Annual Research Review Workshop-2015

Date: 17-18 June 2015

BLRI Conference Hall

3rd floor, Building 3

PROGRAMME

Bangladesh Livestock Research Institute
Savar, Dhaka-1341, Bangladesh

TECHNICAL SESSIONS

Day 1: Wednesday, 17 June, 2015

Technical Session I : **Nutrition, Feeds and Feeding Biotechnology**
Chairperson : **Dr. A M M Tareque**
Professor (Retd.)
Bangladesh Agricultural University, Mymensingh
Co-Chairperson : **Dr. M Jasimuddin Khan**
Professor
Bangladesh Agricultural University, Mymensingh
Rapporteurs : **Dr. SM Amanullah**, SSO, BLRI
Dr. Md. Rakibul Hasan, SO, BLRI

09:00-09:10	Effect of developed and commercial vitamin mineral premix on the growth performance, meat yield traits and internal organ development of broiler chicken	MSK Sarker SSO, BLRI
09:10-09:20	Detection of heavy metals in poultry feed, meat and eggs	A Rashid SO, BLRI
09:20-09:30	Comparative study on feeding values of sole Moringa and other available roughages	BK Roy SSO, BLRI
09:30-09:40	Feeding effects of increasing concentrate levels with different quality silages on beef production performance of native growing bulls	N Huda SO, BLRI
09:40-09:50	Biometrical ranking of available fodder crops	KS Huque CSO, BLRI
09:50-10:00	Study of Moringa plant fodder agronomy and its feeding to ruminants	MK Basher SO, BLRI
10:00-10:10	System modeling for food waste to feed production (F_2F)	NG Das SO, BLRI
10:10-10:20	Effect of pre and post-natal nutrition on the performances of ewes and their lambs	S Ahmed SO, BLRI
10:20-10:30	Effect of replacement of conventional concentrate in a straw diet by Moringa foliage on lamb production performances	N Sultana PSO, BLRI
10:30-10:40	Development of Feed Master Android Application (Thumb rule Version)	MA Kabir SO, BLRI
10:40-11:00	**Tea Break**	
12:30-12:40	Study on the effect of organic manure on production performance of BLRI-Napier-3 and comparative economic analysis of fodder production with rice	MR Islam SO, BLRI
12:40-12:50	Study the feeding effect of silage and soybean straw based total Mixed Ration (TMR) in growth performances of growing calves	D Yesmin SO, BLRI

12:50-01:00	Effect of feeding different high yielding fodders on growth performance of growing Brown Bengal goats	MM Rahman SO, BLRI
01:00-02:00	**Lunch & Prayer Break**	
02:00-02:10	Seasonal dynamics feed resources utilization and management as influenced by different coastal and river basin areas of Bangladesh	MA Habib SSO, BLRI
02:10-01:20	Study the adaptability, biomass yield, nutritive value of HYV fodders cultivars under different saline condition in Southern districts of Bangladesh	NR Sarker PSO, BLRI
02:20-02:30	Study on the effect of organic manures on biomass yield and nutritive values of BLRI Napier -3 and feeding effect in dairy cows	MR Amin SO, BLRI
02.30-2.40	Study on manure management practices in Bangladesh and their impacts on climate	JS Khanam SO, BLRI
02:40-03:00	**Discussion**	

Technical Session II : **Socioeconomics and Farming System Research**

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

Co-Chairperson : **Dr. Md. Shahadat Hossain**
Chief Scientific Officer
Bangladesh Agricultural Research Institute

Rapporteurs : **Dr. Sadek Ahmed**, SO, BLRI
Ms. Sabina Yeasmin, SO, BLRI

03:00-03:10	Evaluation of existing livestock and poultry policies and provide guidelines for development in Bangladesh	R Haque PhD fellow
03:10-03:20	Marketing and Value Chain Analysis of Live Poultry in Savar Upazila	MS Islam SO, BLRI
03:20-03:30	Development of blended yarns and fabrics from jute, cotton and native sheep wool	M Earsha-duzzaman PSO, BLRI
03:30-03:40	Impact of farmers training on adoption of BLRI developed technologies	MZ Rahman SSO, BLRI
03:40-04:00	**Discussion**	

Day 2: Thursday, 18 June, 2015

Technical Session III : **Livestock and Poultry Disease and Health Biotechnology**

Chairperson : **Dr. Nitish Chandra Debnath**
Ex Vice Chancellor
Chittagong Veterinary and Animal Science University

Co-Chairperson : **Dr. Abu Hena Mostafa Kamal**
Professor
Sylhet Agricultural University, Mymensingh

Rapporteurs : **Dr. Md. Abdus Samad**, SO, BLRI
Dr. Md. Hafizur Rahman, SO, BLRI

09:00-09:10	Avian Influenza Viruses Monitoring in Possible "Bridge" Species of Wild and Domestic Birds in Bangladesh	M Giasuddin PSO, BLRI
09:10-09:20	Development of polyclonal antibody based PPRV detection system	MR Islam PSO, BLRI
09:200-09:30	A pilot project on Peste des Petits Ruminants (PPR) control in selected areas of Bangladesh	MR Islam PSO, BLRI
09.30-09:40	Development of herbal anthelmintic against internal parasites-GI nematodes of sheep	MN Munshi SO, BLRI
09:40-09:50	Prevalence of *Salmonella spp*. in poultry and poultry products in Bangladesh	MR Karim SO, BLRI
09:50-10.00	Outbreak and Distribution of Foot and Mouth Disease Virus Serotypes in Bangladesh	MS Mahmud
10:00-10:20	**Discussion**	
10.20-10.40	**Tea Break**	

Day 2: Thursday, 18 June, 2015

Technical Session IV : **Genetics, Breeding and Animal Biotechnology**

Chairperson : **Dr. Syed Shakhawat Hossain**
Professor
Bangladesh Agricultural University, Mymensingh

Co-Chairperson : **Dr. Khondoker Moazzem Hossain**
Professor, Khulna University, Khulna

Rapporteurs : **Dr. Gautam Kumar Deb**, SSO, BLRI
Dr. Parvin Mostari, SSO, BLRI

10:40-10:50	Production of calves through transfer of *in vitro* produced cattle embryos	GK Deb SSO, BLRI
10:50-1:00	Selection of suitable exotic beef breed (s) and performance evaluation of their crosses with native cattle	MP Mostari SSO, BLRI
11:00-1:10	Study on candidate genes for milk production traits of Red Chittagong Cattle	MYA Khan SO, BLRI
11:10-11:20	Study on estrous synchronization, conception rate and comparative performance of crossbred & native buffalo calves	MF Afroz SO, BLRI
11:20-11:30	Conservation and improvement of Munshiganj Cattle	SMJ Hossain PSO, BLRI
11:30-11:40	Study on the performances of Boer and Jamunapari goat at BLRI	P Choudhury SO, BLRI
11:40-11:50	Community based sheep production in Hilly area at Naikhonchari	MM Rahman SO, BLRI
11:50-12:00	Conservation and improvement of Hilly chicken at Naikhongchari regional station	MA Alam SO, BLRI
12:00-12:10	Effects of strains and ambient temperature and their interaction on production performance, egg quality and physiological response of laying hens	MR Hassan SO, BLRI
12:10-12:20	Laying performances of BLRI layer-2 (Shorna) under farmers condition	MA Rashid SO, BLRI
12:20-12:30	Performance of fourth generation of native chicken	S Faruque SSO, BLRI
12:30-12:40	Performance of fourth generation of quail	MY Ali SO, BLRI
12:40-12:50	Conservation, improvement and feeding system development of native duck genotype	H Khatun SO, BLRI
12:50-01:00	Screening of salt tolerance, genetic divergence of HYV fodders through hydroponic, tissues culture and RAPD markers	MK Alam PhD Fellow
01:00-01:30	**Discussion**	
01:30-02:30	**Lunch & Prayer Break**	

INAUGURAL SESSION

(17 June, 2015)

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 Honour : **Mr. Ajay Kumar Ray**
Director General,
Department of Livestock Services

Chairperson : **Dr. Md. Nazrul Islam**
Director General
Bangladesh Livestock Research Institute

11:00-11:05	Guests take their seats
11:05-11:15	Recitation from the Holy Quran
11:15-11:25	Opening remarks and welcome address **Dr. Md. Nazrul Islam** Director General Bangladesh Livestock Research Institute
11:25-11:35	Address by the Guest of Honour **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
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
(18 June, 2015)

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

Special Guest : **Shelina Afroz, PhD**
Secretary
Ministry of Fisheries and Livestock

Guest of Honour : **Dr. Md. Kamal Uddin**
Director General
Bangladesh Jute Research Institute

Chairperson : **Dr. Md. Nazrul Islam**
Director General
Bangladesh Livestock Research Institute

03:00-03:05	Recitation from the Holy Quran
03:05-03:20	Presentation of workshop recommendation
03:20-03:40	Open discussion
03:40-03:50	Address by the Guest of Honour **Dr. Md. Kamal Uddin** Director General Bangladesh Jute Research Institute
03:50-4:00	Address by the Special Guest **Shelina Afroz, PhD** Secretary Ministry of Fisheries and Livestock
4:00-04:10	Address by the Chief Guest **Mr. Narayon Chandra Chanda, MP** Hon'ble State Minister Ministry of Fisheries and Livestock
04:10-04:30	Vote of thanks by the Chairperson **Dr. Md. Nazrul Islam** Director General Bangladesh Livestock Research Institute
04:30-5:00	**Refreshment**

CONTENTS

Project title: Development of vitamin mineral premix for commercial broiler with available resources and proper processing of poultry

Sub-title: Effect of developed and commercial vitamin mineral premix on the growth performance, meat yield traits and internal organ development of broiler chicken

MSK Sarker[1]*, MN Islam[2], H Khatun[1], MY Ali[1], MM Rana[1], S Faruque[1] and NR Sarker[1]

[1]Poultry Production Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka
[2]Director General, Bangladesh Livestock Research Institute, Savar, Dhaka
(*Correspondence: sazdulkarim@yahoo.com)

Executive Summary

Vitamin-mineral are needed as a very small percentage of dietary nutrients for proper functioning of the body such a bone development, immune function, muscle contraction and nervous system function. Although some of them may have boosting effects on poultry production but in some cases they may be used unnecessary. Some of them have deleterious residual effects on human health or some may not respond cost effectiveness. Anything used unnecessarily or without considering their residual effects are a potential threat to the emerging poultry enterprise of this country. Nowadays, the consumers have become very concerned about food safety and their fear relating to the use of growth promoters (antibiotic, drugs or vitamin mineral premixes) in poultry feeding has been widely expressed worldwide (Sarker et al., 2014). Since 2001, almost all vitamins with the exception of vitamin C are dietary essentials for poultry and appetite, metabolism, growth and production of poultry are greatly affected by the deficiency of vitamin B-complex (Saif *et al.*, 2008). They have positive effect on the growth performance of chickens in terms of improving feed utilization and metabolism, stimulating the immune system and minimizing many stresses (Sahin *et al.*, 2003).Chickens are more susceptible to vitamin deficiency because gut flora can synthesize very little amount of vitamins, and therefore complete absence of dietary vitamins in chickens kept intensively undergoes many stresses (Ward, 1996). The commercial poultry feed producers add vitamins-minerals and growth promoters in required amount to feed during manufacturing. The information about listing the vitamin-mineral premixes used for poultry production in Bangladesh. The study was conducted to determine the effect of VMP on growth performance, meat yield traits and internal organ development of broilers.

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, Zinc and Selenium were used. At first fat soluble vitamins and water soluble vitamins were mixed then all mineral containing salts were mixed together. Fine rice polish and calcium carbonate were mixed with vitamin and mineral respectively as binder and formulated the DVMP as per recommendation. A total of 270 day-old broiler chicks were randomly weighed and assigned to six dietary treatments Control and combination of DVMP+CVMP in a group of 45 birds each according to following CRD experimental layout. Each dietary treatment had 45 birds with three replicates of 15 birds. The experimental design was Completely Randomized Design (CRD) and the supplementing vitamin mineral premixes (both DVMP and CVMP) with day old broiler chicks are shown in Table 1.

Table 1. The dietary groups are consisted with DVMP & CVMP

Control	DVMP %+ CVMP%				
Diet 1 (Control)	Diet 2 (0+100)	Diet 3 (25+75)	Diet 4 (50+50)	Diet 5 (75+25)	Diet 6 (100+0)
15	15	15	15	15	15
15	15	15	15	15	15
15	15	15	15	15	15
45	45	45	45	45	45

Total broiler chicks = (15×3) ×6 = 270 day old age
Experimental Diet: According to BSTI (2005)
Starter: CP: 21%, Energy (ME Kcal/kg diet): 2900
Finisher: CP 19%, Energy (ME Kcal/kg diet): 3100
Duration of the study: a) Filed trail (Starter 21 days + Finisher 14 days) = 35 days
Data collection: Weight gain, Feed intake, FCR
Statistical analysis: SAS 9.1 (2006), USA

* DVMP - Developed Vitamin Mineral Premix, CVMP – Commercial Vitamin Mineral Premix

Table 2: Effect of developed and commercial vitamin mineral premix on growth performance of broiler

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	LS
IBW (g)	43.35±0.02	43.35±0.04	43.37±0.03	43.33±0.02	43.33±0.02	43.38±0.00	NS
FW (g)	2134±13.86	2030±36.72	2104±67.35	2081±34.04	2188±88.75	2161±59.75	NS
WG (g)	2091±13.86	1987±37	2060.67±67	2038.33±34	2145±89	2117.33±59	NS
FI (g)	3402^{ab}±18	3530^{a}±90	3379^{ab}±102	3296^{ab}±48	3242^{b}±50	3418^{ab}±134	*
FCR	1.63±0.02	1.77±0.03	1.64±0.01	1.62±0.02	1.51±0.01	1.61±0.02	NS

IBW = Initial body weight, FW = Final weight, WG = Weight gain, FI = Feed intake
^{a,b} means having different superscripts in the same row differ significantly, *: p<0.05, NS: p> 0.05

Table 3.Effect of developed and commercial VMP on meat yield traits, and organs of broiler chicken

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	LS
Live wt (g)	2105±44	2101±60	2058±91	2075±11	2160±75	2114±59	NS
Drum wt (g)	167±3.51	174±8.07	169.50±6.04	165.83±3.08	168.00±8.83	174.83±6.34	NS
Thigh wt (g)	181±9.86	205±8.97	200±11.43	200±7.03	206±6.11	200±4.97	NS
Breast wt (g)	550±7.88	546±13.28	556±23.68	544±11.29	571±34.36	580±44.25	NS
Small Intwt (g)	56^{a}±1.73	47^{abc}±2.24	43c±2.84	47^{bc}±1.45	47^{abc}±4.88	53^{ab}±1.75	*
Large Intwt (g)	20±0.66	19±1.87	20±0.60	18±1.15	20±0.76	18±0.92	NS
Abdom. fat (g)	20±1.36	19±1.01	18±2.89	16±1.48	18±1.04	15±2.84	NS
Dress wt (%)	74.25±.39	74.62±0.07	74.36±1.05	75.34±1.49	75.72±1.77	75.83±0.22	NS

^{a,b} means having different superscripts in the same row differ significantly, *: p<0.05, NS: p> 0.05

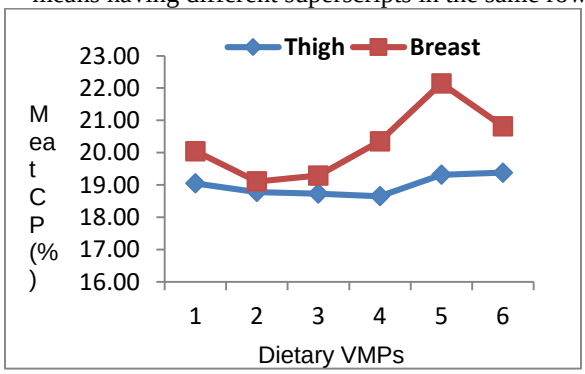

Figure 1. Dietary VMPs & meat CP

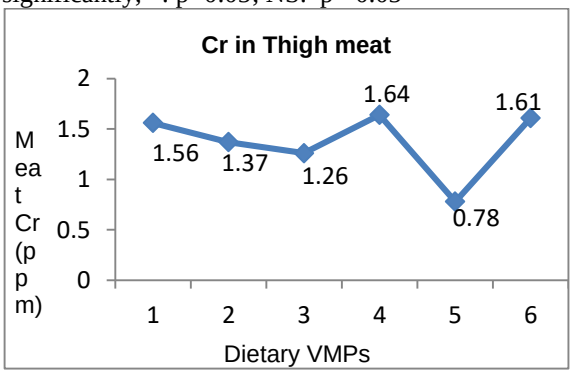

Figure 2. Dietary VMPs & meat Cr

Significantly reduced feed intake was calculated in diet 5 with increased WG and lowest FCR (Table 2).No remarkable variations in internal organ development were noticed except small intestine (Table 3). Increased CP in breast meat (Figure 1) and lowest Cr in thigh meat (Figure 2) were found in diet 5 compare to others. The DVMP showed suitable and about 75% of it may be substituted in the diet of broiler chicken. These findings will indirectly reduce the dependency of imported vitamin mineral premixes and to enhance broiler production in Bangladesh.

Project title: Detection of heavy metals in poultry feed, meat and eggs

MA Rashid, MSK Sarker, NR Sarker, H Khatun, R Khatun and MN Islam

Bangladesh Livestock Research Institute, Savar, Dhaka-1341.

Executive summary

Metals such as Fe, Cu, Mg, Co, Zn are essential for human body but chronic metabolic disturbances may occur due to the deficiency or excess of these metals. Non essential elements such as Pb, Cd, Cr, Ni and As are considered to be toxic and their presence in the body can cause profound biochemical and neurological changes in the body. Due to various consequences the contaminants may enter in to the food chain. Since the poultry products (egg and meat) comparatively cheaper and easily available; therefore, a wide range of consumers intake the poultry products. On the other hand, to make a brisk business some unscrupulous businessmen often add the toxic tannery waste in poultry feeds as protein source, through which the toxic component may enter into the poultry meat and eggs. Recently, heavy metal poisoning in human through poultry products has been earning due attention by the experts; especially for arsenic, lead and chromium. However, literatures' regarding the study of heavy metals in eggs and meat is scant. Therefore, as food safety issues, it is essential to knowthe extend of heavy metal presence in poultry feeds, meat and eggs. With those ideas in mind, the present study was aimed to detect the heavy metals (As, Pb& Cr) in poultry feed, meat and eggsto compare with recommended level for human health. In order to get real scenario about the presence of heavy metals content in poultry feeds, meat and eggs; samples were collected from major poultry rearing areas of the country e.g. Dhaka (Savar, Dhamrai, Gazipur), Chittagong and Sorupkati, Pirojpur. Other than these areas, samples were collected from Narsingdi, Narayanganj, Dinajpur, Sherpur, Jamalpur, and Bogra. In addition, some market samples from Savar, Nabinagar and Nimtoli, Dhaka were collected. To collect the representative sample both from the branded ready feed and locally made loose feed, the farm and market samples, and the urban and peri-urban samples were also collected. In most cases, feed samples were collected along with the eggs and/or meat samples from the same farm. A total of 360 samples for As, Pd and Cr were analyzed from 120 different poultry feed, meat and egg samples. To determine the presence of heavy metals in eggs, the egg samples were boiled and oven dried the yolk and albumen separately for 72 hours with 75-80^{0}C temperature and then make it powder using grinder machine. Meat samples were collected from breast, thigh and drumstick parts of the body then minced by mincing machine and oven dried similar ways done for egg samples and finally made powder by grinder. Feed samples collected from the fields were packed properly giving individual code number and send to laboratory for analysis. Then, 0.5 gram of sample was weighed and transferred to 100 ml of glass beaker. Then 5 ml of pure HNO3 and 1 ml of HClO4 were added and allowed for over night, then the beaker was placed on hot plate to raise its temperature up to 140 -180oC until the sample completely digested with reducing of its volume to 1–3 ml. The digested sample was cooled, diluted with deionizing water and made up to 100 ml in a standard flask. The processed samples were analyzed for the estimation of heavy metals at the laboratory of Soil Science Division, Bangladesh Agricultural Research Institute (BARI), Gazipur; using Atomic Absorption Spectrophotometer (Model: Thermo Scientific-s-series AA Spectrometer, USA, Pb & Cr; Agilent technologies 200 series AA; 240 FJ AA, As) following the method developed by Tripathi *et al*.(2002) with little modifications. The results of heavy metal content are shown in the tables below. Table 1 show that all samples were positive for Cr content with varying level. Concentration of Cr in loose feed and protein concentrates were higher than in ready feed of layer and broiler. On the other hand, layer feed had lower (1.98 ppm) concentration than that of broiler feed (9.09 ppm). Higher concentration (6.36 ppm) was found in the meat of spent hen than in broiler (1.02 ppm) and cockerels (trace).

Table1 Chromium (Cr) content in different samples

Type of sample		No. of sample	"+ ve"/ "- ve"	Level of Content			Maximum Permitted Conc. (ppm)
				Trace (%)	Max. (ppm)	Min (ppm)	
Layer feed	Ready	13	+ ve	50	1.98	0.03	20-30**
	Loose	20	+ ve	55	358.05	0.69	
Broiler feed	Ready	23	+ ve	57	9.09	0.12	20-30**
Protein concentrate	-	9	+ ve	11	1720	0.9	20-30**
Egg	Albumen	15	+ ve	87	0.19	0.16	1*
	Yolk	15	+ ve	100	-	-	
	Whole egg	12	+ ve	100	-	-	
Meat	Broiler	7	+ ve	86	1.02	-	1*
	Cockerel	3	+ ve	100	-	-	
	Spent hen	4	+ ve	25	6.36	0.51	

*Choi Ya Yin (2012); ** IAEA (International Atomic Energy Authority)

Table 2 shows that all samples were positive for Pb content with varying level. The maximum Pb found in Protein concentrate while the minimum level found in broiler meat samples. However, the trace indicates below undetectable limit of Thermo AAS (Pb=<0.01ppm and Cr= <0.01).

Table 2 Lead (Pb) content in different samples

Type of sample		No. of sample	"+ ve"/ "- ve"	Level of Content			Maximum Permitted Conc. (ppm)
				Trace (%)	Max. (ppm)	Min. (ppm)	
Layer feed	Ready	13	+ ve	93	0.75	-	10**
	Loose	20	+ ve	95	0.86	0.69	
Broiler feed	Ready	23	+ ve	100	-	-	10**
Protein Conc.	-	9	+ ve	78	30.27	3.34	10**
Egg	Albumen	15	+ ve	100	-	-	6*
	Yolk	15	+ ve	100	-	-	
	Whole egg	12	+ ve	100	-	-	
Meat	Broiler	7	+ ve	71	0.51	0.09	6*
	Cockerel	3	+ ve	100	-	-	
	Spent hen	4	+ ve	100	-	-	

Table 3 shows the arsenic level in various samples. All the tested samples were positive for As. The highest level found in broiler meat (0.09ppm) which exceeds the permitted level (0.04 ppm) and the lowest concentration was in the spent hen (0.003).

Table 3 Arsenic (As) content in different samples

Type of sample		No. of sample	"+ ve"/ "- ve"	Level of Content	Maximum Permitted Conc. (ppm)
				Max. (ppm)	
Layer feed	Ready	13	+ ve	0.08	1.4**
	Loose	20	+ ve	0.07	
Broiler feed	Ready	23	+ ve	0.03	1.4**
Protein Conc.	-	9	+ ve	0.04	1.4**
Egg	Albumen	15	+ ve	0.01	0.04*
	Yolk	15	+ ve	0.01	
	Whole egg	12	+ ve	0.004	
Meat	Broiler	7	+ ve	0.09	0.04*
	Cockerel	3	+ ve	0.02	
	Spent hen	4	+ ve	0.003	

From the above findings it may be concluded that all the tested samples were positive for all the three heavy metals (As, Pb & Cr); but, the contents were traces in many cases. Thus, the levels were not at the harmful limits except some of the feed samples for Cr & Pb, and broiler meat for As content. Therefore, investigation is needed to provide the guidance for regulatory authority in the country.

Project title: Study on improving feed efficiency of Pabna and RCC bulls
Sub-title: Comparative study on feeding values of sole Moringa and other available roughages

BK Roy, KS Huque, MK Bashar, N Huda and SMJ Hossain
Animal Production Research Division

Executive Summary

Increasing competition of feed availability and cost with an ever increasing demand for safe and high quality beef or dairy products may be minimized to some extent by improving feed efficiencies of animals. Applications of feed efficiency warrant consideration in the beef industry because 55 to 75% of the total costs associated with beef production are feed costs (NRC, 2000; Arthur et al., 2001; Basarab et al., 2002). Fibrous feeds mostly of crop residues, green grasses, and tree foliages & leaves support bulk diets of farm animals being raised mostly by smallholders (rear almost 70% of the total farm animals). The roughage DM produced (56082 million Kg DM) surpasses its demand (49200 million Kg DM) by 3.77%, but losses and otherwise uses result in production deficit of 44.6%. An average 56.2% deficit of roughage DM and 80.0% of concentrate DM results in a very poor plane of nutrition for farm animals in the country (Huque and Sarker, 2013). Any effort that explores quality of feeds and fodders and generate production technologies for making their biomass available to farmers may boost meat and milk production and productivity in the country. This requires qualitative evaluation of available roughages both in terms of chemical composition and feeding values to animals, and ranking them accordingly based on their yield, production cost, nutritional value and productivity. Such a ranking tool or scale may support farmers to feeding their animals cost effectively. Thus, the present research work was undertaken with the objectives of evaluating intake, digestibility and growth performances of growing cattle fed with Moringa plant fodder or Australian Sweet Jumbo keeping Maize silage as control.

Maize (*Zea mays*; Hybrid) and Australian Sweet Jumbo (*Sorghum bicolor*; "AS Jumbo") was cultivated, harvested at their optimum maturity and ensiled for feeding to experimental animals. Moringa (*Moringa Oleifera*) foliage was collected from BLRI fodder plot and processed accordingly having a leaf to stem ratio of 55:45 on DM basis. The three different types of roughage were randomly fed to 18 local growing bulls (Pabna & RCC) of 103.8±14.5 Kg live weight dividing them into three equal groups. The animals were housed individually and fed the roughage diets *ad libitum* for a period of 60 days including a 7 days digestibility trial after 50 days of feeding. The animals were weighed at an interval of 10 days, and their feed intake, digestibility of nutrients and growth performances were used for comparing the nutritional qualities of different roughages. The nutritional responses were compared statistically in an ANOVA of a Completely Randomized Design (CRD) using General Linier Model Procedures of SPSS, 17 computer software packages.

Table 1: Chemical composition of experimental diets

Diets	DM, % of fresh biomass	Chemical composition (%DM)				
		OM	CP	ADF	NDF	Ash
Maize silage	19.18	94.3	9.5	37.9	66.4	5.7
AS Jumbo silage	23.42	92.7	9.2	45.0	64.7	7.3
Moringa foliage	85.52	92.1	18.6	34.3	55.3	7.9

Among the three different roughages Moringa foliage had a higher level of crude protein (CP 18.6%) compared to others (varied from 9.2% to 9.5%), and 34.3% ADF, 55.3% NDF and 7.9% ash. The ADF & NDF content of Maize and AS Jumbo was 37.9% & 45.0% and 66.4% & 64.7%, respectively. Organic matter, as a percentage of DM, was the highest for Maize, followed by AS Jumbo and Moringa foliage (Table 1).

Maize, AS Jumbo and Moringa foliage had per head daily DM intake of 2.75 Kg, 2.46 Kg & 3.10 Kg, respectively, and their intake percent live weight was 2.51, 2.25 and 2.81%, respectively. Daily DM intake of bulls fed Moringa foliage was significantly higher ($p<0.01$) than those fed with Maize or AS Jumbo. A similar trend in CP ($p<0.001$) and OM ($p<0.01$) intake was found among the roughages. Moringa foliage had the highest DM (62.7%), CP (74.4%) or OM (62.8) digestibility, and they were significantly ($p<0.001$) higher than that of Maize or AS Jumbo. Among the dietary groups AS Jumbo fed bulls had a significantly ($P<0.01$) lower digestibility of DM, OM or CP. The digestible DM or CP intake was higher ($p<0.001$) in bulls fed with Moringa than the bulls fed with other roughages. Similarly, the metabolizable energy or metabolizable protein intake (28.4 MJ/day and 154.3 g/day) of bulls fed Moringa was higher ($p<0.001$) than those fed with Maize (23.6 MJ/day and 128.2 g/day) or AS Jumbo (18.5 MJ/day and 100.7g/day). Feeding Moringa foliage had significantly ($p<0.05$) higher average daily gain of 376 g compared to 289g of Maize or 218 g of AS Jumbo with an average feed conversion efficiency of 8.85, 11.52 and 13.08, respectively ($p>0.05$). The cost involvement for kg DM yield of Maize, AS Jumbo and Moringa foliage were Tk. 7.38, 6.68 and 7.50, respectively. However, the total roughage cost including refusal losses of kg live weight gain were Tk. 97.8, 105.7 and 80.3, respectively. Considering feed cost, Moringa foliage fed bulls required less feed cost than other two roughages. Considering the above data the roughages may be ranked as Moringa foliage>Maize>AS Jumbo.

Table 2: Nutritional responses of different roughages

Parameters	Diets			SED	Sig. Level
	Maize	AS Jumbo	Moringa foliage		
DM intake (Kg/d)	2.75^{b}	2.46^{b}	3.10^{a}	0.10	**
CP intake (Kg/d)	0.26^{b}	0.24^{b}	0.60^{a}	0.01	***
OM intake (Kg/d)	2.58^{ab}	2.28^{b}	2.87^{a}	0.09	**
DMI (Kg, % LW)	2.51^{ab}	2.25^{b}	2.81^{a}	0.12	*
DM digestibility %	59.6^{b}	53.83^{c}	62.67^{a}	0.82	***
CP digestibility %	60.11^{b}	58.74^{b}	74.38^{a}	0.83	***
OM digestibility %	61.56^{a}	55.83^{b}	62.84^{a}	0.81	***
DDMI (Kg/d)	59.63^{b}	53.83^{c}	62.67^{a}	0.82	***
DCPI (g/d)	0.16^{b}	0.14^{b}	0.45^{a}	0.01	***
ME intake (MJ/d)	23.56^{b}	18.48^{c}	28.35^{a}	0.87	***
MP intake (g/d)	128.2^{b}	100.7^{c}	154.3^{a}	4.77	***

Table 3: Growth responses, nutritional coefficient and FCR of native growing bulls fed different roughages

Parameters	Experimental diets			SED	Level of sig.
	Maize	AS Jumbo	Moringa foliage		
Initial LW (kg)	104.0	103.6	103.8	5.49	NS
Final LW (kg)	121.4	116.7	126.4	5.43	NS
Ave. daily gain, g	289^{ab}	218^{b}	376^{a}	40.6	*
FCR	11.52	13.08	8.85	1.70	NS
Nutritional Coefficient					
FCR response	1.00	0.88	1.30	-	-

Project title: Study on improving feed efficiency of Pabna and RCC bulls
Sub-title: Feeding effects of increasing concentrate levels with different quality silages on beef production performance of native growing bulls

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Executive Summary

Farmers always aim at achieving of higher productivity with lower feed consumptions. Quality of both silage and concentrate impacts growth performances and the latter replaces the former at a various extent depending on silage quality (Huque 1992). The feeding of concentrates is a major component of feed cost in cattle fattening, and along with limitations in supply (only 20% of the requirement, Huque and Sarker, 2014) its increasing market price considered to be impacted recent price hike of beef in the country. To produce low price meat, roughage to concentrate ratios in diets should be optimized. Thus, the present study was undertaken with the objectives to quantify optimum concentrate level with the silages of different nutritional qualities and harvest maximum growth performances of local growing bulls.

Maize (*Zea mays*; Hybrid) and Australian Sweet Jumbo (*Sorghum bicolor*; "AS Jumbo") were cultivated, harvested at their optimum maturity (90 and 75 days) and ensiled for feeding to experimental animals. The concentrates mixture consisting of crushed maize (12%), wheat bran (35%), Khesari bran (15%), til oil cake (15%), soybean meal (18%), common salt (2%), & dicalcium phosphate (3%) was mixed manually in every two weeks. A vitamin mineral premix was added at a level of 0.1% in the concentrate mixture. Forty eight (48) local growing bulls with an average initial live weight of 205.08 ±43.24 Kg (mean± SD) and an age ranged from 24 to 36 months were randomly divided into eight equal groups. Each treatment group having 6 bulls (3 Pabna + 3 RCC). Eight dietary treatments consisting two roughages and four levels of concentrates 0, 25, 50 and 75% (T_1 = Maize silage (MS) (100%) + concentrate (0.00%); T_2 = MS (75%) + concentrate (25%); T_3 = MS (50%) + concentrate (50%); T_4 = MS (25%) + concentrate (75%); T_5 = AS Jumbo silage (JS) (100%) + concentrate (0.00%); T_6 = JS (75%) + concentrate (25%); T_7 = JS (50%) + concentrate (50%); T_8 = JS (25%) + concentrate (75%) were assigned randomly to eight treatment groups. The animals were housed individually and fed the experimental diets for a period of two months including a 7 days digestibility trial after 25 days of feeding. The animals were weighed at an interval of 10 days, and their feed intake, digestibility of nutrients and growth performances were used for comparing the nutritional qualities of different roughages, level of concentrates and their interaction effects. The treatment responses were analyzed in an ANOVA of 2x4 factorial experiment in completely randomized design. All analyses were made using General Linier Model Procedures of SPSS, 17 computer software packages and the least significant difference test was used for comparing means.

Table 1: Chemical composition of experimental diets

Diets	DM, % of fresh biomass	Chemical composition (%DM)				
		OM	CP	ADF	NDF	Ash
Maize silage	20.54	94.23	9.41	37.24	64.03	5.77
AS Jumbo silage	24.89	92.42	9.10	44.98	67.98	7.58
Concentrate mix.	89.49	87.62	20.98	29.59	28.76	12.38

The chemical composition of the roughages and concentrate is shown in Table 1. Australian Sweet Jumbo had a higher fresh dry matter (24.9%) compared to Maize (20.54%). Feeding increasing level of concentrate from 0 to 75% of the diet increased daily total DM intake linearly (R^2=0.53) from 4.40 Kg/head to 6.84 Kg/head in Maize diets and 3.71 kg/head to 6.35 kg/head in AS Jumbo diet replacing roughage content of both Maize (100 to 39) or AS Jumbo diet (100 to 41). But, the average daily total DM, OM or CP intake, increased linearly ($p<0.001$) with increased concentrate levels. The DM intake was increased by 18.9, 38.6 and 55.5 per cent for maize and 21.3, 46.4 and 71.2 per cent for AS Jumbo in bulls fed silage to concentrate proportion of 75:25, 50:50 and 25:75, respectively compared to only silage feeding. Similarly, the relative CP intake was increased by 52.5, 120, 180 per cent and 48.6, 113.5 and 175.7 percent, respectively. Type of roughage had a significant effect on DM and OM intake; maize fed

bulls with varying levels of concentrate had significantly higher DM ($p<0.05$) and OM ($p<0.01$) intake (5.64 and 5.18 kg/d) compared to AS Jumbo (5.0 and 4.53 kg/d) with different levels of concentrates. The digestibility coefficients of DM ($p<0.05$), OM ($p<0.01$) and CP ($p<0.001$) were increased significantly by the presence of concentrate irrespective of silage types. However, NDF digestibility were decreased linearly ($R^2= 0.41$; $p<0.001$) with the increasing levels of concentrate in the diet with 6.3, 19.7 and 29.2 per cent increased of CP of Maize & concentrate diets and 15.4, 24.3 and 23.7 per cent increased of AS Jumbo and concentrate diets. Type of roughage had a significant effect on DM ($p<0.001$), OM ($p<0.001$), ADF ($p<0.01$) and NDF ($p<0.001$) digestibility. Feeding maize silage with graded levels of concentrate had a significantly higher digestibility of DM (60.6%), OM (63.5%), ADF (57.6%) or NDF (58.0%) compared to AS Jumbo silage with varying levels of concentrate and the values were 54.1, 57.0, 50.6 and 51.7%, respectively. However, the CP digestibility was not affected significantly ($p>0.05$) by silage type. Digestible DM ($R^2 = 0.53$) and DCP ($R^2=0.84$) intake increased linearly ($p<0.001$) with increased level of concentrate. Regardless of the type of roughage, animals fed with Maize silage with graded levels of concentrate consumed significantly higher DDM and DCP compared to feeding of AS Jumbo. Irrespective of silage type, the ADG ($p<0.001$) and FCR ($p<0.01$) improved with increasing concentrate levels. The average daily gain in bulls fed Maize silage & concentrate of 100:0.00, 75:25, 50:50 and 25:75 were 406, 697, 849 and 821 g, respectively. Similarly, the ADG of animals fed AS Jumbo silage to concentrate ratios of 100:0.00, 75:25, 50:50 and 25:75 were 284, 343, 504 and 677 g, respectively.

Table 2: Effect of silage type and level of concentrate on performances of local growing bulls

Item	MS: Concentrate				JS: Concentrate				Source of roughage		SED	Level of sig.		
	100:0	75:25	50:50	25:75	100:0	75:25	50:50	25:75	MS	JS		r	c	r x c
DMI (kg/d)	4.40	5.23	6.10	6.84	3.71	4.50	5.43	6.35	5.64^{a}	5.00^{b}	0.19	*	***	NS
DMI (kg; % LW)	2.13	2.43	2.69	3.10	1.81	2.12	2.50	2.88	2.59^{a}	2.33^{b}	0.07	*	***	NS
R:C ratio	100:0	79:21	54:46	39:61	100:0	76:24	54:46	41:59	68:32	68:32	0.006	NS	***	NS
CPI (kg/d)	0.40	0.61	0.88^{cf}	1.12	0.37	0.55	0.79	1.02	0.75	0.68	0.03	NS	***	NS
DM dig,%	59.17	58.92	59.51	64.80	51.11	53.23	55.63	56.27	60.60^{a}	54.06^{b}	0.94	***	*	NS
CP dig.%	58.08^{be}	61.71^{ae}	69.50^{cdf}	75.04^{d}	56.84^{b}	65.60^{ac}	70.64^{df}	70.30^{f}	66.08	65.84	0.80	NS	***	*
ADF dig. %	55.81	56.06	58.03	60.33	50.49	50.91	48.59	52.58	57.55^{a}	50.64^{b}	1.06	**	NS	NS
NDF dig. %	66.22^{a}	56.15^{b}	55.88^{b}	53.65^{bc}	57.14^{b}	55.07^{b}	48.87^{cd}	45.77^{d}	57.98^{a}	51.72^{b}	0.87	***	***	*
DDMI (kg/d)	2.60	3.09	3.62^{c}	4.44	1.89	2.39	3.01	3.54	3.44^{a}	2.71^{b}	0.11	***	***	NS
DCPI (kg/d)	0.23	0.38	0.61	0.84	0.21	0.36	0.56	0.71	0.52^{a}	0.46^{b}	0.02	*	***	NS
Ini. LW(kg)	204.3	204.9	204.2	204.6	204.8	206.0	206.1	205.6	204.5	205.6	9.6	NS	NS	NS
Fin. LW (kg)	228.6	246.7	255.1	253.9	221.8	226.6	236.4	246.2	246.1	232.7	10.8	NS	NS	NS
ADG	406	697	849	821	284	343	504	677	693^{a}	452^{b}	30.8	***	***	NS
FCR	11.0	7.6	7.3	8.5	15.2	13.2	11.8	9.7	8.6^{a}	12.5^{b}	0.5	***	**	NS
Total feed cost (Tk/Kg gain)	91.8	102.7	142.8	199.7	120.7	182.7	230.8	222.6	134.2^{b}	189.2^{a}	8.18	***	***	NS

Similarly, concentrate level increased ADG and FCR in AS Jumbo silage diets showing a varying level of growth response from that of feeding Maize silage. Bulls fed Maize silage with graded levels of concentrate tended to have higher ADG (693 g; $p<0.001$) and better FCR (8.6; $p<0.001$) compared to ADG (452 g) and FCR (12.5) of AS Jumbo with graded levels of concentrate. As concentrate levels increased, feed cost (silage + concentrate + refusal) Kg gain estimates also increased ($p<0.001$) and it was estimated a lower feed cost in silage to concentrate proportion of 75:25 for both silages. The corresponding relative quantity of concentrate intake with its prices was increased by 1.71 kg and Tk. 57; 3.57 kg and Tk. 119 for Maize and 2.22 kg and Tk. 74; 2.58 kg and Tk. 86 for AS Jumbo, respectively for silage to concentrate proportion of 50:50 and 25:75. The feed cost analysis indicated that silage to concentrate proportion of 75:25 was more profitable for Kg live weight gain in both the roughages. Therefore, it may be concluded that, feeding both maize and AS Jumbo silage to concentrate level on DM basis of 75: 25 is more profitable in terms of feed cost per Kg gain and Maize was better than AS Jumbo.

Project title: Study on improving feed efficiencies of Pabna and RCC bulls
Sub-title: Biometrical ranking of available fodder crops

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Executive Summary

Fodder production practices have been increasing recently even having limitations in land availability. Many of the fodder crops have been becoming profitable to farmers keep farm animals or even to farmers cultivate fodders and harvest fresh biomass for marketing locally. Different seed marketing organizations have been importing seeds of different fodder crops and marketing them locally taking certification of the Seed Certification Agency (SCA) of the country. The authorization system of introduction of new fodder species in the country, in addition to seed quality, must consider the production and productivity of fodder biomass and its response to animals. This requires enforcing of legal authoritative power of the Department of Livestock services (DLS) in the certification system. To make the whole system effective, a database on the quality of different fodders in terms of efficiency of biomass or animal production or benefit & cost ratio or reduction of energy loss as enteric methane in the rumen is required to be developed through careful screening of the available fodder crops in the country. Thus, a research work was undertaken on the development of biometrical ranking systems of available fodder crops in the country.

The fodder crops available in the fodder germplasm bank of the Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka were cultivated, conserved and used here. Maize was considered to be a control roughage feed while a series feeding trials were conducted on native bulls. All the calculations were done using the Excel computer programme to determine different parameters as follows. The parameters used for the calculation of biomass production efficiency of fodder crops (x) were as follows, and the biomass production efficiency of the fodders was expressed as $\boldsymbol{x}\ (\boldsymbol{F}\colon \boldsymbol{M}) = \frac{\boldsymbol{y}\ (\boldsymbol{Fodder\ DDM})}{\boldsymbol{Maize\ DDM}}$.

Fodder crops	DM Yield, Kg	Harvest loss %	Digestibility %	Digestible DM (DDM), Kg/ha (y)	$\boldsymbol{x}\ (\boldsymbol{F}\colon \boldsymbol{M}) = \frac{\boldsymbol{y}\ (\boldsymbol{Fodder\ DDM})}{\boldsymbol{Maize\ DDM}}$

Animal production efficiencies were calculated using the data generated through a series of feeding trials & they are given below. The ratio of fodder to maize for live weight production was determined using $\boldsymbol{x}$(F:M)=$\frac{y\ (Kg\ LW\ of\ Fodder)}{Kg\ LW\ of\ Maize}$.

DM Intake, Kg/day	Growth Kg/day	Live weight, Kg/ha (y)	(F:M)=$\frac{y\ (Kg\ LW\ of\ Fodder)}{Kg\ LW\ of\ Maize}$

Rumen enteric CH_4 emission reduction efficiency of fodders was calculated following the equation of the IPCC (Intergovernmental Panel on Climate Change, 2006); (EF)= $\frac{GE.[\frac{Ym}{100}]}{55.65}$Kg CH_4/head/day, where Ym (CH_4 conversion factor) is 6.50% and GE is gross energy. The ratio of CH_4 from a Kg LW gain of Maize feeding to that produced by feeding of a fodder was calculated to be x (M:F) = $\frac{\frac{\text{KgCH}_4}{\text{Kg LW gain}}\text{ of Maize}}{y}$. The parameters were as follows.

The benefit to cost efficiency of a fodder was calculated to be the ratio $\frac{GR_f}{GC_f}$ of a fodder to that of maize and expressed as $\boldsymbol{x}\ (\boldsymbol{F}\colon \boldsymbol{M}) = \frac{\boldsymbol{y}}{\frac{GR_f}{GC_f}\boldsymbol{of\ Maize}}$. Where, GR_f is gross return & GC_f is gross cost. The parameters are listed below.

MJGE/Kg DM fodders	Daily MJGE intake/head	Emission Factor (EF)= $\frac{GE.[\frac{Ym}{100}]}{55.65}$ Kg CH_4/head/day	$\frac{\text{KgCH4}}{\text{Kg LW gain}}$ (y)	x (M:F) = $\frac{\frac{\text{KgCH}_4}{\text{Kg LW gain}}\text{ of Maize}}{y}$

Yield, Ton/hec	$GC_f = \sum_{i=1}^{f}(P_i \cdot Q_i)$, US$/hec	Present Market price, US$/ton	$GR_f = Q_f.P_f$, US$/year	$\frac{GR_f}{GC_f}$ of fodders (y)	$x\,(F:M) = \frac{y}{\frac{GR_f}{GC_f}\,of\ Maize}$

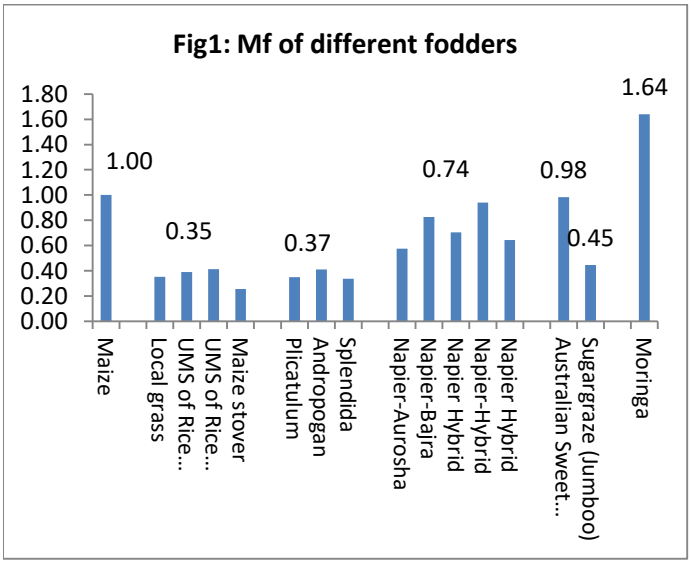
The Maize Index (M_f) of a fodder was calculated as $M_f = \frac{\frac{y\,(Fodder\ DDM)}{Maize\ DDM} + \frac{y\,(Kg\ LW\ of\ Fodder)}{Kg\ LW\ of\ Maize} + \frac{\frac{KgCH_4}{Kg\ LW\ gain}\ of\ Maize}{y} + \frac{y}{\frac{GR_f}{GC_f}\,of\ Maize}}{4}$, & all the data were statistically tested.

The significant linear relations of M_f with Kg DM or Kg LW gain of different fodders per hectare, and they are expressed as ***Y=17817*M$_f$ + 6302.3*** and ***y=2965.2*M$_f$ – 882.27*** with correlation coefficients of 0.82 & 0.98 (r, p<0.01). Similarly, the linear relationship of M_f with $KgCH_4$/Kg gain or daily live weight gain of animals may be described as ***y=0.2449*M$_f^{1.085}$*** (r=0.82) or ***Y=0.2389*M$_f$ + 0.008*** (r=86), and the relations were significant (p<0.001, Table 1).

Table1: Relations of M_f with different important parameters

Relations		Equations	r, Fig No	Significance
Maize Index (M_f) with	Kg DM/ha (y)	Y=17817*M_f + 6302.3	0.82, Fig2	P<0.01, *df 18*
	Kg LW gain/ha (y)	y=2965.2*M_f – 882.27	0.98, Fig2	P<0.01, *df 18*
	$KgCH_4$/Kg gain (y)	y=0.2449*$M_f^{1.085}$	0.82, Fig3	P<0.01, *df 18*
	Daily Kg LW gain (y)	Y=0.2389*M_f + 0.008	0.86, Fig3	P<0.01, *df 18*
	Benefit to Cost (y)	y=0.7112ln(M_f) + 1.6527	0.72, Fig4	P<0.01, *df 18*
Daily Kg gain/head with $KgCH_4$/Kg gain (y)		y=0.068*daily gain$^{-0.928}$	0.97, Fig5	P<0.01, *df 18*

A significant (p<0.01) logarithmic relation of M_f with benefit to Cost ratio of different fodders is quantified by the equation of ***y=0.7112ln(M_f) + 1.6527***, (r=0.72). All these significant (p<0.01) relations of M_f with different attributes of fodder crops may signify the effectiveness of M_f in ranking of fodder crops at least in terms of efficiencies of production of biomass, benefit to cost & animal; and reduction of enteric methane in the rumen. The Maize Indices (M_f) of available fodder crops, thus developed, are shown in Fig1. Local grass, Urea and Molasses mixed Straws and Maize Stover, Plicatulum, Andropogan, and Splendida had 0.25 to 0.41 M_f; and among the different varieties of Napier Aurosha had 0.57 and others M_f varied from 0.70 to 0.94. They, including Sugargraze (0.45), were poorer in quality roughages than fodder Maize. Moringa showing 1.64 M_f was the most quality fodder considering the efficiencies of production of biomass, benefit to cost & animal; and reduction of enteric methane in the rumen compared to fodder Maize. A strong relation of M_f with an increasing DM yield per hectare or a Kg LW yield or an increasing live weight gain of animals, and a lower emission of CH_4 in the rumen with increasing live weight gain (**y=0.068*daily gain$^{-0.928}$**, r=0.97, p<0.01) signifies that the biometric system (M_f) may be considered for ranking of available fodder crops for cost effective and environment friendly fodder production in the country. The ranking system may support the seed certification system of the concerned authority, especially, for releasing fodder crops or seeds for cultivation in the country. However, further studies on the ranking system may be undertaken considering agro-ecological zones, stage of maturity of fodders and physiological stages of animals. More fodder crops available in the country or waiting to be introduced in the existing cropping systems may also be biometrically ranked accordingly.



Project title: Study of Moringa plant fodder agronomy and its feeding to ruminants

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Executive Summary

Gradual transformation of traditional subsistence livestock farming into input supported dairy or beef raising has been demanding more protein rich quality feeds & fodders. Moringa (*Moringa oleifera),* a plant fodder being researched and found responsive to increasing production and productivity of small (Sultana *et al*. 2012) and large ruminants (Foidl *et al*. 1999; Sanchez *et al*., 2006;), was identified as one of the best options for Bangladesh (Huque and Sarker, 2014). Options for Moringa fodder production were tested (Foidl et al., 2001), but it is known more as a natural source of drumsticks and, at a lesser extent, as leafy vegetable locally. Asexual propagation at homesteads without any input intervention or competition for land is followed for vegetable production irrespective of agro-ecological conditions of the country. Sexual propagations were established (Huque *et al*, 2014), but varietal responses on biomass production, their pathology & agronomical interventions (density, fertilization, cutting heights, irrigation or weeding etc); seasonal impacts, quality of biomass & its response to ruminant animals; and cost effective introduction into existing cropping system competing with available cash crops are burning questions remain unaddressed. Without developing systems for cost effective biomass production, value additions or animal production, the unconventional plant fodder may not contribute to increased availability of protein rich quality feeds and fodders in the country. Keeping the above factors in consideration the present research work was undertaken to find a suitable variety of Moringa out of domestic or regional plant biodiversities, investigate pathologies of seeds and saplings, develop agronomical practices for maximizing biomass production and productivity, determine the quality of biomass in lab and in animals, and to determine cost effective biomass production on farm.

The seeds of Black (BSM) and of White (WSM) Moringa, two local varieties, and one Black Seed Moringa of FAO regional office, Bangkok (FAOM) were collected, saplings were raised in seed beds and transplanted in the fodder research land of Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka, Bangladesh to compare their production and productivity of biomass in 12 plots each of 1x1 sq meter area having four replications for each variety following a design of complete replication. More BSM saplings were raised and transplanted in 12 similar size plots arranged into two columns identifying them randomly as weeding or non weeding plots and 12 more similar size plots having similar arrangement of plots in two columns randomly designating them as irrigated or nonirrigated. Fifty more plots were transplanted with the same variety dividing the plots into five blocks and randomly allocating five dosages of Urea Nitrogen UN) (0, 60, 90, 120 and 150Kg UN per hectare) along with a constant dose of MP and TSP (30:15) and cow dung (40.0ton/hectare) to determine appropriate UN dose for Moringa fodder production analyzing treatment response in an ANOVA of a randomized complete block design. Again, twenty eight more plots were transplanted with the same variety arranging the plots into four blocks transplanting saplings in a single density (100,000 per hectare) and keeping fertilizer dose constant, but randomly allocating the plots under different cutting heights (20, 40, 60 or 80cm) to determine suitable height of harvest for maximizing quantity and quality Moringa biomass production per hectare and the treatment responses were analyzed in an ANOVA of randomized complete block design. In addition to chemical analysis of four different samples with variable stem to leaf ratio their rumen degradability was determined using a technique described by (Ørskov *et al*., 1984). Moreover, twenty five more plots were transplanted with the same variety arranging the plots into five blocks transplanting saplings into six densities (25,000, 50,000, 65,000, 100,000, 150,000 or 250,000 per hectare) randomly in the plots keeping fertilizer dose constant (40.0 ton manure/hectare) to determine suitable plant density per hectare for quality Moringa biomass production and treatment responses were analyzed in an ANOVA of randomized block design. For evaluating cost effective on farm production of Moringa fodder a 15 decimal cultivable land of farmers of BLRI surrounding area was leased in and a farmer was allowed to cultivate Moringa in the land following the agronomy being practiced on-station. The Moringa feed

produced by the farmer will be procured considering its market equivalent price, and the benefit and cost analysis will be done using the data being collected and it will be compared with the cash crops cultivate in the area. The land will be continued to be taken as lease in the subsequent years to determine the total length of viable production life of the plant as fodder crops. In addition, to all these works Moringa biomass (containing soft branches and leaves) was produced in a different land and processed, and it was fed to growing animals as a sole diet to determine its feeding response to growth and to compare its nutritional value *in vivo* with Maize or Jumboo silage. The data were dietary responses to dry matter intake, and digestibility and to live weight gain of three different groups each having six growing bulls were analyzed in one way variation ANOVA table and tested for significance among the treatment diets. Some of the salient results are summarized below.

Table1 shows that the average of DM yield per cut (t/hec) of FAOM, WSM & BSM was 1.56, 0.63 and 2.41, respectively with % CP of 22.9, 22.5 & 22.8, respectively. BSM yields significantly ($p<0.05$) higher than others. The second harvest yield in the winter was significantly ($p<0.05$) lower, & the relative growth rate (RGR, Fig2) of DM of three varieties varied significantly ($p<0.05$) both in the winter & spring.

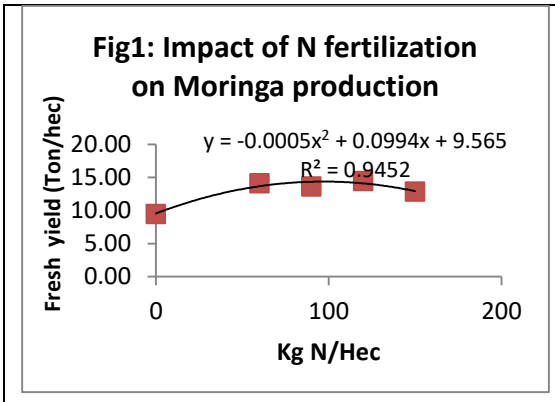
Table1: Varietal impact on biomass

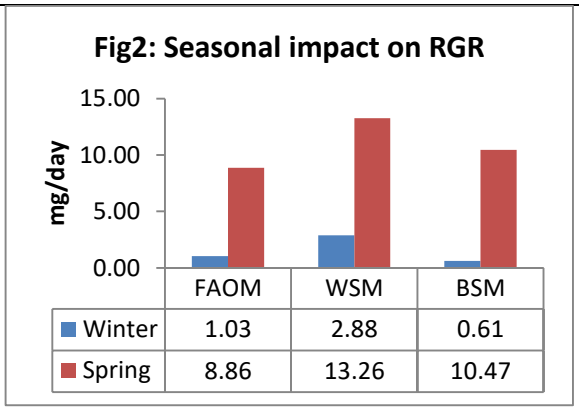
Parameters	Variety of Moringa			Significance	
	FAOM	WSM	BSM	SE	Level
Yield(DM; ton/hec)					
1st cut	2.56^{ab}	0.71^{b}	3.67^{a}	0.50	P<0.05
2nd cut	0.17	0.15	0.14	0.01	NS
3rd cut	1.96^{b}	1.06^{b}	3.41^{a}	0.34	P<0.01
Averag	**1.56^{ab}**	**0.63^{b}**	**2.41^{a}**	**1.34**	P<0.05
% CP	22.9	22.5	22.8	0.49	NS

Table 2: Effect of cutting height on production (1st cut)

Parameter	Cutting Height(cm)				Sig.	
	20	40	60	80	SE	Level
Survival rate (%)	87.3^{a}	79.4^{a}	66. 7^{ab}	54.0^{b}	4.18	P<0.05
(DM; t/hec)	4.76^{a}	4.58^{a}	2.36^{b}	2.13^{b}	0.37	P<0.01
Stem:Leaf	1:0.97	1:0.6	1:0.89	1:0.9		

Fig1 shows that biomass production maintained a polynomial relation (r^2=0.945, Fig1) with the dosages of KgUN/hec that increased with the increase of KgUN up to a level of 90KgUN/hectare, and then it declined. The rate & effective rumen DM degradability of Moringa varied from 18.0 to 26.0, & 58.2 to





73.7%; and feeding Moringa yielded daily LW gain of 375g compared to 289g of Maize or 218g of Jumboo silage. The result so far generated may show that Moringa may be cultivated as a fodder crop following agronomical practices described above, and it may be a good quality fodder for ruminants. The research works required to be continued further to establish it as a cost effective fodder in the country.

Project title: System modeling for food waste to feed production (F_2F)

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Executive summary

The deficiency of roughage and concentrate feeds in Bangladesh was reported as 56.2% and 80.0% of their total requirement, respectively; and it results in a very poor plane of nutrition of farm animals (Huque and Sarker, 2013). Food and vegetable waste (FVW) was estimated to be 3292 x10^3 tons per year in cities and towns of the country (JICA, 2005), and about 3000 tons of FVW are produced daily in Dhaka city, incur disposal costs, and cause environment pollution through emitting greenhouse gases and putrid smell. This huge biomass of FVW can be a potential source of feed for ruminants (ref--). The concept of recycling FVW to feed (F_2F) was, therefore, developed with the objectives to quantify FVW aof households, hotel/restaurants and markets, to develop cost effective collection and value addition system and, to determine their feeding impacts on ruminants. A campus based households of Bangladesh Livestock Research Institute (BLRI), hotels/restaurants at Islamnagar, a food court area of the University of Jahangirnagar, and Ganda, a vegetable market of Savar suburb area close to Dhaka city were selected for the quantification of FVW of different sources. The chemical composition, gross energy and rumen degradability of the processed biomass were done in the nutrition lab of BLRI, and the concentration of heavy metals, and Mycotoxins of FVW were done in the **Public Health lab** of the Ministry of Health. The value addition system consists of collection and transfer of FVW to a processing centre (facilitated with a locally manufactured waste blender and a forage dryer, Fig1) at BLRI, blending them while adding with absorbent (20% rice polish) and common salt (2%), and lastly, drying & packaging. The costs of collection, processing, drying and packing were recorded & calculated accordingly. Two equal groups each with six native RCC bulls of an average live weight of 66.7±9.7 Kg/head were fed with Napier silage. A group was supplemented with 1.6 Kg concentrate per head per day and the bulls of other group fed the same concentrate mixed with FVW-feed at a ratio of 1:1; and a digestibility trial of 34 days was conducted. Both the concentrate mixture contained similar energy and protein (---MJME & --%CP per Kg DM. The blood metabolites were determined outsourcing services to private labs.

Fig1: Locally designed FVW blending and drying machine

A restaurant having a daily customer service capacity of 120 (±32) persons produced 4.14 Kg FVW (Y = 0.028X + 0.698, r^2 = 0.591), and the amount was 65% of its total food wastes (6.39 Kg). A wholesale market having daily selling capacity of 101.98 ton fruits and vegetable produced 270 Kg FVW, and it was 0.28% of the total vegetable and fruits marketed daily (Y = 0.005X - 0.305, r^2 = 0.91). The DM and CP contents of FVW of household and market sources was 13.6% and 9.14% of fresh biomass, and 14.0% & 16.9% of dry mass, respectively, (Table 1). The ADF, NDF & TDN content of the two sources of biomass were 30.1% & --%, 37.1% &---% and 66.8% &--%, respectively (Table1). The concentration of Chromium and Led was 13.3 and 1.53 ng/Kg, respectively; and that of Aflatoxins (B1, B2, G1, G2) (µg/Kg) was below the recommended maximum residual level (3.08µg/Kg) of Bangladesh Standard Testing Institute (BSTI, 2008) (Table 2).

Table 1: Chemical composition of FVW of different sources and FVW-feed

Types of feed	% fresh	% DM				MJ/Kg DM
	DM	CP	NDF	ADF	TDN	GE
FVW (household)	13.6	14.0	37.1	30.1	66.8	9.9
FVW (market)	9.14	16.9	---	---	---	---
FVW-feed*	90.0	12.7	44.9	34.4	63.8	9.4

* ***FVW feed was prepared by adding 20% rice polish to FVW (household) and 2% common salt on DM basis during blending.***

The FVW-feed processed with absorbent and salt contained 12.7% CP, 44.9% NDF, 34.4% ADF & 63.8% TDN. Table 3 shows that the readily degradable (a), rate constant (c) & potential degradable fraction (b) of the FVW of households or market sources were 43.3%, 11.0% & 42.4%, respectively or

25.1%, 4.0% & 54.8%, respectively; and the difference between the two sources was significant ($p<0.01$). The DM intake of FVW-feed based concentrate was significantly ($p<0.01$) lower than the conventional concentrate fed to control group (1.40 and 1.06 Kg/day, respectively); and it resulted in a significantly ($p<0.01$) lower total DM intake (2.46 and 1.93 Kg/day, respectively, Table 4).

The digestibility of DM or CP of the total diet did not differ significantly ($p>0.05$) between the two dietary groups. Blood urea nitrogen (BUN) was higher ($P<0.05$) in the control group, while serum glucose, total cholesterol, triglycerides, LDL and HDL cholesterol remained similar ($P>0.05$, Table5). Similarly, SGOT and SGPT were not affected ($P>0.05$) by the diets indicating normal liver functions of the animals. Creatinine was higher ($P<0.05$) in treatment group than that in the control, but the value was within the normal range for cattle serum (Radostits *et. al*., 2000). The higher cost of collection of FVW from households than that of markets (0.103 and 0.05 UDS, respectively) resulted in a higher feed production cost (0.34 and 0.28 USD/Kg feed DM, respectively). The collection cost of hotel FVW was not determined due to some difficulties in collection.

Table 2: Concentration of heavy metals and Mycotoxin in household FVW

Parameters	Unit	Results (±SD)	MRL
Iron	(mg/Kg)	859.8 ± 289	---
Chromium (Tri or Hexa valent)	(ng/Kg)	13.3 ± 1.31	---
Led	(ng/Kg)	1.53 ± 0.48	5
Aflatoxin (B1,B2, G1, G2)	(µg/Kg)	3.08 ± 1.27	10-20

SD, Standard Deviation; MRL, Maximum Residual Level.

Table 3: *In sacco* DM degradability (%) of FVW from different sources

Parameters	Sources of FVW		SEM	*P* - value
	Household	Market		
a, readily degradable fraction	43.3	25.1	0.5	<0.01
b, potentially degradable fraction	42.4	54.8	0.4	<0.01
c, rate constant (per hour)	0.11	0.04	0.01	<0.01
(a+b), extent of degradation	85.48	79.95	0.36	<0.01

SEM, Standard Error of Mean.

Table 4: Intake and digestibility of feed nutrients

Parameters	Dietary groups		SEM	*P* - value
	Control	Treatment		
DM intake from Napier silage, Kg/day	1.06	0.87	0.07	<0.05
DM intake from concentrate, Kg/day	1.40	1.06	0.04	<0.01
Total DM intake, Kg/day	2.46	1.93	0.09	<0.01
DM intake, percent live weight	3.43	2.76	0.11	<0.01
CP intake, g/day	311	240	0.078	<0.01
DM digestibility, %	55.83	64.57	4.29	>0.05
CP digestibility, %	65.49	68.03	3.59	>0.05

SEM, Standard Error of Mean.

Considering the composition, heavy metals and Mycotoxins of FVW of households or markets and their rumen degradability and digestibility *in vivo* it may be stated that both the FVWs may be potential feeds for cattle feed. However, vegetable market is a cheaper source of FVW compared to households, and further upgradation of processing device may make the former more cost effective, and safe, at least in terms of nutritional quality and physical appearance.

Table 5: Blood metabolic profile and biochemical tests for kidney and liver function

Blood metabolic profile	Dietary groups		SEM	*P* - value
	Control	Treatment		
Random blood sugar, mmol/L	4.22	4.07	0.11	>0.05
Blood urea nitrogen (BUN), mg/dl	23.67	19.5	1.40	<0.05
Total cholesterol, mg/dl	81.33	69.00	7.44	>0.05
Triglyceride, mg/dl	26.60	23.67	4.11	>0.05
LDL, mg/dl	52.33	49.17	9.03	>0.05
HDL, mg/dl	22.33	20.17	2.50	>0.05
Kidney and liver function				
SGOT, U/L	73.50	54.40	9.09	>0.05
SGPT, U/L	36.33	28.50	3.61	>0.05
Creatinine, mg/dl	1.08	1.37	0.09	<0.05

SEM, Standard Error of Mean.

Project title: Development of effective lamb production system in Bangladesh
Sub-title: Effect of pre and post-natal nutrition on the performances of ewes and their lambs

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Executive Summary

The present livestock sector in Bangladesh only produced 30.18% requirement of meat and the per capita intake of meat only 8.6 kg against 42.1 kg and 32.2 kg for 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 species including sheep might be emphasized as a meat animal. Bangladesh has 2.97 million sheep which secure 3rd position in number among the ruminant species of Bangladesh. Their performance is very poor. Nutrition is one of the major limiting factors. Maternal 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 increase. 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. Data on Pre and post-natal nutrition of native Bengal ewes on milk yield, lambs birth weight and growth is scarce. Thus, this study was designed and conducted. Thirty-six native ewes of 2 and 5 parity were randomly allocated to four different treatment groups (T_0, T_1, T_2, T_3) of last 7 weeks pregnancy. Ewes were housed in individual cage and lambs remained with their dams continuously except for the days of milk measurement and they were allowed restricted excess to a creep diet. Ewes of all the treatment group were supplied *ad libitum* German grass (*Echinochloa polystachya*). The ewes ofT_1, T_2 and T_3 group were supplemented with a concentrate 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 maintaining T_0 as control. Chemical compositions of the experimental diets are presented in the table 1. After parturition, lambs were supplemented with a creep mixture (Crushed maize 68%, Soybean meal 30 %, Vitamin-mineral premix 1%, Salt 1%) at the age of 2 weeks @ 20g/lamb/day and an weekly increment of 10g /lamb was done. Beside this, a small amount of German grass was also provided to the lambs *ad libitum* basis at the age of 4 weeks. Milk yield were measured once a week over a 24h period by suckling method and repeated for entire lactation period. The weekly estimate of milk yield was assumed to represent the average milk yield for the week in which it was measured. Ewes and their lambs were weighed weekly. Feed intake, milk yield, rectal temperature, litter size and post-partum oestrus of ewes with birth weight, sex, weight gain and weaning weight of lambs were also recorded. Data only the onset of experiment to 6 weeks postpartum were used for statistical elaboration with Completely Randomized Design (CRD). Data were analyzed using the GLM procedure of the SAS (1994). The differences were tested by DMRT using GLM of SAS.

Table 1:Chemical composition of the experimental diets

Diets	DM (% Fresh)	Chemical composition (%DM)					Estimated ME(MJ/kg DM)	Estimated TDN (%)
		Ash	OM	CP	ADF	NDF		
German grass	15.85	11.70	88.30	10.61	46.31	74.67	6.41	43.27
Concentrate mixture (ewe)	87.65	9.56	90.45	18.27	12.71	19.97	12.39	81.92
Creep mixture (lamb)	88.29	6.18	93.82	17.86	11.56	15.88	12.56	83.24

Table2: Effect of pre and post-natal nutrition on the performances of ewes and their lambs

Parameters	Treatment groups				Overall mean	SEM	Sig. Level
	T_0 (9)	T_1 (9)	T_2 (9)	T_3 (5)			
DM Intake of ewes (kg/day)	0.60^{b}	0.95^{a}	0.90^{a}	0.91^{a}	0.83	0.033	**
DM Intake during pregnancy (kg/day)	0.54^{b}	0.94^{a}	0.86^{a}	0.89^{a}	0.80	0.036	**
DMI during lactation (kg/day)	0.66^{b}	0.96^{a}	0.95^{a}	0.92^{a}	0.87	0.031	**
DM Intake of ewes on % body weight	2.66^{c}	3.62^{ab}	3.19^{b}	3.80^{a}	3.26	0.110	**
Litter size (no.)	1.33	1.44	1.44	2.00	1.50	0.100	NS
Birth weight of lamb (kg)	1.96	2.13	2.31	1.78	2.08	0.091	NS
Daily gain of lamb (g/day)	76.08^{b}	98.93^{ab}	124.35^{a}	91.96^{ab}	98.56	6.453	*
Daily milk yield (g/day)	390.26^{b}	637.55^{ab}	612.52^{ab}	705.67^{a}	571.61	46.518	NS
Lamb weight at 6 weeks of age (Kg)	5.15^{b}	6.29^{ab}	7.53^{a}	5.64^{ab}	6.22	0.339	*

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

The effects of different pre and post-natal nutrition on the performances of ewes and their lambs are shown in table 2. There was a significant effect on DM intake of ewes (P<0.01) and daily gain (P<0.01) and 6 weeks weight (P<0.01) of lambs compare to control (T_0) group. The highest DM intake observed in T_1 group but the highest daily gain of lambs found in T_2 group. Although birth weight of lambs didn't differ significantly for different feeding level but 6 weeks weight of the lambs differed significantly (P<0.05). Higher birth weight of lambs found in T_2 group that also gives significantly a higher (P<0.05) daily gain and final weight. The lowest daily milk yield (390.26 g/day) found in control group (T_0) and the highest milk yield (705.67 g/day) found in the highest feeding level (T_3) group although not differed significantly. It has been generally shown that there is a correlation between milk intake and lamb growth rate. So, results obtained in our study also compared according to lambs birth type (single, twins and triplets), and found single lamb were heavier for birth weight (P<0.01) and the milk yield (P<0.05) of ewes also increased with increasing the birth type (table 3). Thus, the effect of ewe's nutrition on lambs birth weight and ewes milk yield were conflicted with type of birth. Though lambs growth rate according to birth type not differ significantly but growth rate of single birth was numerically higher, may be due to the quantity of milk available for them. Overall birth weight and daily gain of male and female lambs were not significant (Table 3).

Table 3: Effect of type of lamb birth and lamb sex on birth weight, daily gain of lamb and daily milk yield of ewes

Parameters	Birth weight (kg)	Daily gain of lamb (g)	daily milk yield of ewes' (g)
Lamb birth Type	**	NS	*
single (17)	2.40^{a}	111.71	482.81^{b}
Twins (14)	1.71^{b}	84.01	639.71^{b}
Triplets (1)	1.72^{b}	78.84	1127.52^{a}
SEM	**0.091**	**6.45**	**46.52**
Overall mean	**2.08**	**98.56**	**571.61**
Sex of lamb	NS	NS	
Male (21)	2.06	100.82	-
Female (22)	1.93	90.63	-
SEM	**0.080**	**5.453**	-
Overall mean	**1.99**	**95.72**	**-**

*NS= Non significant, * p<0.05,**p<0.01, $^{a, b}$ values within the Same column with different superscripts differ significantly*

The results of this experiment indicated that the pre and post-natal nutrition of ewes significantly affect DM intake of ewes, daily gain of lams and lambs final weight. Comparing different parameters like, DM intake and milk yield of ewes with lambs daily gain, the group (T_2) fed *ad-libitum* German grass with concentrate at 1.5% of their body weight performed better compare to other groups. Further studies on a larger set of data with higher levels of nutrition during the last stage of pregnancy and lactation are recommended to specify actual trends that influence the study, taking the economic advantage into account.

Reference: Huque K. S. 2012. Changes in and challenges of Bangladesh Livestock. BLRI Newsletter.3:1.

Project title: Development of effective lamb production system in Bangladesh
Sub-title: Effect of replacement of conventional concentrate in a straw diet by Moringa foliage on lamb production performances

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Executive summary

The livestock population of the country consisting 24.7 million cattle, 25.21 million goat, 3.12 million sheep and 135.1 million of poultry (DLS, 2013) support per capita intake of 9.12 kg meat calculated to be only 21.0% of per capita annual requirement (43.25 kg, FAO/APHCA, 2008).The consumption of red meat is increasing with increasing population, urbanization and per capita income. The bovine meat production growth rate was 1.36% during the period of 1996 to 2011 but the production of chevon and mutton was almost constant (Huque and Sarker, 2014), and without realizing nutritional values of the latter it is declared as chevon while marketed. However, awareness on nutritional values of lamb and its production potentials using native sheep may support increased red meat production in the country. Inadequate availability and poor quality of feed resources are one of the major limitations for increasing lamb productivity and its quality. Concentrate is expensive and feeding concentrate to sheep is not a common practice to rural farmers. Moringa foliage, available to farmers in the country, possesses high quality nutrition (18 to 24% CP and highly digestible fiber) (Mendieta-Araica *et al.*, 2011; Sultana et al., 2014). Therefore, the study was undertaken with the objective to determine the effect of replacing conventional concentrate with dried moringa foliage on the performances of growing native sheep. A total of thirty growing native sheep of 3 to 6 months of age were randomly allocated to five groups having six lamb per treatment. A control diet containing 30% molasses mixed rice straw (2.5% molasses) and 70%concentrate mixture of broken maize-42%, soybean meal-38%, wheat bran-17%, vitamin-1%, DCP-1% and salt-1% was fed to a group of sheep. The concentrate was replaced with moringa foliage (moringa foliage-97%, vitamin-1%, DCP-1% and salt-1%) at 25, 50, 75 or 100% on DM basis. Thus, five dietary treatments consisted of varying proportion of moringa foliage (MF) and concentrate (C), were T_1 (100MF); T_2 (75MF:25C); T3 (50MF:50C); T4 (25MF: 75C) and T5 (100C). The experiment was arranged in a completely randomized design (CRD). The duration of feeding and growth trial was 93 days. After completing the feeding trial, digestibility trial was carried out for 7 days. Four animals from each treatment were randomly selected to slaughter for evaluating the carcass quality.

The CP and energy content in moringa foliage and concentrate mixture were 23.11and 22.77 percent and 11.36 and 11.33 MJ kg^{-1} DM respectively. Average total DM intake was significantly ($P<0.05$) higher in T_5 (939.0 g d^{-1}) and T_2 (885.5 g d^{-1}) than T_1 (830.0 g d^{-1}), T_3 (826.3 g d^{-1}), T_4 (823.3 g d^{-1}) while there was no significant ($P>0.05$) difference in case of DM intake in percent live weight (3.96 to 4.11%) and DM intake per kg metabolic weight (85.02 to 89.84 g/kg$W^{0.75}$). DM (75.30 to 79.98%), CP (79.20 to 81.74%) and OM (78.63 to 80.07%) digestibility was not significant ($P>0.05$) different among the treatments. However, ADF and NDF digestibility were linearly ($r=0.97$; $r=0.87$ respectively) increased with an increasing level of moringa foliage in the diet (Fig.1). Nitrogen retention (14.14 to 15.91$g^{-1}d^{-1}animal^{-1}$) did not vary significantly ($P>0.05$).Average daily live weight gain, FCR, dressing percent did not vary significantly ($P>0.05$) (Table.1).The percentage of lean meat of warm carcass weight was significantly ($P<0.05$) higher in T_2 (71.22%) and T_1 (70.88%) treatment group compared to T_3 (68.62%), T_4 (68.26%) and T_5 (65.82%). Similarly, lean: fat increased linearly ($r= 0.97$) with the increasing level of *Moringa* foliage in the diet (Fig-2). However, carcass fat and waste fat percentage linearly ($r=0.96$; $r=0.97$ respectively) increased with the increasing of concentrate mixture (Fig.2). The result revealed that decreasing the level of concentrate mixture with Moringa foliage in the diet of growing sheep may shows desirable leaner carcass with a higher proportion of lean meat and lower weight of fat to improve carcass characteristics. Thus, moringa foliage may replace conventional concentrate partially or entirely in a straw based diet of sheep.

Table-1: Effect of replacement moringa foliage with conventional concentrate on performances of growing Bengal lamb fed straw based diet

Variables	Treatments					Sign.
	100M	75M:25C	50M:50C	25M:75C	100C	
ILW (kg)	9.87±0.50	10.23±0.23	10.45±0.70	10.53±0.70	10.87±0.60	NS
FLW (kg)	20.53±0.70	21.42±1.06	21.78±0.96	22.02±0.91	22.80±0.93	NS
TLWG (kg)	10.67±0.35	11.18±0.58	11.33±0.73	11.48±0.73	11.93±0.42	NS
ADLWG (g/d)	118.17±3.82	124.33±5.14	129.83±6.07	129.50±0.50	134.33±3.79	NS
TFI (kg)	55.69±2.48	55.22±2.12	57.04±3.34	57.20±3.05	59.89±4.04	NS
FCR	5.22±0.15	4.93±0.18	5.07±0.30	5.0±0.32	5.0±0.20	NS
SLW (kg)	20.93±0.52	21.13±0.31	20.50±0.61	20.38±1.02	21.15±0.43	NS
WCW (kg)	10.73±0.26	10.87±0.15	10.61±0.18	10.66±0.54	11.30±0.20	NS
Dressing (%)	51.27±0.58	51.43±0.56	51.84±0.91	52.34±0.49	53.41±0.40	NS
Lean (% of wc)	70.88±0.94[a]	71.22±0.94[a]	68.62±1.07[b]	68.26±0.61[b]	65.82±0.20[c]	*
Bone (% of wc)	21.07±0.30	20.45±0.42	20.42±0.28	20.41±0.08	20.10±0.09	NS

*Means within rows with different superscripts are significantly different at 5% level.ILW= Initial live weight;FLW= Final live weight gain; TLWG= total live weight gain; ADLWG= average live weight gain; TFI= total feed intake ; FCR= feed conversion ratio; SLW= slaughter weight; WCW= warm carcass weight;

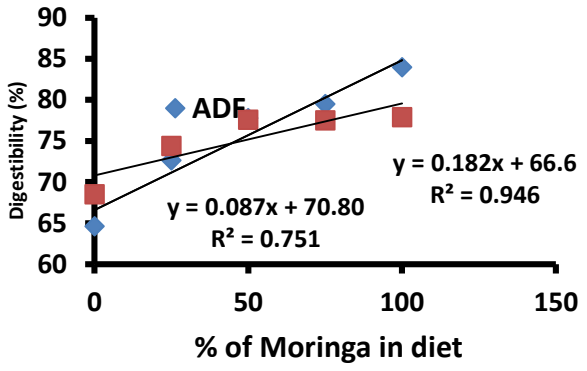

Fig-1. Effect of moringa (%) on ADF and NDF digestibility of male growing sheep

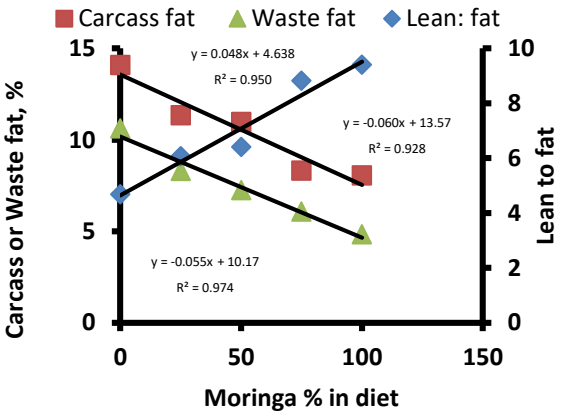

Fig-2. Relation of Moringa % with lean to fat, carcass fat or waste fat content of carcass

Project title: Development of feeding system and least-cost balanced ration with locally available feed ingredients for different selected regions

Sub- title: Development of Feed Master Android Application (Thumb rule Version)

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Executive Summary

Profitable animal production depends on so many factors and feeding is most important among them as feeding cost responsible for 60% cost of animal production. Feeding of animal economically requires proper feed formulation according to animal requirement considering their age, sex and stage of production. In conventional animal production system, farmers are not conscious enough about their animal requirement, available feed sources and their nutritive values as information regarding these issues are scattered. So, approach has been taken to give a complete package to the farmers as well as stakeholder to feed their animals in proper way. Considering these facts, the present study has been designed to fulfill the following objectives: 1) Develop a complete software package for feeding buffaloes that is more farmers and extension worker friendly, 2) Help the farmers and extension worker to formulate a ration by using minimum feed ingredients more accurately and conveniently, 3) Give an idea to the farmerand extension worker for year round fodder production planning and budgeting, 4)Calculate cattle weight instantly and5) Digitalize livestock sector to fulfill vision 2021.

Feed master is an android application that can easily be installed in android device which can formulate ration instantly according to thumb rule. Formulation of ration and feeding to animal is done on the basis of DMI of animal considering their body weight. Studies indicated that daily DMI of buffalo for maintenance was 1.6-2.4% (Puni*a et al*.2003) and it was 2.2-2.6% of BW in heifers (Terramocci*a et al*.2005,Singhal*et al*.2005), 2.5-3.0% of BW in fattening buffaloes (Zicarelli, 2004., Ståhl-Högberg*et al*. 2003), 2.2% of BW in breeding males (Singhal*et al*. 2005), 1.99% of BW in castrated indigenous young males (Bartocci *et al*.2002). In pregnant buffaloes DMI starts to drop before parturition and levels up 1.8-2.5% of BW (Proto V. 1993,Bertoni*et al*. 1994,Singhal*et al*.2005). DMI for buffaloes at lactation period 2.0-2.2% of BW (Bartocci *et al*.2002, Technical-Scientific Committee, 2002., Singhal*et al*. 2005, Paul *et al*. 2003) have been found. Average DM intake is fixed at 2.5 % of body weight. Among total DM requirement 1/3 portion is fulfill by concentrate and 2/3 portion of DM is fulfill by roughages. Animal weight is measured in two ways (Weighing balance and measuring tape). Total animals are divided into two groups: One group consists of growing and bull where no supplement is provided and another group consists of dry, Pregnant and milking animals where supplement feed is provided. The ration of bull and growing animals consists of maize crush, wheat bran, rice polish, khesary bran, soybean meal, salt, di-calcium phosphate and lime stone in a ratio of 25, 20, 15, 20, 17, 1, 1.5 and 0.5 percent respectively which can supply about 19.6% CP and 11.11 MJME/kg DM. The Dry, Pregnant and milking animal ration contain maize crush, wheat bran, rice polish, khesarybran, soybean meal, salt, di- calcium phosphate and lime stone in a ratio of 30, 20, 20, 15,12,1,1.5 and 0.5 percent respectively which supply 17.22 % CP and 11. 67 MJME/kg DM. Milk producing animals are grouped into 5 categories according to their milk production and supplemented concentrate is 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+0.4X milk production(L), Concentrate for less than 12 litters milk production =2.0+0.4X milk production(L) ,Concentrate for less than 15 litters milk production = 3.0+0.3X milk production(L) , Concentrate for less than 20 litters milk production = 3.0+0.3X milk production(L). In case of pregnant (over 6 months) animal average 1.5 kg concentrate supplement is provided. Roughages requirement is fulfilled by different types of seasonal (Maize, Jamboo, Oat and Dhincha) and perennial (German and Napier)fodder according to their DM contain. Land requirement, Seed/cutting, Urea, TSP, MOP, Cow dung requirement is calculated

according to farm practices. Supply of year round fodder to the animal is planned according to season and availability of the fodder. Animal weight in measuring tape is calculated by using formula {(Animal length in inch) x (Animal heart girth length in inch)^2}/660). Animal length is the distance between the point-of-shoulder and the point-of-rump or pin bone. Animal heart girth is measuredfrom a point slightly behind the shoulder blade, down the fore-ribs and under the body behind the elbow all the way around. A feeding trial will be performed to judge the efficacy of this software in the next year.

It is written in Bengali using farmer friendly terminology which is less expensive and convenient than computer. It has been programmed to calculate ration according to the age, sex, production and reproductive stage of animals. So by using this software a farmer and extension worker can easily formulate ration for their buffaloes without any error. This application also give a plan to the farmer and extensionworker how to manage year round fodder production and how much land require for fulfilling their animal requirement if the farmer want to cultivate fodder. It also calculates animal weight instantly which is helpful for drug administration and animal marketing. In next version this apps will formulate least cost nutritionally balanced ration which will giveoption to the farmer to select available feed ingredient. Reproductive cycle and vaccination alarming system will be added in the next version.

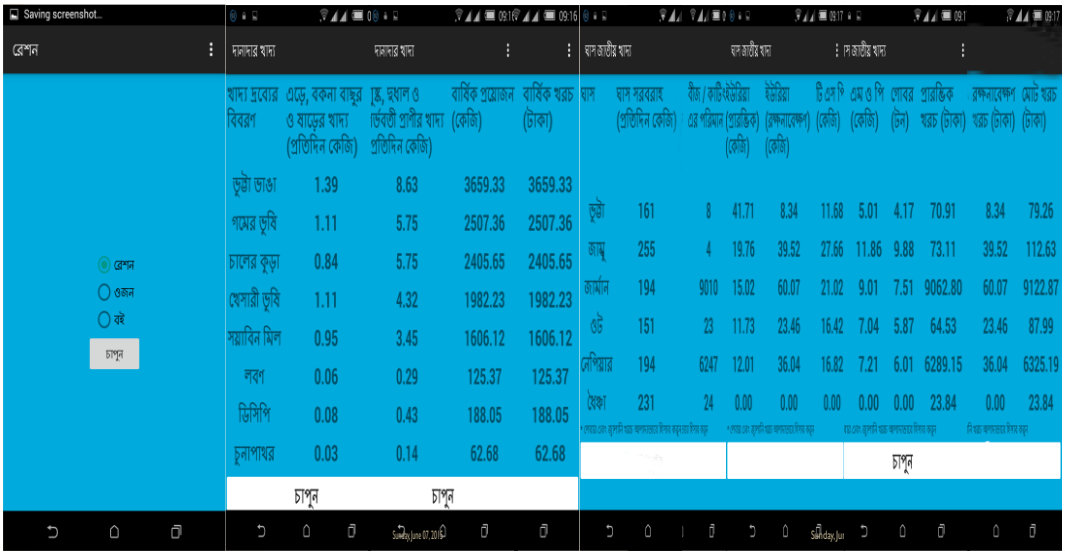

Figure 1 Pictorial visualization of ration formulation in Android mobile

Project title: Collection, conservation, multiplication of high yielding fodder and evaluation their production performances under different agronomical practices

Sub-title: Study on the effect of organic manure on production performance of BLRI-Napier-3 and comparative economic analysis of fodder production with rice

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Executive Summary

Baghabari is one of the important milk pocket areas of Bangladesh. There is a huge demand of greenfodder for dairy cattle production. Bathan is a common pasture land grazing cattle during January to June of a year and it remains under flood water during the rest of the months of a year. Feed scarcity especially green fodder is one of the most important problems for rearing dairy cows in the milk vita area. Traditional green grasses in pasture land have been reducing gradually and the demands of cultivated fodders in these areas are increasing. Assuming that milk production, breeding efficiency, growth rate and disease resistances are reducing due to acute shortage of green grass during the lean period. BLRI developed high yielding fodder crops thosecan minimize the acute feed shortage in those areas. BLRI Regional Station (RS) has taken various effective initiatives to determine the feeds and fodder problems in the milk vita areas. In the recent time, sole fodder production has gained popularity as an income generation & livelihood in the Milkshed and other livestock potential areas of Bangladesh. Therefore, it is necessary to determine the comparative economic analysis between rice and fodder in the respective areas and to disseminate this massage to planner and policy makers for development in this sector. Hence, the studies were undertaken with the objectives: a) to conserve and multiply different high yielding fodder crops to support the fodder production among the dairy farmers, b) to know the effect of organic manures on BLRI developed Napier-4 fodder production and their nutritive evaluations , c) to know the comparative benefit cost ratio (BCR) of fodder vs. rice production at the milk pocket areas. In addition, fodder germplasm bank consisting fifteen different fodder germplasms isbeing successfully conserved and maintained at RS for further research.

Study 1: Effect of organic manures on BLRI developed Napier-4 fodder production at RS

To achieve the second objectives, an agronomical trial was conducted at BLRI regional station, Baghabari, Shahjadpur, Sirajgonj during March 2014 to till now. Twelve experimental plots were distributed into four blocks. The area of each plot was 170 ft^2 and the plots were prepared by ploughing. There were four treatment groups' viz. biogas slurry, broiler litter, layer litter and chemical fertilizer as control. Vegetative propagation method was used for propagation of BLRI Napier-4 fodder with line to line and plant to plant distance of 70 cm and 30 cm, respectively and the experimental layout was done in Randomized Complete Block Design (RCBD). The samples from each plot of different treatment groups were taken for analyzing nutrient composition at BLRI regional station laboratory..'SPSS' statistical program was used to compute data analysis. Duncan's Multiple Range Test (DMRT) was used to determine the differences among the treatment means.

Table 1. Production performances of BLRI –Napier 4 under different treatment groups

Factors		Production parameters (Mean ± SE)	
		Biomass yield	Number tiller/hill
Treatment	Biogas slurry	08.97^{bc}± 0.99	18.00^{a}±1.34
	Broiler layer	10.05^{bc} ± 0.10	15.67^{a}± 1.02
	Layer litter	16.67^{a}± 0.89	19.50^{a} ± 1.05
	Control group	06.65^{c}± 0.90	14.83^{b}± 1.25
	Level of significance	p<0.001	p>0.05
Cutting	1st cutting	8.55^{b} ± 0.69	16.67±0.95
	2^{nd} cutting	12.61^{a} ± 0.72	17.33±0.90
	Level of significance	p<0.001	p>0.05
Overall mean		10.58 ± 0.49	17.00±0.67
Interaction (treatment x cutting)		p>0.05	p>0.05

Table 1 shows that biomass yield (metric ton/hectare) significantly ($p<0.001$) differed for organic manures while not in case of number of tiller per hill. The highest biomass yield (16.67±0.99) was found in the plot applied layer litter, then biogas slurry, broiler litter and control group, respectively. Number of tillers per hill in all plots applied manures was significantly higher than the plot of control group, although overall differences were not significant. Total biomass yield in 2nd cutting was significantly ($p<0.001$) higher than 1st cutting. On the other hand, here was no significant variation of number tiller per hill on cutting interval. The overall biomass yield and number of tiller per hill irrespective of different treatment groups and cuttings were 10.58±0.49 metric tons/hectare and17.00±0.67, respectively.There was no significant ($p>0.05$) interaction effect between treatment and cutting interval for both biomass yield and number of tiller per hill.Chemical composition of Napier fodder under different treatment groups and cutting intervals and their interaction effect are given in Table 2, which shows no significant ($p>0.05$) difference for any of those factors except ADF which differed significantly ($p<0.05$) among treatment groups.

Table 2. Chemical compositions of BLRI- Napier 4

Factors		Chemical composition (Mean ± SE)			
		DM (%)	Ash (%)	CP (%)	ADF (%)
Treatment	Biogas slurry	18.65± 0.44	12.23±1.02	12.50± 0.35	44.08^{ab} ± 0.51
	Broiler layer	18.19 ± 0.44	11.59± 1.02	12.02± 0.35	42.76 ^{a}± 0.51
	Layer litter	19.11± 0.44	12.81 ± 1.02	11.74± 0.35	45.29^{b} ± 0.51
	Fertilizer	19.42± 0.44	11.77± 1.02	11.45v± 0.35	44.91^{b} ± 0.51
	Significance level	p>0.05	p>0.05	p>0.05	(p<0.05)
Cutting	1st cutting	18.92 ± 0.31	12.36±0.72	11.97± 0.25	44.39± 0.36
	2nd cutting	18.77 ± 0.31	11.83±0.71	11.98± 0.24	44.13± 0.25
	Significance level	p>0.05	p>0.05	p>0.05	p>0.05
Overall mean (±SE)		18.84 ± 0.21	12.10±0.51	11.92± 0.18	44.26± 0.26
Interaction effect (treatment x cutting)		p>0.05	p>0.05	p>0.05	p>0.05

Study 2: Comparison of production cost and income between fodder and rice in milk pocket area

To achieve the first objective 1 &3, a total number of 778000 Napier fodder cuttings were distributed to 187 dairy farmers of milk vita areas during the period of November to December 2014. Determine the impact of distribution HYV fodder cuttings, a total of sixty dairy farmers out of 187 farmers distributed fodder cuttings were selected for interview taken with a structured questionnaire to know the comparative production cost and profit of fodder and rice production. Different variable costs of production for fodder and rice are shown in Table 3, which shows that the variable costs for rice production were significantly ($p<0.001$) higher than those of variable costs required for fodder production. Net profit (NP) and BCR between crops were differed significantly ($p<0.001$). NP and BCR were better for fodder production than that of rice production which clearly indicates that fodder production is more profitable than rice production in the study area.

Table 3. Comparative cost-benefit analysis of fodder vs. rice production

Economic parameters	Mean (± SE) per decimal of land		Level of significance
	Fodder production	Rice production	
Fertilizer (BDT)	65.36±5.19	106.84±6.54	p<0.001
Cuttings/seeds (BDT)	50.46±4.38	30.54±2.13	p<0.001
Labour (BDT)	79.43±6.05	177.07±.7.47	p<0.001
Irrigation & others (BDT)	41.39±4.45	81.26±8.85	p<0.001
Total production cost (BDT)	243.52±9.37	401.57±14.47	p<0.001
Net profit (BDT)	445.82±59.34	205.54±21.24	P<0.001
Benefit cost ratio (BCR)	2.97±0.29	1.59±0.08	p<0.001

From the results of the experiment, it can be concluded that layer litter is more suitable for biomass yield of Napier production. The results of the 3rd study also revealed that fodder cultivation may playa significant role for more income generation than rice cultivation in the study area.

Project title: Development of cost effective crop residues based Total Mixed Ration (TMR) for Ruminant

Sub-title: Feeding effect of silage and soybean straw based total Mixed Ration (TMR) on the growth performances of growing calves

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Fodder Research and Development Project

Executive summary

Shortage of feeds and fodder is the single most important constraint to livestock development in Bangladesh. An estimate shows that there is a shortage of 39.8 % dry matter, 38% total digestible nutrients and 43% digestible crude protein and another estimate shows that there is a shortage of 66.5% green fodder and 89.9% concentrates in the country (Huque and Sarker, 2013). This study therefore, was undertaken to formulate, process, and development of Total mixed Ration (TMR) for fattening cattle 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. Five types of TMR were prepared as fed basis with different roughage and concentrate at a ratio of, T_1=70:30(R:C), T_2=60:40(R:C), T_3=50:50(R:C), T_4=40:60(R:C), T_5=30:70(R:C). A total of 30 growing bull calves were selected and equally divided into 5 treatment groups having 6 bulls in each group. It is noted that due to the shortage of required numbers of same genotype of bulls, 3 Pabna bulls and 3 RCC bulls were distributed to every treatment group considering their initial body weight varies from 111.30±6.67 to115.66±10.69 . The crop residue used as a crop by-products for making the TMR was soybean straw was collected from Noakhali district. Before preparation of TMR, soybean straw was milled through the roughage grinder and then mixed with other concentrate ingredients due to bulk low density as per proportion shown in the Table 1. Before feeding in each day to the experimental animals, the silage portion of the TMR was mixed properly with the previously mixed soybean straw+ concentrate manually. Different types of TMR were offered *ad libitum* basis in each group twice daily, once in the morning at 8.00 am and rest in the afternoon at 4.00 pm. The TMR diets were fed to the experimental animals and feed intake, body weight gain and nutrient utilization were recorded daily. The total mixed ration contained around 16% CP and it's DM and CP Contents were analyzed in the laboratory which are given below in Table 2. This feeding trial will be continued for a period of at least 90 days but at this moment 41 days have been completed and partial results are presented here. In the middle of the feeding trial, a metabolic trial was conducted having 7 days collection periods. The samples of feeds and faeces were analyzed for DM, crude protein (CP), OM and Ash. ME, ADF, NDF and Nitrogen analysis were carried out in the laboratory. The data were analyzed using the "MSTAT" statistical programme with one way ANOVA in Completely Randomized Design (CRD). Duncan's Multiple Range Test (DMRT) was used to compare the significance of treatment means among the different parameters.

Table 1. Composition of TMR for different treatment groups

Feed type & Nutrient	Ingredients	Roughage to Concentrate ratios in TMR				
		T_1 (70:30)	T_2 (60:40)	T_3 (50:50)	T_4 (40:60)	T_5 (30:70)
Roughage	Napier-3 silage	56	48	40	32	24
	Milled soybean straw (Kg)	14	12	10	8	6
	Khesari bran (Kg)	3	10	13	23	28
	Soybean meal (Kg)	17.5	16.5	15	14	13
Concentrate	Wheat bran (Kg)	6.5	10.5	19	20	26
	Salt (Kg)	.5	.5	.5	.5	.5
	DCP (Kg)	2.5	2.5	2.5	2.5	2.5
	Total Fresh amount (Kg)	100	100	100	100	100
	DM (% fresh basis))	53.36	54.34	59.86	61.84	64.22
Nutrients	CP (%)	16.76	16.25	16.16	16.06	15.96

T_1=70:30(R:C), T_2=60:40(R:C), T_3=50:50(R:C), T_4=40:60(R:C), T_5=30:70(R:C)

The feed intake of animals supplied different form of TMR is shown Table 3. The TMR intake of animals in T_2 group was significantly higher than from other groups. This could be due to different ratios

of roughage and concentrate in TMR. The CP intake was differed significantly ($p<0.001$) among animals of different treatment groups. The highest CP intake was observed in T_5 and the lowest in T_1 (Table 4). Though, animals of all treatment groups were supplied TMR containing same % of CP but variation of CP intake could be due to variation of DM intake from TMR. Initial body weight and final body weight of different treatment groups are given in Table 4. There were no significant differences for live weight gain among different treatment groups. It is noted that the body weight gain (kg/day), presented here only 41 days data and growth so far obtained it has bit compensatory effect due to the initial plane of nutrition before entering into experimental diets.

Table 2. Crude protein (CP) and DM contents in feed ingredients of TMR

Ingredients	DM (%)	CP (%)
Wheat bran	87.91	16.77
Khesari bran	89.58	13.69
Soybean meal	87.68	40.05
Grind soybean straw	88.19	2.97
Napier-3 silage	20.39	10.25

Table 3. Feed intake of animal for different treatment groups

Parameters	Roughage to concentrate ratios in TMR					
	T_1 (70:30)	**T_2 (60:40)**	**T_3 (50:50)**	**T_4 (40:60)**	**T_5 (30:70)**	Sig. Level
Fresh feed intake (kg/day)	8.58^{b}±0.10	8.59^{b}±0.16	8.32^{b}±0.16	7.71^{a}±0.09	7.79^{a}±0.09	***
DM intake (kg/day)	4.58^{a}±0.06	4.67^{a}±0.09	4.98^{b}±0.98	4.77^{ab}±0.06	5.00^{b}±0.06	***
CP intake (kg/day)	0.49^{a}±0.006	0.53^{b}±0.009	0.61^{c}±0.012	0.71^{d}±0.009	0.77^{e}±0.009	***

***-$p<0.001$

Table 4. Changes of animal's body weight for different treatment groups

Weight parameters	Roughage to concentrate ratios in TMR					
	T_1 (70:30)	T_2 (60:40)	T_3 (50:50)	T_4 (40:60)	T_5 (30:70)	Sig. level
Initial WT (kg)	113.53±6.14	112.90±5.22	115.66±10.69	111.30±6.67	112.93±5.14	NS
Final WT (kg)	150.33±6.81	160.95±10.29	149.68±13.16	150.36±8.90	153.05±7.04	NS
Daily LW gain (g/d)	0.883±.054	1.18±0.16	0.84±.075	0.94±0.16	1.00±0.82	NS

NS-non significant

Table 5. Effect of Different types of TMR on nutrient digestibility (%) of Growing bulls

Nutrients	Roughage to concentrate ratios in TMR					Sig. level
	T_1	T_2	T_3	T_4	T_5	
DM	56.13^{ab}±2.49	56.87^{ab}±1.71	59.98^{b}±1.76	59.21^{b}±1.80	69.43^{a}±4.10	*
CP	57.75±1.03	63.16±1.24	58.74±2.93	67.77±3.83	68.53±9.79	NS
OM	62.24±2.41	58.99±1.63	62.35±1.61	62.07±1.29	56.13±3.54	NS
Ash	23.36^{ab}±2.95	37.72^{bc}±2.44	41.69^{c}±3.31	38.15^{bc}±6.67	40.90^{a}±7.38	**

The digestibility of nutrients of animals supplied different form of TMR based diet in different treatment groups are given in Table 5. The DM and CP digestibility were higher in T_5 group than other groups. However, the body weight gain so far obtained was slightly higher in treatment T_2 (60:40) group but no significant differences were observed among the treatment groups. Therefore, after completion of the feeding trial, it may be possible to draw conclusion about feeding TMR in livestock feeding.

Project title: Project title: Collection, conservation, multiplication of high yielding fodder and evaluation their production performances under different agronomical practices

Sub-title: Effect of feeding different high yielding fodders on growth performance of growing Brown Bengal goats

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Executive Summary

This study was carried out at the BLRI, Regional Station Research Farm, Naikhongchari, Bandarban with a view to evaluate the feeding effect of HY fodders on the growth performances of growing Brown Bengal goats (Hilly Goat). The feeding trail was conducted with 16 growing weaned Brown Bengal goats aged around 4 to 5 months for a period of 75 days during 15, March 2015 to 30, May 2015. The goat each of average 5.442 kg initial live weight were randomly divided into four experimental diets, T_0 (Natural grazing + 101.299 g concentrate supplementation), T_1 (*Ad libitum* Napier-3 + *Ad libitum* cowpea hay + 101.299 g concentrate supplementation), T_2 (*Ad libitum* Napier-4 + *Ad libitum* cowpea hay + 101.299 g concentrate supplementation) and T_3 (*Ad libitum* Rozi + *Ad libitum* cowpea hay + 101.299 g concentrate supplementation). The animals were housed separately in individual pen (metabolic crate, 90x85x75 cm. dimension) on a slatted floor and fed the roughage diets *ad libitum* daily once and basal concentrate mixture (Table 1) twice in a day (9.30 am and 4.00 pm). Napier-3, Napier-4, Ruzi and cowpea were cultivated in farm area (BLRI Regional Station Research Farm) for feeding to animals. The cowpea was after harvest dried and conserved as hay. All the experimental animals were de-wormed, dipped and vaccinated at the onset of the trail. The animals were weighed in the morning at 7.00 before feedingat an interval of seven (7) days. Their feed intake and growth performances were used for comparing the nutritional qualities of different fodders. The collected data were analysed statistically by using Compare Means (CM) procedure of One-Way Analysis of variance (ANOVA): Post Hoc Multiple Comparisons of SPSS 11.5 for Windows (SPSS Inc. 2000).

Table 1. Ingredients composition of concentrate mixture

Sl No.	Ingredient's Name	Composition (% or Kg/100Kg)
1	Wheat Bran	35
2	Khesari Bran	20
3	Broken maize	20
4	Soybean Meal	20
5	DCP	3.5
6	Salt	1.0
7	Min-Vit premix	0.5
Nutritive value of this concentrate mixture: ME=10.93 MJ/Kg DM and CP=194 g/Kg DM		

Among the three different fodders, Napier-4 had a higher level of crude protein (CP 16.94% dry matter) compared to others (Napier-3 had 12.98%, Natural grass had 10.90 and Ruzi had 9.30%), and among them Natural grass had a higher level of DM (22.00% of fresh biomass yield) followed by Ruzi (20.90%), Napier-4 (19.08%) and Napier-3 (18.21%) (Table 2). Alam (1990) observed 19.7% and 8-10% of DM and CP in roadsidegrasses, almost similar to the present findings.Ruzi had the highest level of ash (11.34%). Ruzi had the highest level of ash (11.34%).

Feeding grower Brown Bengal goats with Natural grassor mixed roughage of Napier-3, Napier-4 and Ruzi with cowpea hay had non-significant effect on the intake of DM expressed as total voluntary intake (288.388, 285.711, 293.477 &301.353 g/day) or percentage of live weight (4.000, 3.958, 4.084 and 4.115%) and body wt. gain (3.596, 3.736, 3.733 & 3.718 Kg) in groups T_0, T_1, T_2 and T_3, respectively (Table 3). The treatment group fed Ruzi fodder& cowpea had a

higher total DM intake than that fed with Napier-3, Napier-4 or thenNatural grasses. The total CP intake (gm/d) differed significantly ($p<0.05$) among the HY fodders and Natural grass. It was significantly ($p<0.05$) higher in group T_2 (48.307 gm/d)than that of T_1 (42.076 gm/d), T_3 (38.766 gm/d) or then in group T_0 (38.681 gm/d).

Table 2. Chemical composition of experimental diets

Diets/Roughages	DM, % of Fresh Biomass	Chemical composition (%)	
		CP	Ash
Natural grass (Composite)	22.00	10.90	9.70
BLRI Napier-3	18.21	12.98	8.43
BLRI Napier-4	19.08	16.94	9.18
Ruzi	20.90	9.30	11.34
Cowpea Hay	31.80	16.00	7.70

Table 3. Nutrient Intake and growth response of different fodders on Brown Bengal goats

Parameters	Diets					Level of Sig.
	T_0	T_1	T_2	T_3	Avg.	
Total DM Intake (g/d)	288.39 ± 25.26	285.71±5.41	293.48±9.997	301.35±8.10	292.23 ± 6.63	NS
DMI (Kg, % LW)	4.00 ± 0.00	3.96 ± 0.23	4.08 ± 0.31	4.16 ± 0.18	4.05 ± 0.10	NS
Total CP Intake (g/d)	38.68^b ± 2.75	42.08^b ± 0.69	48.31^a ± 1.51	38.77^b ± 0.87	41.96 ± 1.26	*
Initial Body Wt. (Kg)	5.41 ± 0.65	5.44 ± 0.42	5.47 ± 0.63	5.45 ± 0.40	5.44 ± 0.24	NS
Final Body Wt. (Kg)	9.01 ± 0.63	9.176 ± 0.62	9.198 ± 0.73	9.168 ± 0.58	9.137 ± 0.29	NS
Body Wt. Gain, Kg	3.596 ± 0.24	3.736 ± 0.28	3.733 ± 0.26	3.718 ± 0.37	3.696 ± 0.13	NS
Avg. Daily Gain (g)	47.319 ± 3.14	49.161 ± 3.66	49.115 ± 3.37	48.915 ± 4.89	48.627 ± 1.72	NS
FCR (Kg DMI/Kg Body Wt.)	6.183 ± 0.75	5.903 ± 0.41	6.024 ± 0.25	6.295 ± 0.45	6.101 ± 0.23	NS

NS = Non-significant, *P>0.05, T_0 = (Natural grazing + 101.30 g concentrate), T_1 = (*Ad libitum* Napier-3 + *Ad libitum* cowpea Hay + 101.30 g concentrate), T_2 = (*Ad libitum* Napier-4 + *Ad libitum* cowpea Hay + 101.30 g concentrate), T_3 = (*Ad libitum* Rozi + *Ad libitum* cowpea Hay + 10130g concentrate).

The present findings also had non-significant variation on Daily Body Wt. gain in response to feeding different types roughages.The goat fed with Napier-3 had the highest Daily Body Wt. gain of 49.161 g compared to 49.115 g fed Napier-4, 48.915 g fed Ruzi and 47.319 g fed Natural grasses. In the experiment avg. Daily gain was 48.63 g. In the present trial, feed conversion Ratio (FCR) was not influenced by feeding of different types of roughages (Table 3). Considering the FCR, the three roughages may be ranked as Napier-3>Napier-4>Ruzi.

Project Title: Seasonal dynamics feed resources utilization and management as influenced by different coastal and river basin areas of Bangladesh

Sub-title: Seasonal dynamics feed resources utilization and management as influenced by different river basin areas of Bangladesh

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Executive Summary

The acute shortage of feeds and fodder is the single most important obstacle to livestock development in Bangladesh. Animal feeding systems in this country is mainly based on crop residue and native pasture, which are deteriorating in production and quality; also vary seasonally resulting in poor animal performance. In spite of the rising dependence on fibrous crop residues as animal feeds, there are still certain constraints to their efficient utilization. Sustainable efforts were made to resolve the feed shortage problem in our country. However, the impact was so little to cope with the problem that animal is still subjected to long period of nutritional stress. More efficient management and utilization of available feed resources may help to improve livestock production in sustainable manner. Thus, the study was undertaken with the following objectives: a) to know the livestock status and feeding and management system, and b) to know the seasonal dynamics of feed resources, scarcities and availability in the river basin of Bangladesh. To achieve the goals of the project a purposive survey with a structured questionnaire was conducted by direct interviewing with the farmers in different locations adjacent to river basin areas in Bangladesh. In the questionnaire of the surveyinformation was mainly focused on types of major feed resources, their utilization, seasonal availability, management and associated constraints in relation to livestock production in the respective areas. For this study, ten (10) river basin districts (Rajshahi, Bogra, Lalmonirhat, Kurigram, Faridpur, Kushtia, Tangail, Jamalpur, Munshiganj and Chandpur) were selected and two (02) upazillas from each districtwereconsideredbased on livestock density. Interview was taken from fifty farmers (50) from each upazilla. In addition to surveying, to determine the actual pictures of feeding practices, five farmers having at least 2 dairy cows in each Upazila was selected for collecting the actual data on feeding practices for the period of 7 days. All collected data were checked for any mistakes and were corrected accordingly if there were any and compiled those for analysis using SPSS 17.0 statistical software.

Table 1. Overall livestock keeping status according to farm category

Species	% HHs kept animal and average number of animals per HHs for different farm category											
	Landless (0-49 dec.)		Marginal (50-125 dec.)		Small (126-249 dec.)		Medium (250-749 dec.)		Large (>750 dec.)		Overall	
	%	Av.	%	Av.	%	Av.	%	Av.	%	Av.	%	Av.
Cattle	93.78	3.25	94.35	2.98	92.98	3.63	98.00	4.22	100.0	2.50	94.1	3.32
Buffalo	02.30	2.50	01.13	1.00	01.75	3.00	0.00	-	50.00	3.00	02.1	2.40
Goat	20.05	2.93	16.95	3.17	17.54	2.90	28.00	2.71	00.00	0	19.5	2.95
Sheep	00.46	3.50	01.13	3.50	03.51	2.75	02.00	4.00	00.00	0	01.3	3.22

%-HHs kept animals

Table 2. Feeding status of roughage in the surveyed areas

Type of roughage	Amount of roughage supplied to animals in different season (kg/d/head)			% of HHs supplied in different seasons		
	Summer	Rainy	Winter	Summer	Rainy	Winter
Rice straw	3.7	4.3	4.1	98.5	97.7	98.3
Green grass (cut and carry)	7.3	8.9	7.2	76.4	74.2	75.7
Green grass (cultivated)	7.4	8.1	8.2	9.6	9.2	9.5

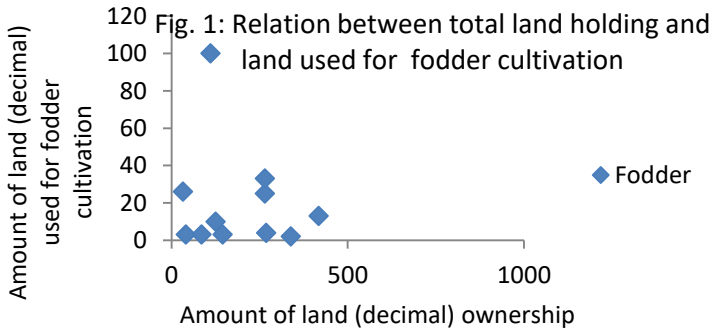
In the surveyed areas, about 94%, 2%, 20% and 1% HHs were keeping cattle, buffalo, goat and sheep with average number of animals per HH of 3.32, 2.40, 2.95 and 3.22, respectively (Table 1). Table 1 also shows that, irrespective of locations, livestock, especially cattle ownerships were belonged to large & medium farmers though the medium farmers had higher average of 4.22 cattle/household than large farm households. Table 2 shows that almost all HHs fed rice straw and around 75% HHs fed cut and carry green grasses to their cattle. It also revealed that feeding straw and green grass as basal feeds were almost similar in all seasons but the quantity supplied to the animals varied somewhat in different seasons.It is noted that in the surveyed areas, irrespective of locations, only around 10% farmers cultivated fodder for feeding their cattle (Table 2). Irrespective of locations, tethering system was followed by most of the HHs, then intensive and semi-extensive system. However, extensive management system was followed by none (Table 3). Some HHs followed more than one system. Duration of grazing in the field varied somewhat in different seasons except in rainy season for tethering (Table 3).

Table 3. Rearing system of cattle around the year

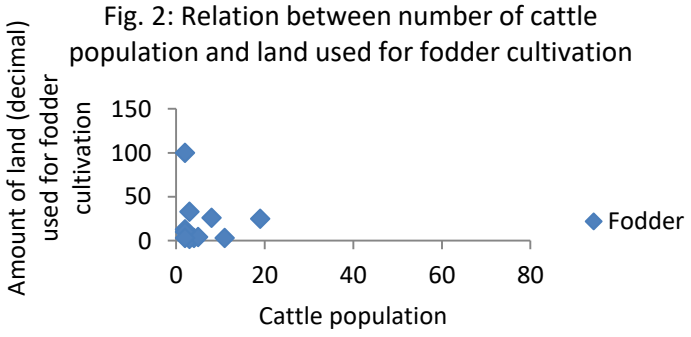
*Different rearing system	Duration per day (hours)			% of HHs followed the systems in different seasons		
	Summer	Rainy	Winter	Summer	Rainy	Winter
Tethering	6.5	5.2	6.9	29.0	29.0	28.6
Extensive	-	-	-	0.0	0.0	0.0
Semi-extensive	3.1	3.1	3.2	16.9	17.7	16.4
Intensive	-	-	-		27.85	

*Tethering-animals graze surrounding an area tied with a rope; Extensive-animals graze freely whole day; Semi-extensive-animals graze partly in a day; Intensive-animals fed in a confinement area of the house.

The relationship between total land holding and land used for fodder cultivation is plotted in Fig.1 which shows that concentration of fodder cultivation lies within 400 land holding HHs and amount of land used for fodder cultivation was within 40 decimal lands. It means land poor people cultivate fodder and this is because number of cattle per poor HHs was higher as shown in Table 1.



On the other hand, relationship between number of cattle and land area used for fodder cultivation is plotted in Fig. 2 which shows that the concentration of fodder cultivation was more within farmers having 10 cattle.Therefore, data so far analyzed revealed that the cattle rearing farmers were found higher in all categories of farm HHs followed by goat and straw was most commonly used as cattle feed.



The results of the present study may contribute to identify the existing practices of utilization of feeds and fodder and to find ways and means to improve these practices. In addition, the study will help to define the prospects for future interventions in developing livestock feeding systems to enhance productivity and viable integration of the crop and livestock sectors in the river basin regions of Bangladesh.

Project title: Collection, conservation, multiplication of high yielding fodder and evaluation their production performances under different agronomical practices

Sub-title: Study on the adaptability, biomass yield, nutritive value of HYV fodders cultivars under different saline condition in Southern districts of Bangladesh

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Executive summary

Salinity intrusion is an increasing problem in the coastal areas in Bangladesh. Climate Change and its associated hazards like sea level rise, cyclone and storm surge have been increasing the salinity problem in many folds. The coastal zone of Bangladesh is already under the constant threat of salinity. Any increase in sea level may intrude much longer distance in the inland as the topography of the coastal zone in Bangladesh is relatively low-lying. The coastal zone, more appropriately, exposed coast has come into focus in a number of policy and academic studies for land desertification and loss in agricultural production due to salinity. As described in the BCCSAP 2009, salinity intrusion is likely to seriously affect agriculture (crops, livestock and fisheries). In changing climate scenarios, fodder production may decrease and disease and mortality rates may rise, which may threaten the viability of the livestock production in future. To address the feeds and fodders problems in the Southern districts of Bangladesh, an agronomic trial was conducted with the objectives to determine the adaptability of HYV fodder cultivars in three different salinity locations viz, Morrelgonj, Dacope and Assasuni upazilas' under Bagherhat, Khulna and Stakhira districts, respectively. A total of 15 innovative farmers having 5 farmers in each Upazila were selected as dispersed replicates for this study. After selecting farmers, a half day training on cultivation methods, management practices and objectives of the experiment were imparted among the selected farmers in each upazila.Five selected high yielding fodder cultivars (BLRI-Naper 1, 2,3, German and Para) were distributed among the selected farmers with five replications ineach treatment. The area of each plot sizewas 2.1x3.5 m. The experimental was arranged in 3×5 factorial design. Soil and water samples from each plot in each location were collected and analyzed in the Laboratory of Soil Science Division, BARI, Joydebpur, Gazipur. Agronomical data such as biomass yield, plant height, number tillers /hill were collected and analyzed in SPSS computer package.

Data on soil parameters revealed that there was no significant ($p<0.05$) differences in soil P^H among three different locations average and P^H was slightly higher in Assasuni followed by Morrelgonj and Dacope, respectively (Table 1). Electric conductivity /salinity was higher in Assasuni (4.65 ±2.47) followed by Dacope (2.61 ±0.84) and (1.44±0.47), Morrelgonj, respectively. Potassium (meq/100g) was significantly ($p<0.05$) higher in Dacope but there was no significant ($p>0.05$) difference between Morrelgonj and Assasuni. It is noted that the soil salinity was comparatively lower all locations than the values reported by Miah and Bari (2011), this possibly due to the effect of seasons. In this experiment, the soil samples were collected during rainy season. The soil organic matter was below the critical level in the selected locations.

Table 1. Soil parameters under different locations

Locations	pH	EC (dS/m)	Organic carbon (%)	Total N (%)	Exchangeable bases (meq/100g)			Available P (µg/g)
					Ca	Mg	K	
Morrelgonj	6.94±0.57	1.44±0.47	0.81±0.16	0.07±0.01	10.14±1.23	3.60±0.48	0.39±0.09[b]	25.14±13.18
Dacope	6.34±0.69	2.61±0.84	1.10±0.31	0.09±0.03	8.86±1.24	3.08±0.41	0.79±0.012a	19.26±5.87
Assasuni	7.64±0.16	4.65±2.47	0.58±0.08	0.05±0.01	12.22±0.70	4.30±0.23	0.35±0.07[b]	12.46±1.38
Pooled	6.97±0.31	2.90±0.89	0.83±0.12	0.07±0.01	10.41±0.68	3.66±0.25	0.51±0.06	18.95±4.68
Sig.	NS	NS	NS	NS	NS	NS	**	NS

**= ($p<0.01$) NS= Non-significant

The survivability of cuttings of different cultivars of high yielding fodder is shown in Table 2. It shows that there were no significant differences in per cent survivability among the cultivars in Morrelgonj and similar results was also obtained in Assasuni. While on the other hand, the significant ($p<0.001$) variation in survivability was found among the cultivars. Considering the locations, it's revealed that BLRI-Napier 3 (hybrid) also performed better than the other adapted cultivars. The morphological characteristics and biomass yield (t/ha) of different cultivars under different locations are shown in Table 3 &4.

Table 2 . Survivability (%) cuttings of different fodder cultivars under selected locations

Locations	Survivability (%) of different fodder cultivars					
	C1	C2	C3	C4	C5	Sig.
Morrelgonj	40.70±12.03	36.50±13.52	53.50±15.34	36.00±14.69	51.60±14.23	NS
Dacope	21.60±9.16^{bc}	25.60±6.52b	48.50±6.40^{a}	4.60±3.48^{c}	6.00±3.67^{c}	***
Assasuni	35.60±3.40	26.90±7.96	47.30±6.05	31.90±10.51	34.60±13.75	NS
Pooled	32.63±5.24^{ab}	29.67±5.40^{b}	49.77±5.50^{a}	24.17±6.79^{b}	30.73±7.99^{b}	*

C1= BLRI-Napier 1, C2= BLRI-Napier 2, C3= BLRI-Napier 3, C4= German C5= Para * =($p<0.05$) *** =($P<0.001$)

Table 3. Morphological characteristics of different HYV fodder cultivars

Location		Plant height (cm)	Hill area (cm)	Tiller/hill (no.)	Leaf: stem ratio (1kg fresh)	Biomass yield/hill (kg)
Morrelgonj	C1	64.83±32.41	29.40±14.70	8.66±4.33	0.52: 0.48	0.62±0.31
	C2	72.86±36.43	22.86±11.43	8.66±4.33	0.42:0.58	1.05±0.52
	C3	79.53±39.76	66.86±33.43	14.00±7.00	0.54: 0.46	0.98±0.49
	C4	82.38±43.42	20.20±10.10	6.33±3.48	0.48:0.52	0.44±0.23
	C5	42.35±21.17	16.26±8.13	10.66±5.33	0.50:0.50	0.26±0.13
Dacope	C1	68.86±6.54	32.54±7.07	13.33±3.84	0.31: 0.69	0.96±0.11
	C2	39.22±20.29	21.27±14.63	11.66±8.41	0.49:0.51	0.70±0.41
	C3	77.00±14.08	30.89±9.17	14.00±5.56	0.65:0.45	0.87±0.26
	C4	28.73±14.36	7.30±3.65	2.66±1.33	0.46:0.54	0.24±0.12
	C5	29.53±14.76	8.73±4.36	8.66±4.33	0.46:0.54	0.12±0.06
Assasuni	C1	81.90±22.56	23.02±6.49	6.00±0.00	0.35:0.65	0.54±0.16
	C3	61.76±6.22	22.42±3.19	6.33±1.45	0.55:0.45	0.56±0.25

C1= BLRI-Napier 1, C2= BLRI-Napier 2, C3= BLRI-Napier 3, C4= German C5= Para

Table 4. Biomass yield (t/ha) different cultivars in different locations

Location	Fresh biomass yield (t/ha)					Sig
	C1 (Mean±SE)	C2 (Mean±SE)	C3 (Mean±SE)	C4 (Mean±SE)	C5 (Mean±SE)	
Morrelgonj	54.84±2.11^{c}	98.48±8.14^{b}	183.72±12.34^{a}	36.73±.55a^{c}	11.34±.59^{d}	***
Dacope	39.54±11.70^{b}	59.87±3.48^{a}	60.25±6.49^{a}	9.37±1.26^{c}	7.57±0.45^{c}	***
Assasuni	11.77±2.69^{a}	0.00±.00	16.30±2.28^{a}	0.00±.00	0.00±.0.00	NS
Pooled	35.38±6.51^{c}	52.78±12.50^{b}	86.76±21.78a	15.37±4.71^{d}	8.22±.74^{d}	*

*** = ($p<0.001$) * =($p<0.05$)

Table 4 shows that the overall total biomass yield was significantly ($p<0.001$) higher in BLRI-Napier-3 compared to other cultivars which was the highest in Morrelgonj, followed by Dacope and Assasuni. The 2nd suitable cultivar adapted in these locations was BLRI-Napier 2. Thus, present study indicated that BLRI Napier 3 is suitable in certain level of salinity in coastal areas of Bangladesh but further detailed study is needed to achieve definite conclusion.

Development of community based fodder production model and demonstration of fodder preservation technology in Haor areas of Bangladesh
Sub-title: Study on the effect of organic manures on biomass yield and nutritive values of BLRI Napier -3 and feeding effect in dairy cows

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Executive Summary

The north eastern parts of Bangladesh is known locally as the haor areas of Bangladesh which are low laying bowl-shaped basin covering about 6,000 sq. km in Sylhet Division**,** mainly the districts of Sunamganj, Moulovibazar, Sylhet, Kishorganj and Netrokona. Virtually all of this land is below 8 meters and is flooded for 7- 8 months to depths of 5 meters or more during the monsoon. Community based fodder model is the present demand in haor areas of our nation to meet-up the animal protein requirement. Recently, fodder production and preservation gets momentum as an income generation and employment opportunity in certain areas of Bangladesh, especially where small scale dairying, fattening and milk marketing facilities are prevailing. Cattle are an inseparable and integrated part of small holder subsistence farming system. It is a fundamental approach to provide good quality diets to dairy cattle in sufficient amounts to maximize production. But in our country, there is heavy shortage of feed both in quantity and quality. The traditional feeding system for dairy cattle is based on the use of rice straw, natural grasses supplemented with a little or no concentrates. The quantity and quality of fodder available from natural pasture shows seasonal fluctuation. There is an acute shortage of feed supply during the dry season and the available feed during this period is of very poor quality. Poor nutrition results in low production and reproductive performance, slow growth rate, loss of body condition and increase susceptibility to diseases and parasites. Thus, effective utilization of the available feed resources and appropriate supplementation of poor quality natural pasture and crop residue based diets appear to be the necessary steps to alleviate the nutritional problems of dairy animals. Fodder conservation practices particularly hay and silage making will be developed in order to enable a stable supply of feed throughout the year. Evaluation of the nutritive value of naturally occurring tree leaves and pods, which will be commonly used as dry season feed resources, would be important to enhance their proper utilization. Hence, the present study was carried out with the objectives: a) to develop community based fodder production model with native or other suitable varieties of fodder in haor embankment, b) to introduce fodder preservation technologies for better use of local feed resources in the haor areas. To fulfill the objectives set in this study, three different places in Sunamgonj haor areas were selected for community fodder production. One of the places was chosen in korchar haor situated in Zinarpur dam of Bishambarpur upazila and another two places were in the Burishtal haor of Sunamgonj Sadar. According to plane of land, two different locations were selected; one from high land and another from low land in that areas.Five dairy farmers were selected for providing the green grasses to know whether the milk production of their dairy cows increase or not. Milk yield records of 15 days were collected from the cows of those farmers. To know the effects of different organic manures on biomass yield and chemical composition of BLRI Napier-3 fodder, all cultivated plots (each having 5m×5m area) were divided into four categories based on fertilizer applied to those plots. The organic manures applied to the plots were goat droppings (T_1), broiler droppings (T_2), cow dung (T_3) and rest of the plot was control (T_0) given no fertilizer or organic manure. Data on biomass yields from different experimental plots and chemical compositions of every sample were entered in to Excel worksheet and were analyzed by SPSS 17.0 program. Table 1 shows that milk production of dairy cows supplied high yielding BLRI Napier-3 fodder increased significantly ($p<0.05$) of about 37% from their existing feeding practices. In all farm houses, daily milk production was significantly higher for cows served BLRI Napier-3 fodder than those of cows reared by existing feeding practices with an overall mean of 2.31±0.04 and 3.17±0.04 kg, respectively for the two feeding systems.The results obtained for biomass yields and nutrients compositionin BLRI Napier-3 fodder showed that treatment had significant ($p<0.001$-$p<0.05$) effect on yield and nutrient contents of fodder for both highland and lowland (Table 2). Biomass yields of fodder were significantly

higher in T_3 (cow dung) than those of other treatment groups for both highland and lowland. DM was found higher in T_0 than those of other groups. CP content of fodder in T_3 group was significantly higher than those of other three treatment groups for both highland and lowland. On the other hand, ash content in fodder was significantly higher in T_2 than those of other groups for both highland and lowland. However, there were no significant ($p>0.05$) variations of biomass yield and nutrient content in fodder between highland and lowland as shown in Table 3.

Table 1 . Changes of milk production for supplying BLRI Napier-3 fodder produced in Sunamganj Haor

Farmer	Duration (days) of milk records	Changes of milk production in ltrs. (mean±s.e) from existing feeding system		% change	Sig. level
		Existing feeding system	Feeding high yielding fodder		
Farmer-1	15	2.27^{b}±0.07	2.96^{a}±0.08	30.4	***
Farmer-2	15	3.20^{b}±0.06	4.03^{a}±0.12	25.9	***
Farmer-3	15	1.07^{b}±0.05	1.90^{a}±0.09	79.2	***
Farmer-4	15	1.03^{b}±0.03	1.70^{a}±0.07	65.0	***
Farmer-5	15	3.97^{b}±0.03	5.23^{a}±0.12	31.7	***
All		**2.31^{b}±0.04**	**3.17^{a}±0.04**	**37.2**	***

***-significant at 0.1% level ($p<0.001$); means with uncommon superscript within the same row differed significantly.

Table 2 . Effect of manure on biomass yield and chemical composition of BLRI Napier-3 fodder cultivated in two land levels

Land level	Parameter	Treatment group				Overall mean	Level of significance
		T_0	T_1	T_2	T_3		
High land	#Biomass	155.7^{b}±6.36	160.0^{b}±2.89	171.0^{b}±3.79	191.7^{a}±4.41	169.6±4.62	**
	DM%	12.08^{a}±0.08	9.69^{b}±0.43	10.22^{b}±0.19	9.89^{b}±0.11	10.47±0.29	***
	CP%	9.39^{b}±0.19	9.90^{b}±0.24	9.83^{b}±0.11	12.04^{a}±0.04	10.29±0.32	***
	Ash%	13.39^{a}±0.21	13.48^{a}±0.62	14.86^{b}±0.29	13.23^{a}±0.21	13.74±0.25	*
Low land	#Biomass	145.0^{c}±2.89	161.7^{bc}±4.41	171.7^{bc}±4.41	199.3^{a}±5.81	169.4±6.25	***
	DM%	11.47^{a}±0.27	8.71^{b}±0.13	9.33^{b}±0.08	11.08^{a}±0.12	10.15±0.36	***
	CP%	10.08^{b}±0.06	10.27^{b}±0.17	10.20^{b}±0.19	13.17^{a}±0.22	10.93±0.39	***
	Ash%	13.05^{a}±0.10	13.30^{a}±0.17	14.09^{b}±0.07	14.14^{b}±0.14	13.65±0.15	***

T_0-control (without manure), T_1-goat dropping, T_2-broiler dropping, T_3-cow dung; *-significant at 5% level ($p<0.05$);***-significant at 0.1% level ($p<0.001$); means with uncommon superscript within the same row differed significantly. # kg/plot (25sqm).

Table 3 . Effect of land level on biomass yield and chemical composition of BLRI-Napier-3 fodder

Parameter	Land level			Level of significance
	High land	Low land	Overall mean	
Biomass yield (kg/plot)	169.58±4.62	169.4±6.25	169.5±3.80	NS
DM%	10.47±0.29	10.15±0.36	10.31±0.23	NS
CP%	10.29±0.32	10.93±0.39	10.61±0.26	NS
Ash%	13.7±0.88	13.65±0.15	13.69±0.14	NS

NS-non significant ($p>0.05$)

The results obtained in this study clearly indicate that fodder production model in haor areas may play an important role for dairy development of those areas by meet up the deficit of huge feed crisis during most of the water logging periods in haor. Cow dung as organic manure was found more suitable for production of BLRI high yielding Napier-3 fodder.

Project title : Study on manure management practices in Bangladesh and their impacts on climate

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Executive Summary

Harnessing the full potential of livestock to accelerate economic growth for reduction of rural poverty is the major objective of National Livestock Development Policy in Bangladesh. Considerable importance was, therefore, also given in livestock policy for the efficient utilization of by-products. Livestock manure could be a valuable wealth to farmers, the potentiality of which is yet to be explored fully. Manure is a valuable resource of soil nutrients, organic matter and, more significantly, it is a source of renewable energy, and the latter is practiced to some extent in the country. However, inefficient management practices may results in the loss of valuable nutrients and energy, causing environmental pollutions and climate problems threatening public health. Therefore, the present study was done to identify the existing Livestock Manure Management (LMM) practices in Bangladesh with the financial support of Climate and Clean Air Coalition (CCAC), Stockholm Environment Institute Asia Centre (SEI-Aisa Centre) & the University of Wageningen, Netherlands, which can be used as benchmark data for future policy development and technology intervention to increase farm income, safeguard the environment and make the livestock production sustainable.

Table1. General Information of the respondents under this study

Parameter	Having Digester (Mean ± SD)		*p*-value
	Digester	Non-digester	
Farm area	1.2 ± 5.2	2.2 ± 7.8	0.153
Agricultural land	3.6 ±8.1	2.46 ± 6.8	0.417
Grassland	0.7±2.6	0.2 ± 0.8	0.004
Dairy Cattle (nos.)	15.2 ± 23.2	3.9 ± 9.1	<0.001
Replacement stock of cattle (nos.)	9.2 ± 19.0	2.5 ± 6.8	<0.001
Chicken (nos.)	6043 ± 28666	200.2 ± 772.4	<0.001

To fulfill the above objectives, a survey was conducted to know the present scenario of LMM practices by farmers in Bangladesh. A questionnaire was constructed by the University of Wageningen, Netherlands and Stockholm Environment Institute (SEI)-Asia centre and data were collected on farmer's general information, livestock farm composition and productivity, housing system, fate of dung and urine, farmer's opinion on major technical, socio-economic and institutional constraints on the issue and their sources of information regarding LMM. However, some salient features of manure management are in the scope of the present summary. A total of 120 farmers (randomly selected) from 11 districts of Bangladesh were interviewed personally. Collected data were inserted into MS Excel spreadsheet and statistical analysis were done using SPSS 17.0 statistical package program. Respondent farmers were divided mainly into two groups i.e., farmers of conventional LMM or of having bio-digester and independent sample t-test was performed where necessary. Moreover, the extent of pollution by methane production from different LMM system was calculated using IPCC **Equation 10.23:** $EF_T=(VS_T.365).[B_{o(T)}.\frac{0.67Kg}{m^3}.\sum_{S,k}\frac{MCF_{s,k}}{100}.MS_{(T,S,k)}]$ of the, where methane emission factor (EF) of

Table 2: Ways of manure management (% of farmers)

Ways of utilization	Digester	Non-digester	Overall
In digester	100	-	25.62
Store solid manure	58.62	78.02	75.21
Dry solid manure	24.14	36.16	34.71
Store urine	6.90	-	2.48
Store liquid manure	17.24	6.59	9.92
Liquid manure storage system			
Silo/Tank	20	33.33	16.67
Lagoon	80	66.67	75.0
Others	-	-	8.33

LMM was calculated using default values of volatile solid (VS), maximum methane producing capacity for manure (B_o) & % methane conversion factor (MCF).

Table 3 Ways of utilization of dried and composted manure (% of farmers)

Ways	Dried	Composted
On-farm fertilizer	40.48	87.5
Aquaculture	2.38	12.5
Off-farm agriculture	11.90	12.5
Fuel	64.29	-

It was observed that solid storage, liquid slurry, burned for fuel and anaerobic digestion are the major LMM system at farm levels. However, farmers having bio-digester had a higher ($P<0.01$) area of grassland as well as a higher number of cattle and poultry (Table 1). Manure from cattle and poultry is usually used in biogas digester. Only 25.6% of farmers use cattle and poultry manure either in individual family digesters or community digesters. The average capacity of family and community digester is about 3.6 and 130m^3, respectively (data are not shown). While those who have not digester, they mainly store or dry their manure. On average, 2.5% farmers store urine and about 10% farmers store liquid manure (Table 2) and the rest release them in open area. These results indicated less efficient utilization of manure especially of liquid manure at farm level and the scope of value addition technology may support sustainability of farms. The ways of utilization of stored or composted manure by farmers are illustrated in Table 3.

Table 4: Annual methane emission factors of different farm animals under different LMM systems

Manure management systems	Annual Methane Emission Factor (EF, Kg CH4/head/Year)				
	Dairy Cattle	Other Cattle	Buffalo	Small Ruminants	Poultry
Solid storage	0.37	0.15	0.34	0.203	
Liquid slurry	5.81	2.41	5.33		
Burned fuel	5.46	2.26	5.01		
Anaerobic digester	1.24	0.51	1.14		0.001
Without Litter					0.023

It was observed that the major uses of dried manure were as on-farm fertilizer (40% farmers) and fuel (64% farmers), composted manure was used mainly as on-farm fertilizer (87.5% farmers). The loss of bio-slurry, a valuable by-product of bio-digester was reported abnormally high at field level. About 24% farmers reported discharge of bio-slurry from their digester, the amount of which was 22.4% of their total slurry (Figure 1). On the other hand, about 7% of farmers waste 100% of their slurry giving an overall loss of about 30% of slurry. Table 4 shows that the average per capita annual methane emission (EF) varied according to animal types and the LMM systems. Dairy cattle and Buffalo had the highest EFs in liquid slurry storage system (5.81 & 5.33 $KgCH_4$/head/year followed by burning of their manure (5.46 & 5.01 $KgCH_4$/head/year). Solid storage (0.37 & 0.34) had the lowest emission with an intermediate (1.24 & 1.14) emission of anaerobic digestion. The EF of solid storage, liquid slurry, burned for fuel & anaerobic digestion of other cattle were 0.37, 5.81, 5.46 & 1.24 per head/year, respectively. Solid storage of small ruminant manure and anaerobic digestion and without litter of poultry emits 0.203, 0.001 & 0.023 $KgCH_4$ per head/year.

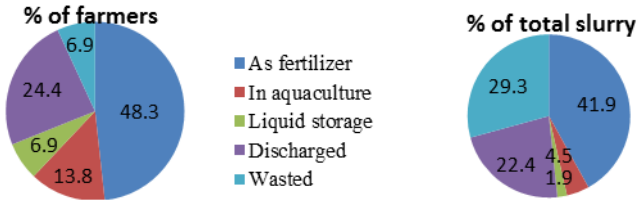

Figure 1 Pattern of bio –slurry utilization

It can be concluded that the existing manure management practices in Bangladesh were found loss incurring and not environment friendly. However, appropriate policy development, supporting farmers with knowledge and technology may ensure harvesting the full benefits of LMM, protect environment from pollution, improve public health, and make livestock production sustainable in rural Bangladesh.

Project title: Evaluation of existing livestock and poultry policies and provide guidelines for development in Bangladesh

R Khatun, MM Hossain, S Ahmed, MR Haque, MA Hashem and MN Islam

Executive Summary

This study was undertaken for the evaluation of existing livestock and poultry policie in Bangladesh. The objectives of the study are to know the views of the different stakeholders involved with livestock production and to identify the gaps between existing policies and expectations from the perspectives of stakeholders. At this stage animal slaughter act, feed act and poultry development policies were considered for investigation. The study was carried out in seven divisions namely Dhaka, Chittagong, Rajshahi, Khulna, Sylhet, Barisal and Rangpur. Total 377 representative samples (covering all stakeholders) were interviewed from selected six divisions. The number respondents interviewed was 377 representing 116 farmers, 64 butchers, 70 dealers and distributors, 66 meat processors, 10 Parent stock/Hatchery owners, 39 Upazila Livestock Officer(ULO)/(Veterinary Surgeon)VS/(Poultry Development Officer) PDO and 12 feed mill owners. In addition, seven FGDs (Focus Group Discussions) and some Key Informant Interviews (KII) were administered with different stakeholders. Descriptive statistics like percentage, mean, ranks, bar and pie chart were used for different variables to describe the present status of different stakeholders regarding different act and policies. Binary logistic regression was used to identify the variables influencing the slaughter act, feeding act and poultry production policy. Most of these analyses were conducted by using the statistical SPSS 20 package. One sample proportional Z test was conducted to identify the significant portion of the stakeholders who know about the particular act and to conclude about the whole population of the stakeholders on the basis of the collected sample. For critical analysis of the existing livestock and poultry policies in Bangladesh, we have chosen three policies namely slaughter act, feed act, and poultry production policy. To investigate the different factors of the existing policies secondary data were collected. The SWOT analysis was performed for three policies. The research team visited Dhaka, Chittagong, Rajshahi, Khulna, Sylhet, Barisal and Rangpur divisions for collecting data in respect of said acts having prepared and developed questionnaire related to the policies and acts from the stakeholders. Information in relation to farmer's age, sex and education is discussed. Range of age of farmers was from 16 to 89 years. Average age of farmers were 42 years. Out of total farmers 98% were male and 2% female. Education is an improtant aspects for farmers to be conscious about livestock policies. From the data it reveals that 89% farmers' rear indigenous cattle and only 11% farmers' rear crossbred cattle for dairy and meat purposes. The average schooling age was 9 years which indicates lower level of education in all the farming system. The average size of family was five. The average farming experience was 12 years. The proportion of farmers having Govt. registration was 36% whereas in case of hatchery owner it was 100%. The policies stipulated that there should have registration in each type of livestock and poultry business. The average annual income of the farms was BDT. 234324. Income of the farmers are increasing annually. Fifty eight percent farmers said that they do not have any idea about slaughter act whereas 85% farmers said sanitary inspector never visit slaughterhouse. More than 80% butchers said they used antibiotics, hormones and opined that slaughterhouse is not environment friendly. More than 82% meat processor said that they did not have modern facilities for the processing plant. More than 80% meat processors mentioned that they did not have chilling, boiling facilities, refrigeration, improve packaging system and fixed pricing system. Regarding feed act, about 70% farmers said that feed prices are fluctuating throughout the year. About 70% said that there was no lot number to identify animal feed. More than 80% dealers and distributors said they did not see any authorized officers visiting and collecting feed samples for quality testing which is the violation of animal feed act. About 75% feed miller owner said they do not use unconventional feed. More than ninety feed mill owner said that feed price did not fluctuate. Knowledge about Feed Act is considered as binary (dependent variable) and others as endogenous variable (Table 1). The table reveals that, none of these endogenous variables have significant effect on the knowledge of farmers about slaughter act except education as $P< 0.05$. So the educated farmers have higher probability of getting known about the feed act. By conducting one sample proportion test (Z test) one can easily

conclude about the population of farmers in particular area that less than 50% of farmers have knowledge about the feed act.

Table 1 Binary logistic regression for farmers knowledge about Feed Act

Variables	B	S.E.	Wald	P value	Exp(B)
Age	.002	.018	.010	.919	1.002
Education	.086	.041	4.431	.035	1.090
Fam size	-.019	.143	.018	.895	.981
Yearly Income	.000	.000	.763	.382	1.000
Farming Experience	.027	.031	.736	.391	1.027
Constant	-1.828	1.261	2.103	.147	.161

* P < 0.05 = Significant

Table 2 Binary logistic regression for farmers knowledge about Poultry Development Policy

Variables	B	S.E.	Wald	P value	Exp(B)
Age	-.024	.020	1.433	.231	.976
Education	.005	.043	.016	.899	1.005
Fam size	.020	.145	.019	.891	1.020
Yearly Income	.000	.000	.094	.759	1.000
Farming Experience	.003	.034	.008	.927	1.003
Constant	-.344	1.320	.068	.794	.709

* P < 0.05 = Significant

Here knowledge about Poultry development Act is considered as binary (dependent variable) and others as endogenous variable (Table 2). The table reveals that, none of these endogenous variables have significant effect on the knowledge of farmers about poultry development act. By conducting one sample proportion test (Z test) one can easily conclude about the population of farmers in particular area that less than 50% of farmers have knowledge about the poultry development act.

Table 3 Binary logistic regression for dealer and distributors on poultry development act

Variables	B	S.E.	Wald	P value	Esp. (B)
Age	-.023	.031	.542	.462	.977
Education	.009	.062	.021	.885	1.009
Fam size	.012	.166	.005	.941	1.012
Yearly Income	.001	.000	5.508	.019	1.000
Farming Experience	.047	.105	.204	.652	1.049
Constant	-2.403	2.186	1.209	.272	.090

* P < 0.05 = Significant

In Table 3 knowledge of dealer and distributors about poultry development act is considered as binary (dependent variable) and others as endogenous variable. The table reveals that, most of these endogenous variables are insignificant. Only yearly income is significant at 5% level of significance as P < 0.05. So it may indicate that distributors with higher income have the probability of getting known about the poultry development act. By conducting one sample proportion test (Z test) it can be easily concluded that the population of dealer and distributor in particular area that less than 50% of them have knowledge about the poultry development act.

It can be concluded that there is a large gap between the regulations and their implementations in the field level due to lack of awareness, communication and enforcement of law and order. Proper implementation of act and policies will help ensure livestock sector development in Bangladesh to a great extent.

Project title: Marketing and Value Chain Analysis of Live Poultry in Savar Upazila

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Executive Summary

The people of Bangladesh greatly benefits from poultry meat and eggs by providing income generation and cheap nutrients, which provide food containing high-quality protein, and a low level of fat with a desirable fatty acid profile. In financial year 2011-12, Bangladesh produced 2.429 thousand lakh chickens including all birds and 1.6 crore eggs against the demand for 2.983 thousand lakh and 1.7 crore, respectively. But this supply and demand gaps lead farmers/industry owners and other market actors to supply live poultry quickly for getting higher benefits without protecting any health measures which hinder the industry for sustaining production. With a view to explain the live poultry marketing, actor's involvement and its impact on human health, the present study was conducted to identify the actors involved in value chain and their functions, and estimate the value addition, marketing costs, margins of different market actors in live poultry marketing; to study spatial and seasonal price fluctuation of poultry and to examine public health impacts of live poultry markets, consumer preference towards poultry and suggest alternative policy guidelines. Savar upazila is the leading area of poultry production and trading in capital city Dhaka and its surrounding districts. For these reasons Savar upazila was purposively selected as study area. For the study the sample included Native Chicken, Broiler and Sonali poultry producers and traders who were involved in poultry marketing. The total sample size was 250 among these 150 farmers (taking 50 from each type of native, broiler and sonali birds producers), 70 traders (trading these three categories of birds) and 50 consumers were selected as sample unit. The data were collected during the months of October, 2014 to January, 2015 by face to face interview technique through using pre-tested three separate types of interview schedules. The traders and consumer were interviewed in the markets of Rajfulbaria, Nobinagar Kitchen Market, Savar Bazar, Pollibidhut, Baipail Bazar, Hemayetpur Bazar, Nayar Hat, Mirzanagar, Ghenda Bazar, Kathghora, Pundhua Bazar, Gherua Bazar, Mirertekh, Baipail Bazar, Polashbari and Pathalia following the value chain maps of birds flow. Average, percentages and other descriptive statistics were followed for calculating value addition, marketing margins and net margins. For calculating seasonal price indices of poultry ratio to moving average method was applied. The study revealed that the prime market actors performed marketing functions were poultry farmers, *farias*, *beparies*, wholesalers and retailers. The main functions of the market actors were live poultry collection, buying and selling, transportation, grading, storing, financing and market information. The longer marketing channels were found (where faria plays an active role) for native chicken followed by the broiler and sonali. The faria purchased 100 per cent of native chicken from the farmers` village or at local Hat and sold 70 per cent to *beparies* and rest to wholesalers. *Bepari* purchased 60 per cent native chicken and 100 per cent both sonali and broiler from farmers. They sold 49 per cent native chicken to wholesalers, 54 per cent sonali to retailer and 65 per cent broiler to wholesaler. Wholesaler purchased 72 per cent native chicken from *beparis*, 77 per cent sonali from farmers and 81 per cent broiler from *beparies*. Wholesaler sold their products 98 per cent native chicken to retailers and 100 per cent both sonali and broiler to retailers. From table 1, it is focused that various poultry farmers incurred production cost per quintal of live poultry were BDT 7,300, BDT 17,063 and BDT 9,488, respectively for native chicken, sonali and broiler which indicating that native chicken rearing is based on scavenging that requires low production cost compared with broiler and sonali production. The average production cost was BDT 11,283. Per quintal net return was found BDT 5,182, BDT 3,714 and BDT 1,123, respectively for native, sonali and broiler meaning that rural women keeping native birds in their backyard as additional income. The average net return was BDT 3,340.

Table 1. Cost and return of poultry farmers

Items	Native	Sonali	Broiler	All average
Gross Return	12,482	20,777	10,611	14,623.33
Total cost	7,300	17,063	9,488	11,283.67
Net Return	**5,182**	**3,714**	**1,123**	**3,339.67**

The study also found the significance difference of marketing costs and net margins across the bird species. The total marketing cost of native chicken was 1.24 times higher than sonali and 1.21 times higher than broiler indicating that native chicken markets need to be more attention for reducing marketing cost. In terms of net marketing margins native chickens market actors received 5.44 times higher return than broiler and 1.93 times higher return than sonali. Among the different market actors for native chicken, *faria* incurred highest marketing cost followed by retailer and bepari. For the sonali and broiler bird marketing, retailer incurred highest cost followed by bepari and wholesaler. Among the intermediaries of the poultry marketing retailers received highest net margin although they incurred second highest marketing cost. (Table 2).

Table 2 Cost and net margin of market actors

Actors	Native		Sonali		Broiler		All average	
	Cost	Net margin	Cost	Net margin	Cost	Net margin	Cost	Net margin
Faria	390	2010	-	-	-	-	390	2010
Bepari	217	482	262	1037	246	254	241	591
wholesaler	206	294	178	622	270	230	218	382
Retailer	406	2094	540	860	487	413	478	1122

Value addition interpreted as the difference between total expenses involved in making of buying of a commodity and total revenue accruing from its sales. The percentages of total value addition cost and total net profit by different intermediaries for native chicken, major cost was borne by retailers (33% of total cost) and major net profit was earned by retailers (43% of total net profit). For sonali bird marketing, major cost was borne by retailers (55% of total cost) and major net profit was earned by beparis (41% of total net profit). For broiler marketing, major cost was borne by retailers (49% of total cost) and major net profit is earned by retailers (46% of total net profit) (Table 3).

Table 3 Value addition by different market actors

Intermediaries	Native		Sonali		Broiler	
	% of total value addition cost	% of total profit	% of total value addition cost	% of total profit	% of total value addition cost	% of total profit
Faria	31.99	41.18	-	-	-	-
Bepari	17.8	9.88	26.73	41.16	24.54	28.32
Wholesaler	16.9	6.02	18.16	24.69	26.91	25.64
Retailer	33.31	42.91	55.1	34.14	48.55	46.04

The seasonal price indices of broiler at retail level price in Dhaka Sadar and Savar market during 2010 to 2014, the highest price indices were in the month of June (111) and July (111.26) and lowest in the month of November (85) and December (84), respectively (Table 4).

Table 4 Retail level seasonal price index of Broiler in Dhaka Sadar& Savar market (2010-14)

Month	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dhaka	93.8	100.4	100.0	103.3	100.6	110.8	108.1	108.0	107.1	95.8	85.3	86.3
Savar	93.1	99.01	101.1	102.2	101.9	107.1	111.2	107.2	102.6	96.9	92.7	84.2

It is observed from Table 5 that in retail level the coefficient of variation of Broiler is highest in Dhaka sadar (8.35) followed by savar (7.42). It revealed that at Dhaka Sadar price risk of Broiler is higher compare to savar. The national level coefficient of variation of native chicken were found highest for medium (5.43) followed by small (4.56) and large (4.51) size of birds. It meant that the price risk was highest for medium and lowest for large birds.

Table 5 Coefficient of variation of Broiler and Native Chicken

Particulars	**Brioler**		**Native**		
	Dhaka Sadar Market	Savar Market	Large	Medium	Small
Coefficient of Variation (CV)	8.35	7.42	4.51	5.43	4.56

From Table 6, majority of the consumers (56%) showed negative opinion in case of processed poultry meat and remaining (44%) had positive attitude indicating that policy should be addressed from the motivation issues of consumers. Process poultry meat market development is a tameable decision that come forward coming days as live poultry marketing brought serious health diseases where near about 58% of market actors suffered different diseases.

Table 6 Processed poultry meat (Halal Method) and market actors attacked by diseases

Response	Processed poultry meat (Halal Method)	Market actors attacked by diseases
Yes	22 (44%)	41 (58%)
No	28 (56%)	29 (42%)

Poultry production and marketing undoubtedly is a profitable business. For sustainable, environment friendly and standard economy for poultry business, it needs modern and updated steps by govt. and private organization for encouraging the rural youth and women as it brings additional income with low capital investment. Ensuring bio-security, Halal method and hygienic way of poultry processing may be the steps for modern economic system of poultry business.

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

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Executive Summary

Native sheep is considered important and promising animal resources in Bangladesh. Currently, the contribution of sheep in Bangladesh can be summarized as a source of meat and wool. Bangladesh possesses 3.156 million sheep (BER, 2014). Wool is a potential by product of sheep which is being used throughout the world for producing 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 BLRI and BJRI. The aims of the research work are to produce blended yarn and fabrics; determine the physical properties of blended yarns and fabrics; Compare the blended properties with respective 100% cotton, jute and woolen properties and increase the diversified use of wool and cotton blended products with small entrepreneur**.** In this regard, 650kg wool was collected from Goat and sheep research farm of BLRI and also from different sub-station of sheep project. After chemical modification of jute with caustic soda, wool was treated with concentrated sulphuric acid to improve the spinable properties of wool. Jute was cut at different length (1, 1.5 and 2 inch) blended the staple length at cotton. According to standard procedure blended wool, jute and cotton fiber were mixed at different proportions (30:30:40). By using cotton processing system blended yarn was produced. After determination of the properties, yarns were used in weaving machine (loom) to produce blended fabrics. Blanket is being produced. Shawls and pant pieces were produced successfully.

plant

Sheep wool Washing plant Breaker cut machine Finisher cut machine







Project title: Impact of farmers training on adoption of BLRI developed technologies

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Executive Summary

Livestock is the second most important agricultural sub-sector in our country. As a national research intitute for livestock development BLRI is commited to develop native breeds of cattle, chicken and duck, techniques for their feeding and nutrition, disease prevention and health management and models for milk, meat and egg production system through strategic research. Since inception BLRI has developed 63 packages/technologies on livestock and poultry production. These technologies have presumably made a significant response to increase milk, meat and egg production and generation of income and creation of employment at farm level. BLRI technologies are important for livestock rearing in our country. During the last 3 years BLRI has conducted training on dairy rearing and management. But after training we have no information about how good or useful it is in the field condition. Considering the situation BLRI set a study to know the impact of farmers training on adoption of dairy rearing and management related technologies in the field. A total of 200 dairy farmers of Shajadpur & Belkuchi under Sirajgong, Badargonj under Rangpur, Rupsa under Khulna, Dinajpur Sadar under Dinajpur and Satkania under Chittagong district were selected to study those who took part in training on dairy rearing & management from 2011 to 2013. Field survey method was followed to collect data. The impact of the study was evaluated by using a "before and after" technique. Mostly descriptive analysis was used to achieve the objectives. T-tests were conducted to compare the mean differences of the farmers. Table 1 reflacts a positive change of possession of dairy cattle. Most of dairy cows were indigenous/local. Some farmers reared crossbred cattle. After having training, 43.7% and 38% increase in milk production (l/d) and birth wt. (kg) were observed. Fodder land (acre) use and fodder production (ton/year) have also increase by 166% and 51.3%, respectively.

Table 1 Information on dairy cattle possession, productivity, mortality and fodder production

Parameters	Before	After	Change	% Change.	Level of sig.
No. of dairy cows	3.00	5.00	+ 2.00	66.0	**
No. of bulls	1.72	2.15	+ 0.43	25.0	***
Milk production (l/d)	3.45	4.96	+ 1.51	43.7	**
Birth wt.(Kg)	20.00	27.60	+ 7.6	38.0	**
Calf mortality (%)	13.80	5.24	- 8.56	62.0	**
Fodder land (acre)	0.03(15)	0.08(51)	+ 0.05	166	**
Fodder prodn(ton/year)	2.18	3.35	+ 1.17	51.3	**

** Significant at 5 percent level, *** Significant at 1 percent level

Table 2 Information of mortality due to disease out break and health problems of dairy cattle

Name of diseases/health problems	Before (%)	After (%)	Change
Mortality:			
FMD	1.60 (3)	-	
Anthrax	1.00 (5)	-	
Health problems:			
Dystocia	1.82 (68)	1.00 (22)	-0.82
Abortion	2.56 (33)	1.11(13)	-1.45

It can be observed from table 2 that before training 1.60% and 1% of dairy cows were died of FMD and Anthrax, respectively but no mortality case was found after having training. After training there was a decline in dystocia and abortion problems of dairy cattle in the farm families.

Table 3 Annual income from dairy cattle and dairy products/by products of farm families (Tk./year)

Source of income	Before	After	Change	% Change.
Milk	63966.8	145365.4	+ 81398.6	127.2
Cattle sale	65919.1	151397.1	+ 85478.0	129.6
Cowdung	8852.6	12675.8	+ 3823.2	43.1
Compost	16000 (3)	37500 (29)	+ 21500	134.3
Total	154738.5	346938.3	192199.8	124.2
Change in total income (Tk)	192199.8**			

** Significant at 5 percent level

Table 4 Total dairy cattle rearing cost (Tk./year)

Source of income	Before	After	Change	% Change.
Rearing cost (Feed, medicine, labor)	69688.8	127456.0	57767.2	82.8

Table 3 indicates an increase in income of farm families after having training. Incomes from milk, cattle sale, cowdung and compost increased by 127.2%, 129.6%, 43.1% and 134.3%, respectively. The total annual income significantly increased from Tk. 154738.5 to Tk. 346938.3.

Table 5 Annual household expenditure (Tk./year)

Particulars	Before	After	Change	% Change
Food	73324.5	84768.2	+ 11453.7	15.6
Clothing	6910.6	8887.4	+ 1976.8	28.6
Health care	4821.2	5678.8	+ 857.6	17.8
Education	11000	17762	+ 6762	61.4
Cosmatics	1471.9	2046.6	+ 474.7	39
Total	97528.2	119143.0	21614.8	22.2
Change in total expenditure (Tk)	21614.8*			

*Significant at 10 percent level

After having training, the farmers were in better position to earn more income and led a better life than before. As a consequence, their household expenditure was increased. Educational expenses were found to be much more than before. On average, the total annual household expenditure increases from Tk. 97528.2 to Tk. 119143. The change in total annual household expenditure was statistically significant. After the training program, farmers' overall consumption of all food items was increased (from 941.5 g to 1023.2 g per day per capita). The changes in per capita daily food intake were statistically significant at 10 percent probability level.

Table 6 Comparative scenario of consumption of different food items (g/d/capita)

Food item	Before	After	Change	% Change
Rice	363.3	373.6	+ 10.3	2.8
Ata	88.9	104.5	+ 15.6	17.5
Pulse	30.5	32.5	+ 2	6.5
Fish	31.2	33.1	+ 1.9	6.1
Meat	29.9	32.6	+ 2.7	9
Milk	202.7	230.7	+ 28	13.8
Egg	4.6	5.9	+ 1.3	28
Vegetables	190.4	210.3	+ 19.9	10.5
Total	941.5	1023.2	+ 81.7	8.7
Change in per capita daily food intake.	81.7*			

*Significant at 10 percent level

Impact study results clearly indicated a positive response to the BLRI developed technologies in increasing dairy productivity to a great extent. Farmer's awareness for dairy production related technology adoption through training was found also good. After having training farmers income was increased from dairy cattle rearing and thereby their overall socio-economic conditions were also improved.

Project title: Avian Influenza Viruses Monitoring in Possible "Bridge" Species of Wild and Domestic Birds in Bangladesh

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Executive Summary

Avian influenza (AI) is a highly contagious disease primarily of birds, and caused by influenza A viruses. AI has greatest concerns for public health that emerged from the animal reservoir. The spread of highly pathogenic avian influenza (HPAI) to countries occurs where hygienic standards are deficient that increases the virus's pandemic potential and raises concerns about food security particularly in rural villages. Since 2003 to January 2014 there were 386 confirmed human deaths in 650 cases by HPAI H5N1 in the world. As of 28 January 2014, the case fatality rate of all confirmed cases is 22%, but many cases are still hospitalized. Most of these infections occurred in association with poultry outbreaks. National Reference Laboratory for Avian Influenza (NRL-AI), Bangladesh was first reported H5N1 HPAI in March 2007, and since then it has spread to at least 51 districts of the country's and become endemic in poultry of Bangladesh. As of May 2014, there have been 558 outbreaks reported to the OIE including seven human cases of H5N1 with one fatality reported to WHO from Bangladesh which results from direct contact with infected poultry. Aquatic birds thought to be natural reservoirs for avian influenza viruses (AIV) and land-based wild birds might also be a major reservoir of influenza viruses. Additionally, they intermingle freely with wild and domestic populations of waterfowl and poultry, making them potentially important "bridge" in the transmission of AIV from aquatic birds to poultry and vice versa. From 2011 it was observed that two new clades 2.3.2.1 and 2.3.4 viruses were introduced in Bangladesh along with clade 2.2 viruses which were circulating since 2007. It has been established that migratory birds are playing important role in introduction of new clades of viruses. In this regards, it is necessary to continue characterization the circulating viruses in migratory birds including different avian bridge species. Since outbreaks of H5N1 HPAI started in Asia in late 2003 and early 2004, there have been some very substantial developments to control this disease. In Asia, some countries that suffered extensive dissemination of infection, including Viet Nam, China and Thailand, have registered great success in bringing the disease under control by maintaining OIE classical methods such as early detection, rapid stamping out, increase bio-security, and modifications to production and market chains, with intelligent use of the suite of measures available improvement and vaccination which is considered as an additional tool to this classical methods. Bangladesh also has taken several measures including OIE classical method to control this disease since 2007, but these methods show limited impact on spread of this disease. In this regards government 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 procedure in 2013. HPAI mass vaccination played a crucial role in HPAI control in China, however they demonstrated multiple disadvantages of HPAI mass vaccination, which had been suspected such as H5N1 subtype HPAI virus has evolved into multiple genotypes, which are all likely vaccine-escape variants and vaccinated chicken flocks can be infected with vaccine-escape variants without showing any illness.

In the light of these above facts, the present study has been undertaken with the following objectives:

i. Virological surveillance for AIV in possible bridge species of wild and domestic birds in Bangladesh.
ii. Isolation and molecular characterization of AIVs from selected vaccinated farm which have undergone further significant genetic evolution with the advent of vaccination.

For virological surveillance, a total of 2993 swab samples (cloacal & tracheal) were collected from possible bridge species of wild birds (n=972) [migratory birds (n=928) and heron (n=44)] and domestic

birds (n=2021) [commercial chicken (n=844), native chicken (n=958), duck (n=146), pigeon (n=31) and quail (n=42)] in Bangladesh.

Table 1 Isolation and identification of AI virus and its subtypes from surveillance samples of NRL-AI

Species		Sample No.	Influenza A by rRT-PCR	% positive	Virus culture in chicken embryonated egg	Subtype specific rRT-PCR			
					HA Positive	H5N1	H7N9	H9N2	**
Domestic birds	Pigeon	31	0	4%	0	0	0	0	0
	Quail	42	3		3	3	0	0	0
	Commercial Chicken	844	38		22	1	0	17	4
	Native Chicken	958	26		19	0	0	17	2
	Duck	146	8		8	1	0	5	2
Wild birds	Migratory bird	928	46	5%	39	0	0	29	10
	Heron	44	3		3	0	0	3	0
Total		**2993**	**124**		**94**	**5**	**0**	**71**	**18**

** Undetermined subtype of avian influenza viruses

A total 124 swab samples, 49 from wild birds (5%) and 75 from domestic birds (4%) were found influenza type A positive by rRT-PCR. The rRT-PCR positive samples were then subjected to grow in embryonated chicken eggs through allantoic sac route. Out of 124 samples, 94 rRT-PCR positive samples were found HA positive which were then confirmed for influenza type A. Subtypes were determined using specific primers and probes against H5N1, H7N9 and H9N2 by rRT-PCR. The bio molecular results revealed that, 5 cases positive for H5N1, 71 cases for H9N2 and 18 cases were undetermined subtype of AIVs. Out of 5 cases of H5N1 viruses, one sample was from commercial chicken, one sample from duck and three samples were from quail. In case of 71 H9N2 positive samples, 17 from commercial chicken, 5 from duck, 17 from native chicken, 29 from migratory birds and 3 from herons. Novel H7N9 AIV was not found in the surveillance samples during this study. Sequence analysis of the H5N1 isolates of the 2014 belonged to 2.3.2.1a clade.

In case of isolation of AIVs from vaccinated chickens, a total of 132 samples were collected (each for both swab and serum) from layer chickens of AI vaccinated chicken farms of Gazipur, Bogra and Kishoregonj districts of Bangladesh. We also collected 8 clinical samples (trachea) from dead birds of vaccinated chicken farms of the study areas. The swab and tracheal samples were processed for RNA isolation and directly tested by rRT-PCR and serum samples were analyzed by hemagglutination inhibition (HI) assay. Out of 132 swabs samples, 10 samples those were collected from two farms of Gazipur and one from Kishoregonj district were positive for influenza type A, in which 9 samples were found H9N2 positive and one was undetermined subtype of AIV. The mean HI titers were 177.07, 175.62 and 15.64 in three farms (two from Gazipur and one from Kishoregonj) respectively against the vaccine of AIV**.** In addition, the 8 tracheal samples from dead birds of three vaccinated chicken farms were also found positive for influenza type A, of which 3 samples were found positive for H5N1 and 5 were undetermined which were not H5N1, H7N9 or H9N2 subtypes of AIV. The mean HI titers were 129.143, 18.64 and 15.64 in these three farms (two from Kishoregonj and one from Bogra) respectively.

Project title: Development of biologics for the diagnosis of Peste des Petits Ruminants (PPR)
Sub-title: 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 vaccination in goats. Serum was separated from blood of vaccinated goats 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-goat HRP 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 at District Veterinary Hospital (DVH), Chuadanga.

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-goat HRP conjugate was added 50 µl/well. Fifty µl/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 at DVH, Chuadanga. Smear from nasal discharges and diarrhea found positive as PPRV in the field level which were performed at room temparature.
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 which will be helpful for the control of PPR disease in Bangladesh.

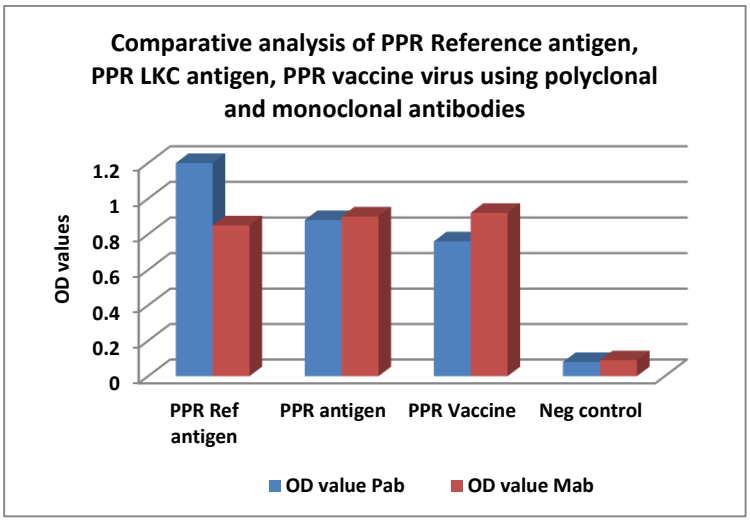

Figure: Pab based PPRV detection system

Project Title: A pilot project on Peste des Petits Ruminants (PPR) control in selected areas of Bangladesh

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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, diarrhea, high morbidity and mortality in small ruminants. In Bangladesh, this disease was first identified in the year 1993. Since then PPR is endemic all over the country causing huge economic loss. To control PPR in Bangladesh, a live attenuated conventional PPR vaccine was developed by Animal Health Research Division of Bangladesh Livestock Research Institute (BLRI) in 2001 and successfully used in the country. But recently farmers and field veterinarians often raise questions about the efficacy of the vaccine. One of the main reasons of reducing the potency of this vaccine may be due to the fact that the vaccine seed become too old and vaccination is not performing properly. Control of economic diseases such as PPR will increase the national productivity of the small ruminants and reduce poverty among poor farmers. Although sporadic vaccination against PPR has been practiced all over the country for a long time but no specific strategic plan was followed. Currently many PPR prevalent countries with development partner like FAO has been trying to develop strategic control plan based on piloted project, so that PPR can be controlled and eradicated effectively. Until now no such project was implemented in our country. So a small scale pilot project implementation with objective of PPR control has been undertake and its findings can be used as a basis to formulate a nationwide strategic control and eradication program. The objectives of the pilot project involves 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 5 selected villages (2 villages of Manikgonj and 3 villages of Jessore district) by door to door baseline survey with pre-tested questionnaire. One village (Pouly) under Sadar upazila of Manikgonj district and two villages (Misridiara and Modhukhali) under Jicorgacha upazila of Jessore district are being treated as treatment villages and one village (Chamta) of Manikgonj and one village (Bahirampur) of Jessore district are being 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 conducting involving both men and women through meeting, regular visit of household, postering and distribution of leaflet. A hand's on training was conducted for the field veterinarian and scientist of field disease investigation laboratories for quick diagnosis of PPR along with sample collection, processing, preservation and transportation process. 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 3 treatment villages (where around 5000 goats were vaccinated) after initial sero-surveillance; subsequently regular vaccination is being carried out for kids and newly purchased goats of treatment villages. Five hundred and six 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 1931 sera samples were collected from vaccinated goats for post-vaccination sero monitoring. All sera samples were tested by cELISA following the instruction of the manufacturer of the kit (ID.vet, France).

Baseline study showed that a total of 952 household rear goats in selected five villages where number of goats per household ranges from 3.03-3.45. Predominating Black Bengal breed is reared by the different catagories goat farmers, among them 73.52% are landless and marginal (<0.05-0.49 acres of land/per household), 24.58% are smallholder (0.5-2.49 acres) and only 2.73% are medium land holder (2.5-7.49 acres) farmers. 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 month, 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. Pre-vaccination sera analysis showed that in three treatment village seropositive goats were 11.36%, 45.39% and 59.72% in Pouly, Modukhali and Misridiara, respectively, whereas in the control villages seropositive goats were 0% and 53.03% in Chamta and Bahirampur, respectively. Sera analysis from 21 days post-vaccinated goat from the treatment villages showed that 89.47%, 97.87% and 95.10% are positive in Pouly, Modukhali and Misridiara, respectively. Overall 46.53% goats were seropositive in three treated villages before vaccination but 21 days post-vaccination herd immunity rose to 95.65%. After 6 months of vaccination, antibody titer was 83%, 95.65% and 97.5% at Pouly, Misridiara and Modukhali, respectively and 9.67% and 40% at Chamta and Bohirampur, respectively as control village. The herd immunity of the three treatment villages were 86%, 89.68% and 82.23% at at Pouly, Misridiara and Modukhali, respectively after one year of first vaccination. After 15 months of vaccination, the average antibody titer was 90% at Misridiara, 90.17% at Modhukhali and 58% at Bohirampur. 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.

Table 1 Sero-monitoring of pre and post vaccinated sera samples tested by cELISA

SI. No.	Name of the village	Total number of goats	Total sample tested		Results (Seropositivity)	
			Prevac	Postvac	Prevac	Postvac
Treatment village						
1	Pouly	251	49	38	4 (11.36%)	34 (89.47%)
2	Modhukhali	788	141	141	64 (45.39%)	138 (97.87%)
4	Misridiara	1363	144	143	88 (59.72%)	136 (95.10%)
Control village						
4	Chamta	208	50	0	0%	-
5	Bohirumpur	350	66	0	35 (53.03%)	-

Table 2 Herd immunity of the treatment villages (one year after first vaccination)

District	Upazila	Village	Level of immunity (%)			
			0-12 mon.	1 yr. to 2 yr.	2 yr.	Average
Manikgonj	Sadar	Pouly	86.62	100	72.73	86
Jessore	Jikorgacha	Misridhiara	87.5	90.30	96.30	89.68
		Modukhali	69.23	89.28	96	82.23

For vaccine efficacy experiment at laboratory level, 5 vaccinated (one year ago) and 5 non-vaccinated goats were selected and challenged intranasally with 10^5 $TCID_{50}$/ml PPRV adapted in lamb kidney cell line. After 8 days, non-vaccinated goats showed typical PPR symptom and started died on day 12th. 40% goats were died in the non-vaccinated group while vaccinated group remain alive without showing any clinical sign. PPR vaccine efficacy index was 100%.

Economic analysis showed that after PPR vaccination in the treatment villages, the goat farmers were gained BDT 7,300 more per household than the control villages. Goat population increment at Misrdiara and Modhukhali were 97.16% and 87.64%, respectively, whereas at Bohirampur it was 57.75% only.

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 34.25% and 68.96%, respectively during outbreaks. There was no outbreak in the treatment villages.

Comparatively sero-positive goats are more in the selected villages in Jessore district as compare to the villages of Manikgonj district. This indicated that either PPR virus circulation was more in Jessore district than that of Manikgonj. It is reflected that locally produced PPR vaccine confers sufficient herd immunity that can protect PPR disease in goat.

Project title: Establishment of health management package for native sheep of Bangladesh

Sub-title: Development of herbal anthelmintic against internal parasites-GI nematodes of sheep

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Executive Summary

Livestock is one of the most prospective sectors of agriculture which addresses the problems of landless, marginal and small-scale farmers and capable of helping in poverty alleviation all over the world including Bangladesh. Among the livestock species, sheep is considered an important and promising animal resource in Bangladesh. Currently, the contribution of sheep in Bangladesh can be summarized as a source of meat, skin and wool. Bangladesh possesses 3.156 million sheep at present (BER, 2014). Sheep rearing is increasing in this country to fulfill the growing demand of animal protein. But without proper health management approach a sheep farm cannot run smoothly. Parasitic infection especially gastrointestinal nematodiasis is a major problem for small ruminants particularly sheep and goats in Bangladesh. The gastrointestinal nematodiasis remains a vital cause of reduced production and impaired animal health. Gastrointestinal nematode infection is commonly treated with synthetic anthelmintics. Thus gastrointestinal nematodes are becoming increasingly resistant to the synthetic drugs used to control them. The cost of routine vermifuge applications on herds and the problem of residues in animal products have prompted research on the anthelmintic activity of plant extracts. That is why, the present study was undertaken to develop a herbal anthelmintic as an alternative to synthetic vermifuge. The experiment was conducted at the sheep research farm of Bangladesh Livestock Research Institute, Savar, Dhaka from July 2014 to June 2015. The faecal samples were collected directly from the rectum of the animals with the help of polybags and brought to the laboratory by using cool box. The gastrointestinal nematodes egg per gram (EPG) of faeces was determined by MacMaster method. A total of 200 sheep having EPG counts ranging from 750 to 3200 was used in this experiment. About 50 sheep of different ages, sexes and body weights were included in each trial. The average age and body weight of the animals were 8 months and 16 kg, respectively. The animals were divided into five groups including control, where each group contained 10 individuals. Four herbal extracts were used in this experiment namely, neem, betel, pineapple leaves and bitter gourds. 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 neem (*Azadirachta indica*) leaves, betel (*Piper betle*) leaves, pineapple (*Ananas comosus*) leaves and bitter gourds (*Momordica charantia*), respectively. The neem leaves, betel leaves, pineapple leaves, and bitter gourds were collected from different locations to prepare the aqueous extracts with the help of a blender, while 200ml of clean drinking water was added to each 50gm. The p^H of the fresh herbal preparations were 6.26, 4.74, 5.14, and 5.93 for neem leaves, betel leaves, pineapple leaves, and bitter gourds, respectively. The prepared drugs were administered orally once in the morning. The doses used were 1ml, 3ml, 5ml and 10ml per kg body weight for all types of extracts. After treatment, the EPG of faeces was determined on day 3, day 5 and day 7 to compare the EPG counts before and after treatment.

Table 1. Effects of herbal drugs @ 1ml/kg body weight on GI nematodes EPG counts

Group	No. of sheep	GI nematodes EPG counts (mean±SE)				Sig.
		Day 0	Day 3	Day 5	Day 7	
T_0	10	1490.00±214.48	1495.00±212.49	1492.50±208.60	1495.00±206.62	NS
T_1	10	1680.00±245.42	1104.00±173.51	1020.00±169.02	1042.50±169.81	NS
T_2	10	1590.00±178.08	1342.00±173.55	1240.00±142.95	1280.00±143.22	NS
T_3	10	1645.00±218.13	1395.00±184.01	1270.00±179.85	1305.00±180.04	NS
T_4	10	1720.00±243.24	1335.00±210.73	1365.00±215.39	1440.00±220.45	NS
Significance		NS	NS	NS	NS	

NS=Non Significant

It was found that the EPG counts were significantly reduced on day 5 and day 7 in case of three treatment groups (T_1, T_2, T_3), whereas remarkable EPG reduction was noted on day 3 in case of the treatment group T_4 (Table 1, 2, 3, 4). The best result was observed for the dose rate of 10ml/kg body weight (Table 4). The EPG counts in the control groups remained almost same on all days for a particular dose used (Table 1, 2, 3, 4).

Table 2 Effects of herbal drugs @ 3ml/kg body weight on GI nematodes EPG counts

Group	No. of sheep	GI nematodes EPG counts (mean±SE)				Sig.
		Day 0	Day 3	Day 5	Day 7	
T_0	10	1705.00^a±253.03	1690.00^a±239.30	1700.00^a±255.71	1690.00^a±231.28	NS
T_1	10	1570.00^a±235.25	885.00^b±138.85	795.00^b±129.84	835.00^b±135.000	**
T_2	10	1615.00^a±219.35	1115.00^b±144.35	1067.50^b±133.34	1102.50^b±139.57	NS
T_3	10	1540.00^a±238.14	915.00^b±158.12	875.00^b±157.98	930.00^b±155.31	**
T_4	10	1510.00^a±236.97	865.00^b±128.89	880.00^b±136.46	885.00^b±137.45	**
Significance		NS	**	**	**	

NS=Non Significant; ^{ab}Data having different superscripts at the same column and row (except row 3) differ significantly; **Significant at 1% level ($p<0.01$).

Table 3 Effects of herbal drugs @ 5ml/kg body weight on GI nematodes EPG counts

Group	No. of sheep	GI nematodes EPG counts (mean±SE)				Sig.
		Day 0	Day 3	Day 5	Day 7	
T_0	10	1470.00^a±180.31	1505.00^a±182.95	1465.00^a±181.21	1467.50^a±163.81	NS
T_1	10	1575.00^a±180.93	665.00^b±88.84	650.00^b±99.16	670.00^b±95.51	**
T_2	10	1420.00^a±173.72	750.00^b±82.33	737.50^b±79.69	740.00^b±76.30	**
T_3	10	1550.00^a±172.56	830.00^b±84.06	820.00^b±87.94	825.00^b±77.91	**
T_4	10	1550.00^a±195.65	775.00^b±97.82	780.00^b±101.1	792.50^b±94.14	**
Significance		NS	**	**	**	

NS=Non Significant; ^{ab}Data having different superscripts at the same column and row differ significantly; **Significant at 1% level ($p<0.01$).

Table 4 Effects of herbal drugs @ 10ml/kg body weight on GI nematodes EPG counts

Group	No. of sheep	GI nematodes EPG counts (mean±SE)				Sig.
		Day 0	Day 3	Day 5	Day 7	
T_0	10	1520.00^a±160.24	1495.00^a±155.18	1460.00^a±156.49	1520.00^a±151.69	NS
T_1	10	1650.00^a±218.58	425.00^b±51.23	365.00^b±47.17	420.00^b±49.27	**
T_2	10	1565.00^a±165.67	585.00^b±66.69	530.00^b±55.38	550.00^b±65.83	**
T_3	10	1600.00^a±152.02	390.00^b±30.55	410.00^b±32.32	427.50^b±31.72	**
T_4	10	1555.00^a±177.08	515.00^b±60.58	530.00^b±57.35	555.00^b±57.47	**
Significance		NS	**	**	**	

NS=Non Significant; ^{ab}Data having different superscripts at the same column and row differ significantly; **Significant at 1% level ($p<0.01$).

However, it can be concluded that all four herbal drugs @ 3ml/kg body weight, 5ml/kg body weight and 10ml/kg body weight may be used as anthelmintics in sheep population although the best option is 10ml/kg body weight.

Project title: Prevalence of *Salmonella spp.* in poultry and poultry products in Bangladesh

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Executive Summery

Salmonella are intracellular pathogens both in cold- and warm- blooded animals and are important zoonotic agents. The genus *Salmonella* contains 2463 serotypes which are currently divided into two species: *Salmonella enterica (2443 serotypes)* and *Salmonella bongori (20 serotypes) due* to the difference in 16S rRNA sequence analysis. More than 99% of *Salmonella* strains causing human infections belong to *Salmonella enterica* subspecies *enterica*. *Salmonella enterica* is one of the most common bacterial causes of foodborne illness. A wide range of foods has been implicated in foodborne illness attributable to *Salmonella enterica.* Foods of animal origin, especially poultry, poultry products and raw eggs, are often implicated in sporadic cases and outbreaks of human salmonellosis. *Salmonella* spp. are transmitted by the faecal-oral route by either consumption of contaminated food or water, person-to-person contact, or from direct contact with infected animals. *Salmonella* infection is one of the major constraints of poultry farming that hindered its development in Bangladesh. In recent days, the prevalence of salmonellosis in breeder flock, commercial broiler, and layer flocks is increasing day by day. Therefore, salmonellosis status of a farm needs to be determined for its proper control and management. At present in Bangladesh, nontyphoidal *Salmonella* vaccine is absent for the control of nontyphoidal Salmonellosis. The proposed project had been undertaken with the following objective of isolation and identification of *Salmonella* organisms from selected different poultry farms in Bangladesh. A total of 355 samples comprising 150 cloacal swab samples of poultry, 50 egg shell and 50 egg content (50 eggs), 30 intestinal content, 30 liver swab, 30 broiler meat and 15 swabs of slaughter house were collected and processed for isolation and identification of *Salmonella* spp. Sterile cotton swab sticks were used for sample collection and collected samples were immediately brought to the laboratory with insulated ice box and examined bacteriologically. Isolation and identification of *Salmonella* were done according to the procedure described by OIE manual (2000), Merchant and Packer (1967) and Cowan (1985).

Data were collected from different poultry farm with direct communication. The information such as strain of layer chicken, drug applied for against Salmonellosis, clinical signs and post mortem findings, mortality rate, age and season of avian *Salmonella* infection were included in the questionnaire. The collected swab containing samples were grown into tetrathionate broth (Oxoid Ltd.) at 37°C for 18–24 hours. Tetrathionate broth-grown cultures were sub-cultured in MacConkey (MC), Brilliant green (BG), Xylose Lysine Dextrose (XLD) and Salmonella-Shigella (SS) agar to get pure and putative *Salmonella* culture. The organisms were further characterized as *Salmonella* species according to their morphology, Gram staining, motility, and biochemical properties. Serogrouping of *Salmonella* isolates was performed by slide agglutination test using commercial *Salmonella*-specific polyvalent 'O' antisera (S and A Reagent Lab). The test was performed according to the protocol supplied by the manufacturer. Out of 355 samples, over all positivity was 25.35% samples (Table. 1), 32% cloacal swab samples of poultry, 28% egg shell, 0% egg content, 36.66% intestinal content, 23.33% liver swab, 20% broiler meat and 26.66% swabs of slaughter house were found positive for *Salmonella* (Table. 1). The microscopic examinations of Gram's stained smears from SS, MC and BG agar revealed Gram-negative, pink colored, small rod shaped appearance, arranged in single and paired.

In biochemical test, all the isolates fermented dextrose, maltose and mannitol and produced acid and gas but did not ferment lactose and sucrose. Acid production was marked by the color change from reddish to yellow and the gas production was noted by the presence of gas bubbles in the inverted Durham's tubes kept inside each of the test tubes containing sugar media.

Table 1 Prevalence of *Salmonella* spp. in poultry and poultry products

Types of Sample	**Total samples**	**Positive sample**	**% of *Salmonella* spp.**
Cloacal swab	150	48	32%
Egg shell	50	14	28%
Egg content	50	0	0
Intestinal content	30	11	36.66%
Liver swab	30	7	23.33%
Broiler meat	30	6	20%
Swab of slaughter house	15	4	26.66%
	Total= 355	**Total= 90**	**Total= 25.35%**

All isolated Salmonellae were positive for MR test, negative for V-P test and negative for indole test. In the slide agglutination test, Salmonella agglutinating antiserum (poly 'O') was used which agglutinated all the isolates and thereby identified the organism as *Salmonella* spp.

In conclusion, continuous monitoring and improvement of biosecurity in poultry farms is needed to reduce the prevalence of *Salmonella* spp. in poultry and poultry products.

Outbreak and Distribution of Foot and Mouth Disease Virus Serotypes in Bangladesh

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Executive Summary

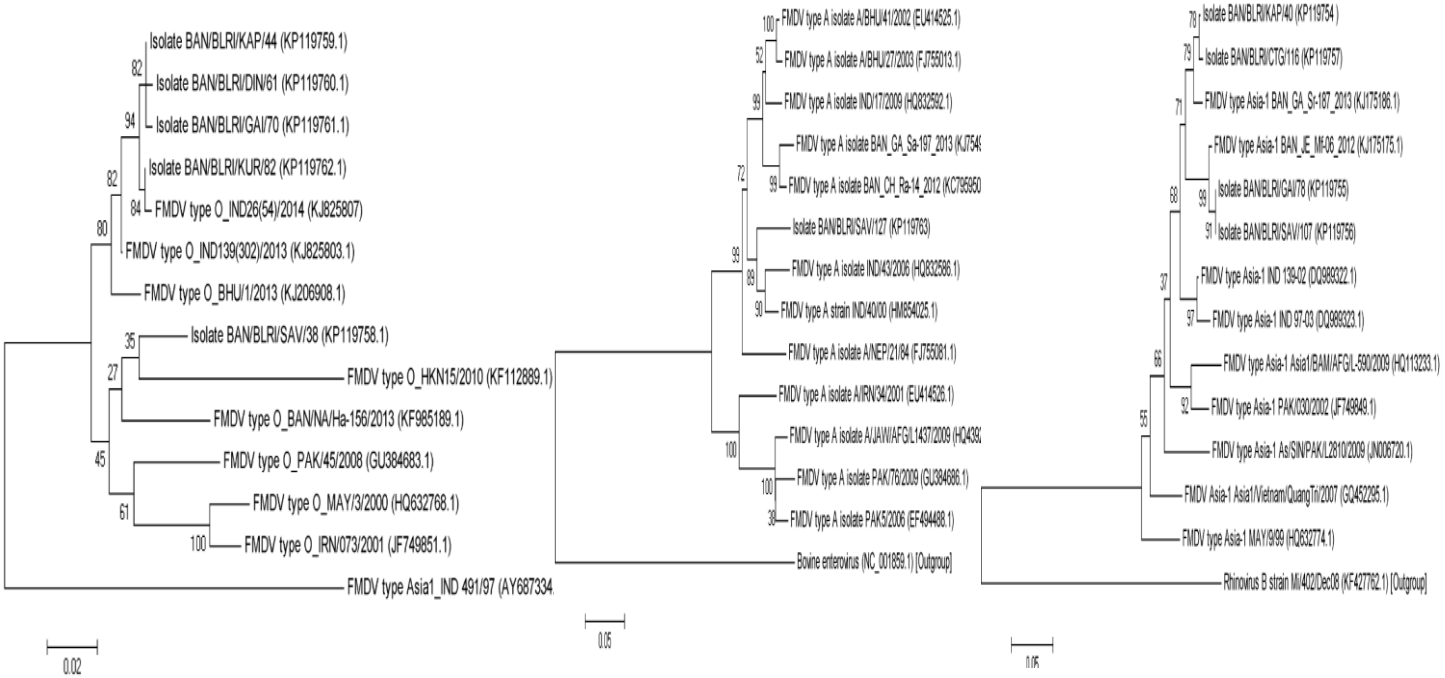
Foot and mouth disease (FMD) is one of the most important transboundary and re-emerging infectious diseases of the ungulates. It causes severe economic losses due to high morbidity and export trade restrictions imposed on affected countries. FMD virus (FMDV) is the etiologic agent of the diseases that causes an acute disease characterized by fever, lameness and vesicular lesions on the feet, tongue, snout and teats, with high morbidity and low mortality. The causative agent of FMDV is a member of the genus *Aphthovirus* and family *Picornaviridae* and has a single-stranded positive RNA genome that possesses high potential for genetic and antigenic variation. There are seven recognized serotypes of FMDV (O, A, C, SAT1, SAT2, SAT3 and Asia1) and about 65 subtypes of FMDV have been defined. FMDV is non-enveloped icosahedral particle and size of FMDV RNA genome is 8.5Kb. The genome encodes four structural proteins (VP1, VP2, VP3 and VP4) and eight non structural proteins (L, 2A, 2B, 2C, 3A, 3B, 3C and 3D). The genome of FMDV is subject to a high rate of mutation because the FMDV RNA-dependent RNA polymerase lacks proof reading ability. Transmission can take place by direct or indirect contact with infected animals and contaminated fomites; virus spread through inhalation of aerosolized virus, contaminated feed, and the virus enters through skin abrasions or mucous membranes. FMD is endemic in Bangladesh. Three of the seven FMDV serotypes (types O, Asia1 and A) are prevalent throughout the Bangladesh. FMD is one of the major constraints for livestock development in Bangladesh. Outbreak of this disease causes severe economic losses to the livestock industries in terms of loss of draft power, meat and milk production, infant and adult animal mortality. About 60 to150 million US$ economic losses is incurred per year only due to the outbreak of FMD in Bangladesh. In consideration of these factors, the study was undertaken to investigate molecular epidemiology, genotyping and employ phylogenetic analysis to determine the relationship of FMDV serotypes circulating in Bangladesh. A total of 134 clinical materials (tongue and interdigital epithelial tissue samples, saliva and milk) were collected from fifteen different FMD suspected areas of Bangladesh during 2011 – 2014 for confirmatory diagnosis. After sample processing, all samples were subjected to RNA extraction and RT-PCR for detection and serotyping of FMDV.

Table 1 Area wise distribution of FMDV with three serotypes in Bangladesh

Region/ District	Total sample	Positive isolates	Serotyping			Mixed infection		Non Typing	% of positivity
			O type	A type	Asia1 type	O +Asia1 type	O+A type		
Savar	52	39	4 (10%)	5 (13%)	16 (%)	-	-	14 (36%)	75
Joydevpur	3	2	1 (50%)	-	1 (50%)	-	-	-	67
Munshiganj	6	6	-	-	2 (33%)	4 (67%)	-	-	100
Kaliganj	5	5	3 (60%)	-	-	-	2 (40%)	-	100
Kapashia	17	14	8 (57%)	1 (7%)	3 (21%)	-	-	2 (14%)	82
Sirajganj	9	7	1 (14%)	-	4 (57%)	2 (29%)	-	-	78
Kurigram	5	3	2 (67%)	-	-	-	-	1 (%)	60
Dinajpur	6	6	6 (100%)	-	-	-	-	-	100
Gaibandha	15	13	6 (46%)	1 (8%)	2 (15%)	-	-	4 (%)	87
Chittagong	5	2	-	-	2 (100%)	-	-	-	40
Comilla	2	1	-	-	-	1 (50%)	-	-	50
Total	**134**	**98**	**31 (31%)**	**7 (7%)**	**30 (31%)**	**7 (7%)**	**2 (7%)**	**21 (21%)**	**73**

The specific primers P33/P38, P33/P40, P33/P74, P33/P110 were used for the detection of the serotypes O, C, Asia1and A, respectively. Out of 134 samples, 98 (73%) samples were for positive FMD virus. Three different serotypes of FMD virus currently were currently found to be present in Bangladesh. Among the positive FMD virus isolates, serotype O accounts for about 31% followed by Asia 1 (31%) and A (7%) have been detected (Table 1).

Phylogenetic analysis of partial VP1 nucleotide sequences demonstrated that all BLRI/FMDV serotype O isolates were closely related to PanAsia strains, including those that originated from Bangladesh, Bhutan and India for the period of 2012–2014. Results of the sequencing of VP1 gene of FMDV serotype O revealed that there was slight divergence (0.5% to 6.3%) among the BLRI isolated strains. While there is an obvious divergence (more than 12%) to the other compared FMDV strains. For the 127 isolates of FMDV type A BLRI showed a close resemblances from isolates originated from India during 2000 to 2006. FMDV type Asia 1 isolates were most closely related to FMDV isolates collected in Bangladesh during 2013. The results of the sequencing of VP1 gene (1D) of FMDV serotype Asia 1 showed minor divergence (0.6% to 6.3%) among the isolated strains. While there were a noticeable divergence (more than 13.1%) between these isolates and the other compared FMDV strains (Figure 1).



O Serotype **A Serotype** **Asia1 Serotype**

Figure 1 Phylogenetic tree of serotype O, A and Asia 1 from FMDV isolates.

It can be concluded that unrestricted cattle importation from neighboring country increased the virus introduction from the infected animals. Effective control of this disease needs sensitive, specific and quick diagnostic tools at each tier of control strategy.

Project title: Production of calves through transfer of *in vitro* produced cattle embryos

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Executive summary

In vitro embryo can be produced from two different sources of oocytes, i.e. slaughterhouse ovary and oocyte from live elite cows. In case of slaughterhouse ovary, the genetic status of oocytes is unknown and mainly used for experimental purposes. 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 IVP (OPU-IVP) has enabled repeated production of large number of IVF calves from donors of high genetic merit without altering their genetic make-up. Now-a-days, the use of the OPU technique is increasing gradually for production of high yielding cows in many developed and developing countries. The technique is applicable irrespective of physiological condition of donor (pregnant vs. non-pregnant, stage of reproductive cycle, 6 months age and onwards). Therefore, the OPU technique has greater potential to improve genetic progress through the maternal lineage. Application of this technology requires a consistent as well as efficient embryo culture, storage and transfer system to recipient. Considering above facts, BLRI is working with OPU-IVP for multiplication of elite (genetic merit) cows since last three year. Meanwhile, the oocyte aspiration protocol from slaughtered ovary, ovarian follicular dynamics of slaughtered and live animal, and IVP protocol for large and small number of oocytes collected from abattoir ovary were adopted at BLRI. The present research project is designed to produce calves through transfer of IVP embryos into the recipient cows. To achieve the above objective, the following research activities were conducted in the current fiscal year- i) improving IVP efficiency through addition of 9 cis retinoic acid (9cisRA) in the maturation medium, ii) to evaluate total blastomere numbers in the IVP embryo, iii) to adopt estrus synchronization protocol suitable for embryo transfer (ET) and iv) embryo transfer to recipients. The 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 IVM. The selected COC were washed 2-3 times in TL-HEPES and 2-3 times in IVM medium before placing them into 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 sperm 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 in IVC-I medium (3 times) 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 conditions during IVM, IVF, and IVC were 5% CO_2 in air at 38.5°C with maximum humidity. Cleavage development rates were evaluated at day 3 (day 0: day of IVF) as a proportion of the presumed zygote transferred into IVC-I medium. The 9cisRA was diluted in DMSO and used at 5 nm/mL concentration. Three different combination of IVM medium used to evaluate effect of 9cisRA on IVP. These include i) Basic IVM medium + no supplementation (control group), ii) basic IVM medium+DMSO (DMSO group) and iii) basic IVM medium+DMSO+9cisRA (DMSO+RA group). This activity was replicated three times. Eight cows were selected as recipients for experimental IVP embryo transfer (ET) to develop a routine IVP-ET protocol. Selected recipients were treated with single dose of prostaglandin$F_2\alpha$ ($PGF_2\alpha$) upon detection of functional corpuslutium (CL) through per 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 ET. The treated recipients came into estrus within 60 to 72 hr of PGF2α administration. Estrus was confirmed by close observation of behavioral symptoms, teaser bull exposure and rectal palpation. Embryos were transferred to 5 cows in

two batches (2 in first batch and 4 in second batch). On day 7 or 8 depending on the morphological development stage of IVP embryo, two embryos (late morulae to early blastocyst) were transferred to each recipient. Embryos were transferred in the horn of the uterus ipsilaterally. Data were analyzed using one way ANOVA procedure and mean differences were tested by Duncuns multiple range test.

Results showed that addition of 9cisRA to *in vitro* maturation medium hastened blastocyst development rates (Table 1). However, 9cisRA have no effect on cleavage of presumed zygotes. Furthermore, no variations were observed between control and DMSO groups for cleavage and blastocyst development rates. This data indicated higher blastocyst development in DMSO+RA group is associated with 9cisRA. The present findings were consistent to those of the previous reports. The beneficial effects of 9cisRA during IVM are thought to be mediated by enhancing oocyte maturation through its effect on FSH or LH receptor expression, increasing mRNA quality and processing during maturation, growth factors signaling, or by endogenous oxidative-stress protection mechanism. Eight recipient cows synchronized and all of them showed estrus following 60 to 72 hr of PGF2α administration (Table 2). However, 5 cows show developed corpus luteum in their ovary and subjected to embryo transfer. This was indicated that recipient preparation rates were 75.0%. Pregnancy will be evaluated 60 days following ET by using ultrasonography and/or through per rectum palpation.

Table 1 In vitro embryo production following addition of 9-cis RA in the maturation medium

Treatment	Presumed zygote	% Cleaved	% Blastocyst
Control	115	76.73±10.03	21.10±0.57
DMSO	105	74.30±2.59	20.20±1.27
DMSO+RA	300	78.23±3.07	31.98±3.82
Level of significance		Non-significant	0.001

Table 2 Preparation of recipient for embryo transfer

Recipient (No.)	Breed of recipients	Estrus detection (No.)	No. of recipient suitable for embryo transfer (%)
4	Red Chittagong Cattle (RCC)	4	2 (50%)
4	BLRI Cattle Breed-1 (BCB-1)	4	3 (75%)
		8	5 (62.50%)

From this study, it might be concluded that the application of 9cisRA might increase blastocyst development rates. Estrus synchronization through administration of PGF2α at luteal phase followed by GnRH after detection of estrus might be useful to prepare recipients for IVP-ET.

Project title: Selection of suitable exotic beef breed (s) and performance evaluation of their crosses with native cattle

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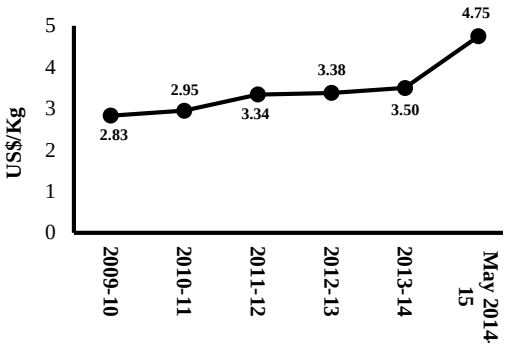
Executive summary

Bangladesh has a great demand of beef but the price of beef in Bangladesh is tremendously increasing (Figure 1) due to insufficient production and supply of beef and the low carcass yield of native cattle. The market price of beef is also increasing due to decreasing per capita average bovine number. Bangladesh Livestock Research Institute has started a crossbreeding program with 4 high yielding exotic beef breeds for production of suitable crossbred beef cattle genotype using native dams of Bangladesh Livestock Research Institute Cattle Breed-1 (BCB-1). The semen of Simmental, Charolais and Limousin beef breeds was imported to inseminate BCB-1 cows and heifers and production of crossbred progenies of 300.0 kg live weight at 24 months of age, an age limit for sacrificing cattle especially from the social and religious point of view of the consumers, and at the same time their production system should be economically viable with efficient FCRs to meet up the growing needs of beef of the country. Determination of the genetic variations of BCB-1 using microsatellite markers was also included with this work.To achieve the objectives of the project, 76 straws of frozen semen of Simmental (red), Charolais (white) and Limousin (light wheat to darker red) were procured from Australia. The production performances of selected exotic beef breeds were reviewed and documented from secondary data sources in the last year. Furthermore, a total of 25 doses of American Brahman supplied by DLS were also introduced under this breeding program. In the last year 60 doses of Simmental (black), Charolais (white) and Limousin (red) were procured and used to support the crossbreeding program. To determine the best performing exotic beef breed(s) for crossing with native cattle, a total of 40 BCB-1 cows and heifers were selected. All cows and heifers have been selected based on their pedigree, individual performances and disease prevalence (brucellosis).Brucella test was performed by using a commercial kit (B. Brucella Ab Test Kit) following manufacturer instruction. Artificial insemination (AI)was performed following standard procedure. The exotic beef breeds were considered as treatments (T_1, T_2, T_3 and T_4) and BCB-1 was considered as control (T_0) for comparison the production performances of their progenies. Accordingly, 10 BCB-1cows and heifers were distributed for crossing with each of the exotic breeds. The control BCB-1 males will be considered from BLRI BCB-1 herd which produced by natural services. After 2-3 months of AI, pregnancy diagnosis was performed by rectal palpation to determine the conception. Not more than 2 AI services were allowed for one conception and subsequent calculation of service per conception (S/C). All parameters of AI (performance indicators) and diseases prevalence during breeding were recorded. The other economic parameters (birth weight, weaning weight, yearling weight, ADG, live weight at 2 yrs of age, FCR, carcass weight and carcass characteristics etc.) will be studied after calving.

For genetic variation study of BCB-1, a total of 93 blood samples from 4 generations of BCB-1, Sirajgong, RCC and Sahiwal as control were collected. Extraction of DNA was performed by using a commercial kit (QIAGEN DNA Mini Kit) following manufacturer instruction and, finally the DNA samples were sent to overseas laboratory for fragment length analysis. The ISAG-FAO recommended 20 bovine microsatellite markers were selected for this study.

Figure 1. Annual average retail price of beef in Bangladesh, BBS & TCB



All selected cows and heifers were free from Brucella and worm. They were also vaccinated against the Foot and Mouth Disease, Anthrax and Black Quarter. Up to now, a total of 51numbers of AI were performed. After AI, 10 cows and heifers including one pregnant were culled from this program due to repeat heat and disease problem. Table 1 shows the distribution of number of dams inseminated under this program. Out of 28, 23 were diagnosed for confirm pregnancy. Table 2 summarizes the AI records which being kept in the breeding program.

Table 1 Distribution of dams of BCB-1 inseminated by beef sires

Beef Sires	Simmental	Charolais	Limousin	Brahman
No. of dams	7	6	9	6

The non-return rate (NRR) was calculated based on first time insemination and the value was71.42 % (Table 3). The first-service conception rate (CR) was calculated as56.52 % (Table 3).The NRR overestimates the CR by about 5 %. This difference may be due to failure of estrus detection, anestrus, early embryonic deaths and the presentation of cows for return insemination. The service per conception rate was estimated as 1.28 (Table 3). About 64 % cows and heifers (Table-3) are pregnant. All late pregnant cows are in pre-natal care.

Table 2 AI records in beef breeding

SL No.	AI records	Number (#)
1	Total AI performed	51
2	Cows used in AI	38
3	Culled cows and heifers after AI	10
4	Total number of cows conceived	28

Genetic variation analysis of BCB-1 using ISAG-FAO recommended 20 bovine microsatellite markers is under ongoing process through lab service procurement. In conclusion, a total of 38 BCB-1 dams were crossed and out of that 28 conceived. Up to now the pregnancy rate was 64.28 %. The offspring is yet to be produced to evaluate their performances for selection of suitable exotic beef genotype. Therefore, this program should be continued for the coming years to achieve its goal.

Table 3 Measures of reproductive efficiency in AI program for beef breeding

SL No.	Indicators	%/#
1	Ist service NNR	71.42 %
2	Ist service CR	56.52 %
3	Service/conception	1.28
4	Pregnancy rate	64.28 %

Figure 2. Pregnant cows in beef breeding program

Project title: Study on candidate genes for milk production traits of Red Chittagong Cattle

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Executive summary

The traits of interest in dairy cattle i.e., milk yield and quality are generally sex-limited and have low heritability. Dairy cattle have lengthy generation interval and it is time-consuming and expensive to perform progeny tests for selection of superior breeding animals. To overcome these barriers it is necessary to have a tool for genetic selection of dairy traits within or between diversified dairy cattle population. The most efficient method of genetic selection is the use of marker-assisted selection (MAS), which involves the identification of functional single nucleotide polymorphisms (SNPs) responsible for changes in phenotypes. However, potential SNPs found in some candidate genes for their association with milk production traits which are under the control of multiple genes. The SNPs in *diacylglycerolacyltransferase 1* (*DGAT1*), *stearoyl-CoA desaturase 1*(*SCD1*), *ATP-binding cassette G2 (ABCG2), fatty acid synthase* (*FASN*), *oxidized low-density lipoprotein receptor 1 (OLR1), prolactin (PRL), signal transducer activator of transcription 5A (STAT5A)* and *growth hormone receptor (GHR)* genes have been shown to affect the composition of bovine milk in different cattle populations. There are variations in milk production traits especially in the milk yield of RCC herd of BLRI at similar feeding management systems. BLRI has been following conventional selection and breeding to improve the milk yield of RCC, which is time-consuming and expensive. Considering the facts, the major objectives of the present work are (1) to identify potential SNPs in candidate genes (*DGAT1, ABCG2* and *SCD*) for milk production traits in RCC and (2) To develop a suitable DNA marker for marker-assisted selection (MAS) of high yielding RCC. For achieving the objectives, phenotypic data of milk production traits (milk yield, fat yield, protein yield, SNF yield and lactose yield) have been recordingin50 RCC cows at different lactation stages. Fat, protein, SNF and lactose percentage of morning and afternoon milk samples have been analyzing using LACTOSTAR (Milk component analyzer, Model 3510) in every 15 days interval. For identification and genotyping of the SNPs blood samples were collected from 50 lactating cows and 5 breeding bulls for DNA extraction and PCR amplification test. The DNA was extracted from blood samples using a commercial kit (QIAGEN DNA Mini Kit) following manufacturer instruction. In order to identify potential SNPs, 18 set primers of *DGAT1, SCD* and *ABCG2* genes were used to amplify all exons (some cases specific exons and introns) and their partial flanking intronic sequences. Primers were designed based on the reference sequence of the bovine *DGAT1, SCD* and *ABCG2* genes (Gen Bank Accession No. AC000171, AY241932 and AC000163) taken from NCBI and using Primer3 (v.0.4.0.) (http://frodo.wi.mit.edu/) and Net Primer (www.PremierBiosoft.com) web based Program. Total 18 sets of primers from SCD and DGAT1 were tested for PCR amplification in 15µl reaction mixture at BLRI Genetics Breeding Laboratory. The amplification condition was 5 min at 94ºC for initial denaturing followed by 30 cycles at 94ºC for 30s; in annealing temperature for 30s,72ºC for 30s; a final extension at 72ºC for 10 min for all primers. PCR amplifications were confirmed by electrophoresis in 2% agarose gel followed by visualization under UV (Figure 1 and2).

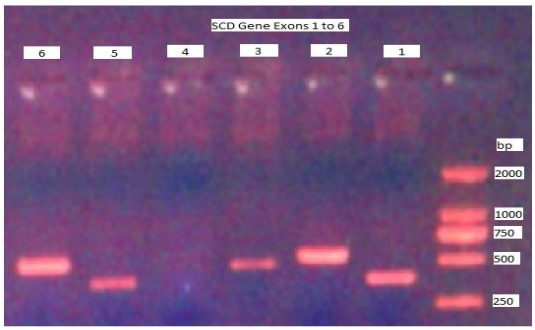

Figure 1 PCR amplification of SCD Genes

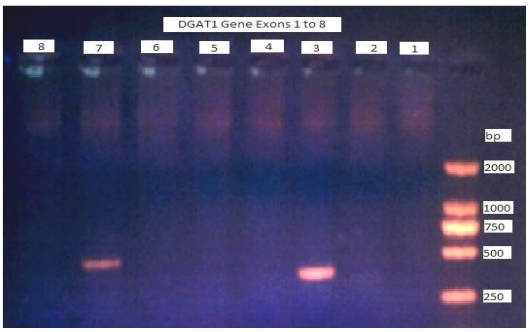

Figure 2 PCR amplification of DGAT1 Genes

The PCR product sent to overseas laboratory for sequencing and necessary follow-up actions (identification and genotyping of SNPs, phenotypic and genotypic association study) will be under taken after having the sequence. Phenotypic variation within the existing RCC herd has identified based on the partial data of milk yield and quality. The RCC were categorized into phenotypic groups for association study with expected SNPsfrom*DGAT1, SCD* and *ABCG2* genes. So far, average lactation yield varies from 527 to 1436 Kg (n=29) and lactation yield has categorized into three groups, they are >500 kg (n=6);>700kg (n=18) and >1000 kg (n=5) kg(Table 1).About18%of lactating cows showed an average of>1000 kg per lactation. There are also variations in fat, protein, SNF and lactose percentage (Table 2).For this study, a complete lactation yield record and its component analysis needed for the evaluation of each cow.

Table 1 Phenotypic variations in Lactation Yield

Lactation Yield (Kg)	Number of cows (%)
>500	6 (20)
>700	18 (62)
>1000	5 (18)
Total recorded cows	29 (100)

Table 2 Phenotypic variation in fat, protein, lactose and solid not fat content of milk

Parameter	Fat %	Protein %	Lactose %	SNF %
Mean±SD (n)	5.26±0.42 (15)	4.05±0.07 (15)	5.82±0.10 (15)	10.75±0.17 (15)
Maximum	6.25	4.13	5.95	10.96
Minimum	4.71	3.86	5.57	10.27

The phenotypic variation within RCC herd has identified on the basis of milk yield and quality but complete data obtained only from 15 cows. Therefore, recordings of milk production traits should be continued. The PCR products were sent to overseas laboratory for DNA sequencing, identification and genotyping of SNPs for phenotypic and genotypic association study.

Project title: Study on the conservation and improvement of native buffalo through selection and crossbreeding

Sub-title: Study on estrous synchronization, conception rate and comparative performance of crossbred and native buffalo calves

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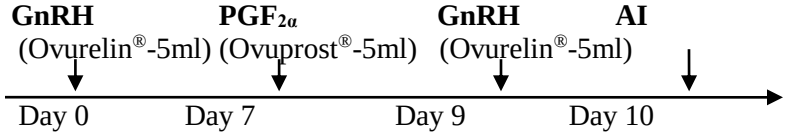
Executive Summary

Estimated buffalo population in Bangladesh is about 1.4 million (DLS-2012) and they are mostly indigenous by type. The buffalo distribution pattern in Bangladesh was found scattered throughout the country although the distribution mostly concentrated in the coastal areas like Noakhali, Feni, Laxmipur, Bhola, Patuakhali and Borguna districts. Buffaloes are used for milk, meat and draft power. Buffaloes are the second largest source of domestic milk production in Bangladesh. Considering fat and total solid contents of milk, buffalo produces two times higher milk than indigenous cattle of Bangladesh. However, the average lactation yield of indigenous buffalo is very low (500-700 liters per 270 days lactation period) compared to high yielding exotic buffalo breed in the world (2000-2500 liters per 305 days lactation period). To increase contribution of buffalo to the national economy, the government has been taken a development project entitled "Buffalo Development Project". The goal of the project is to improve the genetic potentiality of indigenous buffalo breed aiming to increase milk and meat production through crossing indigenous buffalo with high yielding exotic buffalo breeds. The project is running in 39 upazillas of 13 districts in Bangladesh. To achieve the projected goal semen of high yielding Murrah buffaloes (24000 doses) have been imported under Buffalo development Project by the Directorate of Livestock Services and Artificial Insemination (AI) is conducting in the project areas. Estrus synchronization (ES) and AI are two important reproductive management tools commonly used in cattle breeding industry. Synchronization of the estrus cycle has the potential to shorten the calving season, increase calf uniformity and enhance the possibilities for utilizing AI. Successful AI in buffaloes is affected by poor reproductive efficiency of buffalo cows. Estrus symptoms in buffaloes are not prominent as observed in cattle. Heifers are routinely showing silent estrus. Moreover, they are seasonal breeder. In that circumstance, ES might be an option for AI. Considering above facts, this study was designed to adopt ES protocol for indigenous buffaloes and to evaluate ongoing buffalo AI efficiency and to know the comparative birth weight of crossbred and indigenous buffalo. To perform ES, reproductively active 28 adult female buffaloes were selected in two batches (16 cows in summer season and 12 cows in winter season) from BLRI Buffalo Research Farm. The ES protocol was described in Figure 1. The efficiency of AI was evaluated by conception rate (CR). Moreover, birth weight of crossbred calves were recorded and compared with indigenous calves. AI was conducted in the buffaloes rearing by the farmers in nine districts (Bhola, Potuakhali, Noakhali, Moulovibazar, Mymensingh, Sirajganj, Bagerhat, Laxmipur and Jamalpur districts), BLRI Buffalo Research Farm and Bagherhat Government Buffalo Breeding Farms. A total of 394 AI was performed (97 in Bhola; 14 in Potuakhali;17 in Noakhali; 34 in Moulovibaza; 61 in Mymensingh, 8 in Sirajganj; 37 in Laxmipur and 34 in Jamalpur, 24 in BLRI Buffalo Research Farm and 61 in Bagerhat Government Buffalo Breeding Farms). Birth weights of ninety one (91) buffalo calves born during this study period were measured. Among them 52 were crossbred buffalo calves (27 were male and 25 were female) and 39 were naturally mated calves (17 were male and 22 were female). Collected data were analyzed using SPSS 17.0 program.

Figure 1 Schedule of treatments used for synchronization of ovulation for fixed timed insemination in buffalo



It was found that 75% of the synchronized cow showed symptoms of estrus. Estrus was also confirmed by rectal palpation. No differences were observed for seasonal variations in ES outcome. Average conception rate was 47.80% and differences were observed in conception rates among different districts. Highest conception rates were observed in Laximpur 78.38% and lowest in Jamalpur 2.94% (Table 1). The variations in conception rates might be associated with estrus detection, timely AI and skill of the technician performing AI. Moreover, nutritional and environmental factors might be attributed to the differences in conception rates. The conception rates were higher when AI was done in naturally heated animals (50.91%) than animals come into estrus by ES (16.67%). Average birth weights of crossbred male and female buffalo calves were $40.39^{a}\pm0.56$ and $34.18^{b}\pm0.68$ kg, respectively and indigenous male and female buffalo calves were 23.24±1.04 and 20.73±0.93 kg respectively. Crossbred calves ($37.15^{a}\pm0.62$ kg) were heavier ($p>0.001$) at birth than indigenous calves ($21.82^{b}\pm0.71$kg). Moreover, irrespective of genotype (crossbred/indigenous), male calves were heavier than female calves (Table 2).

Table 1 Conception rate (%) of buffalo in selected areas of Bangladesh

Name of District & farm	No. of AI	No. of animal conceived	No. of Calf born	Conception rate (%)
Natural heat following AI				
Bhola	97	42	14	43.30
Potuakhila	14	10	4	71.43
Noakhali	17	13	1	76.47
Moulovybazar	34	13	10	38.23
Mymensingh	61	7	2	11.48
Sirajganj	8	5	-	62.50
Bagerhat	7	4	2	57.14
Laximpur	37	29	11	78.38
Jamalpur	34	1	-	2.94
Bagerhat Farm	61	41	8	67.21
Average				50.91
Synchronization following AI				
BLRI	24	4	-	16.67
Over all	**394**	**169**	**52**	**47.80**

Table 2 Birth weight of buffalo calves for different genotypes

Genotype	Birth weight of calf kg		Sig.
	Male(mean±SE)	Female(mean±SE)	
Crossbred	$40.39^{a}\pm0.78$ (27)	$34.18^{b}\pm0.86$ (25)	***
Indigenous	23.24±1.04 (17)	20.73±0.93 (22)	NS
Overall	$33.61^{a}\pm1.36$ (44)	$27.74^{b}\pm1.12$ (47)	***

[ab] Means with different superscripts in the same row differ significantly($p<0.001$); NS- Non-significant

The above findings inferred that the efficiency of AI in buffaloes was moderate. Birth weight of crossbred buffaloes was higher than indigenous type.

Project title: Conservation and improvement of Munshiganj Cattle

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Executive Summary

Despite of highest cattle densityper km^{2}in Bangladesh compared with some large cattle population countries like India, Ethiopia, Brazil, etc., production of milk, meat are far belowthan the expectation due tolarge 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 conserveand 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. Before introduction of the animals in the nucleus herd they were properly quarantined, vaccinated and dewormed. Having establishment of nucleus all animals are being observed for their performance evaluation.Morphometic measurements of all animals were taken by measuring tape in centimeter and live body weights were taken directly by weighing balance. The animals were heterogenous for lactation order, age and date of calving. So, the design of experiment for milk yield and composition was non-orthogonal factorial in design. Milk recording from the inception of the nucleus herd is being continued and milk composition was measured by LactoStar® digital machine in the BLRI laboratory.

Table 1 Morphometric measurements of Munshiganj cattle

Parameters	Female Animal ID									Male ID		
	MCF1	MCF2	MCF3	MCF4	MCF5	MCF6	MCF7	MCF8	Overall	MCM1	MCM2	Overall
Live weight (kg)	302	182	204	258	228	188	216	216	224.3±13.9	218	208	213.0
Body length (cm)	130	114	120	125	130	117	120	120	122.0±2.1	122	120	121.0
Heart girth (cm)	162	135	142	154	145	139	148	143	146.0±3.1	143	142	142.5
Wither height (cm)	110	102	107	108	108	104	103	110	106.5±1.1	112	105	108.5
Thirl width (cm)	40	35	36	41	40	39	40	40	38.9±0.8	43	40	41.5
Rump length (cm)	30	28	28	30	30	26	29	30	28.9±0.5	36	34	35.0
Hip width (cm)	43	34	35	38	37	35	37	35	36.8±1.0	35	31	33.0
Neck length (cm)	42	38	33	45	44	44	43	40	41.1±1.4	38	36	37.0
Neck width (cm)	37	32	38	37	38	38	36	36	36.5±0.7	40	40	40.0
Head length (cm)	42	42	40	41	41	42	43	44	41.9±0.4	43	43	43.0
Head breadth (cm)	20	19	17	18	17	16	17	18	17.8±0.5	20	20	20.0
Horn length (cm)	38	12	21	23	20	10	22	11	19.6±3.2	9	8	8.5
Horn diameter (cm)	17	10	14	12	12	12	13	13	12.9±0.7	14	15	14.5
Ear length (cm)	23	22	20	24	22	22	23	26	22.8±0.6	25	20	22.5
Ear width (cm)	14	12	11	13	14	13	13	14	13.0±0.4	14	13	13.5
Tail length (cm)	88	76	71	83	77	71	85	82	79.1±2.2	87	87	87.0
Udder length (cm)	18	17	16	19.5	16	17	19	18	17.6±0.5	-	-	-
Udder breadth (cm)	13	17	12	20	24	17	12	18	16.6±1.5	-	-	-
Teat length (cm)	8	6	9	5	8	8	6	8	7.3±0.5	-	-	-
Teat diameter (cm)	10	9	10	9	10	9	8	9	9.3±0.3	-	-	-
Scrotal length (cm)	-	-	-	-	-	-	-	-	-	22	21	21.5
Scrotal breath (cm)	-	-	-	-	-	-	-	-	-	12	12	12.0
Scrotal diam. (cm)	-	-	-	-	-	-	-	-	-	29	29	29.0

The results so far obtained are illustrated in Table 1 to Table 3. The live body weight of adult cows was averaged 224 kg and those of males aged around 2 years were 213 kg. The mean body length, heart girth, wither height, thirl width, rump length, hip width, neck length, neck width, head length, head width, horn length, horn circumference, ear length, ear width and tail length of cows were estimated 122.0, 146.0, 106.5, 38.9, 28.9, 36.8, 41.1, 36.5, 41.9, 17.8, 19.6, 12.9, 22.8, 13.0 and 79.1 cm, respectively and those of males were 121.0, 142.5, 108.5, 41.5, 35.0, 33.0, 37.0, 40.0, 43.0, 20.0, 8.5, 14.5, 22.5, 13.5 and 87 cm, respectively. The udder length, udder breadth, teat length and teat circumference of cows were estimated 17.6, 16.6, 7.3 and 9.3 cm, respectively. The scrotal length, scrotal breadth and scrotal circumference of males were estimated 21.5, 12.0 and 29.0 cm, respectively. The daily milk yields of different cows were recorded from variable durations of different cows and found minimum as 2.4 kg (average 3.14 kg) and maximum as 6.5 kg (average 5.43 kg) with an overall mean of 4.50±0.05 kg per day, whereas, average daily milk yield of those cows in *in-situ* condition were ranged 3.4-4.1 kg. Daily milk yield differed significantly among cows (Table 2). Table 2clearly shows that milk production in *ex-situ* is higher than in *in-situ* that could be due to better feeding and management practices.

Table 2 Daily average milk yield of Munshiganj cows

Cow ID	Lactation order	Period (d) of records	Production (kg) range		Average daily milk yield	
			Min.	Max.	*Ex-situ*	*In-situ*
MCF2	4	40	3.5	5.4	4.73±0.07	3.5-4.0
MCF3	4	29	4.1	6.5	5.19±0.10	3.5-4.0
MCF4	3	40	2.7	6.0	4.54±0.12	4.0-5.0
MCF5	3	21	2.6	5.3	4.60±0.15	3.5-4.0
MCF6	3	21	2.4	4.2	3.74±0.10	3.0-4.0
MCF7	2	40	2.8	4.7	3.79±0.07	3.0-4.0
MCF8	1	40	3.9	5.9	4.82±0.10	3.0-4.0
All			3.14±0.26	5.43±0.29	4.50±0.05	3.4-4.1
Sig.					***	

***significant at 0.1% level (P<0.001)

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 with overall mean of 5.61, 4.31, 6.19 and 11.43%, respectively (Table 3). Fat and protein contained in evening milk were significantly higher than morning milk, while not significantly differed for lactose and SNF content.

Table 3 Milk composition of Munshiganj cows

Animal ID	%Fat		%Protein		%Lactose		%SNF	
	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
MCF1	4.55	6.74	4.15	4.31	6.00	6.15	11.04	11.37
MCF2	4.59	5.34	4.40	4.49	6.37	6.47	11.7	11.92
MCF3	4.77	6.46	4.32	4.42	6.25	6.32	11.49	11.68
MCF4	4.66	6.39	4.14	4.59	5.98	6.59	11.01	12.16
MCF5	6.39	7.66	4.30	4.34	6.15	6.17	11.36	11.42
MCF6	5.20	6.88	4.22	4.30	6.08	6.14	11.21	11.35
MCF7	4.08	4.91	4.10	4.24	5.96	6.14	10.95	11.29
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
Sig.	**		*		NS		NS	
Overall	5.61±0.29		4.31±0.04		6.19±0.05		11.43±0.09	

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

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

Project title: Study on the performances of Boer and Jamunapari goat at BLRI

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Executive Summary

Goat is considered as the most promising livestock species for meat (chevon) production in the country. The country has 20.75 million goats representing 59% of the livestock population of which more than 90 percent comprise of Black Bengal goats.Boer Goat (*Capra hircus*) is considered to be one of the most desirable goat breeds for meat production. They were higher growth rate, drought resistance, tolerance of tannins, efficient fiber digestion, and adaptation to various ambient temperatures.Another type goat of our country is Jumunapari goat. Ten percent (10%) of Jamunapari and their crossbred are available throughout the country. Small ruminants show various patterns of performance but the study of growth rate, milk yield, milk composition and reproductive efficiency of Jamunapari goat is still scanty in Bangladesh condition. Considering the increased demand of meat, milk and skin, goat development program in the country, BLRI has under taken a project "Study on the performances of Boer and Jamunapari goat at BLRI".The objectives of this study are phenotypic characterization,to evaluatethe productive and reproductive performances of Boar and Jamnapari goat and to evaluate the adaptability of Boer goat at hot and humid climatic conditions. At starting period 10 does and 2 bucks of Boar goats were collected from Bengal meat. Similar number of Jamunapari 'does' and bucks were also reared at Goat Research station, BLRI.The breeding program (Boer goat male × Boer goat female and Jamunapari goat male × Jamunapari goat female)was conducted at Goat Research Station of BLRI, Savar, Dhaka, in such way,which resist inbreeding. Green grass was supplied*adlibitum*basis and concentrate (17% CP, 11MJ/kg DM) was offered twice daily (morning and evening) at the rate of 300g per head per day. Milk of Boer and Jamunapari goat were collectedtwice daily (morning and evening) and analyzed by Lactostar Milk Analyzer. Subsequently, data on phenotypic measurement, productive and reproductive performances were recorded and analyzed by SPSS 17.0Statistical computer programme.

Table 1 Morphometric measurement of Boer and Jamunapari goat

Parameters	Boer Goat (Mean±SE)	Jamunapari Goat (Mean±SE)	Level of Significance
Body weight (kg)	52.36^{a}±5.97 (7)	40.47^{b}±2.65 (16)	*
Body length (cm)	69.96±2.09 (7)	72.13±1.63 (16)	NS
Height at wither (cm)	67.98±1.19 (7)	69.69±1.29 (16)	NS
Chest girth (cm)	78.39±2.04 (7)	79.18±2.04 (16)	NS
Ear length (cm)	19.43±0.90 (7)	21.23±0.66 (16)	NS
Horn length (cm)	19.01^{a}±1.29 (7)	7.98^{b}±0.71 (12)	***
Head Length (cm)	22.29±0.52 (7)	23.31±0.51 (16)	NS
Head width (cm)	30.23^{b}±0.63 (7)	33.82^{a}±0.85 (16)	*
Rump length (cm)	13.87±1.28 (7)	11.28±0.69 (16)	NS
Rump width (cm)	17.87^{a}±0.61 (7)	15.19^{b}±0.59 (16)	**
Tail length (cm)	13.91±0.71 (7)	15.30±0.52 (16)	NS
Udder length (cm)	21.83±5.15 (5)	16.22±1.22 (11)	NS
Udder diameter (cm)	30.33±4.41 (5)	28.48±1.11 (11)	NS
Teat length (cm)	5.80^{b}±0.87 (3)	9.15^{a}±0.89 (11)	*
Scrotum length (cm)	15.10±1.10 (2)	14.26±0.94 (5)	NS
Scrotum circumference (cm)	22.25±1.25 (2)	23.46±1.73 (5)	NS

Means with uncommon superscripts differ 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 ($p>0.05$).

Table 1 shows the different Morphometric measurements of Boer and Jamunapari goat. The horn length of Boer goat was significantly (P<0.001) higher than Jamunapari goat. Rump width of Boer goat was significantly(P<0.01) higher than Jamunapari goat. The body weight, head width and teat length differed significantly(P<0.05)between Boer goat and Jamunapari goat.

Table 2 Milk composition of Boer and Jamunapari goat

Parameters (%)	Boer Goat (Mean±SE)	Jamunapari Goat (Mean±SE)	Level of Significance
Fat	5.85±0.47 (18)	6.10±0.34 (7)	NS
Protein	4.33±0.05 (18)	4.41±0.09 (7)	NS
Lactose	6.26±0.06 (18)	6.28±0.09 (7)	NS
SNF	11.51±0.13 (18)	11.58±0.18 (7)	NS
Minerals	0.61±0.08 (18)	0.35±0.16 (7)	NS
DM	13.57^{b}±0.60 (14)	15.68^{a}±0.71 (7)	*
Ash	5.78±0.32 (14)	5.61±0.31 (7)	NS

Means with uncommon superscripts differ significantly. Figures in the parenthesis indicate the number of observation.*= Significant at 5% level of probability (p<0.05). NS= Not significant (p>0.05).

Table 2 shows the milk composition of Boer and Jamunapari goat. The Dry matter percentage of Jamunapari goat milk (15.68±0.71%) was significantly (P<0.05) higher than Boer goat milk (13.57±0.60%).

Table 3 Productive and Reproductive performances of Boer and Jamunapari goat

Parameters	Boer Goat (Mean±SE)	Jamunapari Goat (Mean±SE)	Level of Significance
Birth weight (kg)	3.40^{a} ±0.23 (95)	1.73^{b}±0.08 (35)	***
Growth rate (kg/d)	0.168^{a}±0.01 (5)	0.044^{b}±0.00 (9)	***
Weaning weight (kg)	18.50^{a}±1.42 (5)	7.09^{b}±0.23 (10)	***
Weaning age (days)	90.40^{a}±2.82 (5)	127.30^{b}±7.19 (10)	***
Age at maturity (days)	265.00±1.91 (4)	-	-
Weight at maturity (kg)	25.46±0.82 (4)	-	-
Litter size (no)	1.52^{b}±0.07 (60)	1.89^{a}±0.16 (18)	**
Post kidding wt. (kg)	48.28^{a}±2.54 (6)	30.73^{b}±1.56 (18)	***
Placenta wt.(kg)	0.8^{b}±0.15 (3)	0.34^{a}±0.02 (18)	***
Post Partum Heat Period (days)	145.33^{b}±43.88 (3)	63.00^{a}±7.00 (10)	***
Kidding interval (days)	272.85^{b}±12.78 (13)	226.50^{a}±13.24 (6)	*
Gestation length (days)	147.33±3.84 (3)	145.33±1.58 (15)	NS

Means with uncommon superscripts differ 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).

Table 3 shows the Productive and Reproductive performances of Boer and Jamunapari goat. The Birth weight, growth rate, weaning weight and post kidding weight of Boer goat were significantly (p<0.001) higher while weaning age was significantly (p<0.001) lower than Jamunapari goat. The litter size of Jamunapari goat (1.89±0.16) was significantly (p<0.01) higher than Boer goat (1.52±0.07).The kidding interval of Jamunapari goat (226.50±13.24 days) was significantly (p<0.05) lower than Boer goat (272.85±12.78 days).

From the above findings, birth weight, growth rate and weaning weight of Boer goat were significantly higher while litter size and kidding interval were significantly lower than Jamunapari goat. The study is going on and more data will be collected up to the significant studies.

Project title: Community based sheep production in Hilly area at Naikhonchari

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Executive Summary

Native sheep are small (18-25 kg adult weight), highly prolific (2-3 lambs per lambing and two lambing per year) and meat type (7-10 kg meat per sheep) animals. Native sheep are extremely resistant to infectious diseases including PPR. Lamb mortality rate is less than 5%. They can be reared harsh management condition and can utilize relatively poor quality feed. Unlike goat they are nondestructive social animal with relatively easy management. Bangladesh has no practice of sheep rearing at forest region. There is 4.54% (MAR-SFM, 2010) hilly forest area in Bangladesh. There are a lot of resources such as fodder, tree leaves at forest region which can be a great scope of sheep rearing in forest area. The most of the people's income in hilly region is below the poverty level. Top and slopes of the hill has no scope to produce agricultural crops except 'zump' culture. Natural grass, tree leaves and lots of fallow land are available in hilly areas. Rearing of sheep through scavenging system might be a great scope at hilly region. Environment is very friendly to rearing of sheep at hilly areas. On the other hand plane land day by day decreasing trends to grown in different crops and housing, road, industrial development and scope is very limited and decreasing trends day by day to rearing the sheep. So the research program was conducted to establish the sheep rearing system at hilly region at Naikhongchari. This program was conducted at BLRI regional station, Nikhongchari, Bandarban. At starting period farmers were selected from Naikhongchari regional station at community farm level. The total of 40 ewes and 10 rams of native sheep (4 ewes and 1 ram of each) were distributed to community farmers' level for research purpose. The remaining 16 ewes and 4 rams are being reared at regional station research farm. The animals will be reared up to 36 months or minimum two parities. In the research farm all the 'ewes' and rams are housed by slated floor raised above the ground level with sufficient space to keep them comfortable. As diet, green grass (*adlibitum*basis, twice daily morning and evening*)* and concentrate feed (@ 200g per head per day) is supplying to the animals. The community farmers use wooden stall as night shelter using no bedding materials. They rear their sheep only through scavenging system. Very few supply concentrate feed in community level. Duration of the grazing period is at least 6 hours on an average. They use natural service for mating. PPR vaccine that supplied from BLRI and deworming at least 6 month interval maintains at regular basis. At the onset of the experiment the farm and farmers' level phenotypic, productive, reproductive and disease data was recorded regularly throughout the research period. During that time kids are kept separately from their 'does'. The birth weights of newborn kids are taken by digital weighing balance within one hour after birth. The subsequent weights of lambs are recorded in the morning and before feeding up to fortnightly throughout the year.Bucks are kept separately from 'ewes' to avoid unplanned mating.

Table 1 Socio-economical status of Community farmer level

Criteria	Level of Criteria	Percentage (%)
A. Educational Level :	Illiterateracy	12.5
	Below the primary level	25
	Class 6 to SSC	62.5
B. Occupation :	Agriculture	50
	Service	12.5
	Others	37.5
C. Land (Decimal) :	Below 100	25
	Below 300	37.5
	Above 500	37.5
D. Family Member :	1-5 member	50
	6-10 member	37.5
	Above 10	12.5
E. Income (Yearly) :	Below 50,000	25
	Above 50,000 – 1,00,000	50
	Above 1,00,000	25

The socio economic status of selected farmers are shown in Table-1 the educational level of selected sheep farmers are 12.5% illiterate and 62.5% class (6-10). The occupations of the farmers arehighest in agriculture (50%) and lowest in service (12.5%), the minimum land area of the farmers below hundred decimal at 25%. The most of the sheep farmers (50%) have the number of family members from 1-5 and income nearly 50,000-1, 00,000/- per year.

Table 2 Different body weight of native sheep at farm and community level

Parameter	Farm level	Community level
	Mean±SE	Mean±SE
Birth weight-Male (kg)	1.4±0.04(19)	1.4±0.03(14)
Birth weight-Female (kg)	1.3±0.05(23)	1.36±0.06(7)
Average birth weight (kg)	1.34±0.04(42)	1.39±0.03(21)
Litter size	1.54±0.14(13)	1.33±0.17(21)
3 months body weight (kg)	7.06±0.6(6)	7.2±0.3(6)
6 months body weight (kg)	9.68±0.83(3)	9.93±0.31(4)
9 months body weight (kg)	12.03±0.39(9)	12.03±0.39(6)
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)

The productive performances of native sheep at farm and community level are shown in Table-2. The average birth weights of farm and community sheep are 1.34±0.04 kg and 1.39±0.03 kg, respectively. The litter size of farm sheep was higher (1.54±0.14) than community sheep (1.33±0.17). The three months, six months, nine months body weight of farm sheep and community sheep aremore or less similar. The average body weights of adult sheep at farm and community level were 20.82kg and 23.37kg respectively.

Table 3 Progress of the community farmers last year

Sl. No.	Name of the Farmers	Date of supply	No. of Sheep received by farmer	Present stock (progress)	Return	Income of the Farmers
01.	Moo Cak	01-11-2012	05	11	01	13,600/-
02.	A CracingCak	01-11-2012	05	07	03	22,000/-
03.	Safura Begum	01-11-2012	05	03	02	14,000/-
04.	ShaidNur	02-02-2013	03	11	02	11,000/-
05.	A. Rahman	15-10-2013	05	15	01	-
06.	Zuleka Begum	27-11-2013	05	02	05	8,000/-
07.	NurAysha	13-11-2014	05	07	-	-
08.	TunuBorua	26-02-2014	05	15	-	3000/-
09.	Almas Begum	16-05-2014	05	11	-	-
10.	AtingCak	16-05-2014	05	11	-	-
11.	Zia Uddin	22-01-2015	05	07	-	-
			53	100	14	-

The progress of community farmers last one year are shown in Table-3. Total numbers of supplied sheep in community farmers was 53 and at present it increases up to 100 numbers. The last one year the community farmer's income increases from 3000/- to 22,000.The problems of sheep rearing at community farmers are scarcity of fodder at rainy seasons and dog biting. Finally, it would be concluded that, in the community level, the BLRI native sheep is being well adapted. The study is going on and more data will be collected up to the significant studies.

Project title: Conservation of Farm Animal Genetic Resources (FAnGR) at Naikhongchari
Sub-title: Conservation and improvement of Hilly chicken at Naikhongchari regional station

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Executive Summary

Hilly chickens are native bird of hilly areas of Bangladesh and reared for local consumption and its egg and meat has a unique taste, is regarded as a delicacy, and is popular among consumers which are focusing to do research to know their productive performance. Local non-descript coloured chicken is a vital source of tasty meat and eggs and more acceptable to rural people (Barua and Howlider, 1990). The local people always try to find the indigenous (desi) cockerel for its tenderness and special taste (Ahmed and Ali, 2007). However, the production characteristics of Hilly chicken are not well documented. The heavier body size of the hilly chickens compared to other native birds indicates that it can be used as slow growing meat type chicken in Bangladesh. Rahman *et al*. (2011) found 503g body weight of Hilly Chicken at 8 weeks of age with feed conversion rate 2.8. Recently collected scavenging Naked Neck Hilly chicken from hilly villages of Naikhongchari areas was found heavier in adult body weight (1975 g) than the Naked Neck chicken of plain areas, reported by Khatun *et al*. (2005) (1252 g) and Faruque *et al*. 2013(1170g). As the price of native birds in local market is almost 100% higher than other type of table chickens, so interest was made for further study of Hilly chicken. This study was planned to undertake with the objectives of the improvement and conservation of Hilly chicken at Naikhongchari regional station. Both hilly chicken and naked neck hilly chicken of large body sizes and their hatching eggs were collected from different known sources of hilly areas following a standard procedure of bio-security. The Hilly Chicken management was divided into two systems (cage and floor system). Fifteen cages and six pens were set for the study, where in each cage and pen; there were 1 male and 4 females chicken. For Naked Neck hilly chicken 3 cages and 2 pens were set up for the study and each cage and pen, there were 1 male and 4 females chicken. The floor system has 2 pens where in each pen there were 1 male and 4 female chicken. Intensive management system was followed in open sided poultry house. The chicks were reared on floor, littered with rice husk. Standard starter, grower and layer feed was fed during rearing period. The birds were allowed ad libitum feed and fresh drinking water.

Table 1 Performance of growing Hilly chicken and Naked Neck Hilly chicken reared up to 20 weeks of age at Naikhongchai regional station of BLRI

Parameters	Age (wk)	Hilly Chicken Mean ± SE	Naked Neck Hilly Chicken Mean ± SE	Level of significance
Body weight (g)	Day old	31.4±3	29.6±3	NS
	2	100.3±19.81	107.4±21	NS
	4	224.8±44	221.2±42	NS
	6	401.8±87	413.1±102	NS
	8	578.7±128	583.8±120	NS
	10	770±193	770±121	NS
	12	965±238	1024±101	**
	14	1180±251	1147±127	**
	16	1409±30.8	1351±179	NS
	18	1685±359	1657±155	NS
	20	1864.7±376	1759±209	NS
Mortality (%)		5.44±3.75	7.37±3.19	NS

NS= Not significant (p>0.05).

Starter diet was fed from 1 day to 4 weeks of age; grower diet from 5 to 18 weeks and layer diet from 19 weeks to end of lay. Necessary hygienic measure was ensured for bio-security purposes. Birds were de-wormed on a regular interval. Natural hatching was done by mother hen reared on litter (rise husk) floor

and conventional bamboo basket was used as hatching nest. A standard vaccination schedule was followed. Subsequently, the productive and reproductive performances were recorded and analyzed by SPSS 11.5 Statistical computer programme. The performance of growing hilly chicken and naked neck hilly chicken reared up to 20 weeks are shown in Table 1. There were no significant differences of body weight between hilly chicken and naked neck hilly chicken in growing period (up to 20 weeks of age). The body weights of both hilly and naked neck hilly chicken were higher than previous year. The mortality of hilly chicken was slightly lower (5.44±3.75) than that of naked neck hilly chicken (7.37±3.19) up to 20 weeks of age and also lower in hilly chicken than previous year(6.11±3.75) and higher in naked neck hilly chicken than previous year (7.14±2.14).

Table 2 Hatching performance of Hilly and Naked Neck Hilly chicken as hatched by broody hens

Types of Bird	Egg set (No.)	Egg weight(g)	Hatchability (%)	Chick weight (g)
		Mean ± SE	Mean ± SE	Mean ± SE
Hilly Chicken	153	47.28±3	67.5±10	30.4±3
Naked Neck Hilly Chicken	61	41.48±1	57.0±22	29.6±4
Level of Significance		NS	NS	NS

NS= Not significant (p>0.05)

Hatching performances are summarized in Table 2.There was no significant difference of hatchability between hilly and naked neck hilly chicken hatched by broody hens. However, the lower hatchability in Naked Neck Hilly Chicken (57±22) might be due to the reason of summer season effect on natural hatching process.

Table 3 Performance of Hilly chicken and Naked Neck hilly chicken at Naikhongchari regional station

Parameters	Hilly chicken	Naked Neck Hilly chicken	Level of significance
	Mean ± SE	Mean ± SE	
Body weight of adult hen(g) at 30 wks	2244±134	2005±79	NS
Body weight of adult cock (g) 30 wks	2664±68	2576±68	NS
Egg production (H.D) %	27±1.4	35±3.3	NS
Egg weight (g)	41±4	38±3.6	NS
Age at 1st egg (d)	147	159	NS
Feed consumption (g/bird/d)	97.61±11	102.0±22	NS
Mortality (%)	15.56±3.7	11.0±02	NS

NS= Not significant (p>0.05)

The average body weight of adult hilly chicken and naked neck hilly chicken is shown in Table 3. The adult body weight of hilly chicken at 30 weeks of age was higher than that of naked neck hilly chicken but the difference was not significant. However, the egg production of hilly chicken and naked neck hilly chicken was reduced than previous year (hilly chicken: 42.46±1.28; naked neck:49.68±1.0). There was no significant difference of the age at first egg, feed consumption and mortality between hilly chicken and naked neck hilly chicken. From the results of this study, it may be suggested that both hilly (feathered) and naked neck hilly chicken need to be conserved and improved further through selective breeding and better management system.

Project title: Maintenance and improvement of pure lines and performance of BLRI developed layer strains

Sub-title: Effects of strains and ambient temperature and their interaction on production performance, egg quality and physiological response of laying hens

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Executive Summary

In recent years, poultry farming in Bangladesh are growing rapidly. But, the deficiency of eggs and meat is evident. Therefore, Bangladesh imports parent and grandparent chick from abroad to meet its internal demand of day old commercial chick. Keeping this view in mind, BLRI has developed two layer strains named as Shuvra and Shorna. But, different environmental temperature may not always have the same effect on different strains. Therefore, the present experiment was undertaken to compare the performance, egg quality, heat tolerance ability and stress responses between the BLRI developed layer strains and commercial layer strain under thermo-neutral and heat stress condition of Bangladesh. A total of 192 ready to lay pullets were randomly assigned to a 3 × 2 factorial arrangement of treatments (4 replicate/treatment; 8 birds/replication) consisting of three layer strain (Shuvra, Shorna and commercial white leghorn layer strain) and two ambient temperatures (heat stress 30-32°C; thermo-neutral 18-20°C). The birds were reared following layer strain guidelines and were given access to feed (ME, 2800 Kcal/kg, CP 17%, Ca 3.5%, and P 0.42%) and water throughout the study. Egg production (EP) and feed intake (FI) in each treatment were recorded daily, and body weight (BW) and egg weight were weighed on 1 d/wk. Consequently, egg mass (EM) (% of egg production × egg weight/100) and feed conversion (g of feed/g of egg mass) were calculated based on EP, EW and FI. In each treatment, 10 eggs were randomly picked up and egg quality was measured in each ten weeks interval by Egg Quality Measurement Stand (FHK Japan). Egg shell breaking strength was measured by using an egg shell strength tester (Fujihira Industry Co.,Ltd, Japan). At the end of the experiment, peripheral blood samples (n = 8 per treatment) were obtained by wing vein puncture and allowed to clot for 2 hr at room temperature, centrifuged at 1500 rpmfor 15 min at 4°C, and the sera were collected and stored at -20°C until analyses. Serum Ca, P and Mg (mg/mL) content were measured by using a Humalyzer 2000 chemistry (Germany) using a turbidimetric method as described by the manufacturer. To measure the stress response, 8 blood samples per treatment were collected from the wing vein, smears were prepared, and lymphocytes were counted at ×100 (oil immersion lens) and H/L was calculated according to Wall *et al.* (2008). Hemagglutination Inhibition (HI) antibody titers of the sera samples were measured based on the Sabrin*et al.* (2012). At 50 weeks of age, 8 birds in each treatment were killed and meat quality was measured according to Hassan *et al.* (2014). All data were analyzed as 3 strain (Shuvra, Shorna and commercial white strain) x 2 (ambient temperature) factorial designs by 2-way ANOVA plus interaction (SAS, version 9.1, Cary, NC, USA, 2005). For BW, EP, EW, EM, FI and FCR the cage tier (n=4) were the experimental units. For other parameters (n=8) birds were considered as the experimental unit. Significant differences among treatment means were separated using the Duncan's new multiple-range test (Steel and Torrie, 1980) with Bonferroni adjustment. A *P*-value < 0.05 was considered significant. The performance of the laying hens during the entire trial period (20–50 weeks) is summarized in Table 1. Body weight was significantly ($P<0.05$) increased in Shorna than that of Shuvra and commercial hens. The interaction between strain and temperature were not significantly influence the rate of egg production. Though the egg production of commercial hen was increased under thermo-neutral condition but remarkably decreased under the heat stress condition. The effect of strain on egg weight was significant ($P<0.01$) and was more pronounced in Shorna than Shuvra than that of commercial strain. Therefore, beneficial effect of Shorna on egg mass production which influences to make feed conversion more efficient than that of commercial strain. On the other hand, under the heat stress condition, the average decline of feed intake was the highest in commercial and lowest in Shorna.

Table 1 Effect of strains and ambient temperature on the performance of laying hen

Layer Strains (S)	Temperature (T)	BW (g)	EP (%)	EW (g)	EM (g)	FI (g/b/d)	FCR
Shuvra	Thermo-neutral	1585.78^{b}	79.07	62.27	49.23^{c}	112.16^{a}	2.278
	Heat stress	1612.90^{b}	78.21	61.94	48.44^{bc}	107.39^{b}	2.217
Shorna	Thermo-neutral	1882.67^{a}	80.17	65.54	52.54^{a}	116.71^{a}	2.231
	Heat stress	1910.61^{a}	78.69	65.07	51.20^{a}	109.75^{ab}	2.145
Commercial strain	Thermo-neutral	1463.29^{c}	84.46	60.36	50.98^{a}	113.06^{a}	2.218
	Heat stress	1481.15^{c}	80.47	60.35	48.57^{c}	106.96^{b}	2.203
SEM		39.99	0.612	0.491	0.487	0.694	0.027
				Main effects			
Layer Strains	Shuvra	1599.34^{b}	78.64^{b}	62.11^{b}	48.84^{b}	109.78^{b}	2.249^{a}
	Shorna	1896.64^{a}	79.43^{ab}	65.30^{a}	51.87^{a}	113.23^{a}	2.195^{b}
	Commercial	1472.22^{c}	82.47^{a}	60.36^{c}	49.78^{b}	110.01^{b}	2.211^{ab}
Temperature	Thermo-neutral	1610.59^{b}	81.23^{a}	62.73	50.95	113.97^{a}	2.232
	Heat stress	1701.55^{a}	79.12^{b}	62.45	49.62	108.08^{b}	2.194
Treatment interaction effect (*P*>F)				P value			
S		0.001	0.020	0.001	0.005	0.014	0.031
T		0.001	0.039	0.213	0.194	0.039	0.491
S x T		0.013	0.326	0.508	0.043	0.042	0.058

^{a,b,c}Mean values within a column followed by the same letter are not significantly different (*P*>0.05).

There was no interaction between strain and temperature on egg shell breaking strength (ESBS), albumin height, Haugh units, and yolk color but yolk height was increased by the Shuvra under the thermo-neutral rearing temperature. On the other hand, Shuvra strain showed higher ESBS (3.971kg/cm^2), HU (94.01) and albumin index (12.19) than that of other two strains. Under the heat stress condition, egg quality was affected (P<0.05) and thus decreased albumin height, albumin index, yolk height, yolk index, and Haugh unit as well.

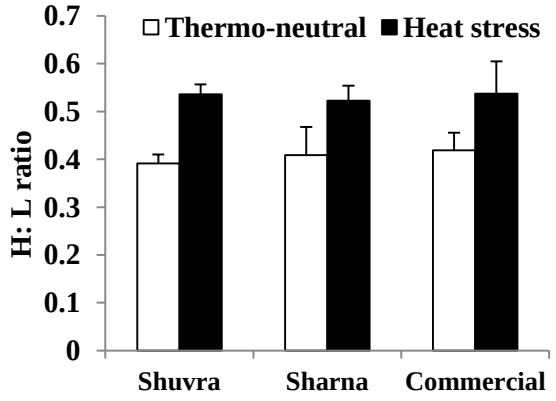

Figure 1 Effect of strain and temperature on H: L ratio of laying hens

Though the H: L ratio was not significantly affected by the interaction of strain and temperature. But, environmental temperature increased from 20 to 30^{0}C might be influenced and thus increased (P<0.05) H: L ratio from 0.406 to 0.532. Consequently, variation of strain and temperature did influence the blood P contents of laying hens and numerically higher Ca content in serum was obtained by the Shorna (11.74, 11.35 mg/dL) and Shuvra (11.68, 9.34 mg/dL) than that of commercial (11.32, 6.75 mg/dL). HI antibody titer in serum was not influenced by the interaction of strain and temperature level, but numerically higher level was obtained (log2 base) by the Sharna (6.601) and Shuvra (6.533) than that of commercial (5.867) strain. The present results, there was no interaction between strain and temperature on meat quality characteristics.

But significantly higher (p<0.05) carcass weight and muscular pH were obtained in Shorna (1631.25 g and 5.85) than that of Shuvra (1304.25 g, 5.73) and commercial strain (1226.01 g, 5.71). The drip loss (%) in breast muscles was not significantly influenced by the interaction of strain and temperature. But pH level of breast muscle was notably declined in heat stressed birdthan that of thermo-neutral groups. These results indicate that Shuvra and Sharna improved egg quality, serum phosphorus, antibody titer level and numerically decreased H:L ratio with increased egg mass productionas evidenced by measured performance and physiological parameters. Thus, the present results indicated that Shuvra and Sharna are comparable with the commercial strain, suggesting physiologically adaptable under existing environmental condition of Bangladesh.

Project title: Maintenance and improvement of pure lines and performance of BLRI developed layer strains

Sub-title: Laying performances of BLRI layer-2 (Shorna) under farmers condition

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Executive summary

Bangladesh Livestock Research Institute (BLRI) initiated a poultry breeding programme in 1999 to develop layer strain for small-scale rural farmers through a collaborative research with Japan International Cooperation Agency (JICA). Since the inception of the breeding programme, BLRI produced more than 20 genotypes from four pure lines donated by JICA and developed a white layer strain named BLRI layer strain-1 or "Shuvra" which released for commercial production through the government of Bangladesh. Presently, the female day-old chicks of Shuvra could be separated from male only by vent sexing at day-old, which is labor intensive and requires skill persons, thus, add more costs to chick prices. In contrary, layer farmers want to get only the female chicks. Moreover, there is higher market demand of brown shelled eggs than white like Shuvra. Considering the fact, BLRI incorporated auto colour sexing and developed another colour layer strain (BLRI layer-2 or Shorna) through the ongoing breeding progermme. The newly developed layer could be sexed at day old by feather colour. The down feather colour of Shorna male chick is white, whereas the female down feather colour is light brown at day old. The feather colour of layer is dark brown or golden. The average egg production of BLRI layer-2 (Shorna) was 295 eggs per year with an average egg weight of 64 gm (at 40 weeks) having brown-shelled eggs in on-station trials. The average feed intake was 115g per bird per day, which is almost similar with "Shuvra". To validate the findings of the on-station results, farmers field trial at different locations of Bangladesh were performed. A total of 750, 865 and 1002 female chicks were distributed among the 3 pre-selected farmers in Sarishabari, Jamalpur; Babuganj, Barisal, and Kalihati,Tangail respectively in between November 2013 and January 2014.The farmers were given proper orientation on the management and record keeping system of Shorna. The growth performances were studied up to June 2014. The laying performances have been studied since July 2014. The farmers were supplied some inputs (vaccine, medicine, disinfectant, feed additives etc.) as incentive to get full cooperation regarding performance data collection. The chicks and growing birds were reared on littered floor up to 16 weeks of age and then the birds were transferred in group cages placed in open-sided laying houses. The locally available ready mixed layer feed was supplied to the birds. Standard vaccination and biosecurity measures were followed during the trials. Record on daily feed intake (gm/bird/day), age at first egg (days), daily egg production (numbers), weekly body weight (g/bird) and egg weight (g), and mortality were kept through the trial period. Mean, percentage and standard deviation (SD) was calculated from the recorded data. Body weight and laying performances of Shorna is shown in Table 1. The early maturity found in Kalihati (132 days) followed by Babuganj (135 days) and Sarishabari (139 days). The highest live weight recorded in Sarishabari (1769g) followed by Kalihati (1762g), and Babuganj (1700g). On the other hand, feed intake in Kalihati was highest (120g) followed by Babuganj (118g), and Sarishabari (117g). Highest egg production found in Sarishabari (82%) followed by Kalihati (77%), and Babuganj (76%) during 25-30 and 51-60 weeks of age. The annual egg production per hen per year was 282, 280 and 275 in Sarishabari, Babuganj and Kalihati, respectively. However, total egg weight was 17, 19 and 18 Kg per hen per year in Sarishabari, Babuganj and Kalihati, respectively. The average egg weight in all locations was recorded 66g and 70g for 41-50 and 61-72 weeks of age, respectively. The average feed conversion efficiency in all locations was recorded 2.34 and 2.32 for 30 and 70 weeks of age.

Table 1 Laying performances of BLRI layer-2 (Shorna)

Parameter	Location			(Mean ± SD)
	Sarishabari	Babuganj	Kalihati	
a) Age at first egg (day)	139	135	132	135.33
b) Live weight (g)				
i) 20th week	1600	1480	1515	1532 ± 6.39
ii) 30th week	1850	1740	1798	1796 ± 55
ii) 50th week	1858	1877	1972	1909 ± 61
Mean	1769	1700	1762	1744 ± 38
c) Feed intake (g/bird/day)				
i) 30th week	112	115	118	115 ± 3.0
ii) 50th week	120	120	121	120 ± 0.58
iii) 70thweek	120	120	121	120 ± 0.58
(Mean ± SD)	117.33 ± 4.62	118.33 ± 2.89	120 ± 1.73	---
d) Egg production (%)				
25-30 weeks	81.33± 5.82	68.83± 9.87	67.67± 10.98	72.61 ± 8.89
51-60 weeks	82± 2.10	82.17± 1.47	85.5± 1.22	83.22 ± 1.60
Mean	82± 0.47	76± 9.43	77.5± 12.61	78 ± 3.29
e) Annual egg production (no./hen/year)	282	280	275	279 ± 3.61
f) Egg weight (g)				
41-50 weeks	60± 0	68.80± 2.35	69.20± 1.55	66.0 ± 1.30
61-72 weeks	65.25± 1.71	71.50± 0.52	71.83± 1.55	69.53 ± 0.87
g) Egg mass (g)				
30 weeks	46	51	50	49.0± 2.65
70 weeks	50	55	51	52.0± 2.65
h) Total Egg weight (kg/hen/year)	17	19	18	18±1.12
i) FCR (Feed intake/ Egg mass)				
30 weeks	2.44	2.24	2.34	2.34±0.10
70 weeks	2.40	2.17	2.39	2.32±0.13
j)Mortality (20-72 wks), (%)	2	5	3	3.33±1.13

The mortality percent during 20-72 weeks was highest in Babuganj (5%) followed by Kalihati (3%), and Sarishabari (2.%). The average mortality (3%) for all locations lies below the ranges of usual mortality for a commercial layer (4-6%) during laying period. However, the variations of the laying performances in different locations might be due to the variations in management, feeds supplied to the birds and local environment as well.

Considering the above results particularly auto sexability at day-old, annual egg production, feed intake, total egg weight, feed conversion efficiency and livability of the BLRI layer-2 (Shorna), it may be suggested that the layer strain seems to be promising for commercial production.

Project title: Conservation and improvement of native chicken
Sub-title: Performance of fourth generation

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Executive Summary

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 fourth generation birds, and (iii) to estimate realized responses to selection to improve 3 Indigenous Chicken genotypes.A total of 1050-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 fourth generation (G_4), selection was practiced at 40-week of age on the basis of an index comprising the parameters of age at first egg (AFE), body weight (BW), egg production (EP) and egg weight (EW). Improvement target of egg weight was to increase by 1g, egg production rate was to increase by 2 % per generation. The data were analyzed by CRD by General Linear Model (GLM) Univariate Procedure in SPSS Computer Program. Expected genetic progress due to selection in a generation for EP was estimated for fourth generation (G_4) using the following equation (Falconer, 1981).$R = 1/2\ h^2 \times S_f$where, R = Expected response , h^2 = heritability, h^2 of EP and S_f = Selection differential for the selected females. The realized selection response was estimated by regressing the generation-wise mean breeding value of a trait on generation number.

Day old chick weight was significantly ($p<0.001$) highest in H (32.73±0.60 g). Significant ($p<0.001$) body weight differences among the genotypes were observed at 4th, 8th and 12th weeks of age, with the highest body weight observed for H genotype (252.66±2.05, 674.68±6.41 and 1193.74±36.34g) than other two genotypes (Table 1) in all stages of age. Chick mortality did not vary significantly ($\chi^2 = 0.775$; $p > 0.05$) among the three chicken genotypes (Table 2) at 0-8 weeks of age.The egg production up to 280 days was expected to increase by 3.34% for ND, 4.25% for H and 1.93% for NN, respectively (Table 3). From the values obtained it was obvious that selection was effective in improving the percentage of egg production in three genotypes of chicken. Singh *et al.* (2005) reported that the response in egg number of purebreds was expected to be positive 2.922, 0.209, 0.028, 0.037 in first four generations. The realized responses in terms of changes in breeding values in egg production and egg weight over generations were 0.722% and 5.349g, respectively (Table 4).

Table 1 Body weight of Indigenous Chicken up to 12 weeks of age

Parameter	Genotype			Level of sig.
	ND (Mean±SE)	H (Mean±SE)	NN (Mean±SE)	
DOC weight (g)	30.39^{b}±0.44 (475)	32.73^{a}±0.60 (256)	29.61^{b}±0.53 (319)	p<0.001
4th week weight (g)	231.02^{b}±1.5 (462)	252.66^{a}±2.05 (249)	212.42^{c}±1.85 (304)	p<0.001
8th week weight (g)		674.68^{a}±6.41 (235)	545.23^{c}±5.61 (300)	p<0.001
12th week weight (g)	942.59^{b}±26.03 (458)	1193.74^{a}±36.34 (233)	835.52^{c}±32.46 (297)	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 ($p<0.05$).

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 (%)	3.10	4.05	2.92	0.752	p >0.05

The negative genetic changes in age at first egg (-0.531 days) was in the expected direction. The realized response in age at first egg was found to decrease 0.531 days over two generations of selection. The realized response in the body weight at 40 weeks of age was found to be -0.001g due to selection over three generations (Table 4). Dev Roy *et al.* (1983) reported that realized genetic gains of 3.41 eggs against the predicted response of 3.32 eggs in broiler dam line. Their findings are in agreement with the present finding though smaller in degree. However, the results indicated that the genetic improvement of Indigenous Chicken for egg production will be effective through selection and breeding program. It may be concluded that the economic traits of Indigenous chicken could be improved in future generations through proper selection and planned mating.

Table 3 Expected response to selection for 280 days egg production (%)

Genotype	Before selection		After selection		Selection Differential (S)	Selection Intensity (i)	Phenotypic standard deviation (sd)	Heritability of the trait (h^2)	Expected response to selection (R)
	No.	Average	No.	Average					
ND	180	49.35	100	56.04	6.69	0.62	10.78	0.50±0.03	3.34
H	107	46.93	50	55.61	8.68	0.68	12.68	0.49±0.03	4.25
NN	93	51.42	50	56.93	5.51	0.67	8.20	0.35±0.01	1.93

ND=Non-descript Deshi; H=Hilly; NN=Naked Neck;

Table 4 Realized responses in egg production, egg weight, age at first egg and body weight at 40 weeks

Trait	Generation	Average breeding value (BV)	Realized response per generation
Egg production (%)	G_0	-0.3583	0.722
	G_2	0.3638	
Egg weight (g)	G_0	-2.6511	5.349
	G_2	2.6987	
Age at first egg (days)	G_0	0.2619	-0.531
	G_2	-0.2696	
Body weight at 40 weeks (g)	G_0	0.0025	-0.001
	G_2	-0.0023	
	G_3	-0.0010	

*****G_0 = Foundation generation; G_2 = Second generation; G_3=Third generation

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Singh N, Singh RP, Malik BS 2005. Expected and realized correlated responses in egg number of crossbreds and purebreds in egg type chicken. Proceedings of XXIII IPSACON. 2-4 February, 2005. Rajendranagar, Hyderabad.

Project title: Conservation and Improvement of Quail
Sub-title: Performance of fourth generation of Quail

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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 production of its 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 production of fourth generation (G_4), parent quails of each genotype were selected from the 3rdgeneration (G_3) on the basis of breeding value according to their 6th week body weight. Hatching eggs were collected from every single pen of the selected parent quails. A total of 1876-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 2nd, 4th, and 6th weeks of age were significantly ($p<0.001$) influenced by genotype (Table 1). The 6th week body weight was 111.52 ± 0.81, 148.23 ± 0.89, 128.29 ±0.78 and 132.06± 1.20 g, respectively for J, W, Br and Bl genotypes. Significantly ($p<0.001$) higher body weight was found in W and Bl followed by Br 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 (67.41%) compared to other three genotypes of W (61.30%), Br (65.26%) and Bl (45.25 %), respectively. Feed intake was not affected by genotype but egg production was significantly ($p<0.001$) influenced by genotype.Brown genotype (13.00%) had significantly ($\chi^2 = 13.61$; $p<0.01$) higher chick mortality than J (8.15%), Bl (9.58) and W (6.49%) genotypes at 0-5 weeks which is shown in Table 3. Selection differential varied from 4.0g body weight in Black quail male to 13.1g body weight in Brown quail male (Table 4). Phenotypic standard deviation varied from 6.8g in Black male to 15.3g in White female. The intensity of selection varied from 0.36 to 1.10 in this population. Based on the performances, W and Bl quail were superior for body weight and Bl quail for egg production. These findings give us more attention for continuing the quail breeding research for production of 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	2ndwk body weight	4thwk body weight	6thwk body weight
Japanese	36.07^{c} ± 0.21 (648)	80.10^{d} ± 0.37 (592)	111.52^{d} ± 0.81(261)
White	40.93^{a} ± 0.30 (311)	90.84^{a} ± 0.52 (302)	148.23^{a} ± 0.89(217)
Brown	37.25^{b} ± 0.30(310)	84.47^{c} ± 0.53 (290)	128.29^{c} ± 0.78(282)
Black	40.15^{a} ± 0.50 (114)	86.21^{b} ± 0.85 (114)	132.06^{b} ±1.20(108)
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

Parameters	Quail varieties(Mean ±SE)				Level of Significance
	Japanese	Brown	Black	White	
Hatchability on setting eggs (%)	67.41^{a} ±2.11	65.26^{a}±2.46	45.25^{b}±4.21	61.30^{a}±2.16	p<0.001
Feed Intake(g/b/d)	18.93±1.16	18.32±1.16	16.78±1.16	18.22±1.16	NS
Egg production (No)	105.86^{b}±1.13	100.98^{c}±1.28	112.40^{a}±2.14	103.04^{bc}±2.19	p<0.001

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

Parameter	Genotype				X^2 (df=3)	Level of Significance
	Japanese	White		Brown		
Mortality (%)	8.15	6.49	9.58	13.00	13.61	p<0.01

Table 4 Selection differential, selection intensity for 6 weeks body weight (g) in fourth generation (G_4)

Genotype	Sex	Before selection		After selection		Selection Differential (S) (g)	Selection Intensity (i)	Phenotypic standard deviation (sd)
		No.	Average	No.	Average			
Japanese	M	437	107.6	220	114.3	6.7	0.68	9.8
	F	409	128.9	220	136.2	7.3	0.58	12.4
White	M	184	129.4	120	135.0	5.6	0.53	10.5
	F	225	148.2	120	159.0	10.8	0.70	15.3
Brown	M	149	112.4	120	125.5	13.1	1.10	12.0
	F	204	133.5	120	141.2	7.7	0.84	9.1
Black	M	50	118.1	36	122.1	4.0	0.58	6.8
	F	47	132.6	36	137.9	5.3	0.36	14.4

Project title: Conservation, improvement and feeding system development of native duck genotype

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Executive Summary

This study was under taken to evaluate the laying performance of BLRI developed native duck (G_1) and vis-a-visto develop the feeding system of native duck in hoar areas. To evaluate the laying performance the ducks were fed a diet containing17.5% crude protein and 2750 kcal metabolizable energy/kg DM during laying period. Clean drinking water was provided all times and the feed was measured everyday in the morning. For mating purpose 5 ducks and 1 drake were reared in a pen. At laying stage individual laying cage was used for individual record keeping. Adult ducks were reared in a natural ventilated duck house and maintained 16h photoperiod with 12h sunlight and 4h artificial lights. Ducklings were vaccinated against Duck Plauge and Duck cholera vaccine as per schedule. Individual records were kept on individual ducks at day old weight, weekly body weight and monthly weight up to 40 weeks, daily egg production and egg weight at 40 weeks of age, feed intake, growth rate and feed conversion ratio. Egg quality characteristics i.e. egg weight, egg length, egg width, shape index, albumen index, yolk index, haugh unit, yolk color, blood spot, meat spot were measured and recorded at 30 and 40 weeks of age. Further, to evaluate G_2, a total of 550 Rupali and 260 Nageswari ducks were hatched. Ducklings were maintained under intensive management condition. Collected data were analyzed by *t*-test.

Production and egg quality performance of generation 1 are shown in Table 1. It revealed that Nageswari duck starts laying at higher age (153 days) compared to Rupali duck (149 days) genotype. Duck weight at sexual maturity and egg weight at first lay were also higher in Rupalithan Nageswari duck but egg production (24-48 weeks) was found almost similar in both genotypes (Rupali 97.36 and Nageswari 98.72 in number respectively).Rupali duck produced heavier eggs (66.37 g) than Nageswari (63.47 g) which differed significantly ($p<0.05$).There were found no significant differences in egg quality aspects such as HU, yolk index, shell thickness and breaking strength ($P>0.05$) among the genotypes. Body weights, body weight gain, feed consumption and feed conversion ratio from day old to 8 weeks of age are shown in Table 2. The average initial body weight of day old ducklings of Rupali and Nageswari were 33.3 and 32.67 g, respectively and their difference were not significant ($P>0.05$). Significantly, the highest daily ($p<0.001$) and total weight gain ($p<0.05$) were found in Rupali duck at day old to eight weeks of age. But at 0-4 week of age no significant ($P>0.05$) difference was found in daily and total weight gain. Mean daily and total gain at 0-8 weeks of age were 24.92 and 22.45 and 1231.43 and 1166.28 g respectively for Rupali and Nageswari duck genotypes. There was no significant ($P>0.05$) variation in feed intake and FCR among the duck genotypes. Based on the laying performance of 1st generation, the study revealed that both native duck genotype are good performing for all laying parameters. These findings give an impetus for continuing the pure breeding research for more generations.

Table 1 Production and egg quality performance of duck genotypes (G_1)

Parameters	Genotype (Mean ±SD)		F value	Level of significance
	Rupali (n=199)	Nageswari (n=157)		
Age at sexual maturity (days)	149.67±11.82	153.58±11.80	2.40	0.123 NS
Body weight at first lay (g/duck)	1560.96±104.56	1496.68±107.46	148.02	0.108 NS
Egg weight at first egg (g)	48.85^{a}±3.16	44.41^{b}±3.54	2.62	0.001**
Eggprod. (no) 24-48 weeks of age	97.36±8.4	98.22±8.1	0.263	0.609 NS
Feed intake (g/duck/day)	136.33±3.12	137.88±1.45	0.234	0.546NS
Egg weight at 40 weeks of age	66.37^{a}±5.16	63.47^{b}±3.5	5.12	0.028*
Breaking Strength (kg/cm)	0.32±0.13	0.40±0.06	3.2	0.089 NS
Haugh unit	71.12±18.56	67.06±13.40	0.228	0.642 NS
Yolk index	4.5±0.13	4.47±0.19	0.355	0.562 NS
Shell thickness (mm)	0.40±0.02	0.37±0.03	2.55	0.136 NS

**, P<0.01; *, P<0.05; NS: Non Significant

Table 2 Effect of genotype on growth performances

Parameter	Age (Week)	Genotype (Mean ±SD)		F value	Level of significance
		Rupali (n=550)	Nageswari (n=260)		
Day old weight (g)		33.3±4.67	32.67±3.98	0.465	0.497^{NS}
Daily weight gain g/duck	0-4	18.55±3.57	19.19±4.80	1.45	0.228 ^{NS}
	0-8	24.91^{a}±4.4	22.45^{b}±3.6	17.9	0.000***
Total Weight Gain (g/duck)	0-4	514.30±110.28	537.54±134.63	0.696	0.406 ^{NS}
	0-8	1231.43±162.24	1166.28±142.19	4.06	0.046*
Average feed intake (g/duck/day)	0-8	100.51±29.81	103.15±22.80		0.401^{NS}
FCR (Feed: gain)		2.74±1.5	2.92±1.9	0.410	0.236^{NS}

***, P<0.001; *, P<0.05; NS: Non Significant

Duck production and evaluation of feeding system were studied at Nasirnagar in the district of Brahmanbaria. The main objectives were to evaluate the existing feeding system &identify the major problems and make a short profile of duck farmer's of that upazila for the development of appropriate feeding strategy within the existing duck farming practices. A total of 21 farmers were selected to conduct a survey from the upazila. Data were collected by using an interview schedule. The profile of the duck farmers and their feeding strategy are summarized in the table 3 and 4 respectively. The results of surveyed showed that majority of the farmer (15.87%) included in young aged group and most of the farmers (12.70%) did not receive any education and also showed that 16.17% of the duck farmers were housewives. Most of the land of the farmers (1554.76 dcm) belongs to middle group (Table 3).

Table 3 Farm and family information of the duck farmers

Parameter	Farm size			Ave.
	5 -500	501-000	> 1000	
Family size (No/farmer)	7.00	8.15	7.86	5.97
I. Male	19.86	22.05	19.05	20.32
II. Female	13.48	16.67	18.38	16.17
Age(Years)				
Young(<30 years)	14.29	19.05	14.29	15.87
Middle(31-49 years)	9.52	14.29	14.29	12.70
Old(>50 years)	4.76	4.76	4.76	4.76
Education				
Illiterate	14.29	14.29	9.52	12.70
Can sign only	9.52	9.52	4.76	7.94
Primary (1-5 classes)	9.52	9.52	9.52	9.52
Secondary (6-10 classes)	4.76	4.76	9.52	6.35
Land size(dcm./farm)				
Homestead	174.62	61.90	28.57	88.37
Cultivable land	268.10	1490.48	1047.6	935.4
Pond	11.10	2.38	6.81	6.76
Total	453.81	1554.76	1083	1030

N.B Figures in the table in percentage within the respective parameter

Duck population, rearing method and feeding practices

The larger number of duck (2207.14) belongs to the group three (>1000) practiced distant grazing6.30 months. Dependency on natural feeds, maximum (64.17%) occurred in 1st (5-500) group and major (55.00%) dependency on ready feed occurred in 2ndGroup (501-1000) and maximum profit gain from group three. Table 4 shows the details of others related factors. To fulfill the objectives need to research on it for long time.

Table 4 Feeding practices of duck farmer's in their farm

Parameters	Farm Size				Parameters	Farm Size			
	5-500	501-1000	>1000	Ave.		5-500	501-1000	>1000	Ave.
Duck (no)	430	783.75	2207.14	1140	B. Purchase %	35.83	55.00	44.29	45.04
Grazing (months)									
Local grazing	2.00	3.23	3.07	2.76	Ready feed (kg)	41.67	156.25	535	244
Distant grazing	7.28	6.15	6.30	6.58	Paddy (kg)	9366	16150	23000	16172
Confinement	2.72	2.63	2.63	2.66	Snail (kg)	74733	98212	225857	132934
Type of feed					Wheat (kg)	0.00	412	85.71	166
A. Natural feed,**%**	64.17	41.88	37.86	47.97	Total (kg)	84141	114931	249478	149517

Project title: Development of salt tolerant Napier cultivar for coastal area through genetic engineering

Sub-title: Screening of salt tolerance and genetic divergence of HYV fodders through hydroponic, tissues culture and RAPD markers

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Executive summary

Agricultural productivity is severely affected by soil salinity and ever-present threat to crop and fodder yields, especially in countries like Bangladesh where irrigation is an essential aid to agriculture. Deficiency in feeds and fodder is identified as one of the major constraints in achieving desired level of livestock productivity. As Napier grass is an important high yielding fodder in Bangladesh, extensive research is necessary to develop moderate to high salinity tolerant fodder germplasm in the country with high biomass yield. Production of transgenic plants with any gene transfer method depends on having an efficient cell, tissue, or organ culture system. Plant regeneration from culture may occur either through somatic embryo-genesis or organ differentiation. Simple and reproducible tissue culture methods to regenerate Napier grass through somatic embryo-genesis will help to facilitate and enhance the efficiency of genetic transformation experiments. The characterization and evaluation of Napier grass may be based on agronomic, morphological, biochemical, molecular, and other information. However, molecular markers (present) offer more advantages because they reveal genetic differences with more details without the interference caused by environmental effects, providing fast results in the discrimination of the present diversity. Thus, RAPD markers were used to estimate the genetic divergenceamong the Napier cultivars. To develop salt tolerant fodder germplasm by utilization of existing fodder resources at Bangladesh Livestock Research Institute, three different studies were conducted; i) Screening of BLRI Napier-1, BLRI Napier-2, BLRI Napier-3, BLRI Napier-4 and Splendida for their salt tolerance level, ii) establishment of tissue culture technique for propagation of fodder crops and iii) study the genetic divergence among Napier cultivars. The screening experiment was laid out in Completely Randomized Design (CRD) with four replications in each 6 different treatment groups. Salinity levels were accounted at T_0, Control; T_1, 3 dS m^{-1}; T_2, 4 dS m^{-1}; T_3, 5 dS m^{-1}, T_4, 6 dS m^{-1} and T_5, 7 dS m^{-1} treatments respectively. For tissue culture the ex plants (leaf roll and node) were cultured on MS (Murashige and Skoog, 1962) and N_6 medium supplemented with 5% coconut water and different levels of 2, 4-D, NAA, and BAP. The total cell DNA was extracted using a commercial kit (Plant Genomic DNA). Amplification reactions were conducted with a total volume of 25 µL. The polymerize chain reactions (PCR) were conducted as follows: 2 min at 95°C, continuing for 42 cycles (95°C for 30 sec, 30- 40°C for 30 sec and 72°C for 1 min), and a final extension at 72°C for 5 min. A total of 10 random primers were selected from Operon Technologies: OPA01, OPA02, OPA08, OPA09, OPA13, OPA16, OPC02, OPC06, OPAK04, OPAK07, OPS04, OPS12, OPAL04, OPAW09, and OPAW19. To estimate the similarity and genetics distance among different species, cluster analysis based on Nei'sunweighted pair-group with arithmetic average (UPGMA) was performed using the 'statistica' software and a dendrogram was constructed

Table 1 Biomass Yield (gm) at different dS m^{-1}

Variety	Biomass Yield at					
	Normal	3 dSm^{-1}	4 dSm^{-1}	5 dSm^{-1}	6 dSm^{-1}	7 dSm^{-1}
BN-3	410.50±220.07^{b}	373.50±87.87^{b}	286.00±22.75^{b}	158.00±53.84^{b}	90.25±36.00^{b}	81.00±29.14^{b}
BN-4	644.00±252.61^{a}	524.50±103.20^{a}	509.50±47.80^{a}	268.00±97.29^{a}	212.25±84.69^{a}	129.75±65.14^{a}
Splendida	204.25±87.93^{c}	136.50±40.27^{c}	133.50±23.00^{c}	52.00±26.87^{c}	12.00±10.09^{c}	4.00±1.15^{d}
BN-1	393.50±102.90^{b}	163.25±82.74^{c}	96.50±63.97^{c}	13.50±13.50^{d}	14.75±9.92^{c}	10.00±10.00^{d}
BN-2	390.00±140.13^{b}	291.00±176.98^{b}	260.50±37.05^{b}	91.25±52.58^{bc}	69.75±10.58^{b}	31.50±11.50^{c}
Sig	*	*	*	*	*	*

The biomass yield decreased significantly with increasing level of salinity. The highest biomass yield was obtained from normal nutrient solution (without addedNaCl),3 dSm^{-1}& 4 dSm^{-1} and lowest was 5 dSm^{-1}, 6 dSm^{-1} and 7 dSm^{-1}. BLRI Napier-4 and BLRI Napier-3 showed better performance than BLRI Napier-1, BLRI Napier-2 and Splendida.

Optimal callus induction was generally achieved at 2 and 4 mg L^{-1} 2, 4-D depending on cultivars and there explants. 40 and 32.5% callus initiation in BLRI Napier-3 and BLRI Napier-4 both leaf roll and node at 2 and 4 mg L^{-1} 2, 4-D. As high as 42.5 & 8.33% and 40.0 & 6.67%, both total of 48.75% callus were induced when leaf roll and node of two Napier grass were cultured in MS medium supplemented with 5% coconut water and 2 mg/l 2, 4-D compared with N_6 media (as 15.63 & 6.25% and 12.50 & 3.13%, both total of 37.5% callus). MS Media supplemented with NAA alone (treatments 1, 2, 3 and 4 mg L^{-1}) generally promoted higher callus initiation frequencies compared with media with BAP and were additionally provided with 2 mg/l 2, 4-D. Treatments of 2 mg L^{-1} NAA with MS media produce higher callus compared to other treatments (1, 3 and 4 mg L^{-1}) of NAA and BAP.

Table 2 RAPD primers with corresponding bands scored and their size ranges in nine Napier grass

Primer	Primer Sequence (5'-3')	Size ranges (bp)	Bands		Total bands
			Polymorphic	Monomorphic	
OPA-01	CAGGCCCTTC	350-1950	82	1	83
OPA-02	TGCCGAGCTG	250-1650	92	1	93
OPA-08	GTGACGTAGG	650-2000	49	0	49
OPA-09	GGGTAACGCC	250-1950	83	0	83
OPC-02	GTGAGGCGTC	250-2000	55	0	55
OPAK-04	AGGGTCGGTC	175-2000	113	0	113
OPS-04	CACCCCCTTG	225-2000	100	1	101
OPS-12	CTGGGTGAGT	450-1950	39	0	39
OPAL-04	ACAACGGTCC	500-2000	33	0	33
OPAW-09	ACTGGGTCGG	600-2000	73	1	74
Total			719	4	723

Each primer produced easily detectable bands with variable intensity, and nonspecific bands. The 10 primers used produced 723 bands. Of these, 719 were polymorphic (99.45%) and 4, monomorphic (0.55%). The number of polymorphic bands varied from 33 to 113, which occurred with the OPAL-04 and OPAK-04 primers, respectively. The sizes of the amplified bands in the nine Napier cultivar genotypes ranged from 175 to 2000 bp. Among the 10 RAPD primers, OPA-02 revealed band sizes that ranged from 250 to 1650 bp, primer OPAK-04 ranged from 175 bp to 2000 bp.

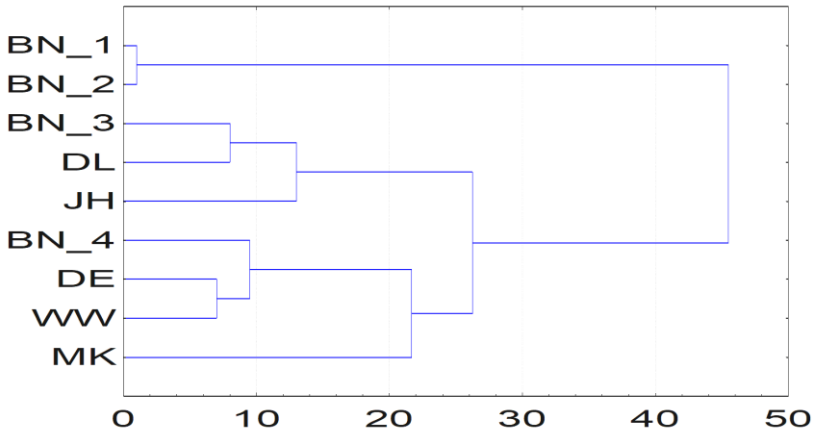

Figure 1 Cluster analysis by unweighted pair group method of arithmetic means (UPGMA) of nine Napier grass cultivar based on RAPD

Annual Research Review Workshop 2015

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7.	Shakila Faruque, SSO, Poultry Production Research Division	Member Secretary

Environment Sub-Committee

1.	Md. Ashraful Islam, Executive Engineer	Convener
2.	Dr. Md. Giasuddin , PSO and Head, Animal Health Research Division	Member
3.	Dr. S M Jahangir Hossain, PSO, Animal Production Research Division	Member
4.	Md. Ahsan Habib, Security Officer	Member
5.	Md. Abdul Karim, LDA-cum-Typist, Biotechnology Division	Member
6.	Md. Abdul Malek, Messenger, Support Service Division	Member
7.	Md. Abdus Samad, Sub Assistant Engineer	Member Secretary