PBRG Sub-project Completion Report (PCR)

A. Sub-project Description

1. **Title of the PBRG sub-project:** Development of knowledge hub on Feed Resources for efficient feeding management of livestock

2. **Implementing organization (s):**

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b.	**Component-1**	**Bangladesh Livestock Research Institute (BLRI)** Savar, Dhaka, Bangladesh Phone: +88 027791675
c.	**Component-2**	**Bangladesh Agricultural University (BAU)** Mymensingh, Bangladesh Phone: (091)67401-6, 66016-18 FAX: +880-91-61510 Email: registrar@bau.edu.bd
d.	**Component-3**	**Sylhet Agricultural University (SAU)** Sylhet- 3100

3. **Name and full address with phone, cell and E-mail of Coordinator, Associate Coordinator and PI/Co-PI (s):**

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4. Sub-project budget (Tk.):

4.1 Total (in Tk. as approved): 1,69,32,244.00 TK

4.2 Latest Revised (if any): N/A

5. Duration of the sub-project:

5.1 Start date (based on LoA signed): 01 July, 2018

5.2 End date: February 15, 2022

6. Background of the sub-project:

The economic transformation of Bangladesh from lower income to upper middle-income country and achieving the per capita income of 2227 USD (188873 BDT) pose the structural change in the Agricultural with particular emphasis to dairy sector in Bangladesh. The livestock improvement with more attention to milk and meat production is the key agenda for the Ministry of Fisheries and Livestock which has been reflected in the World Bank funded project termed as "Livestock and Dairy Development Project (LDDP)". Livestock productivity improvement, achieving self-sufficiency in milk and reaching the exporting capacity in meat through revising existing policy towardsmaking congenial environment for supporting the livestock stakeholders and ensuring nutrition security to all have been targeted through this project. The options to improve livestock production by improving breeding programme and strengthening livestock support services (e.g. veterinary services, extension services, nutrition and feeding services, marketing services) is only possible once adequate feed resources are ensured. Feed is the

foundation for efficient livestock production and linked with major inputs and outputs. Estimation of feed balance at national and farm level would help to identify the feed vis-à-vis nutrient balances (Dry Matter, Crude Protein and Metabolizable Energy). This also helps in spatial and temporal assessments of current and forecasted feed resources which ultimately would help for efficient feed management strategies and in establishing feeding standards.Appropriate feeds and feeding system is the major driver for livestock development. Within livestock feeding system, feeds and fodder production plays a key role to enhance the productivity. A feed inventory analysis of a particular area/region, in this regards, will provide information on the type of feed resources available and their quantities, which can then be compared to available livestock numbers to arrive at the status of the region in terms of feed availability being sufficient, in surplus, or in deficit (Samireddypalle and Koratikere, 2011). Studies have been done by various researchers earlier to document feed resources and their availability in Bangladesh but those might need to update considering feed dynamics. Recently substantial changes have been observed from introduction of new varieties, agronomical practices and climate change issues which influence not only the quantity of feeds but also the chemical composition and quality of the feeds. However, no studies have so far been done to document changes in feed dynamics and nutritive value of feeds potentially derived from these factors. The literature review revealed that only limited number of study has been undertaken on feed inventory and feed balances in Bangladesh. The study done by Huque and Sarker (2014), FAO (2017) and Rahman et al., (2017) has documented the feed resources in Bangladesh. However, their study was based on secondary information based on FAO (2012) methodology based which led to estimate the coefficient on harvest index and extraction ratio (Annandan and Sampath, 2012). This would mislead if we translate those to the local farming practice. This could be over-come once there is feed inventory based on primary data, more specifically on farm level data. In this context, the study done by Saadullah and Hossain (2000) could be of help, however, that study is also too old to address dynamic changes of the feed resources, nutrient content and digestibility as well as prices of the feed ingredients, availability and farming practices.

The information rights and access to right information is the top priority areas of the government's mission for Digital Bangladesh. To exploit this policy, Access to Information (***a2i***) is on-going process for increasing the service provisions to the people of all concerns based on reduction of TVC (Time, Visit and Cost). However, this is not yet sure whether the information on feed and nutritional value would be ensured or not. The proposed studyon the other hand, has been designed to address the information on feed and nutritional value through launching online database which would be interactive so that all farmers can get easy access to the right information on feeds.The farmers who are treated as the center of the livestock development wheel as they steer the wheel of progressing the livestock sector will get benefit from this study. Therefore, the proposed study is of high relevance to the nutritional and economic development perspectives of the country. The proposed study will address those limitations and would provide an excellent basis for developing interactive and dynamic knowledge hub on animal feed resources and related issues as well as help to make step forward for locally applicable feeding standards.

7. Sub-project general objective (s):

The purpose of this study was to generate information for establishing national feed inventory on detailed feeds and fodder available in the country, their chemical composition and nutritive value which would ultimately help to model the specific feeding program in different regions and seasons over the year.

8. Sub-project specific objectives (component wise):

Coordination Component (BARC):

To coordinate and monitor of all activities of the partner institutes

Component- 1 (BLRI):

a) To establish national feed inventory for estimating feed balance (for three selected divisions)
b) To develop model for predicting nutrient (specifically energy and protein) requirements utilizing the concept of meta-analysis for dairy and beef cattle
c) To develop country specific extraction ratio/factors or harvest index for all conventional crop residues and agro-industrial by-products used as animal feed in Bangladesh

Component-2 (BAU):

a) To establish national feed inventory for estimating feed balance (for three selected divisions)
b) To develop online animal feed resources knowledge hub (feed data bank)
c) To develop model for predicting nutrient (specifically energy and protein) requirements utilizing the concept of meta-analysis for dairy and beef cattle.

Component-3 (SAU):

a) To establish national feed inventory for estimating feed balance (for threeselected divisions)
b) To develop model for predicting nutrient (specifically energy and protein) requirements utilizing the concept of meta-analysis for dairy and beef cattle.

9. Implementing location (s):

Component- 1 (BLRI):

Laboratory work was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka campus and the survey was conducted at six locations of Jashore, Jhikorgacha, Manikganj, Munshiganj, Nikhongchari and Patiya.

Component- 2 (BAU):

The implementing location was the Bangladesh Agricultural University, Mymensingh whereas the field survey related activities were conducted in six upazilas of Rajshahi sadar, Paba, Lalmonirhat Sadar, Chilmari, Mymensingh sadar and Dhobaura.

Component- 3 (SAU):

Research activities were conducted at the Sylhet Agricultureal University, Sylhet while the survey related activities were conducted in five upazilas of SunumgonjSadar,Taheirpur, Patuakhali Sadar, Khepupara and Shamnagar.

10. Methodology in brief:

Coordination Component (BARC):

The methodology used relating to Coordination Component (BARC) was as follows:

a. Organizing Annual Review Workshop

A day long annual review workshop was successfully organized at the Conference room of BARC on Wednesday, 23 November 2019 to review the progress of the research activities conducted during the first year of the sub-project where future work plans for the second year were also discussed and finalized. About 60 participants (scientists/experts) from BARC, DLS, BLRI, BAU, SAU, FAO, PIU-BARC and KGF attended the workshop. Participants and expert members delivered their valuable suggestion/opinions for successful implementation of the sub-project.

b. Arranging meetings

The coordination component has arranged meetings with PIs and Co-PIs for smooth progress of the sub-project activities. The fifth coordination meeting was held on 08/12/2019 where progress of the sub-project activities was discussed and future project activities along with the monitoring schedule was finalized. Proceeding of the meeting was sent to the individual sub-project personnel as a guideline to follow for smooth progress and successful completion of the sub-project.

c. Monitoring and Evaluation of Research Projects

Monitoring team of BARC visited BLRI component on July 2018 to June 2021. Team visited the laboratory and discussed with PI about the activities. PI informed the team about the on-going activities of the sub-project regarding sample collection, test and analysis. Team suggested some points regarding the activities improvement.

d. Submission of report

Compiled annual progress report and monthly SoE (Statement of expenditure) was submitted to NATP authority regularly.

Component- 1 (BLRI)

1. Establishing national feed inventory

Activity-1: Review of literature, collection of secondary information on feed availability, collection of feed composition and nutrient requirement data from different laboratory, journal & proceedingson the following aspects of feed data:

- Year round availability of feeds and fodder
- Year round pricing (input and output price)
- Year round use pattern for different feeds
- Year round import and export data of the specific feed ingredients
- Comparison with other ingredients
- Prospective use of unconventional feeds
- Land utilization for specific feed production

The study was highly depend on the extensive review on feed resources, their chemical composition, nutritive value, digestibility and other growth and metabolic trial results. This was done according to region, season, species, authors and publication source. We have employed

improved literature review methodology in order to ensure the quality of the information and collecting appropriate information. Some of the methods are described as below:

- **i)** Literature search through published sources (Journal, proceedings, thesis, magazines, newspapers)
- **ii)** Web-based search (Google, google scholar, institutional website)
- **iii)** Institutional source (Data/information was collected from different institutional archive)

To pertain the data relevant to specific objective and to analyze the data in order to produce the results, a meta-analysis was carried out.

Activity 2: Annual Feed Balance Calculation of Six Different Upazila of Bangladesh

National feed assessment (NFA) is a data and computation based analysis system which represents the demand and supplies of livestock feed in a country. It is a complete set of procedures, facilities, tools, organization and institutions involved in the collecting, handling and processing of data necessary to calculate and report the supplies of livestock feeds from all sources and for all livestock types in a country. An NFA bridges this gap by determining the total quantities of feed available to the livestock relative to the demands of the livestock for feed. National agricultural statistics are used to assess food security, but these statistics have often just included statistics for livestock-based food supplies and have fallen short in assessing supplies of plant materials which are needed to support the livestock. Now a days increasing population, urbanization and income growth are approaching much to enhance the livestock production as the demand of food from animal origin has been increased. But the increased livestock production policy becomes hampered due to their feed crisis compared to demand and supply. This scenario is very acute in developing countries. This is why it is an urgent need to assess the national availability of feeds& fodder, and potentiality of its production along with the demand of it. This is a complex task because livestock feeds are highly diverse and often poorly quantified; they are either not directly measurable commodities or are widely distributed over extensive grasslands and other rangeland environments which are poorly monitored. The scenario is also same for our country too. Bangladesh is a livestock concentrated country and her annual production rate is also in increasing trend. But we have no concrete assessment of annual livestock feed demand and production. The probable potential areas which may contribute in livestock feed management remain out of sight of the policy makers due to the lack of exact database regarding this aspect. Considering this situation, the present study was designed to conduct the national feed assessment for computing and recommending least cost balanced ration and feeding standard for animal in accordance to their age, body condition and stage of production. Moreover, this assessment will support policymakers, government agencies, non-governmental organizations (NGOs), intergovernmental agencies and development agencies. This assessment also will contribute in formulating and implementing sustainable livestock development activities. Spatial and temporal assessments of current and forecasted feed resources, including forage, will assist in disaster management and policy-making.

Methodology

Under this study the national livestock feed demand and supply of 2019-20 was calculated. The work has been conducted jointly with stakeholders in the feed value chain e.g., Ministry of Livestock and Fisheries, Ministry of Agriculture and Natural Resources, Central Statistical Agency, feed industry, feed tradesrs and farmers, among others in the feed value chain.

The model and methodologies for establishment of feed inventory, animal nutrient requirements (as dry matter, DM; metabolizable energy, ME; and crude protein, CP) and feed balance, conducted for 6 regions of Bangladesh and the entire country, were essentially based on FAO (2012). The model used for establishment of feed inventory and feed balance is presented in Figure 1. The feed resources assessed in two categories viz roughage (cereal straws, pulse aerial part, oil seed cake aerial part, stubble feeding, root crop aerial part, industrial crop by product plant part, fruit crop,vegetable crop and cultivated fodders) and concentrate (Cereal &pulse bran, oil seed cake and industrial by product).Livestock data and crop production census was taken from the Department of Livestock Services (DLS) and the Department of Agricultural Extension (DAE) respectively. For converting crop grains to crop residues, oilseeds to oilseed residues, cereal and pulse grains to their milling products obtained during processing, and permanent crops to their residues/by-products various factors were used. These factors have been derived from many publications: FAO (1987), Funte et al. (2010); Akgün et al. (2011); Ayoola et al. (2012); Bhattacharya et al. (1993); De Leeuw et al. (1990); Hemstock et al. (1994); Hofsetz and Silva (2012); Nam et al. (2016); Rodríguez et al. (2010); Ramachandra et al.(2007); Tolera (1990); Wu et al.(1993). After collecting all the feed resource data from DAE it was converted to their DM, CP, ME using the recommended DM, CP and ME value of each feed from Feedapedia, FAO guidelines and NRC. All the livestock population was converted to TLU (Tropical Livestock Unit) assuming the TLU value of 0.7, 0.75, 0.1 and 0.1 for cattle, buffalo, goat and sheep respectively.

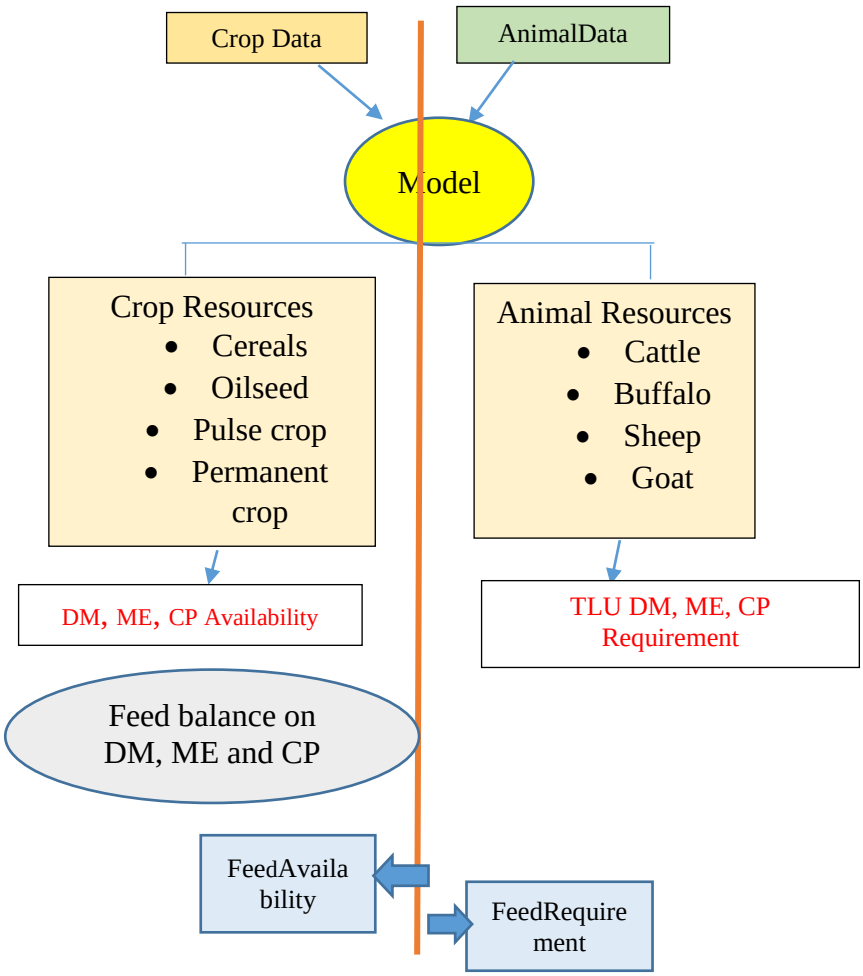


Figure-1: Model used for feedinventory and feed balancecalculation

Activity-3: Survey and inventory of available feedstuffs of different agro-ecological zones of Bangladesh

Survey

The survey study was conducted at six locations (Jashore, Jhikorgacha, Manikganj, Munshiganj, Nikhongchari and Potiya) of three divisions (Khulna, Dhaka and Chattogram) of Bangladesh.

Locations	Division
Jashore	Khulna
Jhikorgacha	
Manikganj	Dhaka
Munshiganj	
Nikhongchari	Chattogram
Patiya	

Figure 2: Six different survey areas of three divisions in Bangladesh

Document review

Before going to survey for this study, the necessary documents were reviewed for pre-assessment which helped us for the development of details methodology, work planning, and questionnaire formation.

Methods of data collection

There was only one approach followed for data collection in the survey. Household survey (HHS) was the quantitative approach of data collection conducted by a group of trained enumerators. In this technique, enumerators randomly visited respondents' house from door to door for direct interviewing with the structured questionnaires.

Development of questionnaires

In the HHS, questionnaires were mostly formed by close ended questions (answer either 'yes' or 'no' or from multiple answers or multiple-choice questions) which may be described statistically. However open-ended questions are effective for acquiring qualitative information and are particularly good for determining people's estimation and feelings. During developing questionnaires, the objectives of thesub-project were considered. Besides, as this was a purposive survey, all questions were made relevant to the dairy farming issues.

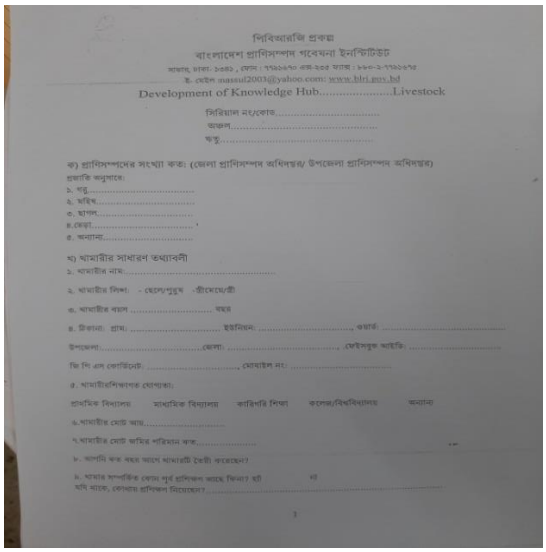


Figure 3: Questionnaire preparation and survey conduction

Sample size for household survey

Although, standard sample size can be estimated statistically by the formula adopted by Cochran (1963), but considering the COVID-19 pandemic and duration of time to accomplish this study, the sample size of the respondent households for conducting the survey study was finalized with the consultation of the sub-project coordinator and PI & Co-PI of other components of the sub-project. Every location was surveyed involving three seasons (summer, winter, mosoon) in a year.Moreover, all the respondents were randomly chosen from among the dairy farmers in the survey areas. The sample size is given in table 1 below.

Table 1: Sample size for data collection

Locations	Households
Jashore	90
Jhikorgacha	90
Manikganj	90
Munshiganj	90
Nikhongchari	90
Patiya	90
Total	540

Approach to collect information from the respondent

During survey, the research objective was clearly explained to all respondents prior to taking interview from them. Verbal consent of each of the respondent was taken before interview. The respondents those who denied or showed any reluctance in providing information were abundoned. The research team was highly committed to the respondents to keep the privacy of their information and source of data as well as put heartiest attempt to be unbiased in collecting data.

Training to the enumerators

For conducting the household survey a debriefing session was held for the enumerators to provide them a clear understanding about the questions to be asked to the interviewers and the techniques of collecting authentic information.

Data checking and quality control

All the questionnaires filled by the enumerators was checked and crosschecked by the PI and Co-PI prior to go for data punching.

Data analyses

After checking and cross examination, all data were imputed in MS excel worksheet and analyzed by pivot table for frequency analysis. Further statistical analysis was performed by SPSS software.

Activity-4: Determination of chemical composition of available feedstuffs during summer, monsoon and winter

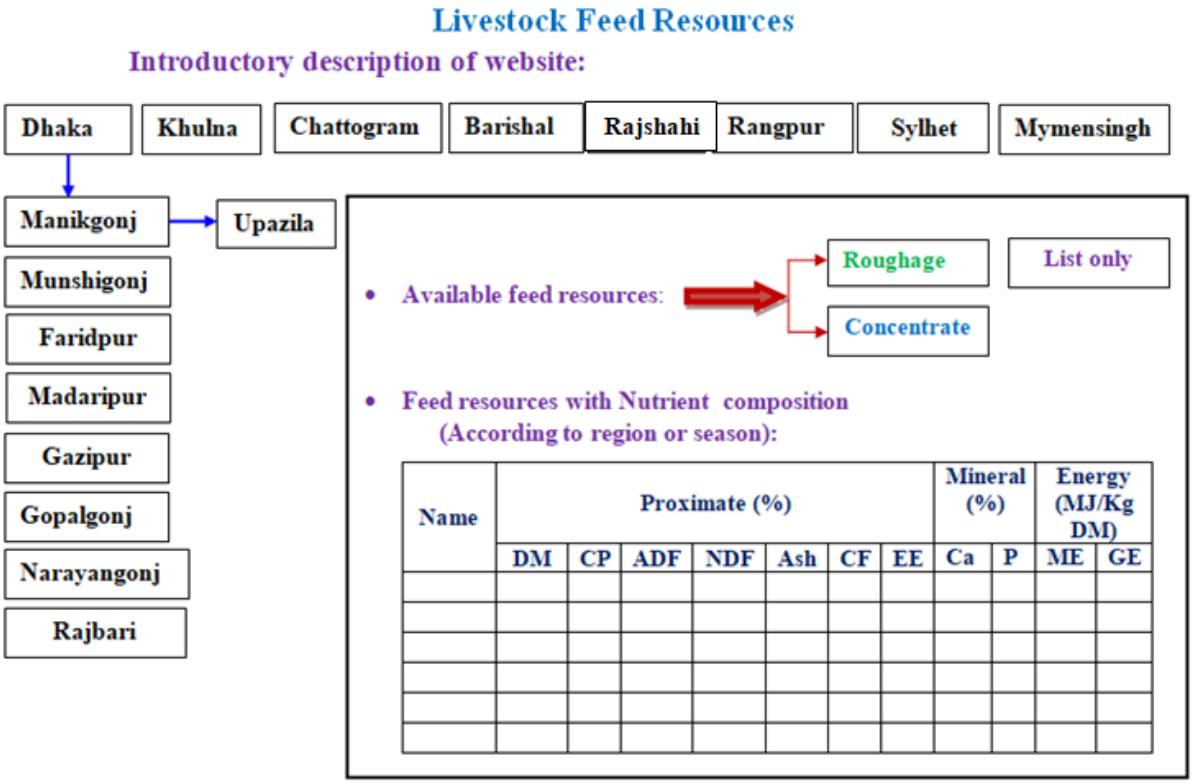
The chemical composition (DM, CP, CF, NFE, EE and TA) and minerals content was determined according to AOAC (2000) method.

Figure 4: Determination of chemical composition of available feedstuffs

Activity 5: Layout and design of the webpage content and oversee the development of interactive web-portal for online documentation of the feed resources.

Evaluating the content of available web page existing in the website, the proposed web page has been designed (its domain, web layout). The content is being ready and available in the newly developed website which is under development at present.

Demo Design of Website:



Feed Classification

Roughage:

- Straw
- Hay
- Grass Forage
  - Commercial grass
  - Local grass
- Leguminous grass
- Tree forage

Concentrate Feed:

- Grain
- Grain by-product
- Pulse
- Pulse by-product
- Oil Plant by-product
- Animal by-product
- Root & Tubers

Unconventional Feed:

- Forage
- Tree
- Concentrate
- Others

The following section will be included in the description of a feed ingredient

1.0 Common Name:
2.0 Scientific Name:
3.0 Feed categories: Grain /grain by -product/pulse :
4.0 Image:

5.0 Production/ Availability:
6.0 Physical Characteristics :
7.0 Nutrient Composition:

Nutrients	Unit	Value				Sample Number
		Average	SD	Minimum	Maximum	
DM	% as Fed					
Ash	% DM					
ADF	% DM					
NDF	% DM					
CP	% DM					
Ca	% DM					
P	% DM					
CF	% DM					
EE	% DM					
GE	MJ/kg DM					
ME	MJ/kg DM					

The website was developed by hiring IT expert but this will be maintained by BLRI. All other participating organization (like, BAU and SAU) will also support to maintain and get access to the administrative section so that they can update whenever they want.

2. Development of model for predicting energy and protein requirements for milk production

The experimental procedures, animal handling, collection of leftover, faces and urine sample were reviewed and approved by the authority of Bangladesh Livestock Research Institute, Savar, Dhaka. The experiment was conducted for 45 days including 10 days of adjustment period. A total of 20 local cows which were assigned a numerical number from 1 to 20,and each treatment group comprises of 5 animals. The brief description of the experimental approaches and methodology followed are presented below:

Experimental place

The experiment as well as the feeding trial was conducted in the Cattle Research Farm of Bangladesh Livestock Research Institute (BLRI) located in savar, Dhaka. Required roughages for the experiment (German grass and Moringa tree fodder) were cultivated at the field of Cattle Research Farm of BLRI.

Experimental design and diet

Twenty local cows (Pabna 10 in number and RCC 10 in number) aged around 18 to 24 months were selected and according to live weight and milk production, the cows were randomly and equally distributed into four groups where two groups contained pabna cattle and other two groups RCC cattle. Five Pabna cows were kept in control and other five cows were kept for treatment weighed 296.0±14.0 kg and 298.0±27.0 kg, respectively. In case of RCC cows similarly two groups of cows were kept as control and treatment purpose weighed 242.0±11.0 kg and 240.0±9.0 kg, respectively. The experiment was conducted following Completely Random Design (CRD). BLRI developed ration was provided for the control groups of RCC and Pabna cows. Besides NATP-1 ration (Moringa silage, rice bran, DCP and molasses) was offered for the treatment groups of RCC and Pabna cows. As moringa silage was used for treatment groups,

unlikely the control group got German grass which was previously cultivated in the cattle research farm of BLRI. German grass was supplied to the animals by chopping in 4mm long.All the animals received roughages and concentrate at 60: 40 ratio. Daily required feed was divided in to two parts, one part was supplied in the morning (8.00h) and another part was supplied in the afternoon (15.00h).The animals were housed in a well-ventilated shed with individual concrete floor stalls fitted with individual feed and water troughs. As routine farm practices, the animals were immunized against foot and mouth disease and anthrax and were dewormed twice a year. Supply of fresh water was ensured for whole experimental period. Before starting the feeding trial 10 days milk production data was collected from the record book and first 10 days of feeding trial was used for adjustment period. Within 45 days of trial, commencing 10 days were recognized as adjustment period,next 21 days was used for recording milk production without taking milk sample for analysis. Milk sample was collected from the consecutive next 7 days for laboratory analysis. Finally, last 7 days of experiment was used for digestibility trail conduction.

Table 2: Proximate composition of German grass, BLRI developed concentrate mixture and NATP-1 ration

Feed items	DM %	CP %	ADF %	NDF %	Ash %	ME (ME/kg DM)
German grass	23.78	11.43	44.79	73.66	7.62	22.15
BLRI ration (conc.mixture)	88.26	18.96	23.02	33.13	7.16	25.62
NATP-1	47.04	15.77	29.34	43.62	10.17	10.56

Preparation of Moringa silage

Moringa seeds were prepared by soaking and drying method. After germination, seeds were transferred in seed bed to grow upto 30 days. After 30 days the growing seedlings were transferred in well prepared plot. The plot size was 8×8 square meter and the plant distance was 1.5×1.5 cm from each plant to other. Before transferring of the seedling, the plots were prepared by cultivation, fertilizer application (cow dung and potash) and foradan as an insecticide. After planting the seedlings first cutting was obtained at 120 days at 60 cm height from land. Subsequent cuttings continued at every 40 days interval. Fresh moringa was chopped in 1.5 to 2.0 cm length. Fresh chopped moringa was packed in small air tight plastic container. A total of 45containers were filled with chopped fresh moringa. Filled moringa containers were opened at 7 days interval upto 63 days and all the samples were subjected to proximate component and fiber analysis at the animal nutrition laboratory of BLRI.

Preparation of NATP-1 ration for treatment group animal

The RCC and Pabnacows of treatment groups were fed with NATP-1 ration which was made by mixing preserved moringa silage with rice bran, DCP and molasses. Molasses was added to increase the palatability of the mixture.For providing the required nutrient to the lactating animals, the DM of the basal diet was evaluated twice a week. During the experimental period, the daily feed consumption was calculated through the conventional method variance between supply and leftover. Before the feeding time, the feeds were weighed and kept in the feed trough. On the next day, in the morning, the leftovers were collected and weighed individually and written down into the data collection sheet before offering the new feed. The DM of the leftover was determined at least once in a week except for the period of digestibility

determination. Supply and refusal of moringa silage and the tested ration were collected daily for sampling and stored in a freezer (−18°C). For proximate analysis, these collected samples were mixed to produce one sample for each cow. Hand milking was carried out twice a day, in the morning and evening. Periodically, the total milk production per cow was weighed and noted, and 100 mL of milk was kept in the milk sample bottle for storing immediately into the refrigerator at 4°C. The milk sample of a cow was mixed to have a pooled sample for the determination of milk composition.

Digestibility trial

For nutrient partitioning and digestibility, the metabolic trial was initiated ten days before the end of the research work, with three days for adjusting to the new system and seven days for data recording. Before morning feedingthe sample collection was completed at 9:00 when the weight of the feed supplied including the leftover, cow dung, and urine were noted. The feces voided from each cow were kept into a large container for 24 h covered with the lid to avoid evaporation. Every day, the cow dung of each container was weighed and thoroughly mixed, and a 5% sub-sample was taken before emptying the container and was stored in the freezer. After the collection period, the total collected feces samples of each cow were melted and assorted properly, and around 300g of mixed feces sample was taken for proximate analysis. After adding 40 ml of H_2SO_4, the total urine voided of each cow was collected into a container. The sub-sample of urine (10 ml/100 ml) was taken for the determination of nitrogen using the Kjeldahl nitrogen method.

Figure 5: Prediction of energy and protein requirements for milk production through feeding trail

Analysis of milk constituents

The milk constituents were analyzed for all milk samples at the BLRI dairy laboratory. Milk fat was determined according to Gerber's method 1891 and the lactose was assessed through the rapid method. By difference, the solid not fat (SNF) was estimated by using the following equation:(A new formula for FCM (3.5%) fat [Fat-corrected milk]. Short communication, 1986)fat corrected milk (FCM) = 0.4 M + 15.0 F, to measure the 4% fat corrected milk, where M = milk yield and F = fat yield.

Chemical analysis

The animal feed and refusal containing DM, CP, and ash were analyzed, following the method described by Association of Official Analytical Chemists (AOAC, 2005). Also, fiber digestion was analyzed [neutral detergent fiber (NDF) and ADF,Van Soest, P. J., J. B. Roberson, B. A. Lewis.1991] according to the method mentioned earlier.

Statistical analysis

All the data were analyzed statically following completely randomized design (CRD) using the SPSS, 2002 computer software packages. Differences at $P < 0.05$ were considered statistically significant.

4. Development of harvest index for all conventional crop residues and agro-industrial by-products used as animal feed

Several methods have been proposed to simulate yield in crop simulation models. In this work, we present a simple method to estimate harvest index (HI) of agricultural crops. (Dennis Pennington, Michigan State University Extension - January 28, 2013). Due to feed shortage there is increasing interest on harvesting crop residues for livestock feed or bioenergy; some farmers are very keen to know how much residues is out there in the different crop residues. Residues is made up of the straw, stalk, and leaves, husks and tassels left in the field after harvesting the grain. Residues can be harvested and used as a livestock feed. The amount of residues produced each crop year depends on weather, soils and management practices like fertilizer and pest control applications. As a general rule, the amount of residues produced is about the same as the amount of grain produced. This is commonly expressed in a ratio called harvest index.

Component-2 (BAU)

1: Establishing national feed inventory

To fulfill the objectives of this sub-project, a series of experiments and field survey was conducted during last three years from July 2018 till May 2021. Since the development of the knowledge base on availablity of the feed resources are quite time consuming and require multiple methodology and multiple stakeholder's participation, a holistic approach was used. The holistic approach involved the following methods and activities:

1) Use of both qualitative and quantitative information collected from the secondary sources as well as primary sources
2) The key innovation of this sub-project is the application of the concept of the meta-analysis where a multiple of knowledge base has been quantified and modelled in the form of readable and useable for the famers and policy makers and also possible to visualize in the website for practical farming practices
3) The formulation of the balanced ration is the ultimate goal of the development of feed knowledge hub;a suitable model development was the mandatory through using different feeding standards and using the existing feeding system. A number of feeding trial was also applied.

4) The combination of the field survey, on-station and on-farm feeding trial, adaptive field survey and number of the secondary sources (Feed Pedia, IFCN, IDRN, google search) was also applied.

Study locations

In order to make the representative samples on feed resources, the country was divided into eight (8) administrative divisions. Within each division, one district and two sub-districts (Upazilas) were selected except for Rangpur division where due to the nature of the geographic coverage and farming system two districts were selected. Bangladesh Agricultural University (BAU) was responsible for conducting research that is depicted in Table 3.

Table 3: Selection of study areas for collection of the feed samples and survey

SL No.	Divisions	Districts	Upazilla	Agro-ecological characteristics	Number of samples
1.	Rajshahi	Rajshahi	Sadar	Highland (Barandra area)	30
			Paba	Highland (Barandra area)	30
2.	Rangpur	Lalmonirhat	Lalmonirhat Sadar	Border area, Plain and char area	30
		Kurigram	Chilmari	Flood plain	30
3.	Mymensingh	Mymensingh	MymesinghSadar	Medium high land	30
			Dhobaura	Medium high land	30
Total	3	4	6		180

Benchmarking dairy farming system: Regional modeling perspectives

The dairy farming system was evaluated through adaptive field survey. A pre-designed and pre-tested questionnaire was used for collecting benchmark data for evaluating the status of the farm management and feeding systems. This was particularly applied to the feeds availability in different seasons and different regions. A total of 50 sampled dairy farms were selected randomly from each Upazilla which was in total 300 farms.

Feed inventory analysis

The feed inventory study was done at national level based on the methods developed by Samireddypalle and Koratikere (2011) which has recently been applied to the case of India. Due to similar farming systems (IFCN, 2011) and socio-economic characteristics between Bangladesh and India, the extrapolation of this method from India to the case of Bangladesh might be meaningful. Also the national feed inventory was based on regional data.

Three major inputs are required for modelling and assessing feed supply and demand in terms of Dry Matter (DM) and feed balance, which are: a) feed resources from crop data b) green fodder from land classification data and c) feed requirement from livestock census.

The feed resources in this study indicate three different types of feeds: i) feed as grain produced from cereal and leguminous crops; ii) feed by-products (grain by products, rice straw etc); iii) green fodder (cultivated in different land).

Estimating total feed resources availability (grains and grain by products and green fodder):

- The extraction ratio (ER) is to be known to calculate **feed from grain (FG)**[1] which is below:
  ER = tons of grain used for feed/tons of total grain harveste
- The harvest indices (HI) of different crop by-products are to be known to arrive at the availability of **feed by-products (FBP)**[2] which can be done as below.
  HI = tons of utilizable crop by-products/tons of primary crops harvested
- In our study, HI and ER was developed based on data obtained from actual field study following the method of Ramachandra et al., (2007) (see Annex 1).
- Total cultivated **green fodder production (FGF)** is calculated based on land allocation (% of land used for green fodder production) and/or extent of land under fodder, average production potential of fodder per hectare of land, average biomass production other land categories. For FGF, there are three options to collect required data: i) use of coefficients as proposed by Ramachandra et al., 2007 (Annex 2); ii) use of survey data on actual land utilization pattern and their corresponding green fodder production per ha of land; iii) crop production and land utilization pattern data can also be possible to take from published national statistics which is updated every year. It is anticipated that the proposed study was rely mostly on real data than use of coefficients and secondary statistics.
- Total feed availability in fresh matter (TFA_f) = Σ FG + FBP + FGF…….(1)
- TFA_d(DM) = Σ FG * DM% + FBP * DM% + FGF * DM% ……..(2)

The corresponding DM% was taken from modified data based on study done by Khandaker and Uddin (2002).

Estimating feed requirements (DM basis) at national level

- For assessing the feed requirements, data is required from livestock census that gives a detailed breakdown in terms of age groups, type and breedsas well as productive functions (milk, meat, draught). The other factors such as stage of production were also taken into account. The correction factors for temperature and regional differences were applied. For livestock data, a census is conducted only in every 12 years; hence the updated data wastaken directly from Department of Livestock Services (DLS) who updated livestock population each year through their district livestock offices.
  A rough estimate of the quantitative adequacy is the first step and this can be done by assessing the requirements in terms of dry matter. Dry matter requirements of ruminants

[1]**Feed from grain (FG)** is defined as the grain crops produced in the country that are used for animal feeds. But nutritional point of view, FG should have minimum 85% DM. high in energy (>6 MJ/kg DM), crude protein of >18% (DM basis), with very low crude fibre (<18%). In Bangladesh perspectives, the examples of FG are: Maize, wheat (whole and broken), broken rice, crushed soybean etc.

[2]**Feed by-product (FBP)** is the leftover of grain. For example, rice straw is a by-product of rice. Nutritionally, by-product has higher crude fibre (>18% DM basis), lower crude protein (< 10% CP) with very low energy content (for rice: it is 3 MJ/kg DM). Interestingly, those feeds are not classified as standard feeds but still they are a major source of feed for Bangladesh and India and other similar countries.

(cattle, buffalo, sheep and goats), equines and camels are calculated on the basis of two approaches:

i) A standard adult cattle unit (ACU) approach
ii) Species wise approach (Cattle, buffalo, sheep and goat).

i) A standard adult cattle unit (ACU) approach

A standard adult cattle unit (ACU)of 350 kg body weight, utilizing the conversion factors for species and age class (The conversion factors was taken from Ramachandra et al ., 2007 (see Annex 3). Assuming that a minimum dry matter intake of 2.5% of body weight would be sufficient, an ACU would require 7.5 kg (300 X 0.025) of dry matter per day. Accordingly the total dry matter requirement can be worked out by converting the livestock numbers into ACU's.
Total Feed Requirement (TFR) = total ACU*365 days* 7.5…… (3a)
(Assuming 2.5% dry matter intake with average body weight of 300 kg) (Modified from Ramachandra et al., 2007)

ii) Species wise approach

In this approach, DM requirement of each of the species was taken into consideration together with their live weight and applied in the calculation.

Total Feed Requirement (TFR) = (Σ Cattle * 365 days * 9.75 + Σ buffalo * 365 days * 16 +Σ sheep * 365 days * 4 + Σ goat * 365 days * 4)…….(3b)

The method assumes that average live weight of cattle, buffalo, sheep and goat are 300 kg, 450 kg, 100 kg, and 100 kg, respectively with a corresponding DM intake of 3.25%, 4%, 4% and 4% of their live weight per day, respectively.

Feed inventory (feed production and feed requirement) at national level

Once total feed production (equation 2) and feed requirements are known, the feed balance can be derived by combining total potential feed availability with total requirements (equation 3) by applying 'feed inventory data base' derived from the previous steps which can be shown as below:

Feed balance (Feed inventory) = TFA (DM) – TFR (DM)…….. (4)
Where, TFA (DM) = total feed availability in DM and TFR (DM) = total feed requirement in DM at national level

Feed inventory (feed production and feed requirement) at national level (including poultry and fisheries)

The estimation of feed inventory including poultry and fisheries would substantially increase the resources needs and increase to some extent the method of completeness and precision. But proper attention must be paid that this would provide "just a rule of thumb" because of more precise estimation might be outreach of this study and would lose the uniqueness of the method designed for ruminants. For the case, where a complete picture of feed inventory is needed and it is still a good insight for the country like Bangladesh where there is no such information at all therefore, the following step wise methodology was proposed:

i) Using secondary statistics on the number of poultry (broiler and layers) and fisheries (with an average marketing weight) and their feed requirement on DM basis.

ii) Total feed availability for poultry and fisheries = allocation of concentrate by the farmers to poultry and fisheries + estimated import (DM basis)…….. (4a)
iii) Total feed availability for all livestock (including poultry) and fisheries = Eq. (2) + Eq. (4a).

The total concentrates required for poultry and aqua sector would be deducted from the total concentrate availability and the remaining is added to dry and green roughages to arrive at the total feed availability to be allocated to the rest of the species of livestock.

This approach described above for ruminant is a simplified approach wherein only ruminants are considered and hence might receive criticism from the point of quantitative assessments. Even though this approach would have a tremendous potential to provide an overview of country's feed resources with limited information and costs. Furthermore, based on this study, there would be a signification potential to expand this model by including more detailed information (e.g. age of cows, specific productive classification of cattle, average productivities, and average body weight). The total feed requirement in this study is based on only DM requirement which can further be assessed based on energy, protein and other nutrient requirements. At the same time, the total feed production can also be assessed based on total energy, protein and other nutrient contents. The expanded approach would require substantially higher costs, time and resources which might be possible if the government would initiate a major program on national feed inventory study. As an alternative, the first approach is to conduct a pilot study on characterizing feeding systems in different regions and production systems because the nutrient content of feed resources and farmers practice to offer feeds for dairy cattle are directly linked to the feeding systems. Therefore, assessing total nutrient requirements in terms of dry matter, protein and energy, the nutrient content of the available feed resources and prevailing feeding practices must be correlated to arrive at the feed balance. Some basic knowledge of animal nutrition with regards to the nutrient requirements of livestock and nutrient profile of feed resources is essential for carrying out this exercise, or alternately, the inputs from animal nutritionists can be sought in arriving at the precise feed balance.

Step wise approach for modeling in xlsprogramme on method for feed inventory

Based on the data obtained (as described above), it is possible to develop an xls based modeling which has advantages that once the model is developed, it is possible to replicate for other country with little inputs (for instances, only changes to country specific coefficients or livestock census).

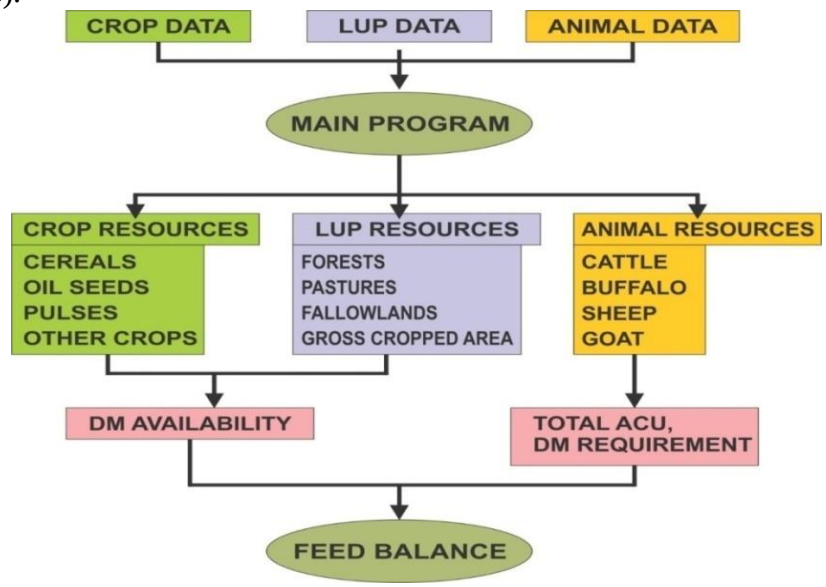


Figure 6: Principles of feed inventory model (source: Ramachandra et al., 2007)

Hence, this study further explores the potential of developing xls based model which can be termed as "**Feed Inventory Analysis Model (FIAM)**". In this stage, the feed supply and requirement wasmodeled in terms of DM by applying 'feed inventory' in database programme using Microsoft Excel 2010. The principles of this model are depicted in Figure 1.

The complete step-wise approach for establishing national feed inventory model in xls is as follows:

a) For grain and grain by-products calculation

- ✓ Data on total crop (grain) production for a region/nation is obtained from the national agricultural statistics which is published every year. The information can also be extracted from the website of the department of livestock services (DLS) and the Department of Agricultural Marketing (DAM).
- ✓ A full list of all kind of crops was listed. The list should cover almost all conventional crops because feed resources originating from crops constitute the major feed resources
- ✓ From crop production data, all the crops and their by-products that are used for feeding livestock are listed.
- ✓ A list of the harvest index (HI) and extraction ratio (ER) are prepared and formulate table. The information can be collected from expert estimation or IFCN panel approach or Delphi Technique (Annex 1)
- ✓ The potential availability of feed resources was calculated in the model by multiplying crop production data and extraction rates.
- ✓ Generally the dry matter content of crops and crop based products are taken by analyzing regional data. Different regions might have different dry matter content. This would increase the precision of the feed availability.
- ✓ Furthermore, imports/exports of resources, alternative uses of resources were used depending on the availability of data. Inclusion of such information would increase the accuracy of the results.

b) For green fodder calculation

- ✓ For estimating green fodder production, proportion of the cropped area used for fodder cultivation and the average production of fodder should be known. These information are derived from both statistical survey by using "allocation of land for dairy" and in case of non-availability, estimating by Panel.
- ✓ The other category of land (forest, fallow land) should be known and enter into the model to calculate the total green fodder production from land (Table 2) which is shown in Annex 2.
- ✓ The total area of land (ha) should be multiplied by the average production for each category of land. This wasprovide the total green fodder production.
- ✓ Determining regional variation of DM content of fodder was used to arrive at total DM production from green fodder

c) Total feed availability (feed resources, feed by-products and green fodder)

- ✓ In this stage of modeling, the total feed resources from crops and green fodder was added together in order to arrive at total potential feed availability of nation.

d) Total feed requirements (in terms of DM)

- ✓ The total feed requirement of ruminants (cattle, buffalo, sheep and goat) can be assessed by converting the different species and categories of animals into adult cattle unit (ACU) based ACU conversion factors as reported by Ramachandra et al ., (2007) in Table 3 (Annex 3).
- ✓ From the total ACU, the total annual feed requirements can be calculated by the model as below:

Feed requirement = total ACU*365 days* 7.5 (assuming 2.5% dry matter intake with average body weight of 300 kg) (modified from Ramachandra et al., 2007)

e) Feed inventory (feed balance in terms of DM)

- ✓ Comparing the total feed availability with the requirement wasgive the status of feed inventory in terms of sufficiency, deficiency of surplus of a particular region and nation.
- ✓ The model wascalculate the bounds by taking value of less than 2.5% DM availability per ACU is deficit, between 2.5 to 3.5 is sufficiency and > 3.5% is surplus regions.

Once the Excel-based model is developed, both raw data and results can be stored in database and can subsequently used in further research. Also it would be helpful for spatial analysis in the future research. A solid database hasto be created based on this model.

2. Feed resources and their management: Meta-analysis

A meta-analysis is a statistical analysis that combines the results of multiple studies in a single study in order to provide holistic view on the "state of art" on subject matter which is further exemplified with primary data. The basic idea behind the meta-analyses is that there is a common truth behind all conceptually similar scientific studies, but which has been measured with a certain error within individual studies.

The aim of the Meta-analytical approaches from statistics to derive a pooled estimate closest to the unknown common truth based on how this error is perceived. In essence, all existing methods yield a weighted average from the results of the individual studies and what differs is the manner in which these weights are allocated and also the manner in which the uncertainty is computed around the point estimate thus generated.

In addition to providing an estimate of the unknown common truth, meta-analysis has the capacity to contrast results from different studies and identify patterns among study results, sources of disagreement among those results, or other interesting relationships that may come to light in the context of multiple studies.

A key benefit of this approach is the aggregation of information leading to a higher statistical power and more robust point estimate than is possible from the measure derived from any individual study. However, in performing a meta-analysis, an investigator must make choices which can affect the results, including deciding how to search for studies, selecting studies based on a set of objective criteria, dealing with incomplete data, analyzing the data, and accounting for or choosing not to account for publication bias.

Meta-analyses are often, but not always, important components of a systematic review procedure. Hence, meta-analysis is statistical methods of combining evidence, leaving

other aspects of ***'research synthesis'*** or ***'evidence synthesis'***, such as combining information from qualitative studies, for the more general context of systematic reviews.

Steps for Meta-analysis

Step-1: Review of literature

Review of literature, collection of secondary information on feed availability, collection of feed composition and nutrient requirement data from different laboratory, journal & proceedings on the following aspects of feed data:

1. Year-round availability of feeds and fodder
2. Year-round pricing (input and output price)
3. Year-round use pattern for different feeds
4. Year-round imports and export of the specific feed ingredients
5. Comparison with other ingredients
6. Prospective use of unconventional feeds
7. Land utilization for specific feed production

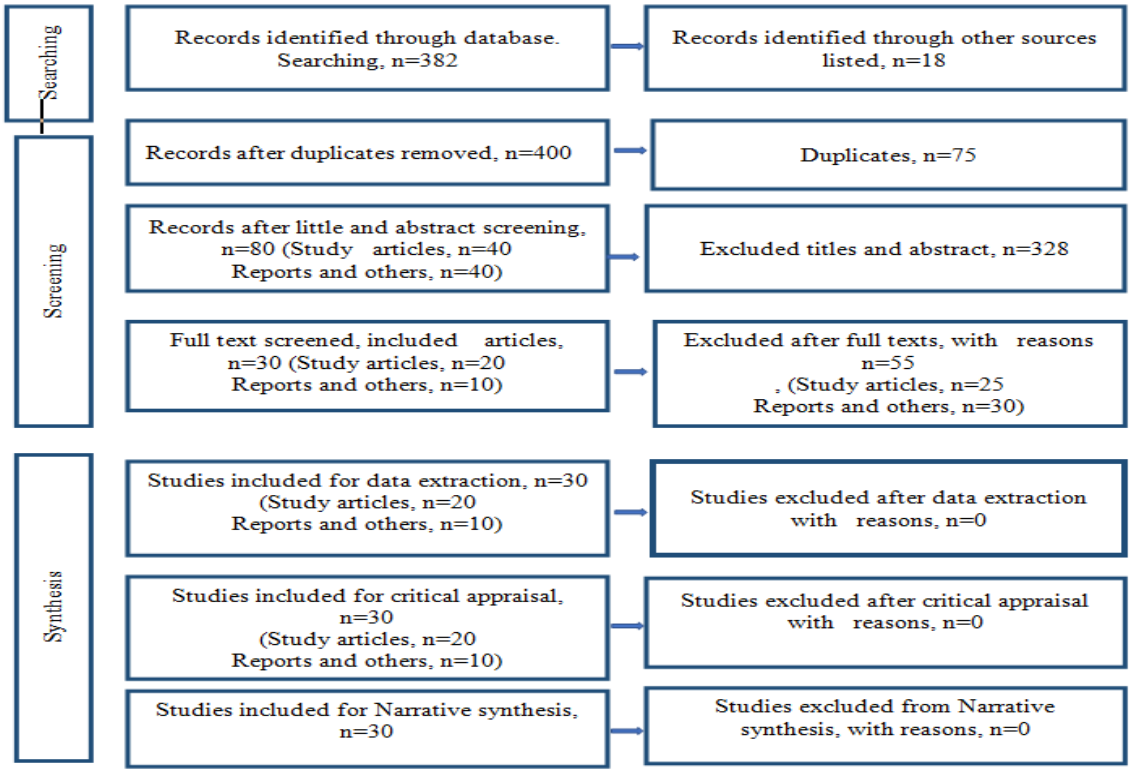


Figure 7: Flow diagram for systematic reviews: meta-analysis

The proposed study is highly depend on the extensive review on feed resources, their chemical composition, nutritive value, digestibility and other growth and metabolic trial results. This was be done according to region, season, species, authors and publication source. We haveemployed improved literature review methodology in order to ensure the quality of the information and collecting appropriate information. Some of the methods are described as below:

a) Literature search through published sources (Journal, proceedings, thesis, magazines, newspapers)

b) Web-based search(Google, google scholar, institutional website)

c) Institutional source(Data/information to be collected from different institutional archive)

To pertain the data relevant to specific objective and to analyze the data to produce the results, a meta-analysis hasto be carried out. A detailed overview of the review of the literature has been provided in Annex 1.

Step-2: Assessment of the Review of literature
The assessment of the review of literature results which were used for further analysis are depicted in Figure 7.

Step- 3: Visual Mapping of the data and information: The data obtained from the various source were visualized with the help of Mapping.

3. Development of model for energy and protein requirement

For Development of the feed model for predicting energy and protein requirement, feeding trial using Agricultural Research Council (ARC), Agricultural and Food Research Council (AFRC) and National Research Council (NRC) was applied.

Feed resources and their variation: regional and seasonal variation

The feed samples were collected from different regions and seasons are transported in plastic bag and stored in the Animal Nutrition Field Laboratory for the chemical composition (DM, CP, CF, NFE, EE and TA) and minerals determintion according to AOAC (2010) method. The DM determination of the green grass was done in the filed using sun dry method and also in the Laboratory using chemical method.

In-vitro analysis (Menke Gas Production Technique) for determination of the Metabolizable Energy

Gas Production Method *(In -vitro* method)

This method makes it possible to estimate the digestibility of organic matter and the content of metabolizable energy in feedstuffs for ruminants. The method is based on the rate of gas produced (CO_2 and CH_4) from incubation of feeding stuffs with rumen liquar in vitro.

Procedure

Preparation of the sample

Crush the sample so that the whole of it could pass a 1 mm sieve. Pellets can be broken in a mortar.Samples of dried materials (200 mg D.M) are introduced into calibrated glass syringes (Piston pipettes). The feeding stuff should be incubated in triplicates on at least two different days. The weight of the sample can be higher (up to 500 mg D.M) with feeding stuffs of low

energy concentration, depending on the amount of gas produced during night. Net gas production should not exceed 90 ml.

Preparation of the medium

- Micromineral solution
- Rumen buffer solution
- Macromineral solution
- Resazurine solution
- Reduction solution
- This mixture is prepared immediately before collection of rumen liquor and kept under CO_2 in a water bath at 39 degree centigrade and stirred by magnetic stirrer.

Incubation

The rumen liquar was sucked from a rumen- fistulae cow through two layers of (cheese cloth) into a warm flask of about 21 volumes filled with CO_2. Rumen liquar was taken before feeding. One part of liquar was mixed with two parts of the medium in a flask with automatic pump, positioned in a water bath at 39 degree centigrade and stirred by a magnetic stirrer. Thirty ml of rumen liquar medium-mixture is pipetted into each syringe, pre -warmed to 39 degree centigrade Incubation should be started in the morning, thus the second reading on the position of the piston was done 6-8 hours later. In case the position exceeding 60 ml. this value was recorded. The clip opened at the piston moved back to the 30 ml piston. The final reading was taken 24 hours after the incubation commenced.

Standardization

Differences in composition and activity of the rumen liquor are controlled by 3 parallel measurements:

1. Rumen liquor +medium mixture without substrate (Gb0)
2. Incubation of the standard hay meal (200 mg D.M) which should give a mean gas production of 44.16 ml per 24 hours (GbH)
3. Incubation of a standard hay (140 mg D.M) and maize starch (60 mg D.M) diet which should give a mean gas production rate of 59.8 ml per 24 hours (GbHS)
   From this measurement it is possible to correct for each series of determinations for different feeding stuffs under investigation. Thus the correction factor for hay meal (FH) is 44.16/(GbH-Gb0) while that for concentrate mixtures (FHS) is 59.8/ (GbHS- Gb0). The mean of these two factors is then used for correction of the sample measurement.

Calculation of In Vitro Digestibility

$$Gb = (V_{24}\text{-}V_0\text{-}Gbo) \times (200/\text{Sample weight}) \times (F_H+F_{HS})/2$$
$$dO = (0.76 \times Gb) + (0.637 \times \%\ \text{Protein}) + 22.5$$
$$DE = (0.1384 \times Gb) + (0.142 \times \%\ \text{Protein}) + (0.111 \times \%\ \text{Lipid}) + 2.86$$
$$ME = (0.1456 \times Gb) + (0.0767 \times \%\ \text{Protein}) + (0.164 \times \%\ \text{Lipid}) + 1.2$$

Here

Gb= *In-Vitro* gas production rate in 24 hours

dO = Organic matter digestibility
DE = Digestible energy
ME = Metabolizable energy
V_{24} = In 24 hours gas production in ml.
V_0 = Initial Volume of sample, rumen liquor and medium mixture that is always constant (30 ml).
Gbo = Blank; without any sample and gas production in 24 hours is 0 ml
F_H = Hay standard and its value is approximately 1.0
F_{HS} = Concentrate standard and its value is approximately

Data Sources and Data management

The methodological steps for generating information on the feed resources are further explained in Table 4.

Table 4: Logical steps for field survey and laboratory analysis on feed resources data

Steps	Primary data	Secondary data (meta-analysis)	Other relevant data
1	Assessing the available data	Preparing suitable tool for searching options	Institutional linkage with DLS
2	Preparation of questionnaire and check list	Using "**Mendeley**" for storing relevant information. Mendeley is considered as "Digital Library"	Using DLS infra structure for respective field areas
3	Self-study by the data collection team	Preparation of excel template for data insertion	Questionnaire on the regional profile data on livestock herd structure and feed resources
Steps	**Primary data**	**Secondary data (meta-analysis)**	**Other relevant data**
4	Training of the data collection	Data analysis and results preparation	Template for the data storage
5	Pre-tested and addressing the feedback from the field	Result interpretation and identifying "Data gaps" in the area of feed resources	
6	Face-to-face interview on the sample farmers	Template for data upload in the website	
7	Feed sample collection, processing and transportation to the analytical lab		
8	Sample preparation for chemical and nutritive value analysis		

Data were inserted into the standard template and has been stored as structure database.

Data analysis and Report writing

Data was analyzed using Microsoft 365 and RegiGraph Software. The Excel is the most popular and common media for any kind of analysis while the RegioGraph is the specialized software for this study. This software visualize the research output in the form of Maps.

Component-3 (SAU)

1. Establishing national feed inventory and determination of harvest ratio of rice

Several comprehensive works were done to achieve the objectives of this project and to establish national feed inventory, the objective number 1, literature review was performed (Laboratories, Journals, proceedings and Web-based search) under Activity- 1 to collect secondary information considering year round availability of feeds and fodder, pattern of different feed uses. Prospective use of unconventional feeds, feed composition and nutritive values, import and export of feed ingredients, nutrient requirements of dairy animal etc. was also determined. Survey and inventory of available feedstuffs of different agro-ecological zones (Deep basins and Coastal/Saline belt) considered as Activity-2. Finally, the following design was followed to harvest the goal regarding feed inventory and their assessment.

Sampling design

SAU was responsible for threedivisions:

- ✓ Sylhet (Deep basin/Haor)
- ✓ Barishal (Costal/Saline zone)
- ✓ Khulna (coastal and saline)
- ✓

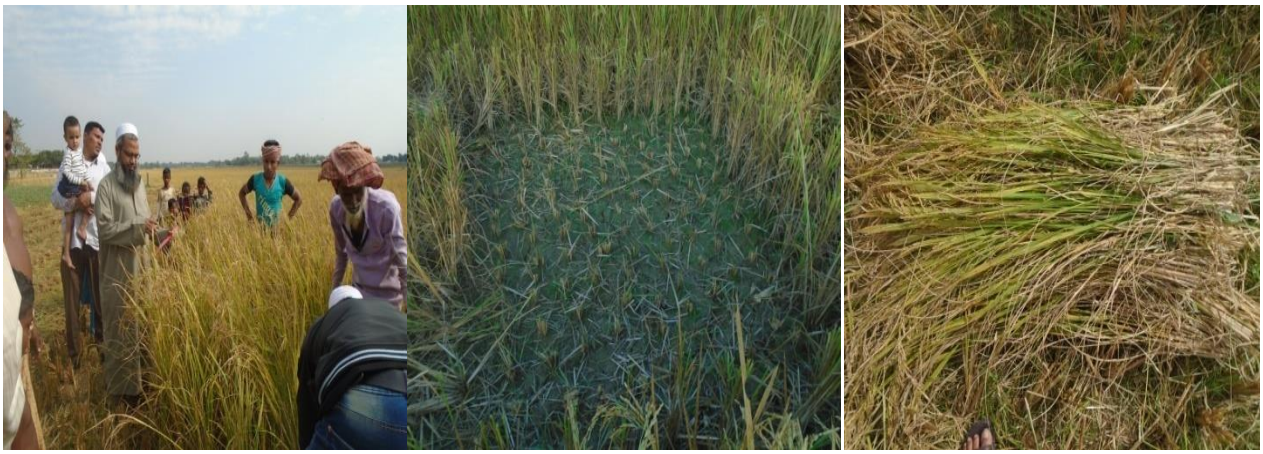
The detail of the sampling design is shown in the Table 5 below:

Table 5: Selection of study areas for collection of the feed samples and survey

Division/ District	Upazila	Agro. Characters	Season	Targeted sampleNo	Revised Sample(No)	Present status	
						Collected	Analyzed
Sylhet Sunumgonj	Sunamgonj Sadar	Haor/deep basin	Summer Rainy Winter	30	25	**29**	**29**
	Taheirpur	Haor/deep basin		30	25	**29**	**29**
Division/ District	**Upazila**	**Agro. Characters**	**Season**	**Targeted sampleNo**	**Revised Sample(No)**	**Present status**	
						Collected	**Analyzed**
Barishal Patuakhali	Patuakhli Sadar	Saline/coastal zone	Summer Rainy Winter	30	20	**31**	**31**
	Khepupara	Saline/coastal zone		30	20	**32**	**32**
Khulna Sathkira	Samnagar	Saline/coastal zone	Summer Rainy Winter		30	**30**	**30**
3/3	**5**	**2**	**3**	**120**	**120**	**151**	**151**

The two upazilas of Sunamgonj district, the Sadar upazilla and Taheirpur were visited to collect the feed samples (roughage and concentrate) that are usually used to feed the animals. Cultivation procedure of rice, its production, straw produced in the field just after harvest (per square meter of land) was also recorded. Fresh paddy was collected and carried to the Animal Nutrition Laboratory, SAU, Sylhet for both nutritional analysis and biomass determination. Samples from the there 3 Amon varieties (BRRI dhan-44, BRRI dhan-46 and BRRI dhan-49) of rice were collected for analyzing the yield, harvest ratio, extraction ratio and nutritive values (Figure 8). Different types of fodder collected from the study areas for chemical analysis are shown in Figure 9**.**

Collected samples from Tanguarhawor, Taherpur, and Sunamgonj during winter and summer were dried, grinded and packed into specific poly bag for chemical, in-vitro and mineral analysis.



Rice harvesting to determine harvest ratio	Harvested empty land	Collected ricewith plant

Washing ricewith plant	Collected rice and straw	Collected straw

Figure 8: Collection of rice and straw for analyzing the yield, harvest index, extraction ratio and nutritive values

Figure 9: Different types of fodder collected from the study areas for chemical analysis

2. Development of model for predicting energy and protein requirements for milk production

Selection of dairy farms

Three local private dairy farms (Fatema Dairy, Baby Dairy and Lipi Dairy) were selected for dairy trial (Figure 10). Farmer's practice for feeding dairy cattle (Table 7) was considered as control feeding. NATP2 formulated concentrate feed (Table 5) and ration (Table 6) was fed for treated group of cattle (Figure 11).

Figure 10: Selection of private dairy farms at Sylhet

Figure 11: Preparation of formulated feed and distribution among the dairy farmers

Table 6: Formulated concentrate dairy feed in NATP-2 project

Items	Amount (g/kg)	Ingredient cost (Tk./kg)	Feed Cost (Tk/kg)	CP (g/kg)	ME (MJ/kg)
Maize	100	26	2.6	10.5	1.2
Ghee residue	200	50	10	44	4.4
Wheat bran	100	28.5	2.85	14	0.95
Soya. Meal	100	42	4.2	44	1.1
Rice polish	100	23	2.3	15	1
Motor Bran	200	22.5	4.5	46	1.8
Lentil Bran	50	36	1.8	12	0.5
Black cumin	80	160	12.8	11.2	0.88
DCP	25	60	1.5	0	0
Oyster shell	25	28	0.7	0	0
NaCl	20	30	0.6	0	0
Total	**1000**	**46.00**	**43.85**	**196.7**	**11.83**

Table 7: Energy and Protein content of provisional Dairy feeding and NATP2 project formulated feed

Feed Ingredients (Farm practice)	Fatema Dairy		Baby Dairy		Lipi Dairy	
	MEI (MJ/d/a)	CPI (g/d/a)	MEI (MJ/d/a)	CPI (g/d/a)	MEI (MJ/d/a)	CPI(g/d/a)
Grass	29.82	376.58	21.77	275	32.2	406
Mixed feed	22.31	280.7	19.36	171	15.64	138
wheat bran	16.53	288.84	15.96	278.88	17.48	305.44
Rice polish					19.14	348
Total	68.66	946.12	57.09	724.88	84.46	1197.44
ME and CP density in concentrate feed						
Conc. Feed	ME (MJ/kg)	CP (g/kg)	ME (MJ/kg)	CP (g/kg)	ME (MJ/kg)	CP(g/kg)
Provisional Concentrate	10	147.35	8.92	113.61	9.64	146.02
NATP2 conc. Feed	12	20	12	20	12	20
ME and CP density in dairy ration						
Ration	ME (MJ/kg)	CP (g/kg)	ME (MJ/kg)	CP (g/kg)	ME (MJ/kg)	CP (g/kg)
Provisional/Farm practice	8.80	121.30	7.32	92.93	10.82	153.52
NATP2 Dairy ration	9.85	157.4	9.85	157.4	9.85	157.4

11. Results and discussion

Coordination Component (BARC)

Activity 01: Annual Review workshop

Livestock Division, BARC organized a very interactive and outcome based Annual Review Workshop on 13 November 2019 at BARC conference room-1. Participants from DLS, BLRI, BARC, universities, FAO, USAID, KGF, PIU-BARC and other relvant organizations attended in this workshop (Figure 12).

Figure 12: Pictorial view of Annual Review workshop

Annual Review Workshop

Livestock Division, BARC organized a very interactive and outcome based Annual Review Workshop on the sub-project on 12 November 2020 at BARC. Participants from DLS, BLRI, BARC, universities, KGF, PIU-BARC and other relevant organizations attended this workshop. The inaugural session was graced by Dr. Shaikh Mohammad Bokhtiar, Executive Chairman, BARC as the chief guest (Figure 13) while Dr. Harunur Rashid, Director, PIU-NATP, BARC was present in the workshop as the special guest. Technical session was chaired by Dr. Kazi M. Kamaruddin, Consultant, Livestock Division, BARC. The annual progress activities of the year 2019-2020 were presented by Principal Investigators of BAU, BLRI andSAU components of the sub-project. The presentations were followed by active discussions. The concluding session of the workshop was graced by Dr. Harunur Rashid, Director, PIU-NATP, BARC. Draft recommendations were finalized in this session. At the end, Member Director, Livestock Division, BARC concluded the annual workshop with giving thanks to the participants for their spontaneous contribution.

Figure 13: Photographic view of Annual Review Workshop of the sub-projectat BARC

Data Validation Workshop

Livestock division, BARC organized a very interactive and outcome based Data Validation Workshop on PBRG sub-project "Development of knowledge hub on Feed Resources for efficient feeding management of livestock (ID-108)" on 12 December 2021 at BARC conference room, Training building (3rd floor). The inaugural session was graced by Dr. Nazmun Nahar Karim, Member Director (Livestock), BARC as the chief guest while Dr. Nathu Ram Sarker, Director (Livestock & fisheries), KGF as the special guests. The inaugural session was chaired by Dr. Mohammad Rafiqul Islam, CSO, Livestock Division, BARC & Associate Coordinator of this sub-project. Welcome remarks as well as short briefing of the projects by Dr. Mohammad Showkat Mahmud, SSO, Livestock Division, BARC. The workshop was attended by the participants from different organizations (DLS, BLRI, BARC, University, PKSF & KGF). Principal Investigators of BAU, BLRI and SAU components were presented their data for validation (Figure 14). The presentations were followed by active discussions of expert members Dr. Khan Md. Shaiful Islam, Professor, Animal Nutrition, BAU, Mymensingh; Dr. Abu Sadeque Md. Selim, Professor, Animal Science and Nutrition, BSMRAU, Gazipur And Dr. A. B. AM Khaleduzzaman, DD, DLS. and recommendations were finalized in this workshop.

Figure 14: Photographic view of Data Validation Workshop on PBRG Sub-project at BARC

Activity 02: Coordination meeting

A coordination meeting was conducted by Livestock Division on 03 December 2019 with the PI

Figure 15: Pictorial view of coordination meeting on PBRG sub-projects

and Co-PI of the sub-project (Figure 15). Member Director, Livestock Division chaired the meeting where all the scientists of the Division were present. PIs of BLRI, BAU and SAU presented their research activities. Minutes of the meeting was sent to the PI and Co-PI for taking necessary actions according the recommendations.

Livestock Division conducted an online coordination meeting using Zoom platform (due to COVID- 19 pandemic) with the PI and Co-PI of the PBRG sub-project "Development of knowledge hub on feed resources for efficient feed management of livestock (ID:108)" under NATP-2, BARC on 22 June 2020. The meeting was chaired by Member Director, Livestock Division where scientists of the Division were present (Figure 16). PIs of BLRI, BAU and SAU components presented their activities followed by future plan. Minutes of the meeting was sent to the PI and Co-PI for taking necessary actions according the recommendations.

Figure 16: Pictorial view of online coordination meeting on the sub-project

Activity 03: Monitoring and Evaluation

Monitoring team from BARC visited the BAU component of the sub-project on 12 February 2020 (Figure 17). The team visited the Nutrition laboratory and discussed with PI regarding sub-project achievements. The team found the activities of the study to be going according to the plan and objectives and appreciated the progress so far made by the PI.

Figure 17: Pictorial view of field monitoring & evaluation of sub-project (BAU component)

Table 8: Overview of the results presentation by various components

SL No.	Results	BLRI	BAU	SAU	Remarks
1	Overview of the farms and farming system on different regions	x	x	x	For all components
2	Feed inventory analysis	x	x	x	For all components
3	Statistical analysis on detailed feed resources and feed composition	x	-	-	BAU and SAU sent data to BLRI*
4	Meta-analysis on the feed resources	-	x	-	BLRI and SAU sent data to BAU
5	Development model for energy and protein requirement for dairy cattle	-	-	x	BAU and BLRI sent Feeding trial data to SAU**
6	Website Development (Interactive)	x	-	-	
*Annex 1 is attached for the dataset sent to BLRI and ** Annex 2 is attached for the dataset sent to SAU					

Component- 1 (BLRI)

1. Establishing national feed inventory

Estimating feed balance

The national feed balance of Bangladesh for 2019-20 is presented in Table-9. Data reveals that the total number of cattle, buffalo, goat and sheep was 24391000, 1493000, 26435000 and 3607000 which were equivalent to 17073700, 1119750, 2643500 and 360700 TLU (Tropical Livestock Unit) respectively. Their entire feed requirement was 40674637 ton roughage and 24375092 ton concentrate of which only 16% concentrate and 96% roughage was potentially available. It was not possible to calculate the actual amount of feed required for livestock due to poor data recording system. Nationally we are in 84% deficit condition of concentrate which is a very essential and expensive feed item for ensuring actual maintenance and production of animal. The scenarios of feed balance of six target areas are presented in **Table10**. Data shows that, all the selected upazilas under this research were in deficit condition both for roughage and concentrate. But all the areaswere potentially rich in both feed items but their actual utilization was very poor. Pattern of crop production was not similar throught the entire region but there was a huge potentiality of utilizing different feed ingredients in livestock feed items. In case of cereal grain rice and maize was most common irrespective of areas with the sporadic wheat cultivation from where straw and stubble could be offered to livestock. Among the pulse crop,grampeawas most common throught all the areas but others like *chola/motor*(*Cicer arietinum*)was not available in all the areas. So the crops which are not directly used as livestock feed can be fed to animal after processing.

Table 9: **National feed balance of Bangladesh in 2019-20**

Parameters	Requirement (Ton/year)	
	Roughage	Concentrate
Cattle (nos/TLU) 24391000/17073700	33385181	22256788
Buffalo (nos/TLU) 1493000/1119750	1532658	1021772
Goat (nos/TLU) 26435000/2643500	5065607	964878
Sheep (nos/TLU) 3607000/360700	691191	131656
Total Requirement	40674637	24375092
Availability	39032424.49	38727552.11
Excess/Deficit (Ton/year)	-1642213	-20502340
Excess/Deficit (%)	-4	-84

Table 10: The scenarios of feed balance of six target areas

Upazila	Roughage (Ton/Year)			Concentrate (Ton/Year)		
	Requirement	Availability	Deficit	Requirement	Availability	Deficit
Manikgonj	152657	88448.5	64208,42	94745	11926.3	82819
Munshigonj	205532	89500.5	116031.5	126517	12805	113712
JeshoreSadar	200007	95050	104957	86316	55000	28316
Jhikorgacha	195430	88448.5	106982	116417	11926.3	104490
Patiya	390231	58772	331509	251941	5812.88	246128
Naikhongchori	131451	88484.5	43003	73947	11926.3	62020

National feed assessment or feed balancing calculation is very important to determine the national annual requirement and availability of feeds and fodder. It also helps to make a national annual fodder production calendar too. But it is somewhat disappointing that, data regarding fodder cultivation throughout the country is not available here properly, so it becomes difficult to calculate accurate demand and supply of fodder. It is essential to record the actual data of feeds and fodder production to quantify the actual demand and supply of feed compared to

animal number. It will ensure least cost feeding management of animal which results in sustainable farming and profitable economy.

Survey and inventory of available feedstuffs of different agro-ecological zones of Bangladesh

The results as obtained in this survey study according to six different locations of three divisions are tabulated and given details in annex. However, a short list of the feeds available locally under different agro-ecological zones of Dhaka, Chattogram and Khulna Divisions are mentioned here below in Table 11, 12 and 13.

Table 11: List of locally available feeds and fodder with their scientific names (where available)

1	Napier grass	*Pennisetum purpureum*
2	German grass	*Echinochloapolystachya*
3	Maize	*Zea mays*
4	Hachi grass	-
5	Arali grass	*Nerium oleander*
6	Durba grass	*Cynodondactylon*
7	Shama grass	*Echinochloacolona*
8	Ghoicha grass	-
9	Kanai grass	*Commelinabenghalensis L.*
10	Sugarcane vaggache	*Saccharum officinarum*
11	Gondhovadail grass	-
12	Local grass	-
13	Water hyachinth	*Eichhornia crassipes*
14	Khesari grass	*Lathyrus sativus*
15	Vutta grass	*Zea mays*
16	Dry khesari grass	*Lathyrus sativus*
17	Bakhsa grass	-
18	Wheat bran	*Triticum spp.*
19	Maize corn (midle)	*Zea mays*
20	Masterd oil cake	*Brassica Juncea*
21	IRRI straw	*Oryza sativa*
22	Quality feed mass	-
23	Broken maize	*Zea mays*
24	Concentrate mixture	-
25	Gomer Vusi	*Triticum spp.*
26	Quality feed pillet	-
27	Khesari vanga	*Lathyrus sativus*
28	Dhal grass	*Hymenachneamplexicaulis*
29	Pakchung grass	*Pennisetum purpureum*
30	Dhol/PARA Grass	*Hymenachneamplexicaulis*
31	Water hyachinth	*Eichhornia crassipes*
32	Durba grass	*Cynodondactylon*
33	Kalmi grass	*Bromus kalmii*
34	Hachi grass	-
35	Shaila grass	-
36	Joina grass	-
37	Potato plant	*Solanum erianthum*

Sl No.	Common Name	Scientific Name
38	Kanaia grass	-
39	Bis katali grass	-
40	Halencha grass	-
41	Linseed oil	*Linumusitatissimum* L
42	Linseed bran	*Linumusitatissimum* L
43	Coconut oil cake	*Cocos Nucifera*
44	Jashorer linseed oil cake	*Linumusitatissimum* L
45	Wheat bran	*Triticum spp.*
46	Rice bran	*Oryza sativa*
47	Lentil bran	*Lens culinaris*
48	Musuri vusi	*Lens culinaris*
49	Gomer vusi	*Triticum spp.*
50	Maskalai daler vangha	*Vigna mungo*
51	Coconut oil cake	*Cocos Nucifera*
52	Linseed oil cake	*Linumusitatissimum* L
53	Musuri Powder	*Lens culinaris*
54	Musuri vusi	*Lens culinaris*
55	Bhadla grass	-
56	Bana grass	*Pennisetum purpureum*
57	Minikate straw & paddy	*Oryza sativa* L
58	Basmoti straw & paddy	*Oryza sativa* L
59	Straw	*Oryza sativa* L
60	Red gold straw	*Oryza sativa* L
61	Bisali straw	*Oryza sativa* L
62	Rice husk	*Oryza sativa* L
63	Sola vangha	-
64	Maize crust	Zea mays
65	Rice bran	Oryza sativa L
66	Wheat broken	Triticum spp.
67	Dabli (khosa)	-
68	Wheat thin bran	Triticum spp.
69	Teer feed (Commercial)	-
70	Wheat thik bran	Triticum spp.
71	Rice polish	Oryza sativa L
72	Sanchilata grass	-
73	Katanoti grass	-
74	Rice straw	Oryza sativa L
75	Gutisorna straw	Oryza sativa L
76	Dablikhosa	-
77	Broken rice	Oryza sativa L
78	Limestone	-
79	ACI feed	-
80	Rumi feed	-
81	Maize broken	Zea mays
82	Khasari vanga	Lathyrus sativus
83	Wheat vusi	Triticum spp.
84	Dablikhosa	-
85	Wheat husk	Triticum spp.
86	ACI feed(commercial)	-
87	Khesari broken	Lathyrus sativus
88	Rice broken	Oryza sativa L
89	Wheat bran	Triticum spp.

Sl No.	Common Name	Scientific Name
90	Musurir bran	Lens culinaris
91	Concentrate mixed	-
92	Milk vita feed (commercial)	-
93	Wheat thin bran	*Triticum spp.*
94	Maize broken	*Zea mays*
95	Dhal grass	*Hymenachneamplexicaulis*
96	Para grass	*Brachiariamutica*
97	Chaga grass	*Hymenochaetaceae*
98	Ghata grass	-
99	Jupara grass	-
100	Dandy Patiya	-
101	Mowluchi grass	-
102	Varoti straw	-
103	Durba grass	*Cynodondactylon*
104	Soybean	*Glycine max*
105	Broken maize	*Zea mays*
106	Wheat thik bran	*Triticum spp.*
107	Rice bran	*Oryza sativa* L
108	Broken rice	*Oryza sativa* L
109	Boot dalerkhosa/ boot dal peel	-
110	Mug powder	*Vigna radiata*
111	Mug frast	*Vigna radiata*
112	Mugdalvushi	*Vigna radiata*
113	Soya meal	*Glycine max*
114	Kalai (mugh)	*Vigna radiata*
115	Chirarkura	-
116	Maize broken	*Zea mays*
117	Mug Vusi	*Vigna radiata*
118	Chirar Kura	-
119	Para grass	*Brachiariamutica*
120	Dhol Grass	*Hymenachneamplexicaulis*
121	Para Grass	*Brachiariamutica*
122	Aahilapata	-
123	Veraker grass	-
124	Fulker grass	-
125	Dukker grass	-
126	Koda grass	-
127	Bhadli grass	-
128	Maize leaf	*Zea mays*
129	Banana tree	*Musa acuminata*
130	Amon straw	*Oryza sativa* L
131	Aus straw	*Oryza sativa* L
132	Molasses	-

Table 12: Locally available roughages and concentrate feed in Chattogram Division

SL No	PatiyaUpazilla		Naikhongchari	
	Green grass	**Concentrate**	**Green grass**	**Concentrate**
1	Hybrid green grass	Mustard oil cake	Hybrid green grass	Wheat bran
2	Napier grass	Boot dal peel	German grass	Mustard oil cake
3	Dhal grass	Chirarkura	Para grass	Rice polish

SL No	PatiyaUpazilla		Naikhongchari	
	Green grass	**Concentrate**	**Green grass**	**Concentrate**
4	Para Grass	Wheat thick bran	Napier grass	Maize broken
5	Local grass	Broken rice	Dhol grass	Rice bran
6	Chaga grass	Maize broken	Local grass	Molasses
7	Ghata grass	Soyabean	Fulker grass	
8	Arali grass	Mug powder	Aahilapata	
9	Gojafurti grass	Lentil powder	Aus straw	
10	Water hyacinth	Chalk powder	Garlic	
11	Futi grass	Wheat thin bran	Dukker grass	
12	Malchi grass	Mugdal vushi	Choda grass	
13	Kanairdogha	Rice bran	Bhadli grass	
14	Durba grass	Patavushi	Maize leaf	
15	Jupara grass	Mug frast	Banana tree	
16	Dandy patiya	Pea bran	Veraker grass	
17	Gojpatiya	Kalai vushi		
18	Gora gora grass	DavliVanga		
19	Patiyagorar grass	Atar kura/grind flour		
20	Mowluchi Grass			
21	Rice straw			

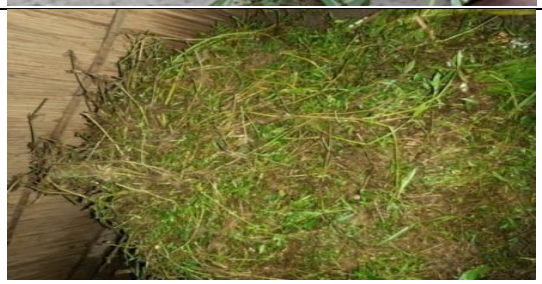
Table 13: Locally available roughages and concentrate feed in Khulna Division

SL No	Jashore Sadar Upazilla		Jhikargacha Upazila	
	Green grass	**Concentrate**	**Green grass**	**Concentrate**
1	Hybrid green grass	Rice husk	Hybrid green grass	Maize broken
2	Napier grass	Wheat bran	Napier grass	Khasari vanga
3	Local grass	Maize crust	Local grass	Flour
4	Durba grass	Mustard oil cake	Sanchilata	Wheat husk
SL No	**Jashore Sadar Upazilla**		**Jhikargacha Upazila**	
	Green grass	**Concentrate**	**Green grass**	**Concentrate**
5	Shama grass	Sola vangha	Shama grass	Broken rice
6	Badla grass	Rice bran	Katanoti	Rice bran
7	Bana grass	Wheat broken	Rice straw	Limestone
8	Straw	Teer feed	Kalai plant	Wheat thick bran
9	Red gold straw	Rice polish		Wheat thin bran
10		Dabli		ACI feed
11				Broken maize
12				Mustard oil cake
13				Rumi feed
14				Lentil bran
15				Dablikhosa
16				Milk feed

Table 14 below shows the picture of some locally available grasses with chemical comoposition.

Table 14: Locally available green grasses

Name of the fodder	Picture	Chemical Composition
Shama grass		DM = 41.2 ASH = 30.1 CP = 11.07 ADF =34.81 NDF =56.92
Badla grass		DM = 40.21 ASH = 24.37 CP = 10.98 ADF =57.1 NDF = 64
Durba grass		DM = 44.13 ASH = 12.05 CP = 8.93 ADF = 50.2 NDF = 60.92
Ghoicha grass		DM =18.14 ASH= 10.44 CP = 5.95 ADF=32.9 NDF=33.27
Maskalai		DM =18.69 ASH= 8.26 CP = 16.3 ADF= 33.7 NDF=49.26

Name of the fodder	Picture	Chemical Composition
Gondhovadail grass		DM =19.9 ASH = 10.78 CP = 9.63 ADF = 30.6 NDF = 39.47
Hachi Grass		DM =14.22 ASH = 16.69 CP = 14.71 ADF = 25.3 NDF = 53.02
Kanai grass		DM = 10.82 ASH = 14.75 CP = 12.26 ADF = 34.46 NDF = 47.01 GE(kcal/g)= 17.84
Halencha grass		DM = 15.42 ASH = 9.96 ADF =30.22 NDF =48.19 GE(kcal/g)=16.22

Socio-economic status of the farmers

The education levels of the respondent farmers in different survey areas are illustrated in Table i (Annex). However, Figure 18 depicts the overall educational status of the respondents in the survey areas. The rates of education in rural areas are comparatively lower than urban areas. In this study it was found that highest, about 43% respondent farmers had secondary level of education, followed by primary (29%) and vocational (15%). However, only about 3% of them were uneducated and about 10% were graduated.

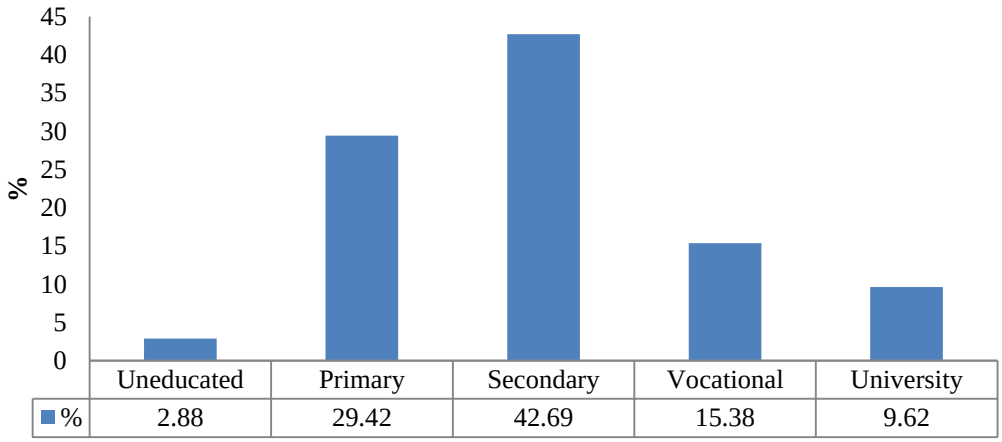


Figure 18: Education level of the farmers

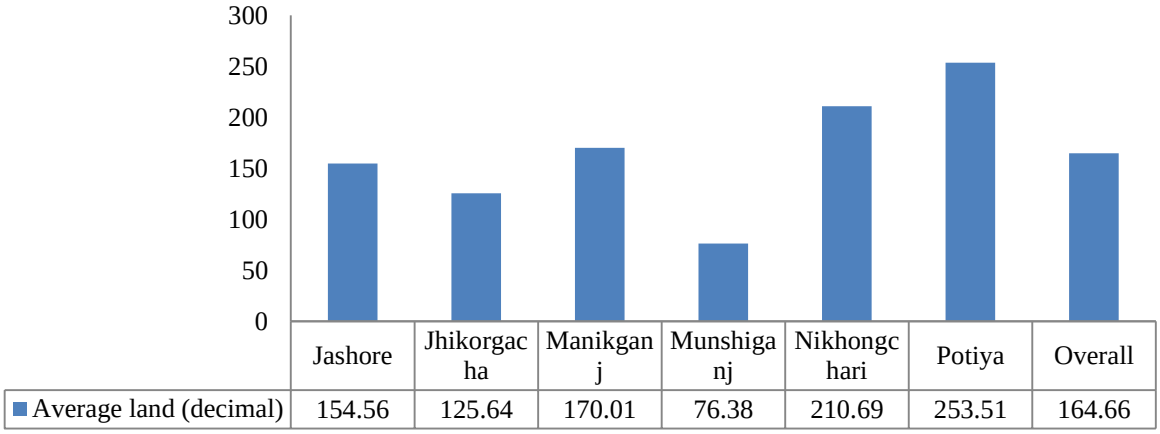


Figure 19: Land owning status of the farmers

Irrespective of location, the average land owned by the farmers was about 165 decimal per household. The annual income of the farmers in different survey areas are given in Table 15. The highest income of Taka 17.38 lakhs per annum was recorded in Patiya and the lowest of Taka 4.55 lakhs in Jashore. As shown in Table 16 that commercial farmers had higher annual income of Taka 13.6 lakhs compared to family farms (Taka 5.99 lakhs).

Table 15: Average family income per year on the basis of location

District	Family income (Taka) per year
Jashore	455630.34
Jhikorgacha	836241.56
Manikganj	868320.94
Munshiganj	878355.34
Nikhongchari	240039.75
Patiya	1737890.69
Average	840510.20

Table 16: Average income per year on the basis of farm type

Farm type	Family income (Taka) per year
Commercial	1359788.83
Family	599331.64
Average	874723.54

The annual income of the farmers based on farm ownership is given in Table vii (Annex), which shows that the highest family income was found for the cooperative farmers and the lowest in single type farmers. Table ix (Annex) illustrates annual family income based on the farmers categorized on farming system, which reveals the highest family income in mixed farmers and the lowest in traditional farmers.

Farming system and cattle genotypes

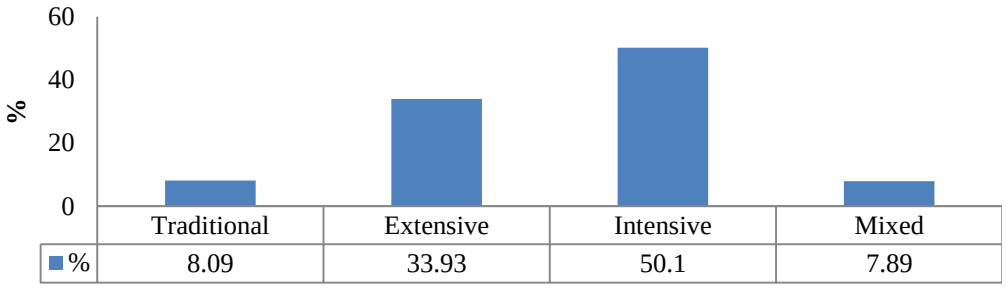


Figure 20: Farming system

The types of farm ownership (community, cooperative and single) as observed in different survey areas are presented in Table ii (Annex), which shows that 98% farms were single type, 1.7% community and only 0.39% cooperative. Besides, Figure 20 shows the farming system followed by the farmers, which shows that 50% farmers followed intensive management system, 34% extensive management system and 8% both traditional and mixed farming system, irrespective of location. However, production systems in different survey areas are elaborately explained in Table iii (Annex). Irrespective of locations, there were about 36% commercial farms and rests were family farms.

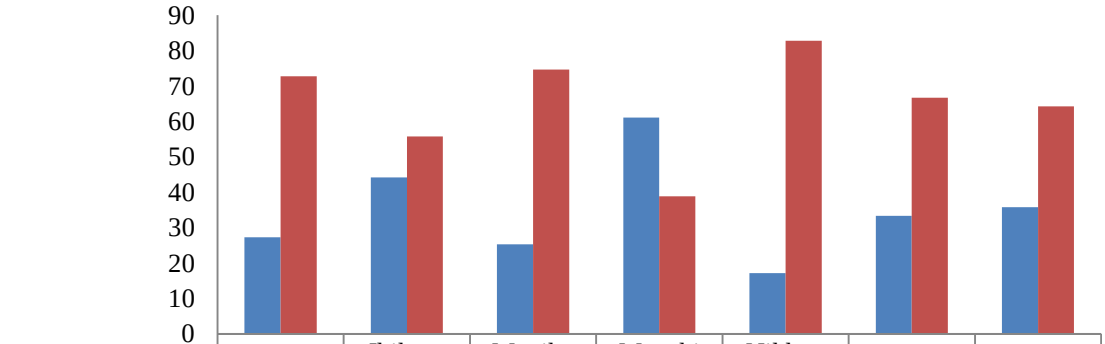
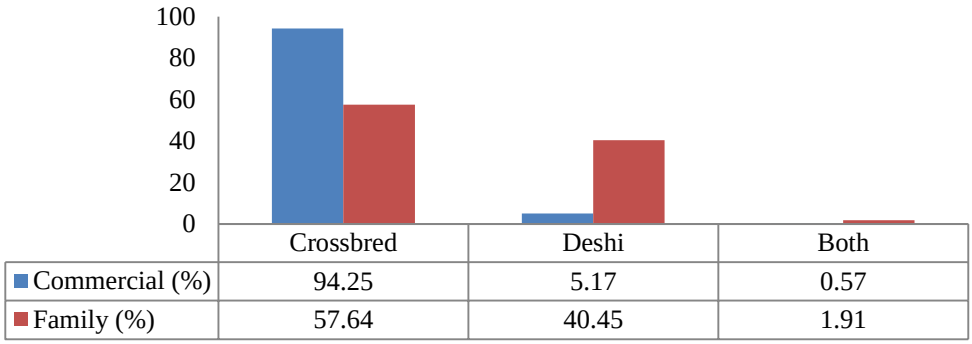


Figure 21: Farming pattern in different locations

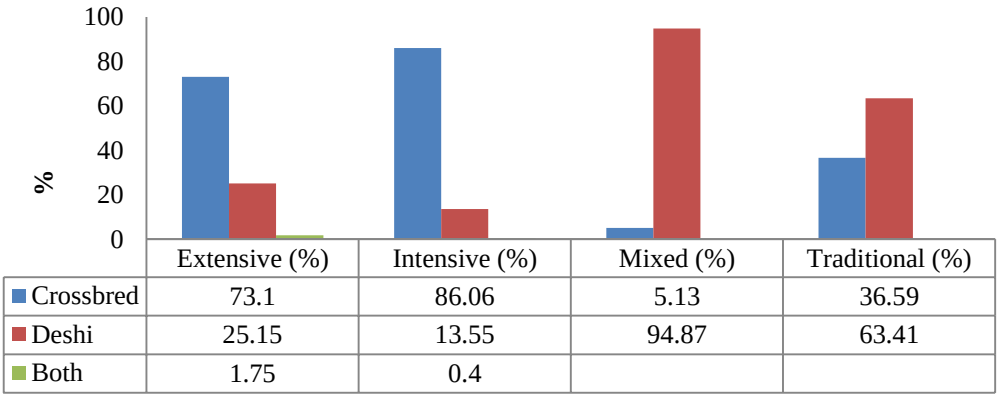


	Crossbred	Deshi	Both
Commercial (%)	94.25	5.17	0.57
Family (%)	57.64	40.45	1.91

Figure 22:Type of cattle reared in commercial and family farming

The types of cattle reared by different farming systems are presented in Table iv (Annex), which shows that all cooperative farms had crossbred cattle. In community farms 75% cattle reared by the farmers were crossbred type and 25% were deshi cattle. Further, 71% crossbreds and 27% deshi cattle were kept by single farm. Figure 22 illustrates types of cattle reared by commercial and family farmers. About 94% commercial farmers reared crossbred cattle and 40% family farmers reared deshi cattle.

The types of cattle reared by different farming systems are depicted in Figure 23. Crossbred cattle was found to be reared in extensive system by about 73% farmers, while about 25% farmers reared deshi cattle in the same system. On the other hand, about 86% farmers reared crossbred cattle by intensive management system and about 14% farmers reared deshi cattle in that system. About 95% farmers reared deshi cattle in mixed farming system and 63% in traditional system.



	Extensive (%)	Intensive (%)	Mixed (%)	Traditional (%)
Crossbred	73.1	86.06	5.13	36.59
Deshi	25.15	13.55	94.87	63.41
Both	1.75	0.4		

Figure 23: Rearing system for different type of cattle

The average number livestock species reared by the farmers in different survey areas are given in Table 17, which shows that the highest number of cattle was reared in Munshiganj (14.77 per household family) and the lowest in Nikhongchari (3.30 per household family). In Nikhongchari, farmers had an average of 7.0 numbers of buffalo per household. The highest number of goat (4.25 per household family) was found in Nikhongchari, and the lowest in Potiya (2.0 per household family). Except Potiya, sheep were found in all survey areas. Like goat, the highest number of sheep per household was also observed in Nikhongchari (10.0 per household family).

Table 17: Average livestock population in farm on the basis of location

Location	Average no. of			
	Cattle	Buffalo	Goat	Sheep
Jashore	7.75	-	2.66	3.0
Jhikorgacha	8.45	-	3.61	7.0
Manikganj	8.94	2.5	3.13	5.0
Munshiganj	14.77	3.0	3.00	1.0
Nikhongchari	6.48	7.0	4.25	10.0
Patiya	13.44	-	2.00	-
Grand Total	10.03	3.75	3.57	6.12

Table 18 illustrates the types of cattle genotypes reared by the farmers in different survey areas. In Munshiganj, all farmers reared crossbred cattle. On the other hand, about 37% farmers in Nikhongchari reared crossbred cattle. Besides, highest about 61% farmers in Nikhongchari reared deshi cattle. Very few farmers reared both types of cattle at a time as shown in Table 6.

Table 18: Genotype of cattle on the basis of locations

Locations	Percent		
	Crossbred cow	Deshi cow	Both crossbred and deshi
Jashore	68.18	28.41	3.41
Jhikorgacha	98.81	1.19	-
Manikganj	76.47	20.00	3.53
Munshiganj	100.00	-	-
Nikhongchari	37.35	61.45	1.20
Potiya	44.71	55.29	-
Overall	71.26	27.38	1.36

Table 6 (Annex) demonstrates the population size of different types of cattle in different survey areas, which shows that the numbers of lactating cows were more than other types (dry cow, pregnant cow, bull, bullock and calves). On an average each farmer had 4.05 lactating cows in their farm. Table v (Annex) further reveals that the highest number of lactating cow was found in Munshiganj (7.21 nos/farm) and the lowest in Nikhongchari (1.44nos/farm).

Milk production

The milk production statistics based on farm ownership is depicted in Table vi (Annex), which shows that the highest 64.55 liters milk per farm was produced in community farm and the lowest of 9.0 liters in cooperative farm. The highest daily milk yield per cow was produced in single farm (10.95 ltrs/cow) and the lowest (2.0 ltrs/cow) in cooperative farm. Table vii (Annex) illustrates milk production status according to farming system, which entails that the highest 43.98 liters milk per farm was produced in intensive farming system, while the lowest production (9.80 ltrs/farm) was found in mixed farming system.

The milk production status at farm and individual cow level is represented in Table 19. The highest farm level milk was produced in Munshiganj (64.67 liter per farm), which was due to highest number of cattle reared in that area. In Nikhongchari, only 3.30 liter milk was produced per farm house, which was due to rearing deshi cattle in that area. In the survey, it was revealed that the average milk production per cow was 10.89 liter per day. In Potiya, the average milk

production per cow was obtained highest of 27.14 liter per day per cow, while the lowest of 2.07 liter per day per cow.

Table 19: Milk production on the basis of location

Location	Milk production per farm (L)	Milk production per cow (L)
Jashore	14.73	5.17
Jhikorgacha	45.81	11.05
Manikganj	38.04	8.54
Munshiganj	64.67	10.02
Nikhongchari	3.30	2.07
Patiya	25.76	27.14
Grand Total	32.99	10.89

The commercial farm produced an average daily milk production of 64.65 liter per day, while family farm produced only 17.10 liter per day (Table 21). The average daily milk production per cow in commercial farm was 10.08 liter, while in family farm it was 11.67 liter.

Table 20: Milk production on the basis of farm type

Farm type	Total milk production per farm (L)	Milk production per cow (L)
Commercial	64.65	10.08
Family	17.10	11.67
Grand Total	34.06	11.10

The milk production performance of crossbred and deshi cow is shown in Table 21. Milk production performance of crossbred cow was higher than that of deshi cow, which was due to difference for genetic potentiality of cattle genotype. The average daily milk production of crossbred cow was observed to be 9.15 liter with peak daily yield of 13.84 liter and sustained to about 255 days. While in the counterpart those were 3.26 and 6.66 liter and 221 days for deshi cow.

Table 21: Milk production on the basis of cattle genotype

Cattle genotype	Milk production per cow(L)	Maximum milk yield(L)	Lactation period(day)
Crossbred cow	9.15	13.84	254.70
Deshi cow	3.26	6.66	221.36

Feed supply to cattle

Cattle in the study area were found to be fed mainly with green roughage, straw and concentrate mixture. As shown in Table 22 that a farmer supplied green grass to cows which averaged to 16.28 kg/day/head. The highest amount of green grass (21.66 kg/day/head) was supplied by the farmers in Munshiganj and the lowest (10.92 kg/day/head) by farmers in Jashore. Irrespective of locations, an average 7.84 kg straw was supplied to each cow in a day. The highest daily 11.40 kg straw per cow was provided by the farmers in Jashore and the lowest (5.67 kg/day/head) by the farmers in Munshiganj. Concentrate feeds play an important role in production of cattle

which was supplied to about 5.54 kg/day/head, irrespective of location. The highest amount of 10.71 kg concentrate feed per cow per day was supplied by the farmers in Jhikorgacha and the lowest (3.87 kg/day/head) by the farmers in Patiya.

Table 22: Supply of roughages and concentrate feed on the basis of location

Location	Fresh grass (kg of cow/day)	Straw (kg of cow/day)	Concentrate (kg of cow/day)
Jashore	10.92	11.40	4.73
Jhikorgacha	15.42	9.45	10.71
Manikganj	19.78	6.35	4.92
Munshiganj	21.66	5.67	7.07
Nikhongchari	11.84	5.92	1.71
Patiya	17.31	5.84	3.87
Average	16.28	7.84	5.54

The allocations of roughage and concentrate feeds supplied by the farmers in different seasons are depicted in Table 23. The investigation revealed that fresh grass and concentrate were provided in highest amount in summer and the lowest in rainy season. In summer, an average 18.08 kg fresh grass was supplied to each cow in a day. The lowest amount of straw (7.50 kg/day/head) was provided in summer, while the highest in winter. In winter, the green grass is seemed to be scarce. Consequently, more straws are supplied to fortify roughage deficiency in diet.

Table 23: Supply of roughages and concentrate feed on the basis of season

Season	Fresh grass (kg of cow/day)	Straw (kg of cow/day)	Concentrate (kg of cow/day)
Rainy	14.05	7.72	3.96
Summer	18.08	7.50	6.54
Winter	16.57	8.19	6.19

Table 24 illustrates the amount of roughage and concentrate feeds supplied to crossbred and deshi cattle, which shows that amount of feeds provided to the crossbred cows were higher than the amount provided to the deshi cows. This is because of higher body size and production of crossbred cows as compared to deshi cows.

Table 24: Supply of roughages and concentrate feed on the basis of cattle genotype

Type of cows	Fresh grass (kg of cow/day)	Straw (kg of cow/day)	Concentrate (kg of cow/day)
Crossbred cow	17.20	7.91	6.64
Deshi cow	14.34	7.70	2.79

Supply of rice straw of different varieties of paddy in different survey areas is depicted in Table x (Annex). On an average the highest 7.21 kg Aman rice straw was supplied to the cows by the farmers. Boro rice straw was supplied to the cows which amounted 3.73 kg. On the other hand, green grasses of different varieties supplied to the cows in different survey areas are depicted in Table xi (Annex), which shows that the highest 13.67 kg Napier grass was supplied to the cows by the farmers. Seasonal variations of roughage feeds supplied to cows are presented in Table xii and Table xiii (Annex). Further, supplies of roughage feeds to cows based on genotype are illustrated in Table xiv and Table xv (Annex).

2. Modeling on prediction of energy and protein requirements for milk production through feeding trial

Animal trial was conducted to determine energy and protein requirement of dairy animal. Twenty local cows (Pabna 10 in number and RCC 10 in number) aged around 18 to 24 months were selected according to live weight and milk production, the cows were randomly and equally distributed into four groups where two groups (control and treatment) containing pabna cattle and other two groups (control and treatment) were formed with RCC cattle. The experiment was conducted following Completely Random Design (CRD). BLRI developed ration was provided for the control groups of RCC and Pabna cows. Besides NATP-1 ration (Moringa silage, rice bran, DCP and molasses) was offered for the treatment groups of RCC and Pabna cows. Moringa silage was used for treatment groups, while the control group was provided German grass which was previously cultivated in the cattle research farm of BLRI. Duration of the trial was 45 days of which milk sample was collected 7 consecutive days from 22nd day and digestibility trial was conducted on last 7 days. Samples of feed, refusal and faeces were subjected to proximate analysis following the standard methods of AOAC (2005). Acid detergent fiber (ADF) neutral detergent fiber (NDF) was determined according to the method of Van Soest*et al*., (1991). All the data generated were sent to SAU for analysis.

Table 25: Effect of NATP ration on body weight gain of milking cows of Pabna and Red Chattogram Cattle (RCC)

Parameters	Animal tag No.	Initial body weight	Final body weight	Growth (gm. /day)
RCC				
NATP Feed (Treatment group)	373	223	235	267
	452	240	245	111
	442	242	253	244
	366	222	231	200
	476	219	234	333
Average		**229.2**	**239.6**	**231.11**
Control/Concentrate (Farm practice)	469	227	241	311
	457	234	242	178
	487	252	262	222
	446	251	261	222
	281	249	258	200
Average		**242.6**	**252.8**	**226.67**
Pabna Cattle				
NATP –Feed (Treatment group)	855	328	334	133
	515	259	267	178
	789	291	303	267
	896	292	301	200
	964	319	342	511
Average		**297.8**	**267.27**	**239**
Control/ Concentrate (Farm practice)	796	281	290	200
	974	292	301	200
	1009	304	314	222
	682	288	298	222
	474	316	327	244
Average		**277.48**	**288.01**	**234**

Table 26: Effect NATP ration on intake and digestibility of milking cow of Pabna and Red Chittagong Cattle (RCC)

Feed Type	Animal no.	TDM	TCP I	TOMI	TADF I	DMD	CPD	OMD	ADFD
RCC	373	4.97	0.82	4.51	50.87	50.87	64.24	63.15	52.39
NATPfeed	452	5.15	0.86	4.68	56.00	56.00	73.57	68.23	57.13
	442	5.56	0.93	5.09	50.79	50.79	68.37	62.72	51.18
	366	4.71	0.77	4.28	54.86	54.86	72.19	66.71	53.31
	476	5.34	0.88	4.87	51.26	51.26	64.86	62.01	48.88
Average		**5.15**	**0.85**	**4.69**	**1.40**	**52.75**	**68.65**	**64.56**	**52.58**
RCC	469	5.56	0.86	5.19	53.46	53.46	65.82	65.08	52.89
Control Farm Practice	457	5.48	0.8	5.1	52.29	52.29	58.86	64.88	47.73
	487	5.46	0.83	5.12	53.10	53.10	65.91	64.49	50.41
	446	5.79	0.86	5.47	51.88	51.88	64.19	65.47	47.11
	281	2.65	0.87	5.37	50.57	50.57	65.32	62.50	50.78
Average		**4.99**	**0.84**	**5.25**	**1.80**	**52.26**	**64.02**	**64.48**	**49.78**
Pabna cattle	855	8.41	1.4	7.64	2.308	53.80	67.75	63.53	53.48
NATPfeed	515	5.91	0.96	5.37	1.6	59.11	70.67	69.11	56.96
	789	7.08	1.18	6.46	1.86	52.71	63.17	64.18	51.99
	896	6.59	1.11	6.01	1.782	50.85	70.64	62.58	53.32
	964	5.41	0.88	4.92	1.474	52.09	69.13	65.19	50.31
Average		**6.68**	**1.11**	**6.08**	**1.80**	**53.71**	**68.27**	**64.92**	**53.21**
Pabna cattle	796	7.71	1.17	7.29	2.61	54.77	67.99	63.06	53.31
Control Farm Practice	974	8.11	1.14	7.2	2.57	53.58	63.65	62.52	55.91
	1009	8.33	1.18	7.56	2.77	53.24	61.56	63.32	52.45
	682	7.85	1.14	7.14	2.5	51.09	62.27	64.65	47.69
	474	7.85	1.13	7.32	2.69	52.31	61.67	66.44	51.92
Average		**7.97**	**1.15**	**7.30**	**2.63**	**53.00**	**63.43**	**64.00**	**52.26**

TDM= Total dry matter, TCPI= Total crude protein intake, TOMI= Total organic matter intake, TADFI= Total acid detergent fiber intake, DMD= Dry matter digestibility, CPD= Crude protein digestibility, OMD= Organic matter digestibility, ADFD=Acid detergent fiber digestibility.

Table 27: Milk Composition before and after experimental feeding

Before Experimental Feeding						
RCC	**Animal No.**	**Fat%**	**SNF%**	**Protein %**	**Lactose%**	**Density**
NATP Feed	373	5.07	9.21	3.37	4.92	1.025
	452	5.71	9.41	3.42	5.00	1.025
	442	4.52	9.44	3.46	5.07	1.027
	366	5.24	9.04	3.31	4.84	1.025
	476	5.00	9.78	3.59	5.29	1.027
Control/Concentrate	469	5.37	9.48	3.49	5.11	1.027

Before Experimental Feeding						
RCC	**Animal No.**	**Fat%**	**SNF%**	**Protein %**	**Lactose%**	**Density**
Farm Practice	457	4.47	9.56	3.50	5.85	1.029
	487	5.37	9.74	3.66	5.38	1.029
	446	4.99	9.17	3.36	4.93	1.026
	281	4.49	9.72	3.61	5.28	1.030
Pabna Cattle						
NATP Feed	855	5.27	9.28	3.36	6.44	1.026
	515	4.44	9.45	3.48	6.81	1.028
	789	4.86	9.67	3.56	6.99	1.028
	896	4.32	9.75	3.57	7.03	1.029
	964	5.55	9.61	3.53	6.88	1.027
Control/Concentrate	796	5.29	9.33	3.42	6.73	1.026
Farm Practice	974	4.57	9.53	3.50	6.81	1.136
	1009	3.45	9.31	3.50	6.84	1.029
	682	4.81	9.40	3.45	6.73	1.026
	474	4.51	9.30	3.41	6.69	1.027

After Experimental Feeding							
Parameters	**Animal No.**	**Fat%**	**SNF%**	**Lactose%**	**Protein%**	**pH**	**Density%**
RCC							
NATP Feed	373	5.26	9.365	5.15	3.43	6.19	1.027
	452	6.08	9.46	3.005	3.46	6.87	1.033
	442	6.68	10	5.5	3.66	7.01	1.029
	531	5.04	8.49	3.02	3.42	6.93	1.025
	476	5.65	9.68	4.23	3.38	6.09	1.027
Average		**5.74**	**9.399**	**4.181**	**3.47**	**6.62**	**1.028**
Control/concentrate Farm Practice	469	5.21	9.54	5.80	3.65	6.60	1.027
	487	5.1	9.81	5.40	3.59	6.26	1.029
	446	4.43	9.71	5.44	3.29	7.12	1.028
	281	5.02	8.69	5.88	3.9	6.59	1.026
	457	4.74	9.30	5.11	3.4	6.72	1.029
Average		**4.9**	**9.41**	**5.52**	**3.57**	**6.66**	**1.03**
Pabna Cattle							
NATPFeed	855	4.87	8.19	4.505	3.34	5.92	1.027
	515	5.66	9.44	5.185	3.45	6.60	1.031
	789	5.13	9.06	4.98	3.31	6.88	1.037
	896	5.00	9.59	4.17	3.92	7.09	1.035
	964	5.24	9.04	4.42	3.94	7.09	1.031
Average		**5.18**	**9.062**	**4.652**	**3.592**	**6.72**	
Farm Practice	474	4.66	8.21	4.52	3.34	6.45	1.028
	974	6.38	9.06	4.98	3.31	6.55	1.038
	1009	4.37	9.79	5.39	3.59	6.80	1.031
	796	6.79	10.26	5.65	3.55	7.10	1.028
	682	7.14	8.50	4.68	3.38	6.46	1.029
Average		**5.87**	**9.16**	**5.04**	**3.43**	**6.67**	**1.034**

3. Development of harvest index for all conventional crop residues and agro-industrial by-products used as animal feed in Bangladesh

Harvest index is defined as the pounds of grain divided by the total pounds of above ground biomass (residues plus grain). Table 28 below shows the harvest index of different crops.

Harvest index = lbs of grain / (lbs residues + lbs grain)

Table 28: Harvest index of different crops

Sl No.	Name of agricultural Crops	Residues (tones/acre)	Grain (tones/acre)	Harvest index
01.	Rice (Amon)	10.12	6.07	0.38
02.	Rice(Hybrid)	0.51	0.85	0.63
03.	Borodhan	8.36	10.40	0.55
04.	Rice (Hybrid)	14.16	8.38	0.37
05.	Rice (Aus)	9.71	5.46	0.36
06.	**Average**			**0.46**
07.	Potato plant	6.29	11.88	0.65
08.	Wheat	14.81	8.76	0.37
09.	Maize	9.11	11.13	0.55
10.	Mustard	3.80	3.47	0.48
11.	Lentils	5.06	3.61	0.42

There is wide variation in the harvest index data of rice crops (range from 0.36 to 0.63). During excessively wet or dry years when grain yields are reduced, the harvest index is usually lower (higher residues yield than grain yield).With advanced breeding, genetics and more intensive management, higher crop yields can be achieved with the same size plant, resulting in higher harvest index. Within the same year there might be variation in the harvest index. This is due to the variability in soil types, geographic distribution of rain and to a lesser extent, management of the crop.

Harvest index is not necessarily something that one should manage directly. The grain is the most economically valuable part of the crop and management decisions should be based on maximizing profit from grain yield. As new opportunities arise for harvesting crop agricultural residues for livestock feed, farmers will want to keep better track of how much agricultural residues they have left in the field after harvest and the value of that agricultural residues.

Component-2 (BAU)

1. Establishing national feed inventory

This report mainly covers the 6 Upazila in 4 districts in 3 divisions (as explained in the methodology section). The results presented here are mostly for providing the facts on the key findings along with its discussions where appropriate.

Overview of the farms and farming system on different regions

Demographic characteristics of farmers in the study regions

Figures 24-27 below describes the demographic characteristics of the farmers in the study region.The Figure 24 is depicted for different age classification while the Figure 25 is for the sex of the different farmers.

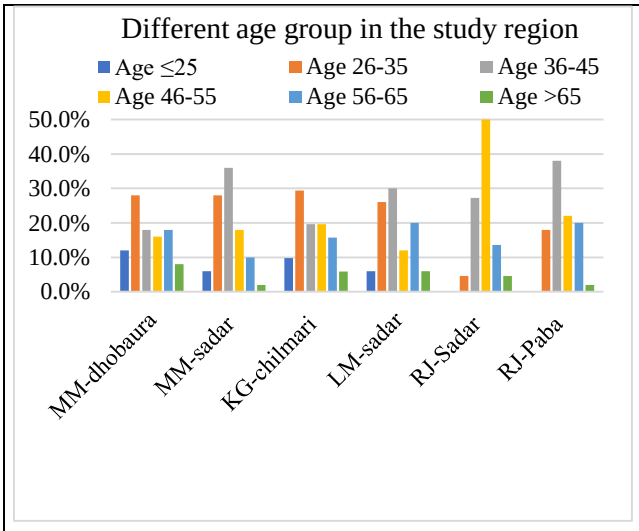


Figure 24: Age group of the farmer

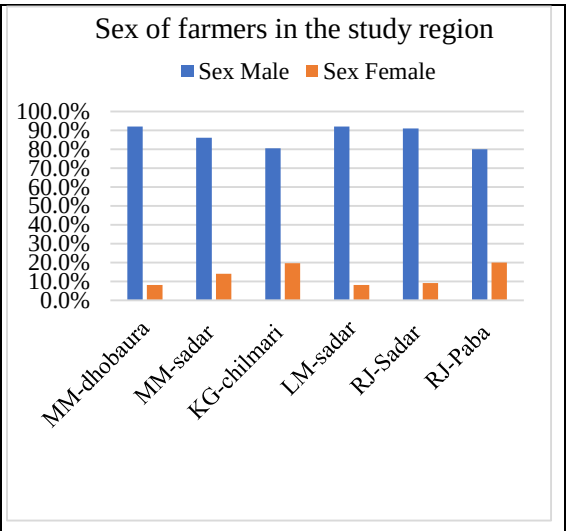


Figure 25: Sex of the farmer

MM = Mymensingh; KG = Kurigram; LM = Lalmonirhat; RJ = Rajshahi (Source: IDRN 2020)

The Figure 26 represents the educational status of the farmers that has been found to be mostly dominated by primary education throughout all the regions. The household size was mainly dominated by 5-6 family members (Figure 27) which is also reflected the national statistics of the average household size of 5.6.

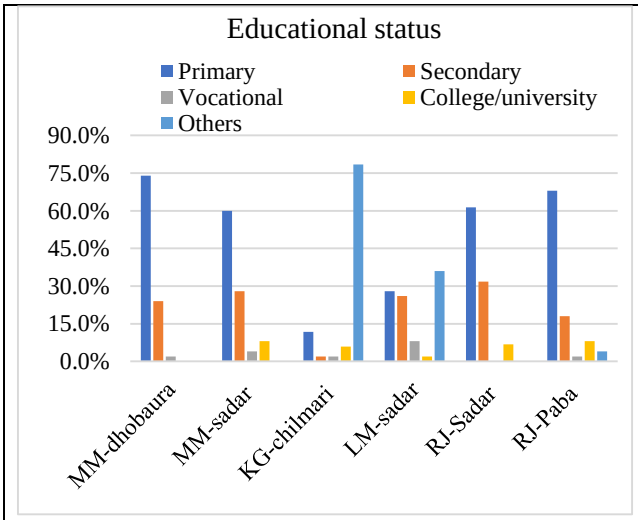


Figure 26: Educational status of the farmer

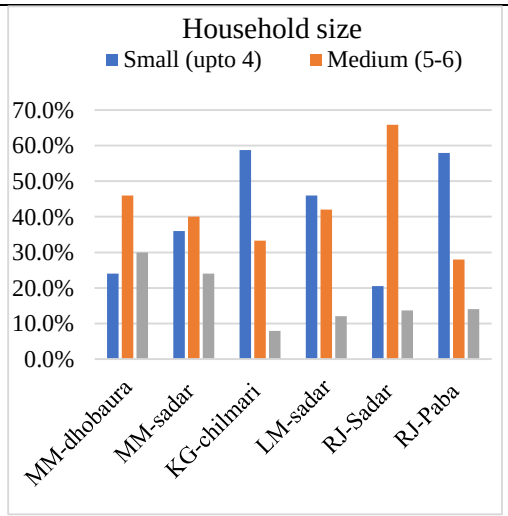


Figure 27: Household size of the farmer

MM = Mymensingh; KG = Kurigram; LM = Lalmonirhat; RJ = Rajshahi (Source: IDRN 2020)

Farm types in Bangladesh

The farm types play significant role in feeds and feeding practices in the study areas. There is no specific classification exists for identifying the farm size although the general definition of the farm types is used on the basis of the land size which is small, medium and large. But for the case of dairy, it is not true reflections. Hence, the classification proposed by Uddin et al. (2020) for dairy farms which are household, family and business farms was followed for the study. The results obtained from this study are shown in Figure 28.

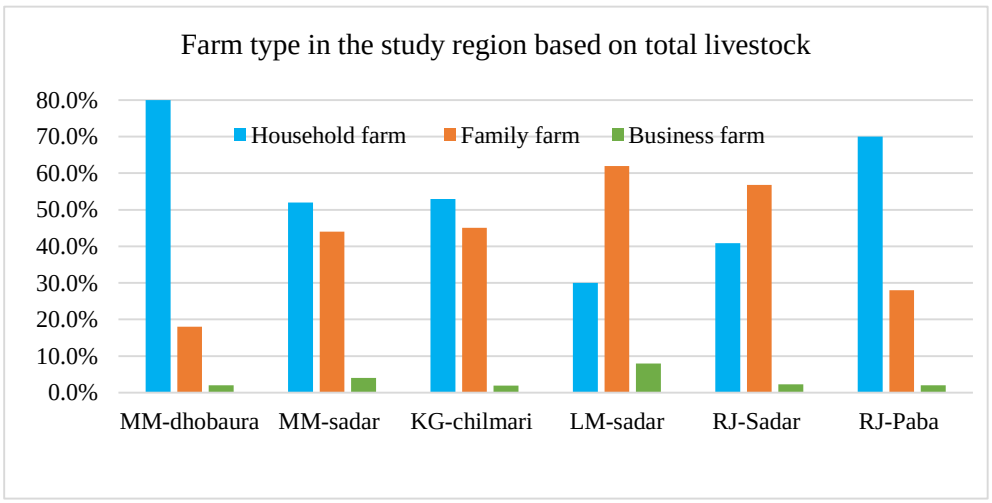


Figure 28: Farm type in the study region based on total livestock

MM = Mymensingh; KG = Kurigram; LM = Lalmonirhat; RJ = Rajshahi (Source: IDRN 2020)

Herd structure of the dairy farm in the study areas

The herd structure of the dairy farm in the study areas are depicted in the Table 29.

Table 29: Herd structure of the dairy farms in the study areas

Herd structure	Dhobaura Mymensingh (N=50)	Mymensingh Sadar (N=50)	Chilmari Kurigram (N=51)	Lalmonirhat Sadar (N=50)	Rajshahi Sadar (N = 44)	Rajshahi Paba (N = 50)
Herd structure for dairy						
Dairy cow	28.22%	51.19%	30.87%	49.70%	39.07%	28.04%
Heifers	12.56%	16.52%	14.73%	27.41%	15.12%	14.43%
Female calf	19.38%	19.38%	14.95%	19.88%	15.50%	31.01%
Male calf	11.63%	17.28%	16.61%	17.44%	18.68%	14.86%
Herd structure for other animal in the farm						
Bull/beef cattle	49.09%	20.78%	34.55%	35.70%	41.40%	38.79%
Others (Buffalo, Sheep, Goat)	50.91%	40.00%	46.55%	111.89%	50.91%	28.24%

Feed inventory analysis

Formulation of balanced ration in the study areas

Formulation of the balanced ration could drive the dairy farming system way forward. The feed rations from the point of key major feed ingredients are shown in the Table 30.

Table 30: Mean value of feed ration in the study region

Variables	Unit	MM-Dhobaura (N=50)	MM-Sadar (N=50)	KG-Chilmari (N=51)	LM-Sadar (N=50)	RJ Sadar (N = 44)	RJ Paba (N = 50)
Concentrate given	kg/cow/day	0.98	2.13	2.15	2.56	2.30	2.11
Rice straw given	kg/cow/day	5.42	5.74	3.90	3.45	6.76	4.56
Green grass given	kg/cow/day	10.17	10.04	7.67	6.16	15.65	3.74
Share of concentrate	%	6.88	14.07	17.97	25.29	23.57	8.51
Share of purchased feed	%	10.02	33.36	15.24	33.20	78.21	14.81
Concentrate intake	ton/cow/year	0.32	0.63	0.79	0.93	0.83	0.77

The feed inventory along with nutrient inventory in the study areas are depicted in the Table 31.

Table 31: Feed inventory (Nutrient inventory) in the study areas

Nutrient requirement for Dairy per farm										
		Dry Matter Intake (DMI) limit in Kg/day			Metabolizable Energy (ME) Requirement in MJ/day			Protein (CP, DCP, MP) Requirement in g/day		
		ARC-1984	AFRC-1993	NRC-2001	ARC-1984	AFRC-1993	NRC-2001	ARC-1984	AFRC-1993	NRC-2001
		DM	DM	DM	ME	ME	ME	CP	CP	CP
		Kg/day	Kg/day	Kg/day	MJ/day	MJ/day	MJ/day	g/day	g/day	g/day
Nutrient requirement										
	MM-Dhobaura	12.34	10.94	9.76	65.81	55.37	74.24	735.24	644.84	1068.30
	MM-Sadar	14.35	12.77	13.40	106.48	94.43	118.72	1328.37	1075.25	1662.27
	KG-Chilmari	13.11	11.47	10.50	73.77	62.94	83.28	842.83	729.97	1179.83
	LM-Sadar	12.64	11.26	10.39	73.58	62.96	82.82	848.46	728.19	1179.99
	RJ-Sadar	15.62	13.78	15.10	125.93	113.20	140.47	1602.23	1283.54	1938.48
	RJ-Paba	13.97	12.24	12.17	90.74	78.97	101.49	1094.91	906.46	1434.81
Nutrient Supply										
	MM-Dhobaura	15.38	15.38	15.38	123.50	123.50	123.50	851.48	851.48	851.48
	MM-Sadar	17.34	17.34	17.34	144.86	144.86	144.86	1082.30	1082.30	1082.30
	KG-Chilmari	13.03	13.03	13.03	111.76	111.76	111.76	886.02	886.02	886.02
	LM-Sadar	12.08	12.08	12.08	106.75	106.75	106.75	887.87	887.87	887.87
	RJ-Sadar	21.76	21.76	21.76	179.54	179.54	179.54	1333.18	1333.18	1333.18
	RJ-Paba	12.55	12.55	12.55	108.13	108.13	108.13	830.31	830.31	830.31
Nutrient balance										
	MM-Dhobaura	3.04	4.43	5.62	57.69	68.14	49.27	116.24	206.64	-216.82
	MM-Sadar	2.99	4.57	3.94	38.38	50.42	26.14	-246.06	7.05	-579.96
	KG-Chilmari	-0.08	1.56	2.52	37.99	48.82	28.48	43.19	156.05	-293.80
	LM-Sadar	-0.56	0.83	1.69	33.16	43.79	23.93	39.41	159.68	-292.12
	RJ-Sadar	6.14	7.98	6.66	53.61	66.33	39.07	-269.05	49.63	-605.31
	RJ-Paba	-1.42	0.31	0.38	17.38	29.16	6.63	-264.60	-76.15	-604.51

2. Meta-analysis of the feed resources available in Bangladesh

Feed availability in the study areas

The feed availability is one of the key indicators that defines the feeding system and feed cost for dairy farming. The feed availability varies across the region and also influenced by the season. The feed availability is depicted in the Table 32.

Table 32: Feed available in all study areas (BLRI components)

SL No.	Season (1=summer, 2=rainy, 3=winter)	Region (Manikjang=225, Munshigsnj=231, JashoreSadar=288, Jhikargacha=286, Naikhangchhori=78, Patiya=107)	Common Name	Scientific Name
1	1	255	Napier grass	*Pennisetum purpureum*
2	1	255	German grass	*Echinochloapolystachya*
3	2	255	Napier	*Pennisetum purpureum*
4	3	255	Napier grass	*Pennisetum purpureum*
5	1	255	Maize	*Zea mays*
6	1	255	Hachi grass	
7	1	255	Arali grass	*Nerium oleander*
8	1	255	Durba grass	*Cynodondactylon*
9	1	255	Shama grass	*Echinochloacolona*
10	2	255	Ghoicha grass	
11	2	255	Kanai grass	*Commelinabenghalensis* L.
12	2	255	Sugarcane vaggche	*Saccharum officinarum*
13	2	255	Gondhovadail grass	*Paederiafoetida* L.
14	2	255	Local grass	
15	2	255	Water hyachinth	*Eichhornia crassipes*
16	3	255	Khesari grass	*Lathyrus sativus*
17	3	255	Vutta grass	*Zea mays*
18	3	255	Dry khesari grass	*Lathyrus sativus*
19	3	255	Bakhsa grass	
20	1	255	Wheat bran	*Triticum spp.*
21	1	255	Maize corn(midle)	*Zea mays*
22	1	255	Masterd oil cake	*Brassica Juncea*
23	2	255	IRRI straw	*Oryza sativa*
24	2	255	Quality feed mass	
25	2	255	Mustard oil cake	*Brassica Juncea*
26	3	255	Broken maize	*Zea mays*
27	3	255	Concentrate mixture	
28	3	255	Gomer Vusi	*Triticum spp.*
29	3	255	Quality feed pellet	
30	3	255	Khesari vanga	*Lathyrus sativus*
31	1	231	Dhal grass	*Hymenachneamplexicaulis*

SL No.	Season	Region	Common Name	Scientific Name
32	2	231	Dhal grass	*Hymenachneamplexicaulis*
33	3	231	Pakchung grass	*Pennisetum purpureum*
34	3	231	Dhol/Para grass	*Hymenachneamplexicaulis*
35	1	231	Water hyachinth	*Eichhornia crassipes*
36	2	231	Durba grass	*Cynodondactylon*
37	2	231	Kalmi grass	*Bromus kalmia*
38	2	231	Hachi grass	
39	2	231	Shaila grass	
40	2	231	Joina grass	
41	3	231	Potato plant	*Solanum erianthum*
42	3	231	Kanaia grass	
43	3	231	Bis katali grass	*Persicarialapathifolia*
44	3	231	Halencha grass	*Enhydra fluctuans*
45	1	231	Linseed oil cake	*Linumusitatissimum* L
46	1	231	Linseed bran	*Linumusitatissimum* L
47	1	231	Coconut oil cake	*Cocos Nucifera*
48	1	231	Jashorer linseed oil cake	*Linumusitatissimum* L
49	1	231	Wheat bran	*Triticum spp.*
50	1	231	Rice bran	*Oryza sativa*
51	1	231	Lentil bran	*Lens culinaris*
52	1	231	Musurivusi	*Lens culinaris*
53	2	231	Gomer vusi	*Triticum spp.*
54	2	231	Maskalaidalvanga	*Vigna mungo*
55	2	231	Coconut oil cake	*Cocos Nucifera*
56	2	231	Linseed bran	*Linumusitatissimum* L
57	3	231	Coconut oil cake	*Cocos Nucifera*
58	3	231	linseed oil cake	*Linumusitatissimum* L
59	3	231	Musuri Powder	*Lens culinaris*
60	3	231	Musurivusi	*Lens culinaris*
61	1	288	Napier grass	*Pennisetum purpureum*
62	2	288	Napier grass	*Pennisetum purpureum*
63	3	288	Napier grass	*Pennisetum purpureum*
64	1	288	Durba grass	*Cynodondactylon*
65	1	288	Shama grass	*Echinochloacolona*
66	1	288	Badla grass	*Cyperusrotundus*
67	2	288	Bhadla grass	*Cyperusrotundus*
68	2	288	Bana grass	*Pennisetum purpureum*
69	1	288	Minikatestraw&paddy	*Oryza sativa* L
70	1	288	Basmotistraw&paddy	*Oryza sativa* L
71	2	288	Straw	*Oryza sativa* L
72	3	288	Red gold straw	*Oryza sativa* L
73	3	288	Bisali straw	*Oryza sativa* L
74	1	288	Rice husk	*Oryza sativa* L
75	1	288	Wheat bran	*Triticum spp.*

SL No.	Season	Region	Common Name	Scientific Name
76	1	288	Maize crast	*Zea mays*
77	1	288	Sola vangha	*Cicer arietinum*
78	2	288	Masterd oil cake	*Brassica Juncea*
79	2	288	Maize crust	*Zea mays*
80	2	288	Rice Bran	*Oryza sativa* L
81	2	288	Wheat broken	*Triticum spp.*
82	2	288	Dabli(khosa)	
83	2	288	Wheat thin bran	*Triticum spp.*
84	3	288	Teer feed(Commercial)	
85	3	288	Musterd oil cake	*Brassica Juncea*
86	3	288	Maize broken	*Zea mays*
87	3	288	Wheat thik bran	*Triticum spp.*
88	3	288	Rice husk	*Oryza sativa*L
89	3	288	Rice polish	*Oryza sativa*L
90	2	286	Sanchilata grass	
91	2	286	Shama grass	*Echinochloacolona*
92	2	286	Katanoti grass	
93	1	286	Rice straw	*Oryza sativa* L
94	2	286	Rice straw	*Oryza sativa*L
95	2	286	Gutisorna straw	*Oryza sativa*L
96	1	286	Dablikhosa	
97	1	286	Broken rice	*Oryza sativa*L
98	1	286	Limestone	
99	1	286	Wheat thick bran	*Triticum spp.*
100	1	286	Wheat thin bran	*Triticum spp.*
101	1	286	ACI feed	
102	1	286	Broken maize	*Zea mays*
103	1	286	Mustard oil cake	*Brassica Juncea*
104	1	286	Rumi feed	
105	2	286	Maize broken Corn	*Zea mays*
106	2	286	Khasari vanga	*Lathyrus sativus*
107	2	286	Wheat vusi	*Triticum spp.*
108	2	286	Dablikhosa	
109	2	286	Wheat husk	*Triticum spp.*
110	3	286	ACI feed(commercial)	
111	3	286	Khesari broken	*Lathyrus sativus*
112	3	286	Rice broken	*Oryza sativa*L
113	3	286	Wheat bran	*Triticum spp.*
114	3	286	Musterd oil cake	*Brassica Juncea*
115	3	286	Musurir bran	*Lens culinaris*
116	3	286	Concentrate mixed	
117	3	286	Milk vita feed (commercial)	
118	3	286	Wheat thin bran	*Oryza sativa* L
119	3	286	Maize broken	*Zea mays*
120	1	107	Dhal grass	*Hymenachneamplexicaulis*

SL No.	Season	Region	Common Name	Scientific Name
121	2	107	Para Grass	*Brachiariamutica*
122	1	107	Chaga grass	*Hymenochaetaceae*
123	1	107	Ghata grass	
124	2	107	Jupara Grass	
125	2	107	Dandy Patiya	
126	2	107	Mowluchi Grass	
127	2	107	Varoti straw	
128	2	107	Durba Grass	*Cynodondactylon*
129	1	107	Wheat thin vushi	*Oryza sativa*L
130	1	107	Soyabean	*Glycine max*
131	1	107	Broken maize	*Zea mays*
132	1	107	Wheat thik bran	*Triticum spp.*
133	1	107	Rice bran	*Oryza sativa*L
134	1	107	Broken rice	*Oryza sativa*L
135	1	107	Boot dalerkhosa/ boot dal peel	
136	1	107	Mug powder	*Vigna radiate*
137	1	107	Mustard oil cake	*Brassica Juncea*
138	2	107	Mug frast	*Vigna radiate*
139	2	107	Mugdalvushi	*Vigna radiate*
140	2	107	Soya meal	*Glycine max*
141	2	107	Kalai (mugh)	*Vigna radiate*
142	2	107	Chirar kura	
143	2	107	Maize broken	*Zea mays*
144	2	107	Soybean	*Glycine max*
145	3	107	Mug vusi	*vigna radiate*
146	3	107	Mustard oil cake	*Brassica Juncea*
147	3	107	Chirar Kura	
148	3	107	Rice broken	*Oryza sativa*L
149	2	78	Napier grass	*Pennisetum purpureum*
150	2	78	German grass	*Echinochloapolystachya*
151	2	78	Para grass	*Brachiariamutica*
152	3	78	Napier grass	*Pennisetum purpureum*
153	3	78	Dhol grass	*Hymenachneamplexicaulis*
154	3	78	Para grass	*Brachiariamutica*
155	3	78	German grass	*Echinochloapolystachya*
156	1	78	Local grass	
157	1	78	Aahilapata	
158	1	78	Veraker grass	
159	2	78	Local grass	
160	3	78	Fulker grass	
161	3	78	Dukker grass	
162	3	78	Koda grass	*Paspalumscrobiculatum*
163	3	78	Bhadli grass	
164	3	78	Maize leaf	*Zea mays*
165	3	78	Banana plant	*Musa acuminate*

SL No.	Season	Region	Common Name	Scientific Name
166	1	78	Rice straw	*Oryza sativa* L
167	2	78	Amon straw	*Oryza sativa* L
168	2	78	Aus straw	*Oryza sativa* L
169	1	78	Mustard oil cake	*Brassica Juncea*
170	1	78	Maize	*Zea mays*
171	1	78	Wheat bran	*Triticum spp.*
172	1	78	Molasses	
173	1	78	Rice polish	*Oryza sativa* L
174	2	78	Mustard oil cake	*Brassica Juncea*
175	2	78	Rice bran	*Oryza sativa* L
176	2	78	Wheat bran	*Triticum spp.*
177	2	78	Maize broken	*Zea mays*

The feed available in BAU component areas are given in Table 33.

Table 33: List of available feeds and fodder of BAU Component

SL No	Season (1=summer, 2=rainy, 3=winter)	Region (Dhobaura=344, Mymensingh Sadar=350,Chilmari=461, Lalmonirhat Sadar =471, RajshahiSadar, Paba=436)	Common Name	Scientific Name
1		344	Crushed maize	*Zea mays*
2		344	Broken rice	*Oryza sativa* L
3		344	Wheat bran	*Triticum aestivum* L
4		344	Soyabean meal	*Glycine max*
5		344	Rice polish	*Oryza sativa* L
6		344	Wheat flour	*Triticum aestivum* L
7		344	Til oil cake	*Sesamum indicum*
8		344	Mustard oil cake	*Brassica Juncea*
9		344	Sesame oil cake	*Sesamum indicum*
10		344	Pulse bran	
11		344	Mixed feed	
12		344	Gram	*Cicer arietinum*
13		344	Rice straw	*Oryza sativa* L
14		344	Napier Pakchong	*Pennisetum purpureum* cv. Pak chong 1)
15		344	Water hyachinth	*Eichhornia crassipes*
16		344	Ca supplement	
17		344	Roadside grass	
18		350	Maize (crushed+broken)	*Zea mays*
19		350	Wheat	*Triticum*

SL No.	Season	Region	Common Name	Scientific Name
20		350	Rice husk	*Oryza sativa* L
21		350	Rice bran	*Oryza sativa* L
22		350	Wheat bran	*Triticum aestivum* L
23		350	Wheat flour	*Triticum aestivum* L
24		350	Soybean meal	*Glycine max*
25		350	Mustard oil cake	*Brassica Juncea*
26		350	Seesame(til) oil cake	*Sesamum indicum*
27		350	Pulse bran (Khesari, musuri, matikalai)	
28		350	Rice straw(aus)	*Oryza sativa* L
29		350	Napier Pakchong	*Pennisetum purpureum*
30		350	Dhal grass	*Hymenachneamplexicaulis*
31		350	Local grass/fodder	
32		350	Mineral	
33		350	Molasses	
34		350	Vit.	
35		350	Water hyachinth	*Eichhornia crassipes*
36		350	Roadside grass	
37		461	Broken rice	*Oryza sativa* L
38		461	Napier Pakchong	*Pennisetum purpureum*
39		461	Maize	*Zea mays*
40		461	Wheat	*Triticum* L
41		461	Paddy	*Oryza sativa* L
42		461	Rice straw	*Oryza sativa* L
43		461	Rice polish	*Oryza sativa* L
44		461	Maize+paddy	*Zeamays*+*Oryza sativa* L
45		461	Cattle feed	
46		461	Wheat bran	*Triticum aestivum* L
47		461	Rice	*Oryza sativa* L
48		461	Sola	*Aeschynomene aspera*
49		461	Durba grass	*Cynodondactylon*
50		461	Paddy crushed	*Oryza sativa* L
51		461	Maize crushed	*Zea mays*
52		461	Rice polish	*Oryza sativa* L
53		461	Wheat bran	*Triticum aestivum* L
54		461	Wheat	*Triticum aestivum* L
55		461	Local grass	
56		461	Mosur	*Lens culinaris*
57		471	Broken rice	*Oryza sativa* L
58		471	Maskalai	*Vigna mungo*
59		471	Maize crushed	*Zea mays*
60		471	Rice polish	*Oryza sativa* L
61		471	Paddy crushed	*Oryza sativa* L
62		471	Mosur	*Lens culinaris*
63		471	Animal feed	

SL No.	Season	Region	Common Name	Scientific Name
64		471	Rice polish	*Oryza sativa* L
65		471	Rice straw	*Oryza sativa* L
66		471	Concentrate mix.	
67		471	Maskalai	*Vigna mungo*
68		471	Napier Pakchong	*Pennisetum purpureum*
69		471	Wheat bran	*Triticum aestivum* L
70		471	Ca	
71		471	Pigeon pea	*Cajanus cajan*
72			Rice straw	*Oryza sativa* L
73			Rice polish	*Oryza sativa* L
74			Mustard oil cake	*Brassica Juncea*
75			Broken rice	*Oryza sativa* L
76			Anchor	
77			Wheat crush	*Triticum aestivum* L
78			Mixed feed	
79			Wheat flour	*Triticum aestivum* L
80			Ready feed	
81			Local grass	
82			Napier	*Pennisetum purpureum*
83			Chatamoyda	
84			Anchor+khesari+wheat	
85			Paddy crushed	*Oryza sativa* L
86			Maize silage	*Zea mays*
87			Chola+wheat+khesari+rice+maize	
88		436	Rice straw	*Oryza sativa* L
89		436	Rice polish	*Oryza sativa* L
90		436	Mustard oil cake	*Brassica Juncea*
91		436	Broken rice	*Oryza sativa* L
92		436	Anchor vushi	
93		436	Wheat crush	*Triticum aestivum* L
94		436	Mixed feed	
95		436	Muger vushi	*Vigna radiata*
96		436	Khesari	*Lathyrus sativus*
97		436	Mosurbhusi	*Lens culinaris*
98		436	Maize crushed	*Zea mays*
99		436	Rice polish	*Oryza sativa* L
100		436	Rice straw	*Oryza sativa* L
101		436	Wheat bran	*Triticum aestivum* L
102		436	Matikalai	*Vigna mungo*
103		436	Chola	*Cicer arietinum*
104		436	Kalmi	*Ipomoea* sp
105		436	Sanchi	*Panax notoginseng*

Feed classification from the survey areas

For knowledge hub creating on feed resources for the formulating of the ration, the feeds are classified in various feeding standards. Among them, we take the Integrated Dairy Research Netwwork (IDRN) Feed Classification which is depicted in Table 34.

Table 34: Classification based on IDRN and BSTI

IDRN-2020		BSTI	
Feed Code	**Feed Category**	**Feed Code**	**Feed Category**
1	Non-leguminous green roughages	1	Energy sources: Roughage
2	Leguminous green roughages	2	Energy sources: Grain & grain by-products
3	Unconventional feeds: Tree leaves	3	Protein sources: Vegetable
4	Unconventional feeds: Aquatic plants	4	Protein sources: Animal
5	Silages	5	Dried leaf meal
6	Hay	6	Minerals
7	Dry Roughages	7	Vitamins
8	Non-concentrate by-products	8	Waters
9	Compound feed/ ready feed	9	Others
10	Concentrate (whole grain)		
11	Concentrate by-products		
12	Feed additives		

Assigning the available feeds in the IDRN feed classification

The feeds assigned into the IDRN feed classification are depicted in Table 35a and 35b.

Table 35a: Assigning the available feeds as per the IDRN classification under BLRI component areas

Feed classification	Manikganj =225	Munshiganj =231	Jashore Sadar =288	Jhikargacha =286	Patiya =107	Naikhangchhori =78
Non-leguminous green roughages	6	4	3	0	2	9
Leguminous green roughages	1					
Unconventional feeds: Tree leaves	10	8	5	3	6	9
Unconventional feeds: Aquatic plants	1	2				
Silages						
Hay						
Dry Roughages	2		5	3	1	3
Non-concentrate by-products						

Feed classification	Manikganj =225	Munshiganj =231	Jashore Sadar =288	Jhikargacha =286	Patiya =107	Naikhangchhori =78
Compound feed/ ready feed	2		2	4		
Concentrate (whole grain)	7	6	2	2	5	2
Concentrate by-products		10	13	17	14	5
Feed additives				1		1
Total	**29**	**30**	**30**	**30**	**28**	**29**

Table 35b: Assigning the available feeds as per the IDRN classification under BAU component areas.

Feed classification	Dhobaura =344	Mymensingh Sadar=350	Chilmari =461	Lalmonirhat Sadar =471	RajshahiSadar	Paba=436
Non-leguminous green roughages	1	2	2		1	
Leguminous green roughages						
Unconventional feeds: Tree leaves	1	2	2		1	3
Unconventional feeds: Aquatic plants	1	1				
Silages						
Hay						
Dry Roughages	1	1		1	1	2
Non-concentrate by-products						
Compound feed/ ready feed			1	1	1	
Concentrate (whole grain)	4	4	6	2	2	2
Concentrate by-products	8	6	9	10	10	11
Feed additives	1	3		1		
Total	**17**	**19**	**20**	**15**	**16**	**18**

Chemical composition of the feed resources

Chemical composition[3]

The shortage of feeds and fodder is one of the most important factors that hinder the livestock development in Bangladesh. To meet up the requirements of the livestock it is very much important to use the available feedsand fodder efficiently to get the desired output. The knowledge of chemical composition of feed is important to assess the animal nutrient requirement fulfillment. The proximate components of feeds reveal its potential utility as animal feed though it varies among country, regions, and seasons and also over the years.

[3] A further detailed analysis on chemical composition as per the feed wise and nutritional value wise including time series is reported in **Annex 3**

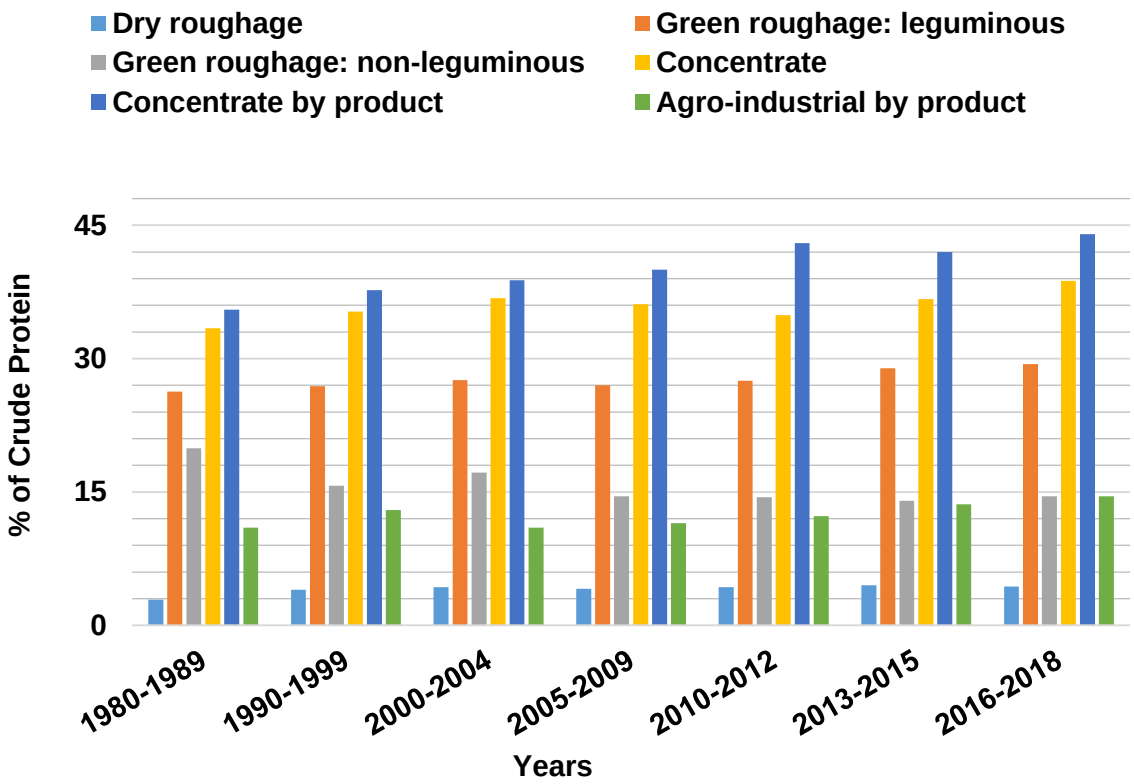


Figure 29: Percent (%) crude protein (CP) of different feeds and fodders

Percentage of crude protein (CP) of different feeds and fodder

Animal performance is highly dependent on some critical elements and crude protein is one of them. So it is needed to analyze the feed value in relation to crude protein of different feeds and fodders. The most commonly used feeds and fodders vary in CP content over the year. The percentage value of CP of different feeds and fodders are depicted in Figure 29.
The CP content varies from feed to feed. The concentrate by products like soybean meal, cotton seed meal, mustard oil cake normally contains more crude protein, about 35% to 44 % than any other feeds and fodders. But these percentages vary from year to year. Along with concentrate by-products leguminous fodder and concentrates also contains more crude protein, about 26% to 30% and 33% to 38% respectively, than roughages. The dry roughages being the basal feed for animal production contain less CP, on an average 2.9 % to 4.5%.

Percentage of crude fiber (CF) of different feeds and fodder

The indigestible part of feed nutrients i.e. crude fiber content of feed also varies over the years. The different feeds and fodders contain different proportions of crude fiber (CF). The % CF of different feeds and fodders is depicted in the Figure 30.

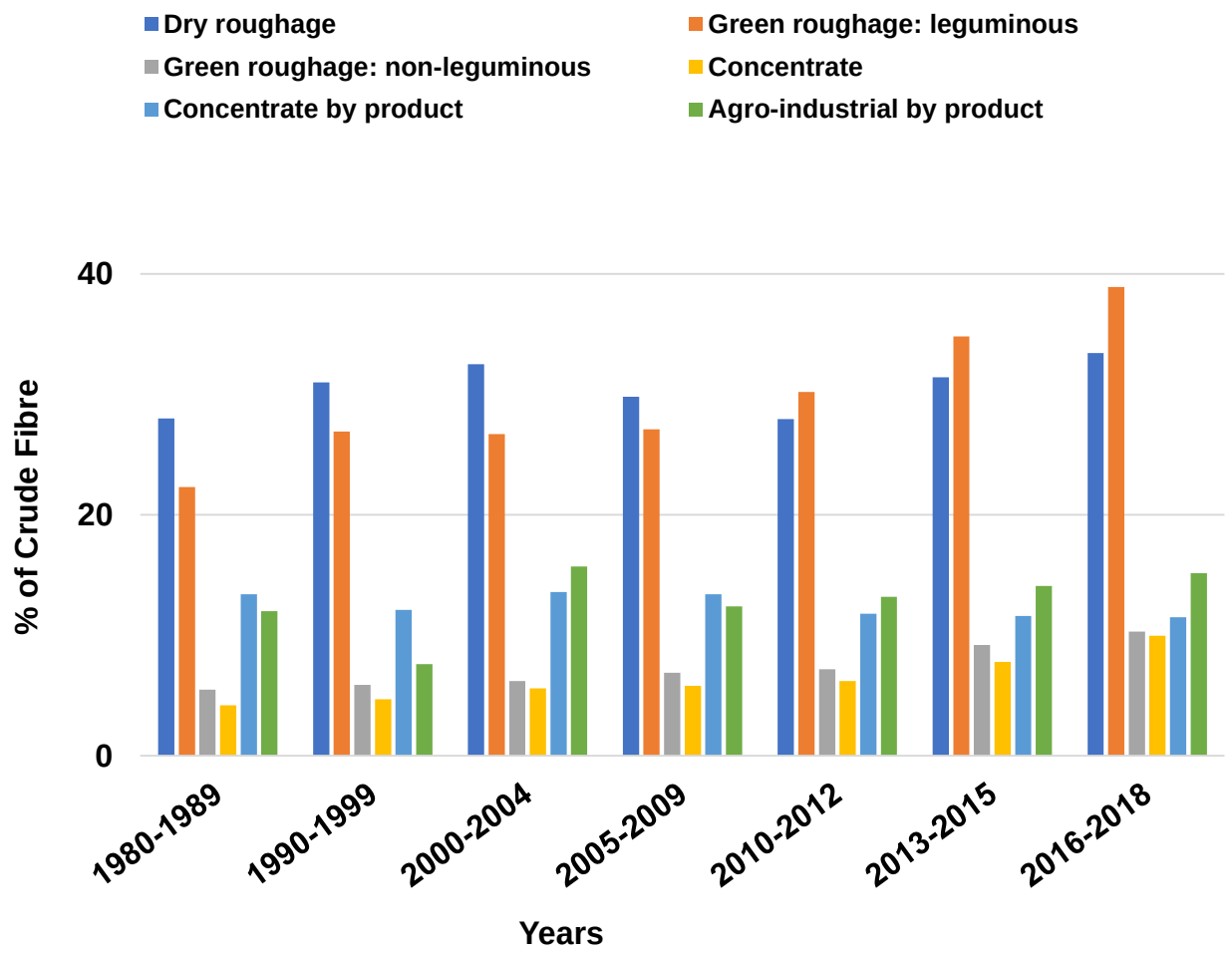


Figure 30: Pencent (%) crude fiber (CF) of different feeds and fodders

The roughages normally contain more crude fiber than any other feeds and fodders which varies over the year. The CF content of roughages varies from 28.0% to 38.9% in dry roughages and 22.3% to 33.42% in green roughages. The crude fiber content in concentrates, concentrate by-products and agro-industrial by-products varies from 4.2% to 10.3%, 11.6% to 13.4% and 7.6% to 15.71% respectively over the year.

Percentage of ether extract (EE) of different feeds and fodder

The main energy value of feed is determined by the ether extract content present in that feed. The variation in EE content in different feeds and fodders over the year is depicted in Figure 31.

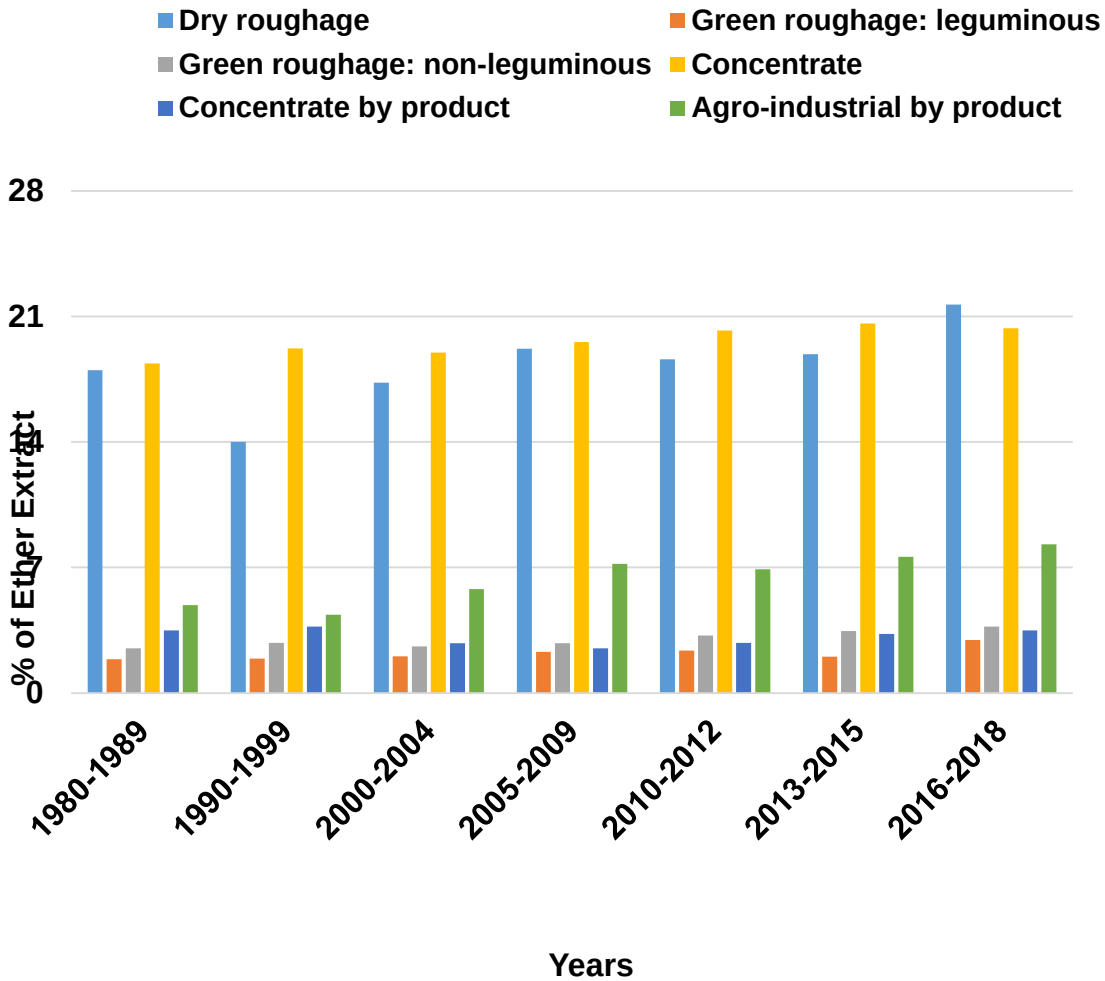


Figure 31: Percent (%) ether extract (EE) of different feeds and fodders

The concentrates like full fat soybean, cotton seed, rape seed, etc. contains more EE, about 18.38% to 20.34% over the year. The dry roughages also contain more EE, about 14.0% to 21.66% compared to green roughages that contain about 1.89% to 3.71% in different fodders over the years. The concentrates by-products and agro-industrial by-products have 2.5% to 3.71% and 4.36% to 8.3% EE respectively.

Percentage of nitrogen free extract (NFE) of different feeds and fodder

The NFE of different feeds and fodders over different years is given in the Figure 32. The dry roughages and agro-industrial by-products normally contain more NFE than any other feeds and fodders. NFE% in dry roughages and agro-industrial by-products usually vary from 44.1% to 61.29% and 40.0 % to 61.5% respectively. The NFE content in concentrates, concentrate by-products and green roughages varies from 28.64% to 58.62% over the years.

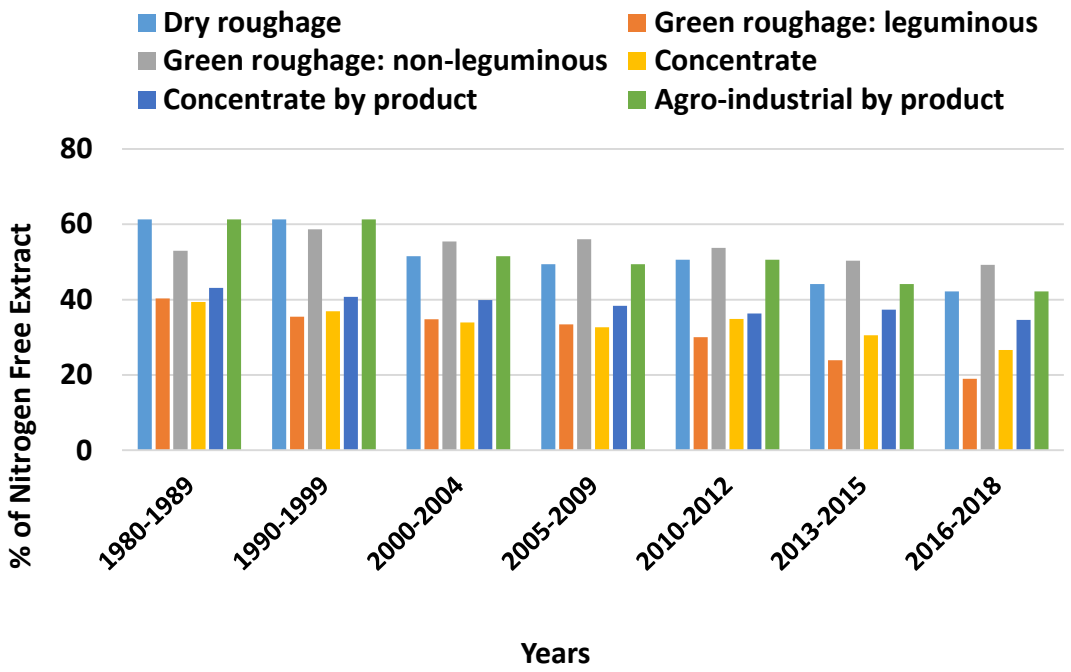


Figure 32: Percent (%) of nitrogen free extract (NFE) of different feeds and fodders

Percentage of total ash of different feeds and fodder

The inorganic part of the feed is total ash which contains mineral matters. The percentage of total ash in different feeds and fodders is presented in Figure 33.

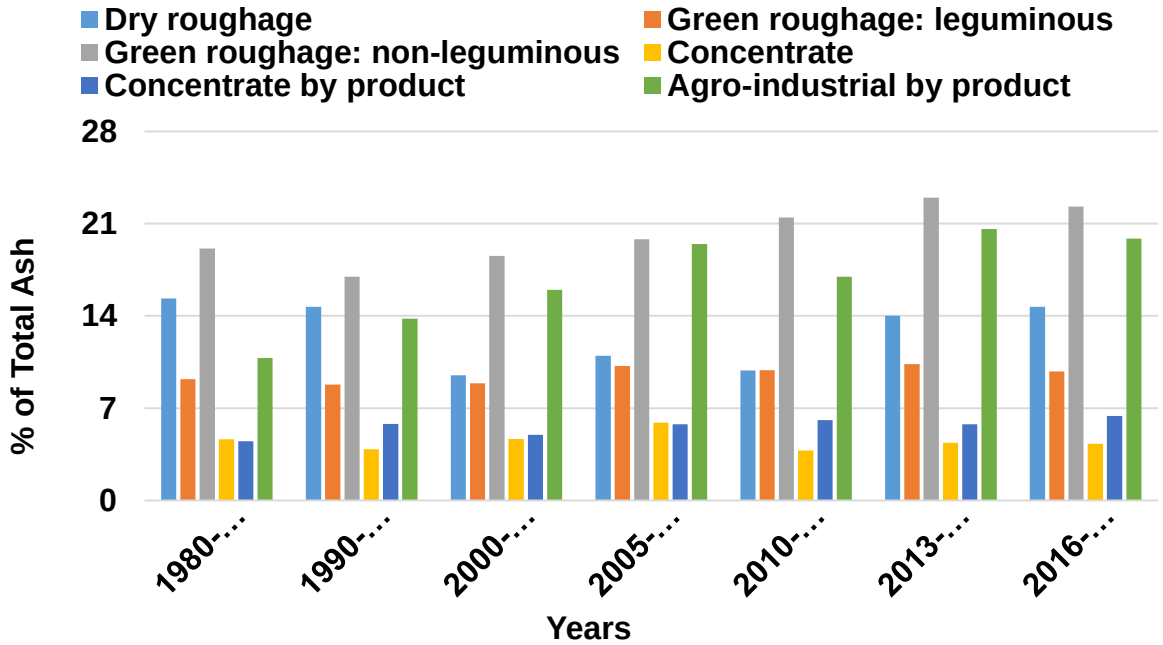


Figure 33: Percent (%) of total ash of different feeds and fodders

The roughages normally contain more total ash than concentrates or concentrate by-products. In dry roughages the % of total ash varies from 9.5 % to 15.32% and in green roughages it is about 8.79% to 22.89% whereas the non-leguminous fodders contain more ash than that of leguminous fodder over the year. The concentrates and concentrate by-products have about

3.79% to 4.65% and 4.5% to 6.4% total ash respectively over the years. The total ash contents in different agro-industrial by-products over the years are 10.8% to 19.87%.

Metabolizable energy (ME) value of different feeds and fodder

Metabolizable energy (ME) is the net energy remaining after fecal and urinary energy loss and this represents the energy available for growth, production, reproduction and also to support metabolic processes of the body. The ME values of different feeds and fodders are depicted in the Figure 34.

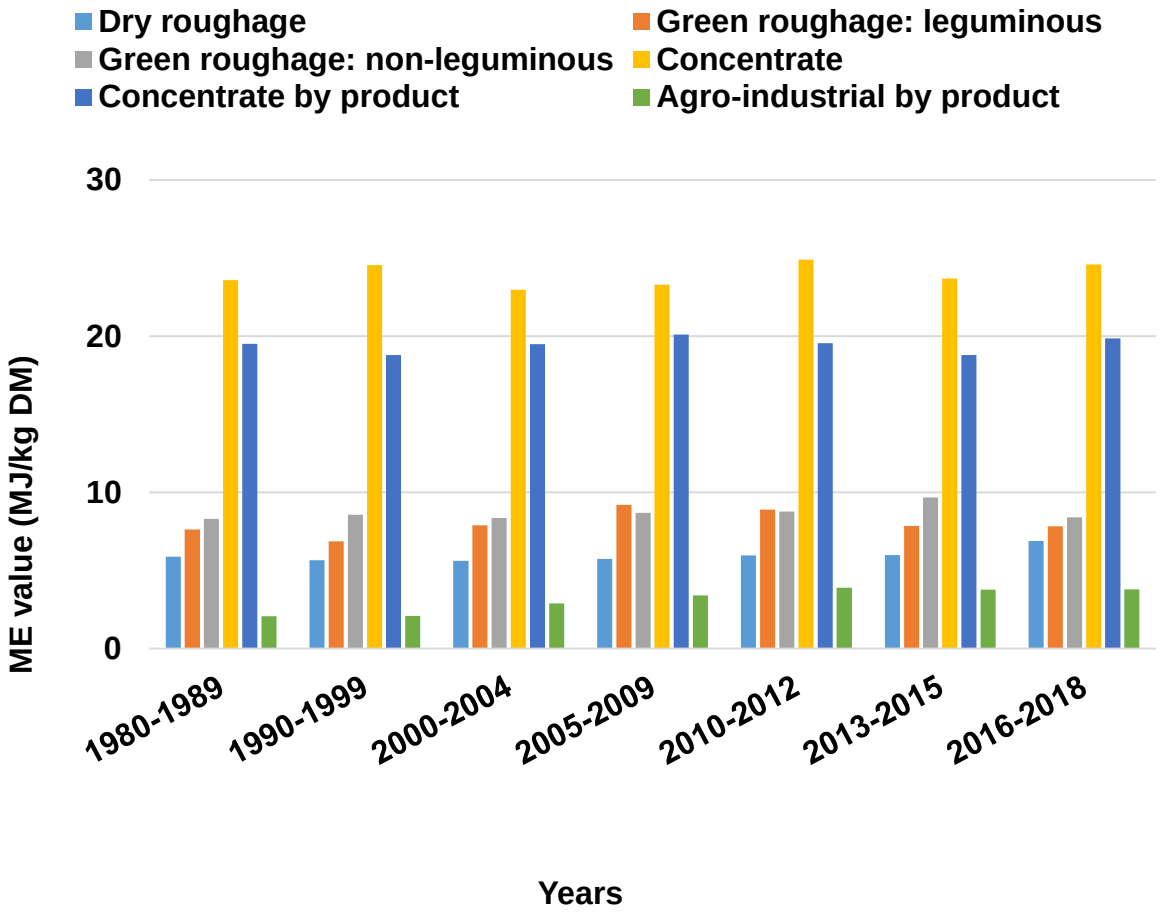


Figure 34: ME (MJ/kg DM) of different feeds and fodders

The concentrates have the highest ME than any other feeds and fodders which vary from 22.98% to 24.6% over the years and the concentrate by-products have 18.79 % to 19.56% ME. The dry roughages and agro-industrial by-products have less ME, about 5.61 % to 5.97% and 2.07 to 3.7% respectively, over the years. The green roughages contain 7.62% to 9.6% over the years.

This meta-analysis results shows that there is a substantial variation in terms of chemical composition and energy content of animal feed resources available in Bangladesh. Therefore, cross checking and validation through primary data collection is justified and would provide a tremendous knowledge base which will be used for formulation of balanced ration and contribute to the development of local feeding standards.

Component-3 (SAU)

1. Establishing national feed inventory

The Table 36 represents the farmer's status of four Upazilas of haor and coastal/saline areas of Bangladesh. Males having age between 37 to 57 years were found to be involved with livestock rearing significantly. Most of the farmers were found to have literacy at primary and high school level. Educational qualification was found to vary significantly among the locations. Annual income insignificantlyvaried from Tk. 89000.00 to Tk. 212000.00 per year in which agriculture was found to play the key compared to livestock. Higher land (378-1200 dcm) ownership was found in Sunamgonj compared to Patuakhali (135-154 dcm).

Table 36: Demographic information of farmers from Haor (Sunamganj) and coastal (Patuakhli) areas

Parameter	Study Zones				SEM	P value
	Sunamgonj Sadar	Tahairpur	Patuakhali Sadar	Kalapara		
Male farmers (%)	87.5[a]±6.36	100 [a] ±5.69	100 [a] ±7.34	100 [a] ±6.80	-	0.43
Female farmers (%)	12.5 [a] ±6.36	0.0 [b] ±0.0	0.0 [b]±0.0	0.0 [b] ±0	-	0.43
Age (year)	39.25 b±3.19	39.60 b±2.85	57.50 [a]±3.68	37.14 b±3.41	-	0.001
Primary education (%)	75.0 ab±21.56	30.0 b±13.63	100.0 a±17.60	28.57 b±16.30	-	0.013
High school education (%)	0.0±0.0	70.0 a±10.46	0.0±0.0	14.29 b ±12.50	-	0.001
SSC (%)	50.0 b±13.11	0.0±0.0	0.0±0.0	57.14 a±14.01	-	0.004
Honors (%)	12.50 a±6.36	0.0±0.0	0.0±0.0	0.0±0.0	-	0.42
Total income (Tk./year)	89000±82369.89	206000± 58244.31	82000±106339.08	212000±75193.08	-	0.51
Income Agriculture (Tk./year)	59000ab±17323.39	54000ab±12249.49	10000b±22364.40	105000a±15814.02	-	0.015
Income livestock (Tk./year)	18000b±7801.09	22857b±6593.13	57600a±10071.17	35000ab ±7121.39	-	0.02
Other income (Tk./year)	56125 ±58526.54	123000 ±52347.73	55533 ±67580.63	74571 ±62567.50	-	0.80
Land Ownership (dcm)	1188.8 a±279.23	378.0 ab±249.75	135.0 b±322.43	154.4 b±298.51	-	0.049
SEM= Standard Error of Mean, SSC= Secondary School Certificate, dcm= decimal						

Farmers were found to practice traditional farming system with no partnership or cooperative farming (Table 37). Animal production system was found dominated by semi-intensive system. Herd size for native animal per household was between 3 to 4 cows while the farmers were found have negative attitude towards rearing hybrid cows due to their higher nutrient requirements and better hygienic management. Goat availability was seen less in deep basins of Sunamgonj compared to Patuakhali. However, Sheep was found remarkably higher in

SunamgonjSadar (more than 7) compared to other areas. Milk production of native cow ranged between 1.84 L/d to 2.2 L/d. Native cows were found to produce more milk in coastal areascompared to that of the haor areas. On the other hand, high yielding cowswere found to yield similar (8.37-8.42l/d) amount of milk both in Sunamgonj Sadarand KalaparaUpazilla, Patuakhali. Lactating length varied significantly in native cows among the four Upazillas ranging from 160 to 240 days while, in hybrid cows it was from 150 to 177 days.

Table 37: Farmers experience, livestock, production system and milk production in Haor (Sunamgonj) and coastal (Patuakhali) area

Parameter	Study Zones				SEM	P value
	Sunamgonj Sadar	Tahairpur	Patuakhali Sadar	Kalapara		
Farming experience	14.25±7.32	28.0±6.55	30.0±10.36	15.25±7.32	4.14	0.38
Training on farming	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.00	-
Own farming	100±0.0	100±0.0	100±0.0	100±0.0	0.00	-
Partnership	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.00	-
Cooperative	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.00	-
Traditional animal rearing	100±0.0	100±0.0	100±0.0	100±0.0	0.00	-
Extensive	0.0±13.05	0.0±11.67	0.0±18.46	25±13.05	6.25	0.47
Semi-intensive	100a±0.0	100a±0.0	100a±0.0	75b±13.05	6.25	0.04
Milk selling in local market	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.00	-
Milk sell middle man	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.00	-
Native cow	3.6±0.85	3.1±0.76	4.0±0.98	2.5±0.90	0.32	0.71
Hybrid cow	0.37±0.18	0.0±0.0	0.0±0.0	0.42±0.20	0.11	0.24
Goat	0.0±0.0	0.0±0.0	0.0±0.0	1.71±0.66	0.43	0.18
Sheep	7.5±3.83	0.0±3.43	0.0±4.42	0.71±4.09	1.82	0.45
Buffalo	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.00	-
Native cow milk prod.(L/d)	1.84±0.21	1.86±0.19	2.19±0.25	2.18±0.23	0.10	0.54
Hybridcow milk prod (L/d)	8.37±1.10	0.0±0.0	0.0±0.0	8.42±1.18	2.42	0.02
Lactation length(days) Native cow	183.13b±8.24	184.30b±7.37	240.0a±9.52	160.0b±8.81	16.99	<0.0001
Lactation length(days) Hybrid cow	172.5a±3.75	172.0a±3.36	150b±4.34	177.14a±4.01	6.08	0.06

Table 38: Available feed ingredients in Sunamgonj, Patuakhali and Sathkhira districts during summer, rainy and winter season (2019 and 2020)

Sl. No.	Sunamjonj		Patuakhali		Sathkhira	
	Summer and rainy	**Winter**	**Summer and rainy**	**Winter**	**Summer and rainy**	**Winter**
1	Local grass *Cynodon dactylon*	Local grass *Cynodon dactylon*	Heli grass *Dactylotenium aygyptium*	Mangrove leaf/Saila pata *Rhizophora mangle*	Dumur leaf *Ficus hispida*	Napier pakchong *Pennisetum purpureum*
2	Sugarcane leaf *Saccharum officinarum*	Kalai/ mashkali *Vigna mungo*	Straw Irri dhan *Oryza sativa*	Kerikdom/ Ipilipil *Leucaena leucocephala*	Rice polish *Oryza sativa*	Napier grass *Pennisetum purpureum*
3	Cassava leaf *Manihot esculenta*	Mula leaf *Raphanus sativus*	Rana Grass *Cyperus esculentus*	Straw Kalijira *Nigella sativa*	Maize/Vutta grain *Zea mays*	German grass *Echinochloa polystachya*
4	Moringa /Shojna leaf *Moringa oleifera*	Bean /Sheem *Phaseolus vulgaris*	Kolmi herb *Ipomoea aquatica*	Durba Grass *Cynodon dactylon*	Wheat barn *Triticum spp*	Water hyacinth/ Kochuripana *Eichhornia crassipes*
5	Dumur/Fig leaf *Ficus hispida*	Straw Amondhan *Oryza sativa*	Water hyacinth/ Kochuripana *Eichhornia crassipes*	Ancor/Motor herb *Cicer arietinum*	Shish flower grass *Calotropis gigantea*	Longbejo/Shama grass
6	Rifuji/mechania *Mikania cordata*	Potato leaf *Solanum tuberosum*	Rice polish Irridhan *Oryza sativa*	Maize leaf *Zea mays*	Buno grass *Cynodon dactylon*	Wheat *Triticum spp*
7	Foni/water hyacinth *Eichhornia crassipes*	Wheat straw *Triticum spp.*	Rifuji/mechania loth *Mikania cordata*	Sweet potato leaf *Ipomoea batatas*	Water hyacinth/ Kochuripana *Eichhornia crassipes*	Rice polish *Oryza sativa*
8	Rice polish *Oryza sativa*	Ghilatashak	Banana/Kola Pata leaf *Musa acuminata*	Durba grass *Cynodon dactylon*	Heli grass *Dactylotenium aygyptium*	Wheat barn *Triticum spp*
9	Haicha/Helmoti *Alternanthera sessilis*	Peanut leaf *Arachis hypogaea*	Neem leaf *Azadirachta indica*	Bean leaf *Phaseolus vulgaris*	German grass *Echinochloa polystachya*	Durba grass *Cynodon dactylon*
10	Lemonder *Cymbopogon citratus*	Orhor leaf *Cajanus cajan*	Dal grass *Hymenache amplexicaulis*	Mongu pod cover *Vigna mungo*	Ada baradi grass *Digitania sanguinalis*	Rice straw/ Bichali *Oryza sativa*
11	Dhoincha leaf *Sesbania bispinosa*	Kanai grass	Cheucha grass *Cyperus rotundus*	Long durba *Cynodon dactylon*	Chaucha grass *Cyperus rotundus*	Durba grass *Cynodon dactylon*
12	Ipilipil *Leucaena leucocephala*	Chalbon	Tilkhoil/Sesame oil cake *Sesamum indicum*	Rice stover *Oryza sativa*	Napier grass *Pennisetum purpureum*	Mustard oil cake *Brassica juncea*
13	Carpet grass *Axonopus fissifolius*	Hizol leaf	Rice polish (Auto) *Oryza sativa*	Rana grass *Cyperus esculentus*	Heska grass *Elymus repens*	Rice polish *Oryza sativa*

Sl. No.	Sunamjonj		Patuakhali		Sathkhira	
	Summer and rainy	**Winter**	**Summer and rainy**	**Winter**	**Summer and rainy**	**Winter**
14	Star grass *Cynodon plectostachyus*	Dauki grass	Mustard/ Shorisha khoil *Brassica juncea*		Napier grass *Pennisetum purpureum*	Rice *Oryza sativa*
15	Shewra leaf *Trophis asper*	Durba grass *Cynodon dactylon*	Straw Paijom *Oryza sativa*		Durba *Cynodon dactylon*	
16	Koromcha leaf *Carissa carandas*	Mashkali /Mongo leaf *Vigna mungo*	Gerrman grass *Echinochloa polystachya*		Rice straw/ Bichali *Oryza sativa*	
17	Hijol leaf *Barringtonia acutangula*	Mustard plant *Brassica juncea*	Cowpea fodder *Vigna unguiculata*		Matipura grass	
18	Wheat bran (Crushed) *Triticum spp.*	Maize fodder *Zea mays*	Chaucha grass *Cyperus rotundus*		Jibli grass	
19	Wheat bran *Triticum spp.*	Cabbage *Brassica oleracea*	Bamboo leaf *Bambusa vulgaris*		Bamboo leaf *Bambusa vulgaris*	
20	Conc. Feed (ACI)	Rice straw *Oryza sativa*	Binna/Sonn		Dumur leaf *Ficus hispida*	
21	Binna sonn *Saccarum spontanium*		Paddy field grass/Arail *Leersia hexandra*		Durba grass *Cynodon dactylon*	
22	Rice straw *Oryza sativa*		Green rice /Paddy fodder *Oryza sativa*		Shapla *Nymphaea pubescens*	
23	Paddy fodder (IRRI) *Oryza sativa*		Haicha *Alternanthera sessilis*		Khor/Straw *Oryza sativa*	
24	Bamboo leaf *Bambusa vulgaris*		Local Kolmi *Ipomoea aquatica*		Hegla grass *Typha domingensis*	
25	Banana leaf *Musa acuminata*		Helencha *Enhydra fluctuans*		Mustard oil cake *Brassica juncea*	
26	Mustard oil cake *Brassica juncea*		Mangrove leaf *Rhizophora mangle*		Rice polish *Oryza sativa*	
27	Til oil cake *Sesamum indicum*		Durba grass *Cynodon dactylon*		Rice *Oryza sativa*	
28	Ground nut cake *Arachis hypogaea*		Cassava *Manihot esculenta*		Broken rice *Oryza sativa*	
29	Coconut oil cake *Cocos nucifera*		Golpata *Nypa fruticans*			
30	Sunflower cake *Helianthus annus*		Grass *Cynodon dactylon*			

Table 38 represents the available feed stuffs usually used for feeding the livestock during summer and winter seasons in Sunamgonj, Patuakhali and Sathkira districts of Bangladesh. Most of the concentrates like broken rice, crushed maize, rice polish, wheat bran, mustard oil cake, til oil cake were available throughout all the seasons.Similarly, some crop residues viz. rice straw, wheat straw, maize stover and some legume and non-legume hulms were very

common. There was abundance of some common tree fodders that could be considered for ration formulation to recover the nutrients deficiency of animal. Moreover, some specific fodder/forages/foliage could be considered for ration formulation on regional basis for livestock feeding. Namely, for coastal livestock feeding *heli*, (*Dactylotenium aygyptium*), *dal* (*Hymenache amplexicaulis*) and rana grass (*Cyperus esculentus*) including mangrove foliage, *heicha* (*Alternanthera sessilis*), *kolmi* (*Ipomoea aquatica*) and *helencha* (*Enhydra fluctuans*) herbs could be considered that are also nutrient rich.

Table 39a: Nutritional composition of feed available in Sunamgonj during summer/rainy and winter season (2019 and 2020)

Sl.	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE%	ADF%	NDF %	ME (MJ/ kg DM)	Ca %	P %
Roughages (Grass and straw)													
1	Durba grass *Cynodondactylon*	W	13.2	12.56	34.64	2.23	13.75	36.82	34	58.21	6.80	1.130	0.228
2	Local grass (Adv. Stg.) *Cynodon dactylon*	S & R	19.12	10.55	34.23	1.58	13.35	40.29	33.21	68.25	6.02	0.350	0.342
3	Maize fodder *Zea mays*	W	13.51	8.66	28.51	1.72	12.5	48.61	26.54	60.15	8.02	0.280	0.035
4	Lemonder grass *Cymbopogon citratus*	S & R	14.12	9.34	26.71	2.45	15.5	46	34.33	57.25	6.05	0.500	0.254
5	Carpet grass *Axonopusfissifolius*	S & R	13.62	14.88	23.67	4.55	15.05	41.85	25.09	40.33	6.54	0.870	0.321
6	Star grass *Cynodonplectostachyus*	S & R	13.18	12.31	21.87	5.55	12.21	48.06	32.07	56.72	8.05	1.840	0.132
7	Kanai grass	W	9.12	20.56	24.81	4.89	16.37	33.37	20.67	36	5.75	-	-
8	Chalbon grass	W	16.55	15.75	31.12	2.7	12.5	37.93	28	46.24	5.54	-	-
9	Dauki grass	W	15	15.81	31.12	2.36	10.53	40.18	21.34	40.13	6.75	-	-
10	Binna sonn (Adv. Stg.) *Saccarum spontanium*	S & R	19.13	6.35	54.25	0.42	10.37	28.61	36.23	68.32	6.75	0.529	0.237
11	Haicha/Helmoti herb *Alternantherasessilis*	S & R	12.25	16.27	23.51	2.23	11.61	46.38	14.23	50.55	8.74	0.981	0.232
12	Ghilatashak	W	10.55	16.63	19.08	3.08	12.21	49	29.74	50.13	6.83	0.170	0.252
13	Straw Amon *Oryza sativa*	S	88.23	3.16	49.11	1.53	15.45	30.75	37.77	68.29	6.70	0.520	0.143
14	Straw Amon *Oryza sativa*	W	95.15	4.63	39.78	1.88	14.29	39.42	36.77	68.29	6.00	0.143	0.120
15	Rice straw *Oryza sativa*	R	90.3	3.64	45.21	1.07	16.78	33.3	32.71	64.21	5.80	0.520	0.143
16	Padddy fodder vegetative stg. *Oryza sativa*	S & R, W	13.54	12.99	25.25	1.32	11.35	49.09	24.12	62.19	7.50	-	-
17	Wheat straw *Triticum spp.*	W	94.39	5.38	38.85	3.33	14.85	37.59	40.21	68.33	7.47	0.750	0.332
18	Mustard plant straw (Adv. Stg.) *Brassica juncea*	W	19.24	11.26	45.22	1.85	11.27	30.4	42.34	56.21	7.35	-	-

Table 39b: Nutritional composition of feed available in Sunamgonj during summer/rainy and winter season (2019 and 2020)

Sl.	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE%	ADF%	NDF %	ME (MJ/ kg DM)	Ca %	P %
Roughage (Tree fodder)													
1	Sugarcane leaf (Adv. Stg.) *Saccharu mofficinarum*	S & R	27.20	6.33	33.5	1.5	13.15	45.52	42.23	71.12	5.50	0.400	0.267
2	Cassava leaf (Adv. Stg.) *Manihotesculenta*	S & R	10.35	15.53	23.5	2.11	12	46.86	13.38	26.00	7.29	1.230	0.608
3	Moringa /Shojna leaf (Adv. Stg.) *Moringaoleifera*	S	9.50	18.23	19.53	2.31	10	49.93	21.45	42.01	7.70	1.320	0.402
4	Moringa/Sojna Leaf with stalk (vege. Stg.) *Moringa oleifera*	R	12.35	19.25	29.25	3.67	11.3	36.53	21.45	42.01	7.71	1.160	0.255
5	Dhoincha Leaf with stalk (Adv. Stg.) *Sesbania aculeate/rostrata*	S & R	12.15	20.13	22.44	4.33	14.21	38.89	22.45	43.01	9.19	1.170	0.208
6	Ipilipil leaf with stalk (Adv. Stg.) *Leucaenaleucocephala*	S & R	12.16	23.19	28.47	9.05	7.98	31.31	30.98	52.32	7.69	0.570	0.318
7	Orhor leaf with stalk (Adv. Stg.) *Cajanus cajan*	W	13.88	17.94	24.5	2.62	9.42	45.52	31.34	50.14	6.92	0.910	1.074
8	Shewra leaf with soft stalk (Adv. Stg.) *Trophisasper*	S	14.12	14.25	28.64	1.53	16.64	38.94	34.44	60.19	5.19	1.210	0.796
9	Shawra leaf with stalk (Adv. Stg.) *Trophisasper*	R	16.31	11.09	35.14	1.48	17.86	34.43	18.31	38.12	5.5	1.210	0.796
10	Koromcha leaf with stalk (Adv. Stg.) *Carissa carandas*	S & R	15.71	15.63	27.31	5.21	10.45	41.4	34.05	56.22	5.55	-	-
11	Peanut leaf (Adv. Stg.) *Arachishypogaea*	W	11.25	16.21	28.51	2.21	5.5	47.57	22.46	33.53	7.55	1.310	0.174
12	Peanut leaf with stalk (Adv. Stg.) *Arachishy pogaea*	S	12.16	14.44	25.19	2.25	8.51	49.61	24.00	31.13	7.00	0.310	0.174
13	Dumur/ Fig (Adv. Stg.) *Ficushispida*	S & R	11.13	14.5	27.55	2.53	15	40.42	13.45	36.23	5.89	1.830	0.290
14	Hijol leaf with stalk (Adv. Stg.) *Barringtoniaacutangula*	S & R	13.79	18.38	35	2.95	7.28	36.39	31.45	50.66	5.88	-	-
15	Bamboo leaf with stalk (Adv. Stg.) *Bambusa vulgaris*	S & R, W	21.03	9.22	51.13	1.75	13.83	24.07	34.23	66.11	4.88	0.572	0.155

Table 39c: Nutritional composition of feed available in Sunamgonj during summer/rainy and winter season (2019 and 2020)

Sl.	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE%	ADF%	NDF %	ME (MJ/ kg DM)	Ca %	P %
Halm/ Herbs/Forages													
1	Mekania/refugi leaf with stem (Adv. Stg.) *Mikania cordata*	S	9.5	21.88	23.26	3.36	15.64	35.86	38.94	67.22	6.55	0.770	0.467
2	Rifuji/mechania leaf with stem *Mikaniacordata*	R	12.11	13.55	23.75	1.52	15.32	45.86	28.94	47.22	5.98	0.770	0.467
3	Potato leaf with stem (Adv. Stg.) *Solanumtuberosum*	W	17.11	15.14	14.13	1.78	14.12	54.83	20.34	40.55	5.67	0.550	0.208
4	Potato leaf with stem vegetative stg. *Solanumtuberosum*	W	16.84	12.06	24.25	1.53	13.75	48.41	24.12	40.42	6.75	0.550	0.208
5	Cabage leaf Ad. stg. *Brassica oleracea*	W	11.58	12.45	26.12	1.52	15.38	44.53	20.12	28.42	7.00	-	-
6	Water hyacinth leaf with pseudo stem *Eichhorniacrassipes*	S & R, W	8.17	8.33	23.15	2.31	13.57	52.64	19.02	46.45	5.56	0.006	0.041
7	Radish/Mula leaf (Adv. Stg.) *Raphanussativus*	W	10.55	13.13	18	2.51	12.39	53.97	33.24	55.56	6.50	-	-
8	Bean /Sheem leaf with stem *Phaseolus vulgaris*	W	22.33	15.61	27.15	2.42	12.55	42.27	22.34	40.55	8.00	1.090	0.289
9	Bean leaf with soft stem *Phaseolus vulgaris*	W	24.07	17.42	25.13	1.53	10.68	45.24	22.14	40.34	8.01	1.090	0.289
10	Banana leaf with rib *Musa acuminata*	S & R, W	14.42	8.66	36	4.11	10.83	40.4	42.14	58.21	6.94	-	-
11	Mashkali /Mungo leaf with rib (Adv. Stg.) *Vigna mungo*	W	11	20.13	31	1.87	16.67	30.33	22	42	7.68	1.190	0.295
12	Jioifol leaf	W	12.8	6.56	26.12	2.02	12.07	53.23	24.56	44	5.63	-	-

Table 39d: Nutritional composition of feed available in Sunamgonj during summer/rainy and winter season (2019 and 2020)

Sl.	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE%	ADF%	NDF %	ME (MJ/ kg DM)	Ca %	P %
Concentrate													
1	Rice polish *Oryza sativa*	S	90.12	12.13	16.45	6.45	9.31	55.66	24.28	54.23	7.93	0.660	1.315
2	Rice Polish *Oryza sativa*	W	86	14.33	12.23	6.81	13.57	53.06	24.23	34.31	7.72	0.660	1.315
3	Black gram/ Mashkali bran *Vignamungo*	W	14.12	18.23	33.45	2.41	14	31.91	21.25	45.14	7.68	1.190	0.295
4	Wheat bran coarse *Triticum spp.*	S	96	13.125	8.38	5.61	10.5	62.385	13.01	40.66	8.80	0.173	0.511
5	Wheat bran coarse *Triticum spp.*	W	90.47	14.15	11.12	3.52	10.69	60.52	13.21	38.17	9.51	0.173	0.511
6	Wheat bran fine *Triticum spp.*	W	96	14.875	7.8	6.21	11.12	59.995	14.92	36.56	9.00	0.172	0.512
7	Mustard oil cake *Brassica juncea*	S & R, W	84.84	28.44	8.27	7.5	11.72	44.07	24.13	35.23	8.90	0.695	0.705
8	Til oil cake *Sesamumindicum*	S & R, W	88.29	26.69	9.5	6.84	11.93	45.04	25.51	37.12	9.02	0.100	0.714
9	Ground nut cake *Arachishypogaea*	S & R, W	85.6	28.88	7.12	7.15	11.79	45.06	20.25	34.55	8.72	1.310	0.174
10	Coconut oil cake *Cocosnucifera*	S & R, W	86.08	23.63	18.13	6.29	7.87	44.08	27.25	37.65	10.10	0.044	1.22
11	Sunflower cake *Helianthus annus*	S & R, W	90.05	25.81	8.72	8.06	11.92	45.49	23.50	35.75	8.70	-	-

Table 40a: Nutritional composition of feed available in Patuakhali during summer/rainy and winter season (2019 and 2020)

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
Roughages													
1	Dal Grass Ad. Stg. *Hymenacheamplexicaulis*	W	18.21	8.99	29.12	2.25	14.12	45.52	33.72	58.61	7.25	0.170	0.225
2	Dal grass Ad. Stg. *Hymenacheamplexicaulis*	S	20.41	10.06	34.15	2.37	14.69	38.73	29.41	50.72	8.02	0.170	0.225
3	Dal grass *Hymenacheamplexicaulis*	R	18.21	11.55	31.61	2.69	19.39	34.76	29.41	50.72	8.02	0.170	0.225
4	German grass Ad. Stg. *Echinochloapolystachya*	R	10.5	7.44	29.25	2.84	10.21	50.26	26.25	46.00	7.42	0.317	0.124
5	German grass *Echinochloapolystachya*	S	18.43	9.63	32.41	2.92	7.48	47.56	35.25	60.01	6.84	0.330	0.198
6	Maize leaf Vegetative stage *Zea mays*	W	10.5	7.44	29.25	2.84	10.21	50.26	34.09	58.02	9.28	0.280	0.250
7	Heli Grass Advanced stg. *Dactyloteniumaygyptium*	R	13.13	7.98	29.17	2.15	11.23	49.47	44.00	66.00	5.74	0.260	0.264
8	Heli grass Ad. Stg. *Dactyloteniumaygyptium*	S	16.46	10.94	35.14	1.85	12.27	39.8	26.46	46.00	5.74	0.260	0.264

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
9	Heli grass Ad. Stg. *Dactyloteniumaygyptium*	w	21.73	14.15	24.47	1.59	9.09	50.7	35.55	67.56	7.89	0.536	0.522
10	Durba grass Ad. Stg. *Cynodondactylon*	S	15.74	13.13	35.31	2.16	8.17	41.23	32.74	52.00	6.80	1.130	0.227
11	Durba Grass Ad. Stg. *Cynodondactylon*	S & R	20.71	13.13	31.23	2.22	9.98	43.44	20.71	50.88	6.05	6.81	1.133
12	Long Durba Ad. Stg. *Cynodondactylon*	W	16.25	11.38	35.61	2.67	17.09	33.25	35.55	60.07	8.53	1.130	0.228
13	Short Durba Ad. Stg. *Cynodondactylon*	W	10.64	17.33	16.69	3.59	12.51	49.88	34.35	61.32	7.68	1.130	0.228
14	Durba Grass veg. Stg. *Cynodondactylon*	W	15.22	11.91	19.97	2.31	13.51	52.32	32.35	52.25	6.80	1.130	0.228
15	Rana grass Ad. Stg. *Cyperusesculentus*	W	20.26	13.56	33.13	2.51	10.59	40.21	20.26	43.16	8.42	0.812	0.214

Table 40b: Nutritional composition of feed available in Patuakhali during summer/rainy and winter season (2019 and 2020)

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
Roughages													
16	Rana Grass Advanced stg *Cyperusesculentus*	R	8.2	8.12	25.14	1.24	10.23	55.27	43.16	72.24	6.46	0.810	0.214
17	Rana grass *Cyperusesculentus*	S	19.83	13.57	34.41	5.5	12.5	34.02	34.55	64.56	8.42	0.810	0.214
18	Chaucha Grass Ad. Stg. *Cyperusrotundus*	S	23.02	11.57	32.16	1.96	9.41	44.9	40.48	57.55	7.37	0.320	0.264
1	Chaucha grass Ad. Stg. *Cyperusrotundus*	R	26.61	14.44	37.41	2.51	12.62	33.02	38.56	65.24	7.37	0.320	0.264
2	Chaucha grass Ad. Stg. *Cyperusrotundus*	W	21.94	16.63	33.08	2.62	13.97	33.7	28.94	40.48	5.00	0.320	0.264
3	Paddy field grass Ad. Stg.	W	11.22	7.22	24.2	2.67	15.52	50.39	33.03	48.35	9.00	-	-
4	Water hyacinth vegetative stg. *Eichhorniacrassipes*	W	7.24	9.23	18.56	2.96	13.25	56	18.12	40.25	4.50	0.408	0.071
5	Water hyacinth Ad. Stg. *Eichhorniacrassipes*	S & R	10.69	5.81	22.12	1.81	16.14	54.12	12.69	28.00	5.22	0.831	0.281
6	Binna/Sonn *Saccarumspontanium*	S & R	20.54	15.71	34.39	5.61	15.66	28.63	37.02	62.34	6.37	-	-
7	Green rice plant	S & R, W	21.16	11.41	34.35	3.43	15.19	35.62	28.51	61.51	8.02	0.080	0.339
8	Straw IRRI *Oryza sativa*	S & R	89	4.12	37.23	1.22	11.45	45.98	34.12	69.23	5.66	0.180	0.169

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
9	Straw Kalijira *Nigella sativa*	W	91.12	4.16	33.57	1.14	10.97	50.16	35.00	68.25	7.72	0.150	0.114
10	Straw Paijom *Oryza sativa*	S & R	90.36	3.94	38.08	3.29	12.78	41.91	35.21	63.33	5.65	0.430	0.104
11	Rice straw *Oryza sativa*	W	86.46	4.38	41.37	2.62	13.42	38.21	39.46	74.00	5.67	0.521	0.143
12	Rice straw *Oryza sativa*	S	86.23	5.25	43.18	2.03	11.47	38.07	46.23	72.50	6.50	0.521	0.143
13	Rice Stover *Oryza sativa*	W	66.67	3.56	46.24	1.59	18.29	30.32	46.67	66.00	5.00	0.521	0.143

Table 40c: Nutritional composition of feed available in Patuakhali during summer/rainy and winter season (2019 and 2020)

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
Tree fodder													
1	Mangrove/Saila leaf *Rhizophora mangle*	W	18.12	9.71	19.23	2.73	7.55	60.78	22.00	38.00	7.34	1.070	0.474
2	Mangrove leaf with soft stem *Rhizophora mangle*	S	20.31	11.84	31.56	4.11	7.26	45.23	23.34	42.14	6.96	1.070	0.474
3	Mangrove leaf with stem *Rhizophora mangle*	W	17.46	14.31	26.31	3.37	10.67	45.34	17.46	32.00	6.96	1.070	0.474
4	Mangrove/Chaila leaf Ad. Stg. *Rhizophora mangle*	R	15.32	11.38	28.34	2.98	13.18	44.12	21.6	38.57	7.34	1.070	0.474
5	Banana leaf *Musa acuminata*	S	19.15	11.64	29.33	1.77	12.22	45.04	34.12	54.32	6.94	-	-
6	Banana leaf with rib *Musa acuminata*	R	18.23	9.5	27.51	3.72	16.09	43.18	34.34	54.32	6.94	-	-
7	Banana leaf *Musa acuminata*	W	11.76	13.13	26.91	3.81	17.28	38.87	31.76	43.98	6.94	-	-
8	Ipilipil /Kerikdom with soft stem *Leucaenaleucocephala*	W	15.11	17.98	25.55	3.81	9.55	43.11	22.21	53.0	7.65	0.320	0.131
9	Neem leaf with rib Ad. stg *Azadirachtaindica*	R	13.12	13.89	26.98	2.16	10.77	46.2	29.11	50.44	6.53	0.220	0.266
10	Neem leaf with rib ans soft stem *Azadirachtaindica*	S	17.31	17.33	23.14	3.45	10.64	45.44	29.11	50.44	8.90	0.220	0.266

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
11	Golpata Ad. Stg. *Nypafruticans*	S & R,W	37.74	12.25	48.19	2.19	9.76	27.61	37.74	44.48	5.00	-	-
12	Bamboo leaf *Bambusa vulgaris*	S & R, W	29.51	6.64	51.15	1.55	14.17	26.49	39.09	66.45	5.84	0.572	0.155
13	Cassava leaf With soft stem *Manihotesculenta*	S & R	13.38	17.88	23.36	1.91	12.37	44.48	13.38	26.00	7.29	1.230	0.608

Table 40d: Nutritional composition of feed available in Patuakhali during summer/rainy and winter season (2019 and 2020)

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ /kg DM)	Ca %	P %
Halm/ Herbs/Forages													
1	Kolmi herb vegitative stg *Ipomoea aquatica*	S & R	14.12	15.76	19.92	1.93	12.13	50.26	31.32	46.23	7.00	1.360	0.155
2	Rifuji/mechania loth with stem	S & R	10.51	14.16	21.67	1.14	17.21	45.82	26.51	42.23	7.50	1.280	0.430
3	Rifuji/mechania leaf *Mikaniacordata*	S & R	11.79	13.56	23.13	2.45	13.91	46.95	22.09	45.71	7.52	1.280	0.430
4	Sweet potato leaf with stem *Ipomoea batatas*	W	15.2	11.88	22.57	1.69	11.96	51.9	28.04	48.24	7.03	0.910	0.443
5	Bean leaf with stem Ad. Stg. *Phaseolus vulgaris*	W	19.31	15.75	28.26	2.5	11.98	41.51	32.09	54.11	8.00	1.840	0.362
6	Cowpea fodder with stem *Vignaunguiculata*	S & R	20.85	9.24	31.79	2.5	11.36	45.11	35.66	51.71	6.59	1.610	0.415
7	Haicha with stem *Alternantheraessilis*	S & R	13.8	17.04	25.12	3.11	13.42	41.31	14.23	51.55	8.74	0.980	0.309
8	Local Kalmi with stem *Ipomoea aquatica*	S & R	17.25	14.44	28.13	4.01	10.94	42.48	24.25	57.55	7.92	1.360	0.155
9	Refugi/Mechnia loth with stem *Mikaniacordata*	S & R	23.92	14.44	27.31	3.41	5.65	49.19	26.45	42.36	9.55	1.280	0.430
10	Mekania/refuge with stem *Mikaniacordata*	S & R	10.65	15.94	24.12	1.51	11.98	46.45	20.65	41.82	9.54	1.280	0.430
11	Helencha with stem Ad. Stg. *Enhydrafluctuans*	S & R	86.39	9.53	28.31	2.12	5.51	54.53	26.79	46.72	6.83	0.981	0.309

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ /kg DM)	Ca %	P %
12	Anchor/Motor herb *Cicerarietinum*	W	88.89	9.75	25.13	2.93	9.82	52.37	34.02	66.45	8.87	0.091	0.410
13	Concentrate												
14	Rice polish with bran *Oryza sativa*	S	92.51	9.98	26.56	4.35	14.23	44.88	11.23	25.56	6.67	0.680	1.315
15	Rice polish (Auto) *Oryza sativa*	W	92.64	12.63	8.14	8.39	13.61	57.23	14.67	26.16	7.72	0.680	1.315
16	Rice Polish with husk *Oryza sativa*	S & R,W	89.77	7.56	46.26	5.38	17.77	23.03	33.77	50.00	6.67	0.091	0.339
17	Rice bran *Oryza sativa*	S & R	92.99	6.13	42.12	8.01	16.58	27.16	36.78	64.04	6.72	0.680	1.315
18	Mongu hull *Vignamungo*	W	20.47	12.13	19.91	4.12	8.97	54.87	31.45	55.64	7.79	1.230	0.062
19	Mustard oil cake *Brassica juncea*	S & R, W	90.08	28.5	8.41	12.52	8.72	41.85	12.45	26.89	7.59	0.110	0.397
20	Til oil cake *Sesamumindicum*	S & R, W	91.18	23.63	13.7	13.98	10.88	37.81	30.14	50.66	9.34	0.100	0.714

Table 41a. Nutritional composition of Sathkhira district during summer/rainy and winter season (2019 and 2020)

Sl	Feed/grass	season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
Roughages													
1	German grass Ad. Stg. *Echinochloapolystachya*	S & R,W	19.43	12.25	29.68	2.54	15.13	40.4	34.67	55.12	7.42	0.317	0.156
2	Durba grass Vegetative Stg. *Cynodondactylon*	S & R	23.25	17.5	26.34	4.21	19.07	32.88	42.78	68.01	6.64	0.779	0.231
3	Durba grass Ad. Stg. *Cynodondactylon*	W	27.73	7.88	31.17	1.36	11.56	48.03	36.11	62.31	6.22	0.731	0.196
4	Durba grass Ad. Stg. *Cynodondactylon*	S & R	21.52	11.2	30.08	3.54	16.33	38.85	34.35	69.31	5.93	0.529	0.237
5	Heska grass Ad. Stg.	S & R	14.24	10.85	29.28	2.91	16.12	40.84	15.09	38.12	4.81	0.511	0.183
6	Napier pakchong *Pennisetumpurpureum*	S & R,W	18.23	12.25	31.26	4.02	13.15	39.32	35.67	58.57	5.43	0.778	0.078
7	Nepiar grass *Pennisetumpurpureum*	S & R,W	18.54	11.03	30.44	2.88	12.23	43.42	36.67	57.41	4.73	0.608	0.349
8	Lobonbejo grass Ad. Stg.	W	17.25	10.5	40.74	12.06	16.24	20.46	32.14	54.44	4.49	0.366	0.415
9	Ada baradi grass Ad. Stg.	S & R	17.23	10.5	12.84	2.4	14.03	60.23	35.67	56.12	6.73	0.505	0.349
10	Chaucha Grass Ad. Stg. *Cyperusrotundus*	S & R	23.04	19.43	26.58	9.61	11.23	33.15	35.66	58.45	5.00	0.395	0.232

Sl	Feed/grass	season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
11	Hegla grass Ad. Stg.	S & R	7.72	17.5	16.84	2.32	9.02	54.32	28.88	41.1	5.85	0.981	0.232
12	Hela grass Ad. Stg. *Dactyloteniumaygyptium*	S & R	13.05	21.88	14.24	2.54	14.13	47.21	25.09	38.12	4.80	0.536	0.522
13	Jibli grass Ad. Stg.	S & R	17.25	13.13	21.22	6.25	15.66	43.74	38.67	60.11	4.88	1.232	0.161
14	Shish flower grass vegetative stg. *Calotropisgigantea*	S & R	18.06	17.33	27.58	8.22	14.05	32.82	36.67	58.98	4.84	0.680	0.364
15	Matipura grass Ad. Stg.	S & R	19.16	9.98	27.42	9.66	18.13	34.81	20.45	43.12	5.54	0.775	0.232
Sl	**Feed/grass**	**season**	**DM %**	**CP %**	**CF %**	**EE %**	**Ash %**	**NFE %**	**ADF %**	**NDF %**	**ME (MJ/kg DM)**	**Ca %**	**P %**
16	Water hyacinth Ad. Stg. *Eichhorniacrassipes*	S & R,W	9.1	1.44	17.56	5.46	11.13	64.41	13.45	27.00	5.22	0.200	0.099
17	Rice straw/ Bichali *Oryzasativa*	W	88.12	6.65	44.46	2.64	19.12	27.13	42.25	56.23	5.22	0.624	0.144
18	Rice straw/Khor *Oryza sativa*	S & R	18.07	5.75	36.69	1.95	16.34	39.27	35.88	59.1	6.60	0.485	0.284

Table 41b. Nutritional composition of Sathkhira district during summer/rainy and winter season (2019 and 2020)

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
	Tree fodder												
1	Fig/Dumur leaf with soft stem *Ficushispida*	S	13.14	20.21	23.92	8.26	16.55	31.06	13.45	36.23	5.85	2.139	0.299
21	Dumur/Fig leaf with soft stem *Ficushispida*	R	19.14	19.08	23.68	6.88	12.02	38.34	22.09	36.23	5.64	0.281	0.294
20	Bamboo leaf Ad. Stg. *Bambusa vulgaris*	S & R	27.5	13.56	51.01	4.81	9.66	20.96	40.61	67.03	6.96	0.572	0.155
	Halm/ Herbs/Forages												
1	Water lilli leaf Ad. Stg. *Nymphaeapubescens*	S & R	14.12	8.49	28.59	3.17	11.98	47.77	32.13	46.25	5.96	0.263	0.082
	Concentrate												
1	Mustard oilcake *Brassica juncea*	S & R, W	88.75	31.06	13.26	12.16	12.06	31.46	19.54	26.13	8.90	0.695	0.705
2	Rice polish *Oryza sativa*	S & R,W	87.75	11.55	9.94	3.28	14.33	60.9	11.13	25.56	6.67	0.273	0.683
3	Rice polish with bran *Oryza sativa*	S & R,W	91.47	4.38	36.4	4.08	17.82	37.32	20.09	28.9	7.72	0.312	0.123
4	Rice grain *Oryza sativa*	S & R,W	87.42	7.79	2.43	4.27	7.62	77.89	2.95	7.77	10.12	0.138	0.106

Sl	Feed/Grass	Season	DM %	CP %	CF %	EE %	Ash %	NFE %	ADF %	NDF %	ME (MJ/kg DM)	Ca %	P %
5	Wheat grain *Triticum spp.*	W	87.59	8.31	5.44	5.05	9.44	71.76	7.14	20.12	10.51	0.185	0.288
6	Broken Rice *Oryza sativa*	S & R,W	97.73	7.7	2.45	3.92	6.08	79.85	2.15	22.23	10.02	0.156	0.126
7	Maize/Vutta grain *Zea mays*	S & R	87.41	11.55	4.58	4.12	11.88	67.87	8.67	25.66	9.55	0.132	0.298
8	Wheat barn *Triticum spp.*	S & R, W	88.78	16.75	8.38	4.61	11.69	58.57	11.09	28.12	9.05	0.173	0.511

Table 39 shows the chemical composition of feed available in Sunamgonj during summer/rainy and winter seasons covering the year 2019 and 2020. Nutritionally, concentrates were found to contain high ME and CP (7-10 MJ/kg DM and 12-29 % respectively). Among the roughages, most of the tree fodder or foliages contained 7-8 MJ ME and 9-23% CP depending on the nature of foliages (non-legume or legume) and the stage of their maturity. Most of the legume foliages contained almost 2 folds CP than that of non-legume foliages. However some aquatic herbs always contained high nutrient values compared to bushes or grasses. Natural grasses possessed moderate amount of ME and CP while cultivated fodder and tree fodder contained high ME and CP as well as low ADF.

Table 40 shows the feeds and fodder samples collected from Patuakhali district during summer/rainy and winter seasons with their chemical composition. Among the 63 samples collected, only few were concentrate samples used by the farmers for feeding their livestock. Rice polish (RP) was found very common concentrate feed ingredients used by the farmers. It was also available in every farmer's house. The quality of RP was found to be moderate in respect of ME and CP content (6.67MJ – 7.5MJ and 6- 9g/100g respectively). Among the protein rich concentrate feeds Mustarded oil cake found to contain higher amount of CP (38.50%) compared to *til* (*Sesamum indicum*) oil cake (23.63%). In case of forages, mangrove leaf in the coastal belt was found to be nutritionally like the other tree fodder in Bangladesh. It contained 9-14% CP and around 7.5 MJ ME/kg DM. Mangrove leaf was found to contain low ADF (32%) and high NFE (75-62%). It seems to be a good source of feed for small ruminant in the saline prone areas. Legume forages were found to contain 16-19% CP along with some nonleagumes, especially aquatic herbs (*haicha*/*Alternanthera sessilis*, *helencha*/*Enhydra fluctuans* and *kolmi*/*Ipomoea aquatica*) were found to contain the same amount of CP (16-17%) and could be considered as food assets to feed the animals.

Table 41 shows the feed composition of Satkhira district (Samnagor) collected during summer/rainy and winter season covering the years 2019 and 2020. Out of the 30 collected feed samples most were roughages (75%). Out of the concentrate feed samples, rice polish and wheat bran have been found to be very frequently used by the farmers. Wheat and maize were found to contain high amount of ME (MJ/kg DM), 10.51 and 9.55 respectively. Rice also possessed more ME (10.12 MJ/kg DM) than that of maize. Mustard oil cake contained high CP (31%) followed by wheat bran (16.75%), maize (11.55%), rice polish (11.55%), wheat (8.31%) and rice (7.7%). Among the roughages only 6.7% were found as tree fodder. Very common was found to be *dumur* (*Ficus hispida*) and bamboo (*Bambusa vulgaris*) leaf that contained 20.21% and 13.56% CP respectively. The tabulated result exhibits that all the roughages contained 5-7 ME (MJ/kg DM) and concentrates contained 7-11 MJ (ME/kg DM). Seasonal variation on nutrient composition of feed was not observed at all.

Table 42: Minerals content (%) of feed samples collected from Sunamgonj during winter and summer

Serial No	Feed/fedder	Season	Minerals (%)					
			K	Ca	P	Mg	Zn	Fe
1	local grass *Cynodondactylon*	Winter / Dry	3.400	0.350	0.342	0.250	0.005	0.287
2	Sugarcane leaf *Saccharumofficinarum*	Winter / Dry	2.400	0.400	0.267	0.180	0.003	0.167
3	Cassava leaf *Manihotesculenta*	Winter / Dry	1.700	1.230	0.608	0.560	0.002	0.080
4	Shojna/moringa leaf *Morinaoleifera*	Winter / Dry	3.100	1.320	0.402	0.190	0.005	0.112
5	Peanut leaf *Arachishypogaea*	Winter / Dry	1.300	1.310	0.174	0.480	0.005	0.043
6	Dumur/fig leaf *Ficushispida*	Winter / Dry	4.000	1.830	0.290	0.360	0.004	0.133
7	Rifuji/mechania leaf *Mikaniacordata*	Winter / Dry	6.000	0.770	0.467	0.180	0.005	0.087
8	MashKalai forage *Vignamungo*	Winter / Dry	2.300	1.190	0.295	0.460	0.007	0.262
9	Local grass *Cynodondactylon*	Winter / Dry	3.200	0.280	0.274	0.210	0.006	0.304
10	Foni grass *Eichhorniacrassipes*	Winter / Dry	2.400	0.200	0.099	0.150	0.006	0.041
11	Shim/bean leaf	Winter / Dry	5.300	1.090	0.289	0.490	0.008	0.077
12	AmonDhan straw *Oryza sativa*	Winter / Dry	2.600	0.670	0.237	0.120	0.004	0.080
13	Potato leaf *Solanumtuberosum*	Winter / Dry	2.800	0.550	0.208	0.120	0.009	0.082
14	Lemonder *Cymbopogoncitratus*	Winter / Dry	3.500	0.500	0.254	0.200	0.004	0.319
15	Wheat straw *Triticum spp.*	Summer/Rainy	3.800	0.750	0.332	0.210	0.003	0.049
16	Sojna/moringa leaf *Morinaoleifera*	Summer/Rainy	3.400	1.160	0.255	0.140	0.005	0.060
17	Dhoincha leaf *Sesbania aculeate/rostrata*	Summer/Rainy	3.100	1.170	0.208	0.170	0.005	0.044
18	Ipilipil *Leucaenaleucocephala*	Summer/Rainy	1.600	0.570	0.318	0.280	0.006	0.077
19	Carpet grass *Axonopusfissifolius*	Summer/Rainy	4.200	0.870	0.321	0.230	0.018	0.968
20	Star grass *Cynodonplectostachysus*	Summer/Rainy	2.400	1.840	0.132	0.360	0.033	0.582
21	Shewra leaf *Trophisasper*	Summer/Rainy	5.200	1.210	0.796	0.550	0.083	0.477
22	Ghi/ latashak	Summer/Rainy	3.200	0.170	0.252	0.120	0.007	0.130
23	Amon straw *Oryza sativa*	Summer/Rainy	1.700	0.520	0.143	0.120	0.016	0.139
24	Orohor leaf *Cajanuscajan*	Summer/Rainy	2.300	0.910	1.074	0.100	0.009	0.612
25	Ghee residue	Summer/Rainy	2.300	0.620	1.221	0.350	0.008	0.213

Table 43: Minerals content (%) of feed samples collected from Patuakhali during winter and summer season

Serial No	Feed/fedder	Season	Minerals (%)					
			K	Ca	P	Mg	Zn	Fe
1	Til oil cake Sesamumindicum	Summer/ rainy	1.300	0.100	0.714	0.260	0.007	0.062
2	Rice polish *Oryza sativa*	Summer/ rainy	2.300	0.680	1.315	0.500	0.009	0.106
3	Mustard/Shorishakhoil *Brassica juncea*	Summer/ rainy	0.800	0.110	0.397	0.180	0.007	0.053
4	Rice polish *Oryza sativa*	Summer/ rainy	0.800	0.090	0.339	0.170	0.005	0.036
5	Motor forage	Summer/ rainy	3.400	0.740	0.295	0.180	0.005	0.036
6	Maize leaf *Zea mays*	Summer/ rainy	4.600	0.280	0.250	0.130	0.003	0.035
7	Mangrove leaf *Rhizophora mangle*	Summer/ rainy	4.100	1.070	0.474	0.150	0.006	0.068
8	Paijom straw	Summer/ rainy	1.500	0.430	0.104	0.120	0.005	0.075
9	Rifuji/machania leaf *Mikaniacordata*	Summer/ rainy	5.200	1.280	0.430	0.150	0.009	0.141
10	Sweet potato leaf *Ipomoea batatas*	Summer/ rainy	4.900	0.910	0.443	0.170	0.005	0.044
11	German grass *Echinochloapolystachya*	Summer/ rainy	2.300	0.330	0.198	0.120	0.006	0.049
12	Bean leaf *Phaseolus vulgaris*	Summer/ rainy	3.400	1.840	0.362	0.110	0.003	0.102
13	Cowpea *Vignaunguiculata*	Summer/ rainy	4.600	1.610	0.415	0.150	0.007	0.036
14	Gram forage	Winter / Dry	3.600	0.120	0.062	0.170	0.009	0.036
15	Heli Grass *Dactyloteniumaygyptium*	Winter / Dry	4.600	0.260	0.264	0.260	0.006	0.113
16	IrriDhan Dry straw *Oryza sativa*	Winter / Dry	5.200	0.230	0.285	0.220	0.004	0.099
17	Rana Grass *Cyperusesculentus*	Winter / Dry	4.900	0.810	0.214	0.980	0.007	0.135
18	Kolmi Grass *Ipomoea aquatica*	Winter / Dry	2.400	1.360	0.155	0.370	0.009	0.089
19	Ipilipil *Leucaenaleucocephala*	Winter / Dry	3.000	0.320	0.131	0.160	0.008	0.053
20	Kalijira rice straw *Nigella sativa*	Winter / Dry	4.400	0.150	0.114	0.190	0.004	0.041
21	IrriDha straw *Oryza sativa*	Winter / Dry	3.000	0.180	0.169	0.210	0.005	0.155
22	Durba Grass *Cynodondactylon*	Winter / Dry	3.100	1.130	0.228	0.360	0.008	0.214
23	Neem leaf *Azadirachtaindica*	Winter / Dry	2.500	0.220	0.266	0.220	0.005	0.378
24	Dal grass *Hymenacheamplexicaulis*	Winter / Dry	3.600	0.170	0.225	0.200	0.005	0.093
25	Chewcha Grass *Cyperusrotundus*	Winter / Dry	3.200	0.320	0.264	0.160	0.005	0.076

Table 42 shows minerals content (Ca, P, K, Mg, Fe and Zn) of feed samples collected from Sunamgonj during winter and summer seasons. Among the 4 tree fodders *dumur* (*Ficushispida*) leaf was found rich in Ca content (18300 PPM) and almost similar to star grass(*Cynodonplectostachysus*) (18400 PPM). *Orohor*or pigeon pea (*Cajanus cajan*) leaf was found to contain high amount of P (10740 PPM) followed by *shewra* (*Trophis asper*) foliage (7960 PPM), cassava leaf (6080 PPM), *refuji* or mechania herbs (4670 PPM) and moringa

leaves (4020 PPM). So it could be suggested that especially in rainy season, when P level usually scarce in fodder/grasses, supplementary feeding with *shewra*, cassava and moringafoliages could recover the deficiency of P in ruminant. *Shewra*, unlike the common folliages, also contained the highest level of Zn (829 PPM) followed by star grass (328 PPM). So far as Fe content is concerned Carpetgrass (9680 PPM), Stargrass (5820 PPM) and *Shewra*(4770 PPM) were found to have the ability to supply more Fe to the ration. Besides, to make the ration rich in K and Mg, the animal ration should be enriched with hurbs and foliages like *refuji* (*Mikania cordata*), bean (*Phaseolus vulgaris*) and *shewra*(*Trophis asper*)leaf as well.

Table 44: Minerals composition (%) of feed ingredients of Satkhira district collected during rainy season

SL No.	Local Name	Seaason	Level of minerals (%)					
			K	Ca	P	Mg	Zn	Fe
1	Dumur *Ficushispida*	Summer and Rainy	2.600	2.139	0.299	0.656	0.006	0.097
2	Rice polish *Oryza sativa*	Rainy	0.850	0.273	0.683	0.384	0.005	0.062
3	Vutta *Zea mays*	Rainy	0.650	0.132	0.298	0.102	0.004	0.083
4	Wheat barn *Triticum spp.*	Rainy	1.000	0.173	0.511	0.251	0.005	0.033
5	Shish flower grass *Calotropisgigantea*	Rainy	3.250	0.680	0.364	0.370	0.005	0.226
6	Buno grass *Cynodondactylon*	Rainy	2.850	0.779	0.231	0.364	0.005	0.115
7	Water hyacinth/Kochuripana *Eichhorniacrassipes*	Rainy	0.800	0.408	0.071	0.186	0.006	0.114
8	Hela grass *Dactyloteniumaygyptium*	Rainy	3.000	0.536	0.522	0.292	0.004	0.143
9	German grass *Echinochloapolystachya*	Rainy	1.900	0.317	0.156	0.124	0.003	0.053
10	Ada baradi grass	Rainy	3.000	0.505	0.349	0.429	0.003	0.105
11	Chaucha Grass *Cyperusrotundus*	Rainy	1.750	0.395	0.232	0.289	0.004	0.113
12	Nepiar grass *Pennisetumpurpureum*	Rainy	3.600	0.608	0.349	0.118	0.008	0.090
13	Heska grass	Rainy	2.050	0.511	0.183	0.420	0.007	0.959
14	Nepiarpakchong *Pennisetumpurpureum*	Rainy	1.350	0.778	0.078	0.086	0.004	0.116
15	Durba grass *Cynodondactylon*	Rainy	1.700	0.529	0.237	0.214	0.005	0.278
16	Lobonbejo grass	Rainy	2.500	0.366	0.415	0.284	0.004	0.278
17	Bichali Rice straw *Oryza sativa*	Rainy	1.750	0.624	0.144	0.258	0.003	0.295
18	Matipura grass	Rainy	3.050	0.775	0.232	0.484	0.006	0.356
19	Jibli grass	Rainy	1.750	1.232	0.161	0.390	0.003	0.094
20	Bamboo leaf *Bambusa vulgaris*	Rainy	1.750	0.572	0.155	0.168	0.004	0.072
21	Dumur leaf *Ficushispida*	Rainy	2.400	0.281	0.294	0.649	0.003	0.067
22	Durba grass *Cynodondactylon*	Rainy	2.050	0.731	0.196	0.309	0.006	0.456
23	Shapla *Nymphaeapubescens*	Rainy	0.900	0.263	0.082	0.095	0.005	0.049
24	Khor *Oryza sativa*	Rainy	2.300	0.485	0.284	0.286	0.007	0.220
25	Haicha grass	Rainy	2.800	0.981	0.232	0.309	0.007	0.063
26	Mustard oil cake *Brassica juncea*	Rainy	1.450	0.695	0.705	0.362	0.006	0.062
27	Rice polish *Oryza sativa*	Rainy	0.500	0.312	0.123	0.087	0.002	0.081

SL No.	Local Name	Seaason	Level of minerals (%)					
			K	Ca	P	Mg	Zn	Fe
28	Rice *Oryza sativa*	Rainy	0.250	0.138	0.106	0.035	0.002	0.035
29	Wheat *Triticum spp.*	Rainy	0.700	0.185	0.288	0.126	0.004	0.038
30	Breaking Rice *Oryza sativa*	Rainy	0.250	0.156	0.126	0.049	0.001	0.028

Table 43 shows the minerals content of feed samples collected from Patuakhali, the coastal district, during winter and summer seasons. In the coastal areas *rana* grass/forage was found to be the keysource of Mg (9800 PPM) followed by rice polish (5000 PPM), *kolmi*harbs (3700 PPM) and *heli* grass (*Dactyloteniumaygyptium*) (2600 PPM). With the special attention to Rana (*Cyperus esculentus*), *heli* and mangrove leaf, all of them were found to be the good source of Ca, P, Mg, Zn, Fe and K. So it could be suggested that in the coastal region, for ration formulation, these special forages and foliages ought to be considered to recover the minerals deficiencies of ruminants.

Table 45 shows the minerals composition of feed ingredients collected fromSamnagor, Satkhira district during rainy season. Among the fodders collected from highly saline prone areaSamnagor, *Satkhirahela/heli* grass (*Dactyloteniumaygyptium*) was found to contain a veery good amount of both P (5220 PPM) and Ca (5360 PPM).On the other hand, *heska* grasswas found to contain the highest level of Fe (9588 PPM)along with a very good source of Ca (5110 PPM). So it is clear that different fodder/ foliages/ forages are rich in different valuable minerals and therefore, combination of those feed ingredients along with the available herbs and concentrates could make an ideal ration to feed the animals in the saline prone areas.

2. Development of model for predicting energy and protein requirements for dairy cattle

The experiments for development of model for predicting energy and protein requirement for dairy cattle were conducted separately at BLRI, BAU and SAU. However the analysis of data from all the experiments was conducted at SAU (Table 45).

Table 45: Feed and Nutrients intake and comparison of milk production of dairy cows at SAU

Name of Farm	Anim No	Treat	Animal wt (kg)	Milk prodn (kg)	DM Feed intake (kg)	Provisional MEI (MJ)	Provisional CPI (g)	NATP2 Feed DMI	NATP2 Feed MEI (MJ)	NATP2 Feed CPI (g)	Milk Prodn. (L)	Milk prodn Incr. %
Fatema Dairy	1	T1	439.6	**15**	8.52	74.98	1033.48	8.52	83.92	1341.05	**16**	**6.67**
	2	T1	358.71	**13**	8.12	71.46	984.96	8.12	79.98	1278.09	**13.5**	**3.85**
	3	T1	435.35	**24**	8.42	74.10	1021.35	8.42	82.94	1325.31	**25**	**4.17**
	4	T1	408.43	**17.5**	8.32	73.22	1009.22	8.32	81.95	1309.57	**18.5**	**5.71**
	5	T1	431.54	**10**	8.45	74.36	1024.99	8.45	83.23	1330.03	**12**	**20**
	6	T0	351.52	**12**	8.12	71.46	984.96	8.12	79.98	1278.09	**11.5**	**-4.17**
Average			**404.19**	**15.25**							**16.08**	**6.03**
Baby Dairy	7	T1	305.47	**10**	7.07	51.75	657.02	7.07	69.64	1112.82	11	**10**
	8	T1	413.35	**14**	7.47	54.68	694.19	7.47	73.58	1175.78	14.5	**3.57**
Baby Dairy	9	T1	327.75	**10**	7.07	51.75	657.02	7.17	70.62	1128.56	11	**10**
	10	T1	455.55	**11**	7.17	52.48	666.31	7.57	74.56	1191.52	12.5	**13.64**
	11	T0	402.35	**10**	7.57	55.41	703.48	7.37	72.59	1160.04	8.5	**-15**
Average			380.8	**11**							**11.5**	**4.44**

			94									
Lipi Dairy	12	T1	462.39	**18**	10.02	108.42	1538.27	10.02	98.70	1577.15	20	**11.11**
	13	T1	481.79	**12**	10.32	111.66	1584.33	10.32	101.65	1624.37	14.5	**20.83**
	14	T0	516.75	**13**	10.52	113.83	1615.03	10.52	103.62	1655.85	13.5	**3.85**
Average			486.97	14.33							**16**	**11.93**

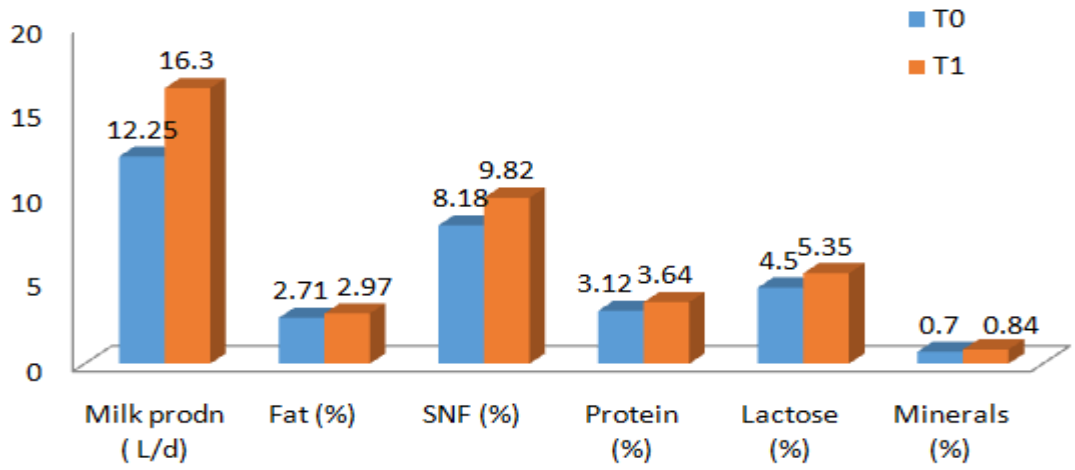


Figure 35: Milk composition of Fatema Dairy

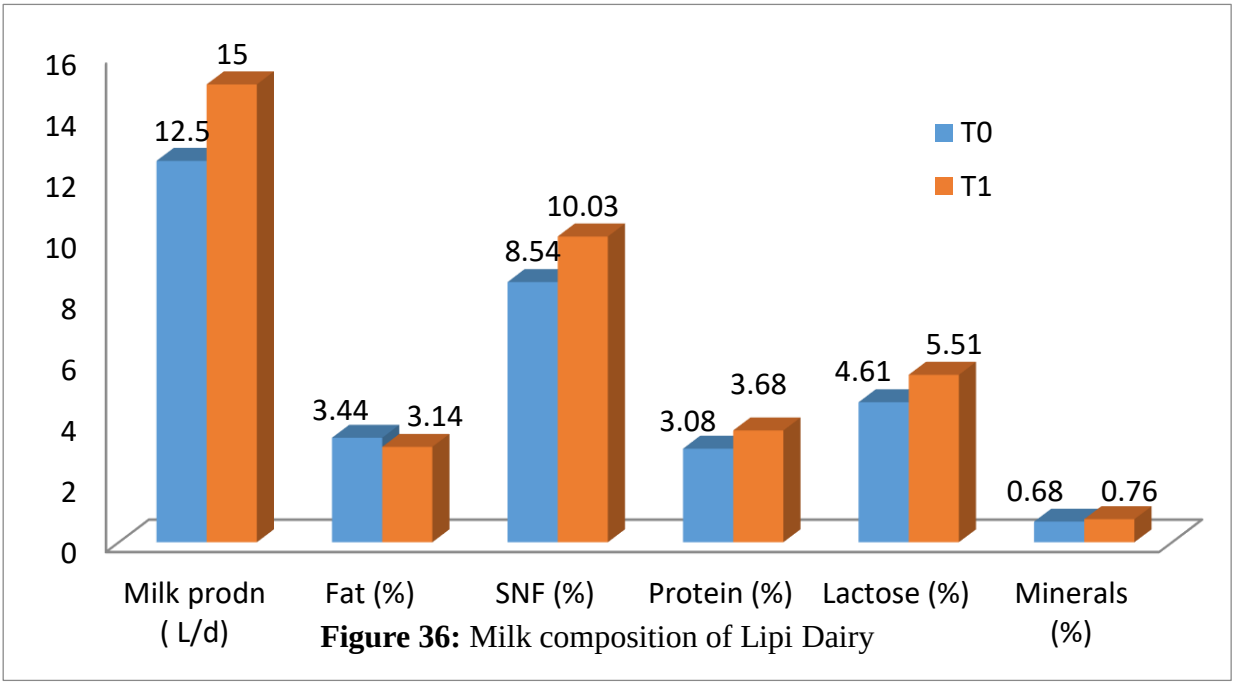


Figure 36: Milk composition of Lipi Dairy

Milk production status, Feed and nutrient (ME and CP) requirements of HF crossbred dairy cows at SAU

Feed and nutrient requirements of dairy cattle at SAU

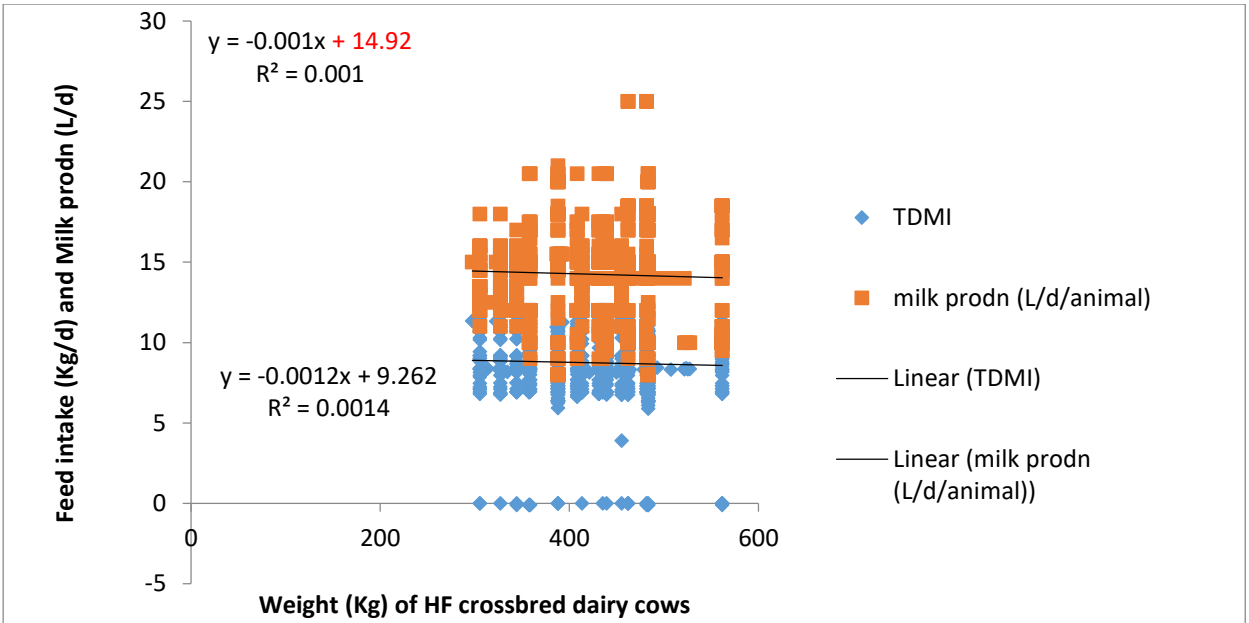


Figure 37: Feed intake and milk production of HF crossbred dairy cows

The average milk production of Holstein Friesian (HF) crossbred dairy cows at sylhet (Figure 38) was found to be higher (14.92 L/d/cow) compared to the cows at Mymensingh (12.79 L/d/cow), as shown in Figure 39. Similarly Figure 36 shows that DM feed requirement (9.26kg) was also positively 15% higher than the HF crossbred cows at Mymensingh (Figure 40).

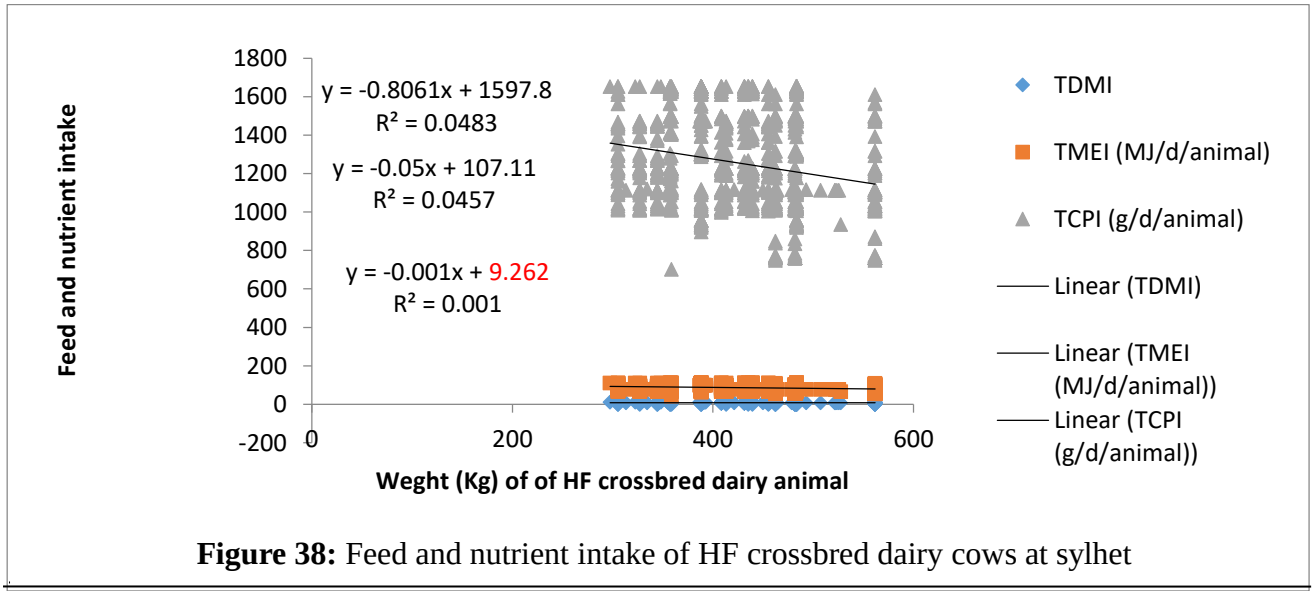


Figure 38: Feed and nutrient intake of HF crossbred dairy cows at sylhet

In Figure 37, the emitted regression equations were y = -0.0012x + 9.262, R^2 = 0.0014; y = -0.8061x + 1597.8, R^2 = 0.0483 and y = -0.05x + 107.11, R^2 = 0.0457, for DM feed, CP and ME respectively. Feed and nutrients (ME and CP) requirements of HF crossbred dairy cows are shown in emitted linear equations amounting 9.26 kg/d DM, 107.11 MJ ME/d and 1597.8g/d CP respectively. The M/D was maintained 11.55 that was also resemble in context with the standard. Likewise, ME and CP requirement for milk production was seems to be 74.6 MJ and 1223g CP for producing 14.92L of milk. Meanwhile, the rest of ME and CP were for their maintenance requirements. In all,it needs intensive on station feeding trial to reach a final conclusion.

Milk production status, Feed and nutrient (ME and CP) requirements of crossbred Holstein Friesian dairy cows at BAU (Using AFRC standard)

Milk yield of Holstein Friesian dairy cows at BAU

Figure 39 represents the milk production performance of Holstein Friesian crossbred dairy cows at Bangladesh Agricultural University research station. The linear performance equation y = -0.0117x + 12.796 (R^2 = 0.0807) implies that milk production potentiality was maximum around 13L/d/cow and with increasing live weight it was in linearly decreasing trend. At the same time, nature of feed intake and utilization of energy and protein in feed is shown in Figure 41. The emitted regression equation in Figure 39 was y = -0.1667x + 1048.3 (R^2 = 0.0017) for daily crude protein (g) requirement; y = -0.0233x + 82.753 (R^2 = 0.0133) for daily energy (ME, Mega jule) requirement per cow and to meet up the above energy and protein needs, the DM feed ought to be supplied maximum around 8.00 kg per cow (y = -0.0018x + 7.9026, R^2 = 0.0065). To maintain the production of 13L/d/cow, it needs to supply 8.00 kg DM feed having 1048g crude protein having 83 MJ energy (M/D 10.38). It seems to be a bit lower value of the standard (M/D 10.5-11) indicating more attention regarding data management needs to be given.

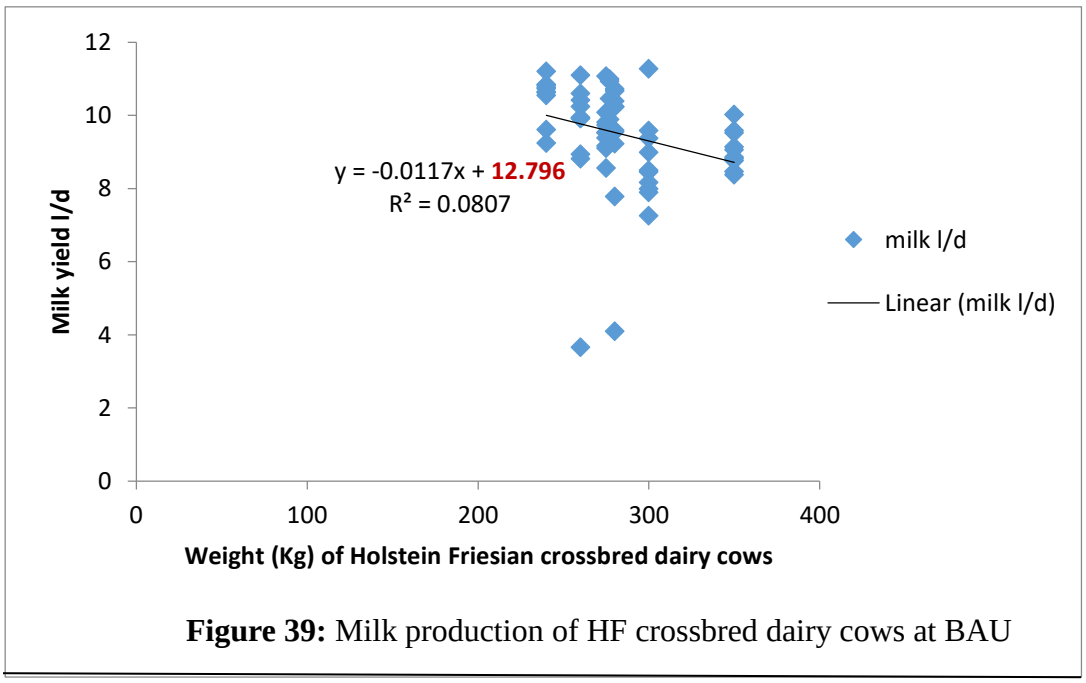


Figure 39: Milk production of HF crossbred dairy cows at BAU

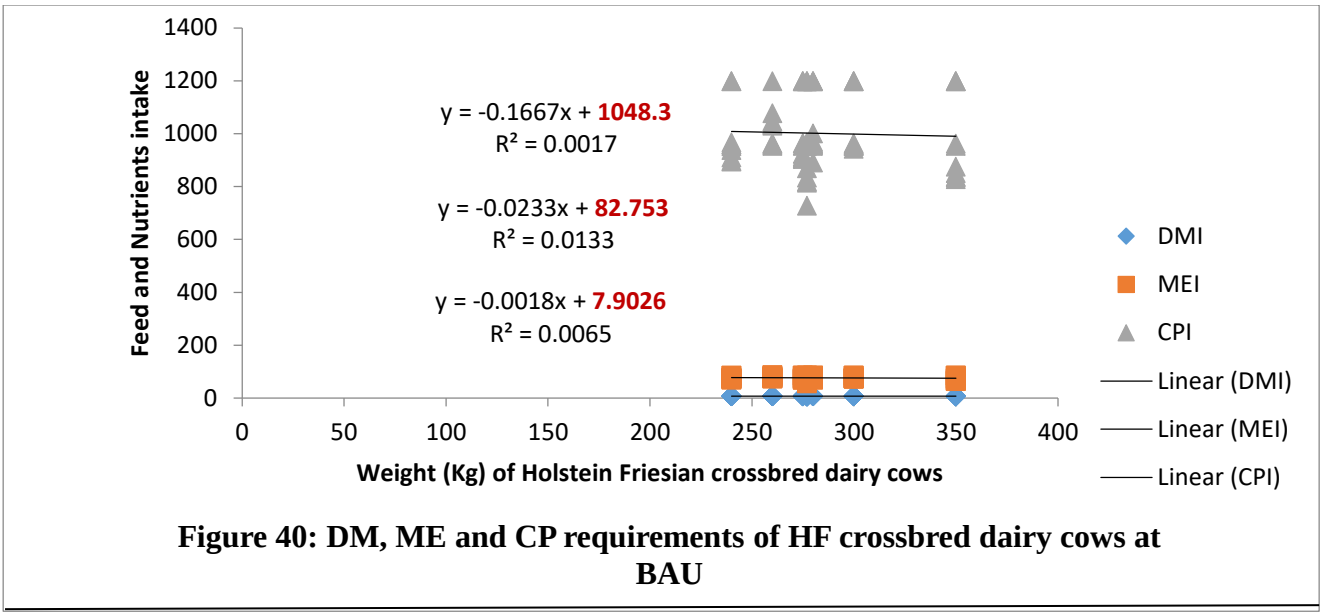


Figure 40: DM, ME and CP requirements of HF crossbred dairy cows at BAU

Milk production status, Feed and nutrient (ME and CP) requirements of Red Chittagong (RC) dairy cows and Pabna crossbred dairy cows at BLRI

Milk yield of RC dairy cows at BLRI

The milk yield of RC cattle at BLRI fed on diet with moringa and without moringa (Figure 41 and 42) was found to be 4.34 L and 4.25 L respectively. However the overall milk production performance of RC cows was 4.61L (Figure 41) when fed with NATP1 diet that also contained moringa. Addition of moringa was found to have a positive effect on milk production. As a native stock, RC cows were found to be good performer so far as milk yield is concerned.

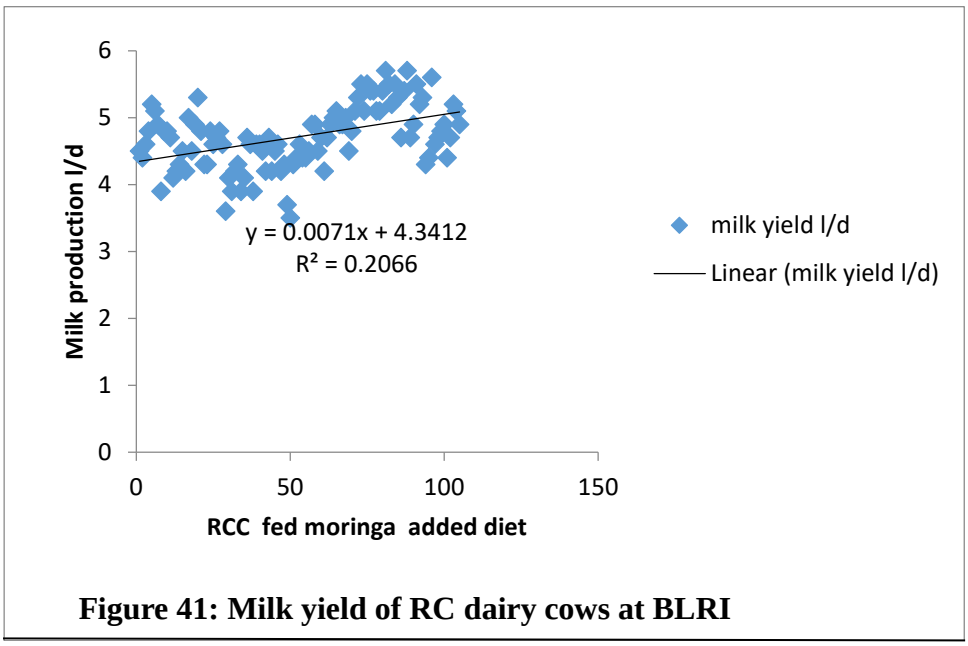


Figure 41: Milk yield of RC dairy cows at BLRI

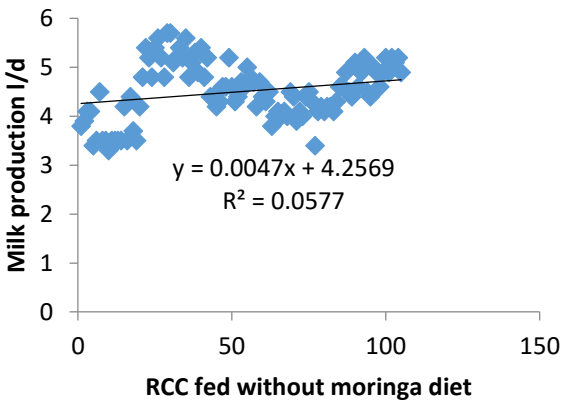


Figure 42: Milk yield of RC dairy cows at BLRI

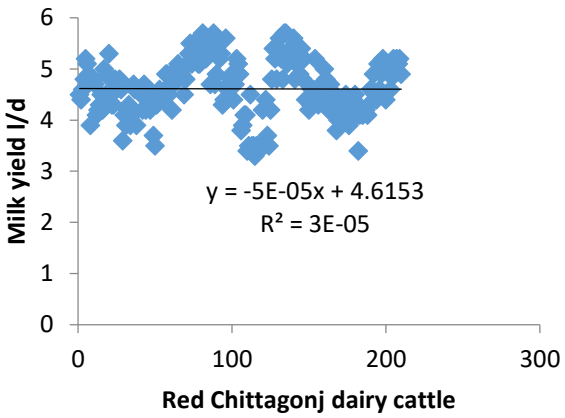


Figure 43: Milk yield of RC dairy cows fed NATP1 feed

DM feed and nutrients requirements of RC cattle at BLRI

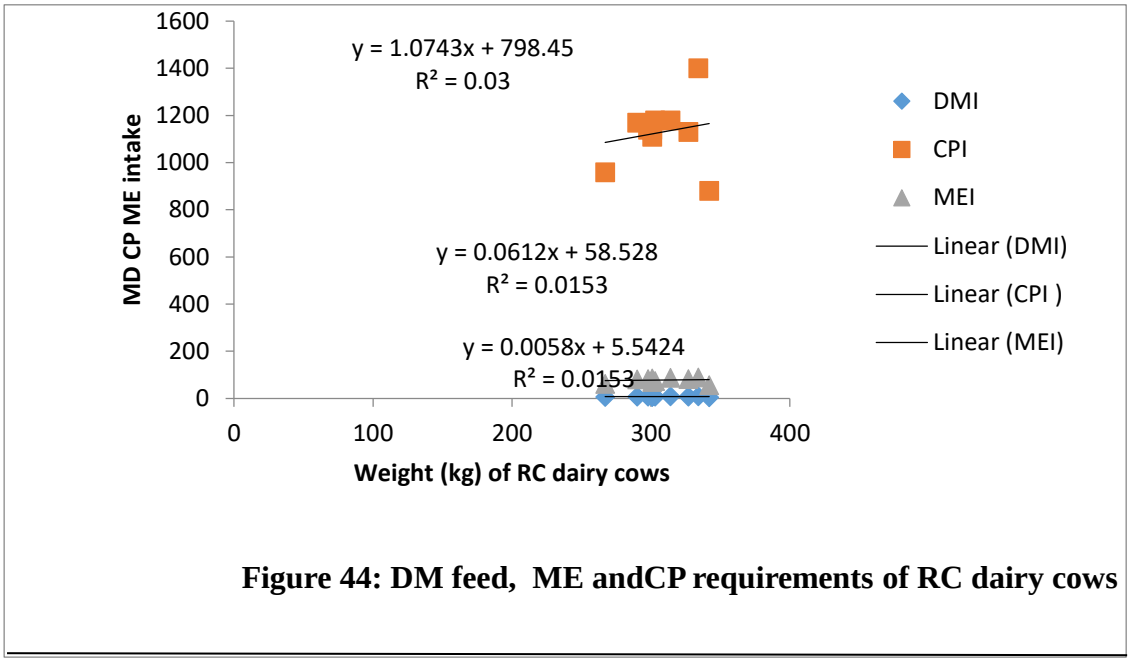


Figure 44: DM feed, ME andCP requirements of RC dairy cows

The feed intake of the native Red Chittagonj cattle is emitted in linear regression equation (Figure43) which is 5.54 DM kg/d (y = 0.0058x + 5.5424, R^2 = 0.0153) where the energy was maintained at 58.53 ME MJ/d (y = 0.0612x + 58.528, R^2 = 0.0153) and crude protein (CP) supply was ensured at 798 g/d (y = 1.0743x + 798.45,R^2 = 0.03). Where, the M/D was 10.56, which were with in the standard level. However, intensive feeding trial and data management is needed to assess the real requirements of animal.

Dairy status and nutrient (ME, CP) requirements of Pabna crossbred dairy cattle at BLRI

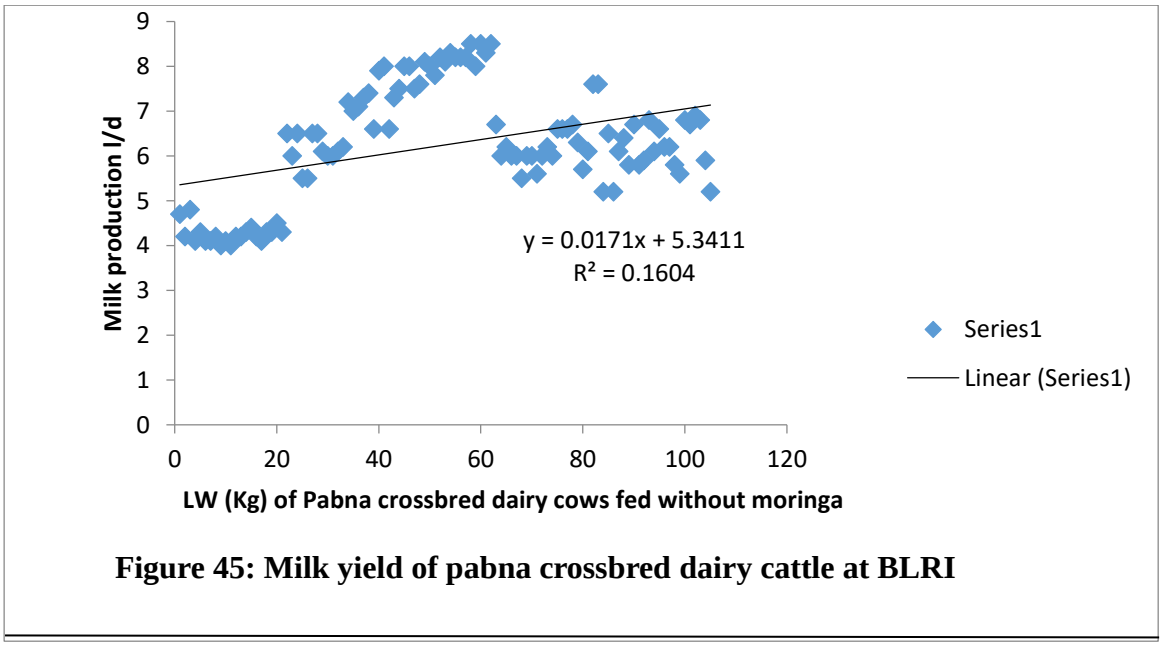


Figure 45: Milk yield of pabna crossbred dairy cattle at BLRI

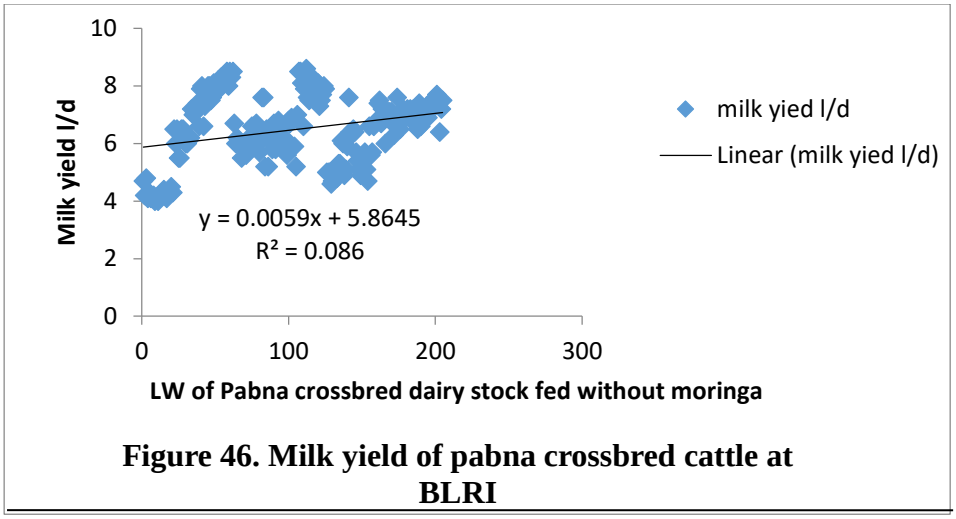


Figure 46. Milk yield of pabna crossbred cattle at BLRI

Similar effect of moringa feeding was observed in Pabna crossbred dairy cattle. NATP 1 ration containing moringa (Figure 45) was found to help increasing milk production (6.61 L/d/cow) compared to the ration without moringa (Figure 46 and Figure 47) where the milk production was 5.34-5.86 L/d/cow. The milk production capacity was higher (6.61L/d/cow) in Pabna crossbred dairy cattle compared to that of RC dairy cattle (4.61L).

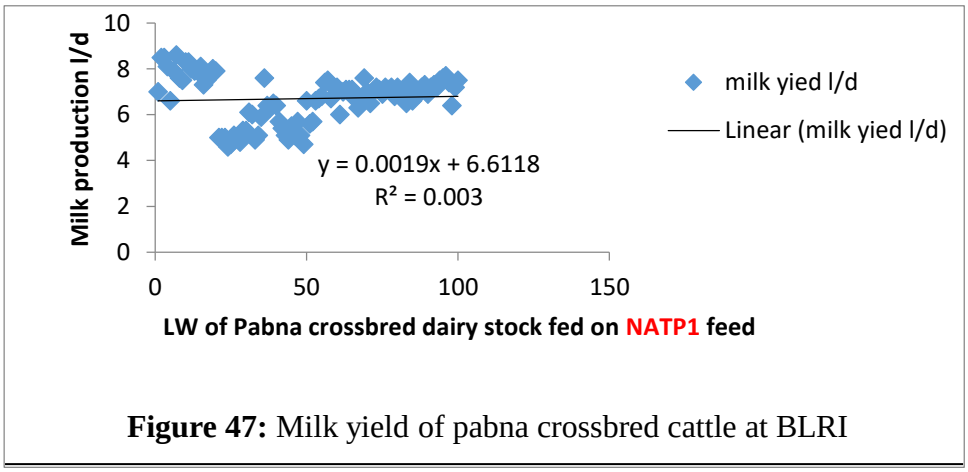


Figure 47: Milk yield of pabna crossbred cattle at BLRI

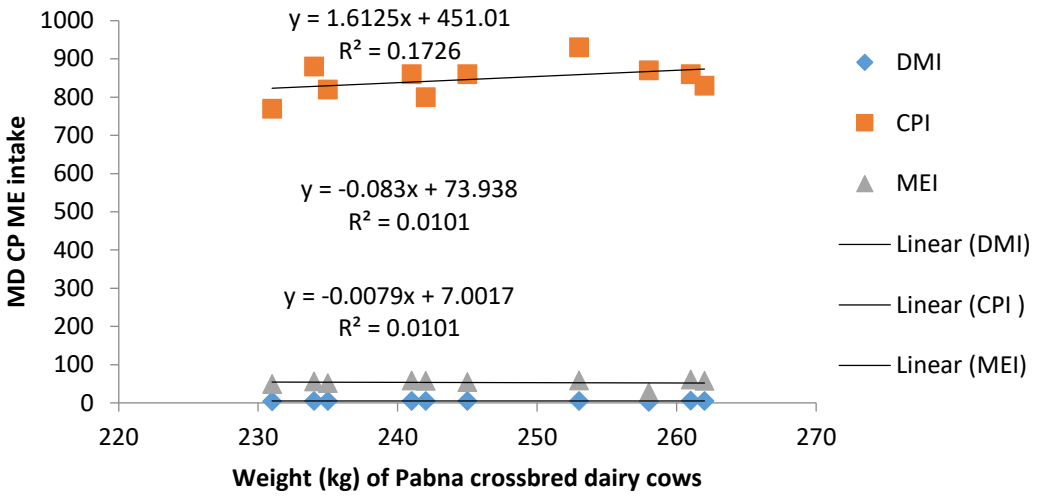


Figure 48: DM feed, ME and CP requirements of Pabna dairy cows

The DM feed requirements was a bit higher in Pabnacerssbred dairy cattle than the RC cattle. The emitted linear equation regarding feed (DM kg/d), crude protein (g/d)and energy (ME MJ/d) were y = -0.0079x + 7.0017 (R^2 = 0.0101), y = 1.6125x + 451.01 (R^2 = 0.1726) and y = -0.083x + 73.938 (R^2 = 0.0101) respectively (Figure 49). M/D was seen 10.56 which also touched the standard level. However, intensive feeding trial is needed to get a worthwhile value unanimously.

3. Development of harvest ratio for rice and its agro-industrial by-products used as animal feed

Under this study the harvest ratio of only the Amon rice vatieties (BR-49, BR-44 and BR-46) in relation to the yield of rice and straw and the extraction ratio of rice and rice bran (polish+husk) was determined. The results in relation to yield of rice, straw yield, harvested top straw and the harvest ratio are presented below.

Yield (kg/Sq.m) of Rice was found to be for: (i) BR-49 (Amon) = 0.5kg/sq.m
(ii) BR-44(Amon) = 0.45kg/sq.m
(iii) BR-46(Amon) = 0.45kg/sq.m

Straw yield (kg/Sq.m) was: (i) BR-49 = 0.75kg/sq.m
(ii) BR-44 = 0.68kg/sq.m
(iii) BR-46 = 0.85kg/sq.m

Harvested top straw (kg/Sq.m) was: (i)BR-49=0.2kg/sq.m
(ii) BR-44=0.18kg/sq.m
(iii) BR-46 =0.19kg/sq.m

Harvest ratio (paddy:straw) of rice was: (i) BR-49 = 1:1.5
(ii) BR- 44 = 1:1.51
(iii) BR-46 = 1: 1.88

Average Harvest ratio: 1:1.63
Average Amon production was 4.7 T/h and the straw production was 7.6 T/h (Figure 49)

Extraction ratio of rice and rice bran (polish+husk): 2.5:1 (Figure 50)

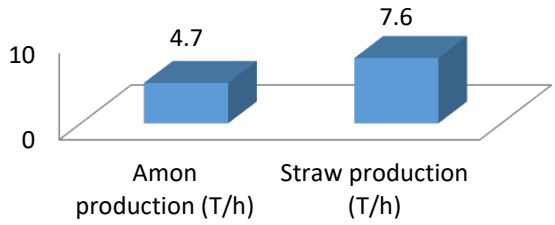


Figure 49: Average production of Amon rice and straw at Sunamgonj

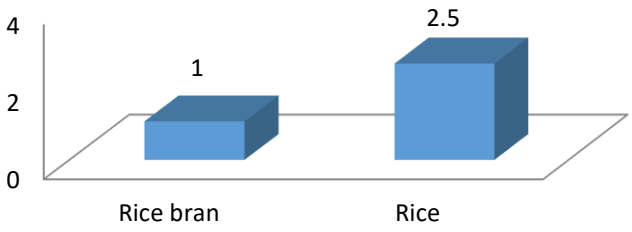


Figure 50: Extraction ratio of rice and bran

12. Research highlights (title, background, objectives, methodology, key findings, and key words):

Title of the sub-project: Development of Knowledge Hub on Animal Feed Resources for Efficient Feeding Management of Livestock

Background: Feed is the fundamental and cost involving item of efficient livestock farming. It relates with the farm economy directly and the use of balanced ration in daily diet at dairy farm defines the production of quality milk with competitive price. The formulation of balanced ration requires a number of steps of which identification of the available feed resources, their chemical and nutritive value, mineral content, regional and seasonal variation are extremely important. The generation of in-depth knowledge on available feeds and fodder along with estimating feed balance at the regional and national level is highly beneficial as this provides tremendous opportunity to understand the country's overall feed resources and their impact on livestock productivity.

Objectives:

d) To establish national feed inventory for estimating feed balance
e) To develop model for predicting nutrient requirements utilizing the concept of meta-analysis for dairy cattle
f) To develop online animal feed resources knowledge hub (feed data bank)
g) To develop country specific extraction ratio/factors or harvest index for all conventional crop residues and agro-industrial by-products used as animal feed in Bangladesh

Methodology: To fulfill the above mentioned objectives of the study review of literature, survey of available feedstuffs, feeds sample collection, chemical analysis of collected feed samples, on-farm feeding trials, meta-analysis, determination of harvest index and online documentation of feed resources were performed through involvement of the three institutes, Bangladesh Livestock Research Institute (BLRI), Bangladesh Agricultural University (BAU) and Sylhet

Agricultural University (SAU). Bangladesh Agricultural Research Council (BARC) was involved with this study as a coordination body. The survey of available feedstuffs was done in eight divisions (Dhaka, Mymensingh, Sylhet, Rajshahi, Rangpur, Khulna, Barishal and Chattogram) covering twelve districts (Manikganj, Munshiganj, Mymensingh, Sunamgonj, Rajshahi, Lalmonirhat, Kurigram, Jashore, Satkhira, Patuakhali, Chattogram and Bandarban). There were 17 upazilas (locations) under 12 districts from where feed samples were collected for chemical (Moisture, CP, NFE, EE, and TA) and nutritive value (Ca, P, Mg, K, and Fe) analysis covering the summer/rainy (wet) and winter (dry) seasons for a period of three years (July 2018 to June 2021). The available feed ingredients included both roughages (legume, non-legume, fodder, forages, foliage, crop residues, preserved feed etc.) and concentrates (grain, grain by-products and agro industrial residues). A total of 871 (540 for BLRI, 180 for BAU and 151 for SAU) feed samples were collected with feed resources survey in the selected locations using pre-designed and pre-tested questionnaire. For conducting meta-analysis Feed Resources Evaluation was done using "Information Screening Index (ISI) and Pyramid Approach". The identified feeds were compared with the various available feed classifications standard, such as Agricultural Research Council (ARC), Agricultural Farm Research Council (AFRC), National Research Council (NRC) and Bangladesh Standard and Testing Institute (BSTI). The chemical composition and minerals content analysis of the feed samples was determined according to AOAC (2000) method. Harvest index for the conventional crop residues and agro-industrial by-products was determined according to Dennis Pennington, 2013. On-farm feeding trials for the development of model for predicting energy and protein requirements for milk production were conducted in Red Chattogram cattle, Pabna cattle and Holstein Friesian cows.

Key findings: Among the available feed resources on an average 20% were found to be concentrates and the rest (80%) were roughages. As usual, concentrates were found to contain high ME (MJ/Kg DM) and CP (%) ranging between 7-10 MJ and 12-29% respectively. On the other hand, among the roughages, most of the tree fodder or foliages contained 7-8 MJ ME and 9-23% CP depending on the nature and maturity. Most of the legume foliages contained almost 2 folds CP than that of non-foliages. However some aquatic herbs (haicha, helencha, kolmi) always contained high nutrient values (16-17% CP) compared to the bushes or grasses (5-13%). Around 17.5% of the feed samples was found to be the tree fodder in which the highlighting/focusing point was mangrove leaf at coastal belt, nutritionally (9-14% CP and 7.5 MJ ME/kg DM) the leaves were similar to other tree fodders. Mastered oil cake contained high CP (31%) followed by wheat bran (16.75%), maize (11.55%) and rice polish (11.55%). Among the macro and micro minerals *dumur*/fig leaf was found to be rich in Ca content (18300 PPM) and almost near to star grass (18400 PPM). P was found in *shewra*(*Trophis asper*) foliage at a remarkable level (7960 PPM) followed by cassava leaf (6080 PPM), *refuji* or mechania herbs (4670 PPM) and moringa leaves (4020 PPM). Rana grass/forage (*Cyperus esculentus*) was found to be the key source of Mg (9800PPM) followed by rice polish (5000 PPM), kolmi (*Ipomoea aquatica*) herb (3700 PPM) and durba (*Cynodon dactylon*) grass (3600 PPM). Under the meta-analysis results showed the feed availability, its variation and quality changes from 1945 to 2020. As concerned to the farm level practices and feed use at farm level our primary data shows that the use of feed ingredients varied according to regional feed resources endowment and milk production and its marketing structure. The nutritional analysis of the feed ingredients collected from different region and season also showed a variation across the country. A 60 day feeding trial providing dairy ration having 10 MJ ME and 16% CP yielded good response regarding milk yield and milk composition. Feed (DM) and nutrients (ME and CP) requirements of Holstein Frisian (HF) crossbred dairy cows were observed to be 9.26 kg/d DM, 107.11 MJ ME/d and 1597.8 g/d CP respectively. For Red Chittagong (RC) cattle the requirement of feed was found to be 5.54 (DM kg/d) where the energy (ME) and crude protein was maintained at the level of 58.53 MJ and 798g respectively. Similarly for Pabna cattle using the emitted linear equation feed (DM kg/d), crude protein (g/d) and energy (ME MJ/d) requirements were found to be $y = -0.0079x + 7.0017$ ($R^2 = 0.0101$), $y = 1.6125x + 451.01$ ($R^2 =$

0.1726) and y = -0.083x + 73.938 (R^2 = 0.0101) respectively. The average milk production of Holstein Friesian (HF) crossbred dairy cows at sylhet was found to be higher (14.92 L/d/cow) compared to the HF cows at Mymensingh (12.79 L/d/cow). The study at BLRI revealed that the milk production capacity is higher (6.61L/d/cow) in Pabna crossbred dairy cattle compared to that of Red Chattogram dairy cattle (4.61L). The average harvest index of rice was calculated to be 0.46 with a range from 0.36 to 0.63. The highest harvest index was found for the potato plant to be 0.65 followed by maize (0.55), mustard (0.48), lentil (0.48) and wheat (0.37). Average harvest ratio (paddy : straw) of rice was found to be 1:1.63 and the extraction ratio of rice and rice bran (polish + husk) was 2.5 : 1.

Keywords: Feed inventory, feed composition, local grasses, harvest index, feed balance, website development

B. Implementation Status

1. Procurement:

Coordination Component (BARC): Not Applicable

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment					
(b) Lab &field equipment					
(c) Other capital items					

Component-1 (BLRI)

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment	03	130000	03	130000	
(b) Lab & field equipment	04	750000	04	750000	
(c) Other capital items	02	35000	02	35000	

Component-2 (BAU): Not Applicable

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
(a) Office equipment					
(b) Lab &field equipment					
(c) Other capital items					

Component-3 (SAU)

Description of equipment and capital items	PP Target		Achievement		Remarks
	Physical (No.)	Financial (Tk.)	Physical (No.)	Financial (Tk.)	
a) Office equipment	1.Desktop 2. UPS 3. Hp Laser Printer 4. Camera	40,000 10,000 10,000 25,000	1.Desktop 2. UPS 3. Hp Laser Printer 4. Camera	40,000 10,000 10,000 25,000	Procured successfully

b) Lab & field equipment	i. Spectrophotom eter ii. Shaking water bath	4,50,000 2,00,000	i.Spectrophotome ter ii. Shaking water bath	4,50,000 2,00,000	Procured successfully
c) Other capital items	-	-	-	-	

2. Establishment/renovation facilities:

Coordination Component (BARC): Not Applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

Component-1 (BLRI): Not Applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

Component-2 (BAU): Not Applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

Component-3 (SAU): Not Applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized:

Coordination Component (BARC)

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
(b) Workshop: Annual workshop	130	50	180	3 day's	
(c) Others (if any)					

Component-1 (BLRI)

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training	6	4	10	1 day	
(b) Workshop					
(c) Others (if any)					

Component-2 (BAU): Not Applicable

Component-3 (SAU): Not Applicable

C. Financial and physical progress (Combined & Component wise)

Financial and physical progress (Combined)

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	4738835	16708591	4512945	136850	100%	
b. Field research/lab expenses and supplies	7969854		7959241	0	0	
c. Operating expenses	1032841		1008863	345	99.88%	
d. Vehicle hire and fuel, oil & maintenance	584676		571756	0	100%	
e.Training/workshop/seminar etc.	443200		343200	0	100%	
f. Publications and printing	220000		69145	125000	0	
g. Miscellaneous	292838		253580.5	0	100%	
h. Capital expenses	1650000		1650000	0	0	
Total	16932244	16708591	16368247	262195		

Financial and physical progress (Component wise)

Coordination Component (BARC)

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	829973	1449962	693123	136850	100%	
b. Field research/lab expenses and supplies	0		0	0	0	
c. Operating expenses	130878		130533	345	99.88%	
d. Vehicle hire and fuel, oil & maintenance	5850		5850	0	100%	
e.Training/workshop/seminar etc.	213200		213200	0	100%	
f. Publications and printing	125000		0	125000	0	
g. Miscellaneous	67399		67399	0	100%	
h. Capital expenses	0		0	0	0	
Total	1372300	1449962	1109618	262195		

Component-1 (BLRI)

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	2829762	2826562	2826562	0	100	
b. Field research/lab expenses and supplies	2792846	2792838	2792838	0	100	
c. Operating expenses	414277	410832	410832	0	100	
d. Vehicle hire and fuel, oil & maintenance	158826	158826	158826	0	100	
e.Training/workshop/seminar etc.	130000	30000	30000	0	100	
f. Publications and printing	30000	29145	29145	0	100	
g. Miscellaneous	91285	91285	91285	0	100	
h. Capital expenses	915000	915000	915000	0	100	
Total	**7361996**	**7254488**	**7254488**	0	100	

Component-2 (BAU)

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
a. Contractual staff salary	372680	4186535	311840	0	100	
b. Field research/ lab expenses and supplies	3243993		3243993	0	100	
c. Operating expenses	179802		179802	0	100	
d. Vehicle hire and fuel, oil & maintenance	280000		260000	0	100	
e. Training/ workshop/seminar etc.	100000		100000	0	100	
f. Publications and printing	40000		40000	0	100	
g. Miscellaneous	70000		50896.50	0	100	
h. Capital expenses	-		-	-	-	
Total	**4286475**	**4186535**	**4186535**	**0**	100	

Component-3 (SAU)

Fig in Tk

Item of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress	Reasons for deviation
a. Contractual staff salary	706420	681420	681420	0	100	
e. Field research/ lab expenses and supplies	1933015	1922410	1922410	0	100	
c. Operating expenses	307884	287696	287696	0	100	
d. Vehicle hire and fuel oil & maintenance	140000	147080	147080	0	100	
e.Training/workshop/ seminar etc.	0	0	0	0	-	

f. Publications and printing	25000	0	0	0	-	
g. Miscellaneous	64154	44000	44000	0	100	
h. Capital expenses	735000	735000	735000	0	100	
Total	**3911473**	**3817606**	**3817606**	**0**	100	

D. Achievement of Sub-project by objectives (Tangible form): Technology generated/developed

Componenet-1 (BLRI)

General/ specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (Short term effect of the research)
To establish national feed inventory for estimating feed balance (for Dhaka, Khulna and Chattogram divisions)	i) Feed balance estimation ii) Feed sample collection iii) Secondary data collection iv) Laboratory analysis v) Meta-analysis was conducted by BAU component vi) A survey on feed resources availability was performed from 540 farmers vii) Data validation and cross checking was done	Feed Balance Assessment Sheet	Comprehensive database of all kinds of available feed resources along with its chemical composition and nutritive value for academia, students, scientists, businessman and farmers.
To develop model for predicting nutrient requirements utilizing the concept of meta-analysis for dairy cattle.	i) Review on various feeding standard ii) Calculation of nutrient requirement, nutrient supply and ration based on various feeding standards iii) Conducting feeding trial at farm level	Model developed for energy and protein requirement.	Feeding trial model *data was send to SAU for model development
To develop harvest index for all conventional crop residues and agro-industrial by-products used as animal feed in Bangladesh.	i) Area selection ii) Consider agricultural crop iii) Determination of harvest index	Model developed for determination of harvest index of agricultural crops	Bangladesh specific Harvest Index (HI) of selected crops for estimating livestock feed production.

Componenet-2 (BAU)

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (Short term effect of the research)
To establish national feed inventory for	i) Feed balance estimation ii) Feed sample collection iii) Secondary data collection	Feed Balance Assessment Sheet	Feed balance estimation

estimating feed balance (for Rajshahi, Rangpur and Mymensingh divisions)	iv) Laboratory analysis was performed v) Meta-analysis was conducted vi) A survey on feed resources availability was performed from 300 farmers vii) Data validation and cross checking was done		Website
To develop model for predicting nutrient requirements utilizing the concept of meta-analysis for dairy cattle.*	i) Review on various feeding standard ii) Calculation of nutrient requirement, nutrient supply and ration based on various feeding standards iii) Conducting feeding trial at farm level	Model on energy and protein	Feeding trial model
*The data was sent to SAU for detailed analysis as the decision of the Coordination meeting			

Componenet-3 (SAU)

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measureable)	Outcome (Short term effect of the research)
i. To establish national feed inventory for estimating feed balance	Availability, chemical composition and nutritive values of feed stuffs	i. Chemical analysis has done. ii. ADF and NDF has done iii. ME has been determined through In-vitro analysis.	Nutrition calendar of feed ingredients at Coastal and Haor belt.
ii. To develop model for predicting nutrient requirements utilizing the concept of meta-analysis for dairy.	A feeding trial has done fixing same ME and CP in feed among three local dairy farms.	ME and CP for maintenance have been predicted.	Feeding trial data has been generated for further experiment.

E: Information/knowledge generated/policy generated

Component-1 (BLRI)

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (Short term effect of the research)
To establish national feed inventory for estimating feed balance (for Dhaka, Khulna and Chattogram divisions)	i) Feed balance estimation ii) Feed sample collection iii) Secondary data collection iv) Laboratory analysis performed v) Meta-analysis conducted vi) A survey on feed resources availability was performed from 540 farmers vii) Data validation and cross	1.Feed balance was established 2. A detailed knowledge hub on feed resources was identified through meta-analysis	A very well documented and validated database on feed resources was established

	checking was done		
To develop model for predicting nutrient requirements utilizing the concept of meta-analysis for dairy cattle.	i) Review on various feeding standard ii) Calculation of nutrient requirement, nutrient supply and ration based on various feeding standards iii) Feeding trial at farm level	i) Model on Predicting energy and protein requirement was established. ii) Application of the feeding model for formulation of the ration is possible using our database	Database was developed on feed resources

Componenet-2 (BAU)

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (Short term effect of the research)
To support to establish national feed inventory for estimating feed balance in divisions (for Rajshahi, Rangpur and Mymensingh)	i) Feed balance estimation ii) Feed sample collection from six regions iii) A number of secondary data was collected iv) Laboratory analysis was performed v) Meta-analysis was conducted vi) A survey on feed resources availability was performed from 300 farmers vii) Data validation and cross checking was done	i) Feed balance was established at farm level in six divisions ii) A detailed knowledge hub on feed resources was identified through meta-analysis	A very well documented and validated database on feed resources was established
To develop model for predicting nutrient requirements utilizing the concept of meta-analysis for dairy cattle.*	i) Review on various feeding standard ii) Calculation of nutrient requirement, nutrient supply and ration based on various feeding standards	i) Model on predicting energy and protein requirement was established. ii) Application of the feeding model for formulation of the ration is possible using our database	Database was developed on feed resources
*The data was sent to SAU for detailed analysis as the decision of the Coordination meeting			

Componenet-3 (SAU)

General/specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output	Outcome (Short term effect of the research)
i. To establish national feed inventory (Availability, chemical composition and nutritive values) for estimating feed balance (for two divisions)	Availability of feed stuffs with their nutritive values	Nutrition calendar of feed ingredients at Coastal and Haor belt.	Easy and economic feed formulation

ii. To develop model for predicting nutrient (specifically energy and protein) requirements utilizing the concept of meta-analysis for dairy.	A feeding trial was done fixing same ME and CP in feed among three local dairy farms.	ME and CP for maintenance initially been predicted.	Primary data regarding intake and nutrient requirements.

F. Materials Development/Publication made under the Sub-project:

Component-1 (BLRI)

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.			
Journal publication	Assessment of Livestock Feed Requirement and Potential Feed Nutrient Availability of Bangladesh.		Nasrin Sultana, Jobaida Shovna Khanom, Nazmul Huda, Md Tarequl Islam
	Study on the availability of livestock feeds and feeding practice of some area's farmers in Bangladesh		Nasrin Sultana, Md Tarequl Islam, Jobaida Shovna Khanom,
Video clip/TV program			
News Paper/Popular Article			
Other publications, if any	One MS thesis Paper		

Componenet-2 (BAU)

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.	**1**		
Journal publication		**1 (under review)**	**Indian Journal of Dairy Science**
Video clip/TV program			
News Paper/Popular Article			
Other publications, if any		**1 (Book chapter)**	**SAARC Book**

Componenet-3 (SAU)

Publication	Number of publication		Remarks (e.g. Paper title, name of jernal, conference name, etc.
Technology bulletin/booklet/leaflet/flyer etc.			
Journal publication			
Video clip/TV program			
News Paper/popular Article			
Other publications, if any			

G. Description of generated Technology/knowledge/policy:

i. Technology Fact Sheet (title, introduction, description, suitable location/ecosystem, benefits, name and contact address of author): Not applicable

ii. Effectiveness in Policy Support (if applicable): Not applicable

H. Technology/Knowledge generation/Policy Support (as applied): Combined

i. Immediate impact on generated technology (commodity & non-commodity)

The immediate impact would be on student, academician and livestock farmer. Nutrient composition of feed resources would be available for balance ration formulation at regional level.

ii. Generation of new knowledge that help in developing more technology in future

Apps based balance ration formulation at farmer level.

iii. Technology transferred that help increased agricultural productivity and farmers' income

The information would help to formulate ration for increasing livestock productivity and milkproduction.

iv. Policy Support

The insight of the feed resources and its results support the formulation of feed policy, feedprice setting policy and feed import policy.

I. Information regarding Desk and Field Monitoring

i. Desk Monitoring [description & output of consultation meeting, monitoring workshops/seminars etc.):

Coordination Component (BARC):

Description	Output
Coordination meeting	Three months interval monitoring
Workshop	Arrange annual review workshop
Training	Arrange officer's training
Research activities	Every months monitor

Component-1 (BLRI): Not applicable

Component-2 (BAU): Not applicable

Component-3 (SAU): Not applicable

ii. Field Monitoring (date & no. of visit, name and addresses of team visit and output):

Coordination Component (BARC)

Date	No. of visit	Name and address of visitors	Location of visit	Output
12.02.2020	01	Dr. Mohammad Rafiqul Islam Dr. Mohammad Showkat Mahmud Dr. Md. Ismail Hossain	Bangladesh Agricultiral University	Monitoring team visited on-going activities of the project regarding samples collection, test and analysis.
Date	**No. of visit**	**Name and address of visitors**	**Location of visit**	**Output**
29.07.2020	01	Dr. Mohammad Rafiqul Islam Dr. Kazi M. Kamaruddin Dr. Mohammad Showkat Mahmud Dr. Md. Nure Alam Siddiky	Bangladesh Agricultural University	The gamma-ray irradiated seeds of Moringa were grown at fodder plot and the biomass yield, morphological characteristics and fractions of fodder were recorded and chemical composition of this fodder are under processing in Lab.
10.01.2021	01	Dr. Mohammad Rafiqul Islam Dr.Kazi M. Kamaruddin Dr. Md. Nure Alam Siddiky	Bangladesh Agricultiral University	Monitoring team visited the experimental fields and laboratories activities along with the PI of this project.

Component-1 (BLRI):

In total three visits were done from the BARC to monitor the sub-project
First Monitoring date: 14.05.19

a) Dr. Mia Syed Hasan, Director, PIU-BARC
b) Dr. Nowsher Ali Sarder, Monitoring and Evaluation Specialist
c) Dr. Suraya Parveen, Senior Scientific Officer, BARC

Component-2 (BAU):

In total four visits were done from the BARC to monitor the Sub-project.

Component-3 SAU:

i. 1st year monitoring
ii. 2nd year monitoring date: 12 to 14 Nov. 2020

Team:

a) Dr. Harunur Rashid, Director PIU BARC NATP2;
b) Dr. Abdul Jalil Bhuyan, Research Management specialist, PIU BARC;
c) Dr. Nouwsher Ali Sarder, Monitoring and evaluation specialist, PIU BARC.

iii. Weather data, flood/salinity/drought level (if applicable) and natural calamities:

Coordination Component (BARC): Not applicable

Component-1 (BLRI): Not applicable

Component-2 (BAU): Not applicable

Component-3 (SAU): Not applicable

J. Sub-project Auditing (covers all types of audit performed)

Coordination Component (BARC)

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Internal	No objections raised	42,383	Satisfactory	
Internal	No objections raised	2,39,485	Satisfactory	

Component-1 (BLRI)

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
Internal	No objection	1761912	Satisfactory	
Internal	No objection	3046258	Satisfactory	

Component-2 (BAU)

Types of audit	Major observation/ issues/ objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
FAPAD	No objection	5,97,136.00	Satisfactory	
FAPAD	No objection	9,42,188.00	Satisfactory	

Component-3 (SAU)

Types of Audit	Major observation/issues/objections raised; if any	Amount of Audit (Tk.)	Status at the sub-project end	Remarks
BARC	No objection	2,274,744	BARC audit finished June 2020	
Company	No objection	26,81,077	Company audit finished October2020	

K. Lessons Learned (combined):

i. The main lesson learned through implementation of this sub-project is that well coordination and synchronization of the work, where BARC has played the central role, helped achieving the objectives of the study effectively.
ii. COVID-19 pandemic situation taught us about how to overcome the problem of research in critical situation.
iii. Without sufficient budget & logistic support research could not be performed to reach the goal.

L. Challenges (if any):

i. The main challenge was COVID-19 pandemic that affected the smooth progress of the research activities.
ii. Delay in purchasing software by the relevant institute also affected the progress of the work.
iii. Unequal distribution of manpower between the components was also identified to be one of the challenges by the institutes suffering from manpower shortage.
iv. Insufficient fund for predicting energy and protein requirements for dairy cattle put the PI under great challenge in conducting the research work.
v. For the calculation of Nutrient Requirement of dairy animal needs a series of feeding trial to perform. However, only one trial was done on this which was not sufficient to draw a conclusion.

M. Suggestions for future planning (if any):

i. Development of online/ web based animal feed resources data bank (for identification of suitable feeding standard and formulation of balanced ration for feeding management and increasing milk production) based on the developed national feed inventory, chemical composition, nutritive value (encompassing regional and seasonal differences) and mineral content of the available feeds.
ii. A standardized format, synchronized process, common questionnaire, comparable reporting type needed to be developed before allowing any coordinated project.
iii. The participated components must be funded based on the workload as well as the number of objectives.
iv. The coordination must be well managed by the Coordinator which is extremely important.
v. A standardized format, synchronized process, common questionnaire, comparable reporting type need to be well thought of before allowing any coordinated project to implement.
vi. Finally, long term intensive research is needed to perform series of experiments (feed analysis & feeding trial) to determine the ME and CP requirements of dairy animal and to determine various other nutrient requirements.

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Signature:……
Name of the Coordinator :
Dr. Nazmun Nahar Karim
Designation: Member Director
Livestock Division, (C. C.)
BARC, Farmgate, Dhaka-1215
Date:
Seal:

Signature…….
Name: Dr. Shaikh Mohammad Bokhtiar
(Head of the organization or authorized representative)
Designation: Executive Chairman (in charge)
BARC, Farmgate, Dhaka-1215
Date:
Seal:

Annexure-I

Component-1 (BLRI)

Table 1. Qualification of Livestock farmers

Location	Percent of Education level				
	Primary	Secondary	Uneducated	University	Vocational
Jashore	17.05	40.91	-	11.36	30.68
Jhikorgacha	26.19	39.29	-	3.57	30.95
Manikganj	27.91	43.02	4.65	12.79	11.63
Munshiganj	41.11	36.67	8.89	6.67	6.67
Nikhongchari	44.58	40.96	3.61	4.82	6.02
Patiya	20.22	55.06	-	17.98	6.74
Grand Total	29.42	42.69	2.88	9.62	15.38

Table 2. Ownership of Farms

Locations	Percent of ownership		
	Community	Co-operative	Single
Jashore	1.14	2.27	96.59
Jhikorgacha	2.33	-	97.67
Manikganj	3.49	-	96.51
Munshiganj	-	-	100.0
Nikhongchari	-	-	100.0
Patiya	3.49	-	96.51
Average	1.73	0.39	97.88

Table 3. Production system of farm

Locations	Percent of production system			
	Extensive	Intensive	Mixed	Traditional
Jashore	37.65	45.88	15.29	1.18
Jhikorgacha	35.29	47.06	-	17.65
Manikganj	30.77	58.97	6.41	3.85
Munshiganj	28.09	71.91	-	-
Nikhongchari	50.60	22.89	-	26.51-
Patiya	21.84	52.87	25.29	-
Grand Total	33.93	50.10	7.89	8.09

Table 4. Genotype of cattle on the basis of ownership of farm

Type of cattle	Percent		
	Community	Co-operative	Single
Crossbred cow	75.00	100.0	71.23
Crossbred cow+Deshi cow	-	-	1.39
Deshi cow	25.0	-	27.38

Table 5. Population size of different types of cattle on the basis of location

Locations	Average no. of							
	Dry cow	Dairy cow	Bull	Bullock	Growing bull	Heifer	Bull calf	Heifer calf
Jashore	1.75	2.78	3.18	2.0	1.62	1.7	1.44	1.46
Jhikorgacha	2.14	4.16	1.0	3.0	1.75	2.21	1.73	1.86
Manikganj	2.28	3.73	3.13	-	2.08	2.12	1.93	2.15
Munshiganj	3.17	7.21	2.40	4.0	1.60	2.59	2.20	2.68
Nikhongchari	1.74	1.44	1.66	1.28	1.52	1.41	1.16	1.19
Patiya	3.50	4.46	4.57	4.0	2.44	3.27	2.20	2.33
Average	2.48	4.05	2.55	1.87	1.80	2.20	1.85	2.07

Table 6.Milk production on the basis of ownership of farm

Ownership of farm	Total milk production per farm (L)	Milk production per cow (L)
Community	64.55	9.55
Co-operative	9.0	2.0
Single	32.53	10.95
Average	33.06	10.91

Table 7. Milk production on the basis of rearing pattern

Rearing pattern	Total milk production per farm (L)	Milk production per cow (L)
Extensive	22.66	6.38
Intensive	43.98	8.70
Mixed	9.80	48.40
Traditional	22.94	6.46
Average	32.49	10.99

Table 8. Average family income per year on the basis ownership of farm

Ownership of farm	Family income per year
Community	1344311.11
Co-operative	2831500.0
Single	822590.5279.0
Average	839575.5263.0

Table 9. Average family income per year on the basis rearing pattern

Rearing pattern	Family income per year
Extensive	537986.07
Intensive	1004189.33
Mixed	1400686.87
Traditional	529398.29
Average	837270.02

Table 10. Supply of roughage on the basis of location

Location	Daily average (kg)			
	Aush rice straw	Aman rice straw	Boro rice straw	Hybrid rice straw
Jashore	4.64	9.66	3.38	12.16
Jhikorgacha	4.25	5.31	3.56	2.62
Manikganj	0.60	7.30	4.47	6.88
Munshiganj	4.44	5.50	5.25	-
Nikhongchari	10.27	8.64	3.88	6.75
Patiya	3.15	5.76	3.10	-
Average	5.44	7.21	3.73	6.84

Table 11. Supply of green grass on the basis of location

Location	Daily average (kg)						
	Natural grass	Dhol	Napier	Pakchong	Jumbo	Para	German
Jashore	6.06	-	10.58	-	-	3.0	4.87
Jhikorgacha	20.0	-	15.21	-	-	-	-
Manikganj	5.97	-	13.77	6.50	5.50	7.0	3.50
Munshiganj	13.51	11.47	17.57	10.0	-	7.33	10.0
Nikhongchari	14.25	-	3.90	-	-	3.50	2.0
Patiya	6.65	10.82	11.82	-	-	-	8.81
Average	10.62	11.15	13.67	7.20	5.5	5.57	7.25

Table 12. Supply of roughage on the basis of season

Location	Daily average (kg)			
	Aush rice straw	Aman rice straw	Boro rice straw	Hybrid rice straw
Rainy	4.18	10.2	3.91	6.50
Summer	4.95	4.51	4.19	7.23
Winter	6.02	4.95	3.24	6.90
Average	5.44	7.21	3.73	6.84

Table 13. Supply of green grass on the basis of season

Location	Daily average (kg)						
	Natural grass	Dhol	Napier	Pakchong	Jumbo	Para	German
Rainy	11.72	-	15.20	-	-	3.5	2.0
Summer	7.03	11.15	14.72	-	-	5.0	8.12
Winter	13.51	-	11.49	7.2	5.5	7.33	5.75
Average	10.62	11.15	13.67	7.2	5.5	5.57	7.25

Table 14. Supply of roughage on the basis of cattle genotype

Location	Daily average (kg)			
	Aush rice straw	Aman rice straw	Boro rice straw	Hybrid rice straw
Crossbred cow	4.53	6.52	3.83	6.86
Deshi cow	7.64	9.17	3.70	5.33
Average	5.49	7.22	3.79	6.64

Table 15. Supply of green grass on the basis of cattle genotype

Location	Daily average (kg)						
	Natural grass	Dhol	Napier	Pakchong	Jumbo	Para	German
Crossbred cow	9.17	11.23	14.21	7.2	5.6	5.57	7.09
Deshi cow	13.69	10.0	11.06	-	5.0	-	-
Average	10.75	11.15	13.74	7.2	5.5	5.57	7.09

Table 16. Supply of different type of bran and polish feed

Location	Rice bran	Rice polish	Khesari bran	Wheat bran	Pulse bran	Lentil bran (mosuri)	Filter maize coat	Wheat bran thin	Wheat bran thick	Pea bran
Jashore	1.77	1.65	0.73	0.94	0.63	0.0	0.0	0.72	1.26	0.0
Jhikorgacha	3.68	4.0	1.7	1.82	2.05	3.07	0.0	1.75	1.76	0.0
Manikganj	2.06	1.31	1.42	1.29	0.7	0.0	0.4	1.03	1.28	0.0
Munshiganj	2.86	0.5	2.11	1.27	1.33	1.8	0.62	1.08	1.48	0.0
Nikhongchari	1.41	0.0	0.0	0.85	0.0	0.0	0.0	0.0	0.58	0.0
Patiya	1.37	1.0	0.29	0.99	0.2	0.0	0.0	0.89	0.93	0.36
Average	2.19	1.50	1.10	1.22	1.01	2.52	0.55	1.03	1.29	0.36

Table 17. Supply of different type of powder and broken feeds

Location	Wheat flour	Broken maize	Broken rice	Broken khesari	Broken mugn	Pulse powder
Jashore	0.3	0.84	0.75	0.55	-	-
Jhikorgacha	-	1.44	1.09	0.2	-	-
Manikganj	-	1.12	0.48	0.39	2	0.1
Munshiganj	0.86	1.16	1.15	0.62	-	1.01
Bandarban	-	0.5	0.937		-	-
Patiya	0.2	0.44	0.70	0.25	0.33	0.45
Grand Total	0.71	0.98	0.93	0.39	1.28	0.80

Table 18. Supply of different type of oil cake and molasses

Location	TisirKhail	Soyabean khail	Mustard oil cake	Molasses	Til oil cake	Coconut extract
Jashore	-	-	0.50	0.90	-	-
Jhikorgacha	0.4	1	0.98	-	-	-
Manikganj	-	0.28	0.45	0.3	0.45	0.14
Munshiganj	1.00	-	0.55	0.6	-	0.79
Nikhongchari	-	2	-	0.382	1	0.5
Potiya	-	0.28	0.26	0.1	-	-
Average	1.00	0.35	0.64	0.56	0.63	0.63

Table 19. Supply of different mixed and brand concentrate feeds

Location	Mixed concentrate	Milk vita feed	Company feed	Salt
Jashore	0.15	-	-	0.5
Jhikorgacha	0.5	1.4	1.35	0.16
Manikganj	1.92	-	1.75	-
Munshiganj	-	-	-	0.21
Nikhongchari	-	-	-	-
Potiya	-	-	-	-
Average	1.39	1.4	1.37	0.19

Table 20. Annual income of the farmers from different sources

District	Animal	Milk	Cow dung	Grass	Others	Total
Jashore	180090.48	179333.43	3898.51	51000.00	144932.25	559254.67
Jhikoregacha	239938.27	525689.00	6582.81	72000.00	150238.10	994448.18
Manikganj	176615.07	237223.49	3770.59	4375.00	235363.53	657347.67
Munshiganj	231901.32	647223.08	3471.88	10000.00	330774.19	1223370.47
Naikhongchari	107580.65	41013.21	1321.43		155321.13	305236.41
Patiya	381962.96	650491.84	5231.03		448261.45	1485947.28
Overall	219681.46	380162.34	4046.04	34343.75	244148.44	870934.11

Table 21. Nutritional composition of Available feeds and fodder of Dhaka division

Feed ingredient	Proximate Composition (manikganj)											
Summer	**DM % (fresh basis)**	**CP %**	**CF %**	**EE %**	**ASH %**	**NFE %**	**ADF %**	**NDF %**	**GE(MJ/ kg DM)**	**ME (MJ / Kg DM)**	**Ca %**	**P %**
Hachi Grass (advance stage)	14.22	14.71	29.81	1.8	11.69	41.99	25.3	53.02	18.5	6.11	0.52	0.26
Napier grass (Pennisetum purpureum)	17.91	13.04	32.36	1.75	11.63	41.22	45.3	77.36	17.8	10.56	0.48	0.27

Arali grass (adv. Stage)	30.32	13.37	21.76	1.34	16.08	47.45	53.92	87.71	18	9.48	0.37	0.24
Durba grass (Cynodon dactylon)	30.03	13.63	19.78	2.34	12.18	52.07	40.41	43.21	18.56	6.12	0.38	0.2
Shama grass (Echinochloa colona)	18.23	13.37	31.33	1.7	14.71	38.89	39.04	66.67	17.3	5.71	0.4	0.26
German grass (Echinochloa polystachya)	21.98	14.51	33.32	3.1	8.34	40.73	39.28	69.22	18	7.77	0.46	0.23
Wheat bran (Triticum Aestivum)	87.48	16.15	12.44	3.9	2.46	65.05	11.06	44.17	18.9	11.15	0.17	0.15
Maize (Zea mays)	26.3	9.45	26.4	1.9	10.04	52.21	28.9	63.73	18.2	8.8	0.42	0.26
Maize corn (whole)	87.32	7.69	4.22	3.2	1.76	83.13	9.74	35.37	18.5	13.4	0.24	0.12
Mustard oil cake (Brassica Juncea)	90.51	29.42	12.21	9.4	8.21	40.76	28.55	52.39	19.7	7.27	0.71	0.19
Rainy season												
Ghoicha grass	18.14	5.95	36.24	1.57	10.44	45.8	32.9	69.27	16.28	5.37	0.02	0.02
Kanai	10.82	12.26	33.99	1.56	14.75	37.44	34.46	47.01	17.84	5.88	0.05	0.16
Sugar cane bagasse(Saccharum officinarum L)	35.53	2.27	42.3	0.34	7.56	47.53	35.78	72.59	17.68	6.83	0.63	0.34
Gondho vadail grass (Fresh leaf and stem)	19.9	9.63	32.24	1.95	10.78	45.4	30.6	49.47	18.82	6.21	0.04	0.01
Napier (Pennisetum purpureum)	18.85	13.52	32.28	2.33	12.3	39.57	41.22	72.35	16.32	7.18	0.53	0.32
Water hyachinth (Eichhornia crassipes)	12.66	9.65	23.11	1.02	11.8	54.42	36.23	54.98	16.38	5.4	0.85	0.72
Rice Straw (Oryza sativa L)	64.36	5.93	25.33	0.45	16.86	51.43	38.64	68.82	16.18	5.36	0.65	1.39
Mustard oil cake (Brassica Juncea)	90.07	32.68	6.49	8.72	14.15	37.96	20.77	29.04	18.48	7.27	0.68	0.21
Winter season												
Khesari grass (Lathyrus sativus)bloom slage	18.82	16.74	22.83	0.63	13.04	46.76	42.82	49.2	16.08	9.08	0.93	0.32
Napier grass(Pennisetum purpureum)	15.7	14.21	32.18	0.94	20.76	31.91	37.18	57.91	16.37	7.18	0.57	0.41
Maize (Zea mays)	11.01	12.91	22.62	0.48	7	56.99	36.72	63.18	16.28	7.16	0.36	0.21
Khesari hay (Lathyrus sativus)	86.9	10.39	44.93	2.3	8.17	34.21	37.45	64.26	16.2	7.13	0.08	0.29
Bakhsa grass (Leaf and stem)	20.19	13.41	1.64	4.87	8.27	71.81	33.42	64.3	17.32	5.72	0.43	0.27

Broken maize (Zea mays)	85.7	12.38	2.24	4.63	3.76	76.99	2.38	14.14	18.65	12.31	0.08	0.22
wheat bran (Triticum Aestivum)	87.45	13.45	8.46	3.99	5.39	68.71	9.66	26.04	18.84	12.43	0.05	0.33
Khesari crusht (Lathyrus sativus)	88.29	13.58	22.28	1.07	15.41	47.66	22.08	40.06	18.24	12.04	0.47	0.3
rice bran(Oryza sativa L)	89.92	5.4	12.42		14.87	67.31	6.09	68.69	11.78			
broken maize(Zea mays)	85.7	12.38	2.24	4.63	3.76	76.99	2.38	14.14	16.65			
Khaseri hay (	87.4	10.13	2.79	1.18	9.76	76.14	46.23		14.98			
Munshiganj												
Summer	**DM % (fresh basis)**	**CP %**	**CF %**	**EE %**	**ASH %**	**NFE %**	**ADF %**	**NDF %**	**GE(MJ/ kg DM)**	**ME (MJ / Kg DM)**	**Ca %**	**P %**
Dal grass (Hymenachne amplexicaulis)	18.59	13.85	24.88	1.83	10.89	48.55	31.94	62.47	17.7	5.84	0.7	0.21
Water hyacinth (Eichhornia crassipes)	10.18	14.14	21.68	1.45	8.22	54.51	31	47.22	16.38	5.41	0.83	0.28
Linseed oil cake-1 (Linum usitatissimum)	89.4	30.57	7.49	10.2	8.02	43.72	25.52	40.24	19.02	12.51	0.05	0.7
Linseed meal -2 (Linum usitatissimum)	90.61	19	11.93	2.25	8.48	58.34	18.74	40.56	17.32	11.79	0.07	0.37
Linseed oil cake-3 (Linum usitatissimum)	92.51	15	12.07	1.18	6.77	64.98	18.66	32.59	17.02	12.55	0.07	0.18
Coconut oil cake (Cocos Nucifera)	93.5	12.55	12.13	2.13	5.96	67.23	19.24	37.34	16.5	11.43	0.04	1.22
Wheat bran (Triticum Aestivum)	89.82	15.84	22.32	1.76	6.93	53.15	10.44	41.61	16.6	11.23	0.51	0.12
Rice bran (Oryza sativa L)	90.77	13.09	24.28	1.1	16.69	44.84	11.25	26.55	16.28	10.89	0.72	0.12
Lentil bran-1 (Lens culinaris)	90.84	30.44	7.19	4.28	3.34	54.75	23.8	58.13	18.96	10.96	0.04	0.03
Lentil bran-2 (Lens culinaris)	89.03	33.66	7.32	3.31	3.66	52.05	23.8	58.61	17.86	10.74	0.1	1.93
Rainy season												
Dal grass (Hymenachne amplexicaulis)	18.59	13.85	24.88	1.83	10.89	48.55	31.94	62.47	17.7	9.44	0.7	0.21
Dal grass (Hymenachne amplexicaulis)	10.28	17.88	23.84	0.78	17.05	40.45	28.95	54.2	15.39	9.16	0.75	0.27
Durba grass(Cynodon dactylon)	26.02	15.35	30.46	1.56	14.04	38.59	28.08	54.87	15.17	5.72	0.74	0.31
Kalmi	15.8	19.4	17.3	0.9	12.18	50.08	38.48	57.53	15.14	5	0.89	0.5

grass(Bromus kalmia)	7	9	5									1
Hachi grass	10.99	14.71	3.63	0.48	20.74	60.44	53.58	62.73	15.91	5.25	1.27	0.35
Shaila grass	27.27	9.54	3.01	0.78	11.95	74.72	53.7	82.49	15.3	5.05	0.77	0.35
Joina grass	16.62	16.1	2.99	0.83	10.15	69.93	22.24	81.56	16.52	5.45	0.49	0.17
wheat bran(Triticum Aestivum)	86.54	17.68	14.2	3.55	5.27	59.3	6.34	28.44	16.08	10.61	0.24	0.75
Maskalai bran (Vigna mungo)	86.46	13.86	24.6	1.39	8.68	51.47	11.26	18.75	15.92	10.51	0.78	0.21
Coconut oil cake (Cocos Nucifera)	90.55	21.02	29.15	9.8	7.68	32.35	26.09	48.6	19.24	11.25	0.01	0.37
Linseed oil cake(Linum usitatissimum)	90.48	32.77	7.16	10.2	10.57	39.3	24.48	40.48	19.36	12.78	0.43	0.9
Winter season												
Pakchung grass(pennisetum purpureum cv. Pak chong 1)	13.84	17.87	30.75	3.14	15.63	32.61	39.79	68.46	18.52	9.74	0.71	0.29
Dal Grass(Hymenachne amplexicaulis)	27.07	14.11	32.07	17.2	12.23	24.39	34.44	76.64	18	7.7	0.79	0.34
potato plant (Solanum tuberosum)	9.2	20.93	17.2	2.7	10.13	49.04	32.22	44.68	16.7	7.04	0.21	0.13
Kanaia grass	9.08	17.91	24.29	0.29	2.43	55.08	38.92	71.36	15.17	5.47	0.17	0.11
Bis katali grass	15.4	13.47	0.2	1.62	13.33	71.38	40.11	13.47	15.89	6.82		
Halencha grass (Enhydra fluctuans)	16.77	12.04	0.35	0.76	14.33	72.52	32.14	67.18	16.22	7.4		
Coconut oil cake(Cocos Nucifera)	94.37	16.56	29.15	9.8	6.34	38.15	19.66	37.84	17.27	11.39	0.25	0.75
Linseed oil cake (Linum usitatissimum L)	90.68	28.61	14.53	10.2	6.17	40.49	22.44	25.41	18.42	12.15	0.42	0.1
Lentil Powder (Lens culinaris)	89.08	13.95	12.48	2.49	5.83	65.25	34.68	44.28	24.37	16.08	0.16	1.36
Lentil bran(Lens culinaris)	89.03	13.09	14.28	1.1	3.66	67.87	23.8	58.61	16.28	10.74	0.07	0.12

Table 22. Nutritional composition of Available feeds and fodder of Khulna division

Feed Ingredients	Nutrient Composition (jashore sadar)											
Summer	**DM%**	**CP %**	**CF %**	**EE %**	**ASH %**	**NFE %**	**ADF %**	**NDF %**	**GE(MJ/ Kg DM)**	**ME (MJ/Kg DM)**	**Ca%**	**P %**
Durba grass (Cynodon dactylon)	44.13	8.93	29.72	1.21	12.05	48.09	50.2	60.92	15.72	5.19	0.37	0.29
Shama grass (Echinochloa colona)	41.2	11.07	30.62	1.09	13.21	44.01	34.81	56.92	16.24	5.36	0.4	0.25
Napier grass (Pennisetum purpureum)	19.42	5.82	35.79	1.12	9.11	48.16	36.91	61.37	16.78	11.07	0.49	0.26
Bhadla grass (Leaf & stem)	40.21	10.98	26.68	1.03	24.37	36.94	57.1	77.58	16.78	5.54	0.47	0.26
Straw-1 (Oryza sativa L)	85.85	7.19	34.16	1.4	10.24	47.01	31.57	64.44	15.88	5.24	0.26	0.11
Straw -2 (Oryza sativa L)	80.48	7.67	38.6	1.11	9.55	43.07	50.96	67.78	15.78	5.21	0.32	0.13
Rice Bran (Oryza sativa L)	90.85	12.2	12.6	8.5	14.53	52.17	18.85	38.58	16.3	10.76	0.17	0.33
Wheat bran -1 (Triticum Aestivum)	86.99	14.3	10.4	3.9	12.99	58.41	19.24	34.22	18.9	12.47	0.17	1.18
Maize Crusht (Zea mays L)	87.46	10.91	2.14	3.6	2.15	81.2	12.85	31.03	18.6	12.28	0.18	2.08
Chickpea bran/Sola Vangha (Cicer arietinum)	89.03	18.89	6.64	1.38	3.32	69.77	9.15	33.29	17.8	11.75	0.21	0.37
Napier grass (Pennisetum purpureum)	21.17	8.09	41.21	0.39	20.84	29.47	44.26	75.11	15.78	5.21	0.69	0.26
Bhadla grass (fresh, leaf and stem)	20.03	14.16	23.8	0.34	32.73	28.97	44.14	68.57	13.67	5.51	0.3	0.49
Bana grass (Pennisetumpurpureum x americanum)	29.12	14.96	33.88	1.99	18.79	30.38	36.99	53.82	17.24	5.69	0.47	0.17
Straw (Oryza sativa L)	83.53	6.69	36.52	0.45	19.27	37.07	46.81	74.94	15.32	5.06	0.29	0.09
Mustard oil cake(Brassica Juncea)	88.52	29.02	7.59	2.12	11.07	50.2	19.4	22.24	18.12	11.96	0.05	1.21
Maize crusht (Zea mays L)	90.06	10.44	12.3	3.4	6.7	67.16	6.47	17.19	18.26	12.05	0.47	0.88
Rice Bran (Oryza sativa L)	90.1	10.01	24.48	4.86	16.68	43.97	18.22	32	18.55	12.24	0.09	1.13
wheat Broken (Triticum Aestivum)	89.02	14.08	2.01	1.08	3.5	79.33	5.57	24.76	16.89	11.15	0.04	0.48
Ancor/Dabli Bran	85.68	5.28	22.96	1.11	13.39	57.26	24.03	44.13	16.66	11	0.38	0.35
Wheat bran	89.06	8.5	9.5	3.9	5.15	72.8	16.7	35.2	18.02	11.89	0.14	1.

(Triticum Aestivu)		5	8			2	8	1				11
Winter season												
Napier grass (Pennisetum purpureum)	14.14	5.17	43.32	0.37	13.94	37.2	47.83	78.92	16.27	5.37	0.43	0.13
Straw-1(Oryza sativa L)	83.3	7.8	36.25	1.35	32.86	21.74	44.12	72.24	17.24	5.69	0.058	0.12
Straw-1 (Oryza sativa L)	84.39	4.45	40.22	0.41	15.89	39.03	57.07	71.26	16.47	5.44	0.09	0.08
Mustard oil cake (Brassica Juncea)	93.91	30.24	6.09	2.09	10.31	51.27	18.24	39.47	18.36	12.12	0.81	1.06
Maize broken Corn (Zea mays L)	88.92	8.07	3.1	4.78	3.74	80.31	6.52	24.34	18.32	12.09	0.01	0.48
Wheat bran(Triticum Aestivum)	87.24	14.36	8.63	4.7	4.64	67.67	13.14	33.62	18.97	12.52	0.07	0.81
Rice bran (Oryza sativa L)	90.76	8.33	4.78	30.07	15.31	41.51	44.14	60.35	16.3	10.76	0.35	0.09
Rice polish (Oryza sativa L)	88.29	14.08	15.6	7.29	15.07	47.96	12.07	33.62	19.14	12.63	4.11	0.62
	Jhikargacha											
Summer	**DM%(fresh basis)**	**CP %**	**CF %**	**EE %**	**ASH %**	**NFE %**	**ADF %**	**NDF %**	**GE(MJ/kg DM)**	**ME (MJ/Kg DM)**	**Ca%**	**P %**
/Anchor/ Dabli Bran(Dry)	84.77	10.46	28.96	0.93	4.16	55.49	33.77	64.77	16.14	10.65	0.0914	0.41
Straw(Oryza sativa L)	85.35	5.19	36.32	0.398	15.14	42.952	49.07	71.68	15.84	5.23	0.29	0.09
Kalai (Vigna Mungo)	87.38	16.67	29.53	1.13	11.33	41.34	34.6	57.88	17.84	11.77	1.23	0.06
Broken rice (Oryza sativa L)	87.79	10.66	1.33	1.48	1.72	84.81	10.66	17.79	17.96	11.85	0.022934	0.11
Wheat bran (fine) Triticum Aestivum	85.57	14.57	12.32	1.99	12.68	58.44	18.74	36.6	15.46	10.2	0.063679	0.33
Wheat thin bran (coarse) Triticum Aestivum	85.78	14.81	7.74	4.72	4.38	68.35	9.64	58.34	18.34	12.1	0.061883	1.15
Broken maize (Zea mays L)	87.05	9.6	4.22	1.93	2.22	82.03	11.02	27.05	16.24	10.72	0.002734	1.8
mustard oil cake (brasica Juncea)	86.03	30.95	7.65	5.06	9.57	46.77	20.79	30.8	18.89	12.47	0.057473	1.2
Rainy season												
Sanchilata grass (	12.8	20.2	33.41		26.81		28.26	50.48	16.56	5.46		
Shama grass (Echinochloa colona)	28.07	14.62	34.4	1.8	18.52	30.66	47.06	77.15	14.24	5.36	0.45	0.22
Katanoti grass (Whole aerial)	14.69	14.96	28.34	1.83	25.83	29.04	32.84	60.04	16.18	5.34		
Straw -1(Oryza sativa L)	85.35	5.19	36.32	0.398	15.14	42.952	49.07	71.68	15.84	5.23	0.29	0.09

Straw -2(Oryza sativa L)	86.68	5.22	36.46	0.389	12.3	45.631	43.22	78.92	15.46	5.1	0.23	0.03
Maize broken Corn (Zea mays L)	86.54	11.33	0.77	1.93	2.87	83.1	4.14	22.12	16.26	10.73	0.2	0.09
Khasari crusht (Lathyrus sativus)	91.83	23.05	16.38	2.07	14	44.5	38.1	52.53	16.24	10.72	0.14	0.6
Wheat bran (fine) Triticum Aestivum	86.36	11.4	12.56	1.88	16.2	57.96	14.18	42.91	15.33	10.12	0.078288	0.2
Anchor/ Dabli Bran (Dry)	84.77	10.46	28.96	0.93	4.16	55.49	33.77	64.77	16.14	10.65	0.0914	0.41
Wheat bran (coarse) Triticum Aestivum	88.82	20.42	8.32	2.7	7.72	60.84	5.36	24.22	17.32	11.43	0.14	1.18
Winter season												
Khesari crusht (Lathyrus sativus)	91.02	20.64	16.38	2.09	6.84	54.05	7.41	33.24	16.95	11.19	0.08	0.29
Rice broken (Oryza sativa L)	89.38	9.56	1.44	6.7	5.72	76.58	8.27	16.48	18.12	11.96	0.05	0.28
Wheat bran (Coarse) (Triticum Aestivum)	90.01	17.29	12.7	1.88	4.73	63.4	10.02	50.65	16.26	10.73	0.078288	0.2
Mustard oil cake (Brassica Juncea)	90.04	28.84	8.12	5.63	10.72	46.69	13.21	34.8	18.12	11.96	0.070647	0.07
lentils bran (Lens culinaris)	90.89	9.6	11.88	3.87	6.84	67.81	37.34	55.11	16.28	10.74	0.62	0.37
Wheat bran (fine) Triticum Aestivum	90.29	14.81	9.58	4.72	6.36	64.53	9.32	34.36	17.04	11.25	0.016167	0.17
Maize broken (Zea mays L)	88.59	8.96	4.12	2.12	3.8	81	8.22	32.32	16.03	10.58	0.47	0.34
Straw (Oryza sativa L)	86.68	5.22		6.46	12.3		43.22	78.92		12.46		

Table 23. Nutrient Composition of different feeds and fodder of Chattogram Division

Patiya Upazila												
Feed Ingredients	Nutrient Composition											
Summer	**DM % (fresh basis)**	**CP %**	**CF %**	**EE %**	**ASH%**	**NFE%**	**ADF%**	**NDF%**	**GE(MJ/kg DM)**	**ME (MJ/Kg DM)**	**Ca %**	**P %**
Wheat Bran (fine) Triticum Aestivum	83.55	14.8	7.9	3.6	6.09	67.61	11.09	39.42	16.02	10.57	0.83	0.17
Soyabean meal (Glycine max)	85.74	42.44	5.33	1.7	9.72	40.81	20.7	44.02	18.7	12.34	0.62	0.42
Broken maize (Zea mays)	89.01	10.89	2.23	4.1	2.93	79.85	12.83	26.34	18.7	12.34	0.55	0.07
Wheat bran (coarse) Triticum Aestivum	87.6	12.41	15.91	3.9	12.67	55.11	19.32	48.87	15.46	10.2	0.83	0.17
Rice bran(Oryza sativa L)	92.18	10.92	14.1	13.2	16.79	44.99	18.01	61.47	20.5	13.53	1.6	0.38
Broken rice(Oryza	87.2	9.5	2.3	1.9	2.39	83.7	8.27	16.4	17.96	11.85	0.1	0.0

sativa L)		7	6			8		8			4	49
Split Bengal Gram /Boot daler khosa	86.44	10.29	28.32	2.3	4.45	54.64	17.2	61.68	17.72	11.7	0.28	0.74
Mung bean powder(Vigna radiate)	88.58	18.48	6.32	3.38	6.93	64.89	18.88	47.52	17.86	11.79	0.15	0.077
Mustard oil cake (Brassica Juncea)	86.45	30.56	2.17	9.4	8.99	48.88	18.51	29.47	18.24	12.04	1.11	0.05
Rainy season												
Chaga grass	17.39	8.19	32.01	1.03	14.35	44.42	41.76	64.28	16.22	5.66	1.01	0.39
Ghata grass	20.06	7.78	31.94	0.78	15.27	44.23	42.18	60.18	14.28	5.77	1.23	0.49
Dhal grass(Hymenachneam plexicaulis)	11.14	13.51	31.8	2.6	13.48	38.61	39.88	62.74	17.7	6.37	0.62	0.53
Mung crusht (Vigna radiate)	88.24	16.81	28.2	2.3	6.28	46.41	23.26	46.14	17.7	11.68	0.041	0.62
Mung Bran (Vigna radiate)	86.74	10.78	15.6	4.6	2.82	66.2	34.27	48.27	18.7	12.34	0.23	0.66
Soyabean meal (Glycine max)	86.48	48	4.4	1.7	13.97	31.93	13.46	36.32	19.7	13	0.24	0.72
Kalai (Black gram) (vigna mungo)	88.26	12.41	36.5	1.5	9.74	39.85	40.36	62.12	18.4	12.14	0.9	0.28
Chirar kura	90.94	5.64	47.23	0.88	20.38	25.87	38.22	70.23	15.74	5.19	0.075	0.33
Maize broken (Zea mays L)	88.54	15.2	6.5	5.8	4.12	68.38	4.4	21.44	18.7	12.34	0.054	0.56
Soyabean meal (Glycine max)	83.28	45.5	7.2	1.9	7.94	37.46	13.21	38.28	19.5	12.87	0.29	0.74
Winter season												
Para Grass (Brachiaria mutica)	23.18	12.87	35.26	1.7	9.56	40.61	41.66	68.93	15.84	5.23	0.72	0.74
Jupara Grass	9.95	12.56	38.11	0.23	4.38	44.72	41.64	71.75	14.25	4.7		
Dandy Patiya	16.59	10.93	37.22	1.44	8.79	41.62	47.74	73.42	15.85	5.23		
Mowluchi Grass	12.7	21.25	24.95	0.207	17.87	35.723	30.66	49.87	15.97	5.27		
Rice Straw (Oryza sativa L)	66.81	11.12	41.19	0.58	6.74	40.37	41.61	79.64	15.48	5.11	0.84	0.27
Durba Grass (Cynodon dactylon)	28.89	13.45	31.97	2.23	7.39	44.96	22.55	74.06	16.12	5.32	0.67	0.29
Mung Bran (Vigna radiata)	89.72	8.74	21.56	3.38	16.93	49.39	29.76	45.1	17.86	11.79	0.07	0.4
Mustard Oil cake (Brassica Juncea)	86.51	7.24	7.46	6.8	28.89	49.61	13.19	33.37	18.24	12.04	0.078	1.67
Chirar Kura	91.11	14.72	26.46	2.49	8.03	48.3	45.91	77.21	16.54	6.19	0.02	0.37
rice broken (Oryza sativa)	86.5	2.22	0.88	2.14	8	86.76	8.67	29.82	18.1	11.95	0.044	0.17
Aahila pata	64.79	9.6	37.47	0.37	15.47	37.09	40.42	59.41	16.35	5.4	1.11	0.09
Veraker Grass	38.43	12.52	41.23	0.61	8.87	36.77	43.85	78.48	15.44	5.1		
Rice Straw(Oryza sativa L)	82.92	5.59	38.55	0.78	15.89	39.19	41.32	71.12	15.5	5.12	0.22	0.069
Mustard oil cake (Brassica Juncea)	89.46	30.81	7.1	7.8	13.43	40.86	23.72	31.12	19.22	12.69	0.05	1.11

Naikhangchori												
Summer	**DM % (fresh basis)**	**CP %**	**CF %**	**EE %**	**ASH%**	**NFE%**	**ADF%**	**NDF%**	**GE(MJ/kg DM)**	**ME (MJ/ KgDM)**	**Ca %**	**P %**
Maize broken(Zea mays)	87.75	7.8	14.3	1	6.98	69.92	4.48	14.88	16.02	10.57	1.23	0.49
Wheat bran(Triticum Aestivum)	88.81	15.79	11.7	3.5	7.56	61.45	3.72	45.2	18.66	12.32	0.18	0.88
Molasses	80.76	0.148	0.1	0.8	8.43	90.522	0.5	0.8	15.7	10.36	0.92	0.07
Rice polish (Oryza sativa L)	88.33	11.73	4.2	15.77	8.09	60.21	11.24	18.32	19.88	13.12	0.32	1.48
Rainy season												
German grass	88.62	11.73	32.57	1.55	12.81	41.34	34.24	60.42	18.92	6.24	0.38	0.13
Rice Straw-1(Oryza sativa L)	85.1	5.95	45	0.78	18.33	29.94	42.46	62.54	15.5	5.12	0.034	0.04
Para grass (Brachiaria mutica)	87.58	8.87	36.57	2.74	10.97	40.85	42.22	76.81	18.49	6.1	0.06	0.05
Rice Straw-2 (Oryza sativa L)	81.49	4.84	42.51	0.56	15.43	36.66	38.41	68	16.22	5.51	0.099	0.031
Napier grass (Pennisetum purpureum)	87.72	8.53	33.54	2	10.49	45.44	34.88	69.35	17.78	7.11	0.34	0.18
Mustard oil cake (Brassica Juncea)	90.72	29.93	8.39	10.22	13.41	38.05	21.87	31.24	19.74	13.03	0.08	2.13
Rice bran(Oryza sativa L)	89.28	7.82	14.1	12.2	9.45	56.43	17.45	37.88	20.14	13.29	0.08	1.32
Wheat bran(Triticum Aestivum)	88.73	14.6	11.4	3.3	4.74	65.96	14.81	54.24	18.3	12.08	0.87	1.54
Maize broken(zea mays)	88.17	12.19	2.6	3.8	9.2	72.21	3.32	13.32	18.25	12.05	0.19	0.63
winter season												
Napier Grass (Pennisetum purpureum)	11.56	16.83	44.43	1.07	12.56	25.11	45.17	78.35	19.82	6.54	0.36	0.29
Dal Grass(Hymenachne amplexicaulis)	17.34	14.67	38.6	2.6	13.04	31.09	38.11	65	22.58	7.45		
Fulker Grass	33.68	11.62	47.61	0.49	9.23	31.05	47.9	80.99	16.52	5.45		
Para Grass (Brachiaria mutica)	26.63	15.2	33.16	2.3	10.2	39.14	47.78	76.42	17.57	5.8	0.47	0.24
Dukker Grass	36.11	12.55	37	0.88	3.72	45.85	33.9	68.64	15.02	4.96		
koda Grass	38.91	10.05	46.03	0.53	8.42	34.97	47.23	80.13	16.36	5.4		
German Grass (Echinochloa polystachya)	26.36	12.05	43.94	1.83	8.98	33.2	42.14	70.5	18.98	6.26	0.35	0.27
Bhadli Grass	29.59	8.99	41.22	0.23	12.26		36.95	73.06	12.98	4.28		
Maize Leaf (Zea mays)	22.05	8.85	28.26	1.8	15.53	45.56	33.88	65.52	18.5	6.11	0.63	0.15
Banana Tree (Stem) (Musa acuminate)	5.8	1.38	48.2	5.8	4.86	39.76	37.34	56.74	13.74	4.53	0.81	0.26

24. Final Questionnaire:

পবিআরজউপ-প্রকল্প

বাংলাদেশপ্রাণিসম্পদগবেষণাইনস্টিটিউট

সাভার, ঢাকা- ১৩৪১ , ফোন : ৭৭৯১৬৭০এক্স-২৩৫ফ্যাক্স : ৮৮০-২-৭৭৯১৬৭৫
ই- মেইল:nassul2003@yahoo.com: www.blri.gov.bd

Development of Knowledge Hub.....Livestock

সরিয়াল নং/কোড.....

অঞ্চল.....

ঋতু.....

ক) প্রাণিসম্পদের সংখ্যা কত: (জেলা প্রাণিসম্পদ অধিদপ্তর/ □□□□□□ প্রাণিসম্পদ অধিদপ্তর)

প্রজাতি অনুসারে:

১. গরু.....
২. মহিষ.....
৩. ছাগল.....
৪.ভেড়া.....
৫. অন্যান্য.....

খ) খামারীর সাধারণ তথ্যাবলী

১. খামারীরনাম:.....

২. খামারীরলিঙ্গ: - ছেলে/পুরুষ-স্ত্রী/মেয়ে

৩. খামারীরবয়স ..... বছর

৪. ঠিকানা: গ্রাম: ..... ইউনিয়ন: ....., ওয়ার্ড: .....

উপজেলা:.....জেলা: .....ফেইসবুক আইডি: .....

জি পি এস কো-অর্ডিনেট: ....., মো-বাইল নং: .....

৫. খামারীরশিক্ষাগত যো-গ্যতা:

প্রাথমিক বিদ্যালয়মাধ্যমিক□দ্যালয় কারিগরি শিক্ষা ব□জে/বিশ্ববিদ্□লয় অন্যান্য

৬.খামারীর মোট আয়.....

৭.খামারীর মোট জমির পরিমান কত.....

৮. আপনি কত বছর আগে খামারটি তৈরী ক□□□□□□□□

৯. খামার সম্পর্কিত কোন পূর্ব প্রশিক্ষণ গ□ছে কিনা? হ্□ না
যদি থাকে, কো-থায় প্রশিক্ষণ নিয়েছেন?.....

গ) খামারের উ□পাদন পদ্ধতি

১. খামাররে মালকিানা	একক মালকিানা	যৌথ মালকিানা	সমবায়		
২. উ□পাদনরে ধরণ	গতানুগতকি	এক্সটনেসভি	ইন্টনে সভি	মক্সিড ক্রপ/ সম্বনতি	বাথান
৩. বাজারজাতকরণ	আনুষ্ঠানকি	অনানুষ্ঠানকি (স্থানীয়ভাবে দুধ বক্রিয় করা হয়/ বাড়ী বাড়ী/ গোয়ালাদরে কাছে ইত্যাদি)			
৪. খামাররে ধরণ	বাণজ্যিকি খামার	পারবিারকি খামার	গৃহস্থালী খামার		

ঘ) গৃহপালতি গবাদি প্রাণি সংক্রান্ত তথ্যাবলী

১) প্রাণীর সংখ্যা

নং	প্রাণরি প্রজাতি	প্রকার	দশেী/সংকর	দুধ উ□পাদন	কাঁচা ঘাস	খড়	দানাদার খাদ্য
১	গরু	দুধ হয়না এমন গাভী					
		দুধালো গাভী					
		ষাঁড়					
		বলদ					
		বাড়ন্ত ষাঁড় (১-২ বছর)					
		বাড়ন্ত বকনা (১-২ বছর)					
		ষাঁড় বাছুর (১ বছররে নচিে)					
		বকনা বাছুর (১বছররে নচিে)					
২	মহষি	যে কোনে (ছোটে-বড় সহ)					
৩	ছাগল	যে কোনে (ছোটে-বড় সহ)					
৪	ভড়ো	যে কোনে (ছোটে-বড় সহ)					

২) গাভীর দুধ উ□পাদন

জাত	সর্বোচ্চ দুধ উ□পাদন (ময়োদ/ দনি)	গড় দুধ উ□পাদন(কজে/দনি)	দুধ ছাড়ার মূহুর্তে উ□দপাদন (কজে / দনি)	মোট দুগ্ধদান কাল (দনি)
দশেী গাভী				
সংকর গাভী				
মহষি				

৩) রাফজে সংক্রান্ত তথ্য

খাদ্যরে ধরন	উ□স a.নজিরে উ□পাদতি b. ক্রয়কৃত	ক্রয়কৃত হলে	
		পরমিান (কজে/বছর)	দাম প্রতি কজে
আউশ ধানরে খড়			
আমন ধানরে খড়			
বোরো ধানরে খড়			
হাইব্রীড ধানরে খড়			
গমরে খড়			
ভুট্রার খড় / গাছ			
প্রক্রয়িাজাতকৃত খড়			
সবুজ ঘাস (দশেী কাটা ঘাস)			
চাষকৃত ঘাসসবুজ ঘাস ১) নপেয়িার			
২) পারা			
৩) জার্মান			
৪) ওট ৫) ভুট্টা			
৬) স্থানীয় (কনে ঘাস.....) ক)			
খ)			
গ)			
ঘ)			
৭.সাইলজে .....হ্যা/না যদি হ্যা হয় তবে কনে ঘাসরে সাইলজে			
৯. অন্যান্য			

৪)সরবরাহকৃত দানাদার জাতীয় খাবার ওতার তথ্যাবলী:

খাদ্যরে ধরন	উ□স a.নজিরে উ□পাদতি b. ক্রয়কৃত	কনে ধরনরে বাজার	ক্রয়কৃত হলে	
			পরমিান (কজে/ বছর)	দাম (প্রতি কজে)
চালরে কুড়া				
রাইস পলসি				
গমরে ভূষি				
খসোরী /কালাই ভূষি				
ছালো /ডালরে ভূষি				

ভুট্রা ভাঙ্গা				
গমরে মোটা ভুষি				
গমরে মহিি ভুষি				
চাল ভাঙ্গা / খুদ				
সরষিার খলৈ				
সয়াবনি খলৈ				
খসোরী ভাঙ্গা				
তলিরে খলৈ				
মোলাসসে/লালী গুর				
দানাদাররে মশি্রন				
আখরে ছোবরা				
নারকিলেরে উচ্ছষ্টি				
লালি				
নারকিলেরে খলৈ				
তুলার বীজরে খলৈ				
অন্যান্য				

ঙ) ভটিামনি মনিারলে সরবরহ

গবাদি পশুকে কোন ফসলরে উপজাত অথবা মনিারলে সাপ্লমিন্টে সরবরাহ করা হয় কি না ?

যদি উত্তর হ্যাঁ হয় তাহলে সরাসরি প্রশ্নে যতেে হবে।

কি ব্যবহার করনে	বছররে কোন কোন মাসে খাওয়ানো হয়	কতটুকু খাওয়ান
০১.		
০২.		
০৩.		
০৪.		
০৫.		

চ) ক্রয়কৃত খাদ্যরে ববিরন(যদি ক্রয় হয়ে থাকে) :

খাদ্যরে ধরন	খাদ্যরে পরমিান (কজেি/সরে/লটিার)	দাম/কজেি	কোন ধরনরে বাজার	বার্ষকি/মাসে ক্রয়কৃত খাদ্যরে পরমিান(কজেি)
খসোরী কালাই				
লালি				
নারকিলেরে খলৈ				
তুলার বীজরে খলৈ				
খসোরী ভাঙ্গা				
ভুট্রা (শস্য সহ)				
সরষিার খলৈ				

ধানরে তুষ, ভূষী				
রাইস পলসি				
সয়াবনি খলৈ				
তলিরে খলৈ				
গমরে মোটা ভূষী				
গমরে মহিি ভূষী				
আখরে ছোবরা				
নারকিলেরে উচ্ছষ্টি				
দানাদাররে মশি্রন				
অন্যান্য.....				

ছ) পরবিাররে আয় – ব্যয় সংক্রান্ত তথ্যাবলী

অনুগ্রহ পূর্বক আপনার পরবিাররে কৃষি ও গবাদি পশু হইতে প্রাপ্ত বার্ষকি আয় বলুন

নং	আয়রে উ□স সমূহ	বর্ষকি আয় (টাকা)
০১	গবাদি পশু-পাখি বক্রিয়	
০২	দুধ বক্রিয়	
০৩	গোবর বক্রিয়	
০৪	সবুজ ঘাস বক্রিয়	
০৫	অন্যান্য.....(উল্লখে করুন)	
	সর্বমোট আয় =	

ঝ) ধানরে খড়রে হারভষে্ট ইনডক্স নর্িণয়:

ফসলরে জাত		ফসল কাটার ধরন					
ফলন/ একক	□□□□□□□□ ন	নম্নিভাগ		মধ্যভাগ		উপররে ভাগ	
ধানরে জাত		□□□□ জ	□□ □□	□□□□ জ	□□ □□	□□□□ জ	□□ □□
আউশ							
আমন							
বোরো							
হাইব্রীড							
মো·ট							
ডালরে জাতীয়	□□□□□□□□ ন	□□□□		□□□□□			
১.							
২.							
৩.							
৪.							
৫.							
অন্যান্য.....							
মো·ট উ□পাদন/একক							
□□□জাতীয় ফসল							
১.							

২.			
৩.			
৪.			
৫.			
অন্যান্য.....			
মো·ট উ□পাদন/একক			
অন্যান্য.....			

ঞ্জ □□□□□□□□□□□□□□□□□□□□:

□□□□□□□□	□□□□□□	□□□□□□	□□□□□□□□□□ (□□□□□□□□ /□□□□□□□□□)
□□□□□			
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□□□□			
□□□□□□□□□			
□□□□□□□□□			
অন্যান্য.....			
□□□□□□□□			
১.			
২.			
৩.			
৪.			
৫.			
৬.			

সময় দেয়ার জন্য আপনাকে অশেষ ধন্যবাদ , ভালো থাকুন , সুস্থ থাকুন

Annexure-II

Component-2 (BAU)

The Data/information that were obtained for this project are given as Annex for providing better overview of the project outcome and database

Annex 1: Detailed list of Review of literature (Name of the feed, Number of the paper, year and author)

Sl No.	Feed name	Number of papers	Year	Author
1	Alfalfa	18	2000	C.D. Hanburya,*, C.L. Whiteb, B.P. Mullanc, K.H.M. Siddiquea,c
2	Alfalfa		1998	E. H. JASTER 2 and K. J. MOORE 3
3	Alfalfa		1985	C V SAVANGIKAR, V A SAVANGIKAR and R N JOSHI
4	Alfalfa		2013	A. Moharrery* and E. Toghyani
5	Alfalfa		1977	Y. YU, G. K. MACLEOD, J. B. STONE, and D. G. GRIEVE
6	Alfalfa		1988	E. H. JASTER 2 and K. J. MOORE 3
7	Alfalfa		1983	M. Hadjipanayiotou, S. Economides and D. Hadjidemetriou
8	Alfalfa		1977	Y. YU, G. K. MACLEOD, J. B. STONE, and D. G. GRIEVE
9	Alfalfa		2006	Deborah A. Samac, Hans-Joachim G. Jung, and JoAnn F. S. Lamb
10	Alfalfa		1991	W. L. SHOCKEY
11	Alfalfa		1983	M. Hadjipanayiotou, S. Economides and D. Hadjidemetriou
12	Alfalfa		1993	I. ANDRIGHETTO, L BAILONI, G. COZZI, and H. F. TOLOSA
13	Alfalfa		2014	V. Laudadio ,* E. Ceci ,† N. M. B. Lastella ,* M. Introna ,* and V. Tufarelli *1
14	Alfalfa		2008	† Akwasi A. Boateng,* Charles A. Mullen, Neil Goldberg, and Kevin B. Hicks
15	Alfalfa		1993	I. ANDRIGHETTO, L BAILONI, G. COZZI, and H. F. TOLOSA
16	Alfalfa		2013	A. Moharrery* and E. Toghyani
17	Alfalfa		1991	W. L. SHOCKEY
18	Alfalfa		1970	'~ D. A. STILES, E. E. BARTLEY, G. L. KILGORE, F. W. BOREN, and H. B. PERRY
19	Andropogon		2012	National Dairy Development Board
20	Andropogon		2013	Trin *A.F. Waziri, S.A. Anka, A.Y. Bala and H.

		03		Shehu
21	Andropogon		2008	J A Odedire and O J Babayemi*
22	Broken Rice		2013	M. De Marco1 , P. G. Peiretti2 , N. Miraglia3 and D. Bergero1†
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
23	Broken Rice	10	2016	Jean Paulo de Oliveira a , Graziella Pinheiro Bruni a , Karina Oliveira Lima b , ShaniseLisie Mello El Halal a , Gabriela Silveira da Rosa c , Alvaro Renato Guerra Dias a , Elessandra da Rosa Zavareze a
24	Broken Rice		1976	P. J. McKINNONI. J. P. BOWLANDl. and SUCHEEP RATARASARN'z
25	Broken Rice		2016	J. C. Dadalt, C. Gallardo, G. V. Polycarpo, F. E. L. Budiño1 , A. Rogiewicz2 , D. A. Berto3 , and M. A. Trindade Neto*
26	Broken Rice		2018	GracieleDalise Schirmann1 Leonardo Tombesi da Rocha2* Henrique da Costa Mendes Muniz2 JosuéSebastiany Kunzler2 MicheliFaccin Kuhn2 Vladimir de Oliveira2
27	Broken Rice		2016	Jean Paulo de Oliveira a , Graziella Pinheiro Bruni a , Karina Oliveira Lima b , ShaniseLisie Mello El Halal a , Gabriela Silveira da Rosa c , Alvaro Renato Guerra Dias a , Elessandra da Rosa Zavareze a
28	Broken Rice		2008	K. Vasupen1*, C. Yuangklang1 , S. Wongsuthavas1 , P. Srenanul1 , J. Mitchaothai2 and A. C. Beynen3
29	Broken Rice		2013	M. De Marco1 , P. G. Peiretti2 , N. Miraglia3 and D. Bergero1
30	Broken Rice		2018	GracieleDalise Schirmann1 Leonardo Tombesi da Rocha2* Henrique da Costa Mendes Muniz2 JosuéSebastiany Kunzler2 MicheliFaccin Kuhn2 Vladimir de Oliveira2
31	Broken Rice		2016	J. C. Dadalt, C. Gallardo, G. V. Polycarpo, F. E. L. Budiño1 , A. Rogiewicz2 , D. A. Berto3 , and M. A. Trindade Neto*
32	Cassava roots	04	2005	Duong Nguyen Khang1 , Hans Wiktorsson* and Thomas R. Preston
33	Cassava roots		2004	Albert Linton Charles a , KlanarongSriroth b , Tzou-chi Huang c,
34	Cassava roots		2013	Kenneth VA Richardson
35	Cassava roots		2014	Salvador E. M.1 , Steenkamp V.2 and McCrindle C. M. E.1 *
36	Cowpea	07	2003	N.J. Tshovhote# , A.E. Nesamvuni, T. Raphulu and R.M. Gous1
37	Cowpea		2005	Sultan Singh ∗, S.S. Kundu, A.S. Negi, P.N. Singh
38	Cowpea		2005	SY Giami∗
39	Cowpea		2006	Aremu M. Olaleke 1*, OlaofeOlorunfemi 2 and T.

				Emmanuel Akintayo 2
40	Cowpea		2005	M.E. Rivas-Vega a , E. Goytortu´a-Bores b , J.M. Ezquerra-Brauer c , M.G. Salazar-Garcı´a b , L.E. Cruz-Sua´rez c , H. Nolasco a , R. Civera-Cerecedo a,*
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
41	Cowpea	07	2007	Leticia Olivera-Castillo,1∗ Fabiola Pereira-Pacheco,2 Erik Polanco-Lugo,2 Miguel Olvera-Novoa,1 Jose Rivas-Burgos ´ 3 and George Grant
42	Cowpea		2008	Henry Fualefac Defang*, Alexis Teguia, J. Awah-Ndukum, AugustaveKenfack, Ferdinand Ngoula and F. Metuge
43	Cowpea		2014	Ginka A. Antova a, *, Tsvetelina D. Stoilova b,1 , Maria M. Ivanova a
44	Dhal	09	2015	HardiSyafria *, NovirmanJamarun , Mardiati Zein and Evita Yan
45	Dhal		2002	A.K.Hira, M.Y.Ali, M.R.Zaman
46	Dhal		2019	HardiSyafria, 2 NovirmanJamarun and 2 Roni Pazla
47	Dhal		2008	M. J. Khan*, M. A. Hannan, S. Islam5 and M. N. Islam
48	Dhal		2012	National Dairy Development Board
49	Dhal		2008	Jasimuddin Khan
50	Dhal			evin U. Hill
51	Dhal		2015	HardiSyafria *, NovirmanJamarun , Mardiati Zein and Evita Yan
52	Dhal		2012	AR Kanak1 , MJ Khan2 , MR Debi*2 , MK Pikar1 , M Aktar
53	Duckweed	03	2018	Klaus-J. Appenroth1*, K. Sowjanya Sree2, Manuela Bog3, Josef Ecker4, Claudine Seeliger4, Volker Böhm5,6, Stefan Lorkowski5,6, Katrin Sommer7, Walter Vetter7, Karla Tolzin-Banasch8, Rita Kirmse8, Matthias Leiterer8, Christine Dawczynski5,6, Gerhard Liebisch9 and Gerhard Jahreis5,6
54	Duckweed		2003	J. P. Goopy and P. J. Murray*
55	Duckweed			
56	Feedstuff	03	2013	Onyeonagu, C. C.* and Eze, S. M.
57	Feedstuff		2009	A Donkoh and V Attoh-Kotoku
58	Feedstuff		2008	S.Arbabi
59	German	06	2001	SHIV A DHAR" S D GUPTA\ A SINGH] and R L ARY N
60	German		2016	Martin Hannan-Jones and Jason Weber
61	German		1958	V. A. OYENUGA
62	German		2009	1 Patrícia Regina de Souza Siqueira Campos2, José Fernando Coelho da Silva3, Hernán Maldonado Vásquez3, Andréa Vittori4, Martinho de Almeida e Silva

63	German		2016	M N Hossain1 , M M Mia2 , M A Baset*1 and M M H Khan3
64	German		2017	MM Islam1, 3, MMH Khan1*, MJ Uddin2 and MJ Islam1
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
65	Groundnut cake	15	2009	V.N.Atasie
66	Groundnut cake		2011	Chitra Purohit &PeramRajyalakshmi
67	Groundnut cake		2015	Koushik Ghosha,∗, Sudipta Mandal a,b
68	Groundnut cake		2008	FAPOHUNDA OlawumiOluwafunmilola
69	Groundnut cake		2016	1 Oche Ikese, 2 Simon Ubwa, 3 Sunday Adoga, 4 Jessica Lenka, 5 Joy Inalegwu, 6 Musa Ocheje, 7 AuduInegedu
70	Groundnut cake		2012	Olanipekun, B.F. Otunola, E.T. Adejuyitan, J.A. Adeyanju, J.A
71	Groundnut cake		2016	Abimbola Kemisola Arise
72	Groundnut cake		2012	National Dairy Development Board
73	Groundnut cake		2013	YosephMekasha and Mengistu Urge
74	Groundnut cake		2006	FEKRIA ALI MOHAMED IBRAHIM
75	Groundnut cake		2011	Satish Ingale* and S. K. Shrivastava
76	Groundnut cake		2012	1 Fekria, A. M., 1,2Isam, A. M. A., 3 Suha, O. A. and 2*Elfadil, E. B.
77	Groundnut cake		2015	Koushik Ghosha,∗, Sudipta Mandal a,b
78	Groundnut cake			Dr. Md. Zulfikar Ali
79	Groundnut cake		2019	AMITAVA ROY*, PARTHA SARATHI ROY , SANDEEP KUMAR , RATNESH KUMAR CHOUDHARY AND 4 NILANJANMANDAL
80	Ipil Ipil	03	2009	Dr Hossain Zamal, Prabal Barua, Belal Uddi
81	Ipil Ipil		1979	Pascual, Felicitas
82	Ipil Ipil		2016	Manika Debnath1 , ZahirulHauque Khandakar2 , Md. Ashadul Alam3* and Md. Abu Heyame
83	juck fruit	01	2008	D V Reddy and N Elanchezhian
84	Jumbo	03	2008	H. M. Dann,* R. J. Grant,*1 K. W. Cotanch,* E. D. Thomas,* C. S. Ballard,* and R. Rice
85	Jumbo		2015	Md. EnamulHaq Hazary1*, Tahmina Bilkis2 , Zahirul Haque Khandaker3 , Md. Ali Akbar3 , A. B. M. Khaleduzzaman4
86	Jumbo		2017	Uğur BASARAN1*, Medine COPUR DOGRUSOZ1 ,

87	Khesari	09	2016	Maria Federica Trombetta, Simona Mattii, Marina Pasquini& Adalberto Falaschini
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
88	Khesari		2005	Sachchidananda D. Chowdhury+ , Zeenat Sultana+, MusabbirAhammed+, Bishan L. Chowdhury, Shubash C. Das- and Bimol C. Roy.
89	Khesari	09	2000	C.D. Hanburya*, C.L. Whiteb, B.P. Mullanc, K.H.M. Siddiquea
90	Khesari		2014	Uddin Md Nazim1*, Belal Shah Ahmed2 , Akanda Md Rashedunnabi3 , Mahfuz Md Shad Uddin5 , Khan Mohammad Mehedi Hasan4 , Baset Md Abdul1
91	Khesari		2005	Secundino Lopez, ´ 1,2∗ David R Davies,3 F Javier Giraldez, ´ 2,4 MS Dhanoa,3 Jan Dijkstra5 and James France6
92	Khesari		2009	Eugeniusz R. Grela • Wojciech Rybin´ski • Renata Klebaniuk • Jan Matras
93	Khesari		2010	V. Tufarelli**, E. Cazzato1 , A. Ficco2 and V. Laudadio
94	Khesari		2016	Maria Federica Trombetta, Simona Mattii, Marina Pasquini& Adalberto Falaschini
95	Khesari		1997	: F.J. Muehlbauer and Abebe Tullu
96	Lucerne	04	2013	Meena Devi VN1*, Ariharan VN2 and Nagendra Prasad P3
97	Lucerne		2008	P K MALIK1 and K K SINGHAL
98	Lucerne		2011	Abou-Elezz F. M. K.1,2, L. Sarmiento-Franco1 , R. Santos-Ricalde1 and F. Solorio-Sanchez1
99	Lucerne		2009	P K MALIK1 and K K SINGHAL2
100	Maize	24	2014	J. T. Amodu1 , T. T. Akpensuen2 , D. D. Dung1 , R. J. Tanko1 , A. Musa3 , S. A. Abubakar1 , M. R. Hassan2 , J. O. Jegede1 & I. Sani2
101	Maize		1992	B. Barrier-Guillot a, Zuprizalb,l , C. Jondreville a, A.M. Chagneau b, M. Larbier b and M. Leuillet a
102	Maize		2017	Yuan He,a*,† Thibaut MB Mouthier,b,† Mirjam A Kabel,b Jan Dijkstra,aWouter H Hendriks,a Paul C Struikc and John W Cone
103	Maize		2018	1 NyimasPopiIndriani, 2 YuyunYuwariah, 2 Anne Nuraini and 2 DediRuswandi
104	Maize		1995	G.E. Schroeder * , L.J. Erasmus, H.H. Meissner ’
105	Maize		2016	Shalini Vaswani1, *, Ravindra Kumar2 , Vinod Kumar3 , Debashis Roy1 and Muneendra Kumar1
106	Maize		2003	G. Getachew∗, P.H. Robinson, E.J. DePeters, S.J. Taylor
107	Maize		1989	A.Azim, Z. Naseer and A.Ali
108	Maize		2018	M. Wadhwa, Balwinder Kumar1 and M.P.S.

				Bakshi*
109	Maize		2016	A.T. Kanengoni1# , B.D. Nkosi1,2, M. Chimonyo3 , B. Ndimba4 & K. Dzama
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
110	Maize		2003	J.L. Snowa,1, H.H. Stein b, P.K. Ku a, N.L. Trottier a,∗
111	Maize			C. debendra
112	Maize		2006	K.A. Darshan, U. Krishnamoorthy ∗, D. Kiran 1, R. Bhaskaran, V. Manjunath 2
113	Maize		2008	José Nobre de Carvalho Junior2, Aureliano José Vieira Pires3,5, Fabiano Ferreira da Silva3,5, Cristina Mattos Veloso3,5, Cristiane Leal dos Santos-Cruz3, Gleidson Giordano Pinto de Carvalho5
114	Maize		2009	A Donkoh and V Attoh-Kotoku
115	Maize		2011	Abou-Elezz F. M. K.1,2, L. Sarmiento-Franco1 , R. Santos-Ricalde1 and F. Solorio-Sanchez
116	Maize		2010	A Akinfemi
117	Maize		2015	M.E. Hossain1* , G.B. Das1 and M.A. Akbar
118	Maize		2013	Meena Devi VN1*, Ariharan VN2 and Nagendra Prasad P3
119	Maize		2016	M N Hossain1 , M M Mia2 , M A Baset*1 and M M H Khan3
120	Maize		1993	B. Barrier-Guillot a, Zuprizalb,l , C. Jondreville a, A.M. Chagneau b, M. Larbier b and M. Leuillet a
121	Maize		2006	K.A. Darshan, U. Krishnamoorthy ∗, D. Kiran 1, R. Bhaskaran, V. Manjunath 2
122	Maize		2003	G. Getachew∗, P.H. Robinson, E.J. DePeters, S.J. Taylor
123	Maize		2016	Shalini Vaswani1, *, Ravindra Kumar2 , Vinod Kumar3 , Debashis Roy1 and Muneendra Kumar1
124	Maize stover			Meng Qingxiang
125	Maize stover	03	2015	* 1Tona, G. O., 2Ogunbosoye, D.O. and 1Ayano, M.O.
126	Maize stover		2017	A.J. Amuda* 1 , O.O. Falola2 and O.J. Babayemi3
127	Mango		1985	Sukhsatej Dhingra and Amin C. Kapoor
128	Mango	02	2001	E Omoregie
129	Mustard Oil cake		2015	Sarker1*, Dipti Saha2 , Hasina Begum2 , Asaduz Zaman2 and Md Mashiar Rahman
130	Mustard Oil cake		2015	swati, snehashewag
131	Mustard Oil cake		2017	Suraj Babu Ghimire and Rahul Ranjan
132	Mustard Oil cake		2017	Mahima1* , Santosh Kumar Tomar2 , Vinod Kumar1 , Debashis Roy1 , Anu Rahal3 and Rajesh Mandil4
133	Mustard Oil		2012	Nasim Al Mahmud, M.D. Robiul Hasan, M. Belal

	cake	08		Hossain and Maruf Hossain Minar
134	Mustard Oil cake		2015	Mahima1, Vinod Kumar1, S. K. Tomar2, Debashis Roy1 and Muneendra Kumar
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
135	Mustard Oil cake			Dr. Md. Zulfikar Ali
136	Mustard Oil cake		2009	P. A. Thacker* and D. Petri
139	Moringa	05	2013	Alikwe, P.C.N* and Omotosho, M. S
140	Moringa		2013	Sodamade, A., Bolaji, O. S. and Adeboye, O. O.
141	Moringa		2011	Ogbe, A.O.* and John P. Affiku
142	Moringa		2015	P.A. Okiki, I.A. Osibote, O. Balogun, B.E. Oyinloye, O. Idris, 11 1 2 1 Adelegan Olufunke, S.O. Asoso and P.T. Olagbemide
143	Moringa		2011	1 E.I. Bamishaiye, 1 F.F. Olayemi, 1 E.F. Awagu and 2 O.M. Bamshaiye
144	Napier	04	2006	S. Premaratne1 and G.G.C. Premalal
145	Napier		2005	A.A.Uganga,U.J. Omhile
146	Napier		2017	C.H. Jagadeesh1 , Y. Ramana Reddy1 , D. Nagalakshmi1 , M. Mahender2 , N. Nalini Kumari1 , K. Sridhar1* and K.B. Suneetha Devi3
147	Napier		2009	José Nobre de Carvalho Junior2, Aureliano José Vieira Pires3,5, Fabiano Ferreira da Silva3,5, Cristina Mattos Veloso3,5, Cristiane Leal dos Santos-Cruz3, Gleidson Giordano Pinto de Carvalho5
148	Sorgumsudan grass	03	2009	A Donkoh and V Attoh-Kotoku
149	Sorghum sudan grass		2008	* R. J. Grant,*1 K. W. Cotanch,* E. D. Thomas,* C. S. Ballard,* and R. Rice
150	Sorghum sudan grass		2017	Uğur BASARAN1*, Medine COPUR DOGRUSOZ1 , Erdem GULUMSER1 , Hanife MUT1
151	Para	04	2012	Baragahoranye Innocent1 , Mupenzi Jean de la Paix1,2, Habiyaremye Gabriel1 ,Ngamije Jean
152	Para		1996	A.B.Serra, M. Fujihara
153	Para		2002	Orlando Guenni1, Douglas Mar´ın 1 & Zdravko Baruch
154	Para		2010	V. Tufarelli**, E. Cazzato1 , A. Ficco2 and V. Laudadio
155	Rapeseed		2016	L. Puhakka, S. Jaakkola, I. Simpura, T. Kokkonen, and A. Vanhatalo1
137	Rapeseed meal		2018	TekebaNega, Yirdawwoldes
138	Rapeseed meal		2013	*Thanaseelaan V
156	Rapeseed		2018	M. Lamminen,1,2* A. Halmemies-Beauchet-

				Filleau,1 T. Kokkonen,1 A. Vanhatalo,1,2 and S. Jaakkola1 †
157	Rapeseed		2018	TekebaNega, Yirdawwoldes
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
158	Rapeseed	26	2017	M. Bojanowska
159	Rapeseed		2019	
160	Rapeseed		2014	P. Matusevicius, Z. Zdunczyk , J. Juskiewicz and H. Jeroch
161	Rapeseed		2013	M. Brask ,* P. Lund ,*1 M. R. Weisbjerg ,* A. L. F. Hellwing ,* M. Poulsen ,* M. K. Larsen ,† and T. Hvelplund
162	Rapeseed		2012	S. Lerch ,* A. Ferlay ,* D. Pomiès ,*† B. Martin ,* J. A. A. Pires ,* and Y. Chilliard *1
163	Rapeseed		2012	Anne Lomascolo& Eva Uzan-Boukhris& Jean-Claude Sigoillot& Frédéric Fine
164	Rapeseed		2012	S. Lerch ,* A. Ferlay ,* D. Pomiès ,*† B. Martin ,* J. A. A. Pires ,* and Y. Chilliard *1
165	Rapeseed		2011	Q. C. Dang Van ,*1 L. Bejarano ,* E. Mignolet ,* D. Coulmier ,† E. Froidmont ,‡ Y. Larondelle ,* and M. Focant *§
166	Rapeseed		2009	
167	Rapeseed		2011	ArtoHuuskonen
168	Rapeseed		2008	* V. Thanaseelaan1 , K.Viswanathan2 , K.Venukopalan3 , R. Prabakaran4 and M. Chellapandian5
169	Rapeseed			R. Leming1 , A. Lember1
170	Rapeseed		2003	Kirsi Partanen, Timo Alaviuhkola, HilkkaSiljander-Rasi and Kaija Suomi
171	Rapeseed		1993	J. M. Bell
172	Rapeseed		2005	R. Leming1 , A. Lember
173	Rapeseed		2009	REX NEWKIRK, PH.D
174	Rapeseed		2011	ArtoHuuskonen
175	Rapeseed		2013	M. Brask ,* P. Lund ,*1 M. R. Weisbjerg ,* A. L. F. Hellwing ,* M. Poulsen ,* M. K. Larsen ,† and T. Hvelplund
176	Rapeseed		2018	TekebaNega, Yirdawwoldes
177	Rapeseed		2012	S. Lerch ,* A. Ferlay ,* D. Pomiès ,*† B. Martin ,* J. A. A. Pires ,* and Y. Chilliard *
178	Rapeseed		2019	M. Lamminen,1,2* A. Halmemies-Beauchet-Filleau,1 T. Kokkonen,1 A. Vanhatalo,1,2 and S. Jaakkola1 †
179	Rice polish	04	1993	Bienvenido O. Juliano
180	Rice polish		2006	N. AMBREEN, N. Q. HANIF1 AND S. KHATOON
181	Rice polish		2012	M.E. HOSSAIN1*, S. SULTANA2, S.M.S. SHAHRIAR3 and M.M. KHATUN4

182	Rice polish		1950-51	V. R. Ellis, H. R. Bird
183	Broken Rice		2018	Prabha R Chaudhari, NisheshTamrakar, Laxmi Singh, Ambika Tandon and Deepak Sharma
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
184	Broken Rice	03	2016	
185	Broken Rice		2013	M. De Marco1 , P. G. Peiretti2 , N. Miraglia3 and D. Bergero1†
186	Rice straw	19	1981	M Saadullah, M Haque & F Dolberg1
187	Rice straw		1985	AFRICAN RESEARCH NETWORK FOR AGRICULTURAL BYPRODUCTS (ARNAB)
188	Rice straw		1986	P. T. Doyle, C. Devendra & G. R. Pearce
189	Rice straw		1986	AFRICAN RESEARCH NETWORK FOR AGRICULTURAL BYPRODUCTS (ARNAB)
190	Rice straw		2015	Kwabena Owusu Ansah
191	Rice straw		1994	C.E.Ramirez, H.Kumgai
192	Rice straw		1995	R.B. Singh, R.C. Sana, Mahendra Singh, Dinesh Chandra, S.G. Shukla, T.K. Walli, P.K. Pradhan and H.P.P.Kessels
193	Rice straw		2008	DANIEL J. DRAKE,GLENN NADER
194	Rice straw		2008	JanewitWannapeera, NakornWorasuwannarak and SuneeratPipatmanomai*
195	Rice straw		2008	Glenn Nader
196	Rice straw		2010	C. Sarnklong, J. W. Cone*, W. Pellikaan and W. H. Hendriks
197	Rice straw		2010	Shaban D. Abou Hussein and Omaima M. Sawan
198	Rice straw		2013	Rob Bakker, Wolter Elbersen, Ronald Poppens, Jan Peter Lesschen
199	Rice straw		2015	Kamla Malik1* , Jayanti Tokkas2 , Ramesh Chander Anand1 and Nisha Kumari2
200	Rice straw		2015	Dan Hoer Brock Phillips Angela Wang Ruby Woodside
201	Rice straw		2017	Imran Ahmed Ganai* , Ankur Rastogi, R. K. Sharma and Vivek Saharan
202	Rice straw		2017	Imran Ahmed Ganai, Ankur Rastogi, RK Sharma, AsifaWali and Vivek Saharan
203	Rice straw		2013	Shalini Vaswani, Ravindra Kumar, Vinod Kumar, Debashis Roy and Muneendra Kumar
204	Rice straw		2017	Huawei Su,*† Matt S. Akins,*1 Nancy M. Esser,‡ Robin Ogden,§ Wayne K. Coblentz,§ Kenneth F. Kalscheur,# and Ron Hatfield#
205	Sesame	05	2014	TeferiAregawi, Getachew Animut1 , Kefelegn Kebede 1 and HabtemariamKassa 1
206	Sesame		2019	A. TeimouriYansari"
207	Sesame		2004	Partha Ghosh a , Prodyot Ghosal a , Swapnadip Thakur a , Patrice Lerouge b , Corinne Loutelier-Bourhis c , AzeddineDriouich b , Bimalendu Ray
208	Sesame		2013	S. Rangabhashiyam, N. Anu, N. Selvaraju *

209	Sesame		2013	TeferiAregawi, Getachew Animut* and HabtremariamKassa*
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
210	Sataria grass	03	2006	V. Tamani Eroni1 and E. M. Aregheore*
211	sataria grass		2006	Mahr-un-Nisa, M. Ajmal Khan1 , M. Sarwar*, M. Mushtaque2 , G. Murtaza3 , W. S. Lee1 and H. S. Kim
212	sataria grass		1972	C. W. FORD*
213	signal grass	01	2008	Dr. Khan Shahidul Huque, Wais Kabir, SAC Nasrin Akter, SPO (Crops), SA
214	Sesame Oil cake	11	2019	Hamed A. A. Omer1 , Sawsan M. Ahmed1 , Soha S. Abdel-Magid1*, Bakry A. Bakry2 , Mohamed F. El-Karamany2 and Eman H. El-Sabaawy1
215	Sesame Oil cake		2017	BiramaSene*1, 2 Fallou Sarr1 Mamadou Salif Sow1 Diegane Diouf 2 MarèmeNiang3 Djibril Traore1
216	Sesame Oil cake		2015	L. Sunil &PrakruthiAppaiah& P. K. Prasanth Kumar & A. G. Gopala Krishna
217	Sesame Oil cake		2015	Haftom Zebib1, Geremew Bultosa2, Solomon Abera3
218	Sesame Oil cake		2014	Ibironke A. Ajayi*, Ademola I. Adeshina
219	Sesame Oil cake		2014	R. Yasothai
220	Sesame Oil cake		2014	Niti Pathak, A.K. Rai1 , Ratna Kumari, K.V. Bhat
221	Sesame Oil cake		2013	Hassan H. E., Elamin K. M., Elhashmi Y. H. A. , TameemEldar A. A., Elbushra M. E. and Mohammed M. D.
222	Sesame Oil cake		2012	M.O.Adegunwa
223	Sesame Oil cake		2009	1,3J.M. Nzikou, 1L. Matos, 1G. Bouanga-Kalou, 1C.B. Ndangui, 1N.P.G. Pambou-Tobi, 1A. Kimbonguila, 2Th. Silou, 3M. Linder and 3 S. Desobry
224	Sesame Oil cake		2008	Murwan Khalid Sabah El Khier, KhogaliElnur Ahmed Ishag and Abu ElGasim Ahmed Yagoub
225	Sorghum sudan grass	06	1968	George F. Worker, Jr. and Vern L. Marble
226	Sorghum sudan grass		2016	Uğur BASARAN1*, Medine COPUR DOGRUSOZ1 , Erdem GULUMSER1 , Hanife MUT
227	Sorghum sudan grass		2008	H. M. Dann,* R. J. Grant,*1 K. W. Cotanch,* E. D. Thomas,* C. S. Ballard,* and R. Rice
228	Sorghum sudan grass		2007	1 P. A. Beck,2 S. Hutchison,3 S. A. Gunter, T. C. Losi,4 C. B. Stewart, P. K. Capps, and J. M. Phillips

229	Sorghum sudan grass		1988	* J. H. Cherney, K. D. Johnson, J. J. Volenec& K. S. Anliker
230	Sorghum sudan grass		1998	Tom Wright
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
231	Soyabean	49	1990	R. M. Wheeler, C. L. Mackowiak, and J. C. Sager The Bionetics Corp. Kennedy Space Center, Florida
232	Soybean		1997	K. Liu, Soybeans © Chapman & Hall
233	Soybean		2009	F M Houndonougbo* , ** , A Chwalibog and C A A M Chrysostome*
234	Soybean		2009	John B. Hall,Scott M. Baker,
235	Soybean		2010	Rex Newkirk
236	Soybean		2011	Dong Hwa Shin
237	Soybean		2011	H.K. Dei
238	Soybean		2012	
239	Soybean		2012	M.M. Ali
240	Soybean		2015	Deepika Sharma1, Raakhi Gupta1*, Ila Joshi1
241	Soybean		2nd edition	J.E.Vaneys
242	Soybean		2017	Etiosa1*, Nnadozie Blessing Chika2 and Anuge Benedicta1
243	Soybean		2016	
244	Soybean		2018	MS Salem S. Alghamdi a , Muhammad A. Khan a , Ehab H. El-Harty a , Megahed H. Ammar b , Muhammad Farooq a,c , Hussein M. Migdadi a,
245	Soybean		2016	Heena Miglani and Sucheta Sharma
246	Soybean		1975	I D. A. PRASAD 2 and J. L. MORRILL
247	Soybean		1979	1,2 M. AHRAR 3 and D. J. SCHINGOETHE
248	Soybean		1981	1 C. D. MIELKE and D. J. SCHINGOETHE
249	Soybean		1983	1 H. J. van DIJK, G. D. O'DELL, P. R. PERRY, and L. W. GRIMES 2
250	Soybean		1988	D. J. SCHINGOETHE, D. P. CASPER, C. YANG, 2 D. J. ILLG, 3 J. L. SOMMERFELDT, and C. R. MUELLER
251	Soybean		1991	M. A. FALDET and L. D. SATTER
252	Soybean		1993	1 YONG KOOK KIM,2 DAVID J. SCHINGOETHE,3 DAVID P. CASPER,4 and FENTON C. LUDENS
253	Soybean		1997	P. Y. CHOUINARD,*,2 V. GIRARD,† and G. J. BRISSON*
254	Soybean		2000	R. Solomon,*,2 L. E. Chase,* D. Ben-Ghedalia,† and D. E. Bauman
255	Soyabean		2000	1 M. Sol Morales,2 D. L. Palmquist, and W. P. Weis
256	Soyabean		2001	J. J. Loor, J. H. Herbein, and C. E. Polan
257	Soybean		2006	S. I. Borucki Castro,* L. E. Phillip,* H. Lapierre,† P. W. Jardon,‡ and R. Berthiaume†1

258	Soybean		2008	O. A. Rego,*1 S. M. M. Regalo,* H. J. D. Rosa,* S. P. Alves,†‡ A. E. S. Borba,* R. J. B. Bessa,† A. R. J. Cabrita,§ and A. J. M. Fonseca‡
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
259	Soybean		2008	Mark L. Wahlberg
260	Soybean		2011	A. R. J.Cabrita ,*1 R. J.Dewhurst ,† D. S. P. Melo ,* J. M. Moorby ,‡ and A. J. M.Fonseca §
261	Soybean		2011	Teresa Banaszkiewicz
262	Soybean		2012	M. H. Kim ,* C. H. Yun ,*† C. H. Lee ,‡ and J. K. Ha *1
263	Soybean		2013	1 G. A. Broderick ,*2 T. M. Kerkman ,† H. M. Sullivan ,‡ M. K. Dowd ,§ and P. A. Funk #
264	Soybean		2013	H. Y. Zhang, J. Q. Yi, X. S. Piao*, P. F. Li, Z. K. Zeng, D. Wang, L. Liu1 , G. Q. Wang and X. Han
265	Soybean		2015	s1 Glen A. Broderick,*2,3 Antonio P. Faciola,† and Louis E. Armentano‡
266	Soybean		2016	GhorbaniVaghei R.1* ; Abolhasani M.H.2 ; Ghorbani R.3 ; Matinfar A.4
267	Soybean		2019	Hamed A. A. Omer1 , Sawsan M. Ahmed1 , Soha S. Abdel-Magid1*, Bakry A. Bakry2 , Mohamed F. El-Karamany2 and Eman H. El-Sabaawy
268	Soybean		1983	1 H. J. van DIJK, G. D. O'DELL, P. R. PERRY, and L. W. GRIMES 2
269	Soybean		2012	M. H. Kim ,* C. H. Yun ,*† C. H. Lee ,‡ and J. K. Ha *
270	Soybean		2000	1 M. Sol Morales,2 D. L. Palmquist, and W. P. Weiss
271	Soybean		2008	O. A. Rego,*1 S. M. M. Regalo,* H. J. D. Rosa,* S. P. Alves,†‡ A. E. S. Borba,* R. J. B. Bessa,† A. R. J. Cabrita,§ and A. J. M. Fonseca‡
272	Soybean		1997	1 P. Y. CHOUINARD,*,2 V. GIRARD,† and G. J.
273	Soyabean			Ron Belyea and Barry Steevens
274	Soybean		2011	A. R. J.Cabrita ,*1 R. J.Dewhurst ,† D. S. P. Melo ,* J. M. Moorby ,‡ and A. J. M.Fonseca §
275	Soybean		1979	Craig William Bair
276	Soybean		2018	ShambelAdino, ZewduWondifraw* and Mesganaw Addis
277	Soybean		1993	1 YONG KOOK KIM,2 DAVID J. SCHINGOETHE,3 DAVID P. CASPER,4
278	Soybean		2016	
279	splendida	05	2016	Christopher Brown1 , Antony P. Martin1, 2, Christopher P. L. Grof1
280	splendida		2016	D. Brown1#, J.W. Ng'ambi1 , D. Norris1 & F.E. Mbajiorgu
281	splendida		1972	C. W. FORD*
282	splendida		2006	Mahr-un-Nisa, M. Ajmal Khan1 , M. Sarwar*, M.

				Mushtaque2 , G. Murtaza3 , W. S. Lee1 and H. S. Kim1
283	splendida		2006	V. Tamani Eroni1 and E. M. Aregheore*
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
284	Straw	02	2005	Secundino Lopez, ´ 1,2∗ David R Davies,3 F Javier Giraldez, ´ 2,4 MS Dhanoa,3 Jan Dijkstra5 and James France
285	Straw		1995	M.islam, N.R.Sarker
286	sudan grass	01	1993	1 George F. Worker, Jr.2
287	Sugarcane	06	2012	T.S. El-Tayeb1*, A.A. Abdelhafez1 , S.H. Ali2 , E.M. Ramadan1,3
288	Sugarcane		2007	H. M. Gado; H.M.Metwally; A.Z. El Basiony; H.S.Soliman and Etab R. I. Abd El Galil
289	Sugarcane		2016	S. Samadi, M. Mohammadi* , G. D. Najafpour
290	Sugarcane		2006	R.L.YADAV and S.SOLOMON*
291	Sugarcane		2015	E.M. Shahowna 1 , A.G. Mahala *2 , A.M. Mokhtar, E.O. Amasaib 2 and Balgees. Attaelmnan
292	Sugarcane		2015	H.HajihaM.Sain
293	Sesame Oil cake	06	2014	R. Yasothai
294	Sesame Oil cake		2012	Ranganayaki, S. 1 , Vidhya, R. 2 and Jaganmohan, R. 3
295	Sesame Oil cake		2010	Adeola Yewande Bamigboye1 , Augusta Chinyeaka Okafor1 and Oladejo Thomas Adepoju∗2
296	Sesame Oil cake		2014	Ibironke A. Ajayi*, Ademola I. Adeshina
297	Sesame Oil cake		2019	Hamed A. A. Omer1 , Sawsan M. Ahmed1 , Soha S. Abdel-Magid1*, Bakry A. Bakry2 , Mohamed F. El-Karamany2 and Eman H. El-Sabaawy
298	Sesame Oil cake		2016	A DEY1, S K BARARI2 and B P BHATT3
299	water hyacinth	01	2016	Oyeyemi Adeyemi a, *, Chris C. Osubor b
300	Wheat	16	2015	Zafar Iqbal*, Imran Pasha**, Muhammad Abrar***, Sharoon Masih**** and Muhammad Shakeel Hanif*
301	Wheat		1945	R. A. McCANCE, E. M. WIDDOWSON, T. MORAN, W. J. S. PRINGLE AND T. F. MACRAE
302	Wheat		2008	Raquel L. Carreira∗ Mauro R. Silva† Ana Lucia P. Starling ´ ‡ Marcos J. B. Aguiar∗∗ Jose N. Januario ´ †† Marialice P. C. Silvestre‡‡
303	Wheat			B. Bruening
304	Wheat		2016	Hala S. Sayed
305	Wheat		2012	Q. Huang, X. S. Piao, P. Ren and D. F. Li*

306	Wheat		2012	Emmanuelle Escarnot (1), Jean-Marie Jacquemin (1), Richard Agneessens (2), Michel Paquot
307	Wheat		2007	Cristina Lanzas
308	Wheat		2005	Source: 2004. MAFRI
Sl No.	**Feed name**	**Number of papers**	**Year**	**Author**
309	Wheat		1994	K. A. Beauchemin, T. A. McAllister, Y. Dong, B. I. Farr and K. J. Cheng
310	Wheat		2009	A. Bandegan ,* W. Guenter ,* D. Hoehler ,† G. H. Crow ,* and C. M. Nyachoti *
311	Wheat		2018	Prabha R Chaudhari, NisheshTamrakar, Laxmi Singh, Ambika Tandon and Deepak Sharma
312	Wheat		2012	Emmanuelle Escarnot (1), Jean-Marie Jacquemin (1), Richard Agneessens (2), Michel Paquot
313	Wheat		2012	Q. Huang, X. S. Piao, P. Ren and D. F. Li*
314	Wheat		2014	: SonaliPrusty*, S.S. Kundu, Dr. Umesh Sontakke and P.A. Bala

Annexure III

BAU component

Table 1: Chemical composition from the secondary source

List of feed with chemical composition, digestibility and cell wall content														
#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	%	%	%	%	%	%	%	MJ/ kg	%	%	%
1	1	Napier-3	14.63	10.73								21.81		
	2	Napier	22.34	8.98										
	3		22.95	8.08				10.46				65.09	87.19	
	4		19.98					10.25						
	5		20.39	9.40										
	6		37.00	13.29		14.42	1.82	6.00		64.38		37.00	51.37	3.50
	7			15.72	23.81	3.65	42.96	13.86				42.76	65.75	
	8			14.86	24.67	3.06	45.23	12.18				39.50	73.71	
	9			14.35	25.32	2.54	46.12	11.67						22.25
	10			13.48	26.64	2.59	45.93	11.46				37.45	40.40	5.68
	11			11.34	29.88	2.56	45.64	10.88				38.46	62.19	5.76
	12		11.92				12.10			66.80		39.14	63.46	5.82
	13		14.04		3.43		7.71					39.85	64.89	5.91
	14		11.40									41.88	69.12	6.17
	15			10.00	27.00		8.20	8.20				39.00	60.00	10.00
	16		5.73				14.46					37.00	68.56	
	18		18.20	7.70								45.00	65.00	
	19		18.50	9.20	30.60	2.40	45.40	12.40	4.50	48.00	9.20			
	20		24.80	7.40	31.50	1.80	45.00	14.30						
	21		36.20	13.81	12.00	1.90	2.49	6.00						
	22		35.00	12.50	10.80	1.86	4.24	5.60						
	23			13.15	26.08	48.35	1.57	10.85						
	24			7.94	25.26	45.61	3.45	17.74						
	25			11.35	27.09	39.09	3.96	18.51						
	26			7.90	29.89	45.53	1.31	15.37						
	27			12.06	27.77	40.89	2.40	16.88						
	28			9.33	28.56	44.74	2.16	15.21						
	29			10.44	31.33	37.86	2.20	18.17						
	30			7.94	27.31	50.65	1.47	12.63						
	31			10.22	27.20	45.43	2.15	15.00						
2	1	Para	24.53	11.96	29.57			8.11				41.70	72.30	5.90
	2			10.90										
	3		18.40	8.90	31.50	2.10	47.90	9.40				39.50	70.60	5.40
	4		18.90	8.10	36.00	3.01	42.50	10.30						
	5		20.00	7.80	40.90	3.60	36.70	11.00	7.90	56.00				

	6			10.80										
	7		19.80	7.40	34.20	1.60	37.60	19.20						
	8			7.40	27.00	2.00	49.28	14.32						
3	1	Splendida	96.23	7.97		0.79		8.63		61.30	2.16			16.50
	2			7.50								50.68	77.88	5.40
List of feed with chemical composition, digestibility and cell wall content														
#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	3		30.30	10.50							13.00	37.40	72.40	
	4		26.91	6.36								33.40	54.70	
	5		15.80	11.10		2.70		12.20					67.71	
	6		61.40									12.20	27.10	
	7													8.19
4	1	German	15.39	12.53								39.10	68.70	5.20
	2		23.21	12.25										
	3		16.00	13.80	32.00	4.20	42.00	12.70				39.10	68.70	
	4		16.50	14.74	25.66	2.55	40.90	10.90						
	5		10.17	22.96		3.80								
	6		21.10	8.20	34.40	2.75	43.70	10.80				39.60	69.10	
	7		19.77	10.14	31.35	2.23	43.48	12.80						
	8		32.51	7.75	41.18	3.88	11.69	3.00						
	9		19.20	9.10	30.90	2.23	46.80	10.80			7.98			
	10		21.10	8.20	34.40	2.75	43.70	10.80			8.18			
	11		21.60	7.50	38.00	3.10	40.10	11.10			8.16			
	12		21.60	12.40	36.40	1.40	37.30	12.50			9.40			
	13			9.00	26.50	48.85	2.15	13.50						
	14													
5	1	Dhal	0.00	12.20						50.10	0.00	45.40	73.70	5.50
	2		17.82	12.35	38.67	3.45	28.90	16.63		0.00	6.87	34.40	64.70	0.00
	3		12.10	9.60	29.80	2.00	45.00	13.60		52.00	9.50	37.30	67.20	4.80
	4		19.90	8.50	32.00	1.30	46.30	11.90		0.00	8.76	34.90	59.20	6.79
	5		19.60	7.90	34.10	2.58	44.40	10.80		0.00	8.36			
	6			7.50	29.30	1.40	52.60	9.20		0.00	8.11			
	7		0.00	13.25	0.00	0.00	0.00	0.00		0.00	0.00			
	8		17.80	12.50	31.80	2.60	0.00	0.00		0.00	17.70			
	9		0.00	9.00	0.00	0.00	0.00	0.00						
	10		18.80	8.90	30.20	2.20	48.20	10.40						
	11		19.60	7.90	34.10	2.58	44.40	10.80						
	12		20.50	7.60	36.10	3.80	41.20	11.30						
	13		12.10	9.60	29.80	2.00	45.00	13.60						
6	1	Signal	0.00	6.35	32.50							37.20	68.10	
	2		0.00	8.20	33.40									
	3		0.00	9.10										
	4		0.00	5.40	36.10									

	5		0.00	6.00	37.10									
	6		0.00	7.30	30.50									
	7		0.00	7.80	0.00									
	8		0.00	8.30	0.00									
	9		26.60	7.60	31.50	1.80	50.40	8.70						

List of feed with chemical composition, digestibility and cell wall content

#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	10		25.30	8.80	0.00	0.00	0.00	0.00						
	11		26.80	8.90	31.40	8.60	0.00	0.00						
	12		15.12	9.51	37.18	7.58	0.00	0.00						
	13		26.60	7.60	31.50	1.80	59.40	8.70						
7	1	Jumboo	24.80	7.20	30.60	1.90	0.00	9.60				0.00	0.00	3.32
	2		29.33	7.30	30.20	2.10	0.00	9.60				0.00	57.90	6.00
	3		10.70	8.90	31.20	2.21	47.40	0.00				41.40	72.40	0.00
	4		0.00	10.00	31.15	0.00	0.00	0.00				48.37	81.17	0.00
	5		17.20	9.70	0.00	0.00	0.00	0.00				41.30	66.40	0.00
	6		17.36	7.86	0.00	2.08	0.00	12.42				48.32	74.89	0.00
	7		28.20	10.20	0.00	3.90	0.00	7.64				48.37	81.17	0.00
	8		12.19	7.51	30.44	2.75	53.40	4.61				45.54	70.58	0.00
	9		0.00	6.28	0.00	0.00	0.00	6.60				42.00	68.00	0.00
	10		26.10	9.78	41.38	1.05	37.29	10.51						
	11		17.36	7.86	0.00	2.08	0.00	12.42						
	12		0.00	8.45	0.00	0.00	0.00	0.00						
	13		17.26	7.50	31.09	0.00	0.00	0.00						
	14		0.00	8.00	0.00	0.00	0.00	0.00						
8	1	Adropogan	0.00	15.10	0.00	1.90	0.00	14.00			9.23	32.71	64.68	5.84
	2		36.90	6.20	0.00	0.00	0.00	0.00			5.65	0.00	59.60	0.00
	3		21.00	7.70	0.00	0.00	0.00	0.00			18.10	26.00	62.00	4.20
	4		21.70	6.72	0.00	7.00	0.00	10.50			18.20	21.50	43.50	0.00
	5		0.00	6.10	30.50	1.80	49.30	12.30			2.00	39.00	60.00	9.00
	6		0.00	6.72	21.70	7.00	0.00	10.50				39.06	60.47	9.00
	7		30.00	7.80	36.80	1.70	0.00	8.30				42.90	71.90	6.00
	8		0.00	6.96	18.30		0.00	5.71				36.90	61.20	0.00
	9		21.79	4.19	24.68	9.20	0.00	9.02				47.30	63.60	16.00
	10		92.70	9.07	0.00	5.41	0.00	10.40						
	14													
	15		27.90	6.40	26.50	1.40		9.90	3.80					
9	1	Maize grass		6.90	28.60	7.20	52.40	4.50			9.20	30.80	58.30	
	2			6.60	27.80	6.80	58.20	5.10			9.20	24.70	58.20	
	3			9.46	26.28	3.46	55.87				14.14	44.50	64.60	6.30
	4			6.90	28.60	7.00	52.60	4.60				48.35	77.65	8.42
	5							4.40				42.26	71.01	8.81

	6											43.42	72.81	8.62
	7			8.39	32.76	2.07	49.64	7.14				44.43	73.36	8.93
	8			6.56	32.00	1.93	50.51	9.00				47.93	77.25	8.98
	9			7.09	40.06	1.72	43.17	7.96				47.20	76.25	8.53
	10			7.80	31.65	1.39	51.96	7.20				42.67	72.29	7.82
List of feed with chemical composition, digestibility and cell wall content														
#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	11			6.29	33.33	1.57	52.50	6.31				41.70	68.80	9.40
	12			6.19	34.66	1.89	49.18	8.08						
	13			7.35	37.66	0.89	46.54	7.56						
	14			10.67	25.92	2.27	51.78	1.40						
	15			9.66	26.73	2.15	54.01	7.45						
	16		26.00	8.40	28.60	3.40	54.20	5.40	4.70	66.00	9.60			
	17		27.50	8.80	27.40	3.00	54.60	6.20			9.70			
	18		28.20	9.40	26.80	2.70	54.50	6.80			10.10			
10	1	Bermuda Grass	27.50	8.90	26.30	1.50	47.60	15.70			9.60	36.70	66.70	4.70
	2		25.60	16.20	42.50	2.40	26.50	12.40			9.60	35.50	73.70	5.90
11	1	Durba Grass	25.60	16.20	42.50	2.40	26.50	12.40			9.60	32.50	65.00	
	2			11.41	20.93	2.03	47.30	18.33						
	3			10.03	24.01	2.17	45.90	17.89						
	4			12.40	25.23	2.53	48.99	10.85						
				11.32	28.01	5.82	39.65	15.20						
12	1	Shama	22.30	12.80	28.00	2.20		17.20	8.90		9.40	40.20	69.60	5.40
	2			15.13	16.60	2.41	54.80	11.06						
13	1	Baksa Grass	22.89	6.13	27.25	2.00		8.08				38.10	73.20	5.70
	2		18.69	6.59	25.42	1.60		7.97						
	3		24.41	7.12	24.51	1.40		7.16						
14	1	pangora		7.76	25.45	4.28	47.86	14.65				42.30	71.40	5.90
15	1	Ruzi Grass		11.39	24.65	2.02	51.56	10.38				38.90	67.70	5.50
16	1	Gunea grass	22.70	11.98	31.10	2.45	40.50	13.97				43.40	72.30	6.10
		Chaila	25.80	7.60	33.60	1.60	43.80	13.40			8.60			
17	1	Ipil Ipil	88.75	24.70				9.54				33.72		
	2		88.66	41.13	9.50	9.14	21.68	7.21				25.40	40.90	10.80
	3			26.14										
	4		90.00	22.20	19.60			4.40						
	5		95.30	25.80	9.90	5.30	48.60	10.40				20.70	38.70	8.80
	6			23.00	16.00		29.00	10.00						

	7		91.00	23.61										
	8			25.90				11.00						
	9			23.30										
	10		92.27	20.00	5.08	4.06		7.06						

List of feed with chemical composition, digestibility and cell wall content

#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	11			16.70	12.70	7.10	51.00	12.50						
	12			24.68	15.17	3.61	46.20	10.34						
18	1	Alfa-alfa		22.50	20.00	1.80	44.60	10.00				46.00	57.00	
	2			18.20	33.80	2.20	37.50	7.90				31.40	43.10	
	3			21.00	30.50	2.40	37.00	9.10				23.60	30.10	
	4		93.00		36.00	1.30	39.00					18.40	33.00	
	5		44.60	19.40								38.74	52.56	
	6		48.50	21.50								28.00	38.00	
	7		18.90	29.90								48.29	56.86	
	8			50.00		4.10		12.30				39.52	24.60	
	9		74.20	14.68		2.67		6.73				31.35	46.49	
	10		84.00	22.00	23.30			11.40				32.90	45.20	8.50
	11		90.80	16.73	41.31	1.45	31.49	9.02				4.20	18.60	1.60
	12		89.80	17.50	3.80			12.60				28.50	40.90	7.70
	13		73.57	21.87	24.53	2.15		10.30				34.50	46.70	8.80
	14			22.46										
	15		92.54	38.00	22.10			8.13						
	16			18.77	25.90	1.90	42.33	11.10						
				24.13	24.40	1.87	38.48	11.12						
19	1	Khesari	89.35	15.24				6.32				61.11		1.50
	2		89.58	13.69										
	3		86.55	12.22										
	4		87.60	31.30	10.00	1.00		3.10					35.60	
	5			32.60	8.30	5.30		2.60				27.94	34.19	1.30
	6		90.00	26.30	5.50	0.70		3.20						
	7			19.42	14.30	4.93	50.87	10.45				9.00	15.50	
	8		91.10	26.90	5.90	0.80		2.90				58.53	70.50	
	9		90.90	34.30				3.90						
	10		91.40	14.80				5.80				12.20	16.00	
	11			26.40	6.00	1.70		2.80				10.70	24.50	
	12		89.00	30.10				3.10				38.40	53.90	
	13			27.60		0.70	61.80	3.10				7.54	16.74	
	14			9.20		2.40						31.20	40.10	
	15		90.78	28.34	4.96	1.20	63.70	1.80						
	16			30.90	6.85	1.90	55.85	4.50						
	17			27.00	4.79	1.00	63.60	3.54						

	18			13.70	3.50	1.10		11.10						
	19		91.30	29.40	8.00	1.60		2.60						
	20		16.50	19.60	25.80	2.60	39.50	12.50	14.30		9.90			

List of feed with chemical composition, digestibility and cell wall content

#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
20	1	Dhaincha		23.52	22.82	2.13	43.10	8.43				20.40	31.30	5.30
	2			26.00	14.00	8.00	40.80	11.20						
	3		86.56	20.65	13.55	4.03	39.04	9.31			4.35	62.00	77	
	4		86.18	23.85	13.70	4.03	35.88	8.72			4.46			
	5		87.16	17.98	15.59	5.17	41.32	7.09			4.72			
	6		85.86	16.08	14.13	5.03	40.81	9.82			4.08			
	7		87.30	17.52	16.33	5.24	41.47	6.74			4.27			
21	1	Cowpea	90.70	26.40	5.15									
	2		95.20	23.80		1.70								
	3			20.60	2.30	2.25		3.10						
	4			12.10	3.23	2.13		3.60						
	5			26.10	2.60		66.28	3.93						
	6			24.70	3.54	1.80	66.66	3.23				27.10	38.60	4.60
	7			24.57	2.70	1.30		3.60						
	8			27.88	9.58	1.27	57.42	3.84				32.80	43.20	
	9			22.13	1.33		58.72	3.86						
	10			2.50	1.70	1.30		3.70						
	11			18.20	25.30	2.60	39.60	14.30						
	11		17.50	17.00	29.40	3.80	36.30	13.50			10.20			
22	1	Mash kalai		21.88	25.30	3.08	39.17	10.57				6.60	18.60	0.30
			19.50	16.40	24.00	2.40	42.80	14.40	9.50		9.50	35.30	51.40	
23	1	Centro	32.40	14.60	32.60	3.00	39.20	10.60	4.00		9.40	39.50	55.60	8.50
24	1	jack fruit	37.43	12.83				17.19				26.90	36.50	7.50
	2		32.40	12.90	15.50	2.98	59.50	9.15						
	3			5.37								25.22	30.09	7.30
	4			5.37		6.05	62.80							
	5			8.03										
	6		42.10	5.70	7.20	2.50	23.00	3.70						
	7			10.13	32.05	2.39	44.58	10.85						
25	1	Banana plant		5.90	24.30	1.00	54.00	14.80			9.90	40.00	55.70	8.20
2	1	Neem	27.82	23.51				13.41				25.72	36.90	

5														
	2			18.25	22.56	3.72	43.85	11.84				30.00	40.30	12.30
27	1	Shaora	44.83	14.56	16.70	1.21	51.32	16.21						

List of feed with chemical composition, digestibility and cell wall content

#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	%	%	%	%	%	%	%	MJ/ kg	%	%	%
28	1	Banyan	42.35	12.70	28.94	2.15	41.33	14.88				34.60	44.70	13.20
29	1	Mango	46.27	8.46	31.36	1.71	49.29	10.89				5.80	23.40	1.10
	2		89.00	6.00	1.11	7.87	67.00	2.35						
	3			5.00			42.00							
	4		54.80	6.36	2.02	3.20								
	5		69.77	7.53	2.20			1.00						
	6		91.50	8.01	1.11	7.87	82.56	0.45				16.60	24.80	
	7			12.59	23.65	3.72	41.53	18.51				17.30	35.50	
30	1	Mandar	38.63	23.25	41.37	3.99	36.15	5.24						
31	1	Tut	37.68	23.92	13.38	2.70	46.04	13.96						
32	1	Karai	39.42	22.74	21.60	1.29	33.83	20.54						
33	1	Moringa feed	88.80	16.59								32.89	40.73	7.00
	2		88.50	17.02								38.97	53.80	3.40
	3		90.67	18.29	15.87	7.65		13.67						
	4		91.00	39.13	5.43	2.43		6.00						
	5		96.79	17.07	7.09			7.93						
	6		96.12	28.00	12.57	3.88		9.82						
	7		94.00	27.61	9.80			5.75						
	8			14.86	20.43	2.25	50.48	12.08						
34	1	Duck Weed	6.40	26.70	13.30	2.40	31.20	26.40			6.05	27.00	42.20	5.70
	2		6.20	25.80	14.50	1.80	37.50	20.40			6.00	30.00	48.30	2.30
	3			23.40	10.90			21.70						
	4		4.60	25.20	9.40	4.70		14.10						
	5		3.30	3.60	10.70	4.50		8.50						
35	1	Azolla	6.80	25.80	11.90	0.90	30.90	30.50			4.91	42.80	57.90	11.40
36	1	Algae	5.20	19.00	12.00	2.30	45.50	21.20			5.33	19.80	62.80	

37	1	Water Hyacinth	8.80	13.70	28.60	1.00	40.90	15.80			5.22	43.90	65.10	8.60
	2		11.20	29.80	19.70	1.90	30.40	18.20			4.85	33.70	67.90	9.30
	3		6.60	8.70	31.70	0.90	42.10	16.60			5.23	48.60	65.90	7.20
	4		9.30	56.38	1.02	1.10		4.88						

List of feed with chemical composition, digestibility and cell wall content

#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	5		9.65	10.30	27.40	1.45	48.80	12.40						
	6		9.00	10.65	26.75	1.66	48.70	12.10						
	7		7.85	10.40	18.70	1.82		24.60						
	8		9.50	24.00				12.27						
	9		9.50	49.90	1.70			5.80						
38	1	Napier 3-silage	24.12	11.28				12.96				45.88		
	2		19.22	9.61								42.21		
	1	Napier Silage	17.65	11.43				11.23				46.88		
	2		22.95	8.08				10.45				65.09	87.19	6.20
	3		17.65	11.43				11.23				36.88		
	4		20.39	10.25								43.60	72.30	
	5		12.95	8.26								62.76	67.14	
39	1	Whole triticale silage	29.30	11.12								41.12		3.80
	2		51.44	9.82								35.90	53.40	4.10
40	1	Jumboo Silage	21.41	8.53				13.52				69.50	75.56	
	2		21.41	8.53				13.52				69.50	75.56	
	3		23.42	9.20				7.30				45.00	64.70	
41	1	Maize Silage	22.63	8.09				6.06				53.30	72.40	3.20
	2		15.63	9.65				9.04				56.31	75.39	2.70
	3		19.18	9.50				5.70				37.24	66.50	2.90
	4		25.43	10.70										2.60
42	1	Splendida grass Silage	26.16	11.30				10.10				34.18	69.50	
43	1	Mugbean residues Silage	24.90	11.31				12.70				59.40		
	2		20.76	12.10				8.76				34.60		
44	1	Triticale forage and rice straw	29.30	11.12								41.12		

		silage(4:1)												
45	1	Khesari hay	89.35	15.24				6.32				61.11		
List of feed with chemical composition, digestibility and cell wall content														
#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	2		89.35	15.24				6.32				61.11		
46	1	Rice Straw	87.08	3.77										
	2		90.00	2.66	34.50	1.50	47.00	13.50						
	3		90.92	3.35				6.06				44.77		
	4		87.08	3.77	35.40	1.20	43.85	15.78				42.40	69.10	4.80
	5		91.90	4.27				16.70				35.80		
	6		90.30	3.45								34.49		
	7		88.31	3.12	35.58									
	8		90.92	3.35				6.06				44.77		
	9		71.71	3.20		0.92		13.93				45.21	67.39	5.20
	10		95.60	4.61				18.20				42.50		
	11		89.23	3.11				13.26				65.21		
	12		89.23	3.11	34.40			13.26				65.21		
	13		87.07	4.20								60.12	73.26	
	14		89.00	2.90	28.00	0.00	0.00	11.00				0.00	0.00	0.00
	15		91.08	3.98	34.89	1.36	43.35	16.42				0.00	0.00	0.00
	16		0.00	2.30	38.00	2.00	49.00	17.00				63.00	86.00	5.00
	17		90.93	4.62	35.39	1.14	38.53	20.32				0.00	0.00	0.00
	18		90.00	2.00	32.50	2.00	38.50	43.76				0.00	0.00	0.00
	19		0.00	0.00	0.00	0.00	0.00	0.00				0.00	0.00	0.00
	20		82.00	4.00	37.00	0.00	43.00	18.00				54.00	75.00	8.00
	21		83.30	3.70	31.00	1.30	0.00	0.00				46.30	67.20	0.00
	22		90.00	3.60	0.00	0.00	0.00	0.00				56.70	0.00	0.00
	23		0.00	0.00	0.00	0.00	0.00	0.00				0.00	0.00	22.30
	24		85.30	4.90	0.00	0.00	0.00	0.00				49.00	73.00	0.00
	25		93.50	4.41	0.00	0.00	0.00	0.00				51.30	62.60	16.20
	27		96.40		0.00	0.00	0.00	13.00				43.52	72.53	0.00
	28		93.05	5.10	0.00	0.00	0.00	0.00				41.38	72.53	6.97
	29		0.00	2.00	0.00	0.00	0.00	16.20				0.00	0.00	10.20
	30		93.05	5.10	0.00	0.00	0.00	0.00				41.38	72.53	6.97
	31		86.10		0.00	0.00	0.00	18.00				0.00	0.00	15.60
	32		82.44	5.23	40.33	0.00	0.00	0.00				49.92	68.60	0.00
	33		90.00	4.50	29.80	0.00	0.00	16.00				0.00	0.00	12.00
	34		88.00	0.00	27.94	0.00	0.00	15.69				0.00	0.00	0.00
	35		92.43	4.25	35.00	0.00	43.00	17.00				43.00	62.41	0.00
	36		0.00	0.00	0.00	0.00	0.00	15.25				0.00	0.00	8.60

	37		85.31	4.76	31.42	1.43	47.70	14.69				50.12	72.09	0.00
	38		0.00	0.00	0.00	0.00	0.00	0.00				0.00	0.00	0.00
	39		0.00	0.00	0.00	0.00	0.00	0.00				0.00	0.00	0.00
	40		92.87	4.35	37.80	1.34	49.39	7.13				53.51	78.04	0.00
List of feed with chemical composition, digestibility and cell wall content														
#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	41		94.00	3.50		1.50	0.00	4.60				61.30	84.90	0.00
	42		0.00	0.00	0.00		0.00					0.00	0.00	10.20
	43		93.05	5.10							6.68	41.38	72.53	6.97
	44		92.81	4.64							5.99	43.62	72.16	4.85
	45		92.84	4.39							5.97	42.83	74.29	4.34
	46		92.73	3.49							5.73	44.22	74.95	5.94
	47		92.84	3.61							5.65	46.32	74.86	4.30
	48		92.21	4.52							5.61	43.64	77.57	4.30
	49		91.41	3.56	31.37	1.20		7.41						
	50			3.90	35.90	1.40	44.00	14.90			7.96			
	51			3.20	38.40	1.20	39.80	17.40						
	52			9.00				12.00						
	53			6.50	24.00	1.00		14.00						
47	1	Wheat Straw	91.90	4.27				16.70				35.80		
	2		93.10	2.40		1.20		1.20				53.60	75.00	8.30
	3		85.90	4.30		1.17		5.87				52.90	79.30	7.20
	4		90.40	2.50				8.90				43.70	73.80	
	5		91.60	3.10	44.70	1.30						42.00	62.20	
	6		91.00	4.20	41.50	1.40		6.70				50.00	77.50	
	7		89.90	3.10	37.88	1.30	47.31					55.49	66.47	
	8			3.00	46.80	1.40	32.00	16.80						
	9		89.57	6.60	33.57	1.68	45.92	10.78						
	10			4.25	40.32	4.29	2.45	10.09						
48	1	Triticale straw	82.62	6.52				19.22				38.78	49.80	
49	1	Soybean straw	87.90	4.20								41.84	43.62	
50	1	Maize Stover	74.78	6.10				6.41				47.46		
	2		88.96	5.72								39.60	69.90	5.60
51	1	UMS	49.00	11.74	33.50	2.65	24.25	28.50						
	2							13.19				42.55		
	3		54.02	6.30	34.13	1.40	39.84	18.22						

	4		60.02	8.94	24.23									
	5		54.99	5.82				13.19			94.72	42.55		
	6		47.01	8.01										
	7		64.92	8.57				14.34				47.53	67.29	

List of feed with chemical composition, digestibility and cell wall content

#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	8		66.34	8.11				12.21	0.07		88.03	61.11		
	9		64.92	8.57				14.34				47.53	67.29	
	10		66.34	8.11				12.21			88.04	47.23		
	12		54.02	6.30	34.13	1.40	39.84	18.22						
	14		54.99	5.82				13.19				42.55		
	15		66.34	8.11				12.21				47.23		
	3	Maize stover	31.10	9.30	32.30	1.80	49.40	7.40				57.50		16.50
	4		91.80	6.25	26.20	2.70						38.20		4.60
	5		93.25	4.71	18.30	3.30	72.74	0.42				48.40		3.00
52	1	Sugar beet	89.18	5.10				9.28				23.80	47.10	2.70
53	1	Sugar cane bagasse						1.64				25.86	63.17	15.40
	2					9.00		4.00						28.50
	3													25.00
	4			1.80		0.60		5.00				58.40	86.90	15.00
	5			8.50		2.25		5.50						10.00
	6					3.50		2.40						19.50
	7					5.50		0.60						4.40
	8													21.80
	9							1.10						25.30
	10							7.00						29.00
	11													18.14
	12													22.00
	13						0.18	2.50						22.90
	14					1.00	0.20	2.50						18-24
	15						0.89							
	16						0.19							
	17		90.50				0.06	2.50						23.00
	18		51.07	2.00										
	19		90.90	2.65		0.80		5.00						23.00
	20		91.66				0.45	1.90						13.40
	21		96.10	2.18	0.00	0.84	0.00	2.70			84.50	60.00		

	22		0.00	0.00	0.00		0.00	1.64			0.00	0.00		
	23				41.90		53.29							
	24		52.00					2.00						
	25		91.64	2.02	43.66	0.79	42.22	11.31			79.08	58.49		
List of feed with chemical composition, digestibility and cell wall content														
#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/kg**	**%**	**%**	**%**
	26		47.60	18.40							79.08	58.49		
54	27	Sugar cane tops	29.80	5.80	34.60	2.40	47.90	9.30	2.70	50.00	8.50	39.20	67.70	5.60
55	1	Cassava root	20.37	2.03	0.00	7.59	0.00	5.21				26.55	37.20	1.70
	2		36.71	2.10	0.00	0.00	0.00	3.00				5.30	7.80	1.60
	3		87.70	1.50	2.50	0.45	0.00	2.05				5.40	8.00	
	4		40.32	1.36	1.80	0.00	0.00	0.62				0.00	0.00	
56	1	Concentrate mixture	88.38	13.70										
	2		88.58	14.76										
	3		89.87	20.83				9.77				15.22		
	4		90.30	16.53								15.22		
	5		86.58	17.58		7.04		8.86				14.06	36.94	
	6		89.87	20.83				9.77				15.22		
	7		89.50	11.80				10.80			10.40	22.70		
	8		88.75	19.95								24.29		
	9		91.30	16.50				7.53				27.67		
	10		91.82	19.98				9.30				20.55		
	11		90.78	15.25		1.30						24.70		
	12		90.85	15.03								24.70		
	13		91.43	18.00				8.85				28.48		
	14		92.25	16.60										
	15		91.43	18.00				8.85				28.48		
	16		91.43					8.87						
	17		85.52	18.60				7.90				34.30	55.30	
	18		88.83	18.30				14.60				24.80	28.20	
	19		88.45	16.44								35.36	51.04	
	20		89.84	11.33								22.00	44.71	
57	1	Wheat	90.48	11.46	1.40		74.17	1.50				5.20	16.50	
	2		0.00	0.00	0.00			0.00				2.22	7.80	
	3		85.00	8.89	2.18			1.52				3.37	11.81	
	4		86.32	8.57	0.00			0.00				0.00	0.00	
	5		0.00	13.00	3.00			0.00				0.00	0.00	0.90

	6		89.00	11.00	2.50			0.00				0.00	0.00	1.60
	7		0.00	14.70	0.00			0.00				6.72	21.52	0.00
	8		11.53	0.00	5.52			1.51				3.80	0.00	2.60
	9		81.09	15.50	1.33	2.25		1.30				4.20	0.00	0.00
	10		87.00	14.10	3.00	2.50		0.00					0.00	0.60
List of feed with chemical composition, digestibility and cell wall content														
#	Sl. No.	Feed stuffs	DM	CP	CF	EE	NFE	Total ash	DCP	TDN	ME	ADF	NDF	Lignin
			%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/ kg**	**%**	**%**	**%**
	11		81.30	17.00	0.00	0.00		0.00				3.60	13.90	1.10
	12		0.00	15.10	2.50	0.00		0.00				3.80	14.30	1.20
	13		0.00	14.90	2.30	0.00		0.00				4.60	15.50	1.40
	14		0.00	12.90	0.00	0.00		1.60						
	15		0.00	15.77	0.00	2.15		2.13						
	16		0.00	17.30		2.20		1.80						
	17		0.00	17.20				0.00						
	18		87.24	0.00				1.89						
	19		89.30	18.00				0.00						
	20		92.40	15.60				0.00						
	21		86.00	10.60				1.40						
	22			12.47	0.04			0.38						
	23			10.63	0.04			0.38						
	24			8.67	0.20			0.71						
	25			9.98	0.26			0.51						
	26			10.60	0.11			0.51						
	27			9.72	0.07			0.51						

Table 2: Chemical Composition from the secondary source
(Time series data on nutritional value of the available feeds and fodders)

Average value of Dry Matter:

Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier-3	DM						14.63
Napier	DM				37.00	11.40	20.99
Para	DM						20.81
Splendida	DM		61.40			49.30	
German	DM					16.47	20.88
Dhal	DM					19.90	16.46
Signal	DM					26.60	22.37
Jumboo	DM	21.61				17.39	20.24
Andropogan	DM					28.72	

Maize grass	DM				27.23		
Bermuda Grass	DM						26.55
Durba Grass	DM						25.60
Shama	DM						22.30
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Baksa Grass	DM						22.00
Gunea grass	DM						22.70
Chaila	DM						25.80
Ipil Ipil	DM		88.66		90.00	95.30	91.07
Alfa-alfa	DM		93.00	64.30	62.25	83.37	81.69
Khesari	DM		87.60	90.55	90.43	90.78	84.41
Dhaincha	DM						86.61
Cowpea	DM					92.95	17.50
Mash kalai	DM						19.50
Centro	DM						
jack fruit	DM		32.40			42.10	37.43
Neem	DM						27.82
shaora	DM						32.40
Banyan	DM						42.35
Mango	DM			89.00		62.29	68.89
Mander	DM						38.63
Tut	DM						37.68
karai	DM						39.42
Moringa feed	DM						92.51
Duck Weed	DM				3.30	4.60	6.30
Azolla	DM						6.80
Algae	DM						5.20
Water Hyacinth	DM			9.50		9.50	8.84
Napier 3-silage	DM					24.12	19.22
Napier silage	DM						17.82
Whole triticale silage	DM					40.37	
Jumboo Silage	DM						22.42
Maize Silage	DM					22.63	20.08
Splendida grass Silage	DM					26.16	
Mugbean residues Silage	DM					24.90	20.76
Triticale forage and rice straw silage(4:1)	DM					29.30	
Khesari hay	DM						89.35
Rice Straw	DM			90.25	82.65	88.79	89.72
Wheat Straw	DM					91.60	89.91
Triticale straw	DM					82.62	

Soyabean straw	DM						87.90
Maize Stover	DM						79.97
UMS	DM					54.51	62.65
Sugar beet	DM						89.18
Sugar cane baggase	DM				96.10	51.54	80.40
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Sugar cane tops	DM						29.80
Concentrate mixture	DM					89.20	89.71
Wheat	DM	87.00			87.00	89.36	73.01
Soyabean	DM					90.67	89.95
Rapeseed	DM			89.70	91.50	90.23	89.53
Maize	DM		86.53		88.15	87.74	65.00
Horse bean	DM						19.80
Khesari crushed	DM					88.60	
Cowpea	DM						17.50
Saw dust	DM					83.80	
Cattle manure	DM					18.70	
Paper mill waste	DM					84.00	
Coconut oil cake	DM					91.20	
Cotton Seed cake	DM					93.90	
Di-calcium Phosphate	DM					95.70	
Fish meal	DM					86.60	88.76
Ground-nut cake	DM					90.36	92.27
Limestone	DM					99.80	
Linseed cake	DM					91.80	
Mustard Oil cake	DM	91.70			88.00	91.47	90.49
Rice bran	DM					93.40	91.22
Broken rice	DM		88.00			87.33	88.31
Rice Polish	DM		91.30		92.07	92.05	92.01
Til bran	DM			93.15			89.48
Til oil cake	DM		90.70		92.48	91.00	91.63
Soyabean meal	DM		90.40		89.47	90.91	89.23
wheat bran	DM	1984.50				88.02	88.28
Sesame oil cake	DM	89.30				94.06	92.71

Average value of CP

Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier-3	CP						10.73
Napier	CP						10.22
Para	CP				10.90		8.28
Splendida	CP					8.99	
German	CP					15.26	8.83
Dhal	CP					10.35	10.71

Signal	CP	7.25	8.30			7.60	8.65
Jumboo	CP	8.35				8.54	8.32
Adropogan	CP					9.41	7.17
Maize grass	CP				8.87		7.92
Bermuda Grass	CP						12.55
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Durba Grass	CP						12.27
Shama	CP						13.97
Baksa Grass	CP						6.61
Pangora	CP						7.76
Ruzi	CP						11.39
Gunea grass	CP						11.98
Chaila	CP						7.60
Ipil Ipil	CP		41.13	26.14	22.20	24.40	22.82
Alfa-alfa	CP			30.47	21.22	26.34	20.37
Khesari	CP		31.95	24.21	28.33	24.16	19.60
Dhaincha	CP						21.99
Cowpea	CP					24.14	14.08
Mash kalai	CP						19.14
Centro	CP						14.60
Jack fruit	CP		12.90	5.37		6.87	11.48
Banana plant	CP						5.90
Neem	CP						20.88
Shaora	CP						14.56
Banyan	CP						12.70
Mango	CP			6.00		5.97	9.69
Mander	CP						23.25
Tut	CP						23.92
karai	CP						22.74
Moringa feed	CP						21.41
Duck Weed	CP				3.60		24.95
Azolla	CP						25.80
Algae	CP						19.00
Water Hyacinth	CP			49.90		10.40	27.06
Napier 3-silage	CP					11.28	9.61
Napier silage	CP						9.92
Whole triticale silage	CP					10.47	
Jumboo Silage	CP						8.87
Maize Silage	CP					8.09	9.95
Splendida grass Silage	CP					11.30	
Mugbean residues Silage	CP					11.31	12.10
Triticale forage and rice straw silage(4:1)	CP					11.12	

Khesari hay	CP						15.24
Rice Straw	CP			3.09	3.85	3.67	4.41
Wheat Straw	CP					3.05	4.00
Triticale straw	CP					6.52	
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Soyabean straw	CP						4.20
Maize Stover	CP						6.08
UMS	CP					8.20	8.27
Sugar beet	CP						5.10
Sugar cane baggase	CP				1.99	5.25	7.69
Sugar cane tops	CP						5.80
Cassava root	CP					2.07	1.43
Concentrate mixture	CP					16.85	16.66
Wheat	CP	10.90			14.10	14.49	14.33
Soybean	CP		40.00		38.90	43.60	38.06
Rapeseed	CP			38.40	38.29	36.32	33.67
Maize	CP		8.75		7.70	8.09	8.60
Horse bean	CP						17.80
khesari	CP					20.35	23.75
Khesari crushed	CP		31.95	24.21	28.33	28.39	
Cowpea	CP						17.00
Country bean	CP					25.80	
Field pea	CP					25.40	
Broiler litter	CP					13.80	
Layer manure	CP					20.30	
Layer litter	CP					12.30	
Rabbit dropping	CP					9.90	
Saw dust	CP					24.00	
Cattle manure	CP					9.30	
Paper mill waste	CP					26.00	
Coconut oil cake	CP					20.40	
Cotton Seed cake	CP					22.30	
Di-calcium Phosphate	CP						
Fish meal	CP					56.75	57.03
Ground-nut cake	CP					48.15	36.47
Linseed cake	CP					35.90	
Mustard Oil cake	CP	23.40			38.60	34.24	31.35
Rice bran	CP		12.77	12.80		7.10	7.76
Broken rice	CP		10.10			11.13	11.04
Rice Polish	CP		10.98	12.90	13.38	12.00	8.78
Til bran	CP						15.86
Til oil cake	CP		39.10	47.10	37.05	26.89	35.76
Soybean meal	CP		17.10	18.25	21.94	39.81	42.94
Wheat bran	CP					15.50	16.02

Sesame oil cake	CP					28.32	28.43

Average Value of crude fiber:

Feed name	Nutrient Parameter	1945 - 171	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	CF					27.00	19.96
Para	CF						30.72
German	CF					28.83	35.04
Dhal	CF					32.00	33.13
Signal	CF	34.45				31.50	33.54
Jumboo	CF	30.79				30.44	36.24
Adropogan	CF					26.50	25.58
Maize grass	CF		27.60				29.45
Bermuda Grass	CF						34.40
Durba Grass	CF						28.14
Shama	CF						22.30
Baksa Grass	CF						25.73
Pangora	CF						25.45
Ruzi	CF						24.65
Gunea grass	CF						31.10
Chaila	CF						33.60
Ipil Ipil	CF		9.50		19.60	12.95	9.51
Alfa-alfa	CF		36.00	23.30	41.31	22.10	17.83
Khesari	CF		9.15	8.57	6.00	4.42	13.55
Dhaincha	CF						16.54
Cowpea	CF					4.36	18.74
Mash kalai	CF						24.65
Centro	CF						32.60
Jack fruit	CF		15.50			19.63	
Banana plant	CF						24.30
Neem	CF						22.56
Shaora	CF						16.70
Banyan	CF						28.94
Mango	CF					2.11	18.71
Mander	CF						41.37
Tut	CF						13.38
Karai	CF						21.60
Moringa feed	CF						12.11
Duck Weed	CF				10.70	9.40	12.40
Azolla	CF						11.90
Algae	CF						12.00
Water Hyacinth	CF			1.70			18.37
Rice Straw	CF			33.02	37.00	33.79	33.31

Wheat Straw	CF					45.75	38.58
UMS	CF					30.62	
maize stover	CF						25.60
Sugar cane baggase	CF					41.90	43.66
Sugar cane tops	CF						34.60
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Cassava root	CF						2.15
Wheat	CF	2.18			3.00	2.63	2.13
Soyabean	CF				0.07	3.79	4.00
Rapeseed	CF			13.70	12.01	12.28	9.25
Maize	CF		2.95		2.43	2.60	2.40
Horse bean	CF						27.20
khesari	CF		9.15	8.57	6.00	4.42	13.44
Khesari crushed	CF					7.50	
Cowpea	CF					29.40	
Country bean	CF					7.00	
Field pea	CF					6.90	
Broiler litter	CF					22.70	
Layer manure	CF					12.80	
Layer litter	CF					10.30	
Rabbit dropping	CF					23.30	
Saw dust	CF					6.23	
Cattle manure	CF					4.59	
Paper mill waste	CF					5.22	
Coconut oil cake	CF					14.60	
Cotton Seed cake	CF					24.10	
Fish meal	CF					1.66	
Ground-nut cake	CF					7.32	5.34
Linseed cake	CF					9.40	
Mustard Oil cake	CF	8.60			11.20	9.80	10.88
Rice bran	CF		8.71	7.00			29.77
Broken rice	CF		1.30			2.40	1.70
Rice Polish	CF		10.73	10.88	10.38	8.78	25.14
Til bran	CF						20.58
Til oil cake	CF		4.70		5.52	5.97	5.27
Soyabean meal	CF		18.40		3.10	6.53	5.16
Wheat bran	CF					9.99	10.26
Sesame oil cake	CF				7.60	3.93	8.85

Average Value of EE:

Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	EE				14.42		12.77
Para	EE						2.29
Splendida	EE					2.70	0.79
German	EE					3.52	5.13

Dhal	EE						2.53
Signal	EE					1.80	6.65
Jumboo	EE	2.07				2.87	1.57
Adropogan	EE					3.05	6.04
Maize grass	EE						4.05
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Bermuda Grass	EE						1.95
Durba Grass	EE						2.99
Shama	EE						2.31
Baksa Grass	EE						1.67
Pangora	EE						4.28
Ruzi	EE						2.02
Gunea grass	EE						2.45
Chaila	EE						1.60
Ipil Ipil	EE		9.14			5.30	4.71
Alfa-alfa	EE	2.13	1.30	4.10	1.45	2.67	2.02
Khesari	EE		3.15	2.14	1.70	1.15	2.03
Dhaincha	EE						4.88
Cowpea	EE					1.70	2.25
Mash kalai	EE						2.74
Centro	EE						3.00
Jack fruit	EE		2.98	6.05		2.50	3.06
Banana plant	EE						1.00
Neem	EE						
Shaora	EE						1.21
Banyan	EE						2.15
Mango	EE					3.20	4.43
Mander	EE						3.99
Tut	EE						2.70
Karai	EE						1.29
Moringa feed	EE						3.72
Duck Weed	EE				4.50	4.70	2.10
Azolla	EE						0.90
Algae	EE						2.30
Water Hyacinth	EE						1.44
Rice Straw	EE			1.64	1.30	1.21	1.42
Wheat Straw	EE					1.35	2.06
UMS	EE					2.03	
maize stover	EE						2.40
Sugar cane baggase	EE				0.72	4.25	2.86
Concentrate mixture	EE					7.04	1.30
Sugar cane tops	EE						2.40
Cassava root	EE					7.59	0.45
Wheat	EE				5.15	5.03	3.90

Soyabean	EE					0.19	7.26
Rapeseed	EE			3.70	3.59	8.50	9.72
Maize	EE				5.15	5.03	3.90
Horse bean	EE						2.80
khesari	EE		3.15	2.14	1.70	1.15	1.81
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Khesari crushed	EE					1.40	
Cowpea	EE					3.80	
Country bean	EE					6.90	
Field pea	EE					1.75	
Broiler litter	EE					18.00	
Layer manure	EE					11.00	
Layer litter	EE					19.00	
Rabbit dropping	EE					11.00	
Saw dust	EE					6.00	
Cattle manure	EE					22.00	
Paper mill waste	EE					6.00	
Coconut oil cake	EE					9.20	
Cotton Seed cake	EE					4.60	
Fish meal	EE					10.00	7.26
Ground-nut cake	EE					8.00	8.20
Linseed cake	EE					7.60	
Mustard Oil cake	EE	46.70			1.40	9.40	5.29
Rice bran	EE		6.87			11.60	6.11
Broken rice	EE		3.80			1.55	2.05
Rice Polish	EE		12.83	17.19	11.93	14.26	7.85
Til bran	EE						8.24
Til oil cake	EE		9.30	9.25	7.15	18.60	5.39
Soybean meal	EE		4.33	2.20	4.59	1.78	2.32
Wheat bran	EE					15.23	7.07
Sesame oil cake	EE				25.81	30.20	11.84

Average value of NFE:

Feed name	**Nutrient Parameter**	**1945 -171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	NFE				1.82	8.20	20.32
Para	NFE						45.23
Splendida	NFE						
German	NFE					41.45	33.22
Dhal	NFE					46.30	39.96
Signal	NFE					50.40	59.40
Jumboo	NFE	47.40				53.40	37.29
Adropogan	NFE						49.19
Maize grass	NFE		54.43				52.90
Bermuda Grass	NFE						37.05

Durba Grass	NFE						41.67
Shama	NFE						54.80
Baksa Grass	NFE						
Pangora	NFE						47.86
Ruzi	NFE						51.56
Feed name	**Nutrient Parameter**	**1945 -171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Gunea grass	NFE						40.50
Chaila	NFE						43.80
Ipil Ipil	NFE		21.68			38.80	48.60
Alfa-alfa	NFE	39.70	39.00		31.49		40.41
Khesari	NFE			50.87		63.03	47.68
Dhaincha	NFE						40.83
Cowpea	NFE					66.47	
Mash kalai	NFE						40.99
Centro	NFE						39.20
Jack fruit	NFE		59.50	62.80		33.79	
Banana plant	NFE						54.00
Neem	NFE						43.85
Shaora	NFE						51.32
Banyan	NFE						41.33
Mango	NFE			67.00		42.00	53.73
Mander	NFE						36.15
Tut	NFE						46.04
Karai	NFE						33.83
Moringa feed	NFE						50.48
Duck Weed	NFE						34.35
Azolla	NFE						30.90
Algae	NFE						45.50
Water Hyacinth	NFE						43.28
Rice Straw	NFE			41.87	43.00	44.25	45.77
Wheat Straw	NFE					32.00	31.89
UMS	NFE					32.05	
Maize stover	NFE						61.07
Sugar cane baggase	NFE					26.74	3.78
Concentrate mixture	NFE						
Sugar cane tops	NFE						47.90
Cassava root	NFE						
Wheat	NFE						74.17
Soybean	NFE						20.03
Rapeseed	NFE			37.10	38.00	35.60	37.27
Maize	NFE		70.52		52.90		
Horse bean	NFE						37.80
Khesari	NFE			50.87		63.03	46.27
Khesari crushed	NFE						

Cowpea	NFE					36.30	
Country bean	NFE					44.60	
Field pea	NFE					45.70	
Broiler litter	NFE					24.80	
Layer manure	NFE					25.10	
Feed name	**Nutrient Parameter**	**1945 -171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Layer litter	NFE					49.50	
Rabbit dropping	NFE					47.70	
Saw dust	NFE					32.20	
Cattle manure	NFE					31.90	
Paper mill waste	NFE					33.00	
Coconut oil cake	NFE						
Cotton Seed cake	NFE						
Fish meal	NFE					12.10	
Ground-nut cake	NFE					36.00	32.90
Linseed cake	NFE					38.90	
Mustard Oil cake	NFE				28.90	27.25	40.91
Rice bran	NFE						24.09
Broken rice	NFE					71.50	
Rice Polish	NFE						37.82
Til bran	NFE						28.09
Til oil cake	NFE		34.30		34.30	39.51	46.96
Soybean meal	NFE		53.00			31.56	22.90
Wheat bran	NFE					58.90	58.05
Sesame oil cake	NFE					24.60	46.96

Average value of Ash:

Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	Ash		6.00			9.28	11.69
Para	Ash						12.96
splendida	Ash					10.42	
German	Ash					11.80	9.59
Dhal	Ash					11.90	13.75
Signal	Ash					8.70	8.70
Jumboo	Ash	9.60				7.82	11.47
Adropogan	Ash					11.08	8.87
Maize grass	Ash				6.13		6.71
Bermuda Grass	Ash						14.05
Durba Grass	Ash						14.93
Shama	Ash						14.13
Baksa Grass	Ash						7.74
Pangora	Ash						14.65
Ruzi	Ash						10.38
Gunea grass	Ash						13.97

Chaila	Ash						13.40
Ipil Ipil	Ash		7.21		4.40	10.20	9.76
Alfa-alfa	Ash	9.00		11.85	9.02	7.43	11.34
Khesari	Ash		2.85	5.52	3.77	4.89	6.84
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Dhaincha	Ash						9.08
Cowpea	Ash					3.51	7.15
Mash kalai	Ash						12.49
Centro	Ash						10.60
Jack fruit	Ash					7.28	13.17
Banana plant	Ash						14.80
Neem	Ash						12.63
Shaora	Ash						16.21
Banyan	Ash						14.88
Mango	Ash			2.35		1.00	12.09
Mander	Ash						5.24
Tut	Ash						13.96
Karai	Ash						20.54
Moringa feed	Ash						9.13
Duck Weed	Ash				8.50	14.10	22.55
Azolla	Ash						30.50
Algae	Ash						21.20
Water Hyacinth	Ash			5.80		12.27	14.65
Napier 3-silage	Ash					12.96	
Napier Silage	Ash						11.04
Jumboo Silage	Ash						10.41
Maize Silage	Ash					9.38	7.83
Splendida grass Silage	Ash					10.10	
Mugbean residues Silage	Ash					12.70	8.76
Khesari hay	Ash						6.32
Rice Straw	Ash			22.46		12.57	14.74
Wheat Straw	Ash						7.89
Triticale straw	Ash					19.22	
UMS	Ash					19.41	13.06
Maize stover	Ash						4.74
Sugar beet	Ash						9.28
Sugar cane baggase	Ash				4.90	2.41	3.81
Concentrate mixture	Ash					9.42	8.69
Sugar cane tops	Ash						9.30
Cassava root	Ash					4.11	1.34
Wheat	Ash	1.56				1.80	1.45
Soybean	Ash		4.90		0.06	2.78	2.88

Rapeseed	Ash			7.60	8.00	6.90	6.52
Maize	Ash		2.37		1.76	3.07	1.35
Horse bean	Ash						14.40
Khesari	Ash		2.85	5.52	3.77	4.89	4.05
Khesari crushed	Ash					13.10	
Cowpea	Ash					13.50	
Country bean	Ash					5.70	
Field pea	Ash					4.40	
Broiler litter	Ash					2.67	
Layer manure	Ash					2.99	
Layer litter	Ash					2.59	
Rabbit dropping	Ash					1.79	
Saw dust	Ash					1.21	
Cattle manure	Ash					1.07	
Paper mill waste	Ash					11.50	
Coconut oil cake	Ash					6.40	
Cotton Seed cake	Ash					5.50	
Fish meal	Ash					26.45	28.09
Ground-nut cake	Ash					5.17	6.69
Linseed cake	Ash					8.20	
Mustard Oil cake	Ash	5.10			7.30	8.29	5.61
Rice bran	Ash		16.76			19.40	17.01
Broken rice	Ash					1.98	1.54
Rice Polish	Ash		11.00	16.67	10.75	10.60	12.51
Til bran	Ash						17.83
Til oil cake	Ash				11.52	6.20	9.10
Soyabean meal	Ash		4.93	4.90	7.13	9.09	7.33
Wheat bran	Ash					11.63	4.53
Sesame oil cake	Ash					7.96	7.59

Average value of DCP:

Feed name	Nutrient Parameter	1945 -171	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	DCP						4.50
Para	DCP						7.90
Andropogan	DCP					3.80	
Maize grass	DCP				4.70		
Shama	DCP						8.90
Khesari	DCP						14.30
Mash kalai	DCP						9.50
Centro	DCP						4.00
UMS	DCP						0.07
Sugar cane tops	DCP						2.70
Horse bean	DCP						6.60

Average value of TDN:

Feed name	Nutrient Parameter	1945 - 1971	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	TDN				64.38		57.40
Para	TDN						56.00
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Splendida	TDN				66.00	55.70	52.00
Dhal	TDN						
Maize grass	TDN						
Sugar cane tops	TDN						50.00
Rapeseed	TDN					18.64	17.80
Horse bean	TDN						52.00
Ground-nut cake	TDN						76.50
Soybean meal	TDN				75.00		

ME:

Feed name	Nutrient Parameter	1945 - 1971	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	ME						9.20
Splendida	ME					7.58	
German	ME						8.43
Dhal	ME					8.76	10.58
Andropogan	ME					11.90	5.62
Maize grass	ME				9.80		11.67
Bermuda Grass	ME						9.60
Durba Grass	ME						9.60
Shama	ME						9.40
Chaila	ME						8.60
Khesari	ME						9.90
Dhaincha	ME						4.38
Cowpea	ME						10.20
Mash kalai	ME						9.50
Centro	ME						9.40
Banana plant	ME						9.90
Duck Weed	ME						6.03
Azolla	ME						4.91
Algae	ME						5.33
Water Hyacinth	ME						5.10
Rice Straw	ME					6.95	
UMS	ME					94.72	88.03
Sugar cane baggase	ME				84.50		79.08
Sugar cane tops	ME						5.80

Concentrate mixture	ME					10.40	
Rapeseed	ME					64.00	64.75
Maize	ME		13.60		13.60		
Horse bean	ME						8.90
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Cowpea	ME					10.20	
Fish meal	ME					12.80	
Ground-nut cake	ME					15.65	11.53
Linseed cake	ME					12.40	
Mustard Oil cake	ME	76.60				12.70	
Rice bran	ME		2.08	3.09			
Broken rice	ME					18.00	13.08
Rice Polish	ME		8.09	6.88	11.26		8.73
Soybean meal	ME				11.69	10.27	11.95
Wheat bran	ME					10.00	
Sesame oil cake	ME					11.80	14.11

ADF:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier-3	ADF						21.81
Napier	ADF				37.00	40.44	46.99
Para	ADF						40.60
Splendida	ADF		12.20			52.90	50.68
German	ADF					39.10	39.35
Dhal	ADF					45.40	35.25
Signal	ADF						37.20
Jumboo	ADF	44.89				44.47	
Andropogan	ADF					28.23	41.21
Maize grass	ADF						39.00
Bermuda Grass	ADF						36.10
Durba Grass	ADF						32.50
Shama	ADF						40.20
Baksa Grass	ADF						38.10
Pangora	ADF						42.30
Ruzi Grass	ADF						38.90
Gunea grass	ADF						43.40
Ipil Ipil	ADF		25.40			20.70	33.72
Alfa-alfa	ADF	33.67	18.40	37.05	21.17	31.35	31.50
Khesari	ADF		27.94	33.77	24.93	19.37	61.11
Dhaincha	ADF						41.20
Cowpea	ADF					29.95	

Mash kalai	ADF						12.60
Centro	ADF						39.50
Jack fruit	ADF			25.22			26.90
Banana plant	ADF						40.00
Neem	ADF						27.86
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Banyan	ADF						34.60
Mango	ADF						14.25
Moringa feed	ADF						35.93
Duck Weed	ADF						28.50
Azolla	ADF						42.80
Algae	ADF						19.80
Water Hyacinth	ADF						42.07
Napier 3-silage	ADF					45.88	42.21
Napier silage	ADF						49.81
Whole triticale silage	ADF					38.51	
Jumboo Silage	ADF						57.25
Maize Silage	ADF					53.30	46.78
Splendida grass Silage	ADF					34.18	
Mugbean residues Silage	ADF					59.40	34.60
Triticale forage and rice straw silage(4:1)	ADF					41.12	
Khesari hay	ADF						61.11
Rice Straw	ADF			63.00	50.15	43.65	49.09
Wheat Straw	ADF					42.00	47.52
Triticale straw	ADF					38.78	
Soybean straw	ADF						41.84
Maize Stover	ADF						43.53
UMS	ADF					42.55	49.08
Sugar beet	ADF						23.80
Sugar cane baggase	ADF				59.20	25.86	58.49
Sugar cane tops	ADF						39.20
Cassava root	ADF					15.93	5.40
Concentrate mixture	ADF					17.49	26.69
Wheat	ADF	2.22				3.80	4.41
Soybean	ADF		9.00		11.30	4.64	8.65
Rapeseed	ADF					17.47	16.48
Maize	ADF		3.90		2.53	3.50	
khesari	ADF		27.94	33.77	24.93	19.37	22.30
Khesari crushed	ADF					14.99	
Cowpea	ADF					27.10	
Field pea	ADF					38.70	

Broiler litter	ADF					25.90	
Cattle manure	ADF					43.90	
Coconut oil cake	ADF					28.70	
Cotton Seed cake	ADF					36.10	
Ground-nut cake	ADF					12.52	18.20
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Linseed cake	ADF					15.30	
Mustard Oil cake	ADF				16.80	20.73	18.53
Rice bran	ADF					3.20	15.40
Broken rice	ADF		3.92			1.98	11.60
Rice Polish	ADF		1.20	11.61	1.20		
Til bran	ADF						8.00
Til oil cake	ADF				26.00	23.00	41.48
Soybean meal	ADF					5.70	
Wheat bran	ADF						13.45
Sesame oil cake	ADF						23.07

NDF:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	NDF				51.37	64.56	70.00
Para	NDF						71.45
Splendida	NDF		27.10			49.30	77.88
German	NDF					68.70	68.90
Dhal	NDF					73.70	63.95
Signal	NDF						68.10
Jumboo	NDF	70.49				71.24	62.40
Andropogan	NDF					59.01	64.12
Maize grass	NDF						65.51
Bermuda Grass	NDF						70.20
Durba Grass	NDF						65.00
Shama	NDF						69.60
Baksa Grass	NDF						73.20
Pangora	NDF						71.40
Ruzi Grass	NDF						67.70
Gunea grass	NDF						72.30
Ipil Ipil	NDF		40.90			38.70	
Alfa-alfa	NDF	43.40	33.00	40.79	33.02	46.49	43.80
Khesari	NDF		34.90	43.00	37.08	28.42	
Dhaincha	NDF						31.30
Cowpea	NDF					40.90	
Mash kalai	NDF						43.35
Centro	NDF						55.60

Jack fruit	NDF			30.09			36.50
Banana plant	NDF						55.70
Neem	NDF						38.60
Banyan	NDF						44.70
Mango	NDF						29.80
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Moringa feed	NDF						
Duck Weed	NDF						45.25
Azolla	NDF						57.90
Algae	NDF						62.80
Water Hyacinth	NDF						66.30
Napier 3-silage	NDF						
Napier silage	NDF						75.54
Whole triticale silage	NDF					53.40	
Jumboo Silage	NDF						70.13
Maize Silage	NDF					72.40	70.95
Splendida grass Silage	NDF					69.50	
Rice Straw	NDF			86.00	71.10	68.25	73.26
Wheat Straw	NDF					62.20	75.23
Triticale straw	NDF					49.80	
Soybean straw	NDF						43.62
Maize Stover	NDF						69.90
UMS	NDF						67.29
Sugar beet	NDF						47.10
Sugar cane baggase	NDF				86.90	63.17	
Sugar cane tops	NDF						67.70
Cassava root	NDF					22.50	8.00
Concentrate mixture	NDF					36.94	46.54
Wheat	NDF	11.81				14.30	14.85
Soybean	NDF		10.00		15.80	14.14	14.50
Rapeseed	NDF					10.19	24.25
Maize	NDF		12.26		11.95	13.70	
Khesari	NDF		34.90	43.00	37.08	28.42	33.90
Khesari crushed	NDF						
Cowpea	NDF					38.60	
Field pea	NDF					54.90	
Broiler litter	NDF					43.80	

Cattle manure	NDF					64.10	
Coconut oil cake	NDF					54.70	
Cotton Seed cake	NDF					48.60	
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Ground-nut cake	NDF					21.19	23.33
Linseed cake	NDF					25.40	
Mustard Oil cake	NDF				20.70	30.51	36.03
Rice bran	NDF					12.40	29.80
Broken rice	NDF		11.17			4.71	21.70
Rice Polish	NDF		4.80	22.41	4.80		
Til bran	NDF						14.80
Til oil cake	NDF				40.50	38.00	50.63
Soybean meal	NDF					10.50	
Wheat bran	NDF						45.40
Sesame oil cake	NDF						25.45

Lignin:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	Lignin				3.50	8.09	7.89
Para	Lignin						5.65
Splendida	Lignin					16.50	5.40
German	Lignin		8.19				5.20
Dhal	Lignin					6.15	4.80
Signal	Lignin						5.10
Jumboo	Lignin	4.66					
Andropogan	Lignin					5.02	12.00
Maize grass	Lignin						8.11
Bermuda Grass	Lignin						5.30
Durba Grass	Lignin						
Shama	Lignin						5.40
Baksa Grass	Lignin						5.70
Pangora	Lignin						5.90
Ruzi Grass	Lignin						5.50
Gunea grass	Lignin						6.10
Ipil Ipil	Lignin		10.80			8.80	
Alfa-alfa	Lignin			8.50	1.60		8.25
Khesari	Lignin		1.30				1.50
Dhaincha	Lignin						5.30
Cowpea	Lignin					4.60	

Mash kalai	Lignin						0.30
Centro	Lignin						8.50
Jack fruit	Lignin			7.30			7.50
Banana plant	Lignin						8.20
Neem	Lignin						12.30
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Banyan	Lignin						13.20
Mango	Lignin						1.10
Moringa feed	Lignin						5.20
Duck Weed	Lignin						4.00
Azolla	Lignin						11.40
Algae	Lignin						
Water Hyacinth	Lignin						8.37
Napier 3-silage	Lignin						
Napier silage	Lignin						6.20
Whole triticale silage	Lignin					3.95	
Jumboo Silage	Lignin						
Maize Silage	Lignin					3.20	2.73
Splendida grass Silage	Lignin					16.20	
Rice Straw	Lignin			5.00	8.00	10.23	11.54
Wheat Straw	Lignin						7.75
Triticale straw	Lignin						
Soyabean straw	Lignin						
Maize Stover	Lignin						7.43
UMS	Lignin						
Sugar beet	Lignin						2.70
Sugar cane baggase	Lignin				22.00	18.47	21.80
Sugar cane tops	Lignin						5.60
Cassava root	Lignin					1.65	
Concentrate mixture	Lignin						
Wheat	Lignin				0.60	1.23	1.70
Soyabean	Lignin					0.30	0.70
Rapeseed	Lignin					1.85	6.91
Maize	Lignin		0.92		0.60	0.40	
Khesari	Lignin			1.50	2.50	1.30	
Khesari crushed	Lignin						
Cowpea	Lignin					4.60	
Field pea	Lignin					7.20	
Broiler litter	Lignin					7.90	
Cattle manure	Lignin					14.50	
Coconut oil cake	Lignin					6.70	
Cotton Seed cake	Lignin					10.60	
Ground-nut cake	Lignin					3.24	3.60
Linseed cake	Lignin					6.20	

Mustard Oil cake	Lignin						3.12
Rice bran	Lignin					1.20	5.45
Broken rice	Lignin		0.80				0.50
Rice Polish	Lignin		0.80	3.91	0.80		
Til bran	Lignin						2.20
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Til oil cake	Lignin				12.00	15.00	13.01
Soybean meal	Lignin						
Wheat bran	Lignin						3.85
Sesame oil cake	Lignin						1.80

Ca:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	Ca				0.11	0.17	0.46
Para	Ca						0.33
Splendida	Ca					0.13	
German	Ca						
Dhal	Ca					0.90	
Signal	Ca						0.36
Jumboo	Ca	0.66					
Adropogan	Ca					2.12	
Maize grass	Ca					1.00	0.56
Bermuda Grass	Ca				0.54		
Durba Grass	Ca						
Shama	Ca						
Baksa Grass	Ca						
pangora	Ca						
Ruzi Grass	Ca						
Gunea grass	Ca						
Ipil Ipil	Ca						
Alfa-alfa	Ca						
Khesari	Ca						
Dhaincha	Ca						
Cowpea	Ca						
Mash kalai	Ca						
Centro	Ca						
Jack fruit	Ca					1.10	
Banana plant	Ca						
Neem	Ca						
shora	Ca					1.85	
Banyan	Ca					2.60	
Mango	Ca					2.02	
Mander	Ca						0.84
Tut	Ca						1.62

Moringa feed	Ca						
Duck Weed	Ca						6.28
Azolla	Ca						1.09
Algae	Ca						1.13
Water Hyacinth	Ca						1.21
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier 3-silage	Ca						
Napier silage	Ca						
Whole triticale silage	Ca						
Jumboo Silage	Ca						
Maize Silage	Ca						
Mugbean residues Silage	Ca					0.26	
Splendida grass Silage	Ca						
Rice Straw	Ca			0.62	0.21	1.35	0.63
Wheat Straw	Ca						0.99
Triticale straw	Ca						
Soybean straw	Ca						
Maize Stover	Ca						
UMS	Ca						
Sugar beet	Ca						
Sugar cane baggase	Ca					3.05	5.00
Sugar cane tops	Ca						0.35
Cassava root	Ca						
Concentrate mixture	Ca						0.97
Wheat	Ca						1.15
Soyabean	Ca				0.21	0.15	1.63
Rapeseed	Ca					0.60	0.72
Maize	Ca		0.03		0.12	0.62	
Horse bean	Ca						0.43
Khesari	Ca		0.28	2.25	0.96	0.28	0.37
Khesari crushed	Ca					0.11	
Cowpea	Ca						
Field pea	Ca						
Broiler litter	Ca						
Cattle manure	Ca						
Coconut oil cake	Ca					0.24	
Cotton Seed cake	Ca					0.20	
Di-calcium phosphate	Ca					24.40	
Fish meal	Ca					5.77	
Ground-nut cake	Ca					2.09	6.79
Linseed cake	Ca	0.30				38.50	
Mustard Oil cake	Ca				0.65	0.60	0.89

Rice bran	Ca					0.05	
Broken rice	Ca		0.51			0.05	0.09
Rice Polish	Ca		0.20	0.73			
Til bran	Ca						
Til oil cake	Ca				1.04	2.68	0.73
Soybean meal	Ca		0.78	0.65		0.39	
Wheat bran	Ca					1.03	
Sesame oil cake	Ca					4.15	1.96

TP:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	TP				0.07		0.28
Para	TP			0.18		0.15	0.26
Splendida	TP					1.00	
German	TP						
Dhal	TP					0.10	0.65
Signal	TP	0.22					0.23
Jumboo	TP						
Adropogan	TP					1.20	
Maize grass	TP						0.08
Bermuda Grass	TP						
Durba Grass	TP						
Shama	TP						
Baksa Grass	TP						
Pangora	TP						
Ruzi Grass	TP						
Gunea grass	TP						
Ipil Ipil	TP						
Alfa-alfa	TP						
Khesari	TP						0.13
Dhaincha	TP						
Cowpea	TP						
Mash kalai	TP						
Centro	TP						
Jack fruit	TP			0.64			
Banana plant	TP						
Neem	TP						
Shaora	TP						0.27
Banyan	TP						0.22
Mango	TP						0.14
Mander	TP						0.20
Tut	TP						0.35
Moringa feed	TP						
Duck Weed	TP						6.47

Azolla	TP						0.62
Algae	TP						0.39
Water Hyacinth	TP						0.76
Napier 3-silage	TP						
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier silage	TP						
Whole triticale silage	TP						
Jumboo Silage	TP						
Maize Silage	TP						
Mugbean residues Silage	TP					0.34	
Splendida grass Silage	TP						
Rice Straw	TP			0.10	0.10	0.12	0.30
Wheat Straw	TP						0.24
Triticale straw	TP						
Soybean straw	TP						
Maize Stover	TP						
UMS	TP						
Sugar beet	TP						
Sugar cane baggase	TP					7.46	0.98
Sugar cane tops	TP						0.27
Cassava root	TP						
Concentrate mixture	TP					5.40	
Wheat	TP						
Soybean	TP		0.01		0.30	0.28	0.49
Rapeseed	TP					1.20	1.46
Maize	TP		0.68			3.13	1.20
Horse bean	TP						0.92
Khesari	TP		0.34		0.35	0.37	0.99
Khesari crushed	TP					0.56	0.96
Cowpea	TP						
Field pea	TP						
Broiler litter	TP						
Cattle manure	TP						
Coconut oil cake	TP					0.69	
Cotton Seed cake	TP					0.28	
Di-calcium phosphate	TP					18.10	
Fish meal	TP					2.81	
Ground-nut	TP					8.43	1.75

cake							
Linseed cake	TP						
Mustard Oil cake	TP	6.00				1.02	1.15
Rice bran	TP					1.40	
Broken rice	TP		0.42			0.36	0.05
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Rice Polish	TP		1.26	2.08			
Til bran	TP						
Til oil cake	TP					1.12	5.88
Soybean meal	TP		0.58	0.60		0.64	1.01
Wheat bran	TP					1.00	
Sesame oil cake	TP					6.47	1.69

Na:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Napier	Na				0.17		
Dhal	Na					0.90	
Signal	Na						0.05
Jumboo	Na	0.01					
Andropogan	Na					0.35	
Maize grass	Na						0.65
Shaora	Na						1.46
Duck Weed	Na						0.33
Azolla	Na						0.65
Algae	Na						2.00
Water Hyacinth	Na			0.10			0.21
Rice Straw	Na			0.20	0.05	0.42	0.42
Wheat Straw	Na						0.15
Sugar cane baggase	Na					0.51	
Wheat	Na						7.53
Soybean	Na					0.02	0.30
Rapeseed	Na					0.06	0.08
Maize	Na					0.50	
Khesari	Na				0.04	0.08	
Ground-nut cake	Na					0.20	4.80
Rice Polish	Na		0.48				
Til oil cake	Na						5.66
Soybean meal	Na				4.99	0.03	
Sesame oil cake	Na					0.11	0.09

K:

Feed name	Nutrient Parameter	1945 - 1971	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	K						0.47
Para	K				0.91		
Dhal	K					1.60	
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Signal	K						1.84
Jumboo	K	1.87				0.17	
Andropogan	K					1.69	
Maize grass	K						1.12
Duck Weed	K						18.65
Azolla	K						3.91
Algae	K						1.09
Water Hyacinth	K						2.62
Rice Straw	K			0.41	1.38	1.98	4.05
Wheat Straw	K						3.12
Sugar cane baggase	K					3.71	
Wheat	K						13.27
Soybean	K		0.89			1.96	0.81
Rapeseed	K					1.30	1.19
Maize	K					3.57	
Khesari	K				0.64	0.95	
Ground-nut cake	K					13.55	7.11
Mustard Oil cake	K						1.30
Rice Polish	K		3.00				
Til oil cake	K					10.65	11.06
Soybean meal	K				10.99	2.15	
Sesame oil cake	K					8.51	0.93

Mg:

Feed name	Nutrient Parameter	1945 - 1971	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	Mg				0.05		0.21
Para	Mg				0.24		
Dhal	Mg					0.20	
Signal	Mg						0.22
Jumboo	Mg	0.39					
Andropogan	Mg					2.96	
Maize grass	Mg						0.88
Shaora	Mg						0.31

Duck weed	Mg						1.07
Azolla	Mg						0.52
Algae	Mg						0.38
Water Hyacinth	Mg						0.27
Rice Straw	Mg			0.32	0.71	0.98	0.92
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Wheat Straw	Mg						0.31
Sugar cane baggase	Mg					2.05	1.17
Soybean	Mg				0.23	0.31	7.86
Rapeseed	Mg					0.64	0.53
Maize	Mg				3.10	2.75	
Khesari	Mg		0.11		0.09	0.40	
Ground-nut cake	Mg					3.69	
Til oil cake	Mg				2.13	1.19	8.24
Soybean meal	Mg		0.30		1.42	0.25	
Sesame oil cake	Mg					5.80	1.15

Fe:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Duck weed	Fe						0.65
Azolla	Fe						1.39
Algae	Fe						1.14
Water Hyacinth	Fe						0.07
Rice Straw	Fe				0.59	0.04	0.45
Sugar cane baggase	Fe					1.28	7.36
Soybean	Fe				4.53	1.70	
Maize	Fe				29.00	14.45	
Ground-nut cake	Fe					6.97	7.10
Mustard Oil cake	Fe						9.47
Til oil cake	Fe				0.70	3.88	18.02
Sesame oil cake	Fe					0.03	6.15

Others:

Feed name	**Nutrient Parameter**	**1945 - 1971**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Shaora	Mn						0.11
Duck Weed	Mn						0.40

Azolla	Mn						0.34
Algae	Mn						0.35
Water Hyacinth	Mn						0.04
Mustard Oil cake	Mn						0.55
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Shaora	Cu						0.71
Duck Weed	Cu						1.15
Azolla	Cu						1.70
Algae	Cu						2.00
Water Hyacinth	Cu						0.77
Jack fruit	Zn			16.45			
Duck Weed	Zn						13.15
Azolla	Zn						6.20
Algae	Zn						10.60
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Water Hyacinth	Zn						6.60

Hemicellulose:

Feed name	Nutrient Parameter	1945 - 1971	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	Hemicellulose					27.24	26.05
Splendida	Hemicellulose		14.60				
Dhal	Hemicellulose					28.40	
Jumboo	Hemicellulose					24.30	
Adropogan	Hemicellulose					33.98	21.00
Maize grass	Hemicellulose						27.96
Alfa-alfa	Hemicellulose	11.35		12.20	10.39		
Khesari	Hemicellulose		6.25				
Jack fruit	Hemicellulose			4.31			
Banana plant	Hemicellulose						
Neem	Hemicellulose						
Shaora	Hemicellulose						
Banyan	Hemicellulose						
Mango	Hemicellulose						
Mander	Hemicellulose						
Tut	Hemicellulose						
Karai	Hemicellulose						
Moringa feed	Hemicellulose						
Duck Weed	Hemicellulose						17.05
Azolla	Hemicellulose						15.10

Algae	Hemicellulose						43.00
Water Hyacinth	Hemicellulose						24.23
Rice Straw	Hemicellulose			23.00	20.90	32.08	26.09
Wheat Straw	Hemicellulose					20.20	10.98
Triticale straw	Hemicellulose						
Soybean straw	Hemicellulose						
Feed name	**Nutrient Parameter**	**1945 - 171**	**1972-1980**	**1981-1990**	**1991-2000**	**2000-2010**	**2011-2020**
Maize Stover	Hemicellulose						23.80
UMS	Hemicellulose						
Sugar beet	Hemicellulose						
Sugar cane baggase	Hemicellulose				15.20	23.88	33.93
Sugar cane tops	Hemicellulose						
Cassava root	Hemicellulose						
Concentrate mixture	Hemicellulose						
Wheat	Hemicellulose					8.20	
Soybean	Hemicellulose					0.03	
Rapeseed	Hemicellulose					4.65	7.88
Maize	Hemicellulose		1.79		1.90		
Horse bean	Hemicellulose						
Khesari	Hemicellulose		6.25				
Khesari crushed	Hemicellulose						
Cowpea	Hemicellulose						
Country bean	Hemicellulose						
Field pea	Hemicellulose						
Broiler litter	Hemicellulose						
Layer manure	Hemicellulose						
Layer litter	Hemicellulose						
Rabbit dropping	Hemicellulose						
Saw dust	Hemicellulose						
Cattle manure	Hemicellulose						
Paper mill waste	Hemicellulose						
Coconut oil cake	Hemicellulose						
Cotton Seed cake	Hemicellulose						
Di-calcium Phosphate	Hemicellulose						
Fish meal	Hemicellulose						
Ground-nut cake	Hemicellulose						
Linseed cake	Hemicellulose						
Mustard Oil cake	Hemicellulose						16.80
Rice bran	Hemicellulose						
Broken rice	Hemicellulose						4.20
Rice Polish	Hemicellulose		85.50	17.21			
Til bran	Hemicellulose						
Til oil cake	Hemicellulose				13.00	14.00	17.06
Soyabean meal	Hemicellulose		12.70				

Wheat bran	Hemicellulose						
Sesame oil cake	Hemicellulose						13.94

Cellulose:

Feed name	Nutrient Parameter	1945 - 1971	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	Cellulose					31.82	32.49
Para	Cellulose						28.98
Splendida	Cellulose		12.18			5.70	
Dhal	Cellulose					34.30	
Jumboo	Cellulose	27.90					
Adropogan	Cellulose					26.58	30.00
Maize grass	Cellulose						30.53
Alfa-alfa	Cellulose	24.00		26.50	34.62	23.44	
Khesari	Cellulose		19.97				
Duck Weed	Cellulose						16.75
Azolla	Cellulose						22.50
Algae	Cellulose						16.10
Water Hyacinth	Cellulose						37.10
Rice Straw	Cellulose				35.40	33.50	37.85
Wheat Straw	Cellulose					32.40	
Maize Stover	Cellulose						39.12
Sugar cane baggase	Cellulose				40.00	47.10	37.18
Wheat	Cellulose					1.78	
Soyabean	Cellulose					0.03	
Rapeseed	Cellulose					6.10	11.86
Maize	Cellulose				3.47		
Horse bean	Cellulose						
Khesari	Cellulose		19.97				
Mustard Oil cake	Cellulose						12.68
Broken rice	Cellulose						93.10
Rice Polish	Cellulose			12.62			
Til oil cake	Cellulose				21.00	24.00	29.99
Soybean meal	Cellulose		12.00				

Digestibility:

Feed name	Nutrient Parameter	1945 - 1971	1972-1980	1981-1990	1991-2000	2000-2010	2011-2020
Napier	Digestibility				44.16		54.40

Splendida	Digestibility						62.10
Dhal	Digestibility					47.73	56.70
Signal	Digestibility	67.80					62.50
Rapeseed	Digestibility					68.85	70.59
Maize	Digestibility		88.50		88.40		
Soybean meal	Digestibility		58.70	58.25	68.90		

Annexure-III

BAU component

Table 1: Chemical composition, Nutrititive value and Mineral content of the feeds and fodder available in Mymensingh in Summer and winter

Mymemsingh Summer											
Feed stuffs	**DM**	**Total ash**	**ADF**	**NDF**	**CP**	**Ca**	**P**	**CF**	**EE**	**NFE**	**ME**
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/kg DM**
Maize (broken + Crushed)	89.8	1.9	3.40	9.50	11.9	0.04	0.30	2.3	2.4	81.5	8.2
Wheat	89.4	2.2	4.40	13.40	14.3	0.09	0.49	3.4	1.8	78.4	11.6
Rice husk	90.7	17.8	13.10	26.10	4.9	0.74	2.81	24.0	6.5	46.9	9.1
Rice polish	89.5	10.6	34.51	46.52	13.5	0.06	1.56	3.5	14.6	57.7	8.0
Wheat bran	87.3	5.2	15.50	42.50	12.9	0.16	1.20	10.6	4.5	66.8	12.6
Wheat flour	89.3	4.9	14.50	41.30	14.6	0.15	1.13	9.7	4.4	66.4	8.7
Soybean Meal	89.4	7.1	6.20	9.80	48.2	0.35	0.73	6.8	5.5	32.4	13.6
Mustard oil cake	85.5	9.7	4.9	3.7	30.3	0.75	0.21	12.1	13.4	34.4	9.1
Sessame (Til) oil cake	91.3	13.8	7.80	10.52	34.5	2.28	1.23	8.1	8.7	34.9	12.3
Pulse bran (Kheshari, mushori, Mati kalai)	84.3	7.3	12.60	27.89	19.5	0.6	0.2	25.9	0.5	46.9	14.2
Rice straw (Aush)	90.0	11.0	57.83	68.45	5.1	0.35	0.15	40.8	1.4	41.7	3.3
Napier Panchon	17.6	11.6	31.70	61.00	8.3	0.31	0.42	31.7	3.0	15.4	7.8
Dhal	18.9	12.6	28.6	58.5	7.3	0.39	0.26	32.3	2.0	45.8	9.0
Local grass/fodder	17.4	12.8	43.61	63.57	3.2	0.51	0.03	37.4	2.6	44.0	5.0
Water hyachinth	7.9	14.8	64.5	70.2	9.2	1.53	0.38	16.0	2.0	58.0	7.0
Roadside grass	20.8	13.4	45.9	59.27	4.6	0.48	0.05	36.8	2.1	43.0	4.9

Winter										
Feed stuffs	**DM**	**Total ash**	**ADF**	**NDF**	**CP**	**Ca**	**P**	**CF**	**EE**	**ME**
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**MJ/kg DM**
Crushed maize	88.6	2.3	3.42	9.61	12.3	0.041	0.31	2.6	2.71	7.62
Broken rice	89.0	7.8	4.3	8.2	9.1	0.05	0.29	1.0	1.4	11.5
Wheat bran	88.6	4.8	16.41	41.34	14.32	0.23	1.35	9.87	3.7	10.29
Soybean meal	91.6	34.1	6.28	9.86	47.6	0.37	0.79	7.21	5.94	12.49
Rice polish	87.32	11.15	51.6	68.62	11.25	0.051	1.76	4.12	12.8	8.71
Wheat flour	92.6	5.21	13.93	39.89	13.52	0.17	1.19	9.23	4.6	8.92
Til oil cake	92.15	12.6	7.51	15.69	36.4	2.29	1.56	8.92	8.62	13.12
Mustard oil cake	86.2	8.6	8.16	18.42	32.4	0.79	0.26	13.1	12.4	8.69
Sesame oil cake	92.5	12.11	6.2	12.5	34.85	0.81	0.62	9.26	8.27	12.61
Pulse bran	88.26	13.2	7.51	12.41	33.21	0.76	1.15	8.6	7.89	13.12
Mixed feed	89.86	13.56	8.15	9.86	18.9	1.25	2.21	7.6	6.59	8.16
Gram	88.0	7.0	7.9	14.9	36.2	0.9	0.8	11.4	7.0	10.24
Rice straw	89.5	14.9	62.7	72.5	3.9	0.5	0.1	35.9	1.4	3.76
Napier Panchon	18.6	11.15	53.14	59.64	7.2	0.76	0.81	29.6	4.2	8.15
Water hyachinth	6.8	15.6	68.18	73.59	7.8	0.019	0.021	17.23	2.51	7.13
Roadside grass	18.25	13.29	61.18	74.52	3.25	0.025	0.01	36.81	3.2	4.23

Table 2: Chemical composition, Nutrititive value and Mineral content of the feeds and fodder available in Rajshahiin Winter and Rainy

Rajshahi Winter season										
Feed stuffs	**DM**	**Total ash**	**ADF**	**NDF**	**CP**	**Ca**	**P**	**CF**	**EE**	**ME**
	%	%	%	%	%	%	%	%	%	MJ/kg DM
Anchor	87.1	3.38	6.5	18.6	24.67	0.21	0.32	19.41	3.33	6.5
Ready feed	93.02	9.3	7.2	16.18	19.07	0.32	0.43	2.85	6.56	8.71
Rice straw	91.5	15.68	43.6	71.52	4.97	0.06	0.35	26.78	4.9	3.95
Rice polish	89.61	9.32	53.21	65.87	10.88	0.089	0.67	13.11	17.61	7.4

Napier	17.89	3.89	41.7	72.53	8.9	0.37	0.56	10.18	1.83	5.95
Local grass	28.9	3.37	46.8	73.96	11.06	0.21	0.71	9.8	3.55	4.99
Chatamoyda	90.75	8.4	9.6	12.43	17.15	0.126	0.09	6.41	7.41	8.84
Anchor+Khesari+wheat	86.73	10.53	7.56	14.53	25.16	0.43	0.08	17.37	1.88	7.95
Feed stuffs	**DM**	**Total ash**	**ADF**	**NDF**	**CP**	**Ca**	**P**	**CF**	**EE**	**ME**
	%	%	%	%	%	%	%	%	%	MJ/kg DM
MOC	89.04	7.61	10.2	17.23	34.24	0.98	0.11	7.55	9.04	8.57
Brokean rice	87.08	1.88	6.8	2.56	8.25	0.05	0.37	3.4	2.91	13.45
Maize silage	23.42	2.85	24.53	47.96	7.84	1.7	0.61	16.07	0.72	10.84
Chola+wheat+khesari+maize+rice	86.65	3.96	37.6	62.5	13.06	0.8	0.6	6.28	2.2	9.86
Mixture feed	88.05	2.91	8.26	12.54	14.41	1.82	0.38	3.49	8.04	9.15
Wheat flour	85.91	2.54	13.68	46.52	14.36	0.14	1.16	4.06	1.94	9

Rajshahi **Rainy season**										
Feed stuffs	**DM**	**Total ash**	**ADF**	**NDF**	**CP**	**Ca**	**P**	**CF**	**EE**	**ME**
	%	%	%	%	%	%	%	%	%	MJ/kg DM
Mugerbhusi	88.28	4.64	8.7	16.7	17.3	0.16	0.14	19.02	7.69	9.17
Khesari+chola	94.28	5.71	11.59	14.62	11.74	0.63	0.18	30.63	1.75	13.16
Mosurbhusi	87.68	9.66	12.5	18.9	18.11	0.89	0.32	22.47	5.4	8.9
Maize crushed	89.29	9.25	4.1	12.6	9.54	0.065	0.36	4.39	6.79	7.94
MOC	87.6	5.6	7.86	12.65	33.63	0.620	0.26	18.96	9.01	8.71
Rice polish	86.89	5.83	54.62	63.24	11.44	0.050	0.42	22.65	7.14	8.15
Rice straw	87.63	6.36	44.9	71.65	4.78	0.250	0.08	28.2	4.34	3.31
Wheat bran	88.51	1.6	14.5	43.51	11.64	0.230	1.42	15.92	4	11.13
Anchor bhusi	86.34	7.44	7.8	15.8	23.54	1.340	0.26	27.85	1.68	6.71
Mati kalai	92.25	1.64	8.92	26.81	15.76	0.91	0.8	13.8	5.71	12.14
Broken rice	88.82	0.91	2.3	6.7	7.96	0.050	0.24	2.33	1.88	12.6
Sanchi+kolmi	28.96	1.84	69.52	76.81	9.58	0.030	0.015	12.03	2.7	5.12
Mixed feed	88.9	3.5	7.9	12.51	19.71	2.300	2.1	7.6	2.57	10.16
Wheat crushed	91.23	7.21	12.51	23.25	13.58	0.080	0.15	3.26	1.55	10.63

Table 3: Chemical composition, Nutrititive value and Mineral content of the feeds and fodder available in Rangpur inRainy and Summer

Rangpur : Lalmonirhat and Kurigram										
Rainy	**DM**	**Total ash**	**ADF**	**NDF**	**CP**	**Ca**	**P**	**CF**	**EE**	**ME**
	%	%	%	%	%	%	%	%	%	MJ/kg DM
Broken rice	95.56	5.6	8.59	4.15	12.703	0.51	0.48	6.4	7.81	12.41
Muskalai	94.53	9.83	9.15	18.14	28.92	0.85	0.27	25.78	5.8	11.43
Maize crushed	92.99	1.86	7.6	16.42	10.71	0.61	0.14	8.71	4.9	8.59
Rice Polish	92.89	17.15	6.9	15.12	15.26	0.51	0.11	34.59	16.37	7.88
Paddy Crushed	98.19	2.64	9.15	5.1	15.675	0.48	0.16	0.93	4.76	10.16
Mushor	95.36	2.5	5.9	12.76	30.41	0.95	0.26	3.41	9.51	9.13
Animal Feed	99.07	9.25	4.96	6.28	15.47	1.18	0.94	14.54	10.32	9.13
Rice polish	95.97	6.03	9.12	14.18	11.76	0.08	0.27	35.29	14.35	6.91
Rice straw	98.01	11.67	68.19	73.61	4.205	0.013	0.18	7.58	3.21	3.68
Concentrate mixture	92.45	3.77	5.6	10.19	19.88	0.98	0.31	7.8	7.5	8.76
maskalai bran	94.07	7.89	7.49	18.76	16.18	0.07	0.58	24.11	8.15	13.24
Napier Pacchong	16.55	9.35	57.53	61.43	9.49	0.03	0.11	33.3	4.89	7.89
Wheat Bran	95.89	2.73	8.15	39.24	18.44	0.76	0.62	6.12	6.957	10.16
Maize	91.266	6.5	32.48	7.6	12.43	0.56	0.49	2.4	8.17	12.14
Summer										
Pigeon pea	92.47	12.9	13.18	19.14	15.675	0.37	0.34	8.7	2.8	14.01
Broken rice	85.14	1.49	14.59	22.16	12.9	0.89	0.61	1.811	6.8	10.46
Napier Pacchong	22.1	7.07	43.18	72.35	10.8	0.37	0.24	34.26	2.18	8.12
Wheat	96.8	1.6	3.18	14.16	12.42	0.08	0.34	6.078	1.8	10.92
Rice straw	84.5	4.58	63.52	67.59	4.15	0.05	0.24	8.38	3.7	3.12
Rice polish	89.96	6.97	12.4	26.34	10.71	0.08	1.8	31.03	16.89	8.19
Maize +rice	95.65	1.45	10.11	20.32	18.36	0.91	0.68	1.58	7.6	11.65

Cattle Feed 1	97.89	21.13	7.9	18.92	18.83	1.8	0.79	34.59	12.32	8.92
Cattle Feed 2	93.52	13.52	9.25	22.32	15.6	1.6	0.49	10.63	14.52	12.67
Summer	**DM**	**Total ash**	**ADF**	**NDF**	**CP**	**Ca**	**P**	**CF**	**EE**	**ME**
	%	%	%	%	%	%	%	%	%	MJ/kg DM
Wheat Bran	56.05	2.86	14.21	43.28	15.89	0.14	1.57	4.34	3.76	12.34
Rice	94.18	0.86	12.11	23.57	10.01	0.79	0.42	2.189	7.2	11.86
Durba	25.58	5.89	38.32	72.13	8.79	0.53	0.34	24.63	2.1	7.65
Sola	94.33	3.78	12.51	32.89	19.93 3	0.09	0.03	10.07	3.2	10.11
Maize Crushed	91.56	1.8	6.15	14.62	30.79	0.05	0.15	2.22	5.24	8.15
Rice polish	92.85	1.56	5.8	48.52	8.98	0.03	0.31	34.59	4.8	9.16
wheat	91.97	0.72	8.9	18.92	15.35	0.92	1.17	3.06	2.7	12.62
Mushor	91.66	4.68	12.59	25.69	22.36 5	0.56	2.1	23.02	7.8	8.91