluded that organic-fertilizer of higher nutritional values with lower levels of heavy metals than National Organic fertilizer Standard may be produced from bio-slurries without using any absorbents, and, in respect to production and productivity of rice, it is on equality with chemical fertilizers. Considering all the on station positive responses of the organic fertilizer, on-farm trial of rice production is being continued with the BRRI at Kishorgonj upazila. Moreover organic fertilizer production and marketing may make livestock farming sustainable and climate cleaner harnessing more profit to farmers. Nevertheless, development of packaging and marketing system is of utmost importance forthe furtherance of improved livestock manure management systems in the country.

Project title: System modeling for food waste to feed production

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Executive summary

Feed production system using waste vegetable of market sources (VWM), lost plant biomass disposed conventionally as waste, is developed. The feed, thus produced, was found to be safe and responsive to animal production. Cost effective production and feeding of animals depend on the quantity available in a market. The present study was undertaken with the objectives to quantify year round VW of Karwan Bazaar, a large wholesale vegetable market in Dhaka, and to determine the optimum level of inclusion of processed VW (VWP) replacing the conventional concentrate of a diet of growing bulls. Data on daily vegetable supply and wastes produced were collected from the ledger of sellers. In addition, a predesigned open questionnaire was used for collecting additional information about wastage. The collected data were tabulated by calculating percentage (%), mean and standard deviations (SD). To determine inclusion levels in the diet, twenty four (24) indigenous growing bulls of Red Chittagong Cattle (RCC) of about 12 to 18 months of age with an average initial live weight (LW) of 85.47 (± 17) kg were divided into four equal groups, and fed with *adlib* chopped fresh German grass as a basal diet for a period of 89 days. Four concentrate mixtures containing 0, 10, 20 and 30 % of VWP were prepared and fed to the bulls through morning and evening equal meals at the rate of 1% of LW on DM basis. The intake and digestibility of nutrients, LW gain, nitrogen balance, and blood biochemical parameters were studied. The data on the intake and digestibility of nutrients, nitrogen balance, blood metabolic profile, and LW gain were analyzed to describe statistical relations between the treatment responses in a simple design using general linear model procedure of SPSS (SPSS 11.5).

The estimated market vegetable supply and waste were 4307, 5000 and 5327 tonnes/d, and 41.4, 56.0 and 61.0 tonnes/d in March, April and May, respectively (Table 1). It was found that the market VW was 0.97, 1.13 and 1.15 % of the total marketed vegetable during those months.

Table 1. Vegetable supply, and its waste at Karwan Bazaar, Dhaka

Parameters	Months of the year (± SD)		
	March	April	May
Vegetable supply, tonnes/ d	4307 ± 754	5000 ± 663	5327± 532
Waste produced, tonnes/d	41.4 ± 6.0	56.0 ± 5.0	61.0 ± 7.0
Waste as % of vegetable marketed	0.97 ± 0.06	1.13 ± 0.10	1.15± 0.08

Table 2. VWof some vegetables in their marketing chain (% supply)

Marketing chain	Months of the year (± SD)		
	March	April	May
Transport	4.06 ± 2.48	3.94 ± 1.60	4.15 ± 1.36
Wholesaler	5.01 ± 3.36	8.38 ± 7.59	9.31 ± 4.54
Retailer	4.07 ±2.46	8.18 ± 2.58	8.66 ± 3.22
Total	13.14	20.5	22.12

The study revealed that except farmers, the wastes of cauliflower, cabbage, spotted gourd, bitter gourd, snake gourd, brinjal, brinjal,cucumber,tomato,ladies finger, cucurbetal, cataract, bean and sweet gourd during transport, wholesales and retails were 4.06, 5.01 and 4.07 %, respectively of the supply during March and it resulted in a total wastes of13.14 % of the supply (Table 2). Similarly, in April and May, the loss in transport, wholesales and retails were 3.94, 8.38 and 8.18 %, respectively and 4.15, 9.31 and 8.66 %, respectively which resulted in a total waste of 20.5 and 22.12 %, respectively during these months. The highest waste was found in cauliflower followed by cabbage, cataract, bitter gourd, snake gourd, brinjal, cucumber, tomato, ladies finger and cucurbetal representing 28.8, 22.1, 20.4, 18.0, 16.6, 16.4, 16.2, 15.9, 12.8 and 10.6 %, respectively, and their average CP% on DM basis varied from 21.8 to 31.8 % (Table 3).

Table 3. Wastes (%) and chemical composition of vegetables

SN	Name of vegetables	% VW	SD	% DM	% CP
1	Cauliflower	28.8	1.6	11.14	31.77
2	Cabbage	22.1	7.2	12.29	24.41
3	Spotted gourd	20.4	2.6	10.15	21.77
4	Bitter gourd	18.0	2.8	5.77	22.47
5	Snake gourd	16.6	3.4	4.96	22.22
6	Brinjal	16.4	3.7	7.84	26.44
7	Cucumber	16.2	7.4	3.26	23.75
8	Tomato	15.9	6.3	5.43	-
9	Ladies finger	12.8	7.7	-	-
10	Cucurbetal (jhinga)	10.6	1.7	-	-

The intake and digestibility study revealed that there was no significant (P>0.05) effect of replacement of conventional concentrates with up to 30% VWP on the dietary nutrient intake, digestibility and nitrogen balance of bulls (Table 4). The calculated VWP intake in the 30% VWP group represented 0.29% LW of bulls or 9.46% of total dietary intake. The digestibility of DM (56.85, 62.78, 62.75 and 63.42 %, respectively)or the N balance (34.81, 36.12, 34.26 and 35.95 g/d, respectively) did not differ significantly (p>0.05) with the increase of VWP. Moreover, with the increase of VWP inclusion levels the daily LW gain (302, 300, 312 and 344 g/d, respectively) increased linearly and significantly (p<0.05).

Table 4. Intake, digestibility of nutrients, nitrogen balance and LW gain in bull

Intake of nutrients	VWP in concentrate (%)				SEM	*P* – Value
	0	10	20	30		
ILW, kg	84.3	85.6	84.2	87.8	18.9	0.986
DM from German grass, kg/d	2.07	2.03	2.12	2.19	0.22	0.614
DM from concentrate, kg/d	0.96	1.00	0.98	1.01	0.20	0.970
Total DM, kg/d	3.03	3.03	3.09	3.2	0.41	0.866
DM, % LW	3.10	3.09	3.20	3.14	0.27	0.686
CP, g/d	365	356	359	368	52.79	0.982
DM digestibility, %	56.85	62.78	62.75	63.42	5.19	0.136
N balance, g/d	34.81	36.12	34.36	35.95	5.49	0.931
LW Gain, g/d	302	300	312	344	78.13	0.499

SEM, Standard Error of Mean; *P*> 0.05, Not Significant

Table 5. Blood biochemical parameters of bull

Blood metabolic profile	VWP in concentrate (%)				SEM	*P* - Value
	0	10	20	30		
BS, mmol/L	4.55	4.28	4.08	3.6	0.61	0.067
BUN, mg/dl	40.28	39.20	36.17	37.83	4.01	0.321
Total cholesterol, mg/dl	76.14	73.40	89.33	79.17	13.27	0.221
Triglyceride, mg/dl	34.71	30.20	33.50	33.67	10.40	0.899
LDL, mg/dl	53.14	45.60	66.83	54.50	17.07	0.247
HDL, mg/dl	16.14	15.60	15.17	16.83	2.73	0.747
SGPT, U/L	38.71^{b}	34.00^{b}	21.00^{a}	27.00^{a}	4.99	0.000
SGOT, U/L	60.85	58.20	43.67	55.67	18.04	0.377
Creatinine, mg/dl	0.91	0.86	0.95	0.98	0.16	0.634

Standard Error of Mean; $^{a\,b}$ superscripts in the same raw differ significantly; *P*> 0.05, Not Significant

Among blood biochemical parameters, serum glutamic pyruvic transaminase (SGPT) activity differed significantly among dietary groups (P<0.05, Table 5). Unlike SGPT, the blood sugar (BS), blood urea nitrogen (BUN), total cholesterol, triglyceride, low density lipoprotein (LDL) high density lipoprotein (HDL), serum glutamic oxaloacetictransaninase (SGOT) and creatinine did not differ significantly (P>0.05). However, all the biochemical parameters were within normal physiological level of cattle.

In conclusion, the VWP may be included by 0.29 % LW of bulls or 9.46 % of total dietary intake without affecting feed intake and blood metabolites of bulls. However, further research is needed to develop more cost effective processing and marketing system other than VWP mesh. Mechanical processing, a cost effective and decent value addition system, may be explored through further research.

Taxonomical and molecular characterization and micro-propagation of selected Moringa cultivars using tissue culture

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Executive Summary

The overall livestock feed deficit in our country is estimated to be 45% of the total digestible nutrients and 80% of the CP required for the farm animals (Huque and Sarker,2013). Exploration of good-quality fodders boosts milk and meat production is essentially required for the vertical improvement of livestock production. *Moringa oleifera*, a tropical plant yields biomass of high nutritional value, may be used as a feed for farm animals (Sanchez et al. 2006).Globally 13 species are available and locally most available and known species is *Moringa oleifera* (Fahey, 2005). The Bangladesh Livestock Research Institute (BLRI) recently conserved four Moringa cultivars of different origins and of different phenotypical characteristics such as Black Seed Moringa of local origin (BSM-L), White Seed Moringa of local origin (WSM), Black Seed Moringa of Thailand origin (BSM-T) and a Black seed Moringa of Indian origin. They are being cultivated in fodder plots. But those cultivars are not yet taxonomically or genetically identified. With an objective to support conservation of Moringa fodder plants and their further improvement, the samples of different plants of the selected Moringa cultivars were collected for taxonomical identification with the help of the Department of Botany, Jahangirnagar University (JU), Savar. At the same time, in coordination with the Department of Biotechnology JU, different DNA markers (RAPD and ISSR) were used for diversity analysis of those cultivars. Aiming at overcoming minimum matches for the sexual propagation of Moringa plants with cultivation seasons, limitations in asexual propagation for Moringa fodder cultivation (Huque *et al*. 2015) and the reduction of germination rate of seeds with storage time (Sharma *et al.*, 1982) testing of micro-propagation using tissue culture technique was also initiated with the help of tissue culture lab of the Department of Biotechnology, JU. Thus, the present research work was undertaken with a view to identification of Moringa cultivars through taxonomical and molecular characterization and development of a simple and efficient tissue culture technique for mass propagation.

For taxonomic identification 5 (five) representative Moringa plants, each of 4 (four) Moringa cultivars were collected, cultivated under the same environment and agronomic practices at the BLRI fodder plot. The different vegetative parts (leaf, flower, and pods) and quantitative and qualitative characters of each cultivar were carefully studied, and they were recorded following standard herbarium techniques (Hyland, 1972) and consulting the experienced plant taxonomists of National Herbarium, Bangladesh and of the JU. Finally, they were matches with the respective voucher specimens housed at the Bangladesh National Herbarium; the JU Herbarium.; and modern floras and the official websites of different international Herbaria. To estimate the genetic diversity at the molecular level similarity and genetic distance among four cultivars, the total cell DNA from each cultivar leaf material was extracted using commercial kits (plant genomic DNA) and ten universal ISSR primers were selected based on their amplification using the Polymerized Chain Reaction (PCR). The PCR amplification, Gel electrophoresis, Gel documentations were done following the standard method with some modifications was made to the techniques for better production. Cluster analyses were performed based on Un-weighted Pair Group Arithmetic Mean (UPGMA) following "STA-CLU" statistical software and a Dendogram was constructed.

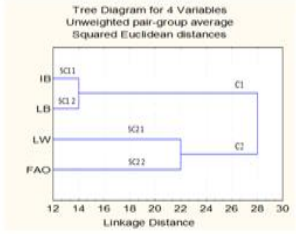
For the micropropagation of Moringa cultivars, the surface sterilization of explants (seed, leaf, and node) were done using different disinfectants and they were transferred to growth media like, MS (Murashige and Skoog, 1962) media added with different concentration and combination of

plant growth regulators like Auxin (2,4D, NAA; IAA and IBA) and Cytokinin (BAP; Kinetin and TDZ) for callus, shoot, and root formation. During each step of initiation, contamination rate, physical appearance, frequency and length of callus/shoot/root were also recorded.

Most of the qualitative and quantitative characters of four (4) Moringa cultivars were found continuous during the taxonomic characterization. Except a few characters, like flower sepal, or petal, the ovary surface of WSM-L cultivar observed as consistent, making a key character and it differentiated the cultivar to others. Seed and/or fruit specimen typically used in taxonomic delimitation in *Moringa* are yet to be collected and conserved.

Fig : 1 ISSR (1,2,and 7) band profile of 4 Moringa cultivars

Fig : 2 Cluster analysis based on UPGMA



The analysis of four (4) Moringa cultivars with ten (10) different ISSR primers in this study identified a total 75 fragments of which 65 were found polymorphic (86.67%) and 25 were monomorphic (13.33%). Based on the band pattern and the pair-wise comparisons of genetic distance values ranged from 14.0 to 32.0, and the range was analyzed by computer software "STA-CLU". The highest linkage distance value (32.0) was recorded in BSM-T cultivar and the lowest linkage distance (14.0) was between BSM-L and the Indian variety. Two major clusters (C1 and C2) were identified through cluster analysis, Cluster C1 belongs to Indian variety and BSM-L and cluster C2 belongs to WSM-L and BSM-T, where cluster linkage distance of C1 was 14 and C2 was 22, respectively.

Almost 80% of de-coated seeds were germinated within 10-15 days and the seedlings were survived without contamination and necrosis, when Clorox concentration was 50% and treatment time was 30 minutes.. On the other hand, a higher percentage of calluses were observed at 0.5 mg/l 2, 4-D and 1mg/l 6-BAPirrespective of other hormone concentration (0; 0.5; 1; 2; 3 and 4mg/l). After 2-3 weeks of callus initiation, nodal explants showed a better degree of callus rather than leaf explants.

Figure 3. Effect of different concentrations of Clorox for different durations of time on surface Sterilization of de-coated seeds and different concentrations of 2,4-D and 6-BAP Plant Growth Regulator (PGR) on callus growth

The extent of morphological characters (qualitative and quantitative) among the four (4) cultivars were considered to be continuous, except the color of sepal; petal; ovary surface of WSM-L, that was found consistent making a key character for infra-specific delimitation. It was applicable for WSM-L cultivar. The rest three cultivars belonged to a different variety of *M. oliefera*. It may be concluded that all of the four cultivars belong to *Moringa oliefera* based on the extent of variation till to this advancement of the present study. Two major clusters (C1 and C2) were identified among the four Moringa cultivars as shown by the molecular characterization. Cluster C1 belongs to Indian black variety and BSM-L and cluster C2 belongs to the rest two genotypes. The work on surface sterilization and callus/shoot/root initiation induced by different explants is being continued and, it needs to be continued for optimization and the development of efficient tissue culture technique of Moringa plant for successful mass propagation.

Identification of local gene sources as donors for salt tolerant trait and *in vitro* regeneration of Napier grass for genetic transformation

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Executive Summary

In Bangladesh, more than 30% cultivable lands are in coastal belt. Out of 2.86 million hector coastal land, 1.056 million hectors are affected by different degrees of salinity (BARC, 2013). Salinity intrusion increased by 27 % from 1973 to 2009 (SRDI, 2010). Farmers are extremely challenged with salinity. Feed shortage is the major reason for low productivity of livestock in Bangladesh especially in coastal area and mainly survives on the common local grasses. It was observed that more than 93 % famers fed paddy straw to their cattle and cut and carry of natural grasses are common practices in the coastal area but it is not available throughout the year. The demand of fodder production is increasing because of limited livestock feed resources in the country. Improvement or development of new fodder helps increase production and productivity of farm animals in the country. The goal of the present research was *in vitro* plant regeneration, isolation and identification of salt tolerant genes and to develop transgenic fodder which is tolerant to certain salinity level and suitable for growing in coastal areas of Bangladesh. *In vitro* plant regeneration is a crucial part of genetic and molecular improvement strategies for various cereal and perennial grass species. Salinity tolerance was defined as the capability of whole plant survival under the salinity level of seawater. Salinity tolerance as a plant's ability to survive under seawater and attempted to identify gene sources as donors for this trait. The tolerance genes of the halophytes have not been fully investigated due to the lesser value of these mostly wild plants.

To identify salt tolerant genes in local grasses some local grasses were collected from coastal region of Khulna, Cox's Bazar and Satkhira district for taxonomical characterization and identification. The quantitative and qualitative characters of each collected samples were carefully studied, and they were recorded following standard herbarium techniques (Hyland, 1972) and consulting the experienced plant taxonomists of National Herbarium, Bangladesh and of the JU. Finally, they were matches with the respective voucher specimens housed at the Bangladesh National Herbarium; the JU Herbarium.; and modern floras and the official websites. To identification of salt tolerance gene from collected grass, total mRNA was extracted and cDNA synthesis was done using a commercial kit (Promega, USA). Ten potential target genes (JcERF011, OsSaIT, TaSc, TaNIP, OsHKT2, AtNHX1, NnGP, PvUGE1, PvMET1 and LcSAIN1) were selectedand a set of forward and reverse primer for each gene was designed for screening target genes in the sample. The PCR were optimized with initial denaturation at 95^0C for 5 minutes and 32-34 cycles of denaturation at 95^0 C for 30 sec., anneling at 49-58^0 C for 30sec to 2 min, extension at 72^0 C for 30 sec to 2 min and final extension at 72^0 C for 5 min.

For *in vitro* regeneration (initiation of callus, shoot, root and plant regeneration) of Napier cultivar, the explants of leaf roll, internodes and nodes were collected from BLRI field grown BLRI Napier-3 cultivar. After carefully removing the outer sheaths, the explants were surface sterilized in 25% Clorox and few drops of twin-twenty for twenty minutes in the laminar air flow chamber. These explants were cultured on MS (Murashige and Skoog, 1962) medium supplemented with 5% coconut

water and different levels & combination of 2, 4-D, NAA, BAP, IBA and TDZ. Each treatment consisted of 64-120 cultures. The culture was maintained in the growth chamber for 12-35 days.

The texonomical characteristics of three collected samples were found similar to *Paspalum vaginatum*, it's English name is Water-couch Grass and local name is Beju or Baksha. *Paspalum vaginatum* is a good fodder grass and a most efficient sand-binder, habited at tidal saline mud, beaches, and river banks near the coast, at low altitude and propagated by seeds and rooted tillers.

Ten sets of primer were used targeting ten different salt tolerant genes of JcERF011, OsSaIT, TaSc, TaNIP, OsHKT2, AtNHX1, NnGP, PvUGE1, PvMET1 and LcSAIN1. Figure 1 and 2 represents the detection of 1034 and 222 bpcDNA fragment from local Beju or Baksha grass (*Paspalum vaginatum*) collected from Khulna, Satkhira and Cox'sbazar area and samples amplified by primer set *PvUGE1and PvMET1,* respectively. In the figure (1) it is clear that primer set *PvUGE1* amplified two samples except Cox'sbazar sample. On the other hand primer set *PvMET1* amplified all three samples (Fig. 2).

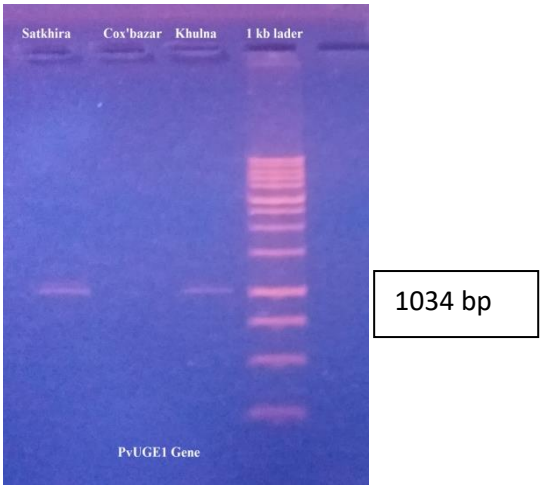

Figure 1

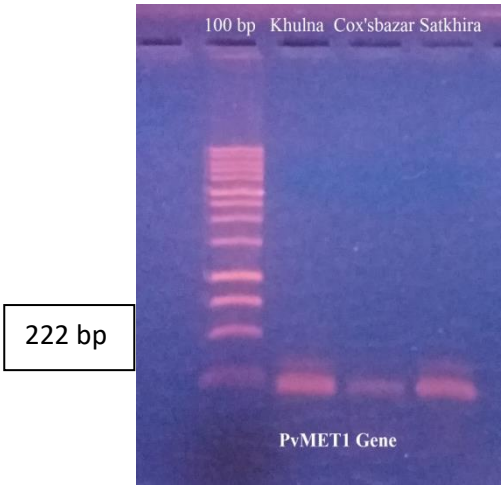

Figure 2

Suitable explants type for use in genetic transformation experiments, and further improve tissue culture procedures on MS agar nutrient media under different plant growth hormone supplementation was examined. Media supplemented with 2 mg L^{-1}2,4-D callus initiation was generally achieved 68 and 65% from leaf roll and inter node and 65 & 63% callus initiation from leaf roll and inter node at 2 mg L^{-1} 2, 4-D &NAA combination. As high as 68 & 64% both callus and root were initiated when leaf roll and inter nodes were cultured in MS medium with 1 mg L^{-1} 2, 4-D+NAA+ 5% coconut water. Shoots were initiation 56 & 62% from inter node and nodes at 2 mg L^{-1} NAA with MS medium. The MS medium containing 5% coconut water and 2 mg L^{-1} NAA gave the both root & shoots production of 60 & 68% from inter node and nodes, respectively. Treatments of nodes at 2 mg L^{-1} IBA roots initiation was 70% and shoots initiation from inter nodes was 60% at 2 mg L^{-1} TDZ. The callus of inter nodes derived from different concentrations of 2, 4-D was subcultured in media containing different concentrations of BAP. The highest percentage (55%) of shoot induction was observed when the concentration of BAP was 2 mg L^{-1}. Simple and reproducible tissue culture methods to regenerate Napier cultivar will help facilitate and enhance the efficiency of genetic transformation experiment. The MS medium containing 5% coconut water and 2 mg L^{-1} NAA gave the best responses for plant regeneration from inter node and nodes. The collected Beju or Baksha samples were similar to *Paspalum vaginatum.*Two salt tolerant genes *PvUGE1*and *PvMET1* were identified in Beju or Baksha grass and these two genes will be used for cloning and transformation in Napier cultivar through tissue culture.

Development of livestock community through intervention of BLRI developed suitable technologies in some selected areas of Sylhet region

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Executive Summary

Farming system research is an approach to agricultural research that views the whole farm as a system. It focuses on selecting targeted areas and farmer's problems as well as identifies the opportunities. Moreover, a design and executes on-farm research and evaluates the result of intervention. If technologies are not developed appropriately at the farmer's level, no other programs will boost up any significant effect. It is generally agreed that new practices and technologies introduced through farming systems research enhanced agricultural production. Livestock at the hilly and haor area of sylhet region is no doubt a promising treasure of Bangladesh but is going to be extinct because of lack of problem based adaptation of new technology and systematic farming system**.** The present study was planned towards reducing morbidity and mortality of animals and birds through routine vaccination and proper medication, awareness build-up for technology adaption and increasing productivity of existing stocks under subsistence farming conditions through technological interventions and livelihood improvement of livestock community. The project is taken for three years with the major following activities i) baselines survey ii) farmers training iii) technology intervention, monitoring and advisory services, and iv) impact study. The baseline survey and farmers training programme was completed in this year. A total of 200 respondents from two upazilas namely Balaganj and Jaintapur of sylhet region were randomly selected and interviewed towards collection of information through pretested questionnaire. Data were collected through face to face interviewing of every family head in the village. A focus group discussion was also carried out to supplement the survey data. The base line survey was completed to assess the asset possession status, identifying existing livestock species with level of productivity, find out feed situation and disease occurrence, and to know the constraints faced by farmers. After completing the base line survey, one hundred beneficiaries were selected randomly from two upazillas (50 from each upazilla) and were given training and demonstration of activities for creating awareness for technology adoption. Collected data was analyzed in accordance with the objectives of the study. Mean, standard deviation and percentage were used mainly to illustrate the results. Simple statistical tools were applied for analysis of gathered data.

The profile of the community farm and farmers are summarized in the table-1. The result of survey showed that the average family size was larger for Jaintapur (7.53) and smaller for Balaganj (6.85) which was the higher than the national average of 4.53(HIES, 2010), but opposite situation was got in earning member of the family. Livestock based community farming is a skill based enterprise and it requires some education to manage the enterprise in a well-tuned manner. But the result of surveyed showed that the one third of the total population of the village were illiterate, however most of the farmers (36%) were having primary education. But the education level did not differ significantly among the location. Agri-based occupation was higher in Balaganj (91.02) than in Jaintapur (77.32) and it differed significantly ($P< 0.01$) but other occupation did not differ among the locations. On the other hand, farmer's experience of livestock keeping differed significantly ($P< 0.05$) but tethering system, extensive, semi-extensive system of livestock rearing differed significantly ($P< 0.01$). It was revealed that livestock dominated farming systems were the common scenario of resource-constrained farming community. The dwelling houses along with homestead land differed significantly ($P< 0.01$) and cultivable land, pond, and vegetable land also differed significantly ($P< 0.05$), but other remaining land categories did not differ among locations. Table 2 shows existing livestock production and acute problems of farmers. The result revealed that the production performance of livestock species were poor due to lack of awareness and inadequate feed and fodder along with poor genetic make-up and incidence of diseases. The most of the farmers in these study areas reported the problem of availability of feeds and fodder, disease and lack of technology for

livestock production. However, the acute shortage and low quality of feeds and fodder is one of the single most important obstacles to livestock development in Sylhet region and also a lack of economic technology for optimum utilization of local feed resources. High and very low land mainly exists in study area which remains unused.

Table1. Farm and family information of the community farmers

Parameters	Location		P value	Sig. level	Parameter	Location		P value	Sig. level
	Jaintapur	Balaganj				Jaintapur	Balaganj		
Family size (no./farmer)	7.53±0.39	6.85±0.38	0.20	NS	Occupation (%)				
Age (Years)	43.0±1.5	43.2±1.4	0.89	NS	Agriculture	77.3±4.2	91.0±4.1	0.01	**
Male((<18yrs)	1.7±0.1	1.4±0.1	0.13	NS	Labor	4.1±2.2	3.9±1.2	0.94	NS
Female((<18yrs)	1.5±0.1	1.4±0.1	0.31	NS	Employment	2.7±1.6	1.3±1.5	0.53	NS
Male (>18yrs)	2.3±0.2	2.0±0.2	0.34	NS	Business	11.3±2.4	15.1±1.1	0.61	NS
Female(>18yrs)	2.1±0.2	2.1±0.2	0.98	NS	Livestock	43.8±2.2	45.0±2.3	0.51	NS
Earning member	1.7±1.2	2.9±0.9	0.43	NS	Fishery	2.5±2.5	3.5	0.71	NS
Education (%)					Livestock rearing (%)				
Illiterate	22.5±4.6	20.0±4.6	0.70	NS	Tethering	10.0±0.5	87.5±0.5	0.01	**
Can sign only	11.3±3.9	17.5±3.9	0.26	NS	Extensive	63.8±0.1	10.0±0.1	0.01	**
Up to Primary	36.3±5.3	36.3±5.3	0.74	NS	Semi-extensive	36.3±0.1	90.0±0.1	0.01	**
Upto high school	20.0±4.5	20.0±4.5	1.00	NS	Livestock keeping experience(Years)	19.0±1.3	14.5±1.3	0.01	*
Up to SSC	10.0±2.6	5.0±2.6	0.23	NS	Land distribution				
Up to HSC	0.0±0.8	12.5±0.8	0.31	NS	Land size (dcm./Farn)	185.6±33.4	223.7±32.8	0.41	NS
Livestock population (no/house)					Homestead	52.1±6.3	18.7±6.2	0.00	**
Native cattle	3.3±0.3	4.1±0.4	0.09	NS	Cultivable land	110.3±27.7	192.7±27.3	0.03	*
Crossbred cattle	0.1±0.0	0.0±0.1	0.05	*	Pond	2.31±1.2	6.0±1.2	0.04	*
Buffalo	0.2±0.1	0.2±0.1	0.99	NS	Vegetable land	2.64±1.62	5.83±1.60	0.16	*
Goat	1.6±0.3	1.3±0.6	0.57	NS	Livestock farm	0.51±0.31	0.4±0.31	0.84	NS
Sheep	0.1±0.1	0.1±0.1	0.66	NS	Fodder	6.82±3.76	0.0±0	0.20	NS
Chicken	9.0±1.1	5.5±1.5	0.05	*	Fellow	10.2±6.0	0.6±5.9	0.26	NS
Duck	2.2±1.1	5.0±1.5	0.13	NS	Annual income (thousand taka)	114.3±8.9	115.7±8.9	0.91	NS

*** Significant at 0.1% level (P< 0.001), ** Significant at 1% level (P< 0.01),
* Significant at 5% level (P< 0.05), NS= Non significant (P> 0.05)

Table 2: Livestock production and Acute Problems of farmers

Study Area	Acute Problems				Production Parameters				
	Feed	Treatment	Lack of technology	Training	Milking cow (no/f)	Milk prod. (l/a/d)	Lactation period (d)	Milk prod./Lac.	Calf prod./y
Jointapur	1.0±0.0	1.0±0.0	1.0±0.0	0.5±0.1	1. 5±0.9	1.4±0.4	183.3±3.5	256.6±0.3	1.2±0.3
Balagonj	1.0±0.0	1.0±0.0	1.0±0.0	0.5±0.1	1.7±0.9	1.6±0.3	1.8±3.5	284.8±0.4	1.2±0.3

If we take proper measures through the project to solve these problems, such problems will be minimized and the overall farming situation will be improved. It can be concluded that a sustainable community may be developed through suitable livestock and poultry technology intervention, training for awareness and monitoring and technical support in selected areas which will lead increase in farmer's income and ultimately will reduce poverty and improve their livelihood.

Livelihood improvement of rural farmers through suitable livestock and poultry Technology Dissemination in Selected Hilly Areas of Bangladesh

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Executive Summary

The term livelihood refers to a means of earning a living by an individual or household that is a combination of the individual or household's assets, including activities and resources and access to these. Hill Tracts region is dominated by different types of tribal people. Majorities of the tribal people live in the hilly forests with primitive ways of life and practice traditional agriculture which predominantly integrated farming system including crop production under shifting cultivation together with homestead garden, livestock, horticulture and forest trees (Alam*et. al*., 1993). One of the constraints to livestock development is the lack of proven farmer's adapted technologies. Higher adoption of technologies ensures increased food and nutrition security and improve total livelihood of the farmers. It is important to assess the impact of agricultural practices on sustainable rural livelihoods, especially in developing countries like Bangladesh. Thus, the project is approved for three years with the objectives; to develop the integrated component technologies (livestock, poultry and fodder) for improving farm practices, to disseminate the livestock technologies and to asses' impact of technological interventions. A baseline survey, farmers training programme and some input supply was completed in this year. To fulfill the above objectives, a detailed baseline survey was carried out in different parts of the selected hilly areas namely: Adarshogram village under Naikhongchari upazilla of Bandarban district and Tulatuli village under Ramu upazilla of Cox's Bazar districts. Data were collected from 100 farmers of each village through face to face interviewing with a structured questionnaire on farmers knowledge regarding livestock (cattle, goat and sheep) and poultry (chicken, duck and pigeon) rearing. After completing the baseline survey, one hundred beneficiaries were selected randomly from two villages (50 from Adarshogram and 50 from Tulatuli) and were given training and demonstration of activities for creating awareness for technology adoption. Twelve service providers were also imparted training on the use of improved livestock and poultry production technology, modern management and health care techniques to serve the community farmers. Fodder cutting distribution, mass vaccination and deworming of all cattle, goat, sheep, chicken and duck of all households in the selected villages were done as per schedule. Required anthelmintics were also provided when needed by farmers. It was revealed that on average, Adarshogram had a higher family size (6.23) than Tulatuli village (5.21) and both figure were higher than the national average 4.90(BBS, 2012). Education must be required for livestock based community farming but the surveyed result showed that, on average, 52.48% and 41.41 % farmers were illiterate in Adarshogram and Tulatuli which is the major constraint to technology adaptation. Number of livestock species in each farm family is very small. The distribution pattern of total existing livestock population were 4.74%,1.31%, 6.30% , 87.53% and 4.64%, 0.01%, 12.00%, 83.26% for goat, sheep, cattle, and poultry in Adarshogram and Tulatuli respectively and most of them were indigenous type. Average farm size was higher in Tulatuli (170.35dcm) than Adarshogram (125.00dcm) whereas 113.09dcm and 100.75dcm were their ownership. About 17.77 % of the total land was occupied by dwelling houses along with homestead garden, 22.09% engaged by crop production, 0.48% by pond, 0.07% by farm and 48.11% remained fallow in Adarshogram. On the other hand, in Tulatuli, these percentages were 16.54%, 48.77%, 2.53%, 0.06% and 32.62% for homestead area, crop production, pond, farm and fallow, respectively. There are different types of diseases identified in both locations. Foot and Mouth Disease (FMD) is the most widely spread livestock disease affecting health and productivity of cattle. About 13% and 24% cattle were affected by FMD and 72% and 74% cattle were affected by warm in Adarshogram and Tulatuli village respectively. On the other hand, PPR and pneumonia is the major issues affecting goat heath and productivity. ND is the most common disease causing massive loss of chicken followed by pox and coccidiosis in study area where as 42.42% and 71.28% chicken were affected by ND in Adarshogram and Tulatuli village, respectively. About 21.78%, 12.87% and 49.49%, 41.41% farmers of

Adarshogram and Tulatuli village were provided anthelmintics and vaccine for their animals and birds respectively. The most of the birds were affected in rainy season. Table 1 reveals the household income and returns of selected farmers in study areas. The income sources were not the same for all selected farmers. They had multi-source to generate income and maintain their livelihood. The annual income sources are broadly divided into two categories such as farm and non- farm income. Farmers of this study area were involved in agriculture, fishery, livestock, labor selling, rickshaw pulling, small trading and pretty business. Table 1 shows that contribution of crop farming (Tk.34114.02) and labor selling (Tk.44642.57)was the highest to their farm income and non-farm income, respectively among the others income source. It was revealed that, on average, non-farm income (Tk.136929.44)was higher than farm income (Tk.50632.15) in the study area. The gross income per farm per year was higher (Tk. 204739.37) in Tulatuli than Adarshogram (Tk. 170383.74) but net income was in opposite direction. The Benefit Cost Ratio (BCR) was higher (1.16) in Adarshogram than in Tulatuli (1.10). The surveyed result indicated that production performance of livestock species were very poor due to inadequate feed and fodder along with poor genetic make-up and incidence of diseases. The study found out farmers facing some problems; such as, disease outbreak, low productivity of animal, modern technology intervention, and awareness of the farmers. If we can overcome such type of constraints through suitable Livestock and Poultry technology intervention in selected Hilly areas, we will get higher return from community. It was observed that farmer's awareness for technology through training was gaining tremendously. So, it may be concluded that, dissemination/intervention of suitable livestock and poultry technology in a selected area is one of the effective way for income generation and employment creation to develop sustainable community which will ultimately reduce poverty and improve their livelihood.

Table 1: Annual cost and Returns of community farmers in study area

Particulars	Study area		Average
	Adarshogram	Tulatuli	
a) Income Source			
Crop farming	17662.37	50565.66	34114.02
Fishery	-	959.59	-
Livestock	11735.24	20341.41	16038.33
Service	45782.17	38488.88	42135.53
Business	28304.95	33535.35	30920.15
Labor selling	52285.14	37000.00	44642.57
Rickshaw/van pulling	14613.86	23848.48	19231.17
Farm income	29397.62	71866.66	50632.15
Non-farm income	140986.14	132872.73	136929.44
b) Gross income	170383.74	204739.37	187561.56
c) Total cost	146518.51	186819.90	166669.21
d) Net Income	23865.23	17919.47	20892.35
e) BCR	1.16	1.10	1.13

Value chain analysis of milk and comparative advantage of milk production in Bangladesh

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Executive Summary

In fiscal year 2014-15, total milk production was 69.70 lakh metric tons whereas demand for milk was 144.81 lakh metric tons. Per capita milk availability is 122 ml/day and deficit is 75.11 lakh metric tons. There is a huge gap between demand for milk and supply of milk. Sufficient milk production and its marketing need proper attention to minimize the gap. The objectives of the study are to estimate profitability of milk production, to determine value addition at different levels of milk marketing by the market actors and to measure the comparative advantage of milk production. This research was performed with the collaboration of BLRI, BARI and BAU. Study areas were selected from three districts namely Panchagarh, Chittagong and Sylhet, purposively considering the representative of normal milk available area, milk pocket area and milk deficit area. From each district at least two Upazilas were selected on the basis of desired data requirement. The selected Upazilas were Tetulia and Debiganj under Panchagarh district, Anwara and Patiya under Chittagong district and Jaintiapur and Gowainghat under Sylhet district. Selected samples were consisted of 300 farmers and 90 traders (market actors). The total sample size was 390. In this study, we selected those farmers who reared dairy cattle for their livelihood and the traders who had supplied fresh milk and milk made products to the consumers. Simple random sampling technique was followed for selecting the respondents. Field survey method was followed to collect primary data from January/2016 to March/2016. To get the meaningful results profitability analysis, marketing system, calculation of marketing margin and net margin of value chain actors and policy analysis matrix (PAM) were adopted.

The study reveals that the production cost of milk for cross-bred cattle was estimated BDT 43,673/ ton where variable cost was BDT 41,381/ ton and fixed cost was BDT 2,291/ton. In variable cost items, human labour occupied the highest (16953/ton). Per ton net return was estimated for cross-bred cattle BDT 2,543. Average gross margin and net margin per 100 liters of milk for milkmen was estimated BDT 5,479 and BDT 969, respectively. In the case of sweet seller, average gross margin and net margin per 100 liters of milk (equivalent to 67 kg sweets) were estimated BDT 11,888 and BDT 4,875, respectively. Tea sellers` average gross margin and net margin was also estimated BDT 12,537 and BDT 6,194, respectively in the study areas. Value addition among the milk value chain actors in the selected areas was estimated in this study. It is observed that the all value chain actors i.e. milkmen, sweet seller and tea seller added different types of value. On average, milkmen added value 29%, sweet seller 150% and tea seller 175%.

To know the state of art of government policy incentives situation and to evaluate these government policies, the policy analysis matrix is very much helpful. In Table 1, we see the tradable and non-tradable input costs at private price are BDT 23594.5 and BDT 36949 per lactation, respectively. On the other hand, at social price the subsequent costs are BDT 24232.5 and BDT 40004.2, respectively. The private profit per lactation period of fresh milk (raw milk) production is BDT 43094.5 which is greater than zero (0) indicates the supernormal returns and possible expansion of milk production in future, unless the per lactation milk production cannot be increased or substitutions are more profitable at private price. This also indicates that existing input and output prices, technologies, and government policies leads to the profitable milk production in Bangladesh. On the other hand, social profit of milk production is BDT 7108.41 per lactation which is also greater than zero. This value point out that milk production under free trade will be in favour of producers compared to existing situations. Thus, Bangladesh has a static comparative advantage of domestic milk production for import substitution and it uses scarce resources efficiently.

The table also shows different policy transfer or divergences such as output, input, factor and net policy transfers. It is evident that output transfer (difference between private revenue and social revenue) is 32292.89. The value is positive which indicates that government protective policies affect positively to the producer incentives. The input transfer (difference between private and social price of tradable inputs) is -638 which is also negative. The negative value illustrates that the domestic producer buy the imported inputs less than the world price for milk production. Thus the government has implemented input subsidy policy to the livestock sector to decrease cost of production. Therefore producer receives input subsidies for milk production in Bangladesh. The factor transfer (difference between private and social price of non-tradable inputs) is -3055.2 which is negative. The negative value shows the opportunity costs of non-tradable inputs are higher than their market prices. On the other hand, the net policy transfers (difference between private and social profit or social revenue minus social cost of tradable and not tradable inputs) is 35986.08 which is positive. This positive value means that milk producer could earn less profit (or high loss) without government intervention. That means under free trade producer will make less profit contrast to the existing policy situation. It can be concluded that milk producers earn high profit under current government policy orientation (Table 1).

Table 1. Policy analysis matrix for fresh milk (cross-bred) per lactation period in Bangladesh

Items	Revenue	Costs		Profit
		Tradable inputs	Domestic factors	
Private prices	103638	23594.5	36949	43094.5
Social prices	71345.1134	24232.5	40004.2	7108.41
Divergences	32292.8866	-638	-3055.2	35986.08

Source: Own estimation

In the study NPCO value under import parity were found to be greater than one (>1) for fresh milk (cross-bred). This indicates that polices of fresh milk provide nominal protection for the producers. NPCI's value was found to be less than 1 (<1) for fresh milk of import parity price suggesting that the government policy are marginally reducing import cost and average market price of input just keeping the world price. NPCI values of less than 1(<1) clearly indicate that government has been providing marginal support to the milk sector. In addition, the study also estimated EPC (Effective protection coefficient) which is better indicator of effective incentive than the NPC, as it finds the impact of production on inputs and outputs, and depicts the degree of protection according to the value addition process in the production activity. The values of EPC were found to be greater than 1 (EPC>1) for fresh milk (cross-bred), implying that government polices provides positive incentives to the produces. The result of DRC calculation has been done on import parity prices. These depend actually on the tradability status on commodity. The value of the DRC estimation revealed that Bangladesh had a comparative advantage for import substitution of fresh milk as on DRC values were less than 1 (<1). In other words, government policy could save foreign exchange by producing fresh milk domestically. This is because the opportunity cost of domestic resources and non- traded inputs use in producing milk is less than (<) foreign exchange saved. The SCB (social cost benefit) is less than one, it indicates that the benefit of government policy of protection is the higher than the cost of protection. Estimated profitability is greater than 1 (>1) indicates that the private profit is higher than the social profit. The policy benefits are in favour of producers (Table 2).

Table 2. Different indictors of protection and comparative advantage

Items	Unit	Value
NPCO = Nominal Protection co-efficient (subsidies to output)	Ratio	1.45
NPCI = Nominal Protection co-efficient (subsidies to inputs level)	Ratio	0.97
EPC = Effective protection co-efficient	Ratio	1.70
DRC = Domestic Resource Cost	Ratio	0.84
SCB = Social Cost Benefit	Ratio	0.90
PC = Profitability co-efficient	Ratio	1.20

Source: Own estimation.

Economic Evaluation of Buffalo Production in Selected Regions of Bangladesh

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Executive Summary

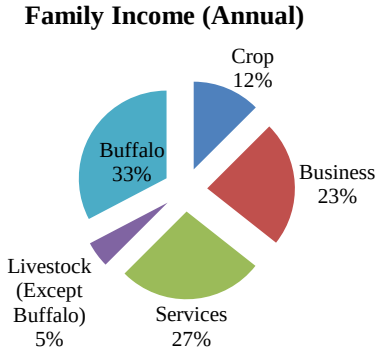
Bangladesh is primarily depending on production of crops, livestock and fisheries. The livestock sub-sector contributes 1.78% to the GDP. In FY 2014-15, the livestock population was 539.72 lakh (ruminant) whereas the number of buffalo was 14.64 lakh. Buffalo is called 'Black gold' and next to cattle as a major source of draft power, milk, meat, hides and skin etc. But very few studies have yet been conducted on socioeconomic status of the buffalo rearing, costs involved in raising buffalo and so on. So, the present study was attempted to examine the different socioeconomic factors related with buffalo production. The objectives of the study were as: to identify the socioeconomic profile of the buffalo keeping farmers, to estimate the income from buffalo and its contribution to farm income and to suggest policy implications is rising from the findings. This research was performed with the collaboration of buffalo development project (component-B) and Socioeconomic Research Division, BLRI. To achieve the objectives of the study 10 (ten) districts namely: Mymensingh, Jamalpur, Moulovibazar, Bhola, Potuakhali, Noakhali, Laxmipur, Chittagong, Tangail and Sirajgong were selected. Then 01 (one) Upazila from each district was selected purposively on the basis of buffalo population and project implementation areas. A total of 500 (50 from each district) buffalo farmers were interviewed following simple random sampling technique. Data were collected in the mentioned regions during the month of January 2016 to April 2016. Data were analyzed using Statistical Package for Social Sciences (SPSS) and STATA software tools. In this study, 'logit model' was estimated using binary dependent variable. Study revealed that the classified age groups of the buffalo farmers were up to 30 years, 31-45 years, 46-60 and above 60 years. The highest per cent of farmers were in age group 31-45 years indicating that farmers were mature and strong enough to give more labour to their farming activities. On average, 85 per cent buffalo farmers were engaged purely in agriculture as primary occupation. Besides, few per cent of buffalo farmers had business and service as primary occupation. On the other hand, 46 per cent buffalo farmers had taken business as secondary occupation. It is evident that the highest (47 per cent) farmers were in primary level education followed by illiterate, SSC, HSC and Degree. The study found that about 53 per cent buffalo farmers had above 15 years of experience of rearing buffalo. It also revealed that average farm size was 1.05 hectare indicating that the farmers were belonged to small and medium category and average family size in the study area was 6.17 persons per family which was slightly higher than the national average. Dependency ratio was also estimated to 1.05.

The cost items involved in the production chain for milking buffalo rearing were human labour, feed cost, medicine, vaccination, insemination, various equipment and housing etc. Cash expenditure and imputed value of family supplied inputs were also included in this computation. Human labour was one of the prime cost factors in milking buffalo rearing in the study areas. Study found that per lactation labour cost was BDT 13,913 followed by feed cost that was BDT 10,063. Per lactation total cost was BDT 24,507, whereas variable cost was BDT 24,249 and fixed cost was BDT 258. From the study, it is estimated that average lactation period was 255 days in the areas. Average milk production was estimated 2 litres/ day. The highest return from milk production was BDT 27,189. The gross return was estimated to BDT 32,114 / lactation. The net return was calculated BDT 7,865. The BCR was 1.31(full cost basis) in the study areas.

It was found from the study that about 64 per cent farmers opined they had artificial insemination (AI) facilities and for that they had to pay about BDT 540 for first time insemination service. The average distance was 8.81 kilometre from the farmers house to AI centre. Seventy per cent farmers in the study areas vaccinated their buffaloes where 66 per cent farmers provided vaccination for FMD disease and only 24 per cent farmers had done vaccination for Black quarter (BQ). Ninety eight per cent farmers feed colostrum to the new born buffalo calves indicating that nowadays farmers are aware of the catering of new born calves. In the study areas, almost 90 per cent

farmers had done D-warming for their buffaloes. On the other hand, 78 per cent farmer showed positive opinion towards good medical services from the Upazila Livestock Hospital. From the study, it was found that buffalo population was highest (64.24/ farm) in Ramgoti Upazila under Laxmipur district and lowest (2.3/ farm) in Haluaghat Upazila under Mymensingh district. Average number of buffalo per farm was found 18.91.

Buffalo farmers had various income sources in the study areas. Among the income sources farming (crop production), service, business, livestock (except buffalo), and buffalo rearing were the major sources. The highest (33%) family income was derived from buffalo rearing followed by service, business, farming and livestock (except buffalo).



To investigate the determinants of participation in buffalo development program, binary logistic regression analysis was adopted. Logistic regression analysis was used when the dependent variable (farmer type) was dummy. In this study, "Binary logistic model' was used applying binary dependent variable i.e., value is given one (1) for those household who had under buffalo development project otherwise zero (0). The independent variables were age, education, family size, occupation, experience, farm size, number of buffalo in the household, distance from AI centre, household income, AI facility and number of death buffalo. It was predicted that age, education, farm size, occupation, experience, household income, AI facilities, number of death buffalo and number of buffalo in the household might have positive influence to come under buffalo development project. Similarly, it was hypothesized that distance from AI centre and larger family size might negatively influence in participation of buffalo development program. It is apparent from the value of coefficient that most of the prediction was justified and statistically significant except experience, number of buffalo, AI facility and number of death buffalo. On the other hand, the households those were far away from AI centre participated less in the buffalo development program than that of nearby households which was found statistically non-significant (Table 1). So, it can be concluded that participation of buffalo development program was helpful and necessary for the buffalo farmers.

Table 1: Determinants of participation in buffalo development project

Independent variables	Coefficients	Standard error	P-value
Age	0.017	0.013	0.190
Education	0.015	0.043	0.713
Family size	-0.011	0.053	0.829
Occupation	0.404	0.484	0.404
Experience	-0.009	0.011	0.434
Farm size	0.323*	0.194	0.097
Number of buffalo	-0.028***	0.009	0.003
Distance from AI centre	-0.003	0.040	0.935
HH income	0.000***	2.44e	0.000
AI facilities	-0.043	0.289	0.880
Number of death buffalo	-0.142**	0.070	0.041
Constant	-2.762***	0.862	0.001

***, ** and * stands for significant at 1%, 5% and 10% level.

Buffalo rearing is a profitable enterprise. In the study areas, buffalo farmers faced some problems such as lack of food especially during flood, deficiency of quality seed for A.I service, unavailable water supply during dry season, financial crisis, lack of hybrid and improved quality fodder etc. To overcome those problems the buffalo farmers sought some assistance e.g. training on scientific and proper management of buffalo and for health treatment they expected the service of mobile medical team.

Modification of grain feeding by hydroponic sprout for increasing production of ruminants

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Executive Summary

Green grass plays an important role for lactating animals to increase milk production and proper health management. Population of Bangladesh is increasing rapidly and land is decreasing. So in future it is difficult to cultivate grasses for animal feeding. Considering this fact present study was conducted to developed sustainable, farmer friendly, mold free hydrophonic grass production technique using locally available grain and to conduct a baseline study of hydrophonic grass production. The experiment was conducted in BLRI biotechnology lab. Local maize, Hybrid Maize and Black gram seed (≥85% germination) were collected and sundried for 24 hours. After sundry seeds were disinfected by proper disinfected solution for 30 minutes and 0.60 kg seed were transfers into 2.52 sq. feet tray with three replications. Then the trays were placed into an incubator (average 21.40˚C temperature and 77.07% relative humidity) for first 3 days. In the 3rd day all germinated spout were disinfected again by proper disinfected solution and were harvested on 8thday. Proximate analysis was performed on BLRI nutrition laboratory and data was analysis by SPSS 20 software.

Table 1. Yield, nutrient and botanical characteristics of hydroponic sprout

Parameter	Local Maize	Hybrid Maize	Black gram	Sig
Biomass yield after 8 days(kg)	1.8±0.57	1.5±0.57	3.62±0.57	**
Harvested non germinated seed weight (kg)	0.17±0.02	0.28±0.02	0.02±0.58	**
DM (%) contain whole spout	21.34±0.58	25.42±0.58	7.89±0.58	**
CP (%) contain whole spout	4.74±0.57	8.04±0.57	26.34±0.57	**
DM loss (%)	29.63	32.14	44.23	
CP gain (%)	50	58	86	
Average number of root	2.07±0.07	2.00±0.00	2.06±0.06	NS
Average sought length (cm)	2.53±0.29	2.88±0.12	4.12±0.12	**
Average root length (cm)	2.03±0.03	0.95±0.05	0.93±0.07	**

This was the initial work of this project. From the above experiment it can be concluded that along with local and hybrid maize Black gram (Leguminous fodder) can grow using this technique and Black gram poses the highest CP gain (86%) comparison to other. Dung et al. (2010) found that crude protein, ash and all other minerals except potassium were higher in concentration on a DM basis on barley sprouts. Morgan, Hunter & O'Haire (2002) also reported that CP was increased due partly to the absorption of nitrogen from the nutrients solution and to the concentration of nitrogenous compounds in a reduced mass of DM. Hybrid maize is Better than local maize in terms of CP contain. It is ongoing project. In the next year in vitro digestibility, Yeast and mold count, Vitamin E and Flavonoid analysis will be performed.

Performance evaluation of Murrahx Local F_1 crossbred and production of Nili-Ravi x Local F_1 crossbred buffaloes in Bangladesh

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Executive Summary

The buffalo is an important livestock resource in several countries and the contribution of buffalo to the Asian economy is considerable by way of milk, meat and draught power production and as a source of security that requires minimum inputs. The domesticated buffaloes in Asia, representing 95 percent of the world buffalo population, are broadly grouped as the river and swamp types. The buffalo in Bangladesh are distributed scatterly throughout the country and are concentrated in the sugarcane belt of northern Bangladesh, Brahmaputra-Jamuna flood plain of central Bangladesh, and in the Ganges-Meghna flood plain of southern Bangladesh. Buffalo shares about 2.0% and 0.94% of total domestic milk and meat, respectively. Contribution of buffalo on national red meat production is also very low (2.06%).This negligible share of buffalo to domestic milk and meat production is associated with their low production potential. In Bangladesh, the average lactation yield of indigenous buffalo is 500-700 liters per 270 days lactation period. However, the average yield of exotic high yielding buffalo breed in the world is 2000-2500 liters. Pakistani Nili-Ravi and Indian Murrah buffaloes were widely used to increase dairy characteristics of local buffalo population in Indo-Chinese Region and South America through crossbreeding. These crossbreeding programmes resulted increase in lactation milk yield from 700 to 2,000 kg per year in China. Considering above facts, the government has been taken "Buffalo Development Project" to improve the genetic potentiality of local buffalo breeds for increasing their milk and meat production through crossing Local buffalo with high yielding exotic Murrah buffalo breed. The project is implementing in 39 upazillas of 13 districts in Bangladesh. To achieve the target project goal, Murrah buffalo semen has been imported and crossbreeding is conducting in the project areas since last three years. By this time, a number of Murrah x Local crossbred buffalo calves were born and are rearing at farmer's houses. The adaptability of these crossbred buffaloes to our farmer's condition is needed to be evaluated. For this purpose, the performance of Murrah x Local crossbred buffaloes in terms of their growth, milk yield, reproduction and disease characteristics are evaluated at farmer's condition and at on-station. Moreover, BLRI received 200 doses of progeny tested Nili-Ravi semen from Pakistan. Pakistan donated Nili-Ravi semen into five SAARC member countries including Bangladesh through SAARC Agriculture Center (SAC) to increase genetic makeup of indigenous buffalo of member countries through crossbreeding with Nili-Ravi buffalo. The objective of the project is to evaluate performance of Murrah x Local (F_1) crossbred buffalo in Bangladesh and to produce Nili-Ravi x Local F_1 crossbred buffaloes in Bangladesh and to select best estrus synchronization protocols for buffalo. Successful implementation of this research develop database regarding adaptability of Murrah x Local (F_1) crossbred buffalo. Moreover, a numbers of Nili-Ravi x Local (F_1) crossbred calves will be available in the country after completion of this research programme. The propose of research outputs will help to take successive research programmes i) to select exotic buffalo breed(s) suitable for crossbreeding in Bangladesh and ii) to develop synthetic high yielding buffalo breed in Bangladesh through two-way or three-way crossbreeding. To select best suited estrus synchronization protocol for buffalo in Bangladesh, four previously used ES protocols were tested (Figure 1). Three reproductively sound indigenous buffalo cows were belonged to each treatment group. After first trial, the treatment 3 was replicated to 15 buffalo cows at BLRI and 15 at buffalo cows/heifers at Godagari upazilla of Rajshahi district. AI were performed twice in the morning and evening after estrus detection at BLRI and once at Godagari. Body weight at different stages was recorded on Murrah x Local (F_1) crossbred buffalo calves born from artificial insemination (AI) done by the Department of Livestock Services (DLS).The DLS is conducting AI in Local buffalo with Mediterranean Murrah Buffalo semen collected under Buffalo Development Project since last three years. A number of Murrah x Local (F_1) crossbred calves were born in last year and some pregnant buffaloes are approaching their delivery date. However, 3 Murrah x Local (F_1) crossbred and 4 Nili-Ravi x Local (F_1) crossbred calves were

born at BLRI Buffalo Research Farm. Body weight of 9 Murrah x Local (F_1) crossbred buffaloes at birth, 1, 3, 6 and 12 months were monitored at on-farm and on-station conditions. Disease incidences in Murrah x Local (F_1) crossbred buffaloes were also recording regularly. Results showed that all four protocols of estrus synchronization were capable to synchronized estrus in buffalo cows/heifer (Table 1). However, conception rates were higher in treatment 3 (38.89%). Over all conception rates were 34.72%.

Table 1. Responses upon estrus synchronization in buffaloes

Treatment	Cow numbers	Estrus observed (%)	Conception rate %)
1	3	100	33.33
2	3	100	33.33
3	18	100	38.89
4	3	100	33.33
Overall	27	100	34.72

The average weight at birth, 1-month, 3-month, 6-month and 12-month age of Murrah x Local (F_1) crossbred buffaloes were 27.23±1.20; 50.89±0.98; 84.5±1.70, 125.0±3.88kg and 209.6±4.15 kg, respectively. On the other hand, weight at birth, 1-month, 6-month and 12-month for on farm and on station were 30.0±2.08 and 25.83±1.19 kg; 52.33±2.60 and 50.17±0.79 kg; 86.0±2.31 and 83.6±2.44 kg; 120.0±9.45 and 128.0±2.97kg and 217.05±6.5 and 204.33±2.9 kg, respectively. This study concluded that any of the tested estrus synchronization protocol may be used for estrus synchronization in buffaloes and crossbred calves are growing normally.

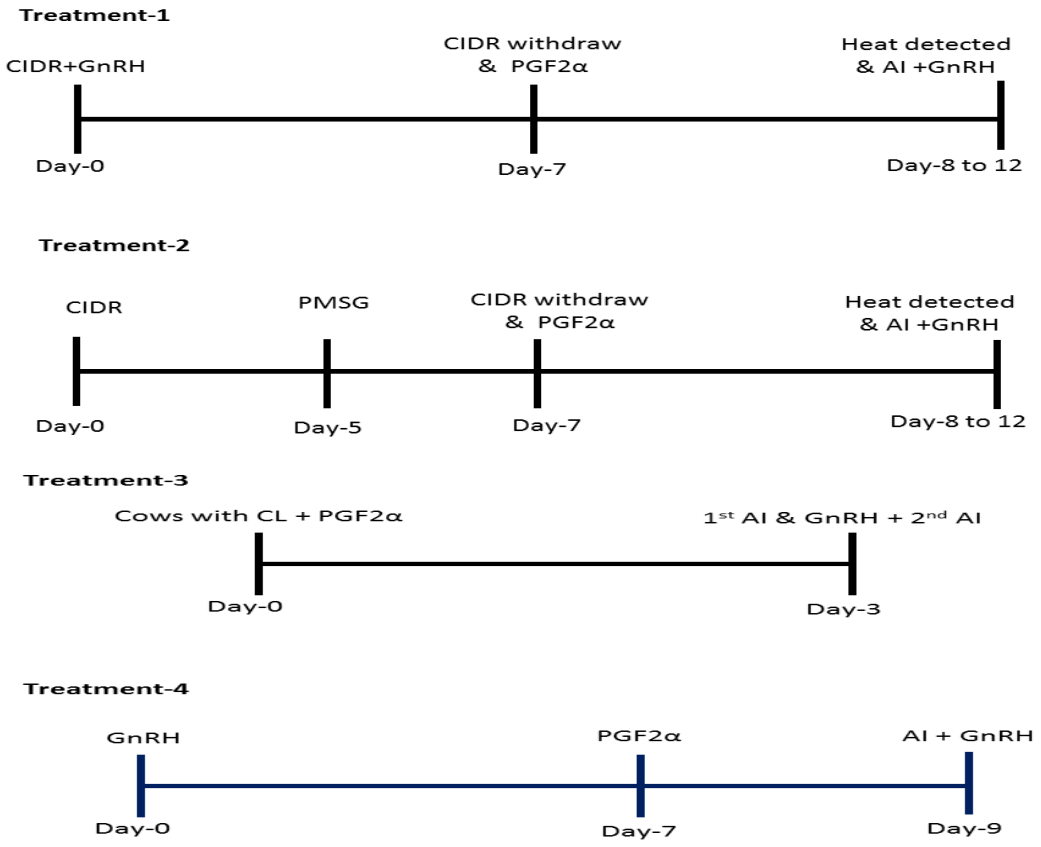

Figure1. Estrus synchronization protocols tested in buffalo

Phenotypic characteristics of buffalo in selected regions of Bangladesh

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Executive Summary

Buffaloes are the second largest source of milk production in Bangladesh and most of the buffaloes are considered as non-descriptive indigenous type. They produce higher total solid and fat in milk. Buffaloes are observed scatterly throughout the country. But their concentrations are higher in the coastal areas. The farmers and government in the recent past are showing interest to utilize the native species to increase milk and meat supply for human consumption and to alleviate poverty through creation of employment. However, commercial utilization of buffaloes is limited due to their poor production and reproduction efficiency. In Bangladesh, a limited research work has been done on characterization of buffalo and there is no clear indication about buffalo breeds available in Bangladesh. For improvement of any species, characterization is the first and foremost priority. Therefore, performance of undocumented indigenous buffalo of Bangladesh needs to be evaluated and focused globally. Considering the above facts, the present investigation was designed to categorize buffalo population into different breeds considering their phenotypic characteristics. This experiment was conducted under financial support from Buffalo Development Project (Component-B). According to International Livestock Research Institute recommendation, on an average 30% of primary level, 17% of secondary level and 4% at household level were considered for sampling purpose. Therefore, 58 upazillas under 32 different districts have been selected for the primary data collection on different phenotypic traits and population of buffaloes. A questionnaire has been developed and pre-tested before final survey for this study. However, during this study, survey has been conducted in seven upazillas under five districts. Buffalo were categorized into different breeds considering their phenotypic characteristics (coat color, horn pattern, white marking, head shape, and body size). Phenotypic data were collected on 362 buffaloes (90 males and 272 females) from Bokshigonj and Mathergonj upazillas of Jamalpur, Tetulia upazilla of Panchogor, Pirgonj upazillas of Rangpur, Komolgonj and Rajanagor upazillas of Moulovibazar and Sandip upazilla of Chittagong districts. A total of 254 households were surveyed during this study period. Percentages of buffalo belonged to different coat color, horn pattern, white marking, head shape, and body sizes were presented in Table 1. Among the studied 362 buffaloes, 334 were belonged to distinct type/breed characteristics. Moreover, among the studied buffaloes, 72.16, 3.29, 16.17, 2.69, and 5.69% were Indigenous, Murrah x Indigenous crossbred, Nili-Ravi x Indigenous crossbred, Water x Swamp crossbred and Swamp type, respectively (Figure 1, Table 2).

Table 1. Phenotypic characteristics of buffaloes in the studied areas

Traits/characters	Percentage %	
Coat Color	Jet Black (n=37)	10.42
	Black (n=202)	56.90
	Grey- Black (n=73)	20.56
	Light Gray(n=41)	11.55
	Whitish(n=2)	0.56
Horn Pattern	Crescent shape (n=9)	2.69
	Sickle shape (n=11)	3.29
	"C" shape (n=181)	54.19
	Back upward front (n=50)	14.98
	Short spiral (n=80)	23.95
	Front downward (n=3)	0.90
White Marking	Head (n=17)	7.65
	Tail (n=135)	60.80
	Hock area (n=49)	22.05
	Dewlap (n=21)	9.50
Head Shape	Thin long (n=118)	33.42
	Big (n=142)	40.23
	Short (n=93)	26.35
Body Size	Large (n=49)	13.96
	Medium(n=233)	66.38
	Small(n=69)	19.66

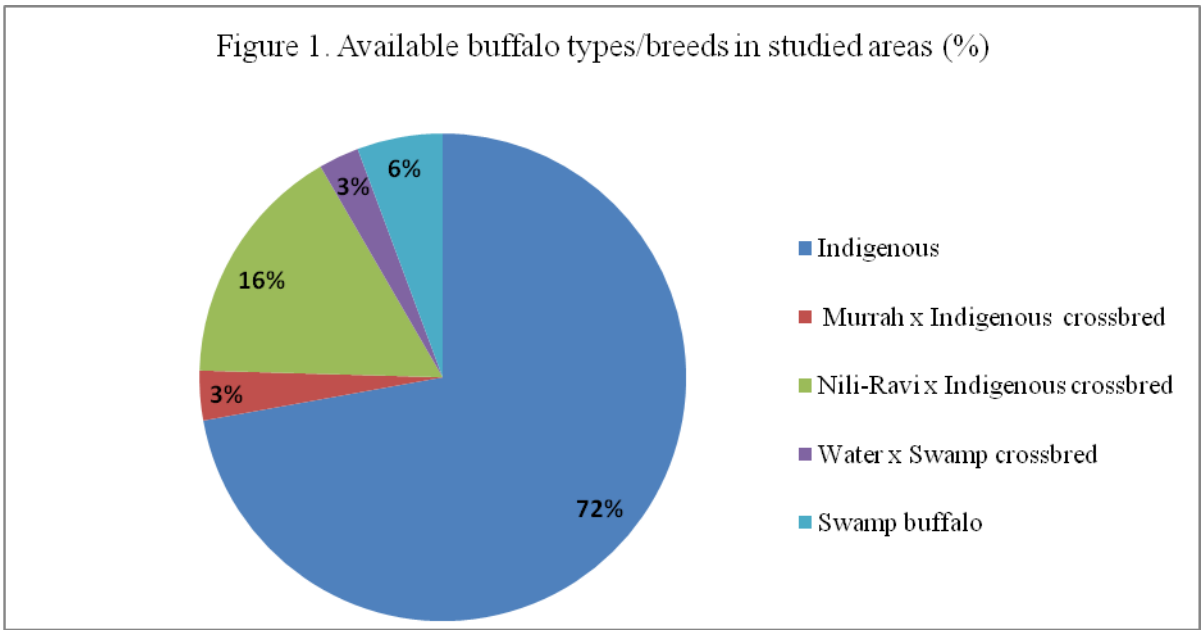

Table 2. Genotypes of surveyed buffalo population

Indigenous	Crossbreed			Swamp
	Murrah x Indigenous	Nili-Ravi x Indigenous	River X Swamp	
241	11	54	9	19

This study concluded that 72.16% of the buffaloes are indigenous. This research is continuing to complete the target study for classification of buffalo population into different types/breeds. Microsattelite markers will be used for molecular characterization of these buffalo types/breeds.

Study on the performance of BLRI Napier-3 (hybrid) cultivar and impact on milk yield in two river basin districts

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Executive Summary

Green fodder production for feeding livestock is yet to be popularized to the rural farmers of Bangladesh but this is indispensable for improvement of ruminant production. Moreover, high price of concentrate feeds is an emerging challenge to sustain ruminant industry in the country. Sustainable production of green roughages will minimize the production cost for profitable farming. Scaling up the adoption of high yielding fodders along with available local feed resources will help improving livestock production in Bangladesh. Due to variable geo-climatic zones, all high yielding fodders are not suitable for cultivation in Bangladesh. For example, in coastal and saline areas, production of high yielding fodders is very limited due to soil salinity and therefore, adoption and cultivation of salt tolerant fodders are indispensable in the regions. So, an appropriate fodder production system for different regions of Bangladesh is a crying need for sustainable ruminant production. For this purpose, a baseline survey was conducted to know the current situation on fodder production, demand, livestock rearing, problems etc. Based on survey results, two districts fromriver basin (Jamalpur and Kurigram) and two from coastal regions (Noakhali and Patuakhali) were selected to conduct on-farm study. Thus, this study was aimed to study the performance of BLRI Napier-3 (hybrid) cultivar and impact of feeding on milk yield in the river basin regions and main objective to develop a sustainable fodder production model based on the existing cropping systems. For this purpose, two upazilas from each district were selected. Thus, a total of twenty farmers from two riverine districts having at least two dairy cows, 5 from each upazilas were chosen according to farmer's interest on fodder production. Selected farmers were trained up on high yielding fodder production, preservation and feeding system. BLRI developed high yielding Napier-3 (hybrid) fodder cuttings were distributed to all farmers for cultivation in their own land. It's mentioned here that leguminous fodder (*Vigna munga*; M*ati-kalai*) was produced in those lands at the time of inter cutting period and were preserved as hay. Prior to cultivation of fodder, soil samples were collected from each fodder plot to analyze soil p^H, total nitrogen (N), organic carbon (C), phosphorus (P), potassium (K) and electro-conductivity (EC) at the Central Laboratory of Soil Resource Development Institute (SRDI), Krishi Khamar Sarak, Farmgate, Dhaka. For land preparation to cultivate fodder, each fodder plot was ploughed, added fertilizer and leveled properly. During the time of first plantation of stem cuttings, line to line and plant to plant distances were 70 and 30 cm, respectively. Conventional agronomical practices were followed for all of the fodder plots. Fodder yields were harvested at a regular interval at 40-45 days after each cutting, whilst first cut was made 60 days after the stem first planted. After, each cutting, lands were ploughed and fertilizers were given to the soil as well as irrigation if required. During the time of harvest, total biomass yields were recorded. For nutritional analyses, samples from each of the fodder plot were also taken. Milk yield of cows for 15 days before and during feeding of cultivated fodder were also recorded as a case study whether farmers were benefited to the proposed fodder production model. All data were analyzed statistically by SPSS 17.0 for estimating mean values along with standard errors.

The results on soil samples are illustrated in Table 1, which shows that except potassium, all soil components did not differ significantly among upazilas. However, concentration of potassium differed significantly among upazillas. Soil of Kurigram Sadar contained more potassium than others. Biomass yield, DM and CP content of Napier-3 cultivar are given in Table 2. Biomass yield differed significantly ($P<0.01$) in different regions, but DM% and CP% did not differ significantly ($P>0.05$). The highest biomass yield (11.3 MT/ha) was produced in Kurigram Sadar and the lowest in Rajarhat (9.6 MT/ha). Irrespective of locations, the overall mean biomass yield was recorded 12.1±0.51 MT/ha. The DM content in Napier-3 ranged from 10 to 18.5% with overall mean of 18.56±0.4%. The CP content in Napier-3 in different locations was found around 11% with overall mean of 11.36±0.02%.

Table1. Chemical composition of soil for different upazilas

Locations	P^H	EC (ds/m)	Org. C (%)	Total N (%)	P (ppm)	K (meq/100g)
Jamalpur Sadar	5.48±0.52	4.22±0.41	1.466±0.18	0.112±0.02	24.30±	0.228±12.16
Melandah	5.19±0.63	2.23±0.74	1.276±0.23	0.107±0.01	23.95±	0.241±14.13
Kurigram Sadar	5.49±0.16	2.40±0,37	1.475±0.36	0.138±0.03	26.67±	0.330±12.22
Rajarhat	5.18 ±0.36	2.51 ±0.54	1.235 ±0.24	0.105± 0.01	34.54±	0.275±13.17
Sig.	NS	NS	NS	NS	NS	**

** = (P<0.01); NS= Non significant

Table 2. Biomass yield and nutrient composition of Napier-3 cultivar from the studied areas

Parameters	Mean±SE for different Upazilas				Overall mean	Sig. level
	Jamalpur Sadar	Melandah	Kurigram Sadar	Rajarhat		
Biomass yield (MT/ha)	13.7±0.68 (05)	13.9±0.76 (05)	11.3±0.34 (05)	09.6±0.78 (05)	12.1±0.51 (20)	**
DM (%)	18.58±0.04 (05)	18.55±0.08 (05)	11.00±0.42 (05)	10.00±0.12 (05)	18.56±0.4 (20)	NS
CP (%)	11.34±0.03 (05)	11.38±0.03 (05)	11.32±0.18 (05)	11.00±0.06 (05)	11.36±0.02 (20)	NS

*Figures in the parenthesis indicate sample size, **-P<0.01; NS-p>0.05

A case study obtaining the variation of milk production, recorded for 15 days due to feeding Napier-3 is shown in the Table 3. Table 3 clearly shows that feeding Napier has positive impact on changing milk yield for each of the studied area. The rate of increasing daily milk yield varied significantly from about 8% to 15%. Highest, about 15% daily milk yield was increased in Jamalpur Sadar upazila and lowest in Rajarhat (about 8%). Irrespective of locations, overall milk yield was increased at about 11% for feeding Napier (Table 3).

Table 3. Results of a case study showing the impact of feeding Napier on 15 day's milk yield of cow

Upazilas	Average milk yield in kg (mean±SE)		% increase	Level of Significance
	Existing feeding	Feeding Napier		
Jamalpur Sadar	6.09±0.13 (10)	6.98±0.14 (10)	14.6	***
Melandah	5.41±0.14 (10)	6.03±0.14 (10)	11.5	**
Kurigram Sadar	6.49±0.13 (10)	7.08±0.13 (10)	9.1	***
Rajarhat	7.13±0.17 (10)	7.67±0.19 (10)	7.6	*
Overall	6.28±0.08 (40)	6.94±0.08 (40)	10.5	***

*Figures in the parenthesis indicate number of cows, *-P<0.05; **-P<0.01; ***-P<0.001; NS-p>0.05

The results so far obtained revealed t6hat the feeding BLRI Napier-3 (hybrid) was significant effect on milk yield, it could be expected that fodder production model with Napier-3 could be adopted in those regions. However, more research and information are needed to justify the fodder production modeling in relation to existing cropping systems, soil type, temperature and climatic parameters. .

Development of existing feed resources based feeding system in Haor areas to increase milk production of smallholder dairy farmers

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Executive Summary

"Haor" a wetland in the North Eastern part is a low lying bowl-shaped basin covering about 6,000 sq. km in Sylhet Division**,** mostly in Sunamganj district in Bangladesh. The topography of Haor regions is uneven mosaic of wetland habitats including rivers, streams and irrigation canals, large areas of seasonally flooded cultivated plains and hundreds of haors and beels. Large areas of Sylhet, Mymensingh, Sunamganj, Habiganj, Maulavi Bazar, Kishoreganj and Netrokona districts are covered by many haors. Hoars are very resourceful and internationally important ecosystem. These wetlands are very important habitats for the unique and dynamic ecosystems, which have immense productive and ecological value. Apart from the livelihood depending on fishing, riverine transportation and crops production, cattle are an inseparable and integrated part of small holder subsistence farmers in haor regions of Bangladesh. But, in haor areas most of the lands are covered by water throughout the year. So, no doubt that there are acute scarcities of feed and forages for ruminants throughout the years. Due to scarcity of green grasses for cattle as a result of water logging for a prolonged period in every year, community based fodder model is the present demand in haor areas for our nation to meet-up the protein requirement (Animal protein). In view of this situation, research was directed towards the development of alternate fodder production model which makes better uses of local resources that are available throughout the year. However, locally available green grasses were conserved in the form of hay or silage for spontaneous supply of roughages throughout the year. So, water tolerant fodder or forges or those grown in water needs to be adopted as an alternative approach. Thus, the present study was carried out to develop a feeding system through varietal demonstration of HYV fodder germplasm with existing feed resources utilization. To fulfill the objective 5 farmers (4 adapted and 1 non-adapted as control having at least 1-2 dairy cows for each farmer) were selected in Burishtalvillage in Sunamganj Sadar. A 45 days feeding trial with 5 dairy cows fed Napier-4 (*Pennisetum purpurum*) and *Chaila* hay (locally most available grass) supplementing with minimum home-made concentrates (rice bran, mustard oil cake and boiled broken rice) was conducted. The control farmers were selected from another village named Ishaghori bazaar in Sunamganj Sadar and their feeding practices were closely monitored and recorded regularly. The parameters studied from the works were feed intake, % feed intake on live body weight and milk yield. The data collected from the study were statistically analyzed by SPSS 17.0.

The comparison of feed intake and milk yield between control and experimental cows are presented in Table 1. The daily intake of straw and hay by control and treatment cows were not varied significantly ($p>0.05$). But daily intake of cultivated fodder by treatment group was significantly ($p<0.001$) higher than intake of local green grass by control group cow. Concentrate supplementation was only for experimental cows. Straw intake as per cent body weight was higher in control cow than those of treatment cows. There was no significant difference of green grass intake on body weight between groups. Daily average milk production differed significantly ($p<0.001$) between groups. The higher milk yield was found in experimental cows (2.56±0.03 kg/d). The Table 2 shows feed intake and milk yield data of the individual cows of experimental group. The result shows a significant differences ($p<0.01$) of daily hay intake among cows. But no significant differences were observed in case of daily fodder intake among cows. Hay, cultivated fodder and concentrate feed intake on live weight per cent differed significantly ($p<0.001$) among cows. Despite of supplying same quantity of feed to all experimental cows, differences of feed intake on per cent body weight could be due to differences of body weight.

Table 1: Comparison of feed intake and milk yield between control and experimental animals

Parameter	Groups of milking cows		Level of significance
	Control	Treatment	
Straw/hay intake in a day (kg)	3.48±0.15	3.50±0.02	NS
Local/cultivated grass intake/day (kg)	16.22^{b}±0.67	19.23^{a}±0.03	***
Concentrate intake/ day (kg)	0.00	1.7±0.00	-
Total straw intake (fresh basis)/day	2.32^{b}±0.09	2.09^{b}±0.01	**
Green grass intake (%) body weight (fresh basis)	10.82±0.45	11.49±0.07	NS
Concentrate intake (%) body weight	0.00	1.01±0.01	-
Milk yield (litre/day)	1.00^{b}±0.05	2.56^{a}±0.03	***

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

Table 2: Comparison of feed intake and milk yield within experimental animals

Parameter	Milking cows within treatment group				Level of Sig.
	Cow-1	Cow-2	Cow-3	Cow-4	
Fresh hay intake/day (kg)	3.60^{a}±0.02	3.50^{b}±0.03	3.44^{b}±0.02	3.45^{b}±0.04	**
Fresh fodder intake/day (kg)	19.23±0.07	19.19±0.06	19.32±0.05	19.19±0.06	NS
Hay intake (%) live weight	2.25^{a}±0.01	2.00^{c}±0.01	2.08^{b}±0.01	2.03^{c}±0.02	***
Fodder intake (%) live weight	12.02^{a}±0.04	10.96^{d}±0.03	11.71^{b}±0.03	11.29^{c}±0.03	***
Concentrate intake (%) live weight	1.06^{a}±0.00	0.97^{d}±0.00	1.03^{b}±0.00	1.00^{c}±0.00	***
Milk yield (litre/day)	2.50±0.09	2.61±0.04	2.54±0.05	2.61±0.06	NS

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

In summing up, it may however, be concluded that farmers in Haor areas may easily increase milk production of their dairy cows by supplying hay prepared from locally available green grasses and producing high yielding fodder in their fallow land with supplementing some concentrate feed.

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

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Executive Summary

The germpalsm of different varieties of fodder crops are available in the country, some of them are popular as cultivars to farmers and a number of private organizations have been introducing new seeds of fodder crops of exotic origins to a backdrop of demand and supply gaps of green grass in the country (Huque and Sarker, 2014). Without considering nutritional benefits to animals or comparative production performances with existing crops new fodder crops are being introduced. The efficiency of on-farm biomass production, it's response to growth & milk production to bovine animals and the reduction of enteric methane emission in the rumen and the cost-effectiveness are major factors affect benefits of a fodder crop in farming systems (Huque et al., 2014). Ranking of fodder crops based on their production efficiency of fodder biomass and animals, the reduction efficiency of enteric CH_4 emission in the rumen and benefit to cost efficiency are important to select a fodder crop for on farm cultivation. This requires development of database on the above biological and mathematical traits of different fodder crops available in the country. Biometrical ranking based on Maize Index (M_f) of Maize, Napier, Jumbo (sugar graze), Australian sweet Jumbo, UMS of Rice straw (Boro and Aman) and Moringa plant fodder is completed so far. Maize Index (M_f) is a co-efficient of production efficiency of biomass and animals, reduction efficiency of enteric CH_4 emission in the rumen, and of benefit-cost ratio compared to Maize silage. In continuation of research works, German (*Echinochlora grousgali*) and Para (*Brachia riamutica*), two important fodder being cultivated by the farmers, and Jumbo-green (*Sorghum bicolor*), a new fodder crop certified by the Seed Certification Agency (SCA) & introduced newly, are considered to be ranked accordingly. Thus, the present research work was undertaken with the objectives of evaluating intake, digestibility and growth performances of local growing bulls fed Jumbo-green, Para or German after being cultivated them along with Maize (*Zea mays*) in the fodder field of the Bangladesh Livestock Research Institute (BLRI). Maize and Jumbo-green were cultivated, harvested at their optimum maturity and ensiled for feeding to experimental animals. Para and German were harvested at an optimum maturity from the existing fodder land of the BLRI, and their fresh biomass after harvest was fed to experimental animals.

Table 1. Chemical composition of experimental diets

Diets	DM, % of fresh biomass	Chemical composition (%DM)				
		OM	CP	ADF	NDF	Ash
Maize silage	20.88	93.21	9.12	56.54	70.33	6.79
Jumbo-green silage	19.20	89.55	9.85	62.68	84.98	10.45
Para	15.15	86.29	10.33	58.67	87.64	13.71
German	10.83	83.12	13.39	59.35	79.34	16.88

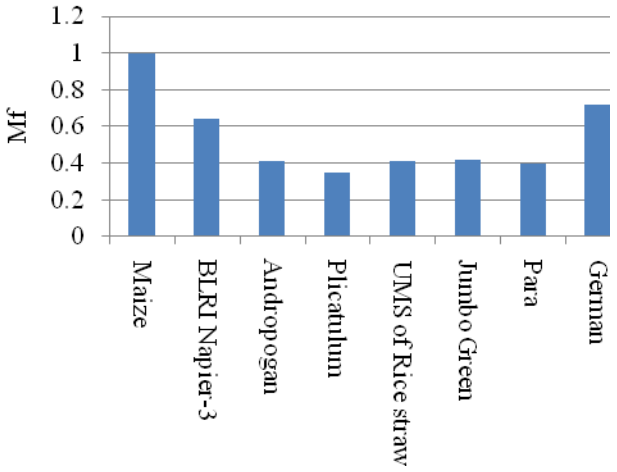
Table 2. Nutritional and growth responses of different roughages

Parameters	Diets				SED	Sig. level
	Maize	Jumbo-green	Para	German		
DM intake (Kg/d)	2.99^{a}	3.12^{a}	2.43^{bc}	2.83^{ac}	0.13	*
CP intake (Kg/d)	0.28^{ac}	0.31^{a}	0.25^{c}	0.38^{b}	0.01	***
OM intake (Kg/d)	2.80^{a}	2.81^{a}	2.09^{bc}	2.35^{ac}	0.11	*
DM intake (kg; % LW)	1.91^{ac}	1.94^{a}	1.55^{b}	1.70^{bc}	0.05	**
DM digestibility	67.25^{a}	53.81^{b}	54.18^{b}	64.23^{a}	1.15	***
CP digestibility	60.24^{ac}	43.51^{b}	55.03^{a}	64.14^{c}	1.34	***
OM digestibility	69.84^{a}	57.79^{bc}	53.74^{c}	64.48^{d}	1.16	***
DDMI (Kg/d)	2.01^{ad}	1.69^{bcd}	1.33^{b}	1.82^{ac}	0.08	**
DCPI (Kg/d)	0.17^{a}	0.14^{a}	0.14^{a}	0.25^{b}	0.009	***
Initial LW (Kg)	160.9	161.0	162.0	162.1	5.63	NS
Final LW (Kg)	166.6	152.1	154.1	168.5	5.90	NS
Daily gain/loss, g	94.00^{a}	-148.0^{b}	-132.0^{b}	106.0^{a}	0.03	***
FCR	36.9^{a}	-24.5^{b}	-27.8^{b}	46.9^{a}	8.28	***

The four different types of fodder were randomly fed to 24 local growing bulls (*Bos indicus;* RCC &BCB-1) of average 161.5±18.2 kg initial live weight at 18 to 24 months of age. Dividing the bulls into four equal groups, they were housed individually and four different fodders were fed *ad libitum* randomly for a period of 60 days including a 7 days digestibility trial without any concentrate supplementation. Fresh and clean water was available in the animal sheds for the whole experimental period. At the onset of feeding trial, animals were dewormed properly with Endex ® (Levamesol BP 600 mg per bolus).The animals were weighed at an interval of 10 days, and their feed intake, digestibility of nutrients and growth performances were determined for comparing their response to animal performances. The enteric CH_4 emission in the rumen was calculated using the equation of IPCC (2006). The nutritional responses were compared statistically in an ANOVA of a Completely Randomized Design (CRD) using SPSS, 17 computer software packages.

German grass had a higher level of crude protein (CP, 13.4%) compared to others (varied from 9.12% to 10.3%). It had 59.4% ADF, 79.3% NDF and 16.9% ash. The ADF & NDF content of Maize, Jumbo-green and Parawere56.5% &70.3%, 62.7% &85.0% and 58.7% & 87.6%, respectively (Table 1). Maize, Jumbo-green, Para and German grass had per head daily DM intake of 2.99 kg, 3.12 Kg, 2.43 kg&2.83 kg, respectively, and, as percent live weight, their intake was 1.91, 1.94, 1.55 and 1.70%, respectively. The daily DM intake of bulls fed Jumbo-green silage was significantly higher ($p<0.05$) than those fed with Maize silage followed by Para or German fresh grass, respectively. However, per day CP intake of bulls fed German fresh grass (0.38 kg/d) was significantly ($p<0.001$) higher followed by bulls those fed with Jumbo-green(0.31 kg/d), Maize(0.28 kg/d) or Para (0.25 kg/d). Maize had the highest DM (67.25%) digestibility followed by German, Para and Jumbo-green. German had the highest CP (64.14%) digestibility followed by Maize (60.24%), Para (55.03%) and Jumbo-green (43.51%). Maize had the highest ($p<0.01$) intake of digestible DM followed by German, Jumbo-green and Para, the CP intake was the highest in the bulls fed with German. Feeding German had relatively ($p>0.05$) higher average daily gain of 106 g compared to 94.0 g of Maize. Feeding Para or Jumbo-green alone resulted in the loss of live weight of the bulls during the feeding period and it was calculated to bedaily-132.0 g/head and -148.0 g/head, respectively. The FCR of the bulls fed Maize silage (36.9) found better ($p<0.001$) compared to that of German (46.9), Jumbo-green (-24.5) and Para (-27.8)

Figure 1. Biometrical ranking of fodder crops



Considering Maize M_f of 1.0, the calculated M_f for Jumbo-green, Para and German was calculated to be 0.42, 0.40 and 0.72. Thus, it may be stated that Jumbo-green and Para are similar in the rank of Andropogan, Plicatulum and even to that of UMS of rice straw. The biometrical rank of German was similar to that of BLRI Napier-3 (Fig1).

Effect of different soil types on growth and production of Napier-4 at the Regional Station of BLRI

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Executive Summary

The organic components of soil are the determinant factors for growing any crops or trees. Soil fertility is very much important for producing any crop which depends on different organic or inorganic components contains in soil. Texture is another important physical property of soil. Based on texture and components soils are categorized in different types like sandy, clay, loamy, silt clay, silt loam, silt clay-loam, sandy loam etc. Depending on the soil type and texture Bangladesh has divided into 30 agro-ecological zones (AEZ) named sequentially from AEZ-1to AEZ-30 which cover all districts in Bangladesh. Though, the property of each type of soil is different, the crops and trees grown in each type of soil is different. So, it is important to determine the properties of soil as to cultivate fodder in different regions. None of the variety of fodder is suitable for all type of soil. It is essential to know the components of soil before growing any type of fodder. A comparative agronomical trial was conducted on two different soil types such as normal soil and sandy soil at BLRI regional station, Baghabari, Shahzadpur, Sirajganj. Three plots for each treatment having similar soil type were taken and each of the plot size was17ft×10ft. The plots were prepared by normal agronomical operations. BLRI developed high yielding fodder, BLRI Napier-4 was chosen and propagated by stem cuttings method and transplanted in lines. Line to line and plant to plant distance were 70 and 30 cm, respectively. Soil samples were collected from each plot of two types of soils during study period. Collected soil samples were analyzed for soil P^H, nitrogen, organic matter, salinity, Ca, K, S, Zn, Pb, Co, Mg, Fe etc. at the Central Laboratory of Soil Resource Development Institute(SRDI), Krishi Khamar Sarak, Farmgate, Dhaka. Routine weeding practices with the utensils like sickle, chen, spade etc. were done to remove undesirable grasses, bushes and plants. In each experimental plot, irrigation was performed by using a plastic pipe through a canal with the help of deep tube well in Baghabari Station. Fodder was harvested at a regular interval at 40 days after each cutting, whilst first cut was made after 55 days of transplanting. After each cutting, the soil of each experimental plot was loosen manually by spade and urea was applied as top dressed. During the time of harvest, records of plant height, stem length, leaf length, number of leaf per stem, number of till per hill, yield per hill and total biomass yield per plot were taken from each of the plot in two soil types. The statistical analyses were done using 'SPSS' statistical program to compute analysis of variance (ANOVA) for Randomized Complete Block Design (RCBD). Differences among the treatment means was determined by Duncan′s Multiple Range Test (DMRT).

The results on analyses of soil composition are given in Table 1 which clearly shows the differences of soil constituents between normal and sandy soil. The P^H was slightly higher in sandy soil (6.6) than that of normal soil (6.2). Percent of organic materials and total nitrogen were higher in normal soil (1.75 and 0.088%, respectively) than that of sandy soil (0.34 and 0.017%, respectively). Except phosphorus, all other minerals were comparatively higher in normal soil than that of sandy soil. Table 2 illustrated the effect of soil type on production performance of BLRI Napier-4 cultivar. Plant height, stem length and leaf length produced in normal soil were significantly higher ($p<0.001$) than those produced in sandy soil. But, the differences of leaf per stem, tillers per hill, yield per hill and biomass yield per plot between two type soil were not significant ($p>0.05$) (Table 2). Table 3 shows the effect of cuttings on production performance of Napir-4 cultivar. Irrespective of soil type, the plant height, stem length, leaf length, yield per hill and biomass yield per plot produced in second harvest were significantly higher ($p<0.001$) than those produced in first harvest. But, number of leaf per stem and number of till per hill did not differ significantly ($p>0.05$) between two cuttings (Table 3).

Table 1. Composition of normal and sandy soil

Soil constituents	Measuring unit	Soil type		Average value
		Normal Soil	Sandy Soil	
P^H		6.20	6.60	6.40
Organic matter (OM)	%	1.75	0.34	1.05
Total Nitrogen (N_2)	%	0.088	0.017	0.0525
Potassium (K)	Millitulanko/100 g	0.15	0.10	0.125
Calcium (Ca)	Millitulanko/100 g	8.05	0.78	4.415
Magnesium (Mg)	Millitulanko/100 g	1.49	0.39	0.94
Sodium (Na)	Millitulanko/100 g	0.15	0.11	0.13
Phosphorus (P)	Micro-gram/g	11.66	16.88	14.27
Sulphur (S)	Micro-gram/g	2.51	1.44	1.975
Boron (Bo)	Micro-gram/g	0.57	0.24	0.405
Copper (Cu)	Micro-gram/g	1.28	0.44	0.86
Iron (Fe)	Micro-gram/g	55.66	19.21	37.435
Manganese (Mn)	Micro-gram/g	4.21	0.85	2.53
Zinc (Zn)	Micro-gram/g	3.36	0.46	1.91

Table 2. Effect of soil type on production performance of BLRI Napier-4 cultivar

Performance parameters	Measuring unit	Soil type (Mean±SE)		Overall mean (±SE)	Level of significance
		Normal	Sandy		
Plant height	Centimeter	151.1±3.60	106.6±3.60	128.8±2.55	***
Stem length	Centimeter	47.2±3.19	27.6±3.19	37.4±2.26	***
Leaf length	Centimeter	104.4±3.10	72.9±3.10	88.7±2.19	***
Leaf per stem	Number	10.4±0.65	10.8±0.65	10.6±0.46	NS
Till per hill	Number	15.4±1.02	14.4±1.02	14.9±0.72	NS
Yield per hill	Kg	3.2±0.41	3.0±0.41	3.1±0.29	NS
Biomass yield per plot	Kg	158.8±20.68	150.4±20.68	154.6±14.62	NS

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

Table 3. Effect of cutting on production performance of BLRI Napier-4 cultivar

Performance parameters	Measuring unit	Number of cutting (Mean±SE)		Overall mean (±SE)	Level of significance
		1st cutting	2nd cutting		
Plant height	Centimeter	96.2±3.60	161.4±3.60	128.8±2.55	***
Stem length	Centimeter	20.8±3.19	53.9±3.19	37.4±2.26	***
Leaf length	Centimeter	75.3±3.10	102.0±3.10	88.7±2.19	***
Leaf per stem	Number	10.6±0.65	10.6±0.65	10.6±0.46	NS
Till per hill	Number	14.9±1.02	14.9±1.02	14.9±0.72	NS
Yield per hill	Kg	0.8±0.41	5.4±0.41	3.1±0.29	***
Biomass yield per plot	Kg	38.3±20.68	270.8±20.68	154.6±14.62	***

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

Finally, it may be concluded that BLRI Napier-4 cultivar may be produced in sandy soil because no differences in term of biomass yield was observed as compare to normal soil (i.e. alluvial soil).

Effect of *DOL* Silage on feed intake and milk production of cross bred dairy cows in the field condition of Bangladesh

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Executive summary

During the last few years concerted efforts were made by the research and extension personnel on technology generation and dissemination for livestock improvement. Some BLRI's technologies like *DOL* silage method, maize straw preservation, UMS, etc have already gone to the fields. This presumably, has made a significant response to increasing milk and meat production, and the augmentation of income and the generation of employment at farm level. All technologies are equally acceptable/adaptable to all areas due to numerous factors. Sustainability of technologies (Islam, 2000) depends on socioeconomics and ecology of the area. However, some technologies might have been more effective than others in providing positive benefits for target beneficiaries (Islam, 2000). It is, therefore, very imperative to make an in-depth study to determine the yield gap of milk and meat of animals received technological interventions, identify constraints to their adoption and get feedback of the scientists for refinement, if any. In order to accelerate technology transfer to the end users, and increasing the involvement and awareness of various stakeholders and development service providers, their capacity enhancement on technologies need to be developed and strengthened. This certainly calls for imparting training to farmers about on technologies and dissemination of information. Keeping these views in consideration, the present study was undertaken to determine the production gap (milk) due to technology of "*DOL* silage method" and identify the constraints to use this technique in the field condition. Therefore, BLRI set a trial in Dinajpur Sadar under Dinajpur and Shajadpur under Sirajgonj district. Ten (10) farmers were selected from each upazila those having fodder plot and minimum two dairy cows/farmer.Twenty cross dairy cows of 2ndor 3rd parity and after calving (2-3 months pregnancy) dividing into two equal groups (T_1 - *DOL* silage, T_0 –control). The animal group T_0 received the dietary treatment containing rice straw and was considered as control group.In control group straw was chopped and soaked before feeding. The trial was conducted from December/2015-June/2016. Whole day training programme was conducted among the selected farmers on "*DOL* silage method" in the field. *DOL* was made by bamboo and its inside sealed with polythene. The Napier grasses were harvested manually. Then the grasses were chopped to 2-2.54 inch in length. During preparation, silage was pressurized manually so that no air could enter inside the Dol. About 1 ton fodder was preserved in each dol. Prepared *DOL* silage was preserved for 3 months.After 3 months a feeding trial was conducted on cross bred dairy cows and at the same time silage quality (color, smell), rottenness, p^{H} were measured and yeast & molds were visually observed as per methods of integrated evaluation (BAPH, 1996). The results of physical observation and chemical composition of *DOL* silage were compared to on station results of BLRI those published as a booklet in 2015. Silage samples were collected for nutritional analysis. The samples were subjected to chemical analysis for the determination of dry matter (DM), organic matter (OM) and crude protein (CP) following the methods of AOAC (2005). The acid detergent fibre (ADF) was determined according to Goering and Van Soest (1970).

Table 1. Integrated evaluation of silage by physical observation

Parameters	On-farm	On station (BLRI HQ)
Colour	Yellowish	Yellowish
Smell	Sweet &acidic	Sweet &acidic
Rottenness	Slightly on Upper (1-3%)	Slightly on Upper (1-2%)
Yeast/ Mould	Very little	Little on surface
pH	6.12±0.211	6.67±0.480
Comments	Good	Good

The silage possess yellowish color and sweet& sour odor. The p^H of the silage was 6.12±0.211. A small layer of yeasts & molds (3%) were observed on the surface of the silages. No difference was observed on physical characteristics of silage between on-farm and on-station (Table 1).

Table 2. Chemical composition of silage

Parameters	On-farm	On station (BLRI HQ)
% DM fresh basis	17.56	17.83
OM	88.69	88.00
CP	10.12	11.50
Ash	11.65	11.08
ADF	46.56	-

The chemical composition of silage used in the trial is given in Table 2. The average values for nutrient intakes (DM, DCP and ME) in different treatment group are shown in Table 3. The study revealed that there was no significant difference in total DM intake between the groups. The DCP (kg/d) intake was significantly (P<0.01) differences between two group. The higher DCP (kg/d) intake was observed in T_1 (0.746) followed by T_0 (0.462). The ME (MJ/d) intake was also significant (P<0.05) differences between the dietary groups. The ME (MJ/d) was 90.12 in $T_1$and 79.12 in T_0. The average milk yield (l/d) was higher in T_1 (10.14) compare T_0 (8.11). The results showed that milk yield was higher in *DOL* silage group. It is interesting to note that although concentrate intake was higher in the group (T_0), yet milk yield was lower. This may due to the difference in basal diet.

Table 3. Feed intake and milk yield of cross bred dairy cows fed different diets

Intake and production	Dietary treatments		Level of sig.
	T_0	T_1	
Rice straw DM (kg/d)	7.11	-	
Concentrate mixture DM (kg/d)	5.19	5.00	
Silage DM (kg/d)	-	7.56	
Total DM (kg/d)	12.30±0.61	12.56±0.62	NS
DMI/100kgLW	3.36±0.48	3.61±0.52	NS
DCP (kg/d)	0.462^{b}±0.38	0.746^{a} ±0.89	**
ME (MJ/d)	79.12^{b}±0.78	90.12^{a}±0.82	*
Milk yield (l/d)	8.11^{b}±0.65	10.14^{a}±0.88	**

^{abc}Mean values in a row with different superscripts differ significantly; NS= Not significant,
*P<0.05; **P<0.01

Among the *DOL* silages one was rotten (5%) which may be due to the absence of anaerobic environment inside the silo. The silage was rotten because the used polythene inside the silo was too thin and as a result it was torn by the pressure. The following points should be considered for preparation of *DOL* silage, such as i) must use coarse polythene during *DOL* silage preparation ii) to avoid using wire for preparation of *DOL* basket and iii) maximum height of *DOL* basket should be 4 ft. However, more trial will be needed of *DOL* silage in the field condition for small scale dairying during lean period.

Effect of formulated vitamin mineral premix on the growth performance, meat yield traits and internal organ development of multi-colour table chicken

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Executive Summary

Vitamin-mineral premix is the combination of vitamins and minerals which is added during formulation of a diet to meet up the requirements of at least few vitamins and minerals that are might be deficient. Usually premixes are commonly used to satisfy the needs. Inclusion of vitamin-mineral premix in a poultry diet has become an indispensable practice as common feed ingredients often remain deficit in essential vitamins and minerals both in terms of their quantity and quality The study was conducted to determine the effect of vitamin mineral premix VMP on the growth performance, meat yield traits and internal organ development of MCTC (multi colour table chicken) chicken. Minerals and vitamins contribute only 10 per cent of the total cost of feed (Singh and Panda, 1988). The overall feed cost increases very little (20 to 60 taka/100kg), but vitamins and minerals play major roles in the metabolic functions of poultry. Meat type chicken has genetic potential for fast growth with efficient feed conversion efficiency. Feed cost comprises the largest share in producing chicken especially during growing phase. Hence, it is important consideration for the producers to maximize their investment by properly feeding their met chicken. Bangladesh Livestock Research Institute (BLRI) has developed an MCTC chicken to supply the desi type chicken meat for consumers. The exotic and native chicken germplasms were used to produce this chicken variety that can provide meat like native chicken, grows faster with economic feed intake. Feed additives are used in the feed due to some positive impacts viz. reduce feed cost, growth promotion, improve products quality, reduce environmental pollutants and improve immune response causing less mortality. The developed vitamin mineral premix (VMP) was evaluated through comparing the performance of MCTC meat type chicken using the vitamin mineral combinations in the diet having different types of carrier materials.

Formulation of vitamin mineral premix: All the individual vitamin and mineral was purchased and vitamin mineral premixes (VPM) were formulated following the recommendation of BSTI (2005) for broiler chicken. In case of DVMP, all the fat and water soluble vitamins were purchased in synthetic form. Fat soluble vitamins were Vitamin-A, Vitamin-D, Vitamin-E, Vitamin-K and Vit-B1 (Thiamin), Vit-B2(Riboflavin), Vit-B6 (Pyridoxin), Pantothenic acid, Folic acid, Biotin and Vit-B12 were used as water soluble vitamin. Individual 8 minerals were purchased as their corresponding salt form from market. Each of them has different colours, smell and texture as powder form. Macro minerals were Calcium and Phosphorus, moreover as trace minerals Copper, Iron, Iodine, Manganese and Zinc were used as trace mineral. At first fat soluble vitamins and water soluble vitamins were mixed then all mineral containing salts were mixed together. Fine rice polish, wheat bran, dicalcium phosphate and calcium carbonate were mixed with vitamin and mineral in 5 various combinations binder and formulated the VMPs as per recommendation.

A field trial was conducted with a total of 378 day-old MCTC chicks for 12 weeks. The chicks were randomly weighed, distributed to replicate pens and assigned to seven dietary treatments Positive and negative control with 5 combinations of VMP in a group of 54 birds each having 18 birds in each replication. The experimental design was Completely Randomized Design (CRD) and the vitamin mineral premixes with day old chicks are shown in Table 1.

Table 1. The dietary groups in the VMP trial with MCTC chicken

Negative Control	Positive Control	*Combinations of VMP				
Diet 1	Diet 2	Diet 3 Career 1	Diet 4 Career 2	Diet 5 Career 3	Diet 6 Career 4	Diet 7 Career 5
18	18	18	18	18	18	18
18	18	18	18	18	18	18
18	18	18	18	18	18	18
54	54	54	54	54	54	54

* 5 combinations are made with 4 different career materials from local sources

Total MCTC chicks = (18×3) ×7 = 378 day old age
Experimental Diet: According to NRC (2000)
Starter diet: CP: 21%, ME/kg diet: 2900
Finisher diet: CP: 19%, ME/kg diet: 3100
Duration of the study: a)Filed trail (Starter 28 days + Grower 42 days) = 70 days
Data collection: Weight gain, Feed intake, FCR = (Feed intake/Weight gain)
Statistical analysis: SAS 9.1 (2006), USA

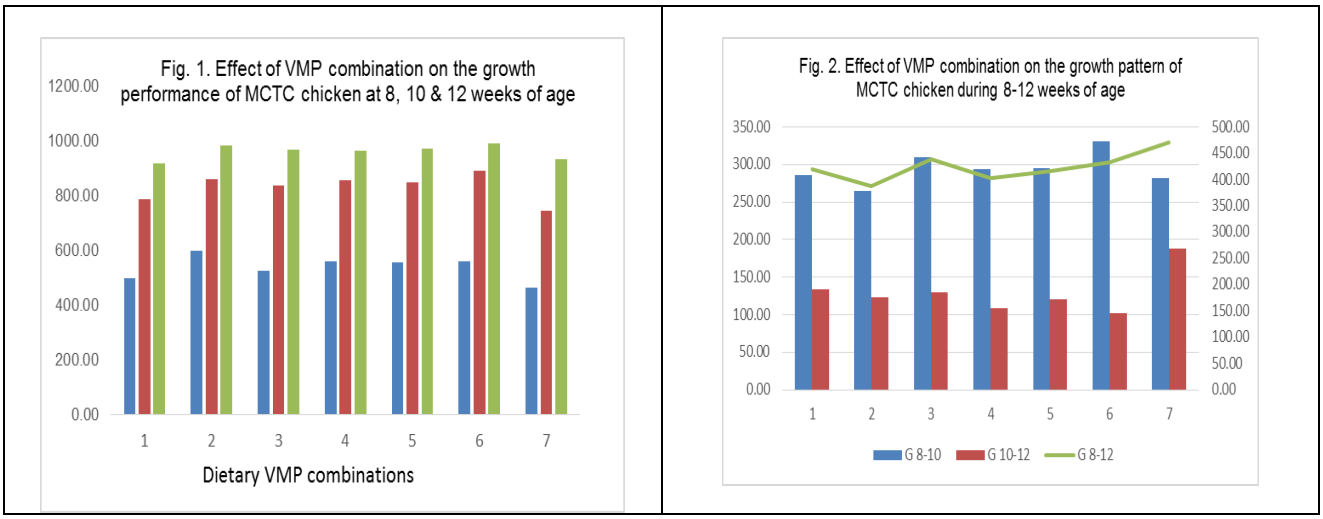

Figure 1. Shows the growth performance of multi-colour table chicken (MCTC) considering seven dietary treatments, with or without vitamin mineral premix combinations. There were five combinations (diet 3 to diet 7) of vitamin mineral premix were formulated using different carrier materials.

Significantly ($p<0.05$) reduced feed intake was calculated in diet 6 with increased WG and lowest FCR. Combination 3 and 6 diets showed better growth pattern during 8 to 10 weeks of age (Figure 1, 2). The formulated VMP showed suitable in growth performance and feed efficiency and it may be substituted in the diet of meat type chicken. These findings will indirectly reduce the dependency of imported vitamin mineral premixes and to enhance MCTC chicken production in Bangladesh.

Modulation of antiviral activity against Infectious bursal disease virus through activation of Toll-Like Receptor (TLR) signaling pathway

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Executive Summary

Host cells use various receptors to detect viral infections by recognizing pathogen-associated molecular patterns (PAMPs) and subsequently induce an antiviral response. Prominent among these are Toll-like receptors (TLRs) (10). There are a total of 13 TLRs known so far in mammals with each TLR recognizing and responding to different microbial components. Out of these 13 TLRs, certain TLRs are expressed on the cell surface and recognize bacterial membrane components (TLR1, 2, 4, 5, 6) while others are present in the intracellular compartments involved in detecting nucleic acids (TLR3, 7, 8 and 9). Several TLRs recognize viral PAMPs: TLR3, detects double-stranded RNA (dsRNA) derived from viral replication whereas single-stranded RNA (ssRNA) are detected by TLR7 and TLR8, and dsDNA is recognized by TLR9. The TLR signaling proceeds via two pathways; the myeloid differentiation factor 88 (MyD88)-mediated pathway and the Toll-interleukin-1 receptor (TIR)-domain-containing adaptor inducing IFN-β (TRIF)-mediated pathway. The TLR signaling pathways arise from intracytoplasmic TIR domains, which are conserved among all TLRs. The TLR7 specifically involves MyD88-dependent pathway, whereas TRIF is implicated in the TLR3-mediated MyD88-independent pathway.

Poly ICLC is a synthetic double stranded RNA comprising of polyriboinosinic-poly ribocytidylic acid (Poly IC) stabilized with L-lysine (L) and carboxymethylcellulose (C). Poly ICLC and liposome-encapsulated Poly ICLC (LE Poly ICLC) are TLR-3 agonists and are potent inducer of interferons and natural killer cells. The X-ray crystal structure of the poly IC:TLR-3 receptor signaling complex has been determined. Intranasal pre-treatment of mice with Poly ICLC and LE Poly ICLC provided high level of protection against lethal challenge with a highly lethal avian H5N1 influenza (HPAI) strain (A/H5N1/chicken/Henan clade 2), and against lethal seasonal influenza A/PR/8/34 [H1N1] and A/Aichi/2 [H3N2] virus strains. The duration of protective antiviral immunity to multiple lethal doses of influenza virus A/PR/8/34 virus had been previously found to persist for up to 3weeks in mice for LE Poly ICLC and 2 weeks for Poly ICLC (22). Taken together, these results do support the potential role of TLR-3 and TLR-9 agonists such as Poly ICLC and LE Poly ICLC in protection against lethal seasonal and HPAI virus infection. Considering these facts the study is under taken with the following objective-

i. Determination of cytokine and chemokines activities of Poly ICLC activated TLR3 in chickens that had not been immunized with IBD vaccine
ii. Determination of efficacy of Poly ICLC activated TLR3 and commercial IBDV vaccine in modulation the innate immune response to IBD

For this study we have collected the Poly ICLC from Oncovir, USA and we are now breeding the semi-SPF chicken from semi-SPF eggs to perform the animal trail.

Development of polyclonal antibody based PPRV detection system

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Executive summary

Peste des Petits Ruminants (PPR) is an important OIE listed transboundary viral disease (TAD) of small ruminants which is characterized by high fever, depression, oro-nasal secretion, respiratory distress, diarrhea, high morbidity and mortality. PPR has devastating socio-economic impacts due to heavy production losses resulting from very high mortality (up to 100%) and high morbidity (10-100%). In Bangladesh, this disease was first identified in the year 1993. Identification of PPR virus infection depends on the clinical phases of disease. During the different phases such as prodromal or erosive phases of the disease, the infected animals excrete virus and act as a source of infection for susceptible animals. Modern molecular techniques like classical and real-time PCR and immunocapture ELISA (icELISA) are highly accurate and sensitive but expensive and need well-equipped laboratory and trained manpower. Due to lack of proper laboratory facilities and detecting tools, many PPR outbreaks remain undetected. Undiagnosed PPR cases help to spread the disease rapidly which causes huge mortality of sheep and goat of the poor farmer. Monoclonal antibody based icELISA is available for the rapid and accurate diagnosis of PPRV which needs to import and very expensive. For early warning and monitoring this economically important disease, it needs to develop less expensive and locally available devices to monitor and control of the disease effectively.

A specific, sensitive and rapid test to detect the virus antigens from field samples at field condition or keeping specimens without refrigeration is essential for developing and underdeveloped countries. With these objectives, a polyclonal antibody based PPRV detection system has been developed.

Polyclonal antibody has been developed by providing 4 times weekly PPR vaccine inoculation in mice intraperitoneally. Serum was separated from blood of inoculated mice after 15 days of last vaccination and measured titer by cELISA. For preparation of PPR antigen, PPR suspected field isolates were collected and confirmed as PPR virus by conventional PCR, real-time PCR and gene sequencing. Newly prepared primary culture of lamb kidney cell (LKC) was used for PPRV adaptation. RT-PCR positive samples were propagated into this LKC and it was continued up to 5th passage. Cytopathic effect was observed in the first passage after 3 days of virus inoculation and the presence of virus was confirmed by RT-PCR. After freezing, thawing and centrifugation these viruses were used as reference antigen. As test antigen, PPR antigen from commercial cELISA kit (IAEA joint division and BDSL, UK), attenuated PPR vaccine antigen (LRI, Mohakhali), nasal, ocular and feces from suspected PPR cases were used. Monoclonal antibody (Mab) from commercial cELISA kit (IAEA joint division and BDSL, UK) was used along with polyclonal antibody (Pab) for comparison. Rabbit anti-miceHRP conjugate and rabbit anti-mouse HRP conjugate were used as secondary antibody for Pab and Mab, respectively. The test was performed with nasal and fecal samples of the experimental cases of PPR at BLRI and suspected cases of PPR in goat of several areas.

PPRV detection test was conducted in the 12 or 6 wells plates. Samples i.e. cell cultured PPR antigen, antigen from kit, PPR vaccine and cell culture fluid as negative were coated in wells and fixed in acetone. Pab developed against PPRV added at an amount of 50 µl/well. After incubation at 37 ºC for an hour, rabbit anti-miceHRP conjugate was added 50 µl/well. Fifty micro-litres per well ortho-phenylendiamine mixed with hydrogen peroxide added to each well and incubated for 15 minutes at room temperature. The reaction was stopped by addition of sulfuric acid. The plate was examined by naked eyes or optical densities of the samples were measured at 450 nm with an ELISA reader. The test was compared with monoclonal antibody based Enzyme Immune Slide Assay (EISA).

The test used to detect the PPR antigen adapted in LKC and PPR vaccine antigen. Both the antigens were detected by the test and OD values ranges from 0.3 to 1.2 at 450 nm. Approximately 10^2 $TCID_{50}$/ml was the minimum LKC infectious virus particles detectable by the test. Reference PPR antigen, vaccine virus and field virus strains were analyzed using both Pab and Mab and showed that Mab and Pab were specific to antigens while PPR Pab identified all the viruses at high level of OD values against PPR antigens.

Smear prepared from nasal discharges and diarrhoeic materials from the experimentally infected goats and tested by Pab. The OD values of samples against Pab varied from 0.265 to 0.789. RNA was extracted from the nasal discharge and diarrhea and subjected to classical and real-time PCR and found positive as Pab based detection system. Similar test was performed on the suspected clinical cases of PPR of different areas of Bangladesh .Smear from nasal discharges and diarrhea found positive as PPRV in the field level which were performed at room temperature.

From the above result, it is concluded that Pab based PPRV detection system can be used as useful and low cost technique for the diagnosis of PPR outbreak in the field as well as helpful for the control of PPR disease in Bangladesh.

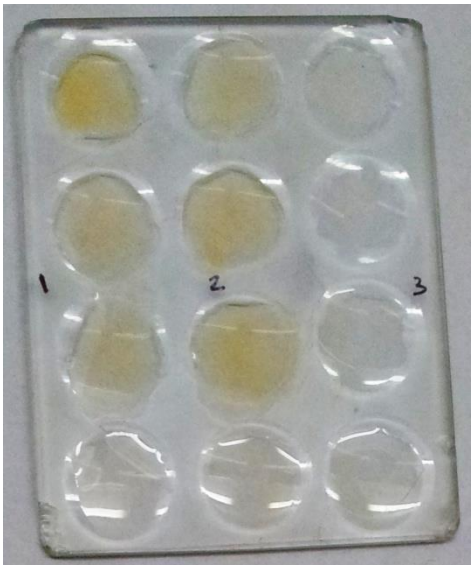
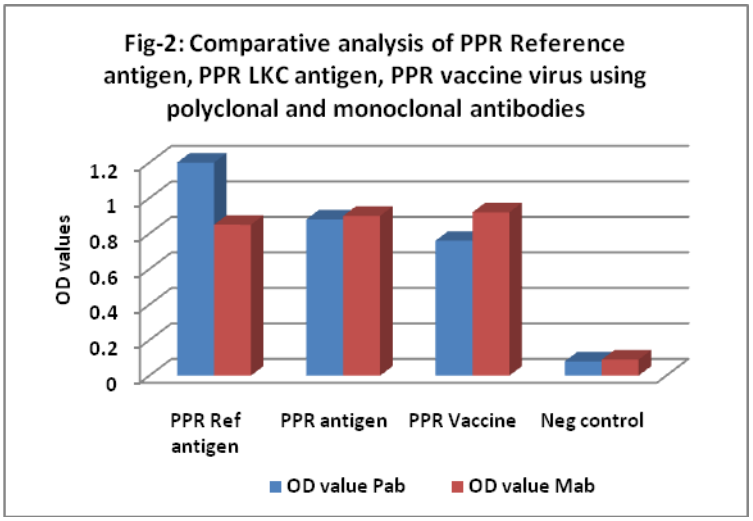


Figure 1: Pab based PPRV detection system



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

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Executive Summary

Native sheep are considered as an important and promising animal resource in Bangladesh. Currently, the contribution of sheep in Bangladesh can be summarized as a source of meat, wool, skin and bio-fertilizer. Bangladesh possesses 3.313 million sheep (BER, 2016). Wool is a secondary product of sheep which is being used throughout the world for producing 25% of the yarn and fabrics. A research has been taken for commercial use of wool in Bangladesh through yarn and fabrics production with the joint collaboration of the Bangladesh Livestock Research Institute (BLRI) and Bangladesh Jute Research Institute (BJRI). The aims of the research work are to produce blended yarn and fabrics; to determine the physical properties of jute, cotton and native sheep wool; to compare the blended properties of wool jute cotton yarn with 50% jute and cotton blended yarn and to increase the diversified use of wool and cotton blended products with small entrepreneur**.** Sheep wool, jute and cotton blended yarn development program was conducted on different aspect of wool viz quality, processability in cotton spinning system and blended yarn development from sheep wool, jute and cotton fibre. In this regard, sheep wool was collected from Goat and sheep research farm of the BLRI and also from the different sub-station of sheep project. Jute was collected from local market; cotton was collected from the cotton board. The required chemical was collected from local market. Raw sheep wool was washed with detergent and carbonized with 8% H_2S0_4 at normal temperature (30°C). Raw jute fibre was treated with sodium hydroxide, sodium carbonate and hydrogen per oxide at boiling temperature.

Sheep wool, jute and cotton fibre blended 12s count yarn has been produced successfully. Fine yarn was produced with the combination of wool, jute and cotton in the ratio of 30:30:40. Shawl is produced with the production cost of Tk. 244 (7ft×3ft) and suiting fabrics (pant piece, blazer piece etc.) with the production cost of Tk. 588 (per 1 meter). Comfortable blanket is produced from 50:50 ratio of wool-jute yarn with the production cost of Tk. 495 (6ft×8ft).

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

Property	Jute fibre	Cotton fibre	Sheep wool
Fibre fineness	5.05µg /inch	3.35µg /inch	8.03µg /inch
Moisture	13-14%	7-8%	9-10%
Tenacity g/tex	35	25	32

Table 2. Wool, jute and cotton blended 12 single count yarn compared with 50% jute cotton blended yarn

Yarn properties	Wool, jute and cotton blended yarn	50% jute and 50% cotton blended yarn
Count	$12\ ^{s}/_{1}$	$12\ ^{s}/_{1}$
TPI (Twist/inch)	16	18
CSP (Count strength Product)	1600	1800

Produced wool blended yarn

Shawl (7ft×3ft)

Blanket (6ft×8ft)

Suiting fabrics

Community based sheep production in hilly area at Naikhonchari

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Executive Summary

Improvement in the productivity of small ruminants especially sheep will directly benefit the poorest part of the society, through poverty alleviation, employment generation, improving nutrition of human diet. However, there are some promising varieties of indigenous genetic resources in Bangladesh. Native sheep is one of them. Because, they have some beneficial characteristics such as highly prolific (2-3 lambs per lambing), heat tolerance, adapted to hot and humid climate, ability to survive with low quality feed stuffs, good degree of resistance to diseases and able to produce good quality meat (7-10kg/sheep). Bangladesh has no practice to sheep rearing at forest region. In forest/hilly region there are lot of resources such as fodder and tree leaves that provide a lot of scope for sheep rearing in this areas. The income of most of the people of hilly region is below the poverty level. Natural grass, tree leaves and lot of follow land are available in hilly areas. Environments are very friendly to rearing of sheep at hilly areas. So the research program was conducted to improve the socio-economic status of the sheep farmers in community level and thus establish the sheep rearing system at hilly region at Naikhongchari. The performances of 130 community sheep from 28 community farmers (12 old, 16 new) were evaluated under this study. The data of productive and reproductive performances of community and farm level were collected at regular basis. The selected community sheep farmers were trained about sheep management practices including breeding practices, lamb nursing, feeding and health management through frequent supervision and special training. The qualitative and quantitative data of selected farmers were generated through personal interview along with participatory observation, interaction and discussion with key information. The assessments of the socio economic development of the old community farmers have measured using some physical and social indicators.

Table 1. Productive and Reproductive performance of native sheep at farm and community level

Parameters	Farm level	Community level
	Mean±SE	Mean±SE
Birth weight-Male (kg)	1.44±0.04(19)	1.53±0.03(14)
Birth weight-Female (kg)	1.38±0.05(23)	1.41±0.06(7)
Average birth weight (kg)	1.41±0.04(42)	1.47±0.03(21)
Litter size	1.68±0.14(13)	1.75±0.17(21)
3 months body weight (kg)	7.06±0.6(16)	7.2±0.3(23)
6 months body weight (kg)	9.68±0.83(16)	9.93±0.31(23)
9 months body weight (kg)	12.03±0.39(16)	12.03±0.34(23)
Adult body weight-Male (kg)	24.92±0.91(4)	26.53±1.76(8)
Adult body weight-Female (kg)	19.56±0.67(22)	22.32±0.78(24)
Average adult body weight (kg)	20.82±0.78(26)	23.37±0.79(32)
Gestation length (days)	158±0.61(29)	153±0.74(34)
Growth rate (g/day)	69±0.83(43)	75±0.31(31)
Mortality (%)	7.0±0.04(43)	11.0±0.23(55)
Disease incidence (%)	Diarrhoea (65), Pneumonia (10), Accident (dog biting, infection) (10), Others (15)	Diarrhoea (45), Pneumonia(15), Accident(dog biting,fallen from hill (30), Others(nutritional deficiency, actinomysis, blot, malnutrition) (10)

The productive and reproductive performances of native sheep at farm and community level are shown in Table-1. The body weight of different stages shows higher in community level because of long grazing period of their animal. The gestation length is slightly higher in farm (158±0.61) than community level (153±0.74) and mortality is higher in community level

(11.0±0.23). Both in community and farm level the mostly occurred disease is diarrhea than other diseases and infection occurred by dog biting that is vital problem in community level.

Table 2. Financial progress of the community farmers last 03 years

SL No.	Name of farmer	Years	Income			Remarks
			2013-14	2014-15	2015-16	
01.	A.Rahman	4.0	-	9,500/=	40,000/=	Nill
02.	Mrs. Safura Begum	4.0	14,000/=	3,000/=	-	
03.	Almas Mian	4.0	-	13,000/=	16,500/=	Nill
04.	AcracingCsk	4.0	22,000/=	13,000/=	5,700/=	
05.	Moo Cak	4.0	13,600/=	9,000/=	7,000/=	
06.	Safura Begum	4.0	14,000/=	3,000/=	-	
07.	SayedNur	3.5	11,000/=	3,200/=	-	
08.	NurAesha	3.5	-	7,600/=	7,600/=	
09.	Julekha Begum	3.5	8,000/=	5,000/=	4,000/=	
10.	TonuBorua	3.5	3000/=	9,800/=	10,400/=	
11.	Joynab Begum	3.5	-	10,000/=	22,700/=	
12.	Ziauddin Ahmed	1.5	-	6,400/=	4,000	
13.	Abdul Majid	1.5	-	1,900/=	10,400/=	
14.	Faridul Islam	1.5	-	3,000/=	4,000/=	

NB. The farmers who spent more than 1.5 years in sheep rearing have considered for financial analysis.

The socio economic improvement of the community sheep farmers is measured by estimating some quantitative change in some socioeconomic characteristics of the community like demographic impact such as changes in the composition of population, wealth, income, occupation, educational level, health status,, housing (construction of new houses, repairing of old houses), employment and income, changes in quality of life (dressing, household items, social involvement, aesthetic impacts etc).But, in table 2 the financial statement estimated only by sheep selling. The farmers sell their sheep from the progeny with costing varies from Tk. 2,500 – 5,500 per animal at recommended age which around 1 year having weight of 17-20 kg to local market or neighbor or bepari.

The progress of community farmers in last three years is looking positive. Total numbers of sheep in community farmers increases up to 130 numbers (28 community farmers). Most of the community farmers are women who look after the sheep flocks and thus play a major role in creating self employment. Feed shortage was perceived as the major problem especially during winters. This year 16 community farmers have received native sheep under this project by honorable minister and state minister of MoFL. The important goal of this project is to increase the community farmer into 100 gradually. All the sheep farmers in community level are looking positive financially by rearing native sheep.

Screening and development of different coat color variants' goat stock at BLRI

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Executive Summary

Goats are prolific small ruminants mostly reared by ultra-poor and poor peoples in Bangladesh. Goats provide meat and skin which contribute national economy of Bangladesh by earning foreign exchange. Bangladesh has only one goat breed of its own named popularly as "Black Bengal Goat (BBG)" which is estimated of about 90% of the total goat population and others being Jamunapari and their crosses. There are varieties of coat color variants in the BBG. The phenotypic variation in a population arises due to genotypic and environmental effects, and the magnitude of phenotypic variability differs under different environmental conditions. Genetic control of coat color in goat is complicated which results from the interaction of two major types of pigments; eumelanin and pheomelan in which are responsible for varying coat color patterns in goat. Plenty of works have so far been conducted on the morphological characteristics like body measurements and body weight, as well as distribution of coat color pattern of native goats in Bangladesh. Literatures revealed that morphological differences have important socio-cultural and economic values to different communities in different countries; as a result, most farmers have specific consideration and choices for goat coat colors followed by body sizes. It was also observed that coloration could be an adaptive trait or selected through farmers' preference for a specific coat color. But, inheritance of coat color in goats has received less attention than has that of quantitative economic important traits and lack of a similar importance for color in most goats. However, attempts to develop and conserve different color variety of goat have not yet been done for the satisfaction of consumer's preference. Coat color is also an identity of a specific breed's character. However, people have a fascination on color phenotype of animals. Although, a lots of solid and mixed colored goats are available in our country but the studies on coat color inheritance are very scanty in our country. Considering the point of view, the study has been taken to develop pure line native goat variety based on specific color available in our country as ultimate goal. Thus, the present study had been taken with the objectives; i) to collect native goat based on different coat color variants from different locations, ii) to establish goat stock of different coat color variants' at BLRI for their genetic and phenotypic characterization, iii) to develop pure-line goat genotypes based on coat color variants and iv) molecular characterization of goat based on coat color variants. Thus, to develop different color variants' goat stock, primarily goats having three distinguished color which are more prevalent viz. Solid white, Dutch belt and Toggenburg pattern have been collected comprising flocks with 6 does and 3 bucks from Toggenburg, 5 does and 2 bucks from Dutch belt and 12 solid white does. Animals were purchased directly from farmers' house in Chapai Nowabganj district and Govt. Goat farm, Rajshahi.*After establishing the foundation flock, primary information on body weight and morphological body measurements for all animals were taken by weighing scale (in kg) and measuring tape (in cm). All data were statistically analyzed (SPSS) and results are given in Table 1 and Table 2.

Table 1 shows the results of morphometrical measurements of does for three different coat color varieties. All morphological parameters estimated for three different color does did not varied significantly ($p>0.05$). Although there are no significant differences of live body weight of does for color variants, but solid white doeshas slightly higher body weight than those of other two colors that could be due to higher ($p>0.05$) heart girth than other twos. Body length and height in Toggenburg pattern goat is slightly higher than other two color goats. The udder characteristics of white color goat are somewhat better than Toggenburg and Dutch belt. Results as shown in Table 1 however reveal that no color variant does have 'Kingship' to others for morphological point of view. However, considering the aggregation of measurements in regards to structure and body weight, solid white seems to be better than other two colors and Toggenburg pattern is better than Dutch belt pattern. Table 2 shows the results of morphological characteristics of two different coat color varieties of bucks. Except neck circumference, all other morphometric measurements in bucks are lower than does which could be due to the fact that collected males were very younger than those of females.

Table 1. Morphological characteristics of does for different color pattern

Morphology	Color pattern			Overall (mean±SE)	Level of Sig.
	Toggenburg	Dutch belt	Solid white		
Body weight (kg)	24.1±3.72 (06)	22.7±1.53 (05)	26.8±3.83 (12)	25.2±2.21 (23)	NS
Body length (cm)	55.8±3.13 (06)	54.4±1.33 (05)	52.3±2.39 (12)	53.7±1.50 (23)	NS
Heart girth (cm)	66.3±2.30 (06)	66.6±2.46 (05)	71.4±3.75 (12)	69.0±2.12 (23)	NS
Wither height (cm)	55.5±2.57 (06)	54.4±0.93 (05)	53.6±1.60 (12)	54.3±1.06 (23)	NS
Head length (cm	16.1±0.92 (06)	16.6±0.81 (05)	17.8±0.56 (12)	17.1±0.43 (23)	NS
Head breadth (cm	10.1±0.40 (06)	11.3±0.70 (05)	9.9±0.54 (12)	10.3±0.34 (23)	NS
Horn length (cm)	8.9±0.76 (06)	10.8±1.15 (05)	11.6±1.39 (12)	10.7±0.81 (23)	NS
Horn diameter (cm)	5.1±1.25 (06)	5.1±1.11 (05)	5.0±0.81 (12)	5.0±0.56 (23)	NS
Ear length (cm)	16.3±0.92 (06)	15.0±0.26 (05)	15.4±0.75 (12)	15.6±0.46 (23)	NS
Ear breadth (cm)	7.1±0.78 (06)	5.5±0.89 (05)	6.9±0.41 (12)	6.6±0.36 (23)	NS
Neck length (cm)	18.2±1.28 (06)	18.0±1.89 (05)	20.3±0.78 (12)	19.2±0.67 (23)	NS
Neck diameter (cm)	30.2±0.95 (06)	30.7±1.50 (05)	32.1±1.71 (12)	31.3±0.97 (23)	NS
Tail length (cm)	11.3±0.49 (06)	12.3±0.85 (05)	11.0±0.51 (12)	11.3±0.35 (23)	NS
Tail breadth (cm)	4.2±0.26 (06)	4.8±0.37 (05)	4.5±0.23 (12)	4.5±0.16 (23)	NS
Foreleg length (cm)	47.5±1.15 (06)	49.0±2.83 (05)	42.5±2.73 (12)	45.0±1.65 (23)	NS
Hind leg length (cm)	49.4±1.02 (06)	52.0±2.78 (05)	44.7±2.77 (12)	47.5±1.67 (23)	NS
Udder length (cm)	14.7±2.42 (06)	13.0±2.55 (05)	16.8±1.01 (11)	15.4±1.01 (22)	NS
Udder breadth (cm)	25.0±5.00 (06)	23.0±3.78 (05)	29.2±2.90 (10)	26.5±2.15 (21)	NS
Teat length (cm)	4.5±1.50 (02)	3.5±0.42 (05)	4.1±0.38 (09)	4.0±0.29 (16)	NS
Teat diameter (cm)	4.0±0.00 (02)	2.6±0.36 (05)	3.2±0.71 (09)	3.1±0.42 (16)	NS

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

Although, all morphological parameters estimated for two different color bucks did not varied significantly (p>0.05), but body weight, height, heart girth, neck and testicular characteristics are somewhat better in Dutch belt than that of Toggenburg pattern. However, considering the aggregation of measurements in regards to body structure and weight, Dutch belt bucksare likely to be better than that of Toggenburg pattern bucks.

Table 2. Morphological characteristics of male goat for different color pattern

Morphology	Color pattern		Overall (mean±SE)	Level of Sig.
	Toggenburg	Dutch belt		
Body weight (kg)	16.3±5.17 (03)	17.2±6.85 (02)	16.6±3.57 (05)	NS
Body length (cm)	49.7±4.26 (03)	48.5±5.50 (02)	49.2±2.92 (05)	NS
Heart girth (cm)	58.0±6.66 (03)	60.5±9.50 (02)	59.0±4.76 (05)	NS
Wither height (cm)	50.7±4.98 (03)	51.5±4.50 (02)	51.0±3.08 (05)	NS
Head length (cm	14.8±0.60 (03)	15.3±1.25 (02)	15.0±0.52 (05)	NS
Head breadth (cm	10.7±0.60 (03)	10.5±0.50 (02)	10.6±0.37 (05)	NS
Horn length (cm)	9.3±1.75 (03)	8.1±0.90 (02)	8.8±1.04 (05)	NS
Horn diameter (cm)	2.9±0.67 (03)	3.3±0.75 (02)	3.0±0.44 (05)	NS
Ear length (cm)	12.5±0.73 (03)	14.5±0.50 (02)	13.3±0.66 (05)	NS
Ear breadth (cm)	4.7±0.37 (03)	5.8±0.50 (02)	5.2±0.37 (05)	NS
Neck length (cm)	13.3±0.88 (03)	14.3±0.75 (02)	13.7±0.58 (05)	NS
Neck diameter (cm)	32.0±5.20 (03)	36.0±4.00 (02)	33.6±3.27 (05)	NS
Tail length (cm)	11.7±0.82 (03)	10.3±1.25 (02)	11.1±0.70 (05)	NS
Tail breadth (cm)	3.8±0.17 (03)	3.4±0.10 (02)	3.7±0.14 (05)	NS
Foreleg length (cm)	44.7±2.73 (03)	43.0±2.00 (02)	44.0±1.67 (05)	NS
Hind leg length (cm)	46.2±3.09 (03)	46.0±3.00 (02)	46.1±1.94 (05)	NS
Testicular length (cm)	8.0±1.53 (03)	11.3±1.75 (02)	9.3±1.28 (05)	NS
Testicular diameter (cm)	15.4±3.19 (03)	19.3±2.25 (02)	16.9±2.11 (05)	NS

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

Preliminary results reveal that three different coat color goats are morphologically homologous to each other. However, it is essential to get more information from large population for drawing conclusions about the findings of different coat color variants' goat which require more times.

Performance evaluation of Boer vs. Jamunapari goat and study of genetic diversity

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Executive Summary

The indigenous goats available in Bangladesh are not able to meet up our huge demand of meat due to their smaller body size and lower growth. Boer Goat (*Capra hircus*) is considered to be one of the most desirable goat breeds for meat production. They are higher growth rate, drought resistance, tolerance to tannins, can digest fiber efficiently and adaptation to various ambient temperatures. Another type goat in our country named Jamunapari or Jamnapari goat and popularly called Ram Chaagol and their crosses are available throughout the country. They are the tallest dual breed and commonly known as the *Pari* (Angel) in its area of origin - Uttar Pradesh - because of its majestic appearance. The Jamunapari is well adapted to the unique ravines of this area with its dense bush. Small ruminants in our country exhibit variable performances. Considering the increased demand of meat, milk and skin, through goat development program in the country, Bangladesh Livestock Research Institute has under taken this project with the objectives toevaluate the productive and reproductive performances of Boer and Jamunapari goat, to study genetic variation in different goat population of Bangladesh and their relationship with Boer goat using Microsatellite marker and to evaluate the adaptability of Boer goat at hot and humid climatic conditions. Initially, ten(10) does and two (2) buck of Boer goats were collected from Bengal Livestock and Fodder, a sister concern of Bengal Meat. Similar number of Jamunapari cross bred 'does' and bucks were also reared at Goat Research Farm, BLRI. Within breed pure breeding program was followed at Goat Research Station of Bangladesh Livestock Research Institute, Savar, Dhaka, in such a way, which maintained as minimum inbreeding level as possible. Green grass was supplied *adlib* basis and concentrate (17% CP, 11MJ ME/kg DM) was offered twice daily (morning and evening) at the rate of 300g per head per day. Subsequently, data on phenotypic measurement, productive and reproductive performances was recorded and analyzed by SPSS 17.0 Statistical computer programme.

Table1. Productive and Reproductive performances of Boer and Jamunapari goat

Parameter	Boer Goat (Mean±SE)	Jamunapari Goat (Mean±SE)	Level of Significance
Birth weight (kg)	3.36^{a} ±0.07 (105)	1.73^{b}±0.08 (35)	***
Growth rate (kg/d) (up to 120 days)	0.156^{a}±0.02 (10)	0.064^{b}±0.01 (9)	***
Weaning weight (kg)	13.78^{a}±1.31 (13)	9.59^{b}±0.49 (33)	***
Weaning age (days)	95.00^{a}±2.09 (13)	124.33^{b}±2.31 (33)	***
Age at sexual maturity (days)	285.00^{a}±20.05 (5)	396.43^{b}±35.08 (7)	*
Weight at sexual maturity (kg)	24.42^{a}±1.22 (5)	18.52^{b}±0.99 (7)	**
Litter size (no)	1.55^{b}±0.07 (65)	1.93^{a}±0.12 (30)	**
Post kidding body wt. (kg)	46.02^{a}±1.97 (10)	31.61^{b}±1.08 (28)	***
Placenta wt.(kg)	0.61^{b}±0.09 (7)	0.36^{a}±0.02 (29)	***
Post Partum Heat Period (days)	145.33^{b}±43.88 (3)	72.06^{a}±5.94 (15)	**
Kidding interval (days)	278.13±12.77 (16)	251.73±14.32 (11)	NS
Gestation length (days)	149.00±1.90 (6)	147.29±1.05 (27)	NS

Means with uncommon superscripts differ within the same rows significantly. Figures in the parenthesis indicate the number of observation.*= Significant at 5% level of probability ($p<0.05$), **= Significant at 1% level of probability ($p<0.01$), ***= Significant at 0.1% level of probability ($p<0.001$), NS= Not significant ($p>0.05$).

Table1 shows the productive and reproductive performances of Boer and Jamunapari goat. The birth weight, growth rate, weaning weight and post kidding weight of does in Boer goat were significantly ($p<0.001$) higher while weaning age ($p<0.001$) and age at sexual maturity ($p<0.05$) were significantly lower than Jamunapari goat. Weight at sexual maturity of Boer goat (24.42±1.22) were significantly ($p<0.01$) higher than Jamunapari goat (18.52±0.99). The litter size of Jamunapari goat (1.93±0.12) was significantly ($p<0.01$) higher than Boer goat (1.55±0.07). The Post Partum Heat Period of Jamunapari goat (72.06±5.94 days) was significantly ($p<0.01$) lower than Boer goat (145.33±43.88 days).

For the evaluation of performances of any breed, it is necessary to know the purity of the breed because pure breed shows different performances than crossbred. For that reason, this activity was under taken. To study genetic variation in different goat population of Bangladesh and their relationship with Boer goat using Microsatellite marker, a total of eighty (80) blood samples, twenty (20) from each population were collected from adult goat of (i) Black Bengal , (ii) Jamunapari , (iii) Hilly goat and (iv) Boer. Samples were collected only from goat of BLRI flock, Bengal Meat and Naikhonchari Regional station of BLRI, Banderban. All samples were collected those animals that were not related each other. Bloods were collected by venoject tube, treated with anticoagulant and carried to Goat and Sheep Production Research Division Health Laboratory of BLRI and preserved at -20^{o}C in refrigerator until DNA extraction. DNA was extracted from blood samples using a commercial kit (QIAGEN DNA Mini Kit) following manufacturer instruction. DNA samples were quantified using Nanodrop 2000 spectrophotometer. PCR using microsatellite markers will be performed and data will be analyzed for genetic diversity analysis. Polymorphic alleles will be identified through agarose gel electrophoresis of PCR products. Thirteen ISAG-FAO recommended microsatellite markers (FAO, 2011) will be used in this study, their sequences, size range and chromosomal locations are shown in Table 2.

Table 2. Microsatellite markers, their sequences, size range and their locations

Primer Name	Chromosome	Primer sequences	Annealing temperature	Allele range
MAF065	OAR15	F: AAAGGCCAGAGTATGCAATTAGGAG R: CCACTCCTCCTGAGAATATAACATG	58	116-158
MAF70	BTA4	F: CACGGAGTCACAAAGAGTCAGACC R: GCAGGACTCTACGGGGCCTTTGC	65	134-168
SRCRSP5	CHI21	F: GGACTCTACCAACTGAGCTACAAG R: TGAAATGAAGCTAAAGCAATGC	55	156-178
OarFCB48	OAR17	F: GAGTTAGTACAAGGATGACAAGAGGCAC R: GACTCTAGAGGATCGCAAAGAACCAG	58	149-173
OarAE54	OAR25	F: TACTAAAGAAACATGAAGCTCCCA R: GGAAACATTTATTCTTATTCCTCAGTG	58	115-138
OarFCB20	OAR2	F: GGAAAACCCCCATATATACCTATAC R: AAATGTGTTTAAGATTCCATACATGTG	58	93-112
MCM527	OAR5	F: GTCCATTGCCTCAAATCAATTC R: AAACCACTTGACTACTCCCCAA	58	165-187
ILSTS087	BTA6	F: AGCAGACATGATGACTCAGC R: CTGCCTCTTTTCTTGAGAG	58	135-155
ILSTS011	BTA14	F: GCTTGCTACATGGAAAGTGC R: CTAAAATGCAGAGCCCTACC	58	250-300
ILSTS005	BTA10	F: GGAAGCAATTGAAATCTATAGCC R: TGTTCTGTGAGTTTGTAAGC	55	172-218
LSTS029	BTA3	F: TGTTTTGATGGAACACAG R: TGGATTTAGACCAGGGTTGG	55	148-170
MAF209	CHI17	F: GATCACAAAAAGTTGGATACAACCGTG R: TCATGCACTTAAGTATGTAGGATGCTG	55	100-104
BM6444	BTA2	F: CTCTGGGTACAACACTGAGTCC R: TAGAGAGTTTCCCTGTCCATCC	65	118-200

F: Forward primer; R: Reverse primer

Most of the productive and reproductive parameters of Boer goat were significantly higher than Jamunapari goat. The study is going on and more data will be collected up to the significant results.

Improvement of Black Bengal Goat through community breeding

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Executive Summary

Bangladesh has only one goat breed of its own, popularly known as the Black Bengal goat. It is also observed that there are wide variations in color, body size and weight of goats found in different locations (Husain, 1993). The Black Bengal is a dwarf breed of goats and known to be famous for its high adaptability, fertility, prolificacy, delicious meat and superior skin (Devendra and Burn, 1983, Devendra, 1985, Saadullah, 1991 and Husain *et al*, 1996). Selection is one of the vital tools for improving the native genetic resources. Since 1988, the Bangladesh Livestock Research Institute has been attempted to improve Black Bengal goat through selective breeding. In this situation, "Co-operative Village Breeding Program" may play a vital role in the improvement of indigenous goat. Such type of breeding program was tested in Africa as "Community Breeding Program" and found to be very successful (Husain, 2004).The primary objectives of community breeding program is to improve indigenous goat and provide smallholder goat farmers with improved breeding animals particularly males. The objectives of this study are to evaluate the productive and reproductive performances of Black Bengal goat at farm and farmer level, to improve the Black Bengal goat at farmer level and to improve livelihood of community farmer through rearing Black Bengal goat. The research was conducted at three villages namely Pachpai, Borochala and Gangatia under Bhaluka Upazilla, Mymensingh district. A well organized questionnaire was developed for baseline survey through Participatory Rural Appraisal (PRA) which was helped to know population number of Black Bengal goat, local management, feeding and breeding system of Black Bengal goat, available local breed of goat, social status of farmers etc. Fifty (50) farmers were selected randomly in the project area to conduct baseline survey. Fourteen (14) farmers were selected randomly on the basis of elaborate questionnaire who had at least 4-5 years Black Bengal goats rearing experiences to form goat rearing community in the project site area.

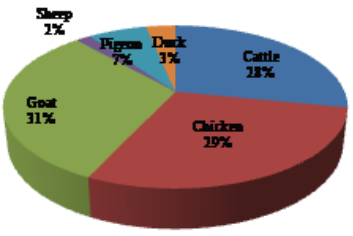

Figure 1. Types of livestock rear

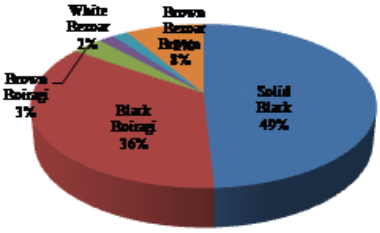

Figure 2. Coat color of goat

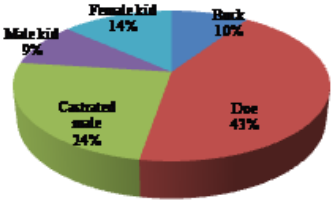

Figure 3. Type of goat rear

Table 2. Reproductive performances of goat	
Parameters	Mean±SE
Age at first heat (m)	8.87±0.19 (49)
Age at first kidding (m)	13.85±0.19 (49)
Litter size (no)	1.92±0.06 (49)
Service per conception (no)	1.08±0.04 (46)
Birth weight (kg)	1.49±0.02 (49)
Age at sold (m)	25.42±1.25 (41)
Weight at sold (kg)	19.48±0.61(42)
Market prize (Tk.)	5964.29±349.86 (42)
Service cost (Tk.)	33.66±0.91(41)

Twenty (20) maiden does from Goat Research farm, BLRI were given to 10 selected farmers and 6 superiors bucks were also given to the 4 buck rearing farmers. There was a control group (10 nos.) at Goat Research farm at BLRI. Goats of each farmer in the community were identified through the giving identification number. A well organized recording card was given for recording of each of the goat in each farmer's house in the goat rearing community. After certain period the buck will be exchange to prevent inbreeding at farmer's level. Routine vaccination and de-worming were practiced. Obtained information was putted and stored on to the Excel spread sheet. Then data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0.

Among livestock, 31 % goat, 29% chicken and 28% cattle were reared in the project areas. 49% goats were solid Black and 36% were Black Boiragi. 43% and 24% goats were doe and Castrated male, respectively (Fig. 1, 2 and 3). Table 1 shows the socio-economic status of the farmers. Maximum family head was men (90%). The profession of the farmer was agriculture (80%). Most of the farmer's family earning person was one (86%). The education level of the farmers was 32% illiterate and 36% were also completed primary education (1-5 class). The average family size, annual income and land size were 4.28±0.15, 83910.00±4330.61 Tk. and 45.78±6.12 decimal, respectively. Farmer's goat rearing experience was 11.70±1.05 years. Table 2 shows the some reproductive performances of goat in the project site. Age at first heat, age at first kidding, litter size and birth weight of goat were 8.87±0.19 months, 13.85±0.19 months, 1.92±0.06 and 1.49±0.02 kg, respectively.

Table 1. Socio-economic status of the goat rearing farmers

Parameter	Category	Number of farmers	%
Head of the family	Self	5	10
	Others	45	90
Sex of head of family	Men	45	90
	Women	5	10
Profession	Agriculture	40	80
	Business	1	2
	Govt. service	1	2
	Daily labour	5	10
	Others	3	6
Earning person	One	43	86
	Two or above	7	14
Education level	Illiterate	16	32
	1-5 class	18	36
	6-10 class	11	22
	SSC pass	3	6
	HSC pass	2	4
Family size (no)	4.28±0.15 (50)		
Annual income (Tk.)	83910.00±4330.61 (50)		
Land size (deci.)	45.78±6.12 (50)		
Goat rearing experience (years)	11.70±1.05 (50)		

Table 3. Rearing and management of goats in the studied areas

Parameter	Category	Number of farmers	%
Rearing system	Extensive	2	4
	Semi-intensive	37	76
	Intensive	10	10
Type of grazing field	Crop field, road side and open field	30	65
	Low land, crop field, road side and open field	8	18
	Crop field and open field	4	9
	Road side and open field	1	2
	Crop field	2	4
	Road side	1	2
Type of farmers	As usual	1	2
	Commercial	3	6
	Community	44	92
Type of house	Goat house	3	8
	Farmers house	1	2
	Cattle house	17	44
	Baranda	1	3
	Deshi goat rearing house	8	20
	Others	9	23
	From farmer house	7	17
Deworming practice	Yes	49	98
	No	1	2
Vaccination	Yes	45	90
	No	5	10

Maximum farmers (76%) were reared their goats by semi-intensive systems. 65% farmers were used crop field, road side and open field as grazing filed for goats. 44% and 20% farmers were kept their goats in cattle house and Deshi goat rearing house, respectively. 98% and 90% farmers were practiced deworming and Vaccination program, respectively. Twenty (20) maiden does and 6 bucks were distributed to the 14 selected farmers. Different data were recorded in flock record keeping book regularly and the study will be continued until significant to build model community based goat production.

Annual Research Review Workshop 2016

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