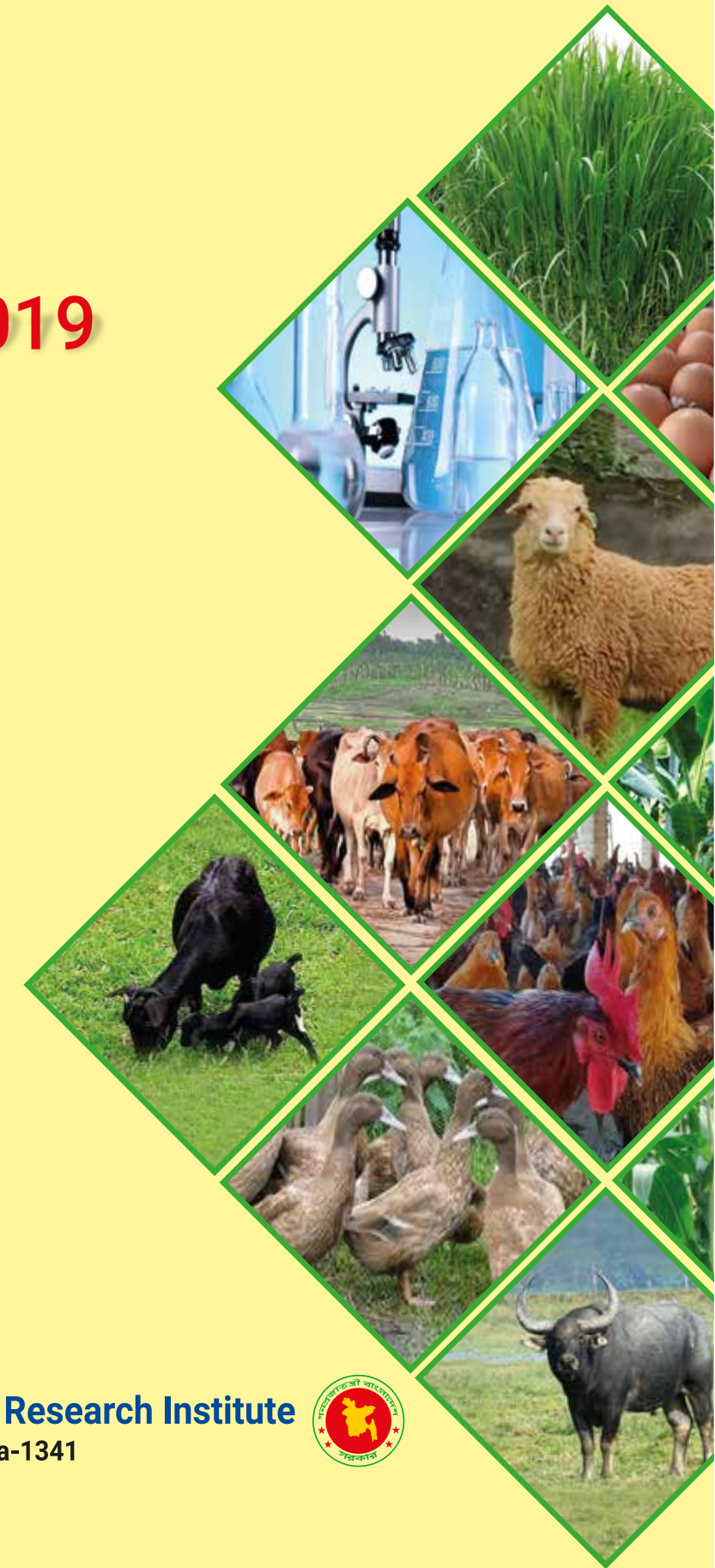




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ANNUAL REPORT 2019

BLRI ANNUAL REPORT 2019



Bangladesh Livestock Research Institute
Savar, Dhaka-1341



ANNUAL REPORT 2019

Edited by

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Director General

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CSO & Director (Research)



Bangladesh Livestock Research Institute

Savar, Dhaka-1341

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মুজিব শতবর্ষে জাতির পিতা বঙ্গবন্ধু শেখ মুজিবুর রহমানের প্রতি বিনম্র শ্রদ্ধা



গণপ্রজাতন্ত্রী বাংলাদেশ সরকারের মাননীয় প্রধানমন্ত্রী শেখ হাসিনা



Minister

Ministry of Fisheries and Livestock



Preface

Bangladesh Livestock Research Institute (BLRI) is the only Livestock Research Institute under the Ministry of Fisheries and Livestock. BLRI is committed to generate need based livestock technologies and is playing a vital role in the reduction of poverty, malnutrition and employments problems of our country. Since its inception in 1984, BLRI has developed 91 technologies and packages, which are contributing more in boosting country's economy.

Livestock development is one of the priority targets of the present Government. It was their political commitment to double the production of chicken and ducks within 2023, increase sectorial growth rate; minimizing expense in animal feed, medicine and treatment, development of marketing systems for ensuring better price, improving waste management and providing financial, technological and policy support for this sector development. Government is providing all sorts of support to flourish the livestock, dairy and poultry industry with a goal to attain safe food security and creation of employment opportunity. We are committed to attain our goals under the visionary leadership of the honorable Prime Minister Sheikh Hasina, who is working very hard to fulfill the dreams of the father of the nation Bangabandhu Sheikh Mujibur Rahaman. I strongly believe that the BLRI scientists will continue to support our national development through their research mandate.

I hope this publication will help concerned people, academicians, researchers, extension workers, farmers and development organizations to find new knowledge, science and technologies for the improvement of this sector and will pave the way of co-operation and co-ordination in research and development (R&D) with BLRI.

Joy Bangla, Joy Bangabondhu

May Bangladesh Stay forever

(S M Rezaul Karim MP)



Secretary

Ministry of Fisheries and Livestock
Bangladesh Secretariat, Dhaka



Preface

I am pleased to know that Bangladesh Livestock Research Institute is going to publish its Annual Report of 2018-19.

BLRI is the only research institute at national level, has been working on livestock and poultry production from laboratory to farmers' fields with the objectives to flourish the livestock, dairy and poultry production with a goal to attain food security and reduction of poverty, malnutrition and employment problems as well as improving the income and living standards of livestock farmers.

The vision 2041 of our Government is to gain self-sufficiency in every sphere of agricultural production, most notably milk, meat and eggs. Therefore, BLRI is working jointly with the Ministry of Fisheries and Livestock to develop demand-driven and farmer-oriented technologies for solving existing problems in livestock and poultry production of the country. I am glad to know that, during the last 30 years, BLRI has developed 91 technologies and packages. Dissemination of these technologies, packages and knowledge among the end-users for accelerating livestock and poultry development in the country is also an important issue for the institute. As far I know, BLRI disseminates technologies, packages and knowledge through organization of annual workshop, printing and publication of proceeding, scientific journal and newsletter. Every year BLRI is publishing an annual report that includes research findings and all other activities of the institute. This will ensure transparency and information sharing among stakeholders.

I hope this report will be useful for the researchers, academicians, extension workers, policy makers, concerned people, farmers and development organizations from home and abroad to be updated on continuous research activities at BLRI and to find new knowledge, science and technologies.

Joy Bangla

(Dr. Nahid Rashid)



Director General

Bangladesh Livestock Research Institute
Savar, Dhaka 1341, Bangladesh



Preface

Bangladesh Livestock Research Institute, the leader of livestock research in Bangladesh, has been working on livestock and poultry from laboratory to farmers fields with an objective to develop technology and knowledge through research for solving the existing problem of livestock and poultry production to ensure food and nutrition security of the country. BLRI conducting research in different disciplines mostly Breeding and Genetic; Feeds, Fodder and Nutrition; Livestock, Poultry Diseases and Health; Dairy Science, Biotechnology, Environment and Climate Resilience and Socioeconomic and Farming System disciplines. During 2018-19 fiscal year, BLRI has conducted 41 research programmes under revenue budget and 17 under development project. The research programmes were accepted for implementation came through proper reviewing by national Technical Committee constituted with expert members' from different Universities, Department of Livestock Services (DLS) and other organizations. Research programmes were implementing based on current problems on Livestock & Poultry farming. The Findings of these researches were presented in the Annual Research Review Workshop.

The technologies and knowledge generated through the research will definitely be helpful for the farmers, academicians, researchers, planner and policy maker working for the development livestock sector in the country.

The institute is grateful to the MoFL for all-out support in carrying its research and other activities. BLRI is also thankful to the DLS, Bangladesh Agricultural University, Mymensingh and other Agricultural Universities, Bangladesh Agricultural Research Council, different ARS institutes, NGOs and expert for their active participation and knowledge sharing for improving BLRI research quality through their constructive criticisms and advice.

Many of the finding from short term research would not have immediate utility in the field but a series of continuous thoughtful work will be helpful to develop technologies for the farmers, and generate knowledge for the academicians, researchers, planners and policy makers those who are working for the development livestock sector in the country.

I believe all the reports compiled here are important, which are waiting for being a shape as technology in near future. I congratulate all the scientists who were keen to accommodate their reports in this issue. I am grateful to the people who managed time to compile, edit and made the report more readable.

I expect the report will be useful for the scientists, extension agents, policy makers and other partners at home and abroad to be updated on continuous research activities at BLRI.

Joy Bangla

(Dr. S M Jahangir Hossain)

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Map of Bangladesh BLRI Head Quarter and Regional Station



Mandates and Organization Structure of the Institute

Mandates

- To identify the basic problems affecting livestock and poultry both at the national and farm levels;
- To solve these problems through multi and inter-disciplinary and inter-institutional research;
- To develop techniques and knowledge for livestock and poultry production to help safe food and nutrition security for the increasing population, poverty alleviation, employment creation and environment pollution control;
- To train scientists in the appropriate fields of research, at home and abroad, thereby filling the gap of skilled scientists;
- To strengthen research-extension-NGO linkage and expedite quick dissemination of the developed and introduced techniques to the end users,
- To assist the Government and all concerned in policy decisions related to livestock and poultry research and development.
- To impart training to trainers, farmers and front line extension of livestock technologies to the farmers.

Organization Structure

BLRI has 8 (eight) research divisions, one support service division and five regional stations under development as mentioned below:

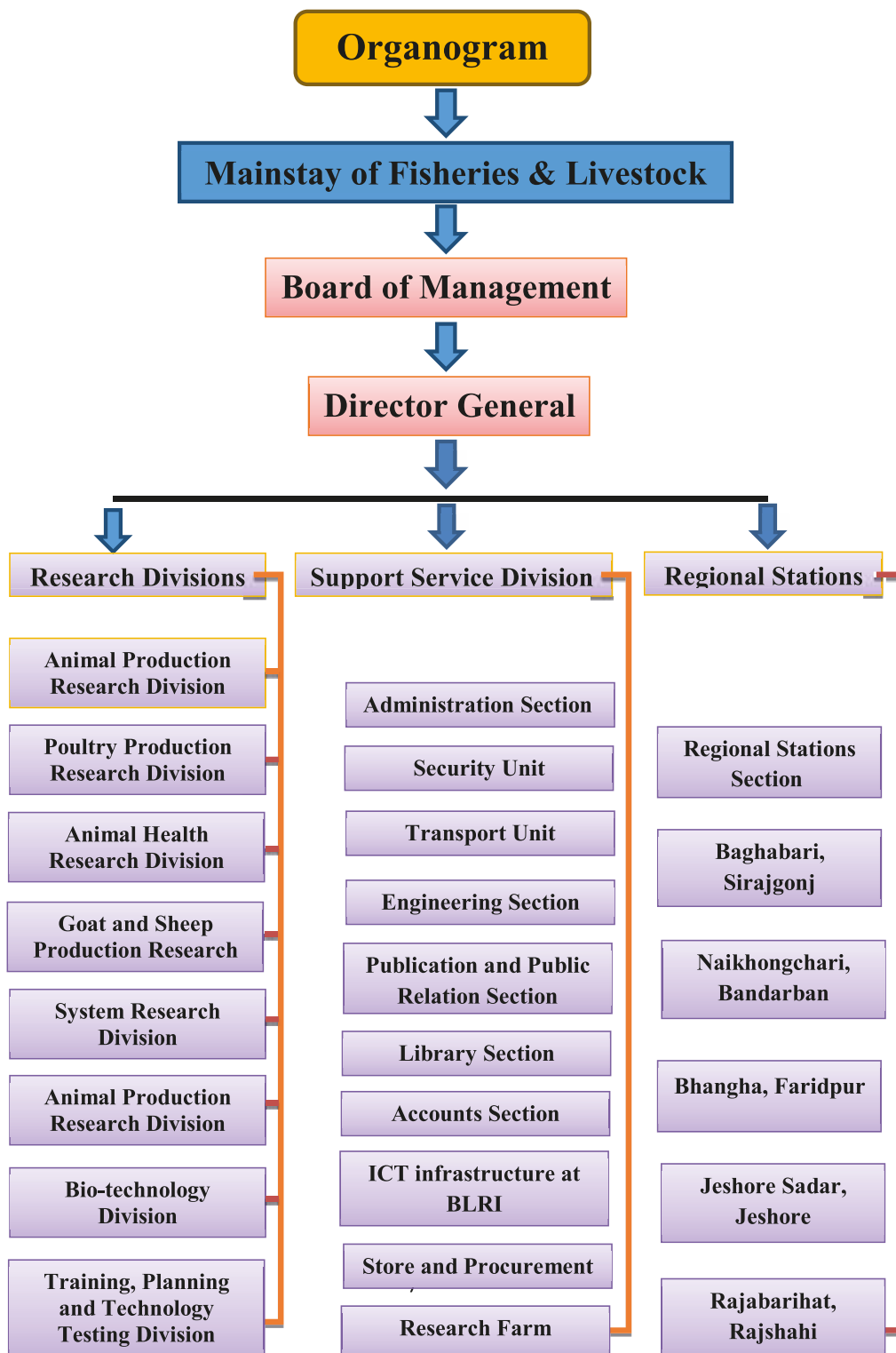
Research Divisions

- Animal Production
- Poultry Production
- Animal Health
- Goat and Sheep Production
- Bio-technology
- Socio-economic
- System Research (On-Farm Research)
- Training, Planning and Technology Testing

Support Service Division

Regional Stations

- Baghabari, Sirajgonj
- Naikhongchari, Bandarban
- Bangha, Faridpur
- Jessore Sadar, Jeshore
- Rajabarihat, Rajshahi



Board of Management



The institute is administered by a Board of Management. The Board is the highest making body in the Institute's organizational structure and holds full re possibility determine and execute policies and undertakings of the Institute within the frame of policy directives issued by the Ministry of Fisheries and Livestock of Bang1ade h Government. The Director General is the executive head and works on behalf of the Board of Management. The Board consists of Management. The Board consists of:

Chairman

Hon'ble Minister,Ministry ofFisheries and Livestock.

Vice-Chairman

Secretary, Ministry of Fisheries and Livestock,ex-officio.

Member

- ❖ Two Members of Parliament to be nominated by the Hon'ble Speaker.
- ❖ Secretary, Ministry of Finance, ex-officio.
- ❖ Member (Agriculture), Planning Commission, ex-officio.
- ❖ Executive Chairman, Bangladesh Agricultural Research, Farmgate, ex-officio.
- ❖ Vice-Chancellor, Bangladesh Agricultural University, Mymensingh, ex-officio.
- ❖ Director General, Department of Livestock Services ex-officio.
- ❖ Two persons to be nominated by the Government from among persons having interest in Livestock and poultry.
- ❖ Two persons to be nominated by the Government from among persons engaged in research activities in the insti

Member Secretary

Director General, Bangladesh Livestock Research Institute



The Technical Committee (TC) is an advisory body which provides professional input, scrutinizes and reviews the technical aspects of research programs including research budget and recommend for final approval to the Board of Management. The TC is composed of multidisciplinary and inter-institutional experts with the following members:

❖ Director General	Chairman
Bangladesh Livestock Research Institute	
❖ Member-Director (Livestock)	Member
Bangladesh Agricultural Research Council	
❖ Representative	Member
Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh	
❖ Representative	Member
Faculty of Animal Husbandry, Bangladesh Agricultural University, Mymensingh	
❖ Specialist representative on required subject	Member
❖ Director (Research)	Member
Department of Livestock Services	
❖ Head	Member
Poultry Production Research Division, BLRI	
❖ Head	Member
Animal Health Research Division, BLRI	
❖ Head	Member
Goat and Sheep Production Research Division, BLRI	
❖ Head	Member
Animal Production Research Division, BLRI	
❖ Head	Member
Socio-economic Research Division, BLRI	
❖ Head	Member
Biotechnology Division, BLRI	
❖ Head	Member
System Research Division, BLRI	
❖ Head	Member
Training, Planning and Technology Testing Division, BLRI	
❖ Additional Director	Member-Secretary
Support Service Division, BLRI	

Research Divisions



Animal Production Research Division

1. Development of feeding system for growing buffalo in coastal area of Bangladesh

An investigation was made with the objectives: i) to increase production and productivity of buffalo through improving the existing feed resources in the southern deltas of Bangladesh & ii) to develop a sustainable and cost effective roughage based feeding system for buffalo fattening under on-station and on-farm conditions. To achieve the above objectives, BLRI head quarter and coastal region like Bhola Sadar Upazila was selected as the on-station and on-farm experimental site, respectively for this study. Under on-station condition, fifteen (15) local growing buffalo bulls age between 2-3 years were put on feeding trials in three different diets such as UMS based diet, Silage based diet and Fermented Corn Mixture (FCM) based diet as denoted by T1, T2 and T3, respectively. In case of T1 and T2 dietary treatment groups, the total DM intake during the feeding trial of animals were fulfilled approx. 40 percent from concentrate mixture and the rest 60 % were provided from roughage sources (adlib) on DM basis. However, animals under T3 treatment group were provided FCM and protein supplement/protein mixture at a rate of 1.25% and 0.25%, respectively in addition to supply adlib roughages on their live weight. In on-farm condition, a total of 12 local buffalo bulls of age ranges from 2-3 years were fed only UMS based diet. In on-station conditions, feeding Napier silage based diet had higher ($p>0.05$) average daily gain of 1.00 Kg compared to 0.97 Kg of UMS or 0.84 Kg of FCM based diet with an average feed conversion efficiency of 7.10, 8.35 and 7.24, respectively. The results on validation of UMS based feeding system under on-farm condition and its comparison with the results obtained from on-station trial revealed that the ADG and FCR of bulls fed UMS based diet however did not differ significantly ($p>0.05$) between on-station and on-farm conditions. The total cost and net benefit analysis of buffalo fattening under on-station feeding condition revealed that the total cost involved per Kg gain was higher ($p<0.001$) in bulls fed UMS based diet (Tk. 216.00) followed by bulls fed Napier silage (Tk. 176.00) and FCM based diets (Tk. 126.00). Considering the total cost involved for 90 days fattening of a bull, the net profit on the other hand were significantly ($p<0.05$) higher in bulls fed both FCM and Napier silage based diet than bulls those fed with UMS based diet. Therefore, it may be concluded that, considering the results of FCR and cost-benefit analysis, the bulls fed both FCM and silage based diets performed better than that of UMS based diet under on-station condition. Though, the FCR and profit margin was relatively less but still feeding UMS to buffalo bulls showed an efficient and cost effective dietary system both on-station and on farm condition.



2. Canned meat production and its preservation quality assessment

The present study was undertaken to produce canned meat following an effective and cost-effective technique for having safe and hygienic ready product to cook along with the determination of its preservation quality. For this purpose, raw meat (beef) was purchased from local market immediate after slaughter and brought at meat processing laboratory of BLRI. The pH of raw meat was measured immediate after collection and the pH of canned meat was recorded with a digital pH meter (Hanna; model no. HI2211-02) following the method of University of Nebraska-Lincoln (2005). The drip loss (%) and cook loss (%) of raw meat was measured following the method described by Joo et al. (1995) and Yang et al. (2006), respectively. The microbiological test viz, Total Viable Count (TVC), Total Coliform Count (TCC), presence or absence of *Salmonella* spp. and *Staphylococcus* spp. in both raw (fresh meat) and canned meat were done at Food Safety Laboratory in BLRI following the standard protocol. For the preparation and production of canned meat, raw meat was sliced with a knife in a standard size for filling the canning jar. Glass jar of half kilogram size was used in this study. Each jar was filled with about 470 g fresh sliced beef where common salt (NaCl), Na-nitrite (NaNO_2) and Kalojira (Fennel flower; *Nigella sativa*) oil were added and treated as preservative groups. However, raw meat without added any preservative kept as control group. The physical properties viz, pH, drip and cook loss of fresh raw beef were 6.40, 5.55% and 27.71%, respectively. The moisture content and crude protein content in raw beef were 74.61 and 25.39%, respectively. The total viable bacteria count and Coliform count in fresh raw beef however, were 8.8×10^6 and 4.3×10^4 cfu/g, respectively. The pH of canned beef was higher ($p < 0.05$) in meat preserved with NaNO_2 and Kalojira oil than that of NaCl and control group. Preservatives, however, had no effects ($p > 0.05$) on moisture or DM and CP content in canned beef. Though, there was no significant ($p > 0.05$) effect, but Kalojira oil performed as impressive preservative compared to others. In microbiological aspects of canned meat, the TVC, TCC, *Salmonella* spp. and *Staphylococcus* spp. were entirely absent in Kalojira group. In case of NaNO_2 and NaCl group, only a very few number of viable bacteria was found (1×10^2). On the other hand only the *Staphylococcus* bacteria were found in case of control group. Considering the physico-chemical and microbiological aspects in canned beef, it may be concluded that the Kalojira oil could be a suitable value added preservative in meat canning compare to NaCl and NaNO_2 the two recognized preservatives.



Canned meat production

3. Carbon footprint of beef cattle production in Bangladesh

The carbon footprint of livestock production in a farm may describe the environmental cost of production and help in identifying scopes for taking mitigation measures to achieve a climate-smart livestock production. The study was undertaken to investigate the carbon footprint of beef cattle production in certain regions of Bangladesh. To estimate, a survey was conducted at 202 beef cattle farms in 5 different districts of Khulna Division, Bangladesh. The partial tier 2 approach of IPCC was followed to estimate the greenhouse gas emission factors for enteric fermentation, manure management, farm operation and farm feedstuffs in a system boundary from cradle to farm gate. The difference in emission factor between small (1-5 cattle) and large farms (>5 cattle) was calculated. The results indicated that the emission factors of CH₄ from enteric fermentation differed significantly ($P<0.01$) between small and large farms (38.02 and 47.10, kg/year CH₄), whereas the emission factors of CH₄ from manure was similar (6.48 and 9.54, kg/year CH₄; $P>0.05$). The emission factors of direct and indirect N₂O emission from manure management between small and large farms (1.93 and 2.37; and 0.06 and 0.10 kg/year N₂O, respectively) were also different ($P<0.01$). Similarly, emission factors of farm operation activities and feedstuffs (193 and 140; 2.63 and 5.04 kg/year CO₂e, respectively) were different ($P<0.01$). However, the carbon footprint of beef cattle production (11.23 and 11.02 kg CO₂e/kg LW, respectively) did not differ ($P>0.05$). The mean carbon footprint was 11.12 (7.59-19.42) kg CO₂e/kg LW, with share of 49.8% by enteric methane, followed by direct N₂O from manure, methane from manure, CO₂ from farm operation, indirect N₂O from manure and CO₂ from farm feedstuffs, representing 30.1, 9.4, 8.7, 1.1 and 0.9%, respectively.

4. Adaptation and validation of processing waste vegetable as feed at farm level

Vegetable wastes (VW) that pollute environment was reported to be ensiled successfully and fed as a basal diet to animals. Therefore, the study was conducted with the objective to investigate the impact of feeding such silage in beef cattle production at farm level. The VW – including cabbage, cauliflower, reddish, carrot and other leaves at 31, 24, 22, 20 and 3%, respectively, as found during collection – was ensiled by shredding, dewatering and adding molasses and chopped rice straw (2-3 cm) at 85:5:15 ratio in 65 kg plastic drums for 150 days. In a beef cattle farm at Savar, Dhaka, twelve native bulls of 2-2.6 years old with average live weight (LW) of 196 (43) kg were randomly allocated into two groups. One group was fed maize silage (control) as basal diet, while in other group a mixture of maize silage and VW silage (1:1 ratio, fresh) was fed for 56 days. A common concentrate mixture was fed at 1.5% of LW of bulls. Results indicated that inclusion of VW silage by replacing maize silage did not affect ($P>0.05$) the dry matter intake of bulls (2.81 and 2.84% LW, respectively). Daily gain was also similar ($P>0.05$) (670 and 684 g/d). It may be concluded that feeding VW silage by replacing maize silage from the diet of bulls at farm level did not affect intake and gain of bulls.

5. Study on Production Potentiality and Preservation Technique of Moringa Fodder and Assessment of its Nutritional Quality

Considering the excellence of Moringa fodder, BLRI started research work on exploring the potentiality of it as livestock feed and develop cultivation technique and validated in different regions. Based on the results of continuous research and validation program, in the current fiscal year the expectancy of moringa as livestock feed and its agronomical practice is already been handed over as technology to Department of Livestock Services (DLS). To expand the hidden potentiality of Moringa some exotic variety (PKM-1, PKM-2 and Parynal) of Moringa has been imported and cultivated at BLRI farm to study the germination rate, yield and its nutritional value assessment. At the same time, another experiment was designed to develop a simple and cost-effective fresh biomass preservation technique and its impact study on dairy production. Results showed that, Fresh biomass and dry matter yield were significantly higher in Paraynal variety compared to PKM1 and PKM2, respectively. Dry matter (DM), crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF) and ash was nearly similar in all varieties of fresh moringa. The same nutritional parameter of preserved fresh moringa foliage and added 5.0% straw in fresh moringa foliage were similar, except ADF and NDF at 7, 14, 21, 28, 35, 42, 49 56 and 63th days. Moringa silage increased milk yield by about 14.17%. No significant ($P>0.05$) difference was observed in milk composition of bot treatment while milk fat was a bit higher (5.52%) in Moringa supplemented RCC cows compared to control (5.06%). Moringa silage increases polyunsaturated fatty acids (PUFA), linoleic acid (C18:2), linolenic acid (C18:3), arachidonic acid (C20:0), ecosopantanoic acids (C20:1) and decreases saturated fatty acid (SFA) and mono unsaturated fatty acids (MUFA) in milk. Milk cholesterol was found lower (0.092 mg/kg) in moringa supplemented milk compared to control (0.142 mg/kg). No difference was observed in Ca, P and Pb content of both treatment and Cd and Cr was found to be below the detected level. Moringa silage had no significant effect on the concentration of serum cholesterol, HDL, LDL, triglyceride and glucose. The study shows that parynal variety of moringa produced higher fresh yield of moringa biomass. Fresh moringa fodder can possibly to be preserved as silage.

6. Study on production, nutritive value and land use efficiency of fodder maize (*Zea mays*) intercropped with alfalfa (*Medicago sativa*)

This research was conducted at BLRI to study the yield, quality and land use efficiency of fodder maize intercropped with alfalfa. 40 plots (25m²/plot) were laid out in five blocks with 8 treatments (four sole crops and four intercrops with two sowing methods; line and broadcasting for each combination). The seed rates of maize and alfalfa were 40 and 15 Kg ha⁻¹, respectively for sole cropping, while rates of both fodders were halved in intercropping. Fodder maize was harvested at every 60 days after plantation, while alfalfa was first harvested at 60 days after sowing and subsequent harvests were done at 30 days interval. Data from 4 harvests of alfalfa and 3 harvests of maize was collected and analyzed statistically. Highest biomass and dry matter yields (170.64 and 20.65 tones ha⁻¹, respectively from all harvests) were obtained from fodder maize monoculture and lowest (30.21 and 5.96 tones ha⁻¹,

respectively) from alfalfa monoculture. CP yields in intercrops (2.90 tones ha⁻¹) were higher than sole crops (2.164 tones ha⁻¹). CP% in intercrop maize fodder was higher than sole crop. Lowest N-uptake was observed in fodder maize monoculture (10.29 kg ha⁻¹) and highest in alfalfa monoculture (38.42 kg ha⁻¹). Highest residual-N was obtained in alfalfa monoculture (2360 kg ha⁻¹) and lowest (1880 kg ha⁻¹) in intercrop. Land equivalent ratios of intercrops were more than 1 (1.53-1.77), indicating higher efficacy of intercropping yields. The competition indexes of intercrops yields were less than 1 (0.09-0.44), which means that intercropping is more profitable than monoculture yields. Thus, it was revealed that maize fodder intercropped with alfalfa was better than mono culture in terms of CP yields. Further, intercropping of alfalfa enhanced the nutrient quality of fodder maize.

7. Performance evaluation of F1 progeny of different beef breeds with native cattle

Crossbreeding of native cattle with suitable high yielding exotic beef sire (s) is prerequisite to meet up the growing demand of beef in the upcoming years. Brahman crosses are being produced to support increased productivity of the cattle, but strategic approach for breed development that needs screening of multiple genotypes is ignored. Thus, the present work was undertaken with an objective to develop market beef cattle of average 200.0 kg carcass weight at 2 years of age under on farm feeding and management conditions. Aiming at developing breeding bulls, the cows of BLRI Cattle Breed 1 (BCB-1) were inseminated with the imported frozen semen of Brahman, Simmental, Charolais or Limousine. Under the study all crossbred F1 progeny performed better than BCB-1 in terms of live weight at different ages. At birth, both male and female calves of Charolais showed the highest live weight but at 2 years (Market age) of age male of Simmental cross showed the highest live weight followed by Charolais, Limousine, Brahman crosses and BCB-1. Interestingly, at 3 years of age males of all crosses did not differ statistically among them. Similarly to male, Simmental female also attained higher live weight compared to other crosses and BCB-1 at market age. Purebred BCB-1 took the lowest DM and showed the highest feed conversion efficiency compare to other crosses. Considering the data so far obtained, it may be stated that among the four crosses Simmental×BCB-1 performed the best on the basis of growth. More F1 progeny is yet to be produced and required to evaluate their production and breeding performance. Carcass characteristics and meat quality of F1 progeny of different beef breeds at different ages will be determined in the upcoming fiscal year. Therefore, this breeding program should be continued to achieve its goal.

8. Genetic variants of beta-casein in native and crossbred cattle of Bangladesh

The most frequently observed forms of β -casein gene (CSN2) in dairy cattle breeds are A1 and A2. This difference in structure results in A1- β -casein preferentially releasing an opioid peptide called β -casomorphin-7 (BCM-7) upon digestion, which may lead to adverse physiological effects. However, screening of available cattle genotypes in Bangladesh has not yet been undertaken for CSN2 polymorphism. Considering the healthfulness of A2 milk as well as

positive relationship of A2 allelic variant with milk performance traits in different cattle breeds, the present study was undertaken with the objectives to (i) identify genetic variability (A1/A2) of beta-casein in existing cattle genotypes of Bangladesh and (ii) to make breeding decision at policy and farmers level to enhance A2 milk production. To achieve the objectives, Red Chittagong (RCC), BLRI Cattle Breed-1 (BCB-1), Munshiganj (MC), North Bengal Grey (NBG), non descriptive native cattle and their crosses with Holstein-Friesian, Sahiwal, Jersey, Brahman, exotic breeds & other available cattle genotypes were selected for the genetic variability study of A1 and A2 beta-casein. In the financial year of 2018-19, a total of 278 blood samples were collected from four native cattle breeds and crossbreds of which 47, 61, 69, 50 and 51 samples were from RCC, BCB-1, MC, NBG and crossbreds, respectively.

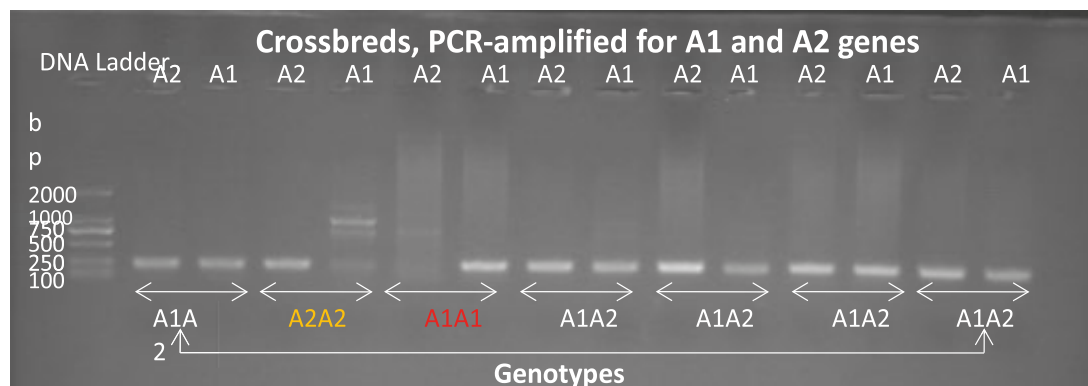


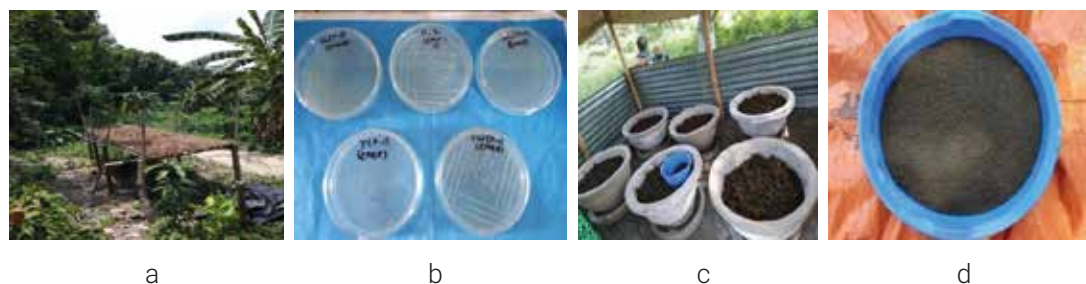
Figure 1. Identification of A1 and A2 alleles in crossbreds through AS-PCR and agarose gel electrophoresis

Genotype frequencies of A2A2, A1A2 and A1A1 in RCC were 89.40, 10.60 and 0.00. However, the corresponding frequencies in BCB-1 were 85.25, 13.11 and 1.64 and, in MC were 79.70, 18.80 and 1.40, and, in NBG were 72.00, 28.00 and 0.00 and, in crossbreds were 64.71, 29.41 and 5.88, respectively (Table 1). The present investigation offers a plenty of scope for changing gene frequency through using A2A2 genotyped bulls in artificial insemination program.

9. Study on the improvement of existing manure management system of Bangladesh

The present study was designed to determine the existing bio-slurry management practiced by farmers, to introduce the BLRI developed bio-slurry management technique to farmers and to explore the potentiality of bio-slurry water (BSW) on crop pest controlling. A baseline survey was arranged at some selected areas among digester having farmers to represent the existing management approach of bio-slurry. Three biogas digester having farmers were selected at Dhamrai upazila to introduce the BLRI developed bio-slurry management technique. A laboratory based experiment and agronomical trial was designed at BAU to determine the

microbial association of slurry water and its efficacy on crops. Results showed that, the respondents supplied both roughage and concentrate from mixed sourced (cultivated and purchased) to animals at the respective rate of 11.94 ± 0.39 and 3.28 ± 0.11 kg/day which costs 3500 ± 411.52 taka/month. But in return, they got daily 1.82 ± 0.08 kg and 7.04 ± 0.24 kg milk from local and cross animal whose average price was 50.01 ± 1.01 taka only. In the mean time, daily 10.73 ± 0.19 kg dung from each adult animal was produced of which 2% goes for burning fuel, 8% for fertilizer, 1% for compost, 75% for bio-gas and 9% become totally wasted. A devastating scenario was observed in case of of slurry management as most of the respondents never quantify the produced amount of slurry and remove slurry from tank at a fixed interval or immediate after fulfilling the tank. Only 12% bio-slurry was used in crop field and 8% at fish pond, 10% in different purposes and remaining 70% of total produced bio-slurry become totally wasted. The farmers selected for introducing BLRI developed slurry management technique, did not give any attention for bio-slurry management before and maximum time it remains in unused condition. Only in summer season some of them prepare burning fuel from it and locally sell at very nominal price which accounts 1500-2000 taka per year. But following BLRI technique they produced organic fertilizer from slurry at 50% return rate and impressive nutrient content. Bio-slurry water contains *Pseudomonas fluorescence* (bacteria), *Bacillus* sp (bacteria), *Xanthomonas* sp. (bacteria) z and *Trichoderma* sp (fungus) for which it was assumed to be active on controlling crop pests effectively. Data also reveals that, association of 50% soil with 100% foliar BSW application (T4) on selected crops (Brinjal and Chilli) resulted minimum incidence of pest infestation and maximum quantity of crop yield (16.10 ± 0.55 A and 5.64 ± 0.22 a ton/ha) compared to 100% soil or foliar application.



* a- Existing bio-slurry management system at field condition, b-Microbial content observation of bio-slurry water under specific media, c- vermicomposting system, d-Vermicompost fertilizer

10. Development of system generated database at BLRI research farm for genetic evaluation in progressive generations

Animal recording integrates animal registration, identification, traceability, health and performance recording; a top priority for any genetic improvement program. Successful animal breeding requires collection and storage of animal's data; complete pedigree information, statistical methods and computing hardware. However, records need to be stored

electronically for computer manipulation and analyses. A good farm management keeps lots of registers; animal inventory, breeding, milk, calf, feed, health, disease registered. BLRI maintains such type of records and since its inception, a lot of data had been generated to date. These data are mainly being kept in paper book. However, it is very difficult to pick up all data from this paper book for genetic evaluation of individuals in the herd. Computer aided analytical programs (CAAP) are now very much convenient ways to make it ease of such type of complex task. To do so, database software is essential for BLRI animal research farm. Hence, to digitalize farm database, this work was designed to develop system generated database software that is useable both in PC and mobile phone. In the developed software, input facility of economic important traits was created with systematic arrangements (Fig. 1 and Fig. 2). Based on the imputed data, output will be obtained within a moment. The software will facilitate to filter data from large data set. Besides, population data of any trait of interest will be obtained from the whole dataset for statistical analyses. The software is securely stored in cloud; lifelong protected and only authorized user(s) may access in database. With the aid of this software, a farm manager can be able to take decision for selection and culling of animals based on the genetic merit analyzed by taking data from the software.

Animal Health Research Division

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

Avian Influenza is a highly contagious viral disease and it is causing tremendous economic losses to the poultry industries throughout the last decade. It is very difficult to control the disease because of its huge number of serotypes and mutation nature. The virus is zoonotic in nature and easily mutates to HPAI from LPAI. The main objectives of this study were to detect and isolate the highly pathogenic serotypes (HPAIVs A/H5N1, A/H5N6, H5N2, H5N8 and H9N2) at farm level. A total of 561 swab samples were collected from different small and medium poultry farms in study area. Immediately after collection, the samples were transferred to the National Reference Laboratory for Avian Influenza (NRL-AI) and all the samples were processed for genome extracted and tested using the Australian Animal Health laboratories (AAHL) protocols which is an OIE reference laboratory. Among the 561 samples 45 samples (8.02%) were positive for AIV type A. Out of 45 AIV type A positive samples, 21 (47%) samples were positive for H9N2 and 18 (40%) samples were positive for H5N1 and 6(13%) samples were positive for both H5 and H9. All positive samples were stored for the molecular characterization which will be done in coming financial year. In conclusion it can be stated that this study will be helpful to control and eradicate avian influenza to achieve SDG goal 2.

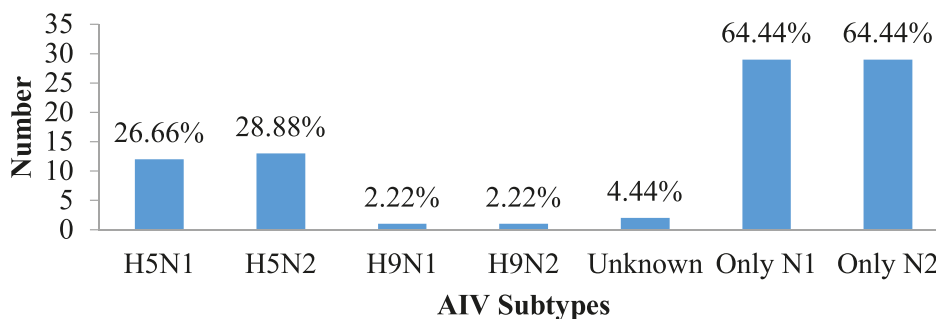


Figure 1. Prevalence of highly pathogenic avian influenza virus (HPAIV) in Bangladesh

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

Food safety is a global health concern which describes hygienic handling, preparation, and storage of food in ways that prevent foodborne illness. Foodborne diseases are widespread and becoming a growing public health concern not only for the developing countries but also for the developed nations. Antibiotic agents have been used for the last 70 years to treat patients who have infectious diseases. Since the 1940s, these drugs have greatly reduced

illness and death from infectious diseases. However, the emergence of resistance of bacteria to antibiotics is a common phenomenon. Emergence of resistance often reflects evolutionary processes that take place during antibiotic therapy and become a great concern. Considering these facts, the study was undertaken with the objectives to assess herd-to-herd variation in antimicrobial resistance in faecal commensal enteric bacteria in finisher livestock and poultry, and to assess spatio-temporal variation in antimicrobial resistance profile in retail meat in LMBs and slaughter houses. We have collected 520 fecal samples from finisher livestock and poultry farms and 450 samples from super shops of Dhaka city. Among the 450 samples of 10 super shops of Dhaka city; *Salmonella* spp. and *E. coli* were isolated from the samples by using selective enriched media and confirmed by real-time PCR. Phenotypic resistance was determined by disk diffusion method. Extended-spectrum β -lactamases (ESBLs) and quinolone resistance genes were determined by PCR. The overall prevalence of *Salmonella* spp. was 21.5% comprising in chicken meat 28%, beef 17%, mutton 19% and environment 13%. In antimicrobial assay, 57% isolates were found multi-drug resistant (MDR). Among the phenotypically resistant isolates, ESBL encoding genes and Quinolone resistance genes were observed.

3. Monitoring of Peste des Petits Ruminants (PPR) virus and Peste des Petits Ruminants (PPR) like disease in Bangladesh

Peste des petits ruminants (PPR) is an acute, highly fatal viral disease, world organization for animal health (OIE) notifiable and economically important transboundary disease of small ruminants associated with high morbidity and mortality and caused by PPR virus. To ensure the efficacy of mass vaccination of PPR with the aim of monitor the PPR control strategy in Bangladesh to determine the level of conferred immunity in vaccinated flocks and conduct surveillance of PPR and PPR like diseases. A total number of 185 villages were surveyed in four Upazila which was the southern part of Bangladesh by GPS location method. 1794 blood sera was collected randomly from vaccinated goats and sheep flocks and tested by cELISA kit to assess the post antibody levels. Among them, 93.70% Jibannagar, 64% Debhata, 78% Damurhuda and 75% Meherpur Sadar after 3 months of post vaccination. The overall herd immunity level in vaccinated small ruminants was 80% whereas 28% of positive antibody found in control villages. After 48 months of post vaccination, the immunity level against the PPR virus in goats and sheep was 83.70% at Jichorgacha upazila under the Jessore district. During outbreak investigation, the clinical nasal swabs (n=25) were extracted and 80% (25/20) RT-PCR positive was found. Epidemiologically, PPR, FMD and some other non-specific diseases were recorded in the selected areas. New entry of goats is the most important risk factors for PPR virus circulation. Morbidity and case fatality rate recorded were 14% and 70.55%, respectively during outbreaks. In case of sick goat, about 82% goats were received treatment, 13% goats were sold and 5% goats were slaughtered. The 93% dead goats were buried under soil. In conclusion it can say that this study will helpful to PPR eradication program 2030 to achieve the goal 2 in SDG.

4. Seroprevalence of Tick Borne Blood Protozoan Diseases of Cattle and sheep and Standardization of BLRI Developed TBDs Autogenous Killed Vaccine

Anaplasmosis, Babesiosis and Theileriosis are the silent killer blood protozoan disease in exotic and high yielding animal throughout the world including Bangladesh. A total 525 blood samples was collected in which 480 from cattle and 45 from sheep. The collected blood samples were examined through Giemsa's stained technique and confirmatory diagnosis through polymerase chain reaction (PCR). The thick and thin blood smear was stained with Giemsa's stain and examined under microscope with emulsification on 100X objectives. The prevalence of blood protozoa was 78% (n=199) in Savar, 53% (n=70) in Shirajganj (Bathan) area, 47% (n=43) in Rangpur and 100% (n=45) in exotic sheep at BLRI and overall prevalence was 68% (n=357). Among the protozoa *Anaplasma* spp. was 33%, *Babesia* spp. 24%, *Anaplasma* spp. and *Babesia* spp. mixed infection 29%, *Theileria* spp 11% and mixed protozoa were detected 4%. Selected positive sample was processed for DNA extraction and PCR was done where *Anaplasma marginale* shown positive band in 265 bp, *Babesia bovis* in 166 bp, and *Theileria annulata* in 312 bp, *Babesia ovis* in 422bp and *Babesia motasi* in 518bp. From the blood protozoa positive samples autogenous killed vaccine was prepared in Parasitology Laboratory, BLRI through lysis of RBC by NH_4Cl_2 . For autogenous vaccine preparation blood protozoa (*Anaplasma* spp, *Babesia* spp and *Theileria* spp) was killed by heat treatment (boiling water) technique and gently mixed with oil adjuvant. The vaccine is ready for animal trial which will be done next year.

Poultry Production Research Division

1. Conservation and improvement of native chicken: laying performance of seventh generation

The present study was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka with the objectives (i) to assess the laying performances of three native chicken (Non-descript Deshi, Hilly, Naked Neck) genotypes under intensive management, ii) to study the comparative performances among native and Kadaknath chickens. Egg quality was observed at 40 weeks of bird's age and blood profile was analysed. At 10 weeks of age, a total of 24 birds (Naked Neck, Hilly, Non-descript Deshi and Kadaknath chicken) (6 birds in each genetic group, 3 males and 3 females) were randomly selected and peripheral blood samples (2-3 ml) were obtained by wing vein puncture. Glucose, Haemoglobin, Iron content were measured on a Humalyzer 2000 chemistry (Germany) using a turbidimetric method as described by the manufacturer. The data were analyzed in CRD. Egg production (20-40 weeks) number was significantly ($p<0.001$) affected by genotype. The highest egg production number of ND, H and NN were 79.08, 69.33 and 74.86, respectively. Hen-day egg production (HDEP %) was affected ($p<0.001$) by genotype. There were non-significant ($p>0.05$) differences in shape index among the genotypes. Non-significant ($p>0.05$) variation was found in breaking strength. Haugh unit was significantly ($p<0.01$) affected by genotype. Significantly ($p<0.05$) the highest dressing yield (76.47 %) and breast meat weight (10.37 %) were observed in H genotype followed by other three genotypes. Significantly ($p<0.05$) the lowest glucose content was found in Kadaknath chicken (4.34 mMol/L) compared to H (7.34 mMol/L), NN (5.88 mMol/L) and ND (5.76 mMol/L). Iron content of blood was non-significantly highest in K chicken compared to other three native chickens. Haemoglobin content of blood was non-significantly highest in H chicken. Non-descript Deshi was superior for egg production. No extra ordinary result was found in case of Kadaknath chicken.



2. Conservation and improvement of Quail: Performance of eighth generation

Four genotypes of quail like Dhakai (D), White (W), Brown (Br) and Black (Bl) quail are being maintained at BLRI with the objectives i) to increase the sixth week body weight of Dhakai and BB (BLRI, BAU) white quail through selective breeding, ii) to select parental birds (males and females) and breed them in an assortative plan for the production of 8th generation birds. The parent males and females were maintained in cages for single pair mating. For producing

eighth generation (G8), parent quails of each genotype were selected from the seventh generation (G7) on the basis of breeding value according to their 6th week body weight. A total of 1118-day-old quail chicks comprising of 4 types of quail namely White (W-681), Black (Bl-193), Brown (Br-84), Dhakai (D-160) were hatched to produce eighth generation (G8). Collected data were analyzed in a CRD. The genotype had significant ($p<0.001$) effect on the body weight of quails at 5th week of age. The hatchability rate was significantly ($p<0.001$) higher in D (78.47%) compared to other three genotypes of quail. The eggs production (%) up to 24th week of age was 85.27 ± 1.0 , 80.22 ± 1.61 , 81.07 ± 1.2 and 96.12 ± 1.1 , respectively for D, W, Br and Bl and significantly ($p<0.001$) differed among all genotypes. Mortality among 4 genotypes did not differ ($p>0.05$). Sixth (6th) week body weight of males of D, W, Br and Bl quails were expected to increase by 4.06, 6.36, 2.39 and 3.12 g, respectively. While in females of D, W, Br and Bl quails, the expected responses were 5.60, 3.61, 4.17 and 3.91g, respectively. Based on the performance Dhakai quail was superior for body weight. These findings suggested for continuing the quail breeding research for producing a suitable meat type quail genotype in our country.



White



Brown



Dhakai



black

3. Collection, conservation and improvement of specialized fowl (Turkey, Guinea Fowl and Pigeon) at BLRI

The study was conducted during the period of July 2018 to June 2019 with the attempts i) to evaluate the performances of specialized fowls (Turkey, Guinea fowl and Pigeon) varieties at research farm of BLRI, ii) to introduce new varieties of specialized fowls with the existing stock at BLRI, and iii) to know the existing turkey production system in some selected areas of Bangladesh. A total of 265 turkey poults were hatched including White and Mixed colored as new varieties with the existing Black and Bronze turkey germ plasm. Their weekly live weight and daily feed intake were recorded up to 12 weeks of age. A total of 100 turkey raisers were surveyed in Mymensingh, Gazipur, Narsingdi, Narayanganj and Dhaka district. At 12th week of age irrespective of varieties the average live weight, feed intake and FCR of turkey recorded 70, 316, 800 and 1700g/bird; 9, 31, 87 and 129g/bird/day, and 2.3, 2.0, 5.4 and 3.4, respectively. The overall mortality up to 12 week of age was 1.13%. The survey revealed that small scale turkey farming (60%) is favorable to the farmer and profitability estimated 150,000.00 (Approx.) per 50 turkeys per year. Higher growth rate, suitable for Bangladesh, low disease incidence, good meat quality were advantages of turkey rearing. Problems faced by the farmers in rearing turkey were unstable market, higher feed cost and low quality feed, lack of

proper marketing channels, veterinary services and potential breeds. Some research initiative is imperative to overcome the existing problems in turkey production in Bangladesh e.g. i) Development of suitable breed ii) Formulation of low cost ration with the inclusion of nutritious forages, and iii) Established an organized marketing channels. A total of 460 hatching eggs of Pearl, White, Lavender and Black varieties of guinea fowl were collected and hatched for further breeding research. The performance of existing pearl variety of guinea fowl were live weight and feed intake at 20 weeks of age 1339g/bird and 100g/bird/day, respectively. Age at sexual maturity was 17 week and hen day egg production up to 52 weeks was 20%. A total of 13 pairs of pigeons were selected from the existing 52 pigeons on the basis of coat colour of Golla variety. There are 3 distinct colour were selected (White, White-Black and Mixed) to establish a foundation stock for high producing squab production. Average egg weight of both the white and white-black variety found 20.5g and day-old weight of white variety recorded 15g. Adult male and female weight of Golla variety were the White (M-345g, F-312g); White-black (M-332g, F-311g); Mixed Colour (M-321g, F-287g); The adult weight of male and female pigeon of King variety was recorded 712 and 691g, respectively. Average feed intake of Golla and king variety was 40 and 50g, respectively. In conclusion, a good number of new varieties of specialized fowls were introduced and their performance study through planned breeding is going on to produce high producing specialized fowl breeds/varieties at BLRI.

4. Conservation and improvement of exotic germplasms and development of egg and meat type chicken

In recent years, climates are changing in Bangladesh. Therefore, summers becoming hotter; monsoon irregular, untimely rainfall directly affects bird performance specially broiler chicken. Keeping those issues in mind, BLRI has developed multi-color table chicken (MCTC) for meat production using native germplasms which has mixed feather color (light yellow, black, and mix with multi-color) like native chicken. Therefore, to know the performance, adaptability, problems and prospects of MCTC, several experiments were conducted. In Experiment 1, a total of 600 day old chicks were allotted in 30 pens (20 chicks per pen) and birds were feed with the starter (1-21 d), grower (22-35 d) and finisher (36-56 d) diet. Body weight (BW), weight gain (WG), feed intakes (FI) and feed conversion ratio (FCR) were measured weekly. In results, the average day-old weight was found 39.46 grams. At 7 weeks of age, average body weight was found 750-820 g by feeding of 1600-1700 g per bird. During 0-8 weeks, average BW, WG, FI and FCR were found 900-1050 g (male 1050-1200g and female 800-950 g), 860-1010 g, 2150-2250 g and 2.3-2.4 respectively. Average mortality was found 1-2 %. In Experiment 2, a total of 12000 day old chicks of MCTC were distributed to twelve different district of the country to validate the performance, adaptability and benefit cost ratio under farmer's existing condition. Growth performance was found significantly higher in Rajbari (1040 g) and lower in Rangpur region (895.63 g). Therefore, better FCR was found in Rajbari which might be due to the variations in season, housing and management system. In economic evaluation, the average total cost and gross return were found 145935.97 and 185744.10 taka respectively. Therefore, the average net returns were found 39809.04 taka within 8 weeks rearing of 1000 MCTC chicken. Based on the on station and on farm trials, results indicated that production performance of MCTC is consistent, adaptable and profitable under farmer's condition.

5. Conservation and improvement of native duck and geese genotypes

This research was aimed to improve the egg production performances and to estimate selection response and selection intensities of fifth generation (G5) deshi white (Rupali) and white breasted black (Nageswari) duck genotypes through an individual selection program. All the ducks were reared in a natural-ventilated duck house. The male and female were separated and marked with wing band after 12 weeks of age. Diet containing 17.5% CP and 2750 Kcal ME/kg and fresh water provided twice daily in the morning and evening. Individual egg production was recorded from each duck. After 40 weeks of age, female ducks were selected on the basis of selection index and selection differences, selection intensity and responses were also measured. Selected male and female were mated at the maximum ratio of 1: 5 using natural mating. Egg weight, egg production and feed intake were recorded and FCR, egg mass was calculated. All recorded data were analyzed by SAS and differences were determined by DMRT. The selection criteria of fifth generation (G5) of both duck genotypes were studied. As a result of selection, age at sexual maturity, egg weight and egg production % were expected to improve by -1.63 d, 0.60 g, 1.01% and -0.85 day, 0.39g, 0.47% for Rupali and Nageswari ducks, respectively. Egg mass was significantly ($P<0.05$) higher in Rupali (40.24g) than Nageswari (37.55g) duck whereas, egg weight was not significantly differ in both genotypes. Egg production in Rupali and Nageswari duck was 65.41% and 62.74%, respectively. Rupali ducks were significantly ($p<0.05$) consumed more feed (134.54 g) than Nageswari ducks (126.23 g). The FCR was significantly ($p<0.05$) better in Rupali (3.34) than Nageswari (3.61) ducks. The egg quality results showed that egg shell thickness of Rupali duck was significantly ($p<0.05$) higher than Nageswari. Higher values for albumen width (65.03mm) was also found in Rupali than Nageswari ($p<0.05$) duck. On the other hand shape index, albumen index, yolk index and haugh unit were not found significantly different in both genotypes but the yolk color score of Nageswari found highest score than Rupali ducks egg. Proximate composition of eggs was not significantly different of both duck genotypes. These findings revealed that Rupali duck was better in terms of egg weight, egg mass and egg production. But Nageswari genotype was found attain maturity earlier than Rupali genotype.

6. Processing, packaging and preservation of safe poultry meat production for the consumers

The main attributes related to poultry meat that may determine its quality, are color and its water holding capacity (Gaya, 2006). The ability of preserving food in general is related to environmental air quality and temperature, as well as conditioning and packaging characteristics. Poultry meat is a perishable product consisting of carbohydrates, protein, lipid, and water. Product conservation must meet certain standards in order to preserve its quality until consumption by the final user. Shelf life is related to WHC and meat pH, the influence of pH of a determined enclosed environment on the development of microorganisms. Packaging and branding of the products are gradually conducted with BLRI logo and HACCP guidelines are followed. The present research program was undertaken to know the effect of processing procedures on the microbial load and meat quality characteristics of poultry meat. About 9300 poultry (chicken, ducks, quail, guinea fowl and turkey) were dressed, packaged, stored and supplied from our mini poultry processing plant to the consumers in last fiscal year

2018-19. This mini enterprise of processing plant at our division is playing role in different ways. This mini enterprise may generate income and livelihood improvement in different communities and selling points around the country. Moreover, this profession the processors are earning monthly about 20 to 40 thousand taka per processors. The poultry species processed at our plant are shown below (Fig. 1).



Killing cone for proper bleeding Manually de feathering Staughterable broilers

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

7. Strategic development of feeding and management techniques to improve the performance of egg and meat type chicken and their qualities

The present experiment was undertaken to investigate the effects of low protein diets with glutamine supplementation on growth performance, meat quality, gut morphology and noxious gas emission of broiler chicken. A total of 600 day old Lohman broiler chicks were equalized and distributed into 30 pens (5 replicate pens/treatment; 20 birds/pen) and were provided 2 level of CP and 3 level of L-Glutamine resulting in a 3x2 factorial arrangement of dietary treatments (Starter T1, 23x0; T2, 23x0.2; T3, 23x0.3; T4, 21x0; T5, 21x0.2 and T6, 21x0.3 % CP and glutamine level) respectively. During grower (2-3 weeks) and finisher (4-5 weeks) period, dietary CP level was reduced 2% in each treatment. Body weight (BW), weight gain (WG), feed consumption and feed conversion ratio (FCR) were recorded weekly. In results, there was significant dietary interaction between CP and glutamine on BW, WG and FCR of broiler chicken. With decreasing dietary CP levels and increasing glutamine (reduce 2 % dietary CP and 0.30% glutamine in T6 treatment) highest BW, WG and lowest FCR were found in T6 group compared to T4 treatment which contains low CP without supplementation of glutamine in the diet. In meat quality, muscular pH, color and cooking loss % were significantly improved in T6 treatment as compared to other dietary treatments. On the other hand, T6 treatment was showed higher ($P<0.05$) villus height and villus height: crypt depth ratio in compare to T4 group. A significantly higher level of NH_3 and H_2S gases were produced in T1 treatment as compared to other dietary treatments. However, there were no dietary protein and glutamine interactions regarding CO_2 and O_2 gases production of broiler litter. Therefore, starter (21x 0.30 %), grower (19 x 0.30 %) and finisher (17 x 0.30 %) level of dietary protein and glutamine may enhanced growth performance, gut morphology and meat quality characteristics of broiler chicken.

8. Development of feeds and feed additives for producing value added poultry meat and eggs emphasizing lipid profile and antioxidant

Various nutritional manipulations to the chicken diet can be done to produce different types of value-added meat and egg products. Two different experiments were performed to fulfill these objectives. At first experiment was carried out to investigate the effects of *Moringa oleifera* and *Spirulina platensis* on lipid profile, oxidative stability and fatty acid profile in broiler meat. Two hundred forty-day old Cobb 500 broiler chicks were assigned to five dietary treatments for 5 weeks with four replications having 12 chicks per replication. The dietary treatments were: positive control (T1), *M. oleifera* leaf meal 1% (T2); 1.5%, (T3) and *S. platensis* 1% (T4); 1.5% (T5). Final body weight gain was significantly ($p < 0.05$) higher in T2 and T5 group and feed conversion ratio improved in T2 group (1.68). The lowest ($p < 0.05$) thiobarbituric acid reactive substances values (TBARS) obtained in breast meat T3 (10.38) and T4 (14.52) groups, respectively than the control (27.11 $\mu\text{mol MDA}/100\text{g}$) after 3rd week preservation. In addition, serum cholesterol (mg/dl) level was significantly reduced in additives group 124.11 in T2 and 100.93 in T5 group. It was interesting that T2 (93.52 mg/100g) and T5 (76.56 mg/100g) had lower total cholesterol compared to control group (269.42 mg/100g). The fatty acids profiles both breast and thigh meat showed that total ω -3, have the highest concentration in additives group (T2-T5) compared to control. In the second experiments, two hundred native chickens at the age of 26 weeks were selected and fed treatment diets as in first experiment for 42 weeks. The birds were housed in a close, ventilated caged-layer house and were distributed in five dietary groups having 40 birds in each group with 5 replications having 8 birds per replication. The average egg weight was found to be increased in additives groups. Serum cholesterol levels were significantly reduced ($p < 0.05$) in all additive groups. In contrast, total egg cholesterol content in T2 and T5 was the lowest with the value of 173.95 and 226.21 mg/100g compared to control group, 283.86 mg/100g. Omega 3 fatty acids in egg (g/100g) of the said dietary treatments were increased in T2 group with the value of 1.57 and 1.55 in T4 group. However, higher omega 3 fatty acid was found in commercial egg 1(CE1) with the value of 2.03 g/100g. Similar trends were found in total PUFA compared to control diet fed chicken egg. Based on this study, it may be concluded that functional meat and egg, rich in n-3 PUFA and antioxidant can be produced by feeding hens with functional feed additives (*M. oleifera* and *S. platensis*) containing bioactive ingredients. Consumption of such functional meat and eggs by humans may significantly improve their health. Further trails may be required to produce designer or value-added egg production as well as commercialization.



Moringa leaf meal



Poultry meat



Broiler meat

Figure 1. Feed ingredient for formulation of value-added poultry product

Goat and Sheep Production Research Division

1. Conservation and Improvement of Black Bengal Goat at Bangladesh Livestock Research Institute (BLRI)

The Black Bengal goat is the heritage and pride of Bangladesh which is popular for higher prolificacy, short generation interval and better adaptability to adverse environmental conditions. But, the breed is being diluted by unwanted crossing all over the country resulting genetic erosion of this valuable goat breed. Objectives under the project were, conservation, improvement and performance evaluation through selective breeding and to reveal the factors affecting kid mortality of Black Bengal goat. The breeding program was conducted through Open Nucleus Breeding System avoiding inbreeding. The selection targets of the study were minimum 2 kids per kidding, 0.5 litter/day milk and 12 kg body weight at 6 months. The selection index was calculated by the following equation, $IB = b_1x_1 + b_2x_2 + \dots + b_nx_n$. Where, b_1, b_2, \dots, b_n were phenotypic values for the traits and x_1, x_2, \dots, x_n were relative economic values given to each of the traits. The following model was used to estimate factors affecting kid mortality, $Y_{ijklmn} = \mu + B_i + G_j + T_k + S_l + V_m + e_{ijklmn}$. Where, μ = Overall population mean for any of the said traits; B_i, G_j, T_k, S_l, V_m were the effect of i 'th parity, j 'th birth type, k 'th sex l 'th birth weight, m 'th birth season and e_{ijklmn} = Random residual error. The average prolificacy, milk production and 6 months body weight were 2.12 ± 0.03 , 0.28 ± 0.02 litter and 8.59 ± 0.18 kg, respectively. Higher prolificacy was found in generation 1 (2.29) whereas, higher 6 months body weight in generation 2 (9.32 kg). The kid mortality of selected Black Bengal goat was 10.33%. Among the dead kid, highest mortality was found in female kid, birth weight more than 1 kg, rainy season, twin birth and second parity. In conclusion, superior bucks and does will be selected by the individual performance score. The findings suggested for further research to improve the Black Bengal goat at BLRI.



Black Bengal Buck



Black Bengal Doe

2. Conservation and improvement of native sheep at BLRI

Sheep production is an important component of livestock sector to address the food insecurity and reduce poverty among smallholder farmers in the developing countries like Bangladesh. Having unique adaptation ability to marginal environments with low level of input, high prolific nature sheep contributes much for sustaining rural livelihoods. Continuous improvement by genetic selection, feeding and other management system may contribute to improve sheep genetic resources in Bangladesh. The project has designed for conservation and improvement

of native sheep at Bangladesh Livestock Research Institute (BLRI). The breeding program was conducted at Goat and Sheep research farm of BLRI through Open Nucleus Breeding System (ONBS) in such a way, which resists inbreeding. All the ewes and rams were housed in slated floor permanent house raise above the ground level with semi-intensive management system. Data on productive and reproductive performances were recorded regularly. Phenotypic measurements on indigenous sheep populations (Barind, Jamuna river basin, Coastal) were recorded using measuring tape and hanging digital balance following the guidelines of FAO. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0. Body weight, body length, height at wither, tail length were significantly ($p < 0.001$) higher in Coastal sheep than Barind and Jamuna River Basin sheep. Chest girth was significantly ($p < 0.5$) differed among Coastal, Barind and Jamuna River Basin sheep. Post lambing ewe weight and Birth weight of lamb were significantly ($p < 0.01$) differed among Coastal, Barind and Jamuna River Basin sheep. There was no significantly difference among Coastal, Barind and Jamuna River Basin sheep for Gestation Length, Litter size and Placenta weight. It can be concluded from the result, coastal sheep is better the Jamuna river basin and Barinda sheep except the birth weight of lamb. Superior rams and ewes will be selected by the individual performance. These findings give us more attention for continuing further research program to develop a superior sheep stock.



Coastal



Barind



Jamuna river besin

3. Evaluation of the weaning stress and estimation of weaning age of Black Bengal kids at different weaning age

Weaning is normally a stressful period in the young kid's life and is often characterised by a decrease in weight gain, total cease in growth and in some cases even weight loss. In Bangladesh, farmers weaned their kids in different ages and often claimed for above mention problems as well as higher kid mortality. Thus, the objective of the study was to evaluate the weaning stress and estimation of appropriate weaning age of Black Bengal kids. 24 lactating does with kids were selected and divided into four different groups having 06 doe in each group. Kids of different groups were weaned at different ages after kidding i.e. 45, 60, 75 and 90 days after kidding and designated as A, B, C and D, respectively. The group D is considered as control group. The BPM (no. of heart beat/minutes) of the kids were measured 03 days before (-3), days at weaned (0) and 03 days after (+3) of respective weaning schedule of different treatment groups. Similarly -3 and +3 days, blood samples were also collected from the kids to analysed T3 (triiodothyronine), T4 (thyroxine) and cortisol hormones. Besides these,

kids birth weight, weight changes and weaning weight were also recorded. Considering all the study parameters, the results of this study suggest that, weaning of Black Bengal Goat kids before 75 days of age was more stressful that may affect post weaning growth and production. Thus, it can be concluded that weaning age should not be less than 75 days for Black Bengal Kids.



4. Improvement of Black Bengal Goat in Rural Areas

The Black Bengal Goat (BBG) is known to be famous for its high adaptability, fertility, prolificacy, delicious meat and superior skin. Improvement of BBG through community breeding can be one of the tools to meet up the increasing demand of meat production in the country and also will improve the livelihood status of community farmers. The objectives of this project were to improve the Black Bengal goat at farmer's level, to improve livelihood of community farmer through rearing Black Bengal goat and to operate community based Buck Park at farmer's level. The research was conducted at Pachpai, Borochala and Gangatia villages under Bhaluka Upazilla of Mymensingh district. After conducting baseline survey 14 farmers were selected to distribute improved BLRI goat among them. Data on productive and reproductive performances were recorded regularly. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0. The birth weight, 3 month weight, 6 month weight, 12 month weight and litter size were significantly ($p < 0.001$) higher in progeny of BLRI bucks than progeny of BLRI does. Result showed that, sex had significant effect on birth weight ($p < 0.05$), 3 month weight ($p < 0.05$) and 6 month weight ($p < 0.01$). There was no significant effect of sex on gestation length. There was no significant effect of parity on birth weight, 3 month weight, 6 month weight and gestation length. There was no significant effect of litter size on birth weight, 3 month weight, 6 month weight except on gestation length. It can be concluded that, progeny of BLRI bucks showed better performance than the Progeny of BLRI doe. However, superior bucks and does will be selected for breeding purpose according to their performance. The study will be continued until a significant level of achievement through community based goat production in the study areas.



BLRI Buck



BLRI Doe

5. Production and evaluation of crossbred sheep of Coastal with Damara, Dorper and Parendale

Protein deficiency has been taken as the major contributory factor in malnutrition in Bangladesh. It is therefore, important to develop crossbred sheep besides different conventional sources to minimize the deficiency of animal protein. Thus, the present study was undertaken to evaluate the productive and reproductive performances and also the adaptability of different crossbred genotypes in hot and humid climatic conditions. The breeding program was conducted at Goat and Sheep Research farm of BLRI. A total of 75 native Coastal type ewes were crossed naturally with the ram of pure Damara, Dorper and Parendale sheep breed (25 ewes for each breed). All the ewes and rams were housed in slated floor permanent house raise above the ground level with semi-intensive management system. Data on productive and reproductive performances were recorded regularly. The collected data were analyzed by SPSS 17.0 Statistical computer programme. Birth weight, body weight at 3 and 6 month of Damara-Coastal crossbred were 1.98 ± 0.06 , 9.80 ± 0.35 and 12.12 ± 0.52 kg, respectively. On the other hand, growth rate of Damara-Coastal crossbred at 3 and 6 month were 87.2 ± 0.04 and 71.00 ± 0.02 g/d, respectively. Birth weight, 3 and 6 month weight of Dorper-Coastal crossbred were 1.97 ± 0.19 , 11.56 ± 0.76 and 13.98 ± 0.74 kg, respectively. Beside this, 3 and 6 month growth rate of Dorper-Coastal crossbred were 104.6 ± 0.01 and 65.2 ± 0.01 g/d, respectively. In case of Parendale-Coastal crossbred, birth weight, weight at 3 and 6 month were 1.87 ± 0.86 , 8.57 ± 0.78 and 12.87 ± 0.65 kg, respectively. The growth rate of Parendale-Coastal crossbred for 3 and 6 month were 73.00 ± 0.02 and 69.59 ± 0.03 g/d, respectively. Superior rams and ewes will be selected by the individual performance. These findings give us more attention for continuing further research program to produce a suitable crossbred sheep genotype in our country.



Damara Ram

Dorper Ram

Parendale Ram

Coastal Ewe



**Damara-Coastal
crossbred**

**Dorper-Coastal
crossbred**

**Parendale-Coastal
crossbred**

Biotechnology Division

1. Improving production performance of local buffalo through crossbreeding

Crossbreeding is adopting in Bangladesh to improve milk production efficiency of indigenous buffalo. The adaptability of those crossbred buffaloes in terms of their growth, milk yield, reproduction, and disease characteristics need to be evaluated. Considering the fact this study was aimed 1) to produce crossbred buffalo, 2) to evaluate their production performances at BLRI Buffalo Research farm and 3) to validate previously adopted estrus synchronization (ES) protocols. For production of crossbred buffalo indigenous buffalo was inseminated/ naturally mated with imported pure Murrah and Nili Ravi bull semen at BLRI Buffalo Research Farm (39 cows with Murrah and Nili Ravi bull/semen) and Godagari, Rajshahi (14 Cows with Murrah semen). Body weight from birth to 30 month age, age at first heat and calving and gestation period were recorded to evaluate performance of Murrah×Local and Nili-Ravi×Local crossbred buffaloes at BLRI. BLRI has developed an estrous synchronization (ES) technology to synchronize and breed large number of buffaloes at time. However the efficacy of this technology has not been validated yet. ES protocols were validated on-farm at Fulbaria of Mymensingh district and on-station at BLRI. Two ES protocols (1. cows with corpus luteum were treated with PGF2α followed by mating on day 3 and GnRH administration just after mating and 2. GnRH administration at any stage of the cycle and PGF2α on day 7 and AI on day 9 followed by 2nd dose of GnRH) were applied during this experiment. During this study period, 4 calves (Murrah×Local) were born at Rajshahi and 35 calves (21 Murrah×Local and 14 Nili-Ravi×Local) at BLRI through crossbreeding. The conception rates in AI at Rajshahi and natural mating at BLRI were 35.71% (5 out of 14) and 92.31% (36 out of 39) respectively. Although both Murrah and Nili ravi crossbreds have almost similar birth weight (30.07 ± 0.64 kg VS 29.93 ± 0.64 kg) but at 30 month age Nili-Ravi crossbred (355 ± 12.78 kg) gain more body weight than Murrah crossbred buffalo (291 ± 2.00 kg). Two Murrah×Local crossbred heifers showed first heat at 767 and 1126 days, respectively. One heifer delivered first calf at 1065 days with a gestation period of 298 days. Responses of buffalo cows on ES protocol 1 and 2 at BLRI were 83.33% (10 out of 12) and 100% (12 out of 12), respectively. However, responses of buffalo cows against ES protocol 1 and 2 at Fulbaria, Mymensingh were 33.33% (2 out of 6) and 44.44% (4 out of 9). None of the experimental buffalo cow established pregnancy. Research is conducting to find out the reason behind failure in conception following ES. For this purpose, 5 Animals were daily examined by ultrasonography from day 1 of treatment till day 10 after treatment (day of estrus) with ES protocol 2 to characterize the follicular statistics, pattern of growth and regression of the dominant follicle and CL. Follicular growth (small, medium and large follicle) occurs in even manner in left (4.48 ± 2.92) and right ovary (4.25 ± 3.47) of the treated animal. Buffaloes that were subjected to ES 1 protocol at the beginning of treatment the mean diameter of the largest follicle of left and right ovary was found (8.40 ± 1.47 mm) and (7.765 ± 1.58 mm) respectively. On day 7 of treatment (day of PGF2α administration) the mean diameter of the largest follicle of the left and right ovaries of the buffaloes was (10.79 ± 2.44 mm) and (7.65 ± 0.21 mm) respectively. On day 10 of treatment the mean diameter of the largest follicle of left and right ovary was (9.20 ± 0.92 mm) and ($7.75 \pm$

0.22 mm) respectively. Out of 5 buffaloes 4 buffaloes shows heat and inseminated with frozen semen followed by second dose of GnRH. After AI two animals shows repeat heat after 21 days.

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

The objectives of the studies were taken to develop pure-line goat genotypes based on coat color variant and phenotypic characterization of different genotype. The research conducted at BLRI goat research farm. To develop three type color variants goat stock, like Solid white, Dutch belted and Toggenburg pattern. Within color variants pure breeding were performed. Progeny was screened based on their color inheritance. Semi-intensive management was followed for animals of each flock. Genetic and phenotypic characterizations of different coat color variants' goat were recorded. The collected data were analyzed statistically with IBM SPSS 20.0. Irrespective of different genetic factors, the overall mean birth weight (BWT), three month body weight (3MWT), six month body weight (6MWT), growth rate at 0 to 3 month (GR0-3) and growth rate at 3 to 6 month (GR3-6) were 1.17 ± 0.01 (197) kg, 7.43 ± 0.16 (133) kg, 11.75 ± 0.28 (105) kg, 69.45 ± 1.73 (133) g/d and 48.10 ± 1.84 (103) g/d, respectively. The 3MWT of kids were significantly ($p < 0.05$) higher than those of parity. BWT of kids were highly significant ($p < 0.001$) than those of litter type. However, sex and genotype had no significant effect on BWT, 3MWT, 6MWT, GR0-3 and GR3-6. The overall gestation length (GL) (days), litter size (LS) (no.), post-partum heat period (PPH) (days) and kidding interval (KI) (days) were 159.13 ± 2.14 (92), 2.21 ± 0.09 (101), 50.79 ± 9.06 (39), and 214.44 ± 16.66 (38), respectively. Color genotype, had no significant effect on GL, LS, PPH and KI. On the other hand, parity had significantly effect on GL ($p < 0.05$) and LS ($p < 0.01$) but had no significant effect on PPH and KI. This study revealed that phenotypic performances among three coat color goat genotypes showed almost similar and they are very prolific in terms of growth rate and litter size. Selective breeding programme may be continued to improve their performance for establishing as pure line indigenous goat population based on coat color phenotype.

a-b) Solid white female-male, c-d) Toggenberg female-male, e-f) Dutch belt female-male





3. Baseline study on available Horse genetic resources in Bangladesh

The present study was conducted to explore the socioeconomic status of horse rearing farmers along with distribution, farming system and phenotypic characteristics of available horse genetic resources in Bangladesh. Data was collected from 233 horse owners from all administrative division (Coxs bazar, Chittagong; Jaintapur, Sylhet; Bogra and Rajshahi Sadar, Rajshahi; Dinajpur and Lalmonirhat, Rangpur; Kuakata, Barisal, Muktagacha, Mymensingh; Bangabazar, Gopalganj and Modhupur, Dhaka and Dumuria, Khulna division). Data were collected through direct interviewing of horse rearing farmers following a pre-tested questionnaire. After intensive processing and synthesizing data were analyzed using descriptive statistics with SPSS 20 software. From the study it was revealed that most of the horse rearing farmers were illiterate or only can sign (62.20%) and agriculture (43.30%) was the main occupation along with horse rearing. The highest literacy level among the horse keepers was H.S.C (0.9%) and most of the farmers were literate (84.7%). Horses are reared mostly in semi-intensive (90.60%) and extensive system (7.70%) with the purpose of carrying load (Wood, paddy, pineapple, banana etc.), human transportation and recreation purpose (Horse riding competition, riding in beach). About 29.60, 38.20, 26.20, and 4.30% horse rearing farmer's yearly incomes were TK 0-50000, 50001-100000, 100001-150000 and 150001-200000 respectively. Generally no specialized horse breed was observed during this study and available horses are non-descript indigenous types (86.70%). About 43.30% respondents are rearing horse for business and 77.30% for livelihood. Horse rearing is more profitable and easier than other livestock rearing (40.30%). Among different age and sex group of horses found in surveyed area 43.30% of horses were stallion followed by gelding (21.00%) and mare (17.60%). Natural breeding is common all over the country (100.00%) and they use their own (22%) or neighboring stallion (78.00%) for breeding purpose. Chestnut and bay coat color is predominating whereas black, albino, grey and roan color are also available. Star, stripe and patch color was observed on the faces. More concentrate and less roughage based feeding practices for horses are almost common throughout the country. Their ration comprises with rice polish, maize/wheat crushed, mustard cakes and wheat/maize bran and salt. Farmers are practicing regular deworming (89.69%) but they do not vaccinate their animals. Farmers are rearing horse their animals in traditional method without having any scientific knowledge on breeding, feeding and managements practices. Respondent farmers did not receive any training on horse rearing. The average body weight, body length, heart girth, neck length, head length, ear length, front height, back height, ear to tail length, kesore length and tail length were found 166.437 ± 41.315 kg, 110.120 ± 11.452 , 126.832 ± 11.391 , 40.543 ± 6.395 , 43.428 ± 4.865 , 14.870 ± 1.503 , 115.778 ± 7.931 , 112.820 ± 7.829 , 156.875 ± 17.459 ,

67.092±9.850 and 42.700±13.312 cm respectively. Therefore, more research on horse rearing should be conducted to explore and execute the potentiality of horse rearing in Bangladesh.

4. Conservation and improvement of Munshiganj cattle

Munshiganj cattle (MC) are one of the promising milking cattle variety predominantly found in Munshiganj and its adjacent periphery areas. Farmers are replacing MC with high yielding crossbred cattle and population of MC is rapidly declining in their breeding tract. As this variety is only concentrated in a certain area so its conservation in its pure form and subsequent development is necessary. The on-going artificial insemination programme throughout the country is also popular in Munshiganj district. Despite having good quantity of milk production potentiality of MC farmers are yet intend to inseminate their pure MC with foreign germplasm in order to get more milk. As a result population of MC is rapidly declining in their breeding tract. Considering the above facts, steps has been taken by Bangladesh Livestock Research Institute (BLRI) for conservation, characterization and subsequent improvement of this valuable germplasm at their own habitat and BLRI. For in situ conservation, a Munshiganj cattle rearing community was established in Munshiganj district having at least one MC cow. A mini nucleus herd was established in BLRI and this herd has been enlarged with a total population of 32 animals including 10 cows, 6 breeding bulls, 8 heifer calves and 8 bull calves. Different productive and reproductive performance was recorded in the nucleus herd. For conservation of this variety to regain its purity in the farmer's house artificial insemination is ongoing in their original breeding tract with pure Munshiganj frozen semen. Some non-descript indigenous cattle are also selected for AI to increase the population of MC. Following AI, 45 calves has been born so far and 220 AI was done with an average conception rate of 52.19%. Among 220 AI performed 190 AI was performed in MC and 40 Munshiganj calf has born so far in which 16 is male calf and 24 female calf. The colour of body-coat was mostly creamy to dull pinkish and looked different from other indigenous varieties of Bangladesh. The average birth weights of male calves and female calves were found (19.47±0.79 kg) and (16.14±0.52 kg) in on station. On farm male and female calf birth weight were found (16.91±1.24 kg) and (14.32± 0.79 kg) respectively (Table. 2). Average lactation length (LL), daily milk yield (DMY), postpartum heat period (PPH) and number of services for each conception (NSPC) was found (218.82±16.78) days, (4.13±0.39) L, (279.17± 3.76) days, (63.42± 22.08) days and (1.58± 0.79) for on station and (210.58±14.44), (3.03±0.57), (279.84±1.34), (70.89±9.32) and (1.67± 0.67) for on farm respectively. Along with steps has been taken to increase mass awareness and concern regarding its conservation and maintaining purity through cattle fair, seminar, farmers training and door to door personal communication. Munshiganj cattle fair was organized and 50 farmers with their pure munshiganj cattle and AI driven pure calf were participated in the fair. Farmers having best Munshiganj cow, heifer and bull were awarded and acknowledged. The current ongoing AI programme in the community will ensure availability of potential Munshiganj cattle conforming pure characteristics ready in hand for sustaining their unique features, so that it can be disseminated in their original breeding tract.

5. Adaptation of somatic cell nuclear transfer (SCNT) technologies for cattle in Bangladesh

Somatic cell nuclear transfer (SCNT) technology is applying to multiply genetically elite farm animals, to produce transgenic animals with the desired trait, or to conserve endangered species. SCNT requires a combination of some technologies including oocyte aspiration, in vitro maturation, in vitro embryo culture and embryo transfer and nuclear transfer among others. Oocyte aspiration, in vitro maturation, in vitro embryo culture and embryo transfer protocols has been adopted by BLRI. Considering the above facts, the proposed research project aimed to adopt SCNT technology at BLRI. For this purpose, ovaries were collected from slaughtered cattle. Cumulus-oocyte-complexes (COCs) possessing an even cytoplasm and covered with minimum 3 layers of compact cumulus cells was selected for in vitro maturation (IVM) and placed into a 4-well culture dish containing IVM media (TCM199 + 10% FBS, 1 µg/mL β -estradiol, 10 µg/mL FSH, 0.6-mM cystein, and 0.2-mM sodium pyruvate) for 24 hr (5% CO₂ in air at 38.5°C with maximum humidity). After maturation, oocytes were denuded by gentle pipetting and treatment with trypsinase enzyme for complete removal of cumulus cells. For the development of fibroblast cell line, ear tissue was collected from slaughtered cattle in saline solution. The ear tissue was cleaned and washed three times with Dulbecco's phosphate-buffered saline (D-PBS; Invitrogen, Carlsbad, CA), finely cut into 1-2 mm pieces, and digested in 0.25% (v/v) Trypsin-ethylenediaminetetra acetic acid solution at 37°C for 1 hour. Thereafter, cells were washed three times with donor cell culture medium (Dulbecco's modified Eagle's medium [DMEM; Gibco] supplemented with different (0, 10,15 and 20) percentages of [v/v] fetal bovine serum [FBS; Gibco], 1% [v/v] l-glutamine, 1% [v/v] non-essential amino acids, and 1% [v/v] penicillin–streptomycin [P/S]), centrifuged at 1000 rpm for 2 minutes, and seeded into a 100 mm plastic dish (Becton Dickinson, Franklin Lakes, NJ). Seeded cells were subsequently cultured in donor cell culture medium at 37°C in a humidified atmosphere of air containing 5% CO₂ for 15 days. After 15 days, % of the viable cell were counted using hemacytometer followed by adding 0.4% solution of trypan blue dye. A 0.1 mL trypan blue stock solution was added to 1 mL of cells. Results showed that FBS has a positive effect on fibroblast cell growth. Fibroblast cell culture adding with 15% FBS showed the highest viable cell count (96.39%). It was recommended that cell viability should be at least 95% for healthy log-phase cultures. Hence, this study has been suggesting addition of 15% FBS into the cell culture medium for preparation of donor nucleus. The viable cell number was highest (6.74×10^5) in culture media containing 15% FBS. Moreover, skill on the preparation of holding and injection pipette for enucleation of recipient oocyte and injection of donor nucleus were developed during the experimental period. Researches on enucleation of recipient oocyte and injection of donor nucleus into the recipient oocyte is on-going. It was a new project with an objective to adopt SCNT technology at BLRI. Hence, baseline activity was conducted. After completion of this project, SCNT technology will be adopted which may help to produce transgenic animal in near future.

6. Efficient management of poultry manure: anaerobic co-digestion for biogasproduction and application of additives for odor reduction

In this research study two separate experiments were conducted to know the efficacy of layer droppings (LD) for biogas production and composition in co-digestion with slaughter-house rumen digesta, SHRD (Experiment 1) and effects of additives for odor reduction during temporary storage (Experiment 2). In experiment 1, LD was mixed with SHRD at 100:0 (RD0), 75:25 (RD25), 50:50 (RD50), 25:75 (RD75) and 0:100 (RD100) on total solid (TS) basis and anaerobically digested in laboratory simulated biogas digester at 350C for 56 days. Gas production was measured daily, gas composition was analyzed weekly, pH and microbial load was determined at beginning in fresh substrate and bio-slurry at the end. In experiment 2, LD was surface applied with either "no additives" (control) or aqueous solution (5%) of different chemicals e.g., aluminium sulfate (AS), calcium chloride (CC), hydrogen peroxide (HP) or aqueous extract (10%) of different plant sources e.g., Sapindus mukorossi (SM fruit, Azadirachta indica (AI) leaf and Yucca schidigera plant (YS) for 4 consecutive days. The pH and concentration of NH₃ and H₂S at surface was analyzed before and immediately after (0h) additive application and then daily up to day 4. The E. coli and Salmonella spp. was counted at the beginning and the end. Gas composition data were analyzed using repeated measures in General Linear Model (GLM), while other data were subjected to Analysis of Variance (ANOVA) in complete randomized design (CRD) in SPSS 20. In experiment 1, results showed that, biogas production was observed highest ($P<0.01$) in RD50 and RD25 than that in others, which was almost double compared to the control. Similarly, CH₄ concentration was found triple time higher ($P<0.01$) in RD25, RD50 and RD75, compared to the control. Though the fresh substrates contained E. coli (Average 5.9 ± 0.02 log₁₀ CFU/g) and Salmonella spp. (Average 5.2 ± 0.02 log₁₀ CFU/g) but none of the slurries contained any of these microorganism after anaerobic digestion. In experiment 2, NH₃ and H₂S concentrations were reduced ($p<0.01$) in all additives compared to the control after 24h, while they were similar ($P>0.05$) at the beginning. However, extent of gas reduction was varied among treatments. The highest reduction of NH₃ was in AS (95.9%) followed by CC (64.4%) and SM (50.8%), while for H₂S, reduction rate was highest in AS (93.7%) followed by CC (85.5%) and SM or HP (79.0%) for the aeration time of 96h from their initial concentration. All additives reduced E. coli and Salmonella count, but plant extracts showed more antimicrobial activity. In conclusion, PM can be co-digested with SHRD from 25-50% for doubling biogas production with increased (triple time) CH₄ concentration. Again, aqueous solution of chemical additives, especially AS and CC and plant origin extract, especially SM can be surface applied on PM for reducing odorous gases like NH₃ and H₂S as well as microbes (E. coli and Salmonella) of public health concern.

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

Forage ensiling for feeding dairy cattle as well as selling silage in the market are getting momentum, coupling with dairy development in recent years in Bangladesh. Although, silage fermentation occurs naturally under anaerobic conditions due to the native epiphytic bacteria, the speed and efficiency of fermentation are variable, depending on the numbers and types of

lactic acid bacteria (LAB) on the crop. Bacterial inoculant of selective species was found effective to ensure quick fermentation with minimum nutrient losses and increased aerobic stability of silage after opening silo. Therefore, the purpose of the present study was isolation and molecular identification of lactic acid bacteria (LAB) from Maize (*Zea mays*) and Napier (*Pennisetum purpureum*) fodder and silage for the development of microbial silage inoculant. Growing stage of maize and napier-4 fodder was obtained from fodder field of Bangladesh Livestock Research Institute, Savar, Dhaka. Samples were chopped into 10mm lengths, and three replicates of the same fodders were used for microbiological analysis. Samples (20g) were blended well for 30 sec. by hand with 180 ml of sterilized distilled water, and 10⁻¹ to 10⁻⁸ serial dilutions were made in 0.85% sodium chloride solution. LAB colonies were isolated from diluted fodder samples spread on MRS Agar media by incubating at 37°C for 48h. Based on colony morphology and size, Gram's staining and biochemical properties, twenty one colonies were selected and isolated following purification through culturing in MRS agar and MRS broth sequentially. In addition to above tests, biochemical characterization also included growth at different temperatures (5, 10, 15, 30, 40, 43, 45 and 50°C), different NaCl concentrations (2, 3, 4, 6.5, 7, 8 and 10% NaCl), different pH (3.0, 3.5, 4.0, 4.5, 5.0, 6.5, 7.0, 8.0, 8.5, 9.0 and 9.5) and carbohydrate fermentation profile (glucose, sucrose, arabinose, ribose, melibiose, cellobiose, sorbitol and raffinose etc.). Molecular confirmation of isolates was done by using 16S rRNA gene sequencing for specific level identification. All twenty one isolates were found Gram positive and hetero-fermentative, while only one isolate was coccus in shape, two found cocco-bacillus and the rest eighteen were bacilli. Seven strains were found catalase negative, while fourteen were catalase positive. Based on these characteristics six isolates were identified as *Lactobacillus*, fourteen as *Bacillus* and one as *Staphylococcus* genus. Together with the results of biochemical characterization, sequence data revealed that seven isolates were *Bacillus subtilis*, six were *Lactobacillus fermentum*, four were *Bacillus* spp., two were *Bacillus megaterium*, one was *Lysinibacillus sphaericus*, and *Staphylococcus* spp. Among these isolated strains, *Lactobacillus fermentum* and *Bacillus subtilis* are being used as silage inoculant and therefore, will be tested for their potential as silage inoculant.

System Research Division

Bangladesh Livestock Research Institute has five regional stations that are working under System Research Division. This division helps to validate different technologies developed by the institute and identified field based problem and prospect of livestock and poultry farming. In 2018-19, research programed on Conservation and Improvement of Farm Animal Genetic Resources (FAnGR) at Hilly Region at Naikhongchari and conservation of different fodder germplasm; repeat breeding, mastitis control; Socio-economic analysis of cattle production, establishment of FMD free zone, morphology and pigmentation patterns of local Pabna cattle program are ongoing in Baghabari regional station. The other regional stations will start their activities very soon. A total number of 600 farmers got training from these regional stations in the last fiscal year. Other activities such as fodder cuttings distribution ; Feed and feces samples analysis, post-mortem of farm animal; Backyard meeting and technical support were regularly provided to the farmer at the same time different national day celebration, different social activities were conducted in the regional stations.

1.0 Research Activities at head Quarter

A. Development of Model village through BLRI Technologies at Dhamrai areas

The aim of the study to disseminate BLRI developed most popular and commonly practiced livestock based information and technology to farmers level for increasing productivity; observe the impact of their interventions on socioeconomic status of farm families; identification of constraints facing during acquaintance with the technologies and adoption. Keeping this mind, three villages namely Shorifbag, Chybaria and Fukutia under Dhamrai Upazila (100 farm households in each village) were surveyed through structured questionnaire for a model village selection considering livestock prone area; farmer's interest; Govt. and Non-Govt. activities scenario and natural barrier like river. A total 301 households were under baseline survey to know existing scenario of selected village where the farming system pattern were 60% of livestock +vegetable; 20% of Crop + lobber; 8% of livestock + Fodder and 12% of livestock + businessman found. Out of 301 farmers 50 farmers were given scientific hands on training and demonstration and a Society/Forum was formulated with holistic approach. Three local service provider (LSP) developed to service the community peoples. Mass deworming, vaccination & vitamin supply programme were completed for developing a FMD and PPR free control village and poultry biosecurity measures. Total 60 blood samples were collected randomly before vaccination and after one month vaccination to detect titer level. Total 20% farmers were directly involved with BLRI developed eight technologies intervention but almost 100% were involved with FMD, PPR control model and poultry biosecurity measures. Three farmers were selected for adaptation of TMR technology; seven farmers for high yielding fodder (HYF) cultivation and preservation; 25 farmers for improved native chicken (ND) rearing model; 15 farmers for beef fattening; 3farmers for developed bio-slurry based bio-fertilizer management; 3 famers for sheep and 3 farmers for goat rearing. Total Mixed Ration or TMR

were prepared by using maize stover as roughage with the concentrate (R:C=50:50). A feeding trial was conducted using TMR technologies on 15 growing bull calves to determine the feeding effect on body weight gain where 15 growing calves were equally divided into 3 treatment groups having 5 bulls in each group and duration feeding trial was 90 days. Total 70 decimal land were cultivated under HYF production and used this fodder for their livestock feeding and four new kids were born under sheep and goat rearing. The animal waste management model will be developed to validate of BLRI developed technique of organic fertilizer production from bio-slurry and bio-slurry water use as an organic pesticide. Under this study, a survey of existing system of bio-slurry management by farmers, organic fertilizer production using bio-slurry, feed feces, fresh bio-slurry and produced organic fertilizer sample collection for nutrient evaluation was done. The end of feeding trial study revealed that body weight gain per day (0.955gm) was higher in beef cattle fed 50:50 (roughage: concentrate) TMR compared to control (0,669g). No clinical outbreaks against FMD, PPR, ND and duck plague were found during this period and antibody level was protective level in ELISA report. In case of native chicken, the age at sexual maturity at 20 wks. Mortality rate in growing and laying period were found 1.6% and 0-1.2%, respectively under semi-intensive condition compare to existing native chicken. The body weight at 12th, 20th and 26th weeks of age 813g, 1274g, 1406g for desi fowls respectively Average egg production (%) at 21-27 weeks of age was 25% and feed intake was 70.00 (g/bird/d) and observed egg weight varied from 32-35g and afternoon egg production found 21.19% where scavenging local native birds with an annual average production of 35-49 eggs/hen each weighing 35-39g. So, a sustainable community or technology based village may be developed through validation and adaptation of developed technologies in selected areas which will lead to an increase in farmer's income.



2. Activities of Naikhongchari Regional Station, Bandarban-2019

One of the largest regional stations of Bangladesh Livestock Research Institute is situated at Naikhongchari Upazilla under Bandarban Hill Tracts district. It was established in 1989-1990. From the very beginning it works to identify the problems and reasonable solutions for livestock and poultry development through research based knowledge and sustainable technological intervention. It also works for Conservation and Improvement of Farm Animal Genetic Resources (FAnGR), establishment of HY fodder germplasm for distribution of its cuttings/seeds to the concerned farmer's in the project areas.

Research works

A. Conservation and Improvement of Farm Animal Genetic Resources (FAnGR) at Hilly Region at Naikhongchari

The study was undertaken to evaluate the productive and reproductive performances of HBB goats, Hilly chickens, gayal and deer at Naikhongchari; To know the influence of different level of dietary energy supplementation on the growth performance of growing HBB goats.; To find out the current herd structure of gayal and their dynamic movement at Hill Tract areas. Sixteen HBB Goat of 5 month age and average initial body weight 7.86 kg were selected for conducting a feeding trial at BLRI Naikhongchari Regional Station Research Farm for a period of 105 days. The studied of experimental hilly chickens were reared in open sided poultry house under intensive management system for collecting hatching eggs. The chicks were reared on floor, littered with rice husk. Standard starter, grower and layer feed was fed during rearing period. On the other hands, a field survey of Gayal was conducted at Ruma, Thanchi and Bilaichari upazilla of Chittagong Hill tract region with the help of respective local Livestock Offices and local tribal people. The result for Hilly chicken showed that average body weight of 861.10 ± 171 g in growing period up to 12 weeks of age. The feed intake and mortality of Hilly chicken was 33.5 ± 13 g per bird per day and $8.46 \pm 1.87\%$. It was found that hatchability of Hilly chicken was $62.12 \pm 9.13\%$ hatched by both broody hens and the incubator. The adult body weight up to 30 weeks of age of Hilly hen and cock were 1852.67 ± 166 g and 3097.23 ± 110 g, respectively. The egg production (H.D) of Hilly chicken was $36.60 \pm 5\%$. Egg weight and day old chick weight of Hilly chicken were 45.34 ± 7 g and 30.01 ± 5 g, respectively. Age at first egg, feed consumption and mortality of both Hilly chickens were 157 days, 84.48 g and 15.27 %, respectively. Survey result also showed that gayal population at Ruma, Thanchi and Bilaichari upazilla were 300, 360 and 185, respectively and the average number of gayal of the household were 5.12. About 95% farmers were not supplied concentrate feed to their gayal and were reared in separate house. About 44% farmers provided anthelmintic and no vaccine were administered to their gayal. Respondents replied about 72% gayal were affected by FMD. On the other hand, for HBB goat, result showed that the initial body weight (kg) of T0, T1, T2 and T3 treatment were 7.85 ± 0.30 , 7.88 ± 0.38 , 7.50 ± 0.33 and 8.20 ± 0.24 , respectively and the final body weight (kg) of 12.57 ± 0.46 , 12.10 ± 0.30 , 12.17 ± 0.48 and 12.98 ± 0.37 , respectively whereas, there were no significant differences of initial body weight and final body weight among four treatments groups of growing HBB goat. Daily weight (g) gain of T0, T1, T2 and T3 treatment were 44.96 ± 3.15 , 40.21 ± 2.93 , 44.46 ± 4.06 and 45.60 ± 2.79 , respectively and there were no significant ($p > 0.05$) differences among treatments groups.

Activities:

1. Conservation and improvement of Hilly Chicken, Jungle fowl and Naked neck hilly chicken

- Body weight, egg weight, hatchability, fertility and daily feed intake data on Hilly chicken, Jungle fowl and Naked neck were collected and analyzed for their improvement.
- Vaccination, de-worming, de-beaking and artificial insemination is also done regularly. Prevent jungle fowl from extinction in the hill tracts areas.



Figure 1. Hilly chicken and Jungle fowl

2. Conservation and Improvement of Goat, Sheep, Gayal and Deer

- The productive and reproductive data of Brown Bengal goat, native sheep, gayal and deer were recorded and analyzed for characterization. Routine activities such as vaccination, de-worming, dipping, castration, culling and mating is done in a scientific way for the betterment of farm animals. Conserve Deer and gayal from extinction in the hill tracts areas.



Figure 2. Brown Bengal goat, Sheep, Gayal and Deer at research farm

3. Conservation of different types of animals at research farm

Sl. No.	Animal	Number	Class based on Age & sex
1	Goat	258	Male- 84, female- 125, Kids- 49
2	Sheep	95	Ram- 30, Ewe- 62, Lamb- 3
3	Gayal	10	Male Gayal- 5, Female Gayal- 5
4	Deer	19	Stag- 10, Hind- 9
5	Hilly Chicken	357	Hen- 144, Cock- 78 and Chicks- 135
6	Jungle Fowl	55	Hen- 8, Cock- 3 and Chicks- 45.

B. Conservation and Improvement of native sheep through community and commercial farming project

Native sheep were distributed to the selected local farmers and technical support (vaccination, de-worming, dipping, castration etc.) were provided to the farmers. Adaptations of native sheep at hilly regions, their productive and reproductive data is recorded and analyzed.



Figure 3. Native sheep in community

C. Conservation of seasonal and perennial fodder at the Research Farm

Establishment of fodder germplasm bank having different types of perennial HY fodders (Napier Hybrid-1,2,3& 4; Para, German, Signal, Endropogon, Rozi, Splendida, Red napier, Pacchong etc) and Seasonal (Maize, Cowpea, Matikalai, Dhaincha) at Research Farm. Production, cultivation and processing of seasonal fodders and distribution of fodder cuttings to hilly farmers.



Figure 4. Fodder germplasm bank and cutting distribution to the farmers

D. Others Activities:

1. Laboratory Activities

Collection of Samples (animal faeces, blood, feed, milk etc.) from research farm and from community. Carefully Analyzed and recorded the result of the samples and give suggestions to overcome the problems. Regular post-mortem of animals and birds is done and keeps record.



Figure 5. Collection of Samples, Analysis and post-mortem of farm animal

2. Training Program

Training programs were arranged at Naikhongchari regional station to disseminate ideas about cattle, sheep and poultry rearing and management. In those training program around 300 beneficiaries were participated.



Figure 6. Training program at BLRI regional station Naikhongchari, Bandarban.

3. Backyard meeting program

Two Backyard meeting program were arranged in each month at different locations of Naikhongchari, Bandarban to build up awareness of the farmers about livestock and poultry rearing.



Figure 7. Backyard meeting program at Naikhongchari regional station

3. Technical support to Livestock and Poultry Farmers

Technical support were provided to the farmer about modern livestock rearing and health management. Near about 350 farmers took suggestion about animal rearing, poultry rearing, animal and poultry health and fodder cultivation. This station also provide vaccination facilities to the farmers lives around the farm territory. Normally vaccination program was conducted against PPR, sheep and goat pox, BCRDV, RDV, fowl pox and so on.



Figure 8. Discussion with farmer about livestock & poultry rearing and vaccination/medication program

3. Distribution of sheep, goat, hilly chicken, fertile egg

Native sheep, brown bengal goat, buck, hilly chicken and fertile eggs were distributed among the interested farmer based on their application. This regional station also distributes the above mentioned inputs through different project work.



Figure 9. Distribution of sheep, goat, hilly chicken

6. Field visit

Field visit is very important to boost up the activities under community level. Field visit was conducted at least twice a month to exchange ideas with the livestock farmers.



Figure 10. Field visit at different places

8. Celebration of different important days

Different important days like independence day, victory day, 15th august etc. were celebrated with due respect.



Figure 11. Celebration of different days at the regional stations.

9. Awareness building and social work

This regional station is working continuously to create awareness among the farmers as well as livestock products consumer. Creating awareness against zoonotic and contagious diseases. During lumpy skin pandemic, the station worked hard to create awareness among the farmers. It also provided some sort of incentive like grass cuttings, fertilizer, liquid money, chicks, eggs and so on to the marginal farmers after the outbreak of any natural calamities.



Figure 12. Awareness building programs.

3. Activities of Regional Station, Baghabari, Shahjadpur, Sirajganj -2019

System Research Division carried out field trials of different technologies and identified field based problem and prospect of livestock through this regional stations. In 2018-19, research programme on Conservation, Multiplication and Adaptation of High Yielding Fodder Variety at BLRI regional station. We also worked about follicular physiology of repeat breeder cows in Baghabari milk shed areas. Other activities such as fodder cuttings distribution to farmers; maintained fodder germplasm centre; sample analysis and post-mortem of farm animal; Regularly Uthan Boithak and technical support to the farmer; Implementation of Livestock Services Week; different national day celebration, different social activities were conducted in this regional station.

1. Research Programme:

Study-01. Conservation, Multiplication and Adaptation of High Yielding Fodder Variety at BLRI regional station

The experiments were conducted at the Experimental Plot of Bangladesh Livestock Research Institute, Regional Station, Baghabari, Shahjadpur; Sirajganj and on-farm at farmer's community at the village of Tiar Bond during the economic year 2018-19. We selected 6 farmers from 3 villages of Shahjadpur Upzilla for on farm fodder cultivation and each plot were 20 decimal. At the same time we also maintained the same amount of land at BLRI regional station for trial of Napier and Sugar beet. We prepared the land in both on farm and on station according to the guideline of BLRI developed fodder cultivation techniques/guidelines. Through this project we collected, adapted and evaluated the production potentiality of Sugar beet (*Beta Vulgaris*) as another HYF fodder variety at BLRI regional station. We did this work for distribution of HYF cuttings/seeds among the farmer; determine the biomass yield & nutritive value of different high yielding fodder with different cuttings or interval.

Table 1: Production performance of high yielding fodder variety (Napier) at 40 days of cuttings

Parameter	On-station (Mean±SE)	Farmers community (Mean±SE)	P Value	Sig. level
Biomass(t/ha)	57.66±4.68	54.89±1.20	0.568	NS
Leaf length(ft.)	3.59±0.04	3.37±0.02	0.010	*
Leaf number (Leaf No/Plant)	16.24±0.79	17.13±0.18	0.231	NS
Plant height(ft.)	6.36±0.20	6.00±0.03	0.011	*
Tiller number (No/Hill)	30.72±4.27	18.21±0.65	0.000	**
Hillar number (thousand/ha)	58.66±5.15	55.20±1.06	0.425	NS
Stem perimeter (cm)	6.68±0.06	6.14±0.02	0.000	**

NS= Non significant (P>0.05), * stands for significant differed and ** stands for highly significant.

Table 2. Production performance of *Beeta vulgaris* (Sugar Beet)

Parameter	Plot (Mean±SE)					P value	Sig. level
	1	2	3	4	5		
Fresh root wt. with leaf/plant	480±70.6 ^a	248.4±70.6 ^{ab}	224.4±70.6 ^{bc}	266.0±70.6 ^b	229.2±70.6 ^c	0.70	NS
Fresh root wt. without leaf /plant	393.6±57.7 ^a	210.4±57.7 ^{ab}	178.8±57.7 ^{bc}	219.2±57.7 ^b	189.6±57.7 ^c	0.65	NS
Leaf weight (g/plant)	84.4±19.6 ^a	38.0±19.6 ^c	45.6±19.6 ^{ab}	46.8±19.6 ^b	39.6±19.6 ^b	0.14	NS
Existing plant no. (thousand/ha)	54.0±0.97 ^a	44.0±0.9 ^{ab}	42.0±0.9 ^{bc}	50.0±0.9 ^b	40.0±0.9 ^c	0.12	NS
Survivability	51.8±4.4 ^b	43.8±4.4 ^c	47.9±4.4 ^{ab}	54.0±4.4 ^a	44.9±4.4 ^{bc}	0.15	NS

NS= Non significant (P>0.05)

Study-02. Study on follicular physiology of repeat breeder cows in Baghabari milk shed areas

The experiment was implemented at farmer's house and Bathan areas of Shahjadpur upazila under Sirajgonj district. This experiment was conducted to fulfill the following objectives to know the incidence rate in Holstein Frisian (HF) Repeat Breeder cows (RBC) compared with the normal HF cows; to know the physiology of different follicles of RB cows at different stages of estrus cycle; to know the deformity of ovary and uterus. For this study we selected forty (40) RB cows of Holstein Friesian (HF) selected initially identified on the basis of age and parity

number. A herd comprising 10 cows at farmer's house and another 30 cows at Bathana areas were brought and maintained under this study. All RBC were marked by ear tag and maintained breeding record by Cattle Herd Book. After selecting the RB cows, infection like pyometra, endometra, cervicitis, sulphagitis and tumor like growth etc. in uterine wall were identified with the help of modern veterinary approaches. The status of ovarian follicles at different stages of estrus cycle observed. Finally Luteal and follicular cyst (if present) were also identified with the veterinary concerned researchers. All experimental cows were synchronized by the treatment of GnRH (day-0), PGF2 α (day-7) and Artificial Insemination (AI) + GnRH (day -9). Pregnancy tests were done after 50 days of AI by rectal palpation as well as chemical test in the laboratory. Number of growing follicle appeared ultrasonically, size of Graafian follicle, breed, cows body size, and inheritance level and parity, nutritional factors, heat stress (record temperature and Relative Humidity at the time of estrus), days calving to first service, hormone (estrogen, progesterone and LH) around the time of estrus, luteal and follicular cyst and different reproductive diseases were recorded properly. All collected data were statistically analyzed by the SPSS soft-ware program. Results revealed that, significantly ($P<0.05$) highest Body Condition Score (BCS) was 3.47 ± 0.05 observed in the cows of group-D whose age was more than 8 years compared to others group (Table 1). In-case of average daily milk yield and remained dry condition differences were highly significant ($P<0.001$). Maximum milk yield (20.41 ± 0.82 l/day) was observed in group-C compared to others group but minimum dry condition remaining period was observed in group-A than others. Days of heat showed number of AI service were non-significant ($P>0.05$) in the whole experiment (table-1). The percentage of infection (Pyometra, Endometra and Metritis) in the uterine wall differed non-significantly ($P>0.05$) among all the groups and minimum values were observed in group-A (Table 2). Percentage of cyst presented in both ovaries is given in table-2. Highest percent of cyst observed in the right ovary than left of the cows of group-D compared to others groups but the differences were non-significant ($P>0.05$). Comparatively higher percentage (58.82 ± 12.30) of follicles observed in left ovary of group-D than right ovary in the whole duration of the experiment (Table 2). The highest average number (2.40 ± 0.44) of follicles was observed in left ovary of the group-C than the cows of others group but the differences were non-significant ($P>0.05$). Though the follicle size in the end of luteal phase differed non-significantly ($P>0.05$) but comparatively larger (3.47 ± 1.34 mm) follicle in diameter were observed in group-A than the follicles of others groups.

Table 1. Phenotypic parameter of repeat breeder cows

Parameters	Group				P Value	Sig. level
	A(2-4 years)	B(5-7 years)	C(7-8 years)	D(>8 years)		
BCS(0-5)	2.94 ± 0.17	3.00 ± 0.14	3.22 ± 0.06	3.47 ± 0.05	0.01	*
Milk yield(L/d)	18.15 ± 1.52	15.27 ± 0.76	20.41 ± 0.82	20.06 ± 0.94	0.00	**
Remained dry condition (M)	20.66 ± 1.36	31.07 ± 1.32	30.27 ± 1.12	30.23 ± 1.98	0.00	**
Heat showed interval(days)	31.50 ± 6.91	47.56 ± 7.71	44.90 ± 4.11	41.47 ± 9.28	0.71	NS
Service given (No)	8.67 ± 1.95	6.74 ± 0.95	5.79 ± 0.62	8.18 ± 2.34	0.37	NS

*= Significant, **= Highly significant, NS= Non significant

Table 2. Physiological parameters of the ovaries of repeat breeder cows

Parameters	Group				P Value	Sig. level
	A(2-4 years)	B(5-7 years)	C(7-8 years)	D(>8 years)		
Pyometra (%)	33.33±16.67	37.04±9.47	60.47±7.54	64.71±11.94	0.11	NS
Endometra (%)	22.22±14.69	29.63±8.95	23.26±6.51	29.41±11.39	0.91	NS
Metritis (%)	0.00	11.11±6.16	11.63±4.94	11.76±8.05	0.77	NS
Right ovarian cyst (%)	66.67±16.66	48.15±9.79	48.84±7.71	70.59±11.39	0.35	NS
Left ovarian cyst (%)	11.11±5.11	14.81±6.96	23.26±6.51	17.65±9.53	0.76	NS
Follicles in right ovary (%)	33.33±16.66	25.93±8.59	37.21±7.45	11.76±8.05	0.26	NS
Follicles in left ovary (%)	44.44±17.56	29.63±8.95	37.21±7.45	58.82±12.30	0.27	NS
Follicles in right ovary (no)	2.00±0.80	2.00±0.52	2.40±0.44	1.33±0.80	0.31	NS
Follicles in left ovary (no)	1.67±0.70	0.85±0.46	0.90±0.38	1.00±0.70	0.38	NS
Right ovarian follicle diameter(mm)	1.34±0.91	1.07±0.60	2.10±0.50	2.59±0.91	0.20	NS
Left ovarian follicle diameter (mm)	3.47±1.34	2.94±1.10	1.26±0.73	2.81±1.34	0.21	NS

2. Others Activities:

A. Fodder cutting supplied to dairy farmers

A total of seven lakh cuttings were distributed among the dairy farmers with the rate of BLRI fixed price in 2018. These cuttings were purchased by three hundred dairy farmers in the Baghabari Milk shed areas.



Figure. Distribution of HYF cuttings to the dairy farmers

B. Laboratory activities

The mandate of these laboratories is to collect, test and reporting to the related personal/authority for improving the livestock sector in these areas. All received samples of feeds, disease related sample of blood, milk, urine, faces serum etc were analyzed in both Animal Nutrition & Health Laboratories. Samples of emerging & reemerging diseases were collected, prepared, conserved and send to the BLRI, Head Quarter for further analysis.

C. Training Program

Training programs were organized at BLRI regional station to gather knowledge about cattle, sheep and poultry rearing and management system. In those training program about 200 beneficiaries were participated.



Figure -Training activities at regional station

D. Uthan Boithak program

Every Month two Uthan Boithak programs were organized at baghabari areas to build up awareness of the farmers about livestock, poultry rearing, fodder cultivation system, disease control and management etc.



Figure - Uthan Boithok program at Baghabari area.

E. National day celebration:

We celebrated every national day with hundred percent participation.



Figure - National day celebration program.

F. Social activities:

Awareness building program on recent issues was successfully arranged at BLRI, RS. Baghabari.

Design and Development of Products from Native Sheep Skin

Since ancient times, human beings have used animal skins and learned to make leather. Leather is animal skin that has been chemically modified to produce a strong, flexible material that resists decay. Driven by its wide applications in everyday life, the demand for leather products has become increasing from time to time. Sheep have been a key animal in the history of farming and have a deeply entrenched place in human culture. They were one of the first animals to be domesticated along with man's best friend the dogs they were easily trained and formed an animal companion and sheep as they have a natural herding instinct and could be easily managed in groups. Sheep skin is used to produce sheep skin leather products and soft wool-lined clothing or coverings, including gloves, hats, slippers, footstools, automotive seat covers, baby and invalid rugs and pelts. At present, more than 50 percent of bovine hides and approximately 40 percent of sheep and goat skins are processed into footwear, with the remainder being used for the production of garments, furniture and travel goods. So, the development of local sheep skin and value added products may enable to unlock the enormous potential of this skin and provide very good scope for sheep farmer to generate income. A research was conducted for commercial use of sheep skin in Bangladesh through leather production with the joint collaboration of Bangladesh Livestock Research Institute and Leather Research Institute of Bangladesh Council for Scientific and Industrial Research (BCSIR). The aims of the research work are to assess the properties (physicals and chemicals) of sheep skin and produce leather products from native sheep skin.

Twenty one (21) raw sheep skin was collected from sheep research farm of Bangladesh Livestock Research Institute and twenty five (25) raw sheep skin was collected from local market and bring it to Leather Research Institute for processing. The processing of leather, starting from preserved raw sheep skins, as follows. Once cured, the skins were then soaked in water for several hours to several days. The water and surfactants helps in the removal of salt, dirt, debris, blood and excess animal fats. Rehydration was also reintroduced. Subcutaneous material and majority of hair was removed. This was used to loosen the fibers allowing the skin to absorb chemicals that was used later in the tanning processes. Limed hides appear swollen and with an increased thickness, therefore can be easily split into two or more layers. This process brings to removal of alkali from the pelt with the consequent dispelling of the fibers and helps lowering of the pH to the values used in the bating process. It was [carried out with slightly acidic chemicals. This was an operation to complete the deliming process, by eliminating residues of other substances and loosen the fibers of the skin, in order to smooth the grain and achieve soft and flexible leather. Pelts were soaked in a solution of water, salt, and hydrochloric (or sulphuric) acid. This was the process which converts the protein of the raw hide or skin into a stable material which was not putrefy and it was suitable for a wide variety of end applications, the leather. There were several types of tanning: chrome tanning was the most widespread. At the end of the tanning the hides or skins appear blue-green. This is called wet-blue and temporary preserved. The vegetable tanning was the oldest, made with the use of tannins which gave the vegetable tanned leather shades of brown, more or less intense. The tanned leather was not yet usable to produce articles. To turn it into a marketable product the leather must be further treated with syntan, fatliquor, filler and mechanical processes in the drums. It was the final stage and the most complex process,

which includes all operations to be, carried out on dried skins, to change the surface effect, both for aesthetic and functional aims. Finishing can be mechanical or chemical. During manufacturing a product, the following important steps were involved as select target groups, gather ideas, select ideas, design development, pattern development, assorting the materials, cutting, sub-assembling processes, assembling and stitching, finishing. Manufacturing of some leather products such as ladies bag and purse were completed and such products are going on. If products is available with the help of supporting company, it is demandable so no problem in marketing.



Sheep leather made ladies bag and ladies purse

Socio-economic Research Division

1. Determination of Income Elasticity of Demand and Forecasting Demand for Milk, Meat and Egg in Bangladesh in 2030 and in 2041

Protein is an important nutrient requirement in food chart. Milk, meat and egg are the main source of protein. In Bangladesh, these livestock products play an important role to fulfill the protein consumption requirement of people. With this sense, our study presents the relationship between income and demand for milk, meat and egg which we get from income elasticity of demand for these products by estimating coefficients through log linear regression. The overall income elasticity for milk is elastic (1.69) and for meat (chicken, mutton, beef) and egg the income elasticity is inelastic. Besides, our study describes the growth pattern of milk, meat and egg production and demand in Bangladesh by growth model with time series data using model selection criteria where cubic model is best fitted and quadratic model is the 2nd best fitted for each product. By calculating demand, our study estimates the surplus/deficit amount of milk, meat and egg in 2025 and 2030. In 2025, there will be surplus in milk, meat and egg and the amount is 73.31 lakh metric ton, 124.07 lakh metric ton, 1641.33 crore numbers respectively. In 2030, there will also exist surplus in milk, meat and egg and the amount is 216.61 lakh metric ton, 257.11 lakh metric ton and 3746.35 crore numbers respectively. This study also shows socio-economic graphing by descriptive statistics where 700 households have been used. The findings of this study will help to recommend policies to take necessary steps for the demand and production of milk, meat and egg in near future.

2. Determinants of Profitability of Cattle Fattening: A technical and allocative efficiency analysis of fattening enterprise in Bangladesh

The study assessed the determinants of profitability of cattle fattening enterprise in selected area of Bangladesh. Two-stage sampling procedure was employed in selecting 250 respondents from 8 districts, namely Sirajganj, Jamalpur, Mymensingh, Dhaka, Jessore, Bogra, Pabna and Manikganj for the study areas. It was observed that cost of feeder cattle accounts for 79% of Total Variable Cost, Feeds 10%, Labour, 7% while Drugs and Vaccines, 4%. On the average, respondents obtained about 13,500 per cattle as profit of 90 days fattening period. Regression estimates of factors affecting Gross Margin (GM) of cattle fattening enterprise show that the coefficient of cost of feeds, number of cattle fattened were positive and significant to GM of the enterprise. The coefficient of cattle fattening experience, was also positive and significant ($p \leq 0.01$) to GM of the cattle fattening business. The study revealed that inadequate financial capability, scarcity of feeds and space for fattening were the major constraints to the enterprise and analysing management records throughout 3 years. The linear programming was developed to optimize beef production according to the following

decision criteria: minimum cost under energy and time constraints; and maximum yield under energy and time constraints. These simulation models, which represent the production frontiers that these enterprises may achieve, are later compared to the management results obtained; this allows analysing, the technical and allocative efficiency of farms. The results obtained in the actual scenarios indicate that production may be four folded by modifying breed, feeding strategy, and increasing profits of around 40% if a criterion of maximum yield is adopted and the allocative efficiency is improved. The study concluded that cattle fattening enterprise is profitable in the study area and various factors affect profit of cattle enterprise and should be provided in form of loan to cattle fatteners by government and Non-Governmental Organisations (NGOs).

Training Planning and technology Testing Division

1. Field testing of BLRI Feed Master mobile application in selective locations of Bangladesh

The current research was designed to measure the efficacy and identifying the constraints of adaptation FeedMaster technology at farmer's level. For this purpose, firstly, three days of training on the application was given to 19 District Livestock Officers (Livestock expert) working in field level and efficacy of the software was evaluated through a pretested questionnaire. Secondly, a field demonstration of FeedMaster technology was conducted on Rajabarihat and Savar upazilla. For field demonstration 5 farmers were selected from each location and hands-on training was provided. Three months close supervision on feed, vaccination, production cost and income from milk as well as milk composition of selected farmers were assessed. Finally, data were analyzed by using SPSS software. From the data analysis, it was observed that according to livestock expert BLRI FeedMaster application was very much helpful (100%) for ration formulation, animal weight calculation and technology dissemination at field level. However, 89.47% of livestock expert believe that vaccination was helpful for the farmers whereas 47.37% recommended for modification. Moreover, applying this technology at field level reduced time, cost and visit significantly ($P < 0.001$). Furthermore, during field testing, it was observed that feed price was reduced by 5.88% per kg than the existing system. Along with, the average milk production of farmers increased by 12.2. % per animal/day and milk fat percentage was increased significantly ($P < 0.001$). Hence, it may be concluded that by adopting FeedMaser application farmers may able to produce balanced ration which may create a positive impact on farm profitability.

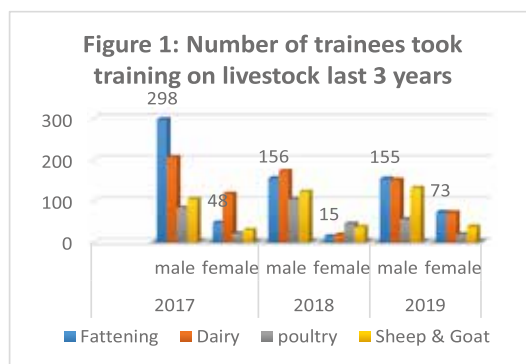
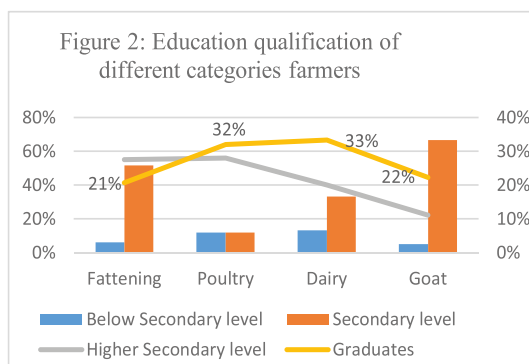


2. Impact of farmers training on adoption of BLRI developed technologies

Most of the people in Bangladesh live in rural areas and almost all have cultivable lands for cash crop cultivation. Besides this, most of them rear different species of livestock of indigenous chicken, cattle, buffalo, goat and sheep. Thus, the economy of Bangladesh is mostly dominated by Agricultural sector. Livestock also plays an important role in the national economy and its. Livestock contribution in GDP is about 2.5%. But almost all of them have no scientific knowledge and training on how to manage profitable livestock farming. Bangladesh Livestock Research Institute (BLRI) is providing training to livestock and poultry farmers

alongside with research. This study was conducted to assess the impact of BLRI training on changes of socio-economic status of livestock and poultry farmers by taking information from poultry, goat, dairy and beef fattening farmers. Farmers of each category were taken face to face interview with a structured questionnaire prior to orientation of training and again after some period of training. Simple statistical measures like mean, average, and percentage were estimated for categorization and calculating data.

Total 1756 number of male & 511 numbers of female had been trained in four technologies last 3 years. Among them cattle fattening was the highest demanded technologies. To assess the output of training it should be essential to explore the socio-economic status of the farmers who were considered for interviewing. The analytical results revealed that respondent farmers were received various educational qualifications having graduation of 21%, 32%, 33%, 22%; fattening, poultry, dairy and goat rearing training respectively (figure 2). In case of occupation of the farmers most of them were occupied by business (33%), farming (27%), and service (13%). Rest 27% of them had different kind of occupations. Among the interviewed respondents about 73% household families had 4 to 6 family members. According to land lordship, about 35% were landless (0-49 d.m), about 36% were marginal (50-125 d.m), 17% were small (126-249 d.m), about 12% were medium (250-749 d.m), and only 1.28% were large (>750 d.m), farmers. Based on cropping pattern, about 21% farmers cultivate crops once in a year, about 47% twice in a year and about



32% thrice in a year.

After getting specific training related to technology from BLRI, about 16% poultry farmers adopted poultry rearing technology, about 56% goat farmers adopted goat rearing technology and 100% dairy and fattening farmers adopted the relevant technologies in their own farms. Among poultry farmers, population size of chicken (native chicken) was 50.4 per household before training and it was increased to 250.4 chicken per household after training, while duck population was remain unchanged. In the goat keepers, the average population size per household of goat, sheep and kids before training were 5.56, 2.67 and 2.78 numbers, respectively, which increased to 5.78, 5.44 and 3.56. The average population size of dairy cows before training was 5.87 cows per household, which increased to an average of 10.00 cows. In

the fattening farmers, the average population size of fattening bull before training was 4.04, which increased to 10.83 after training. Finally it concluded that the sign of increasing animal population size, income and food habit after getting training the improvement of socio-economic status of different categories of farmers. But they face several natural & marketing problems. To solve these, have to work more about disease control, vaccination, record keeping, marketing and women empowerment.

Planning

Different technology based farmers training courses; scientist training, seminar, workshop, internship and study visit program are arranged by this division. The main vision of planning is to support all kinds of administrative and logistic supports or works to accomplished proper planning of Bangladesh livestock Research Institute (BLRI). Other than scheduled ones BLRI receives request from ministries and other organizations to incorporate new issues under this divisional activities and also to maintain the national and international linkage of Research-Extension-NGO for collaborative research, transfer of technology and capacity building development program. The following activities were accomplished during the financial year 2019-20.

The mandates of this division are to -

- a. To train scientists in the appropriate fields of research, at home and abroad, training of trainers (TOT), training of farmers GO and NGO workers;
- b. Harmonization of research planning, management and evaluation
- c. Strengthen Research-Extension-NGO linkage and explore quick dissemination of locally developed and introduced techniques to the end users;
- d. Assists BLRI and all other concerned stakeholders for policy making decisions related to livestock and poultry research and development;
- e. Co-ordinate the inter and intra-institutional/divisional activities achieving of institutional goal

1. Research Management

a. Planning & Evaluation encompasses a series of activities are being performed as

- **Policy Planning:** Determination of goals, objectives, priorities, strategies and policy measures for development plans.
- **Sectorial Planning:** Identification the role of various sectors is required to play in the context of the Plan objectives and goals.
- **Programme Planning:** Formulation of detailed resource allocation to realize the Plan objectives and goals.

- **Project Planning:** Appraisal of projects embodying investment decisions for the implementation of the sectorial plans.
- **Evaluation:** impact analysis of projects, programme and technology by institutional and evaluation committee.

b. Approval:

Last 2019-20 fiscal year a total 69 (Core research 40 + Development project 29) research project were approved by technical committee.

c. Budgeting:

Allocation of total Tk. 67.127 (core research Tk. 29.000 million + Development project Tk. 37.127 million) million for implementation of the approved research project

d. Midterm evaluation:

It is a regular basis work and usually arranged in middle of the respective fiscal year. In 2019-20 FY midterm evaluation meeting was held on 8 April' 2020.

e. Reporting:

Accumulate all approved project reports and compiled those reports according to five disciplines in every year.

2. ADP Management (Both for Institutional and Ministerial)

- a) **Monthly report:** During 2019-20 near about total 12 reports from six running Development Projects, were submitted to the respective ministry at monthly basis as per ministerial direction.
- b) **Quarterly report:** Submitted 4 quarterly reports during 2019-20 year.
- c) **Cabinet report:** 12 progress report were prepared based on cabinet meeting decision
- d) **ADP Meeting:** Arranged total 12 number of ADP meeting round the year at BLRI.

3. Reporting

- a. **Ministry:** In 2019-20, division submitted near about 66 reports/letters to the Ministry of fisheries and Livestock. Provide information about the activities of BLRI in FY 2019-20, report about last 10 year institutional achievement, institutional APA, economic somikkha 2020, formulate budget implementation and progress report, Deliver report to include into the budget speech FY 2019-20 etc. are remarkable.
- b. **Institutional:** In 2019-20, division coordinated and formulated the following reports

Annual Report: One Annual Report published like other years.

Proceedings: Proceedings of Annual Research Review Workshop 2017-2018 was published.

c. Other Institutional: BARC: BLRI submitted reports to the Bangladesh Agricultural Research Council namely Project proposal and budget evaluation, Research Highlights 2019-20.

4. Interpretation of Different policy: BLRI comments were given to develop Livestock and other development policy.

5. Research Monitoring: For preparation and processing of development projects and inquiries on any of the subjects allotted to the research division are to be monitored by a scheduled committee.

Training – 2018-19

1. Short term training program

Short term training program has been arranged for farmers/entrepreneurs on technologies & techniques developed by BLRI and scientist/officer/staff on skill development. This division arranged 13 courses of short term training for entrepreneurs and 10 courses for Scientists in this year. Total participants were 419 numbers (female-99 and male-320) for Officer's short term training and total no of participants were 747 numbers (female-249 and male-498) for farmer's short term training (Table-1).

Table 1. Short term training programs of BLRI for the year 2018-19

Sl. No.	Name of courses	Duration (days)	Budget (TK)	No. of participants		Total participant	Location
				Male	Female		
Officer's and Stuff training							
1.	Annual Bio-safety awareness training at BLRI	17-18/12/2018	1,40,985.00	48	14	62	BLRI, HQ
2.	Hands on training of Bio-security	18/12/2018	89,015.00	23	07	30	BLRI, HQ
3.	National Integrity Strategy	26/12/2018	53,400.00	26	04	30	BLRI, HQ
4.	E file management	12-13/3/2019	1,21,500.0	23	07	30	BLRI, HQ
5.	National Integrity Strategy	28/3/2019	70,700.00	13	08	21	BLRI, HQ

Sl. No.	Name of courses	Duration (days)	Budget (TK)	No. of participants		Total participant	Location
				Male	Female		
Officer's and Stuff training							
6.	Innovation for Service	30-31/3/2019	1,86,900.00	20	10	30	BLRI, HQ
7.	National Integrity Strategy	12/5/2019	48,200.00	25	05	30	BLRI, HQ
8.	Fire distinguishers related training	10/04/2019	1,37,100.00	88	26	114	BLRI, HQ
9.	Training on scientific report writing	16-20/06/2019	3,15,400.00	16	06	22	BLRI, HQ
10.	E file management	23-24/06/2019	2,03,700.00	38	12	50	BLRI, HQ
Total				320	99	419	

Farmer's training							
1.	Cattle fattening using improve technology	22-24/12/2018	1,79,900.00	51	09	60	BLRI, HQ
2.	Profitable farm management using scientific technique	28-31/12/2018	2,52,800.00	56	19	75	BLRI, HQ
3.	Dairy cattle rearing and management	5-7/2/2019	1,93,000.00	64	05	69	BLRI, HQ
4.	Dairy cattle rearing and management	17-19/2/2019	1,96,600.00	31	19	60	Naikhongch ari, Bandarban
5.	Dairy cattle rearing and management	24-26/2/2019	1,94,000.00	14	36	50	Baghabari, Sirajgonj
6.	Goat rearing and management	19-21/3/2019	1,81,100.00	59	01	60	BLRI, HQ
7.	Fodder processing, organic	02/05/2019	1,01,700.00	03	47	50	Savar Upazilla

Farmer's training							
	manure and Moringa cultivation technology						
8.	Cattle fattening using improve technology	2-4/04/2019	1,99,200.0	18	32	50	Naikhongch ari, Bandarban
9.	Cattle fattening using improve technology	9-11/4/2019	1,99,000.0	24	26	50	Baghabari, Sirajgonj
10.	Cattle fattening using improve technology	15-17/4/2019	2,05,500.0	62	06	68	BLRI, HQ
11.	Goat rearing and management using scientific technique	19/05/2019	1,16,100.0	39	11	50	Baghabari, Sirajgonj
12.	Goat rearing and management using scientific technique	12/06/2019	1,17,200.0	34	26	60	Naikhongch ari, Bandarban
13.	Dairy cattle rearing and management	26-28/5/2019	1,80,100.0	43	12	55	BLRI, HQ
Total				498	249	747	
Grand Total				818	348	1166	

2. Long term training program

Different Ph.D. (Foreign and In-county) program is included in long term training program. Total 21 numbers of Ph.D. scholars are studying in different universities (Table-2).

Table-2. Information about long term training program (Foreign and Local scholarship) of BLRI

Sl. No	Name and Designation	Title	University and Country	Remarks
Foreign scholarship				
1.	Dr. Md. Hafizur Rahman	Determination of genetic diversity and molecular evaluation of west Nile virus in Sydney, Australia	University of Technology, Sydney	On-going 25/02/2017- 24/02/2020
2.	Md. Masud Rana, SO	Comparative study on single or multi-stage probiotics through Isolation and suitability of their economical utilization in the growth performance of poultry	Chonbuk National University in South Korea	On-going 01/03/2017- 01/02/2020
3.	Md. Sirazul Islam, SSO	Study on possible factors and measures of repeat breeding problems in dairy cows under artificial insemination program	University Putra Malaysia (UPM)	On-going 14/05/2018- 13/05/2021
4.	Md. Rezaul Hai Rakib, SO	Pathomorphological study of bovine mammary epithelial cells infected with streptococcus agalactiae/dysgalactiae/uberis isolated from bovine mastitis	China Agricultural University, China	On-going 01/09/2018- 31/08/2021
5.	Md. Obayad Al Rahman, SO	Genetic correlation between reproduction and wool traits in Corriedale sheep	University of New England, Armidale, New South Wales, Australia	On-going 24/09/2018- 23/09/2021
6.	Md. Saiful Islam, SO	Farmers education and farms efficiency (technical and allocative efficiency) – a case of Bangladesh	Graduate School of International cooperation Studies, Kobe University, Japan	On-going 24/09/2018- 23/09/2021
7.	Dr. Md. Humaun Kabir, SO	Screening of avian paramyxoviruses and molecular characterization	Tokyo University of Agriculture and Technology, Japan	On-going 01/10/2018- 30/09/2021
8.	Dr. Md. Amirul Hasan, SO	Development of a novel HACCP – based approach to control of infectious diseases in dairy herds	Tokyo University of Agriculture and Technology (TUAT) Japan	On-going 01/10/2018- 31/03/2020
9.	Md. Khairul Bashar. SO	Life cycle assessment (LCA) of greenhouse gas emission intensity of dairy cattle rearing under different production systems and their mitigation options	University of Hohenheim, Germany	On-going 22/10/2018- 21/10/2021

Sl. No	Name and Designation	Title	University and Country	Remarks
10.	Md. Nuruzzaman Munshi, SSO	The relationship between dietary iron and zinc, and the gut microbiota: Can dietary iron and zinc regime be exploited to improve health	University of Reading, UK	On-going 28/11/2018- 27/11/2021
11.	Md. Ponir Choudury, SO	Genome-wide association studies for high prolificacy and meat production traits in indigenous Bangladeshi Black Bengal goat	Graduate School of Chinese academy of Agricultural Sciences, China	On-going 01/09/2019- 31/07/2022
12.	Md. Yousuf Ali Khan, SO	Genome-wide association studies for milk production traits of buffalos in Bangladesh	China Agricultural University, China	On-going 01/09/2019- 31/07/2024
13.	Dr. Md. Rezaul Karim, SO	Emergence of colistin resistance in Enterobacteriaceae in poultry value chain	University of Putra Malaysia	On-going 25/01/2019- 24/07/2022
14.	Dr. Md. Anwar Hossan	Molecular Characterization of Toxin Genes and Antimicrobial Susceptibility of <i>Staphylococcus aureus</i> isolates in Fish and Meat	Sunchon National University, Korea	On-going 18/08/2019- 31/08/2023
Local scholarship				
1.	Kamrun Nahar Monira, STO	In situ characterization and assessing of Aseel and Indigenous chicken	(Bangladesh Agriculture University) BAU, Mymensingh	On-going 29/01/2014- 01/7/2017
2.	Md. Abdur Rashid, SSO	Genetic evaluation of performance potentials & molecular characterization of BLRI improved indigenous native varieties	BAU, Mymensingh	On-going June 2015- june 2018
3.	Shamim Ahmed, SSO	Characterization of available moringa cultivars, their micro pragation and nutrition evaluation as feed for ruminants	BAU, Mymensingh	On-going Oct. 2015- June 2018
4.	Dr. ASM Ashab Uddin, SO	Emergence of antimicrobial resistant (AMR) foodborne and zoonotic pathogens in poultry value chain in Bangladesh	Sylhet Agricultural University (SAU)	On-going 01/03/2018- 01/03/2021
5.	Md. Asadul Alam, SSO	Impact of feeding system on qualitative and quantitative improvement of milk in dairy cows.	BAU, Mymensingh	10/09/2018- 09/09/2021
6.	Mst. Farhana Afroz, SSO	Genetic evaluation of Pabna cattle and their crosses in Pabna region	BAU	10/09/2018- 09/09/2021
7.	Mrs. Mahfuza Khatun, SO	Welfare assessment of Dairy-based farming system in Bangladesh: An Economic analysis of cattle dedelopment programme in farm level	SAU	30/11/2018- 29/11/2021

3. Foreign training programs

BLRI arranged foreign training program for development of the skill of respective scientist and officer in regular basis. In 2018-19, 13 scientists of BLRI participated in 09 numbers of foreign training programs (Table-3).

Table 3. Foreign Training Programs of BLRI for the 2018-19

Sl No	Program Type	Program Title	Venue	Duration	Name of Participant
1.	Training	Indian Grassland and Fodder Research Institute	India	26/06/2018-26/07/2018	Shamim Ahmed SSO, Mukhlesur Rahman SO, Rezaul hai Rakib SO, Yousuf Ali SO
2.	Workshop	One health poultry hub pre-launch workshop Srilanka.	Sri-lanka	21-25/01/2019	Dr. Md Gias Uddin PSO, Dr. Md. Abdus Samad SSO
3.	Meeting	Technological Innovations in muscle food processing for nutritional security quality and safety	India	22-24/11/2018	Dr. Nasrin Sultana PSO
4.	Workshop	Regional workshop on biological safety cabinet technology	Thailand	26-28/11/2018	Dr. Md. Zulfiker Ali SO
5.	Meeting	Transforming livelihoods in Asia through sustainable livestock research and development	Nepal	13-14/11/2018	Dr. Nathu Ram Sarker DG
6.	Meeting	5 th meeting of the SAARC laboratory directions forum	Bangkok	-1-05/10/2018	Dr. Md. Gias Uddin PSO
7.	Workshop	AFACI program workshop on basic agriculture and Animal service	Cambodia	27-31/08/2018	Dr. Nathu Ram Sarker DG
8.	Meeting	First SAARC Regional Animal Health Laboratory Technical Advisory group (lab-tag) meeting	Thailand	17-22/06/2019	Dr. Md. Abdus Samad SSO
9.	Seminar	Invitation as a speaker in the feed additives Asia 2019 seminar	Bangkok	26-28/06/2019	Dr. Nathu Ram Sarker DG

(4) Career development courses

This is the participatory professional training which is offered by other organizations arranged total 47 numbers of career development courses in 2017-18 (Table. 4).

Table 4. Career development courses for the year 2018-19

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
1.	5-8 August, 2018	Clinical lab subject matter expert exchange	Dr. Rezaul Karim, SO	Army Golf Club (Palmview Restuant), Dhaka
2.	7-8 August, 2018	Digital Service Implementation Plan Road map-2021	Dr. Md. Abdul Jalil PSO; Dr. Nasrin Sultana, PSO; Md. Lutful Haque SA	Dhaka
3.	21-26 July 2019	Molecular diagnosis and laboratory surveillance of PPR	Dr. Abu Yousuf, SO	BLRI HQ
4.	29/06/2019	Research Extension Linkage	Dr. Nazmul Huda, SO	Rahamatpur, Barisal
5.	18/06/2019	Future Bansdock : Present status	Dr. Md. Ataul Goni Rabbani, SO; Md. Al-Mamun, Librarian	Bansdock Auditorium
6.	17/06/2019	Consultation meeting on research project formulation on Community based Dairy farming	Dr. Md. Gias Uddin PSO, Dr. Biplob Kumar Roy, SSO	Conference room of KGF, Dhaka
7.	16/05/2019	Consultative workshop on finalization of National Strategic Plan (NSP) for control of Peste des Petis Ruminants (PPR) in Bangladesh	Dr. Md. Gias Uddin PSO, Dr. Md. Abdus Samad SSO, Dr. Abu Yousuf, SO,	BARC, Dhaka
8.	22- 23/05/2019	7 th Fifth Annual Planning and Sustainable Development Goal SDG	Dr. Md. Zillur Rahman, SSO Dr. Md. Rakibul Hasan SSO,	Planning Commission, Ser-e-Bangla, Dhaka
9.	22-05-2019	RCC Development and Conservation – Farmers Program	Dr. Nasrin Sultana, PSO; Md. Lutful Haque SA Dr. Shakila Faruque SSO Dr. Sarder Mohammad	BLRI HQ

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
			Amanullah SSO, Dr. Md. Rakibul Hasan SSO Dr. Gautam Kumar Deb SSO, Md. Shah Alam IO	
10.	05/05/2019	Research Highlights	Dr. Razia Khatun SSO	BARD, Comilla
11.	29/04/2019	Molecular detection and utilization of indigenous sheep of Bangladesh	Dr. Md. Abdul Jalil PSO, Dr. Gautam Kumar Deb SSO, Dr. Md. Ali Akbar Buiyan SSO, Nur-e Hasina Disha SO	Bangladesh Agriculture University, Mymensingh
12.	08/05/2019	Quarterly Media Based Agriculture margin Workshop Srabon – Ashin 1426	Dr. Razia Khatun SSO Md. Sha Alam IO	AIS, Khamarbari, Farmgate, Dhaka
13.	04/04/2019	A1/A2 Milk: Status of Cattle in Bangladesh	Dr. Parven Mushtary SSO, Dr. Md. Ali Akbar Buiyan SSO	National Institute Of Bio-Technology, (NIB)
14.	29/01/2019	NDC implementation plan and engagement in climate markets under article 6 of the Paris agreement	Jobaida Shovona Khanam SO	Conference room, BCAS, Dhaka
15.	06-07/03/2019	“Asia Open Access” Workshop	Dr. Md. Rakibul Hasan SSO	BARC
16.	21/01/2019	Climate Change Related Workshop	Dr. Biplob Kumar Roy, SSO	Ministry of MoFL, Dhaka
17.	24/01/2019	Bangladesh is on the path of prosperity	Dr. Nathu Ram Sarkar, DG	Auditorium of BPATC
18.	19/12/2018	Review Workshop on Matured Technology Developed NARS Institutes (2016-17 to 2017-18)	Dr. Md. Sazedul Karim Sarkar, SSO, Dr. Razia Khatun SSO	BARC
19.	08/08/2018	Nomination of participant for attending The Inception workshop on PBRG sub-projects, PIU-BARC, NATP-2 under Livestock Division,	Dr. Md. Sazedul Karim Sarkar, SSO, Dr. Sarder Mohammad Amanullah SSO, Nazmul Huda SO,	Conference room, SAARC Agriculture Center, BARC

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
20.	14/08/2018	Workshop on Implemented climate tolerant innovative biological living in the coastal region	Jobaida Shovna Khanam SO,	Bonbobhon, Agargao, Dhaka
21.	16/082018	Press Conference	Dr. Biplob Kumar Roy, SSO	Ser-e-Bangla Agriculture University, Dhaka
22.	4-5/08/2018	51 th Annual Planning Conference of BARD	Shamim Ahmed, SSO	BARD, Comilla
23.	14/11/2018 And 20/11/2018	PMU Regional Progress Review Workshop - 2018	Dr. Razia Khatun SSO Md. Yousuf Ali, SO	RDA, Bogra And BINA, Mymensingh
24.	25/08/2018	Development of Agricultural Diploma Education in Bangladesh	Dr. Shakila Faruque SSO	Krishi Khamar Sarak, Farmgate, Dhaka
25.	18/09/2018	The Training courses of the organization gradually transformed into e-learning course	Kamrun Nahar Monira STO, Mr. Lutful Haque SA	KIB, Farmgate, Dhaka
26.	18/09/2018	National Workshop on Strengthening Food Safety Governance in Poultry Sector	Dr. Md. Sazedul Karim Sarkar, SSO,	BARC Center, Mohakhali, Dhaka
27.	31/07/2018	Agricultural Technology Selection and Extinction	Dr. Shakila Faruque SSO, Dr. Razia Khatun SSO,	BARD, Comilla
28.	19/07/2018	“Bangladesh Climate Change Strategy and Action Plan (BCCSAP)” Workshop	Dr. Parven Mustary SSO	Ministry of MoFL, Dhaka
29.	5-6/07/2018	International Seminar on Rice Bran as Animal Feed 2018	Dr. Md. Sazedul Karim Sarkar, SSO, Dr. Sarder Mohammad Amanullah SSO, Dr. Sadek Ahmed SSO, Dr. Noni Gupal Das SSO, Mohammad Khairul Basar SO	BAU, Mymensingh
30.	05/07/2018	SDG Implementation Review (SIR)	Dr. Nathu Ram Sarkar, DG	BICC
31.	05/07/2018	International Seminar	Dr. Nasrin Sultana PSO,	BAU,

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
		on Rice Bran as Animal Feed 2018		Mymensingh
32.	17/07/2018	Video Conference on Development of suitable rural poultry value chain for poverty reduction	Dr. Shakila Faruque SSO	Dhaka
33.	16-18/02/2019	Food security cluster training on livestock emergency guidelines and standards (LEGS)	Md. Yousuf Ali SO,	Hotel Lake Castle, Gulshan-2, Dhaka-1212
34.		ICT Related (Assistant Focal Point)	Mr. Lutful Haque SA, Md. Al-Mamun, Librarian	Farmgate, Dhaka
35.	04-06/03/2019	MIS Module Meeting	Kamrun Nahar Monira STO, Md. Al-Mamun, Librarian, Md. Farid Miah PO, Md. Rezaul Karim, TS Md. Abdus Samad DAE	BARC
36.	24-25/02/2019	MIS Module	Dr. Sarder Mohammad Amanullah SSO, Dr. Gautam Kumar Deb SSO,	BARC
38	19/02/2019	A Training program on molecular techniques in Micro Biology	Dr. Md. Abu Yousuf SO, Dr. Eusha Islam SO, Dr. Anowar Hosen SO, Md. Faizul Hossian Miraz SO, Dr. Sonia Akter SO	CVASU
37.	17-28/02/2019	Online Office Management (13 th batch)	Dr. Md. Azharul Amin, AD	Shobanbag, Mirpur, Dhaka
38.	24-29/11/2018 And 02-07/12/18	“Financial Management” Training	Kamrun Nahar Monira STO, Dr. Anawar Husain SO, Jobaida Shovna Khanam SO, Dr. Md. Ataul Goni Rabbani, SO Dr. Md. Zillur Rahman, SSO Dr. Gautam Kumar Deb SSO,	Shobanbag, Mirpur, Dhaka
39	10-23/06/2019	Training on data center operation & network administration	Mr. Lutful Haque SA,	BARC
40.	23-29/04/2019	Project Formulation and Implementation	Dr. Md. Sahin Alam, SSO	Planning Commission

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
41.	29-30/04/2019	Intellectual Property Rights	Dr. Shakila Faruque SSO, Dr. Biplob Kumar Roy, SSO	BARC
42.	06-11/04/2019	Financial and Procurement Management	Dr. Parven Mustary SSO, Md. Abu Hemayet SO Nazmul Huda SO Md. Yousuf Ali SO, Dr. Md. Habibur Rahman SO, Md. Tarequl Islam SO, Md. Ahasanul Kabir SO	BARC
43.	26-28/2/2018	Training course on Bioinformatics for Sustainable Development in Agriculture	Dr. Gautam Kumar Deb SSO, Dr. Md. Rakibul Hasan SSO,	Farmgate, Dhaka
44.	2-7/03/2019 and 9-14/03/2019	Public Procurement Management	Dr. Md. Ali Akbar Buiyan SSO, Dr. Sadek Ahmed SSO, Dr. Biplob Kumar Roy, SSO Dr. Sazedul Karim SSO	Shobanbag, Mirpur, Dhaka
45.	10-14/03/2019 and 7-11/04/2019	A Training program on molecular techniques in based laboratories	Dr. Md. Abu Yousuf SO, Dr. Eusha Islam SO, Dr. Anowar Hosen SO, Md. Faizul Hossian Miraz SO,	CVASU
46	10-14/03/2019	Application of Economics in Agricultural Research	Sabina Yesmin SO	BRC
47.	02-06/03/2019 and 09-14/03/2019	Procurement Management	Dr. Sazedul Karim SSO Dr. Gautam Kumar Deb SSO, Dr. Biplob Kumar Roy, SSO Dr. Sadek Ahmed SSO,	BIM, Shobanbag, Mirpur, Dhaka
48.	22-24/02/2019	Global Public Health Research Foundation (GPHRF)	Dr. Md. Zulfekar Ali SO,	Uttara, Dhaka
49	24-28/02/2019	Project Development and Management	Dr. Md. Ali Akbar Buiyan SSO,	BRC
50	10 February to 09 June 2019	26 th Foundation Training	Md. Yousuf Ali SO, Dr. Md. Zakir Hasan SO,	NATA, Gazipur
51	03-07/02/2019	Technical Report Writing and Editing	Dr. Md. Zakir Hasan SO,	BARC

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
52	17- 19/02/2019	Climate Change, Carbon Sequestration and adaptation strategies	Dr. Nasrin Sultana PSO,	BARC
53	20/01/2019	Online Complaint Reduction Software Version-2	Mr. Lutful Haque SA	Bangladesh Secretariat
54	17- 23/12/2018	Financial Management of Agriculture based Project	Md. Ashadul Alam SSO	FIMA
55	24- 31/12/2018	Project Appraisal Tools and Techniques	Dr. Shakila Faruque SSO,	Planning Commission, Dhaka
56	19/11/2018 – 01/12/2018	Research Methodology	Nazmul Huda SO Sabina Yesmin SO	Mymensingh
57	13- 18/10/2018	Financial and Procurement Management	Dr. Biplob Kumar Roy, SSO Dr. Gautam Kumar Deb SSO, Dr. Parven Mustary SSO, Shamim Ahmed, SSO Halima Khatun SSO Md. Abu Hemayet SO Md. Yousuf Ali SO,	BARC
58	14- 18/10/2018 And 28- 01/11/2018	Project Development and Management	Dr. Md. Rakibul Hasan SSO, Md. Ahasanul Kabir SO, Md. Yousuf Ali SO, Md. Panir Chowdhury SO	Shobanbag, Mirpur, Dhaka
59	24/10/18 – 05/11/18 and 06-18 /11/18	“Administrative and Financial Management” Training	Dr. Biplob Kumar Roy, SSO Md. Abdur Rashid, SSO Dr. Sarder Mohammad Amanullah SSO, Dr. Sadek Ahmed SSO,	BRDA, Comilla
60	29 September to 01 October 2018	Farming Systems Research & Development (FSRD)	Dr. Md. Abdul Jalil PSO; Kamrun Nahar Monira, STO	BARC
61	03- 15/10/2018	Research Methodology	Md. Redoan Akhond Sumon SO, Dr. Sonia Akter SO,	Mymensingh
62	16/9/2010	Nomination of library professionals to attend	Md. Al-Mamun, Librarian	CVASU

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
		the upcoming seminar		
63	5- 17/09/2018	Research Methodology	Md. Ahasanul Kabir SO Dr. Md. Ataul Goni Rabbani, SO;	Mymensingh
64.	05 August to 02 December 2018	25 th Foundation Training	Dr. Noni Gupal Das SSO, Dr. Md. Abu Yousuf, SO	NATA, Gazipur
65	03/02/2019	“Digital Signature” Training	Dr. Gautam Kumar Deb SSO, Dr. Sarder Mohammad Amanullah SSO, Kamrun Nahar Monira, STO Dr. Md. Rakibul Hasan SSO, Dr. Sadek Ahmed SSO, Dr. Md. Abdus Samad SSO Md. Abdur Rashid, SSO Shamim Ahmed, SSO Dr. Md. Ali Akbar Buiyan SSO, Halima Khatun SSO Mst. Farhana Afroz, SSO Md. Ashadul Alam SSO Dr. Noni Gupal Das SSO, Ashraful Islam EE, Md. Shah Alam IO Shek Md. Mahabubor Rahman AO Md. Masum Billah SM,	Idea Academy, ICT Tower
66	04/02/2019	“Digital Signature” Training	Md. Al-Mamun, Librarian Md. Yousuf Ali Khan, SO Md. Panir Chowdhury SO Mukhlesur Rahman SO, Md. Ahasanul Kabir SO, Nur-e Hasina Disha SO Dr. Md. Ataul Goni Rabbani, SO; Md. Faizul Hossian Miraz SO, Dr. Sonia Akter SO, Dr. Shabiha Sultana SO, Dr. Md. Zakir Hasan SO, Md. Abu Hemayet SO Dr. Md. Zulfekar Ali SO, Dr. Abu Yousuf, SO Sabina Yesmin SO Jobaida Shovona Khanam SO	Idea Academy, ICT Tower
67	05/02/2019	“Digital Signature”	Md. Redoan Akhond Sumon	Idea Academy,

Sl. no.	Date/ Duration	Title	Name of Participants & Designation	Venue
		Training	SO, Dr. Md. Habibur Rahman SO, Dr. Nazmul Huda, SO	ICT Tower
68	30/01/2019	“Digital Signature” Training	Dr. Nathu Ram Sarker DG, Dr. Md. Azharul Islam Talukder, CSO Dr. Md. Gias Uddin PSO, Dr. Md. Ershaduzzaman PSO, Dr. Md. Abdul Jalil PSO; Dr. S.M. Jahangir Hossain PSO,	Idea Academy, ICT Tower
69	19/01/2019	iBAS++ Training	Shek Md. Mahabubor Rahman AO Md. Abul Khair Md. Rakibuddin	IPF
70.	24- 31/03/2019 and 15- 22/04/2019	Policy Analysis	Dr. Gautam Kumar Deb SSO, Dr. Md. Ataul Goni Rabbani, SO;	BIGM, Dhaka And Planning Commission, Dhaka
71.	07- 11/04/2019 And 05- 09/05/2019	Project Formulation and Implementation	Dr. Md. Sahin Alam, SSO Dr. Noni Gupal Das SSO	Planning Commission, Dhaka
72.	19- 23/05/2019	Food Safety and Security Issues in Bangladesh	Dr. Razia Khatun SSO	Planning Commission, Dhaka

5. List of Memorandum of Understanding (MoU), Material Transfer Agreement (MTA) and Letter of Agreement (LOA) of Bangladesh Livestock Research Institute and other organization in this year.

Table 5. List of Memorandum of Understanding (MoU) for the year 2018-19

SL. No.	Country/International Organization	Subject/ Area of cooperation	Date of signing	Progress	Remarks
1.	Bangladesh Livestock Research Institute And International Food Policy Research Institute (IFPRI)	Food technology	08/08/2019	On going	Memorandum of Understanding (MoU)
2.	Sho+TEJ prakritik Khaddo	Nutrition Technology	05/08/2019	On going	Memorandum of Understanding (MoU)
3.	Tokyo University of Agriculture and Technology	Health Technology	07/07/2019	On going	Letter of Agreement (LoA) of Materials Transfer
4.	International Livestock Institute (ILRI)	Livestock Technology	12/11/2018	On going	Memorandum of Understanding (MoU)
5.	IUBAT International University of Business and Agriculture Technology	Livestock Technology	30/03/2019	On going	Memorandum of Understanding (MoU)
6.	Sher-e-Bangla Agricultural University	Livestock Technology	23/01/2019	On going	Memorandum of Understanding (MoU)
7.	Access to Information Programme (A2i)	Training Technology	27/02/2019	On going	Memorandum of Understanding (MoU)
8.	Chittagong Veterinary and Animal Sciences University (CVASU)	Livestock Technology	31/10/2018	On going	Memorandum of Understanding (MoU)

SL. No.	Country/International Organization	Subject/ Area of cooperation	Date of signing	Progress	Remarks
9.	Bangladesh Council of Scientific & Industrial Research (BCSIR)	Leather Technology	24/09/2018	On going	Memorandum of Understanding (MoU)

6. Internship program and Study tour

The internship program and study visit of different college/universities/institutes were arranged by this division at BLRI Head Quarter. Total 47 number of students of Sher-e-Bangla Agricultural University was completed their internship program at BLRI (Table-6). In this current year 718 visitors from 15 different University/Institutes visit BLRI. Details are described at Table-7.

Table 6. Internship programs at BLRI for the year of 2018-19

SL. No.	Name of University/Institute	Date of visit	No. of participants
1.	Shere Bangla Agricultural University, Dhaka	15/10/2018	47
Total			47

Table 7. Study visit programs of BLRI for the 2018-19

SL. No.	Name of University	Date	No. of participants
1.	International Learners School (ILS)	13/07/2019	168
2.	North South University	02/08/2019	120
3.	Biotechnology and Genetics Engineering Department, Jahangir Nagar University, Savar.	21-22/7/2019	38
4.	Exposure visit team, Tanngail Sadar, DLS	02/05/2019	30
5.	Exposure visit team, Nagarpur, Tanngail, DLS	02/05/19	30
6.	R V and F depo, Savar Cantonment	28/04/2019	11
7.	Exposure visit team, ULO Office, Manikgong Gior	27/04/2019	30
8.	Animal Science and veterinary Medicine faculty, SAU	26/03/2019	70
9.	University of Development Agriculture	27/03/2019	25
10.	Biotechnology Department, Jahangir Nagar University, Savar	11/02/2019	30
11.	Moulana Vasani Science & Technology University	18/12/2019	42
12.	Financial management Academy (FIMA)	24/12/2018	18
13.	Biotechnology Department, Jahangir Nagar University, Savar	10/11/2018	30
14.	Leadership for Future Education (a2i teachers)	15/10/2018	10
15.	Zoology Department, Dhaka University	30/09/2019	66
Total			718

7. Workshop/Seminar

Generally this institute organizes the Annual Research Review workshop, to review the completed and ongoing research programs and plan for future agenda of research. The workshop is attended by senior executives and policy makers, NARS scientists and academicians, field-level senior officials of the Department of Livestock Services including NGO's with relevant professional background and interest in livestock research and development. Progress of research is also reviewed in a day-long workshop in the institute and comments and contemplated changes are incorporated to minimize shortfall and ensure right direction of research. Sometimes this division conducts different workshop, seminar to focus the new theme/new entrants. In 2017-18, total 308 numbers of participants have been participated in annual workshop.

Dairy Development Research Project

1. Morphological features and growth traits of half sib local Pabna calves up to yearling stages

Phenotypic features and growth traits are important parameters for breed characterization and performance evaluation. Data of various pre selected phenotypic measures and growth were collected from 18 and 22 half sib Pabna calves, respectively, using measuring tape and digital weighing balance up to 12 months of calving at BLRI Regional Station, Baghabari during March, 2018 to June, 2019. Data analyses of phenotypic measurements were conducted following independent sample t-test and one-way ANOVA of Completely Randomized Design (CRD). Linear increasing trend identified in all morphological features from birth to yearling stages for both body and head characteristics of Pabna calves in which heart girth, wither height, carpal circumference, mouth circumference and head length had significant differences ($p < 0.05$) in male calves compare to female (Table 1). Body weight of Pabna calves also showed linear fashion from birth to yearling stages including strong correlation at first (53%) and yearling (48%), and weak at weaning (7%) stages (Figure 1). the variations of phenotypic feature and growth trait from birth to yearling stages could be used for selection among the G1 (Generation 1) local Pabna calves for further breeding purpose.

Table 1. Effect of sex on morphological features of Pabna cattle calves up to weaning period

Morphological features	Sex	At birth (n=18; M-6, F-12)		Pre-weaning (n=17; M-6, F-11)		Weaning (n=14; M-4, F-10)	
		Mean	SE	Mean	SE	Mean	SE
Body characteristics (cm)							
Heart girth (HG)	Male	63.33	1.31	91.83	2.18	101.00	2.58
	Female	59.42	0.74	86.50	1.00	102.90	1.92
	<i>P value</i>	0.013		0.022		0.594	
Wither height (WH)	Male	65.83	1.01	84.17	0.60	90.50	1.71
	Female	64.58	0.69	79.77	0.69	88.15	0.86
	<i>P value</i>	0.317		0.000		0.196	
Carpal circumference (CC)	Male	10.50	0.50	11.17	0.17	12.13	0.31
	Female	9.25	0.22	10.86	0.14	12.05	0.41
	<i>P value</i>	0.016		0.193		0.915	

Head characteristics (cm)							
Mouth circumference (MC)	Male	21.33	0.33	26.58	0.76	31.00	1.00
	Female	20.17	0.27	24.73	0.48	29.20	0.74
	<i>P value</i>	0.020		0.047		0.204	
Head length (HL)	Male	21.25	0.40	30.08	0.99	33.88	0.83
	Female	21.08	0.36	27.45	0.35	32.70	0.26
	<i>P value</i>	0.779		0.007		0.094	

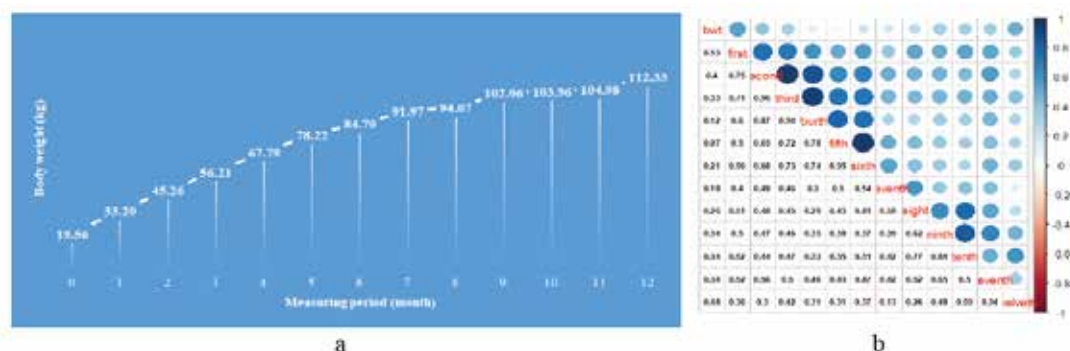


Figure 1. Body weight of Pabna calves up to yearling stages (a) including correlation (b) among the periods

2. Test-day and adjusted full lactation yield of local Pabna cows in Bangladesh

The local Pabna cows are more promising among the native cattle varieties in Bangladesh. Data of 320 test-day milking (15 days' interval started from 6th day after parturition) were collected from 21 local Pabna cows having 1-3 parity number during January, 2018 to June, 2019 (DDRP-BLRI solution, Source Trace System, Massachusetts, USA). Adjustment factors (morning to evening) were calculated based on percentage from the 1st to 21st test days' milking and these factors were used to calculate the missing evening milking (out of test day) for 305 days full lactation yield. Multivariate analysis using GLM (General Linner Model) under Randomized Complete Block Design (RCBD) was applied including Bonferroni post hoc mean separation test. The effect of dam parity, calving season and lactation stages showed significant differences ($p < 0.05$) on test-day milking (Figure 1) after fifth day of calving (Table 1). Based on 305 days of lactation (Figure 1), the cows covered full lactation provided statistically ($p < 0.05$) higher milk (1037.67 ± 94.68 L) than those cows (734.91 ± 57.95 L) having lower lactating days. The parity number and body weight of dam, calving season and calves' birth weight, lactation stage, and lactation length could be considered as section parameters for local Pabna cows considering total milk yield.

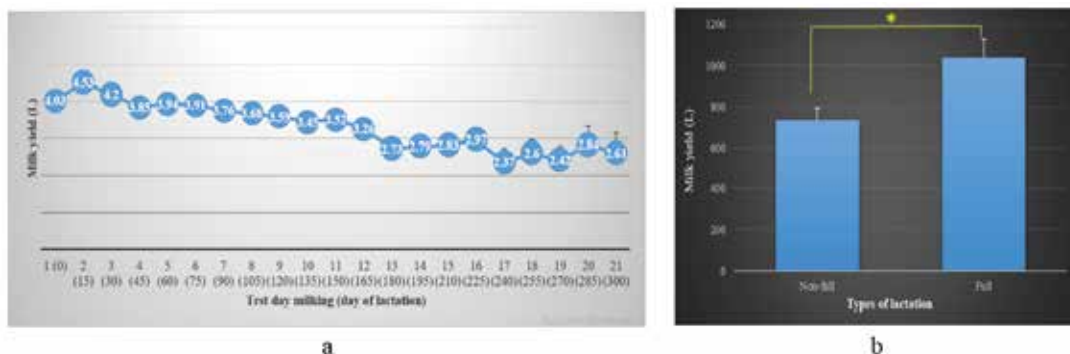


Figure 1. Milk yield up to 300 days of lactation (a) including types (b) in local Pabna cows

Table 1. Effect of dam parity, calving season and lactation stages on milk yield of local Pabna cows

Variable	n	Milk yield (L)		Minimum	Maximum	P value
		LSM	SE			
Parity						
1 st	50	2.72 ^b	0.18	0.64	7.40	0.000
2 nd	258	3.54 ^a	0.08	0.78	9.10	
3 rd	12	4.06 ^a	0.33	2.60	6.60	
Calving season						
Summer	68	3.74 ^a	0.16	1.76	6.20	0.001
Rainy	56	3.39 ^{abc}	0.25	1.44	5.51	
Autumn	51	3.08 ^{abc}	0.18	1.27	4.77	
Late autumn	42	2.50 ^c	0.25	0.64	7.84	
Winter	51	3.55 ^{ab}	0.19	0.78	9.10	
Spring	52	3.63 ^{ab}	0.16	1.42	7.40	
Lactation stage						
0-105 th day	147	4.00 ^a	0.13	1.41	9.10	0.000
106 th -210 th day	116	3.09 ^b	0.14	1.40	5.78	
211 th -305 th day	57	2.48 ^c	0.19	0.64	4.50	

Interactions						
Parity*Season						0.008
Season*Lactation stage						0.053
Parity*Lactation stage						0.679
Parity*Season*Lactation stage						0.071

3. Development of mobile and web-based data recording applications for Dairy Development Research Project

Data recording is utmost important for farm management and conducting research. Except few research station or farms, data recording is not available in the dairy sector of Bangladesh, while it can be done well with the utilization of digital data recording. Thus, the Dairy Development Research Project (DDRP) of Bangladesh Livestock Research Institute (BLRI) looked for database software to establish a digital data recording system leading its smart dairy research initiatives. The data recording system of DDRP-BLRI applications includes genotype-based pedigree history of individual cattle with climate changing parameters (Figure 1). This software incorporated cattle and calf enrollment with cattle herd book, characterization, growth, breeding and reproduction, milking cows, dairy characteristics, semen characteristics, daily feeding, body condition and health modules (Figure 2). There are few supporting modules (weather, transaction summary, cattle list, settings, exit etc.) added with mobile's applications for facilitating enumerator works. This software enables to capture farm pictures with GPS coordinates and physical positioning on maps, in addition, input (feeding, vaccinations, deworming etc.) and output (milk yield, physio-chemical parameters of milk and semen, growth etc.) tracking. Additionally, it has been using for breed history tracking that would contribute to develop a digital cattle herd book for individual animal considering a lifetime certificate. After inputting primary data in that software, all those data can be downloaded either by excel or pdf format from report section of that applications to analyze in future.

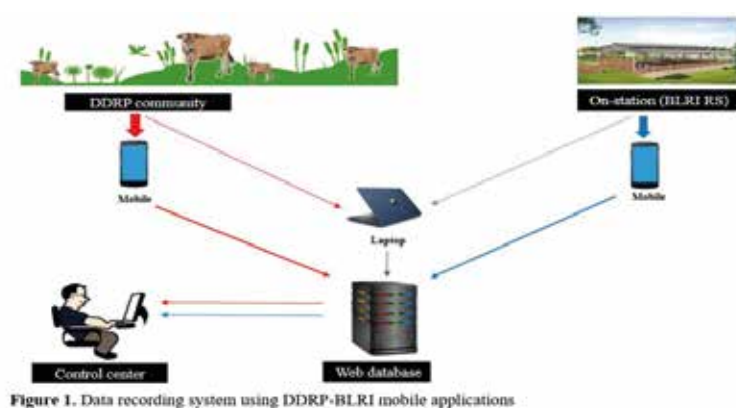


Figure 1. Data recording system using DDRP-BLRI mobile applications

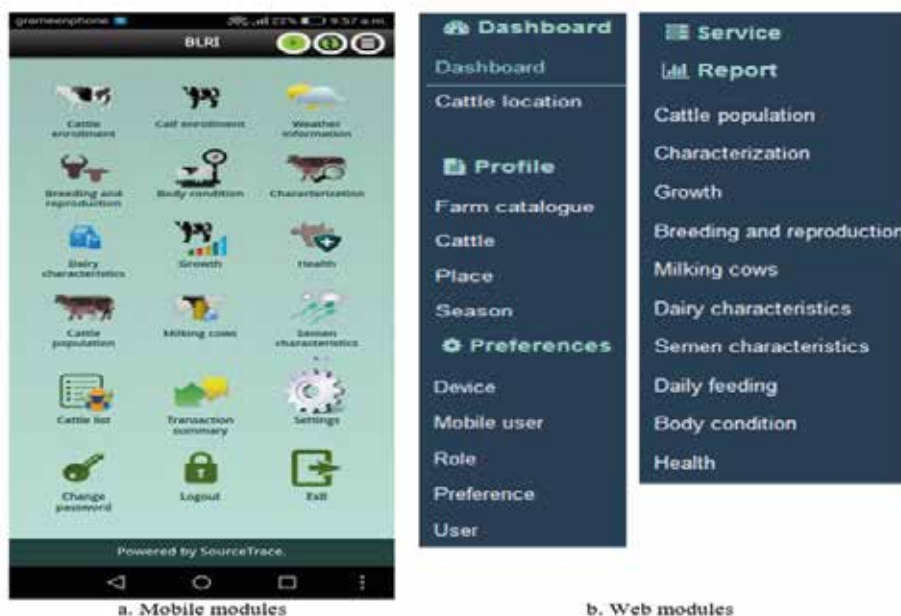


Figure 2. Modules of DDRP-BLRI applications

4. Effect of nitrogen fertilizer on morphological parameter, biomass yield and nutritive value of Napier fodder

Nitrogen is one of the major essential plant nutrients before phosphorus and is the most deficient plant nutrient. For the work soil samples were analyzed for soil pH, nitrogen, organic matter, salinity, Ca, K, S, Zn, Pb, Co, Mg, Fe etc. at the Central Laboratory of Soil Resource Development Institute (SRDI), Dhaka. The pH value, organic matter, total nitrogen (N), potassium (K), calcium (Ca), phosphorus (P), sodium (Na) content of the soil was 6.20, 1.75%, 0.088%, 0.15 millitilanko/100g, 8.05 millitilanko/100g, 11.66 millitilanko/100g, 0.15 millitilanko/100 g, respectively. The experiment was conducted by using 4 levels of Nitrogen fertilizer namely 0 (T1), 50 (T2), 100 (T3) and 150 (T4) kg Urea/ha at 12 plots. All the recorded data were analyzed using 'SPSS' statistical program to compute analysis of variance following one way ANOVA for Completely Randomized Design (CRD).

Effect of nitrogen fertilizer doses on morphological characteristics and biomass yield of Napier fodder is presented in Table 1. The result showed that the application of nitrogen fertilizer had significant ($p < 0.01$) effect on plant height. The highest plant height (235.44 ± 8.79 cm) obtained at 100 kgN/ha (T3) at 60 days age. The biomass yield was highest on T4 group (101.76 ton/hector). The effect of nitrogen fertilizer base on chemical composition of Napier fodder showed Table-2. Therefore, the application of N (Nitrogen) at the rate of 150 Kg/ha could be used for Napier grass production.

Table 1. Effect of nitrogen fertilizer doses on morphological characteristics and biomass yield of Napier

Performance parameter	Measuring unit	Groups (Mean \pm SE)				P value
		T1	T2	T3	T4	
Plant height	Centimeter	186.33 \pm 8.06 ^b	230.0 \pm 4.97 ^a	235.44 \pm 8.79 ^a	226.55 \pm 6.71 ^a	0.000
Stem length	Centimeter	87.11 \pm 6.35 ^a	94.55 \pm 6.06 ^a	86.88 \pm 4.58 ^a	99.11 \pm 2.55 ^a	0.281
Leaf length	Centimeter	95.11 \pm 2.40 ^{ab}	91.11 \pm 4.52 ^b	104.55 \pm 3.97 ^a	102.33 \pm 0.98 ^a	0.023
Leaf wide	Centimeter	2.74 \pm 0.16 ^b	3.76 \pm 0.49 ^a	2.74 \pm 0.13 ^b	3.31 \pm 0.19 ^{ab}	0.045
Leaf per stem	Number	13.11 \pm 1.59 ^a	14.66 \pm 0.66 ^a	14.55 \pm 1.68 ^a	13.11 \pm 0.67 ^a	0.699
Till per hill	Number	7.00 \pm 0.50 ^b	5.00 \pm 0.28 ^c	4.66 \pm 0.16 ^c	9.66 \pm 0.16 ^a	0.000
Yield per hill	Kg	1.16 \pm 0.14 ^c	1.95 \pm 0.08 ^b	1.34 \pm 0.07 ^c	2.36 \pm 0.04 ^a	0.000
Biomass yield	Ton/hector	50.02 \pm 6.26 ^c	84.13 \pm 3.83 ^b	57.62 \pm 3.01 ^c	101.76 \pm 1.89 ^a	0.000

N.B: T1 (0 kg Urea/ha), T2 (50 kg Urea/ha), T3 (100 kg Urea/ha) and T4 (150 kg Urea/ha)

Table 2. Effect of nitrogen fertilizer doses on chemical composition of Napier fodder

Parameter	Measuring unit	Groups (Mean \pm SE)				P value
		T1	T2	T3	T4	
DM	%	20.29 \pm 0.25 ^{ab}	19.97 \pm 0.17 ^b	20.31 \pm 0.28 ^{ab}	21.03 \pm 0.16 ^a	0.042
CP	%	11.81 \pm 0.12 ^c	12.87 \pm 0.18 ^b	12.69 \pm 0.19 ^b	13.78 \pm 0.06 ^a	0.000
ADF	%	40.64 \pm 0.08 ^c	40.52 \pm 0.07 ^c	43.07 \pm 0.02 ^b	43.60 \pm 0.04 ^a	0.000
NDF	%	63.18 \pm 0.12 ^c	63.52 \pm 0.07 ^b	64.01 \pm 0.06 ^a	64.27 \pm 0.04 ^a	0.000
Ash	%	9.89 \pm 0.04 ^a	8.84 \pm 0.01 ^c	9.04 \pm 0.08 ^b	9.14 \pm 0.12 ^b	0.000

N.B: T1 (0 kg Urea/ha), T2 (50 kg Urea/ha), T3 (100 kg Urea/ha) and T4 (150 kg Urea/ha)

5. Comparison on different morphological parameter, biomass production and nutritive value of three fodder germplasms

Scarcity of animal feeds and fodder has been identified as a major constraint for the development of livestock in Bangladesh. The comparative agronomical trial was conducted at BLRI Regional Station, Baghabari, Shahajadpur, Sirajganj where the experiment was laid out in a Completely Randomized Design (CRD) with three treatments (Napier-4, Pukchong and Jumboo- Australian sweet) and each treatment having three replications. Three plots for every treatment having homogenous soil parameters were taken and the plot size was 17ft \times 10ft. The first cut was made at 55 days after the stem sowing and then subsequent harvest was made at 40 days after each cutting. The result showed that plant height, stem length of three fodder differed significantly and highest plant height (267.00 \pm 13.45 cm) was observed at Napier but highest stem length was measure at Jumboo fodder. A significant effect ($p < 0.01$) in biomass yield was observed between the groups and highest yield (182.00 \pm 4.04 Ton/ha) was observed at Napier fodder (Table 1). Comparison on morphological characteristics and biomass yield of three fodder germplasms is presented in Table2. The findings (at 55 days age) of the study

showed that there were no significant differences ($p>0.01$) among the groups for DM, CP and ADF content but highest CP (17.37 ± 0.36) and ADF (42.83 ± 0.85) were observed at Pukchong grass and similarly highest DM (18.48 ± 0.40) was observed at Napier grass. Thus, among the three fodder germplasms, Napier fodder was superior for biomass production while Puctune was better for nutritive values.

Table 1. Comparison on morphological characteristics and biomass yield of three fodder germplasms

Parameter	Measuring unit	Groups (Mean \pm SE)			P value
		Napier	Puctune	Jumboo	
Plant height	Centimeter	267.00 \pm 13.45	220.00 \pm 11.23	263.33 \pm 8.81	0.000
Stem length	Centimeter	158.00 \pm 24.84	112.66 \pm 8.83b	174.66 \pm 22.87	0.006
Leaf length	Centimeter	91.00 \pm 9.00	102.66 \pm 4.17	82.66 \pm 2.90	0.145
Leaf wide	Centimeter	4.16 \pm 0.60	3.16 \pm 0.44	6.66 \pm 0.66	0.004
Leaf per stein	Number	18.33 \pm 3.17	16.66 \pm 1.45	21.64 \pm 3.48	0.499
Till per hill	Number	17.33 \pm 0.88	7.66 \pm 0.33	7.00 \pm 0.57	0.000
Yield per hill	Kg	5.20 \pm 0.11	2.20 \pm 0.15	1.93 \pm 0.33	0.000
Biomass yield	Ton/hector	182.00 \pm 4.04	85.80 \pm 5.95	75.40 \pm 13.00	0.000

Table 2. Comparison on nutritive value of three fodder germplasms

Parameter	Measuring unit	Groups (Mean \pm SE)			P value
		Napier	Puctune	Jumboo	
DM	%	18.48 \pm 0.40	17.37 \pm 0.36	17.94 \pm 0.14	0.133
CP	%	11.36 \pm 0.21	13.90 \pm 0.20	12.52 \pm 1.22	0.303
ADF	%	40.53 \pm 0.22	42.83 \pm 0.85	41.17 \pm 0.49	0.076
NDF	%	63.85 \pm 0.28	62.33 \pm 1.15	69.01 \pm 0.69	0.004
Ash	%	8.58 \pm 0.09	10.31 \pm 0.30	8.87 \pm 0.11	0.001

6. Prevalence of different dairy cattle diseases in selected dairy areas and farms of Bangladesh

The present study was designed to have a comprehensive epidemiological data of the circulating diseases in the Nucleus breeding herd (NBH) and the community of Dairy Development Project of BLRI. A total of 1250 clinical cases of cattle of different breed and sex were diagnosed during the period from July 2018 to June 2019. Parasitic infestations were diagnosed by faeces examination under microscope (Soulsby, 1986). Blood smears were prepared and examined under microscope after Giemsa's staining. The prevalence of endo-parasites, bovine ephemeral, foot rot, nonspecific diarrhea and postpartum anoestrus were higher among the parasitic, viral, bacterial, digestive disorder and reproductive disorder respectively. In case of other diseases, there were not any significant difference between on station and community. Nonetheless, in paired t-test, there is no significant difference in the

pattern of diseases. The descriptive statistics suggested that Endo-parasites (10.56 %), Bovine Ephemeral Fever (10.97%), Non-specific Diarrhea (10.51 %) and Post-partum anoestrus (8.43 %) are the most prevailing diseases in the community and Foot-rot (26.82%), Maggot infestation (14.06%), Endo-parasites (9.38%), UTIs (9.12%) and Hump sore (3.65%) are the most prevailing diseases in the NBH (Nuclear Breeding Herd).

7. Prevalence of sub-clinical mastitis in Pabna cows and high yielding crossbreeds and its control strategies

Bovine mastitis is the costliest disease of dairy cattle due to economic losses from reduced milk production, treatment costs, increased labour, milk withheld following treatment, death and premature culling. The present study was taken the prevalence of SCM (Sub Clinical Mastitis) in selected dairy areas and to develop prophylactic treatment and management practices.

Table 1. Farming practice in the study area

Parameter	Homestead	Farm	Bathan	% Adoption of the good practice
No. of cows	42 (18 farms)	45 (6 farms)	34 (3 farms)	-
Barn type Free	Open stall-tethered	In house-tethered	Open stall-natural Free	-
Floor type	Muddy & unclean	Watery & unclean	Muddy & unclean	0
Milking	At the barn	At the barn	At the barn	0
Milking machine	Not used	Not used	Not used	0
Feeding	Before milking	Before milking	Before milking	0
Post milking teat-dipping	No	No	No	0
Dry cow therapy	No	No	No	0
Periodic use of CMT	No	No	No	0
Post-milking udder massage	No	No	No	0
Milking interval (hours)	Not fixed, 9-12	Not fixed, 11-13	Not fixed, 9-12	-

The study areas were the NBH (Nuclear Breeding Herd) and the community of the Dairy Development Research Project. California Mastitis Test (CMT) was performed in three parameters (weak, distinct and strong) healthy cows to study the prevalence. Commercial anti-mastitis preparation, vit-E and selenium supplementation was given to CMT positive cows

(Data not shown).The study showed that prevalence of different types of SCM varied significantly ($p < 0.001$) within the two genotypes of cattle and in their quarter (Table 2) while the difference was non-significant ($p > 0.05$) between the two genotypes (59.61% in Pabna and 53.96% in crossbreds). Although clinical mastitis was absent in Pabna cattle but SCM was present in higher percentage.

Table 2. Prevalence and severity of subclinical mastitis in lactating cows

Genotype	Types	Total No. Tested	Positive No. (%)				Negative No. (%)	Level of sig.
			Weak	Distict	Strong	Total		
Pabna	Cows	52	14 (26.92)	4 (7.69)	13 (25)	31 (59.61)	21 (40.39)	0.000***
	Quarters	208	48 (23.08)	20 (9.62)	19 (9.13)	87 (41.83)	121 (58.17)	0.000***
Cross	Cows	63	6 (9.52)	10 (15.87)	18 (28.57)	34 (53.97)	29 (46.03)	0.000***
	Quarters	252	36 (14.28)	30 (11.90)	28 (11.11)	94 (37.30)	158 (62.70)	0.000***
Overall	Pabna	52	14 (26.92)	4 (7.69)	13 (25)	31 (59.61)	21 (40.39)	0.076 ^{NS}
	Cross	63	6 (9.52)	10 (15.87)	18 (28.57)	34 (53.96)	29 (46.04)	

Anti-mastitis drugs can successfully reduce the severity of SCM in lactating cows. In 11 identified cows with different severity of SCM we used a commercial anti-mastitis drug (MasticareR, Square, Dhaka, Bangladesh). The recommended dose (30 gm/cow/day) for 7 days was effective and 9 days treatment made all the cows negative for CMT. In the community we conduct campaign and training for hygienic milking, udder health management and general healthcare to reduce the SCM. But after one year we found 57.65% CMT positive cows in the community. In this study period, clinical mastitis was absent in the NBH and scanty in the community which should be investigated further.

Fodder Research and Development Project

1. Study on production, nutritive value and land use efficiency of fodder maize (*Zea mays*) intercropped with alfalfa (*Medicago sativa*)

This research was conducted at BLRI to study the yield, quality and land use efficiency of fodder maize intercropped with alfalfa. 40 plots (25m²/plot) were laid out in five blocks with 8 treatments (four sole crops and four intercrops with two sowing methods; line and broadcasting for each combination). The seed rates of maize and alfalfa were 40 and 15 Kg ha⁻¹, respectively for sole cropping, while rates of both fodders were halved in intercropping. Fodder maize was harvested at every 60 days after plantation, while alfalfa was first harvested at 60 days after sowing and subsequent harvests were done at 30 days interval. Data from 4 harvests of alfalfa and 3 harvests of maize was collected and analyzed statistically. Highest biomass and dry matter yields (170.64 and 20.65 tones ha⁻¹, respectively from all harvests) were obtained from fodder maize monoculture and lowest (30.21 and 5.96 tones ha⁻¹, respectively) from alfalfa monoculture. CP yields in intercrops (2.90 tones ha⁻¹) were higher than sole crops (2.164 tones ha⁻¹). CP% in intercrop maize fodder was higher than sole crop. Lowest N-uptake was observed in fodder maize monoculture (10.29 kg ha⁻¹) and highest in alfalfa monoculture (38.42 kg ha⁻¹). Highest residual-N was obtained in alfalfa monoculture (2360 kg ha⁻¹) and lowest (1880 kg ha⁻¹) in intercrop. Land equivalent ratios of intercrops were more than 1 (1.53-1.77), indicating higher efficacy of intercropping yields. The competition indexes of intercrops yields were less than 1 (0.09-0.44), which means that intercropping is more profitable than monoculture yields. Thus, it was revealed that maize fodder intercropped with alfalfa was better than mono culture in terms of CP yields. Further, intercropping of alfalfa enhanced the nutrient quality of fodder maize.

2. Evaluation of new developed lines from BLRI Napier-3 cultivar under saline condition in coastal region of Bangladesh

Saline intrusion is widely considered to have a negative impact on agriculture, reducing plant growth and decreasing productivity as well as grazing land and fodder crops for livestock production. Salinity level fluctuates due to season and different geographical areas. In the view of developing salt tolerant Napier cultivar, BLRI Napier-3 cultivar was exposed to gamma rays (Gys) irradiation along with micro-propagated by tissue culture technique. The objective of this research was to assess the survivability and growth performance of new developed lines from Napier-3 on traditional agronomical practices in Debhata upazila of Satkhira district under soil and water salt stress during wet (June- November) and dry seasons (December-May). In wet season, soil EC was estimated as 3.65±0.51 dS/m which significantly ($p<0.05$) increased as 5.02±0.63 dS/m in dry season. Water EC in dry season (11.98±0.12 dS/m) was significantly ($p<0.01$) higher than in wet season (4.95±0.09 dS/m). Survivability between control and different lines in wet and dry season showed significant variations ($p<0.01$). Highest survivability was obtained in Line-2 in both seasons. Biomass yield varied significantly ($p<0.01$) among lines in both seasons. Highest biomass yield was obtained in Line-2 and Line-3 in both

seasons. Number of tillers per clump differed significantly among lines in both seasons. Highest tillering was obtained in Line-2 in both seasons. Plant height influenced significantly ($p < 0.01$) for different lines in both seasons and mutant lines had shown to be higher plant height than control line. Highest plant was obtained in Line-2 in both seasons. LSR differed significantly among different lines in wet season but did not differ in dry season. In wet season, LSR in Line-1 was significantly higher than other lines. Mutant Line-2 performed better than control and tissue culture line. Due to low level of salinity, overall performance seemed to be higher in wet season.

3. On-farm validation of TMR technology for fattening cow

Owing to get more profit by reducing feed cost, this experiment was carried out to know the effect of feeding maize stover based complete ration (TMR) on feed intake and efficiency, growth and economic outcome in fattening bulls. Three farmers each having five fattening bulls were selected from Sharif Bagh at Dhamrai upazila, Dhaka. Three animals from each farmer were given TMR and rest two animals were given conventional feeds. Before experiment, all animals were de-wormed followed by a 7 days adjustment period along with next 53 days trial periods. The dry matter (DM), crude protein (CP) and metabolizable energy (ME) in TMR were around 60%, 15% and 9.70 mega joule (MJ)/kg DM. TMR was prepared every day and supplied to animals along with clean drinking water ad lib. Fresh feed, DM and ME intake by animals in conventional feeding group was significantly higher than TMR feeding group (23.81 ± 0.54 kg, 8.93 ± 0.46 kg and 87.73 ± 5.48 MJ/day vs 10.78 ± 0.70 kg, 6.37 ± 0.43 kg and 61.76 ± 4.15 MJ/day), but CP intake did not differ between groups (1.06 ± 0.07 kg/day vs 0.97 ± 0.06 kg/day). Feed utilization efficiency expressed as feed conversion ratio (FCR) of TMR group (6.67) was better than opposite group (13.35). Body weight gain of animals in TMR group (0.955 ± 0.03 g/day) was significantly higher than another group (0.669 ± 0.01 g/day). Based on the economic analyses, net return from a single fattening animal within 53 days TMR feeding was BDT 15570.00, giving a benefit cost ratio (BCR) of 1.24. While in counterpart, net return was BDT 8946.00 with BCR 1.13. Hence, maize stover based TMR feeding can improve body weight gain and feed utilization efficiency, with concurrent higher profit margin from fattening bulls.

Red Chittagong Cattle Research and Development Project

1. Development of low input community breeding model for Red Chittagong Cattle

Red Chittagong Cattle (RCC) is one of the promising variety of cattle in Bangladesh. The habitats of these cattle are greater Chattagram and hill tracts. This variety evolved in the locality by natural selection and breeding among themselves for a long historic period. Purebred populations are declining due to indiscriminate breeding within the native stock and crossbreeding with exotic breeds. In order to maintain the purity of Red Chittagong Cattle, it is important to maintain the purity during breeding with either natural mating or artificial insemination. Thus, the present study was designed with the objectives to develop a sustainable community led pure breeding program for Red Chittagong Cattle. For the formation of model RCC community, farmers having at least one RCC cow or heifer preferably nearest peripheral circle was selected and registered under the project in the selected upazilla of Chattogram division. To ensure semen of pure meritorious RCC bull for the community members, semen collection, evaluation and cryopreservation was done at BLRI. Six (6) pedigree tested pure meritorious RCC bull was supplied to DLS for production of frozen semen. Both BLRI and DLS ensure the supply of RCC frozen semen to the community on regular basis for artificial insemination to maintain purity of Red Chittagong cattle. The mean volume, concentration, total, progressive, and static motility of fresh semen were 3.94 ± 1.15 , 1638.42 ± 923.51 , $77.68 \pm 13.48\%$, $57.59 \pm 14.42\%$, $22.37 \pm 13.47\%$ respectively. The mean total, progressive, and static motility of frozen semen were 67.57 ± 2.99 , $46.86 \pm 2.79\%$, $32.12 \pm 3.24\%$ respectively. Till date 15000 doses of frozen semen has been prepared and distributed and 128 AI (Patia=23, Chandanaish=12, Anowara= 18, Satkania =18, Hathazari=27, Swandip =30) were done so far in the project. A total 300 farmers were selected in 6 upazilla of Chattogram district where 415 animals (Adult cow, heifer, bull and calf) were registered. Among the registered animals 77.11% were adult cow and 58.31% were registered as RCC. Among the registered adult cow overall 40% animals were inseminated so far by using pure RCC semen. All the reproductive data of the animals are being recorded in a herd book maintained by community farmers. The ongoing artificial insemination programme may results more number of graded RCC cattle in the community that will eventually results conservation of this germplasm in the community.

2. Adaptation of ovum pick up based in vitro embryo production technology for production of Red Chittagong calves

Ultrasound-guided transvaginal ovum pick-up (OPU) is a technique used to collect oocytes from live cows for the production of in vitro embryo for genetic up-gradation as well as for conservation purposes. At present, the government has taken initiative to improve the production potential of Red Chittagong cattle and conserve them for future use. Considering these facts, the present research program was designed to adopt OPU technology for the collection of oocyte from donor cow followed by blastocyst production and transfer into the uterus of recipient RCC cows for multiplication of genetically high yielding RCC cows. For this

purpose, follicular dynamics and hormonal level during the estrus cycle was studied using five RCC cows and five RCC heifers. Follicular wave emergence (Day 0) was identified using trans-vaginal ultrasound technique and follicular growth was then monitored from Day 0 to Day 23 during three consecutive estrus cycle and blood samples were collected. After measuring the growth and diameter of the follicles, hormonal assays of collected blood samples were performed using Enzyme Linked Immunosorbent Assay (ELISA). From experimented animals, it was observed that there were no significant differences ($p>0.05$) for the length of the estrus cycle between RCC cows and heifers and the value was 20.00 ± 1.50 and 19.00 ± 1.70 days, respectively. Moreover, in both in RCC cow and heifer two follicular waves were observed. The first follicular wave occurred the day after ovulation, and an average of 8.33 ± 2.06 and 10.00 ± 2.72 follicles for RCC cows and RCC heifers respectively were observed on the ultrasound. Follicular deviation in the first wave took place at 4.00 ± 2.00 days for RCC cows and 4.62 ± 1.84 days for RCC heifers, with a diameter of the dominant follicle of 10.00 ± 1.4 mm and 8.9 ± 1.7 mm, respectively. Moreover, the second wave of follicular growth began at 14.00 ± 1.00 days for RCC cows and 13.50 ± 1.00 days for RCC heifers. An average of 8.37 ± 2.26 and 8.00 ± 1.51 follicular structures was ultrasonographically observed for cows and heifers, respectively. The second wave of follicular growth started on day 12.21 ± 3.10 with 6.50 ± 1.70 follicles recruited. The maximum diameter reached by the preovulatory follicle was 12.00 ± 1.60 mm for RCC cows and 11.00 ± 1.90 mm for RCC heifers. When comparing the waves of follicular growth among themselves, regardless of the group, it was found that the interval since the emergence of the wave to the deviation of the dominant follicle was 4.29 ± 1.89 , 3.29 ± 2.17 days for the first and second wave, respectively; likewise, the number of follicles was 9.11 ± 2.47 and 8.18 ± 1.86 . Finally, the diameter of the dominant follicle in the deviation was 9.56 ± 1.58 mm for wave one, 9.75 ± 1.67 mm. The maximum luteal diameter was 17.58 ± 4.16 mm for RCC cows and 18.74 ± 3.32 mm for RCC heifers. Luteal regression took place at 15.22 ± 5.26 and 17.62 ± 1.68 days of the oestrous cycle for RCC cows and RCC heifers, respectively. Hence, the knowledge about ovarian follicular waves will create a base line for reproductive management of RCC as well as to allow reproductive biotechnologies to improve and multiply this cattle variety.

3. Identification of candidate gene markers for prediction of RCC sperm quality and fertility

The present cattle breeding policy encouraging artificial insemination (AI) program throughout the country to increase productivity of milk and meat. Purebred populations are declining due to indiscriminate breeding within the native stock and crossbreeding with exotic breeds. In order to maintain the purity of indigenous genetic resources like Red Chittagong Cattle, it is important to maintain the purity during breeding with either natural mating or Artificial insemination. But in both cases, quality of the breeding male is most important as artificial insemination allows semen from one bull to be used to inseminate thousands of females. Thus, bull effects are paramount on herd genetics, dynamics, and production. Use of sperm from a low fertility (or infertile) bull leads to lower pregnancy rates, which results in greater economic costs of housing these bulls and non-pregnant cows. Evaluation and early prediction of fertility of RCC bull before mass AI will results more conception rate as well as more calves

and reduces the cost of rearing low fertility bull in the breeding center. Therefore this study was designed to identify molecular markers associate with fertility of bulls. During this study period, twelve (12) RCC bulls were selected considering their true breed characteristics and pedigree record. The selected bulls were trained for semen collection. Semen was collected from each bull using artificial vagina method twice in a week. After initial evaluation with computer assisted semen analyzer (CASA), semen sample was diluted with extender to give a sperm concentration of 20 million/dose. Diluted semen was placed in a cold handling cabinet (Minitube, Germany) for 4 hr at 4°C for equilibration. The semen samples were filled and sealed in standard printed straws (0.25ml) using an automated sealing filling machine. After equilibration, freezing of straws was carried out in liquid nitrogen (LN2) vapor using a programmable bio-freezer (Minitube, Germany). The straws were then plunged in LN2 (-196°C) for overnight storage. Data were analyzed using Microsoft excel programme. The mean volume, concentration, total, progressive, and static motility of fresh semen were 3.94 ± 1.15 , 1638.42 ± 923.51 , $77.68 \pm 13.48\%$, $57.59 \pm 14.42\%$, $22.37 \pm 13.47\%$ respectively. The mean total, progressive, and static motility of frozen semen were 67.57 ± 2.99 , $46.86 \pm 2.79\%$, $32.12 \pm 3.24\%$ respectively. Bulls were categorized into three groups on the basis of fresh and frozen semen quality and motility. Prepared frozen semen straws are using for AI to evaluate their fertility potentiality. Gene expression analysis will be carried out in coming year with frozen semen of studied bulls.

3. Development of herd book based RCC recording system at the community level

Red Chittagong Cattle (RCC) is one of the promising variety of cattle in Bangladesh. The habitat of these cattle are greater Chattagram and hill tracts. Notably, there is no evidence of foreign blood in RCC which have been developed in the locality by natural selection and breeding among themselves for a long historic period. But, this potential variety is under the threat of extinction due to indiscriminate crossbreeding across the country, especially in their home tract. Thus, an in-depth study on this type of cattle is our national demand in the perspective of conservation and improvement of local animal genetic resources (AnGRs). Therefore, Bangladesh Livestock Research Institute (BLRI) had been taken initiative for conservation and further improvement of RCC through selective breeding and applying biotechnological tools since 2001. But due to interruption of succeeding activity for a long period, the outcome has not yet been reached up to the mark of expectation. Recently, BLRI has been implementing second phase of the previous research work taking a wider range of areas in the country. Community based breeding program is being conducted for the conservation and improvement of RCC. Pedigree & recording system is the utmost breeding tool for genetic improvement of livestock. Moreover, herd book is an essential component for the successful breeding operation of the breeding farm or community breeding programs. Considering this fact, the objective of this activity was not only adopting farmers for keeping records of their animals but also establishing a central information recording hub of Red Chittagong Cattle. For this purpose, a farmer's friendly herd-book was formulated by analysis of different forms of herd book used by farmer and their recording system. Then the hard book was pretested and disseminated to the selected farmers of the project area. Moreover, Animals of the farmers were numbered using tattoo machine. A total 300 farmers were

selected from six project areas (Anwara, Chandanish, Hathazari, Patiya, Sandwip, Jaintiapur) having local or RCC cattle and 514 animals were numbered. To accustom with recordkeeping on herd-book, three days of training in each project area was conducted. Moreover with the help of scientific officer and community assistant proper recording was monitored. After baseline data collection, it was analyzed using SPSS software. After data analysis, it was observed that (Table:1) among selected animals 50.40% animals were non-descriptive and 49.60 % were RCC cattle. Non descriptive cattle were dominating on Jaintiapur, Sandwip, Anwara and Patiya. However, RCC cattle was dominating on Hathazari and Chandanish. For genetic up-gradation artificial insemination was conducted using frozen semen obtained from RCC bull NO. 387,499 and 323. AI activity was on going and still now a total 99 AI was conducted among them highest number of AI was conducted in Anwara but lowest number was Jaintiapur and the values were 50% and 2% respectively of total cattle numbered. Moreover, RCC bull were using for reproduction but the value was very poor (0.80%). Among the project area service per conception rate was higher in Anwara and among inseminated animal 25.80% animal showed repeated heat. The second highest was in Patiya (1.33 %). Beside breeding vaccination and deworming activity was ongoing. After completion of the project farmers of the selected community will be adopted to keep in their animals' records in the herd book which will help in the selection of superior parents for producing progeny with higher genetic worth. Also, this will help in designing the breeding road map in the future.

Upazilla	AI using RCC semen (%)	Natural breeding Using local RCC bull (%)	Repeated breeding (%)	Service /conception rate
Anwara	50.00 (28)	5.40 (3)	25.80 (8)	1.55
Chandanish	21.00 (13)	0.00 (0)	0.00 (0)	1
Hathazari	18.30 (15)	1.20 (1)	12.50 (2)	1.14
Patiya	26.20 (28)	0.00 (0)	20.00 (7)	1.33
Sandwip	12.30 (13)	0.00 (0)	0.00 (0)	1
Jaintiapur	2.00 (2)	0.00 (0)	0.00 (0)	1
Total	19.30 (99)	0.80 (4)	15.50 (17)	1.002

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

Numbering animal properly for identifying as well as recording different features of productive and reproductive performance of individual and pedigree are the key tools for improving genetic potentiality along with the production of livestock. In developed countries, farmers are recording animals properly by using different software on electronic devices. However, in Bangladesh record keeping is a tedious job for farmers, lack of willingness to record properly because of farmer-friendly recording system is not properly developed. Considering these facts, the present activity was conducted to develop a smart animal recording system in the project area through a combination of mobile and computer applications. Through using this application animal population, phenotypic feature, breeding and reproductive condition, growth and milk production, health condition, feeding practice can be recorded. Before animal

recording, animal numbering was conducted. For this purpose, 514 animals under 6 project areas were numbered using tattoo marker, along with baseline data about animal type, source of cattle and milk production of individual animals were collected and analyzed using SPSS statistical software. From the baseline data it was observed that, among selected animals total RCC were 49.60% and the highest percentage of RCC was in Hathazari Upazilla. Among selected animals 81.90% were adult where as 18.10% animals were growing. It was also found that 72% cattle were owned by the farmers and 26% was purchased. From the baseline data it was also revealed that, among selected animals average milk production of RCC was 2.36 (litter/animal/day) and the highest was 3.07 ± 0.22 (litter/animal/day) in Anwara Upazilla. The highest milk production of RCC was 8.00 (litter/day) was found in Anwara Upazilla and lowest milk production was found 1.00 (litter/day). After completion of the project farmers will take part in keeping their animals' records by their smart cell phone and thus enabling accumulation of all records in a central RCC recording server. Finally, the selection of superior sires and dams with high genetic merit and controlling breeding road map will be established

Table 1. Types and source of cattle in the study areas

Type of animal (%)					Source of cattle		
Upazilla	Local/Non descriptive	RCC cattle	Growing	Adult	Owened	Purchased	Others
Anwara	62.5 (35)	37.5(21)	33.9(19)	66.1(37)	76.8(43)	16.1(9)	7.1 (4)
Chandanish	11.3(7)	88.7(55)	30.6(19)	69.4(43)	100.0(62)	0.0(0)	0.0(0)
Hathazari	1.2(1)	98.8(81)	41.5(34)	58.5(48)	80.5 (66)	19.5(16)	0.0(0)
Patiya	57.0(61)	43.0(46)	19.6(21)	80.4(86)	91.6 (98)	6.5(7)	1.9 (2)
Sandwip	63.2(67)	36.8(39)	0.0 (0)	100(106)	38.7 (41)	61.3(65)	0.0(0)
Jaintiapur	87.1(88)	12.9(13)	0.0(0)	100(101)	59.4 (60)	40.6(41)	0.0(0)
Total	50.4 (259)	49.6 (255)	18.1(93)	81.9(421)	72.0(370)	26.8 (138)	1.2(6)

Note: Number in the parenthesis indicates number of cattle

Table 2. Milk production performance of RCC in different project areas

Upazilla	Average milk production (Litter/animal/day)	Highest milk production (Litter/day)	Lowest milk production (Litter/day)
Anwara	3.1 ± 0.2	8.0	1.3
Chandanish	2.2 ± 0.1	3.5	1.0
Hathazari	1.8 ± 0.9	5.0	1.0
Patiya	2.3 ± 0.1	4.0	1.0
Sandwip	2.1 ± 0.2	3.0	1.0
Jaintiapur	2.7 ± 0.1	3.0	2.5
Overall	2.4 ± 0.5	8.0	1.0

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

Livestock production is one of the major components of the agricultural economy of developing countries and goes well beyond direct food production. Sales of livestock and their products provide direct cash income to the farmers. Conservation of promising indigenous cattle genetic resources through utilization following pure breeding program and farmer-managed in-situ approaches may work for cattle development and rural livelihood enhancement in Bangladesh. So, it is an important issue that RCC needs to be conserved in-situ by keeping them into the rural farmers' house. Besides, increasing the production potentiality of this type should be considered, so that rural poor farmer can lead their live more securely. Considering these facts, present research work is designed to develop a model for the up-scaling livelihood of the rural poor people by keeping RCC and conserve RCC in the farmers' house (in-situ). For this purpose, 200 farmers from four Upazilas (Anowara, Patiya, Sakhipur and Godagari) of 3 Districts (Chattogram, Rajshahi and Tangail) under the project area were selected and getting some privileges provided by the project like training, RCC semen, vaccine and medication, etc. Baseline data of the selected farmers were collected and analyzed descriptively by using SPSS. From the base line survey it was found that from 200 sampled farmers male and female farmers were 84.73% and 15.26 % respectively. About 72.24 % farmers were found educated and 27.76% were uneducated. Agriculture was found as the main occupation of the farmers and 47.07% farmers were directly involved in agriculture. Livestock farm, laborer, Business, job, fisheries, remittance and others occupation were found 24.55%, 11.21%, 11.48%, 4.47%, 0%, 0.34% and 0.27% respectively. Average land holding per household was 97.87 decimal. Average cattle population per household of indigenous, RCC and crossbred were 4.98, 1.90 and 6.90 respectively. Semi-pakka, katcha, full tin and shabby housing of cattle were found 10.80%, 24.32%, 24.05% and 40.81% respectively. It was observed that 27.48 % HHs cattle rearing systems were stall feeding, about 32.65% half grazing and about 39.87% full grazing. Cleaning and hygienic management such as regular cleaning, regular washing and regular disinfection performed by the farmer about 83.70%, 82.87% and 27.29% respectively. About 8.79% and 13.44% farmer supplied feeds with grass-straw and grass-concentrate respectively. About 34.67% farmers used natural insemination and 48.54% used artificial insemination and 16.78% used both natural and artificial methods. The average incomes from indigenous, RCC and crossbred cattle were found BDT 1,44,985.66, 73,748.00 and 3,12,208.33 respectively in the last one year. The higher amount of income was generated from crossbred cattle. The average milk yield (lit/day) were found 2.26, 1.33 and 9.86 from indigenous, RCC and crossbred cow respectively. It also shows that average income from milk selling were BDT 18,418, 15,965 and 1,88,195 for indigenous, RCC and crossbred cow in the last one year respectively. The average annual family income and expenditure were BDT 2,36,933.33 and 1,95,306.67 respectively. Average savings was BDT 41,626.66 in the study area. About 79.37% farmers had deposited and 9.95% had deficit annually. About 10.67% farmers had found that income and expenditure were equal. Finally, the impacts of the model will be assessed based on the overall changes in the socio-economic status of the farmers, animal management practices and production of animals at the end of the project.

Conservation and Improvement of Native Sheep through community and commercial farming (component A, Research -2nd Phase) Project

1. Cryopreservation of exotic ram semen for conservation and multiplication of sheep germplasm of BLRI

Bangladesh Livestock Research Institute has imported 3 improved foreign sheep breeds (Perendale, Dorper and Suffolk) from Australia in March 3, 2016 to judge their efficacy and adaptability in Bangladesh as well as to improve productivity of indigenous sheep through cross breeding. Ram of this three breeds have been used for natural mating within breed and crossbreeding with indigenous stock for production of crossbreed offspring and therefore to produce a flock of improved sheep germplasm in BLRI. Besides, all of this improved valuable germplasm are now being conserved in live form which involves a huge maintenance and management cost. Therefore, the present study was designed to develop of ram semen cryopreservation technique using standardized semen extender to conserve this valuable germplasm to maintain their purity for future use through AI.

For semen collection ram was selected on the basis of their pedigree record and based on their true breed characteristics. A thorough physical examination was conducted to ensure that the rams are free from abnormality and do not display clinical symptom(s) of any infection or any contagious diseases. Prior to introduction of new rams for semen collection, breeding soundness examination was carried out. The rams were kept under hygienic conditions at all times. Balanced diet along with sufficient amount of clean drinking water was supplied to the rams regularly. Semen was collected from three different foreign sheep breeding ram on regular basis through artificial vaginal method. After collection, volume and concentration of semen was recorded. For AI purpose estrous synchronization was performed in indigenous sheep breed. Total animals were divided into two groups each group consists of 7 animals. Synchronization process was done by GnRH and prostaglandin hormone treatment. Average volume was (0.88 ± 0.13) , (0.85 ± 0.12) , (0.8 ± 0.11) ml and the mean of concentration was (1301.64 ± 111.51) , (2405.42 ± 76.31) and (2258.05 ± 108.39) million for Perendale, Dorper and Suffolk respectively. Here the highest volume was found in Perendale and the lowest in Dorper but concentration was the highest in Dorper and the lowest in Perendale. The semen sample was placed in a water bath at 30-34°C and examined with Computer Assisted Semen Analyzer (CASA) for determination of motility. Then semen was diluted with commercial andromed semen extender at 34°C and was evaluated under microscope for progressive sperm motility. Sperm concentration, total volume of diluents and number of straws to be filled with diluted semen was determined by CASA. The degree of dilution was aimed at giving an insemination dose rate of 20 million sperm cells per straw. Till now we are able to prepare 500 straw from Perendale, 120 straw from Suffolk and 200 straw from Dorper. Quality of stored frozen semen was evaluated after 24 hr of storage for different parameters. The semen quality characteristics of Perendale, Suffolk, Dorper are presented in table 1. The mean percentage

total, progressive, static and slow motility of fresh and frozen semen samples of perendale was (72.36 ± 6.82 , 49.74 ± 6.50), (51.36 ± 5.45 , 42.33 ± 1.51), (27.64 ± 7.63 , 50.26 ± 6.51), (21 ± 2.34 , 7.42 ± 5.05), Suffolk was (67.85 ± 3.32 , 45.8 ± 3.67), (47.11 ± 3.80 , 37.89 ± 2.04), (32.15 ± 3.32 , 54.2 ± 3.67), (20.74 ± 0.48 , 7.91 ± 1.63) and Dorper was (64.23 ± 12.40 , 46.81 ± 7.53), (41.02 ± 6.75 , 35.03 ± 5.41), (35.76 ± 12.40 , 53.18 ± 7.53), (23.21 ± 5.65 , 22.16 ± 6.12); respectively. The highest mean value of total, progressive, static and slow motility was found in Perendale and the lowest in Dorper. This variation could be caused by the age of animals and different breed characteristics.

2. Impact of sheep project on socioeconomic conditions and sheep management practices in selected areas of Bangladesh

Livestock plays a vital role for the economy of Bangladesh. Quality protein mainly comes from animal protein source. Small ruminants, specially goat and sheep are very effective source of quality protein supply through meat and milk. Most of the small ruminants of the country belong to landless, marginal and small farmers. Improvement in the productivity of small ruminants especially sheep will directly benefit the poorest part of the society, through poverty reduction, employment generation and improvement of nutrition. The present study was conducted to assess the impact of the project "Conservation and Improvement of Native Sheep through Community and Commercial Farming (Component A, Research-2nd Phase)". The objectives of the research work are to identify the socio-demographic characteristics of native sheep farmer; to assess the before and after effects of native sheep rearing on livelihoods of beneficiary farmer; to assess the before and after changes of native sheep management practices; to assess the problems facing by the farmer in native sheep rearing; and to suggest adequate policy recommendation. The project implementation created noticeable awareness and changes among the sheep farming communities of selected 11 Upazilas of 6 District. Relevant primary data was collected from project beneficiaries with the help of interview schedule through direct interview. Data will be analyzed with a combination of descriptive statistics & the appropriate econometric models.

From the research, it was found that the average age and family size of sheep farmers were found 42.86 years and 4.01 respectively. The male-female ratio of sheep farming households was 1.01. The dependency ratio of the households was 2.22. Most of the sheep farmer were found uneducated. About 53.31 percent farmers were found that they only can sing. About 52.42 percent family member including respondent were found agriculture as their main occupation. The average land holdings of the households were found 158.13 decimal. Average sheep per households was increased 100.79 percent in the project areas. Remarkable livelihoods improvement is occurred among the project beneficiary farmers. On an average all kinds of livelihood assets were increased by 54.09 percent.

The average annual income of the sheep farming household was increased by 62.81 percent. Annual savings of the sheep farmers were increased by 80.49 percent. Both male and female participation in sheep rearing was found increased remarkably. Most of the household's expenditure increases remarkably. The average expenditure of sheep farmer were found 144661.00 (Tk.) per year which is 62.81 percent higher than before of implementation of sheep

project. It implies that both demand and purchasing power of sheep farmers increased remarkably.

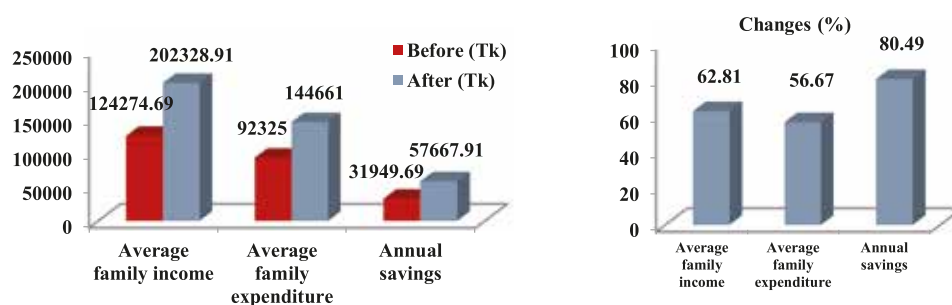


Figure 1. Changes in household income, expenditure and savings (yearly)

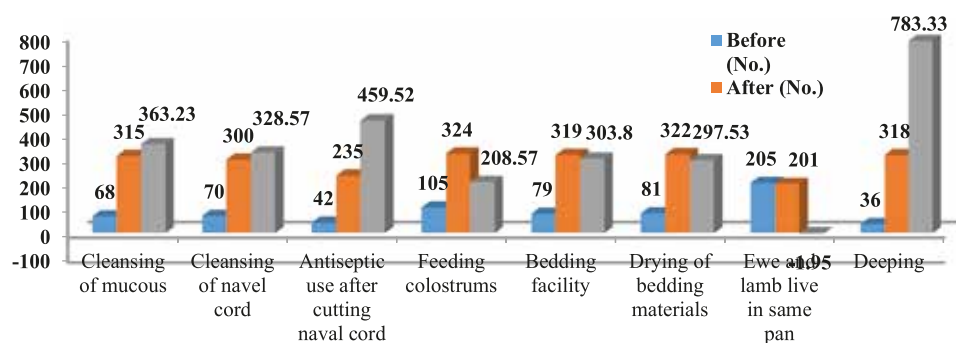


Figure 2. Changes of neo-natal nourishment and dipping practices of sheep

A noticeable improvement occurred in neo-natal nourishment practices of sheep. Housing facility, anthelmintic and vaccine uses were found increased by 438.89, 1275.00 and 3567.00 percent respectively. Mixed feeding system was increased by 168.10 percent. Remarkable improvement occurred in disease management of sheep in the project areas. Pneumonia, diarrhea, bloat and parasite infection were found the main diseases of sheep. A few numbers of problems that still faced by the sheep rearing farmers. About 46.08 and 38.85 percent sheep farmer reported for problem of grazing land and higher feed price. Furthermore, dog bite, sheep marketing, improved ram, housing, lack of finance, social obstacle and low milk production problems were also found. Most of the sheep farmer reported that sheep rearing was helping them to generate their income, reducing poverty, providing ready cash in hand and empowering rural poor women. They want credit facility, wool marketing facility, improved marketing system and also more social awareness. It is recommended that further improvement is needed to develop technologies related to sheep breeding, nutrition, health management and socioeconomic problems and make them available at the field level and to develop market institution capable of making markets work better for the sheep farmers by making awareness, improve market coordination and ensure availability of price information. Interventions should aim to improve the functioning of sheep markets and linkages. There is scope for increasing access in the lamb supply chain to improve linkages by increasing access

through national and international meat supply agencies.

3. Empowerment Factors of Rural Women through Homestead Native Sheep rearing in hilly area at Naikhongchari

This paper attempts to assess the empowerment factors of rural women of the community people at Naikhongchari upazilla in Bandarban district of Bangladesh through establishing the BLRI improved native sheep rearing. Generally, a rural woman spends her time taking care of her husband, children, elders and other members of her family. Rural women are unable to work outside their home or beyond their homestead because of family restrictions, social and traditional barriers. Therefore, their potentiality often remains unutilized or underutilized. The determinants associated with the empowerment of rural women from selected community were identified. Data were collected from fifty rural women involved home-based in native sheep rearing practices through interviews using a structured questionnaire. All responses were measured using a five point like scale (1 = strongly disagree through 5 = strongly agree).

Multiple regression analysis was used to identify the relationships between the six empowerment factors and the overall empowerment of rural women. From fifty women who were rearing native sheep for at least one year from seven villages (bisamara, kalukata, thandajiri, mandoliagona, chakheadman para, adorshogram and jaruliasiri) of Naikhongchari sadar upazilla included in this survey. Fifty completed questionnaires were obtained and these questionnaires were used in our analysis. Data of sample population, age of the respondents, number of years involved in sheep rearing practices and list of empowerment factors (husband's behavior, independence for spending money, independent decision making authority, control over sheep rearing practices, position in the family, involvement in family affairs) were used for analysis.

We used multiple regressions to identify which were the most significant factors in the empowerment of rural women. The results of the regression analysis indicated that the overall model was supported ($R^2 = .196$, $p < .05$). Analysis of the significance levels indicated that independent decision making authority ($b = 0.294$, $p < .01$) and involvement in family affairs ($b = 0.201$, $p < .10$) are significantly associated with the empowerment of rural women in Bangladesh (Table 2). The findings of our study indicated that sheep rearing programs empowered women by improving their economic condition and enhancing their ability to contribute to their family. The first significant factor associated with the empowerment of rural women was independent decision making authority. When women were given the freedom to initiate and run their sheep rearing business, their status in the family improved considerably. Involvement of rural women in sheep production increases their disposable income. The husband's behaviors towards his wife become changed by observing that his wife can earn money and contribute to improve the living standards of the family. The second significant factor associated with the empowerment of rural women in Bangladesh was involvement in family affairs. Greater involvement results in women being able to provide financial assistance when buying household assets. Usually, rural women are not consulted when decisions are made in rural households. Historically, women are perceived as inferior to their husbands in Bangladesh. However, when they become important in the family by earning money they were asked by the husbands to take part in making family decisions. They also can make decisions

on their own for the betterment of their children, husband and family. They can establish control over the income of the sheep business. The overall decision-making authority of rural women was increased when they exercise their own methods to initiate, run, and expand the sheep business. When the women had earned control over their sheep business, it was possible to help rural families in many respects such as, children's education, financial support for the family etc.

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

Native sheep are considered as an important and promising animal resource in Bangladesh. Bangladesh possesses 3.468 million sheep and the present annual rate of growth is ever increasing (Bangladesh Economic Review, 2018). Average 700 to 800 gms of raw wool can be collected from each sheep per year. Resulting three thousands (3000) metric tons of raw wool will be obtained. Cotton, jute, wool and silk are some of the major fibers which are widely used throughout the world for producing yarn and fabrics. Wool fiber is the natural hair grown on sheep and is composed of protein substance called as keratin. Wool is composed of carbon, hydrogen, nitrogen and this is the only animal fiber, which contains sulfur in addition. The characteristics of wool fiber are composed of amino acids, excellent absorbency, high moisture regain, tend to be warmer than others, poor resistance to alkalis but good resistance to acids and good elasticity and resiliency. Enormous quantity of local sheep wool is wasted due to lack of processing. This fiber can play a significant role if proper processing technology and products of today's necessity can be developed out of this fiber. Due to natural source, wool, jute and cotton blended yarn has tremendous potentiality for making good quality warm cloth, floor mate, blazer cloth etc. So, the development of local sheep wool blended yarn decorative fabrics and value added products may enable to unlock the enormous potential of this fiber and provide very good scope for sheep farmers to generate income. A research was conducted for commercial use of wool in the country producing yarn and fabrics with the joint collaboration of Bangladesh Livestock Research Institute and Bangladesh Jute Research Institute. The objectives of the research work are to produce blended yarn and fabrics from jute, cotton and Native sheep wool and to determine the physical properties of jute, cotton and Native sheep wool. Sheep wool was collected from sheep research farms of BLRI and also from the different sub-stations of sheep project and Bengal Meat Processing Industries Ltd, Pabna and sent to the Bangladesh Jute Research Institute. Jute was collected from local market. Cotton was collected from the cotton board. The required chemical was collected from local market. Raw sheep wool was washed with detergent and carbonized with 8% H₂SO₄ at normal temperature (30°C). It is known that jute is long fiber but cotton is short staple length fiber so jute was cut at different length (1, 1.5 and 2 inch) blended the staple length of cotton. According to a standard procedure blending of wool, jute and cotton fiber was mixed at different proportion. By using cotton processing system blended yarn was produced. After producing blended yarn (jute, cotton and sheep wool), this yarn was used in weaving machine (loom) to produce blended fabrics.

For processing of wool, jute and cotton fiber, we should know about some physical properties of these fibers.

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

Property	Jute fiber	Cotton fiber	Sheep wool
Fiber fineness (μg /inch)	5.05	3.35	8.03
Moisture regain (%)	13-14	7-8	9-10
Tenacity (g/tex)	35	25	32

Note: Tenacity is the customary measure of strength of a yarn

Fibers are generally classified as very fine if they have a μg /inch value up to 3.1; Fine if they have value between 3.1 to 3.9; Medium if they have value between 4.0 to 4.9; Slightly coarse between values of 5 to 5.9 and Coarse if they have a μg /inch value above 6. So, Sheep wool is coarse fibers, jute is slightly coarse fibers and cotton is fine fibers. For the production of smooth blended yarn, sheep wool is mixed with jute and cotton fibers. In the present study, it was observed that 30%, 30% and 40% respectively wool, jute cotton fiber blended 12s (yarn count system) count yarn has been successfully developed. After operating, there were observed some limitation in spinning section. Wool dropping was more than jute and cotton fiber. Yarns were produced at different proportion. Jute and wool is available in the locality. Cotton fiber is costly. For this reason, the cost of blended yarn is less than 100% cotton yarn. Shawls, blanket and suiting fabrics (pant pieces, blazer piece) were produced successfully. Shawl is produced with the production cost of Tk. 244 (7ft \times 3ft) and suiting fabrics (pant piece, blazer piece etc.) with the production cost of Tk. 588 (per 1 meter). Comfortable blanket was produced from 50:50 ratio of wool-jute yarn with the production cost of Tk. 495 (6ft \times 8ft). Dining mate and floor mate were produced with the combination of wool and jute in the ratio of 40:60 and the production cost of Tk. 280 and Tk. 140.

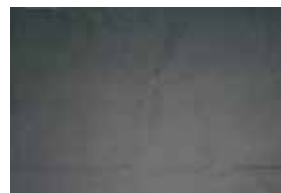
Spinning technique and types can play a vital role for the perfection of blended yarn properties and specific blended ratio is very important to get diversified products. Fine wool is more effective for making yarn than coarse wool. Wool, jute and cotton blended yarn may be a new horizon for developing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



Wool blended yarn



Shawl (7ft \times 3ft)



Suiting fabrics (1 meter)



Blanket (6ft \times 8ft)



Dining mate (4.5ft \times 1.2ft
and 1.5ft \times 1.2ft)



Floor mate (2.5ft \times 1.5ft)

4. Design and Development of Products from Native Sheep Skin

Since ancient times, human beings have used animal skins and learned to make leather. Leather is animal skin that has been chemically modified to produce a strong, flexible material that resists decay. Driven by its wide applications in everyday life, the demand for leather products has become increasing from time to time. Sheep have been a key animal in the history of farming and have a deeply entrenched place in human culture. They were one of the first animals to be domesticated along with man's best friend the dogs they were easily trained and formed an animal companion and sheep as they have a natural herding instinct and could be easily managed in groups. Sheep skin is used to produce sheep skin leather products and soft wool-lined clothing or coverings, including gloves, hats, slippers, footstools, automotive seat covers, baby and invalid rugs and pelts. At present, more than 50 percent of bovine hides and approximately 40 percent of sheep and goat skins are processed into footwear, with the remainder being used for the production of garments, furniture and travel goods. So, the development of local sheep skin and value added products may enable to unlock the enormous potential of this skin and provide very good scope for sheep farmer to generate income. A research was conducted for commercial use of sheep skin in Bangladesh through leather production with the joint collaboration of Bangladesh Livestock Research Institute and Leather Research Institute of Bangladesh Council for Scientific and Industrial Research (BCSIR). The aims of the research work are to assess the properties (physicals and chemicals) of sheep skin and produce leather products from native sheep skin.

Twenty one (21) raw sheep skin was collected from sheep research farm of Bangladesh Livestock Research Institute and twenty five (25) raw sheep skin was collected from local market and bring it to Leather Research Institute for processing. The processing of leather, starting from preserved raw sheep skins, as follows. Once cured, the skins were then soaked in water for several hours to several days. The water and surfactants helps in the removal of salt, dirt, debris, blood and excess animal fats. Rehydration was also reintroduced. Subcutaneous material and majority of hair was removed. This was used to loosen the fibers allowing the skin to absorb chemicals that was used later in the tanning processes. Limed hides appear swollen and with an increased thickness, therefore can be easily split into two or more layers. This process brings to removal of alkali from the pelt with the consequent dispelling of the fibers and helps lowering of the pH to the values used in the bating process. It was [carried out with slightly acidic chemicals. This was an operation to complete the deliming process, by eliminating residues of other substances and loosen the fibers of the skin, in order to smooth the grain and achieve soft and flexible leather. Pelts were soaked in a solution of water, salt, and hydrochloric (or sulphuric) acid. This was the process which converts the protein of the raw hide or skin into a stable material which was not putrefy and it was suitable for a wide variety of end applications, the leather. There were several types of tanning: chrome tanning was the most widespread. At the end of the tanning the hides or skins appear blue-green. This is called wet-blue and temporary preserved. The vegetable tanning was the oldest, made with the use of tannins which gave the vegetable tanned leather shades of brown, more or less intense. The tanned leather was not yet usable to produce articles. To turn it into a marketable product the leather must be further treated with syntan, fatliquor, filler and mechanical processes in the drums. It was the final stage and the most complex process,

which includes all operations to be, carried out on dried skins, to change the surface effect, both for aesthetic and functional aims. Finishing can be mechanical or chemical. During manufacturing a product, the following important steps were involved as select target groups, gather ideas, select ideas, design development, pattern development, assorting the materials, cutting, sub-assembling processes, assembling and stitching, finishing. Manufacturing of some leather products such as ladies bag and purse were completed and such products are going on. If products is available with the help of supporting company, it is demandable so no problem in marketing.



Research Farm

BLRI Cattle and Buffalo Research Farm remains a number of Native cattle resources and foreign beef breed and milking buffaloes breeds also namely as BLRI Cattle Breed-1(BCB-I); Red Chittagong Cattle (RCC); Munshigonj Cattle. Besides this 54 Fodder germplasm banks conserved at BLRI Pacutia Cattle Research Farm. All these breeding stock and fodder germplasm are being used in different breeding and nutritional research work for conservation and improvement (meat milk and feed for the benefit of our total livestock sector. From Research Farm year-round fodder cuttings and Breeding Bull specially RCC cattle is being distributed in different Universities, DLS and large Argo- based company for their experimental or extension works

Breeding Stock for BCB-1

Category	Present Number
Milking Cows	18
Dry Cows	45
Adult bulls (Teaser, Brahman &breeding)	16
Heifers (Weaning to before puberty)	36
Growing bulls (Weaning to before adult)	34
Milk calf (Female)	14
Milk calf (Male)	17
Total	180

Breeding stock for RCC Cattle

Category	Present Number
Milking Cows	45
Dry Cows	80
Adult bulls(Adults &breeding)	20
Heifers (Weaning to before puberty)	53
Growing bulls (Weaning to before adult)	60
Milk calf (Female)	23
Milk calf (Male)	25
Total	306

Breeding stock for Beef Cattle

Category	Present Number
Milking Cows	8
Dry Cows	1
Adult bulls(Adults &breeding)	15
Heifers (Weaning to before puberty)	6
Growing bulls (Weaning to before adult)	5
Milk calf (Female)	8
Milk calf (Male)	5
Total	48

Breeding stock for Munshigonj Cattle

Category	Present Number
Milking Cows	4
Dry Cows	10
Adult bulls(Adults &breeding)	7
Heifers (Weaning to before puberty)	3
Growing bulls (Weaning to before adult)	10
Milk calf (Female)	2
Milk calf (Male)	1
Total	37

Breeding stock for Buffaloes

Category	Present Number
Milking Cows	7
Dry Cows	50
Adult bulls(Adults &breeding)	8
Heifers (Weaning to before puberty)	78
Growing bulls (Weaning to before adult)	30
Milk calf (Female)	10
Milk calf (Male)	9
Total	192

Annual Fodder cultivation and Distribution Plan (2017-2018)

Sl No.	Plot no.	Land(Hectre)	Fodder	Work schedule	Fodder Production	Comments
1	F1	1	Napier	Cutting, Transplant, Cow dung & Urea supply	200	Fresh Grass Supply -200 (Ton)
2	F2	3	NapierBLRI-3	Cutting, Transplant, Cow dung & Urea supply	250	Fresh Grass Supply -200 (Ton)
3	F6	3	Napier	Cutting, Transplant, Cow dung& Urea supply	100	Silage-100(Ton)
4	F7	3	Triticale &Maize	Cutting, Transplant, Cow dung Urea supply& Silage	75	Fresh Grass Supply -50(Ton)
5	P1	7	Maize &Oats	Cultivation, Cow dung & Urea supply	200	Fresh Grass Supply--200(Ton)
6	L1	4	Oats	Cultivation, Cow dung & Urea supply	150	Fresh Grass Supply-150(Ton)
7	L2	3	German	Cutting, transplant & urea supply	150	Fresh Grass Supply-150(Ton)
8	L3	3	German	Cutting, transplant & urea supply	150	Fresh Grass Supply-100(Ton)
9	L4	3	German	Cutting, transplant & urea supply	200	Fresh Grass Supply-200(Ton)
10	L5	2	German	Cutting, transplant & urea supply	100	Fresh Grass Supply-60(Ton)
11	M1-R1	1	Splendida	Cutting, transplant & urea supply	80	Fresh Grass Supply-50(Ton)
14	F8-F10	8	Napier	Cutting, Transplant, Cow	350	Silage-300(Ton)

Sl No.	Plot no.	Land(Hectre)	Fodder	Work schedule	Fodder Production	Comments
				dung Urea supply& Silage		
15	J1	2	Spelndida	Cutting, transplant & urea supply	120	Fresh Grass Supply-120(Ton)
16	H1	2	Oats	Cutting &Urea supply	100	Fresh Grass Supply-100(Ton)
17	H2	2	Oats	Cutting &Urea supply	100	Fresh Grass Supply-100(Ton)
18	H3	0.5	Oats	Cutting &Urea supply	75	Fresh Grass Supply-75(Ton)
19	H4	0.5	Napier	Cutting, transplant & urea supply	100	Fresh Grass Supply-100(Ton)
20	H5	0.5	Napier	Cutting, transplant & urea supply	70	Fresh Grass Supply-50(Ton)
21	H6	0.5	Napier	Cutting, transplant & urea supply	70	Fresh Grass Supply-70(Ton)
22	H7	0.5		Cutting, transplant & urea supply	80	Fresh Grass Supply-60(Ton)

Fresh Grass Supply-2135 Ton, Silage- 350 Ton; Grand Total – 2485Ton

Sl No.	Name Of Germplasm	No of Cuttings Distribution	No of Farmers Cutting Taken
1	Napier(3&4 variety)	1850000	365
2	Packchong	405000	86
3	German	265000	55
4	Para	55000	23
5	Oats(kg)	2200	12

Engineering Section

Engineering Section under Support Service Division has been working from the beginning of the Institute. The Section is headed by an Executive Engineer (Civil) with 2 (two) Sub-Assistant Engineer (Civil), 1 (one) Sub-Assistant Engineer (Electronics), 1(one) Electrician and 1 (one) Mason.

Following development and repair/renovation/maintenance works has been implemented by the Engineering Section under revenue budget & development project during the year 2018-2019.

A. Under revenue budget (Repair and renovation works)

Sl. No.	Name or works	Qty.	Unit	Value of works In Lakh Tk.
1.	Repair of Residential Building	1.00	L.S	40.00
2.	Repair of other Building and Infrastructures	1.00	L.S	40.00
3.	Others Repair & Maintenance (Water, Electricity & Gas)	1.00	L.S	40.00
4.	Repair & Maintenance of Equipment's & Furniture.	1.00	L.S	12.50
Sub-Total Tk. =				132.00

B. Under Development Project

1.	Red Chittagong Cattle Improvement & Conservation Project (Phase-II), BLRI, Savar, Dhaka.	Qty.	Unit	Value of works In Lakh Tk.
	a. Construction of Training Dormitory with Conference Compound & R.C.O Road at BLRI H.Q., Savar, Dhaka	1270.00	Sqm.	200.00
	b. Construction of Electric Sub-Station	15.00	Sqm.	4.89
	c. Construction of Boundary wall	808.00	Rm	76.20
	d. Construction of HBB road with land development	900.00	Sqm	28.40
	e. Construction of Pump house at BLRI Regional Station, Rajshahi	1.00	L.S	10.00
	f. Construction of Deep tube well at BLRI Regional Station, Rajshahi	1.00	L.S	33.46
	g. Construction of LT overhead electric line at BLRI Regional Station, Rajshahi	1.00	L.S	9.58
	h. Construction of External water line at BLRI Regional Station, Rajshahi	1.00	L.S	11.50
Sub-Total Tk. =				374.03

2.	Dairy Development Research Project, BLRI, Savar, Dhaka.	Qty.	Unit	Value of works In Lakh Tk.
	a. Construction of Dairy Laboratory at BLRI Regional Station, Sirajgonj.	250.00	Sqm.	102.25
	b. Construction of Dairy Laboratory at BLRI Head Qtr. Savar, Dhaka.	250.00	Sqm.	102.25
	c. Construction of External electrification line at BLRI Regional Station, Sirajgonj.	1.00	L.S	10.00
	d. Construction of Bio-Gas plant at BLRI Regional Station, Sirajgonj.	1.00	L.S	5.00
	e. Construction of Breeding Bull shed at BLRI Regional Station, Sirajgonj.	242.00	Sqm	69.47
	f. Construction of Heifer Shed at BLRI Regional Station, Sirajgonj.	242.00	Sqm	69.47
	g. Construction of Calf Shed at BLRI Regional Station, Sirajgonj.	200.00	Sqm	56.57
	h. Construction of Quarantine Shed at BLRI Regional Station, Sirajgonj.	50.00	Sqm	10.00
	Sub-Total Tk. =			425.01

Publication and public Relation Section

BLRI's Publishes Publications includes Journal, Annual Report, Proceeding, Newsletter, Scientific monographs, Leaflets, Bulletins, Technical papers, Research reports, Brochure. The Institute also publishes others Publications, Following is the list of Publications:

No.	Journal
1.	Bangladesh Journal of Livestock Research, Vol. 1, No. 1, July-1993
2.	Bangladesh Journal of Livestock Research, Vol. 2, January-1994 to Vol. 5 No.2, January-1998
3.	Bangladesh Journal of Livestock Research, Vol. 6, No. 1 & 2, January-1999. June-2002
4.	Bangladesh Journal of Livestock Research, Vol.7, No. 1 & 2, January-2000 and Vol.8, No. 1 & 2, January-1001, June-2002
5.	Bangladesh Journal of Livestock Research, Vol.9, No.9, No.1 (Jan-June)-2002 and Vol.9, No.2 (July-Dec.) 2004, June-2004
6.	Bangladesh Journal of Livestock Research, Vol. 10, No.10, No.1 (Jan-June)-2003 and Vol. 10, No.2 (July-Dec.)-2003, June-2004
7.	Bangladesh Journal of Livestock Research, Vol. 11, No. 1 (Jan-June) & No.2 (July-Dec.)-2004 November-2005
8.	Bangladesh Journal of Livestock Research, Vol. 12, No.1 & 2, (Jan.-June and July-Dec.)-2005, March-2007
9.	Bangladesh Journal of Livestock Research, Vol. 13, No. 1 & 2, (Jan.-June and July-Dec.)-2006, June-2007
10.	Bangladesh Journal of Livestock Research, Vol. 13, No. 1 & 2, (Jan.-June and July-Dec.)-2007, June-2008
11.	Bangladesh Journal of Livestock Research, Vol. 15, No. 1 & 2, (Jan.-June and July-Dec.)-2008, June-2009
12.	Bangladesh Journal of Livestock Research, Vol. 16, No. 1 & 2, (Jan.-June and July-Dec.)-2009, June-2010
13.	Bangladesh Journal of Livestock Research, Vol.16, No. 1&2, (Jan.-June and July-Dec.)-2010, June-2011
14.	Bangladesh Journal of Livestock Research, Vol. 18, No. 1&2, (Jan.-June and July-Dec.)-2011, June-2010
15.	Bangladesh Journal of Livestock Research, Vol. 19, No.1, (Jan.-June) and No.2 (July-Dec.)-2012, June-2013
16.	Bangladesh Journal of Livestock Research, Vol. 20, No.1, (Jan.-June) and No.2 (July-Dec.)-2013, May -2016
Annual Report	
17.	Annual Report (Progress Report)-1985-91, July-1991
18.	Annual Report(1992-93 to 1997-98, June-2002
19.	Annual Report-1999, December-2002
20.	Annual Report-2000, June-2004
21.	Annual Report-2001, February-2005
22.	Annual Report-2002, December-2005
23.	Annual Report-2003, June-2006
24.	Annual Report-2004, December-2006
25.	Annual Report-2005-2006, June-2007

26.	Annual Report-2007, June-2008
27.	Annual Report-2008, June-2009
28.	Annual Report-2009, June-2010
29.	Annual Report-2010, June-2011
30.	Annual Report, 2011, June-2012
31.	Annual Report-2012, June-2013
32.	Annual Report-2013, June-2014
33.	Annual Report-2014, June-2015
34.	Annual Report, 2015, June-2016
35.	Annual Report-2016, August-2017
36.	Annual Report-2017, June-2018
Proceedings	
37.	First Annual Livestock Research Workshop Proceedings, Bangladesh Livestock Research Institute, Nov. 20,1986
38.	Bangladesh Livestock Research Institute (BLRI), Progress of Research, October-1988
39.	Proceeding of Workshop on Livestock Development in Bangladesh, 16-18 July-1991
40.	Proceedings of the Workshop on Livestock Research in Bangladesh, February-2, 1992
41.	বার্ষিক গবেষণা ও সম্প্রসারণ কর্মশালা, ১১-১২ জুন-২০০৩, জুন-২০০৩
42.	Proceedings of Annual Research Review Workshop-2004, June-28-29-2004
43.	Annual Research Review Workshop-2005, April-25-26-2005
44.	Annual Research Review Workshop-2006, June-15-16-2006
45.	Annual Research Review Workshop-2007, June-13-14, June-2007
46.	Annual Research Review Workshop-2008, June-17-18-2008
47.	Annual Research Review Workshop-2009, June-15-16-2009
48.	Annual Research Review Workshop-2010, June-22-23-2010
49.	Proceedings of the Annual Research Review Workshop-2009-2010, June-2011
50.	Annual Research Review Workshop-2011, June-28-29-2011
51.	Proceeding of the Annual Research Review Workshop-2010-2011, May-2012
52.	Annual Research Review Workshop-2012, June-24-25-2012
53.	Proceeding of the Annual Research Review Workshop-2012-2013, December-2014
54.	Proceeding of the Annual Research Review Workshop-2013-2014, October-2015
55.	Proceeding of the Annual Research Review Workshop-2014-2015, April, 2017
56.	Proceeding of the Annual Research Review Workshop-2015-2016, June -2018
Newsletter	
57.	BLRI Newsletter, Vol. 1 No. 1, December-1989
58.	BLRI Newsletter, Vol. 2 No. 1, March-1991
59.	বিএলআরআই নিউজলেটার Vol.1 issues No. 1&2, 2010
60.	বিএলআরআই নিউজলেটার Vol.2 issues No. 1&2, 2011
61.	বিএলআরআই নিউজলেটার Vol.2 issues No. 3&4, 2011
62.	বিএলআরআই নিউজলেটার Vol.3 issues No. 1&2, 2012
63.	বিএলআরআই নিউজলেটার Vol.5 issues No. 1&2, 2014
64.	বিএলআরআই নিউজলেটার Vol.6 issues No. 1&2, 2014
65.	বিএলআরআই নিউজলেটার Vol.7 issues No. 1, 2,3&4, 2016
66.	বিএলআরআই নিউজলেটার Vol.8 issues No. 1,2,3 & 4, 2017
67.	বিএলআরআই নিউজলেটার Vol.9 issues No. 1&2, 2018

Other Publications	
68.	বন্যার পর গবাদি পশু ও হাঁস-মুরগির জন্য চাষী ভাইদের করণীয়
69.	ইপিল ইপিল, পশু উৎপাদন গবেষণা বিভাগ
70.	Black Bengal Goat Under Stall-Fed Condition, APRD
71.	Completed, on-going and Future Studies and project programme of Animal Production Research Division, BLRI
72.	Effect of molasses supplementation of roughage based diet on growth performance of cattle
73.	গবাদি পশুর ক্ষুরারোগ ও তার দমন ব্যবস্থা
74.	বাংলাদেশী ডেড়ার জাতসমূহ ও এর বৈশিষ্ট্য শীর্ষক পোস্টার
75.	‘পোল্ট্রি খামারে জৈব নিরাপত্তা’ শীর্ষক পোস্টার
76.	Laboratory Manual for Homologous Goatpox Vaccine Production, June-2007
77.	আবদ্ধ অবস্থায় কাল ছাগল পালন
78.	ছাগল উৎপাদন বৃদ্ধির মাধ্যমে দারিদ্র্য বিমোচন ব্রশিওর
79.	Sugarcane utilization as a dual purpose crop for sustainable livestock farming
80.	Development of beef cattle breed using Gayal (<i>Bos frontalis</i>)
81.	কর্নস্ট্র প্যালেট ফিডঃ বিএলআরআই কর্তৃক উদ্ভাবিত একটি পূর্ণাঙ্গ গো-খাদ্য শিল্প প্রযুক্তি
82.	মুরগির রোগ নিয়ন্ত্রণ ব্যবস্থাপনা প্রশিক্ষণ সহায়িকা
83.	লাভজনক দুগ্ধ খামারের জন্য নেপিয়ার (নেপিয়ার বাজরা) ঘাস চাষ
84.	আরসিসি চিটাগাং অঞ্চলের একটি অষ্টমুখী লাল গরু
85.	লেয়ার মুরগি পালন নির্দেশিকা
86.	Foot and Mouth Disease
87.	কবুতর পালন
88.	Reproductive Performances of Cows in Savar Dairy Farm
89.	Memorandum of Agreement Between BLRI and DLS on Hand-over of Savar Farm to BLRI
90.	Livestock Sub-sector in Bangladesh: Status and Development Potentials.
91.	1963-85 Abstracts of Research in Parasitology in Bangladesh. 1963-1985
92.	1986-90 Poultry Production Research Division. Research Report-1986-90
93.	1988-89 Epidemiology of Foot and Mouth Disease in Bangladesh and Selection of Vaccines Virus Strains. Annual Report-1998-89
94.	1988-89 Proceedings of the Workshop on the Achievement of Research Under PL 480 Title-III, 1988-89, February-1990
95.	1989-90 Report on Farming System Research. FSR Report No. 1, 1989-1990
96.	1989-90 Performance of Black Bengal Goat under Stall-fed condition, 1989-1990
97.	1989-90 Development of fodder production Programme for BLRI fields, 1989-90
98.	1989-90 Epidemiology of Foot and Mouth Disease in Bangladesh and Selection of Vaccines Virus Strains, Annual Report, 1989-90
99.	1989-90 Development of Straw Based Ration for Feeding Ruminants (1989-1999)
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101.	1991-96 Farming Systems Research and Development Project, 1991-96
102.	1990-91 Report on Farming System Research. FSR Report no.2, 1990-91
103.	1990-91 Performance of Black Bengal Goat under Stall-fed Condition. Progress Report-1990-91
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105.	1990-91 Evaluation of Artificial Insemination Programmes in Bangladesh. Progress Report, 1990-91
106.	1990-91 Fodder Research and Production Programme, 2 nd Annual Progress Report, 1990-

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107	1993-94	Poultry Breeding and Rearing in BLRI, Progress Report, April-1993 to June-1994
108	1986	Check lists of Helminthes of Animals and Birds in Bangladesh. December-1986
109	1987	Characteristics of two village for farming system research, February-1987
110	1987	Fattening of Beef Cattle, May-1987
111	1988	বাংলাদেশ গবাদিপশু গবেষণা ইনস্টিটিউট, ডিসেম্বর, ১৯৮৮
112	1988	About BLRI (in English) December, 1988
113	1988	An Epidemiological Study of Calf Diseases in Bangladesh, Annual Report for 1988
114	1989	Proceedings of the Meeting of Counterpart Scientists of SAARC Member of Countries on Livestock Improvement, December 18-19, 1989
115	1989	Survey report on existing farming system at raw Tara village, Baghabari, June-1989
116	1989	Research abstracts of livestock Activities at Baghabari Farming System Research Site, June-1989
117	1989	Identification of Problems Affecting the Livestock and Poultry Production and Transfer of Technology to Improve Their Production at Farming System, June-1989
118	1990	Feeding Pattern of Birds (Chicken and ducks) Under Scavenging Condition and Formulation of Supplementary. Ration Using the Local Ingredients. Second Annual Report, September-1990
119	1990	Development of feedings Regimes for Calves, Second Annual Progress Report, 9 th Oct-1990
120	1990	Study on Livestock Feeds Fodder and Feeding Practices in Bangladesh and Their Nutritive Evaluation, 9 th October, 1990
121	1991	দল ঘাস, পশু উৎপাদন গবেষণা বিভাগ, মে-১৯৯১
122	1991	About BLRI, June-1991
123	1991	Proceeding of the Meeting of Counterpart Scientists of SAARC Member Countries on Animal Genetic Resource Conservation, 11-12 November, 1991
124	1991	বাংলাদেশ ক্ষুরারোগ ভাইরাসের টাইপ ও সাব-টাইপ, মার্চ-১৯৯১
125	1992	A Socio-economic Evaluation of the Artificial Insemination Programme in Bangladesh, June-1992
126	1994	Development of straw based ration for feeding ruminants, June-1994
127	1994	Collaborative Livestock Research and Extension Programme Between BLRI and Proshika, June-1994
128	1995	Status of beef cattle production in Bangladesh, May 1995
129	1995	Evaluation of Productive and Reproductive Performances of F1, F2 and F3 Progenies of Local x Friesian and Sahiwal x Friesian Cross-bred Cattle in the Savar Dairy farm, Research Report, July-1995
130	1995	A report on the straw preservation under wet condition and its utilization for the ruminant, August-1995
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132	1997	Socio-economic Impact of Small holder Livestock Development Project in Bangladesh, October-1997
133	1998	পশু সম্পদ ও হাঁস-মুরগি উন্নয়ন প্রযুক্তি পরিচিতি, জানুয়ারী-১৯৯৮
134	1998	স্বল্প খরচে উৎকৃষ্ট গো-খাদ্য ইউরিয়া মোলাসেস স্ট্র (ইউ.এম.এস) (Urea Molasses Straw

		(UMS) for Beef Fattening), জুলাই-১৯৯৮
135	1998	গরুর জন্য সবুজ ঘাসের বিকল্প হিসাবে এ্যালজির (শেওলা) ব্যবহার, প্রথম সংস্করণ, জুলাই-১৯৯৮
136	1998	দেশী পদ্ধতিতে স্বল্প ব্যয়ে সবুজ ঘাস সংরক্ষণ, প্রথম সংস্করণ, জুলাই-১৯৯৮
137	1998	মুরগির বাচ্চা পালন নির্দেশিকা, প্রথম সংস্করণ, জুলাই-১৯৯৮
138	1998	হাঁস পালন ব্যবস্থাপনা নির্দেশিকা, প্রথম সংস্করণ, জুলাই-১৯৯৮
139	1998	গিনিফাউল প্রতিপালন প্রথম সংস্করণ, জুলাই-১৯৯৮
140	1998	কোয়েল পালন ব্যবস্থাপনা নির্দেশিকা, প্রথম সংস্করণ, জুলাই-১৯৯৮
141	1998	বাড়ন্ত মুরগির বাচ্চা পালন, প্রথম সংস্করণ, জুলাই-১৯৯৮
142	1998	ছেড়ে পালনের উপযোগী মুরগি ফাওমী, প্রথম সংস্করণ, জুলাই-১৯৯৮
143	1998	পশু পাখির খাদ্য হিসেবে সমন্বিত খামারের বর্জ্য হতে ডাকউইড উৎপাদন এবং এর ব্যবহার, ১৯৯৮
144	1998	লাভজনক দুগ্ধ উৎপাদন ও গরু মোটা তাজাকরণে কয়েকটি খাদ্য প্রযুক্তি, জুন-১৯৯৮
145	1999	Research Achievements and Activities, April-1999
146	1999	বাহুর ব্যবস্থাপনা, জুন-১৯৯৯
147	1999	লাভজনক দুগ্ধ খামার স্থাপন, জুন-১৯৯৯
148	1999	ট্রেনিং ম্যানুয়েল-লাভজনক গবাদিপশু ও হাঁস-মুরগি, জুন-১৯৯৯
149	1999	মিশ্র ফসল হিসাবে গো খাদ্য ভুট্টার চাষ, প্রথম সংস্করণ, সেপ্টেম্বর-১৯৯৯
150	1999	ELISA Technique ব্যবহার করে ক্ষুরারোগ নির্ণয়, প্রথম সংস্করণ, সেপ্টেম্বর-১৯৯৯
151	1999	ছাগল বসন্তের টিকা, প্রথম সংস্করণ, সেপ্টেম্বর-১৯৯৯
152	1999	পিপিআর রোগের এন্টিসিরাম-এ্যান্টিবায়োটিক সমন্বিত চিকিৎসা পদ্ধতি, প্রথম সংস্করণ, সেপ্টেম্বর-১৯৯৯
153	1999	পিপিআর রোগের ভ্যাকসিন, প্রথম সংস্করণ, সেপ্টেম্বর-১৯৯৯
154	1999	দেশীয় মুরগির জাত পরিচিতি, প্রথম সংস্করণ, সেপ্টেম্বর-১৯৯৯
155	1999	দারিদ্র্য বিমোচনে গ্রামীণ পরিবেশে সংকর প্রজাতির মুরগি পালন পদ্ধতি, প্রথম সংস্করণ, সেপ্টেম্বর-১৯৯৯
156	1999	Economics and Marketing Research Division, Progress Report, June-1999
157	2009-10	A Compendium on Red Chittagong Cattle of Bangladesh, 2009-10
158	2010-11	দুগ্ধপণ্য উৎপাদনে দেশী প্রযুক্তি, ২০১০-১১
159	2000	ট্রেনিং ম্যানুয়েল, প্রথম সংস্করণ, ফেব্রুয়ারী-২০০০
160	2000	Economics and Marketing Research Division, Progress Report, June-2000
161	2000	BLRI: A Brief Acquaintance, January-2000
162	2000	Paste des petites ruminants (PPR), A brief introduction, its diagnosis and control, February-2000
163	2001	BLRI An Overview, June-2001
164	2001	Improvement of Black Bengal Goat through selective breeding, May-2001
165	2002	বর্ষাকালে ভিজা খেড়ের পচন রোধকল্পে স্বল্প খরচে সংরক্ষণ, দ্বিতীয় সংস্করণ, জুন-২০০২
166	2002	গরু মোটা তাজাকরণ প্যাকেজ প্রযুক্তি, প্রথম সংস্করণ, জুন-২০০২
167	2002	ছাগল পালন ম্যানুয়েল, এপ্রিল-২০০২
168	2002	পশু খাদ্য ও জ্বালানি হিসেবে ইপিল ইপিলের চাষ ও ব্যবহার, প্রথম সংস্করণ, জুন-২০০২
169	2002	খামারের বর্জ্য হতে সারা বছর ডাক উইড উৎপাদন এবং পশুখাদ্য হিসেবে এর ব্যবহার, প্রথম সংস্করণ, জুন-২০০২
170	2002	ভুট্টা-কাউপি মিশ্র গো-খাদ্য চাষ ও ব্যবহার, প্রথম সংস্করণ, জুন-২০০২
171	2002	সেমি ইন্টেনসিভ পদ্ধতিতে দেশী ছাগল পালন, প্রথম সংস্করণ, জুন-২০০২
172	2002	দারিদ্র্য বিমোচনে ছাগল পালন মডেল, প্রথম সংস্করণ, জুন-২০০২
173	2002	গো-খাদ্য হিসেবে কলাগাছের সংরক্ষণ ও ব্যবহার প্রথম সংস্করণ, জুন-২০০২
174	2002	আখের উপজাত সংরক্ষণ ও গো খাদ্য হিসেবে ব্যবহার, প্রথম সংস্করণ, জুন-২০০২
175	2002	লবগাক্ত, বন্যাকবলিত ও মধুপুর গড় এলাকার জন্য ঘাস উৎপাদন, প্রথম সংস্করণ, জুন-২০০২
176	2002	এনজাইম ইমিউনো ব্লাইড এসে পদ্ধতিতে দ্রুত রোগ সনাক্তকরণ, প্রথম সংস্করণ, জুন-২০০২
177	2002	গবাদিপশুর পরজীবী মুক্তকরণের আদর্শ প্রযুক্তি, প্রথম সংস্করণ, জুন-২০০২

178	2002	মুরগির মাইকোপ্লাজমা রোগ নির্ণায়ক (ডায়াগনস্টিক এন্টিজেন), জুন-২০০২
179	2002	পাহাড়ি জমিতে সবুজ ঘাস উৎপাদন ও ব্যবহার, প্রথম সংস্করণ, জুন-২০০২
180	2002	মুরগির সালমোনেসিস রোগ দমনে ফাউল টাইফয়েড ভ্যাকসিন, প্রথম সংস্করণ, জুন-২০০২
181	2002	মুরগির সালমোনেসিস রোগ নির্ণয় ও দমনে পুরোরাম এন্টিজেন, প্রথম সংস্করণ, জুন-২০০২
182	2002	ছাগলের পিপিআর রোগের স্বাস্থ্য ব্যবস্থাপনা, প্রথম সংস্করণ, জুন-২০০২
183	2002	ভূমিহীনদের জন্য লেয়ার মুরগি উৎপাদন মডেল, প্রথম সংস্করণ, জুন-২০০২
184	2002	মাঠ পর্যায়ে মুরগির রাণীক্ষেত রোগ দমনে স্থানীয়ভাবে তৈরি টিকা ও অস্ট্রেলিয়ান NDV ₄ HR, প্রথম সংস্করণ, জুন-২০০২
185	2002	Proceedings of the Workshop on Poverty Alleviation Through Goat Production: National Programmed (27 April-3 May 2002), December-2002
186	2003	ট্রেনিং ম্যানুয়াল (পরিমার্জিত, দ্বিতীয় সংস্করণ, ২০০৩)
187	2003	স্টল ফিডিং পদ্ধতিতে ছাগল পালন, প্রথম সংস্করণ, জুন-২০০৩
188	2004	Research and Development Strategic Plan (2003-2006), February-2004
189	2004	হিমোলাইসিন প্রভুত প্রণালী, প্রথম সংস্করণ, জুন-২০০৪
190	2004	মাঠ পর্যায়ে পোল্ট্রি ও পশু খাদ্যের গুণগতমান নির্ণয়, প্রথম সংস্করণ, জুন-২০০৪
191	2004	মানসম্পন্ন ব্রয়লার ও লেয়ার বাচ্চার বৈশিষ্ট্য, প্রথম সংস্করণ, জুন-২০০৪
192	2004	হাওড়ে লাভজনকভাবে হাঁস পালনের কৌশল, প্রথম সংস্করণ, জুন-২০০৪
193	2004	বন্যাকালীন ও বন্যার পর গবাদিপশু ও হাঁস-মুরগির জন্য চাষী ভাইদের করণীয়, জুলাই-২০০৪
194	2004	কমপ্লিমেন্ট ফিশেশন পরীক্ষা (একটি গবেষণাগার ম্যানুয়াল), প্রথম সংস্করণ, আগস্ট-২০০৪
195	2004	ভেড়া পালন ম্যানুয়াল, ডিসেম্বর-২০০৪
196	2005	গবাদিপশু, হাঁস-মুরগি এবং মৎস্য খাদ্য ও রোগ চিকিৎসায় উদ্ভিদ ম্যানুয়াল প্রথম সংস্করণ, ফেব্রুয়ারি-২০০৫
197	2005	এডিয়ান ইনফ্লুয়েঞ্জা ক্লিনিক্যাল ও পোস্ট মর্টেম লক্ষণ এবং দমন ও প্রতিরোধম পদ্ধতি, প্রথম সংস্করণ, ফেব্রুয়ারি- ২০০৫
198	2005	পশুসম্পদ ও পোল্ট্রি উৎপাদন প্রযুক্তি নির্দেশিকা, জুন-২০০৫
199	2006	ছাগলের বাচ্চার মৃত্যুর কারণ ও প্রতিকার, প্রথম সংস্করণ, জুন-২০০৬
200	2006	A Compendium of Livestock Technologies Developed by Bangladesh Livestock Research Institute, First edition, June-2006
201	2006	ট্রিটিক্যালি উৎপাদন ও ব্যবহার, ২য় প্রকাশকাল, আগস্ট- ২০০৬
202	2007	মোটাজাকরণের জন্য গরু নির্বাচন, ফেব্রুয়ারি-২০০৭
203	2007	গরুর তড়কা রোগ দমন ব্যবস্থাপনা, ফেব্রুয়ারি-২০০৭
204	2007	গরুর বাদলা রোগ দমন ব্যবস্থাপনা, ফেব্রুয়ারি-২০০৭
205	2007	গরুর গলাফোলা রোগ দমন ব্যবস্থাপনা, ফেব্রুয়ারি- ২০০৭
206	2007	ছাগলের বসন্ত রোগদমন ব্যবস্থাপনা, মার্চ- ২০০৭
207	2007	পোল্ট্রি খামারের জীবনিরাপত্তা নিশ্চিত করণের লক্ষ্যে নিম্নের বিষয় গুলির প্রতি সতর্ক থাকা উচিত, মার্চ- ২০০৭
208	2007	ভেড়ার খাদ্য ব্যবস্থাপনা, ডিসেম্বর- ২০০৭
209	2007	পিপিআর ভাইরাসের বিরুদ্ধে এন্টিবডি নির্ণয়ে C-DISA পদ্ধতি, জুন- ২০০৭
210	2007	BLRI-A Brief Acquaintance, June-2007
211	2007	‘বিশ্বে ভেড়ার জাত ও বাংলাদেশে প্রাপ্ত ভেড়াসমূহ’ শীর্ষক পোস্টার, জুন- ২০০৭
212	2007	পশুসম্পদ ও পোল্ট্রি উৎপাদন প্রযুক্তি নির্দেশিকা, পরিমার্জিত সংস্করণ, জুন ২০০৭
213	2008	উচ্চ ফলনশীল ঘাসের চাষ, দ্বিতীয় সংস্করণ, নভেম্বর-২০০৮
214	2008	স্টলফিডিং পদ্ধতিতে ভেড়াপালন, প্রথম সংস্করণ, এপ্রিল-২০০৮
215	2008	দেশীভেড়ার প্রজনন পরিকল্পনা ও ব্যবস্থাপনা, প্রথম সংস্করণ, মে-২০০৮
216	2008	ভেড়ার ফুটরট রোগের চিকিৎসা, প্রথম সংস্করণ, মে-২০০৮
217	2008	ভেড়ারবহিঃপরজীবীরপ্রতিরোধ ও চিকিৎসা, প্রথমসংস্করণ, মে-২০০৮
218	2008	ভেড়ার প্রজনন ব্যবস্থাপনা, মে-২০০৮
219	2008	ক্ষুদ্র খামারীদের জন্য ছাগল পালন পদ্ধতি, প্রথম সংস্করণ, জুন-২০০৮

220	2008	মহিষ পালন ব্যবস্থাপনা, প্রথম সংস্করণ, জুন-২০০৮
221	2008	ভেড়াপালন নির্দেশিকা, প্রথম সংস্করণ, জুন-২০০৮
222	2008	ছাগলের বাচ্চার প্রতি পালন, ২য় সংস্করণ, নভেম্বর-২০০৮
223	2008	এভিয়ান ইনফ্লুয়েঞ্জা প্রতিরোধে জীবনিরাপত্তা নির্দেশিকা, সেপ্টেম্বর-২০০৮
224	2008	ব্রয়লার পালন নির্দেশিকা, প্রথম সংস্করণ, সেপ্টেম্বর-২০০৮
225	2009	মুরগির গামবোরো রোগ নিয়ন্ত্রণের কার্যকর পদ্ধতি, দ্বিতীয় সংস্করণ, নভেম্বর-২০০৯
226	2009	মুরগির রানীক্ষেত রোগ নিয়ন্ত্রণের কার্যকর পদ্ধতি, দ্বিতীয় সংস্করণ, নভেম্বর-২০০৯
227	2009	এইচআই (HI) পরীক্ষার জন্য ফিল্টার পেপারের সাহায্যের ক্ষমতা নমুনা সংগ্রহ পদ্ধতি, দ্বিতীয় সংস্করণ, নভেম্বর-২০০৯
228	2009	বাণিজ্যিক মুরগির খামারে জীব নিরাপত্তা ব্যবস্থাপনা, প্রকাশকালঃ নভেম্বর-২০০৯
229	2009	মুরগির সালামোনেলা রোগঃ প্রতিরোধ ও নিয়ন্ত্রণ পদ্ধতি, দ্বিতীয় সংস্করণ, নভেম্বর-২০০৯
230	2009	মুরগির খামারের বর্জ্য ব্যবস্থাপনা ও কম্পোস্টিং, দ্বিতীয় সংস্করণ, নভেম্বর-২০০৯
231	2009	পশুসম্পদ ও পোল্ট্রি উৎপাদন প্রযুক্তি নির্দেশিকা তৃতীয় সংস্করণ, জুন-২০০৯
232	2009	দেশী ভেড়ার পশম হতে ঘরে বসে চাদর, শাল ও মাদুর তৈরির সহজ পদ্ধতি, প্রথম সংস্করণ, মার্চ-২০০৯
233	2009	ভেড়ার বাচ্চার প্রতিপালন, মার্চ-২০০৯
234	2009	A Study on Highly Pathogenic A van Influenza in Bangladesh, June-2009
235	2009	মুরগির কৃত্রিম প্রজননের সহজ পদ্ধতি, প্রথম সংস্করণ, জুন-২০০৯
236	2009	ফড়ার থেকে ডিএনএ (DNA) পৃথকীকরণের সহজ পদ্ধতি, প্রথম সংস্করণ, জুন-২০০৯
237	2009	মাইকোটগিন নিয়ন্ত্রণের উপায়, প্রথম সংস্করণ, জুন-২০০৯
238	2009	রক্তের নমুনা থেকে ডিএসএ নিষ্কাশন, প্রথম সংস্করণ, জুন-২০০৯
239	2009	ক্ষুদ্র পোল্ট্রি খামারীদের 'খামার ব্যবস্থাপনা' বিষয়ে প্রযুক্তি হস্তান্তর কর্মকর্তার নিকট প্রতিনিয়ত প্রশ্ন ও জবাব, প্রথম সংস্করণ, নভেম্বর-২০০৯
240	2009	কৃত্রিম গো-প্রজনন ম্যানুয়েল, প্রথম সংস্করণ, জুন-২০০৯
241	2009	ভেড়ার খামার জীব নিরাপত্তা, প্রথম সংস্করণ, নভেম্বর- ২০০৯
242	2010	ভেড়াপালন নির্দেশিকা, ২য় সংস্করণ, অক্টোবর- ২০১০
243	2010	অ্যানথ্রাক্স বা তড়িকারোগ আতঙ্ক নয়, প্রয়োজন সচেতনতা, আগস্ট- ২০১০
244	2010	পশুসম্পদ ও পোল্ট্রি উৎপাদন প্রযুক্তি নির্দেশিকা, ২য় সংস্করণ, জুন- ২০১০
245	2010	ভেড়ার খাদ্য ও পুষ্টিব্যবস্থাপনা, প্রথম সংস্করণ, জুন-২০১০
246	2011	ভেড়ার ব্যাপক অ্যালোপেসিয়া (লোমউঠা) রোগের কারণ, লক্ষণ ও প্রতিকার, মার্চ- ২০১১
247	2011	ছাগলের ঠান্ডা-সর্দি নিরাময়ে বা নিউমোনিয়া প্রতিরোধে তুলসী পাতার ব্যবহার, মার্চ- ২০১১
248	2011	শুভ্র বাবি এলআরআই কর্তৃক উদ্ভাবিত লেয়ার স্ট্রেনইন-১, জুলাই- ২০১১
249	2012	MUN: a Modern Diagnostic Tool for Improvement of Dairy Nutrition, September-2012
250	2012	একন জরে বিএলআরআই-২০১২
251	2012	বার্ষিক টিকা প্রদান ও কৃমিনাশক কর্মসূচি-২০১২
252	2013	আঞ্চলিক প্রাণিস্বাস্থ্য ও পুষ্টি ল্যাবরেটরির কার্যক্রম ও সেবাসমূহ, ২০১৩
253	2013	বার্ষিক টিকা প্রদান ও কৃমিনাশক কর্মসূচি- ২০১৩
254	2013	তাপ-সহিষ্ণু পিপিআর ভ্যাকসিন, ২০১৩
255	2013	বাছুরের জন্য সটি পাউডার ভিত্তিক মিল্করিপ্লেসার, ২০১৩
256	2013	বহুবর্ষজীবী উচ্চফলনশীল ঘাস বিএলআরআই নেপিয়ার- ৪, ২০১৩
257	2013	ড্রাম সাইলেজ- ২০১৩
258	2013	বাংলা ল্যাম্ব- ২০১৩
259	2013	বার্ষিক প্রতিবেদন ২০১২, জুন- ২০১৩
260	2013	বিএলআরআই নিউজ লেটার- ২০১৩
261	2013	দেশী ভেড়ার ফিতা কৃমির সংক্রামণ ও প্রতিকারের উপায়, ডিসেম্বর- ২০১৩
262	2013	ভেড়ার টেলোজমোসিস ও প্রতিকার, ডিসেম্বর- ২০১৩

263	2014	ভেড়ার প্রেগন্যানসি টক্সিমিয়া (একটি বিপাকীয় রোগ) এর কারণ, লক্ষণ ও প্রতিকার, ফেব্রুয়ারী- ২০০৪
264	2014	ভেড়ার খামারে ডিওয়ামিং ডিপিং ভ্যাকসিনেশন, ফেব্রুয়ারী- ২০১৪
265	2014	প্রজননের জন্য মহিষ ষাঁড় নির্বাচন ও পালন ব্যবস্থাপনা, ফেব্রুয়ারী- ২০০৪
266	2014	মহিষের অমতঃ পরজীবী বা কৃমি দমন, মে- ২০১৪
267	2014	ভেড়ার গর্ভফুল আটকে যাওয়াঃ কারণ, লক্ষণ ও চিকিৎসা, মে- ২০১৪
268	2014	প্রাণিসম্পদ ও পোল্ট্রি উন্নয়ন প্রযুক্তি ভিত্তিক প্রশিক্ষণ মডিউল, জুন- ২০১৪
269	2014	দুধের মিনি পাস্তুরিকরণ ও সংরক্ষণ প্রযুক্তি, জুন- ২০১৪
270	2014	ভেড়ার নিউমোনিয়া প্রতিরোধ ভেষজ উদ্ভিদ তুলসী, আগস্ট- ২০১৪
271	2014	আর্থ-সামাজিক উন্নয়ন দারিদ্র্য বিমোচনে ভেড়া পালন, সেপ্টেম্বর- ২০১৪
272	2014	উন্নত ব্যবস্থাপনার মাধ্যমে দেশি ভেড়ার প্রজনন, ডিসেম্বর- ২০১৪
273	2014	ভেড়ার খাদ্য হিসেবে সাইলেজ ও ইউ এম এস তৈরির পদ্ধতি ও ব্যবহার, ডিসেম্বর- ২০১৪
274	2015	ডোল পদ্ধতিতে কীচাঘাস সংরক্ষণ প্রযুক্তি, জুন ২০১৫
275	2016	গবাদী প্রাণীর মারাত্মক সংক্রামক ক্ষুরারোগ ও এর নিয়ন্ত্রণ ব্যবস্থাপনা, জানুয়ারী- ২০১৬
276	2015	দানাদার খাদ্যের বিকল্প হিসেবে সাজনা পাতা ও কচি ডালপালা ব্যবহার করে বাড়ন্ত ভেড়া মোটাতাজাকরণ, অক্টোবর, ২০১৫
277	2016	দেশী ভেড়ার পশম, পাট ও তুলার মিশ্রণে তৈরি সুতা থেকে শাল, কম্বল ও স্যুটিংকাপড় তৈরির পদ্ধতি, সেপ্টেম্বর- ২০১৬
278	2016	সম্ভাবনাময় দেশীয় জাতের মুরগি পালন, মে, ২০১৬
279	2016	একনজরে বিএলআরআই আঞ্চলিক কেন্দ্র নাইক্ষ্যংছড়ি, বান্দরবান
280	2016	ছাগলের পিপিআর রোগ মুক্তকরণে বিএলআরআই মডেল, জুন- ২০১৬
281	2017	বিএলআরআই এ বিদেশী ভেড়ার সফল কোয়ারেন্টাইন, জানুয়ারী- ২০১৭
282	2017	ল্যাম্ব (ভেড়ার মাংস) উৎপাদনে ইউএমএস এর ব্যবহার, এপ্রিল- ২০১৭
283	2017	ল্যাম্ব উৎপাদনে গর্ভবতী ভেড়া ও বাচ্চার খাদ্যের পুষ্টি ব্যবস্থাপনা, মে-২০১৭
284	2017	একনজরে বিএলআরআই আঞ্চলিক কেন্দ্র বাঘাবাড়ী, শাহজাদপুর, সিরাজগঞ্জ, মে-২ ০১৭
285	2017	বাণিজ্যিক ল্যাম্ব (ভেড়ার মাংস) উৎপাদনে স্থানীয় জাতের ভেড়ার উপযোগীতা, জুন- ২০১৭
286	2017	মহিষের ইস্ট্রাস-সিনক্রোনাইজেশন প্রযুক্তি (Estrus synchronization in buffalo) , জুন ২০১৭ খ্রিঃ
287	2017	নর্থবেঙ্গলগ্রে জাতের দেশী গরু, আগস্ট- ২০১৭
288	2017	মুঙ্গিগঞ্জ জাতের দেশী গরু, জুলাই- ২০১৭

Packages and Technologies Developed by BLRI

A. Packages

Sl. No	Name of Package	Year developed
1.	Cattle Fattening	1998
2.	Health management package to control PPR	1999
3.	Quail rearing	2000
4.	Calf rearing	2002
5.	Dairy Farming	2002
6.	Forage production and preservation	2002
7.	Goat rearing model for poverty alleviation	2002
8.	Rearing of Black Bengal goats under semi-intensive management	2002
9.	Commercial layer model for small farmers	2002
10.	FMD control measures	2002
11.	Goat rearing under stall-fed condition	2003
12.	Broiler rearing under model for small farmers	2003
13.	Duck rearing in rural area	2003
14.	Rabbit rearing model for small farmers	2004
15.	Gumboro disease control package	2004
16.	Newcastle disease control package	2004
17.	Cockerel rearing	2005
18.	Management of Sheep Breeding and Genetics	2007
19.	Pigeon Rearing	2009

B. Technologies

Sl. No	Name of Technologies	Year developed
1.	Salmonella vaccine	1995
2.	ELISA- based techniques for the diagnosis	1995
3.	Salmonella antigen for the diagnosis of pullorum disease	1995
4.	Use of coconut, mustard oil cake and ipil-ipilleaf meal in the poultry diet	1997
5.	Urea-Molasses-Straw (UMS)-a basal feed for cattle	1998
6.	Appropriate exotic blood level for crossbreeding program of dairy cattle	1998
7.	Straw preservation under wet condition	1998
8.	Urea-Molasses Block preservation technique	1998
9.	Algae production and its use as an alternative feed for ruminants	1998
10.	Low cost preservation of green gras	1998
11.	Molasses utilization as a feed for cattle	1998
12.	Livestock feed and fuel production from cultivation of ipilipil	1998

Sl. No	Name of Technologies	Year developed
13.	Maize and cowpea mixed forage production and utilization	1998
14.	Combined antibiotic hyper immune serum therapy for PPR	1999
15.	Hygienic and improved chick brooder	2001
16.	PPR vaccine	2001
17.	C-EISA method for antibody determination against PPR virus	2001
18.	Enzyme Immuno Slide Assay (ELISA) for diagnosis of PPR and Rinderpest disease	2001
19.	Banana foliage processing and preservation for feeding cattle Sugarcane by-products processing and preservation for feeding cattle	2002
20.	Sugarcane by-products processing and preservation for feeding cattle	2002
21.	Manure-based year-round duckweed production and its utilization for feeding livestock and poultry	2002
22.	Dairy cattle development through artificial insemination and selection techniques	2002
23.	Control model for gastro- intestinal helminth parasites	2002
24.	Mycoplasma antigen	2002
25.	Improved technique for the production of organic chicken	2002
26.	Techniques for selection of best genotypes of Black Bengal goat for farm establishment	2002
27.	Manufacturing process of Astagram Ponir (cheese) and its marketing	2003
28.	Embryo transfer technique use in native cows	2003
29.	Baksa-a native grass production and its use in dairy cattle	2003
30.	Maize stover preservation and its use for feeding cattle	2003
31.	Pruning level of jackfruit leaves and system of feeding to goat	2003
32.	ND antigen for HI test	2003
33.	Bio-security in commercial poultry farms	2003
34.	Filter Paper-strip blood collection method for HI test	2003
35.	Fodder crop production for saline belt, flood prone and Madhupur tract	2004
36.	Fodder production on the hill slopes for livestock production and to alleviate soil erosion	2004
37.	Hemolysin for complement fixation test	2004
38.	Goat kid management	2006
39.	EISA method for determination of Goat pox disease	2006
40.	Goat pox Vaccine	2007
41.	'Mina Mix' as source of mineral for livestock	2009
42.	Corn straw Pellet Feed	2010
43.	Shuvra-BLRI Layer Strain-I	2011
44.	Non-electric chick brooder	2011

Sl. No	Name of Technologies	Year developed
45.	Thermostable PPR Vaccine	2012
46.	Napiar-4 High yielding grass	2012
47.	BLRM DNA Extraction Kit	2012
48.	Milk replacer for calves	2012
49.	Bio-security model for commercial small scale poultry farmer	2012
50.	বিএলআরআই এফএমডি ২০১৬ ত্রিযোজি (O, A, Asia-1) টিকার মাস্টার সীড	2016
51.	ছাগল ও ভেড়ার পিপিআর রোগ দমনে বিএলআরআই মডেল	2016
52.	বিএলআরআই ফিড মাস্টার মোবাইল এপ্লিকেশন	2016
53.	গবেষণাগারে ভ্রূণ উৎপাদন	2016
54.	প্রজননের জন্য মহিষ ষাঁড় নির্বাচন ও পালন ব্যবস্থাপনা	2016
55.	মহিষ খামারে অন্তঃপরজীবী বা কৃমি দমন মডেল	2016
56.	মহিষ খামারে জীব নিরাপত্তা ব্যবস্থাপনা	2017
57.	বিএলআরআই লেয়ার স্ট্রেন-২ বা “স্বর্ণা”	2017
58.	ব্রয়লার খাদ্যে এন্টিবায়োটিকের বিকল্প হিসেবে সাজনা পাতার ব্যবহার	2017
59.	মহিষের ইন্ট্রাস-সিনক্রোনাইজেশন প্রযুক্তি	2017
60.	ডোল পদ্ধতিতে কীচাঘাস সংরক্ষণ প্রযুক্তি	2017

Library Section

BLRI library which functions as a resource center, is constantly being enriched. BLRI maintains the library to support the research, training and disseminate the research findings and activities of the institute's researchers. This support is provided through a variety of activities as stated below. BLRI library has been continued to extend its various facilities to the researchers, including those in the regional stations at various places in the country. Some services were also enjoyed by persons other than the BLRI officer-staff.

Library use: More than 500 users including researchers, research support personnel, administrator and trainees from both within and outside the institute take advantage of the library's major facilities and services. Among the outside reader-visitors, the university students, M.Phil and Ph.D Student, scientists and researchers from various NGO's, Savar Dairy Farm, RV & F Depot and Military Dairy Farm use this library frequently. The library's infrastructure facilities and physical environment is constantly being improved. The reference service, Document delivery, dissemination channels, automated library service and on-line facilities are under-way to further improve with a view to making it a specialized library for livestock research in country and more useful to the users. BLRI library is open Sunday through Thursday, from 9:00 a.m. to 5:00 p.m.

Collection development: The authority is always careful to increase the library collection, upgrade its services and improve the information support for the scientists and researchers of the institute. The authority also allocates a regular revenue and project budget in every financial year to purchase reading materials for the library. The library received a remarkable number of journal & workshop proceedings, conventional and non-conventional research reports, annual reports, newsletters and magazines etc. on complimentary or exchange basis. The library always monitored the needs of the scientists of the institute for scientific literature and took special care to procure those in the fastest possible way. Total number of books 7412, Journals title 200 and reports 250 in the BLRI library respectively. Recently as the part of online journal collections BLRI has newly added agriculture based online journal AGORA which is conducted by 'Research for Life' as well as a world prominent e-journal database 'The Essential Electronic Agricultural Library (TEEAL)' newly added to BLRI library services.

Photocopying service: There are photocopy machines in the library to improve the document delivery services and information support such as CAS, SDI etc. to facilitate the researchers. The library's photocopying service is made available to them as needed. Number of 161265 Photocopy materials has been delivered for official and research purposes for the year 2018-19.

Computer: One personal computer was acquired for the library to facilitate word processing and database related work. Another one personal computer were added from NATP Project BARC to develop library database. New database process is under-way to computerize the library collections in near future to strengthen information retrieval facilities.

Borrowing facilities: The library's borrowing facilities were made available as usual to the researchers, administrators, M.Phil students, Ph.D students, scientists, officers and staffs of the institute and those of the RV & F Depot, Savar Dairy Farm (on a limited basis). The library maintained formal relationship with the SAIC, AIC, BAU Library, BANSDOC Library, BARI Library, Jahanginagar University Library and BPATC Library.

Reference service: The library staffs are often required to find answers to formal/informal reference queries, they are committed to response the queries and to check various reference citat

Accounts Section

Financial Statement for the Year 2018-2019 (Revenue Budget)

Taka in lakh

Economic Code	Particular	Total budget	Total expenditure	Balance
3111101	officers Salary	359,68	354,07	5,61
3111201	Staff Salary	240,32	238,22	2,10
3631102	Allowances	390,76	385,15	5,61
3631103	Supply & Service	1925,51	1888,95	36,56
3631104	Retirement allowance Gratuity	90,91	90,91	-
3621105	Grant for medical treatment	1,44	1,44	-
3421506	Contributory provident fund	140,38	140,38	-
	Grand Total:	3149,00	3099,12	49,88
	Revenue Budget Adjustment	(-) 95,00	(-) 95,00	-
	GOB Net Expenditure	3054,00	3004,12	49,88

ICT infrastructure at BLRI

Bangladesh Livestock Research Institute (BLRI) has improved its Information Communication Technology (ICT) infrastructure and services for R&D and other official activities. Recently the server room has been structurally enriched after installing some valuable devices like Power full Servers with server racks, CISCO network equipment, Online UPS and other related accessories. Server room rearranged with raised-floor and now it is almost well-equipped. Important areas of office building and research farm areas are now under IP Camera based surveillance system. Two regional sub centers Baghabari, Sirajgong and Naikhongchari, Banderaban of BLRI are also under IP Camera based surveillance system.



Figure 1. Server room and Surveillance system

BLRI is electronically connected with Bangladesh Research and Education Network (BdREN) to use different ICT related services of University Grants Commission (UGC). (VPN). Scientists are using The Essential Electronic Agricultural Library (TEEAL), a digital library of research



Figure 2. TEEAL database.



Figure 3. www.blri.gov.bd

in the agricultural and related sciences and accessing more than 465,000 full-text PDF articles from over 350 (1990-2011) international journals using Local Area Network (LAN). All office buildings are connected through underground optical fiber backbone including some farm areas. All office rooms, laboratories, library, conference room, guest house and DG's Bungalow

are connected to the LAN. Scientists and officials are getting the facilities such as file or data sharing, print sharing, communicating among themselves through the LAN for better R&D activities. Dedicated 100 Mbps full duplex Internet connectivity is attached to the LAN. Scientists and officials are using 24 hours uninterruptible Internet from every computer under the LAN. Some areas of office are under wireless internet connection (Wi-Fi). Internet is accessible through mobile device like Smart phone, Tablet PCs, Laptop etc. Scientists are communicating with different international Research Institute, Universities and related organization for better R&D activities by using internet. Updated R&D information, news, reports, and other activities are available in BLRI official website <http://www.blri.gov.bd> both in Bangla and English language.



Figure 4: Video conference room

BLRI is started using Internet Protocol (IP) based intercom phone service for better communication. Regional stations also connected with IP phone. Regional offices are also connected with the local IP based intercom.

Now a dedicated international standard video conference system is available at BLRI. Training, meeting or any other international research collaboration and online communication is available from BLRI.

Store and Procurement Section

During 2018-19 Financial year store & procurement section procured the following goods.

Sl. No.	Name of goods	Cost lac (Tk)
1	Animal & Poultry feed	600.00
2	Stationaries goods	6.34
3	Electric goods	8.10
4	Sanitary & Plumbing goods	6.73
5	Computer	11.35
6	Printing & Publication	4.47
7	Milk Pasteuzer Machine	4.88

List of Personnel

No.	Name	Designation
1.	Md. Abdul Jalil, Ph.D (Zoology)	Chief scientific Officer
2.	Nathu Ram Sarker, Ph.D (Animal Nutrition)	Chief Scientific Officer
3.	Md. Azharul Islam Talukder, Ph.D (Animal Breeding)	Chief Scientific Officer
4.	Md. Giasuddin, Ph.D (Vet. Parasitology)	Chief Scientific Officer
5.	Md. Ershaduzzaman, Ph.D (Bacteriology, Molicular Biology)	Chief Scientific Officer
6.	S.M. Jahangir Hossain, Ph.D (Animal Breeding & Genetics)	Chief Scientific Officer
7.	Nasrin Sultana, Ph.D (Animal Nutrition)	Chief Scientific Officer
8.	Mohammad Lutful Haque, M.Sc. (Computer Eng.)	System Analyst
9.	Shakila Faruqe, Ph.D (Animal Breeding & Genetics)	Principal Scientific Officer
10.	Md. Sazedul Karim Sarker, Ph.D. (Poultry Nutrition)	Principal Scientific Officer
11.	Most. Parvin Mostari, Ph.D. (Neuroendocrinology & Animal Reproduction)	Principal Scientific Officer
12.	Md. Zillur Rahman Ph.D. (Animal Nutrition)	Principal Scientific Officer
13.	Biplop Kumar Roy, Ph.D. (Livestock Production Management)	Principal Scientific Officer
14.	Gautan Kumar Deb, Ph.D. (Reproductive Biotechnology)	Principal Scientific Officer
15.	Razia Khatun, Ph.D. (Food Safety)	Principal Scientific Officer
16.	Kamurn Nahar Monira, Ph.D. (Animal Breeding & Genetics)	Principal Scientific Officer
17.	Sardar Mohammad Amanullah, Ph.D. (Applied Life Science)	Principal Scientific Officer
18.	Md. Asrafur Islam, B.Sc, Eng. MBA	Executive Engineer
19.	Dr. Md. Nuruzzaman Munsil, M.S. (Therigenology), PhD fellow	Principal Scientific Officer
20.	Md. Rakibul Hasan, Ph.D. (Agriculture poultry nutrition of physiology)	Principal Scientific Officer
21.	Sadek Ahmed, Ph.D. (Animal Nutrition)	Principal Scientific Officer
22.	Mohammad Abdus Samad, Ph.D. (Bio-medical Engineering)	Principal Scientific Officer
23.	Md. Shahin Alam, PhD	Senior Scientific Officer
24.	Mohammad Abdur Rashid, PhD	Senior Scientific Officer
25.	Shamim Ahmed, PhD fellow	Senior Scientific Officer
26.	Ali Akbar Bhuiyan, PhD	Senior Scientific Officer
27.	Halima Khatun, PhD	Senior Scientific Officer
28.	Mohammad Sirajul Islam, Ph.D fellow	Senior Scientific Officer
29.	Md. Asadul Alam, Ph.D fellow	Senior Scientific Officer
30.	Farhana Afroz, PhD fellow	Senior Scientific Officer
31.	Noni Gopal Das, M.S. (Animal Science)	Senior Scientific Officer
32.	Md. Saiful Islam, PhD fellow	Scientific Officer
33.	Mrs. Mahafuza Khatun, Ph.D fellow	Scientific Officer
34.	Md. Abu Yousuf, M.S. (Pathology)	Scientific Officer
35.	Md. Nazmul Huda, B.Sc. & AH. (Hon's)	Scientific Officer
36.	Md. Hafizur Rahman, M.S. (Microbiology)	Scientific Officer
37.	Md. Mukhlesur Rahman, M.Sc. (Animal Nutrition)	Scientific Officer
38.	Ponir Chowdhury M.S. (Animal Breeding & Genetics)	Scientific Officer
39.	Md. Abu Hemayet, MS. (Poultry Science)	Scientific Officer
40.	Md. Rezaul Hai Rakib, B.Sc, (A.H.) Hon's	Scientific Officer
41.	Md. Masud Rana, M.S. (Poultry Science)	Scientific Officer
42.	Md. Obayed Al Rahman, M.S. (Poultry Science)	Scientific Officer
43.	Md. Ahsanul Kabir, M.S. (Dairy Science)	Scientific Officer
44.	Md. Rezaul Karim, M.S. (Microbiology)	Scientific Officer
45.	Md. Khairul Basar, M.S. (Poultry Science)	Scientific Officer
46.	Md. Yousuf Ali, M.S. (Poultry Science)	Scientific Officer
47.	Yousuf Ali Khan, M.S. (Animal Breeding & Genetics)	Scientific Officer
48.	Md. Zakir Hasan, M.S (Medicine)	Scientific Officer
49.	Md. Anwar Hossain, M.S. (Microbiology)	Scientific Officer
50.	Sabina Yasmin, M.S. (Agriculture Economics)	Scientific Officer
51.	Md. Humayun Kabir, M.S (Pathology)	Scientific Officer
52.	Md. Amirul Hasan, M.S. (Medicine)	Scientific Officer

No.	Name	Designation
53.	Jobaida Shovona Khanam, M.S. (Animal Breeding & Genetics)	Scientific Officer
54.	Md. Faizul Hossain Miraz, M.Sc. (Animal Science)	Scientific Officer
55.	AS.M. Ashab Uddin, DVM	Scientific Officer
56.	Sabiha Sultana, Ph.D (Poultry Nutrition of Physiology)	Scientific Officer
57.	Md. Ataul Gani Rabbani, B.Sc. AH. (Hon's)	Scientific Officer
58.	Md. Zulfekar Ali, M.S. (Microbiology)	Scientific Officer
59.	Md. Habibur Rahaman, DVM	Scientific Officer
60.	Nure Hasni Disha, M.S. (Animal Breeding & Genetics)	Scientific Officer
61.	Sonia Akter, M.S. (Pathology)	Scientific Officer
62.	Md. Redoan Akond Sumon, M.S. (Animal Nutrition)	Scientific Officer
63.	Md. Mahmudul Hasan Pasha , B.Sc. A.H. (Hon's),	Scientific Officer
64.	Md. Al-Mamun, M.A (Information Science & Library Management)	Librarian
65.	Md. Zahidul Islam M.S.S (Public Administration)	Publication Officer
66.	Devjyoti Ghosh (Journalism and media studies)	Information Officer
67.	Md. Keramot Ali, Dip-in-Eng. (Civil)	Sub-Assistant Engineer
68.	Md. Abdus Samad, Dip-in-Eng. (Civil)	Sub-Assistant Engineer
69.	Md. Shafiqul Alam Mondol, Dip-in-Eng. (Electric)	Sub-Assistant Engineer (Electronics)
70.	Md. Ahsan Habib, M.Com	Security Officer
71.	Md. Farid Miah, M.B.S.	Procurement Officer