FEEDING PRACTICES & NUTRITIONAL EVALUATION OF CONCENTRATE FEED OF CATTLE USED IN SMALLHOLDER FARMING SYSTEMS OF SOUTH-WEST PART OF BANGLADESH

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CERTIFICATE

This is to certify that the thesis entitled, "FEEDING PRACTICES & NUTRITIONAL EVALUATION OF CONCENTRATE FEED OF CATTLE USED IN SMALLHOLDER FARMING SYSTEMS OF SOUTH-WEST PART OF BANGLADESH" submitted to the Department of Animal Nutrition, Genetics and Breeding, Sher-E-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE (MS) IN ANIMAL NUTRITION embodies the result of a piece of bona fide research work carried out by MD. SHAFIQUR RAHMAN, REGISTRATION NO. 12-04795 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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THIS PAPER IS DEDICATED

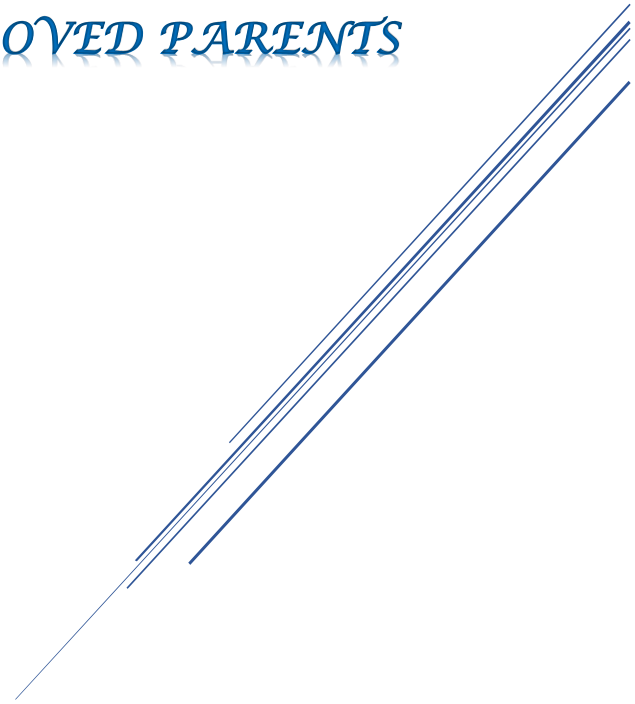
TO

FATHER OF THE NATION

BANGABANDHU SHEIKH MUJIBUR RAHMAN

AND

MY BELOVED PARENTS



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The Author

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LIST OF ACRONYMS AND ABBREVIATION

ABBREVIATION		FULL MEANING
A:P Ratio	=	Acetate Propionate Ratio
ADF	=	Acid Detergent Fiber
ADG	=	Average Daily Gain
ANOVA	=	Analysis of Variance
BER	=	Bangladesh Economic Review
BW	=	Body Weight
CF	=	Crude Fiber
CP	=	Crude Protein
D	=	Day
DLS	=	Department of Livestock Services
DM	=	Dry Matter
DMI	=	Dry Matter Intake
e.g.	=	Exempli Gratia (L), For Example
Et al.	=	And Others
Etc.	=	Etcetera
FCM	=	Fat Corrected Milk
GDP	=	Gross Domestic Product
H	=	Head
Hr	=	Hour
i.e.	=	That Is
Kg	=	Kilogram
Km^2	=	Square Kilometer
LW	=	Live Weight

MT	=	Metric Ton
NDF	=	Neutral Detergent Fiber
NRC	=	National Research Council
OM	=	Organic Matter
RDP	=	Rumen Degradable Protein
SE	=	Statistical Error
SNF	=	Solid Not Fat
SPSS	=	Statistical Package for Social Sciences
Tk.	=	Bangladeshi Taka
USDA	=	United States Department of Agriculture

LIST OF SYMBOLS

SYMBOLS		FULL MEANING
*	=	5% level of significance
&	=	And
℃	=	Degree Celsius
>	=	Greater Than
<	=	Less Than
/	=	Per
%	=	Percentage
±	=	Plus-minus
:	=	Ratio

FEEDING PRACTICES & NUTRITIONAL EVALUATION OF CONCENTRATE OF CATTLE FEED USED IN SMALLHOLDER FARMING SYSTEMS OF SOUTH-WEST PART OF BANGLADESH

ABSTRACT

The study was undertaken to identify available feed resources & evaluation of concentrate feed of cattle used by the farmers of southwest part of Bangladesh. A field survey was conducted to collect data from 180 farmers of Rajbari, Chuadanga, Jhenaidah and Magura district with a pretested survey questionnaire. The collected concentrate feed samples were evaluated through chemical analysis. Results showed that farmers' used rice straw, different types of uncultivated grass, vegetable waste, napier grass, tree leaves, sugarcane top, fruits peel, maize leaves, urea molasses straw, water hyacinth & sorghum as roughage source and rice bran, wheat bran, broken rice, broken maize, mustard oil cake, broken wheat & molasses as concentrate source. They also used boiled rice water, vitamin mineral premix and commercial cattle pellet. The average price of per kg rice straw, napier grass, rice bran, wheat bran, broken rice, broken maize, broken wheat, mustard oil cake, molasses, vitamin mineral premix, commercial cattle pellet feed was Tk. 3.44, 2.78, 10.69, 30.81, 23.21, 26.47, 25.89, 40.75, 26.75, 722.34 & 32.93 respectively. Proximate composition of available concentrated feed items showed average DM% of rice bran, wheat bran, broken rice, broken maize, mustard oil cake and broken wheat is (89.23 ± 0.26), (86.62 ± 0.28), (87.55 ± 0.33), (88.04 ± 0.36), (87.85 ± 0.26) & (88.82 ± 0.33) respectively. Average CP% of rice bran, wheat bran, broken rice, broken maize, mustard oil cake and broken wheat is (7.25 ± 0.21), (14.77 ± 0.40), (8.78 ± 0.19), (8.13 ± 0.14), (31.66 ± 0.38) & (11.75 ± 0.18) respectively. Average CF% of rice bran, wheat bran, broken rice, broken maize, mustard oil cake and broken wheat is (19.18 ± 0.52), (9.32 ± 0.23), (0.54 ± 0.04), (4.16 ± 0.14), (10.89 ± 0.18) & (2.61 ± 0.15) respectively. Highest number (91.67%) of farmers claimed higher price of feed as the key challenges and 87.78% farmers suggested that reducing feed cost was the primary solution to overcome the challenges regarding cattle feeding. On the basis of above study it is evident that rice straw is the main roughage feed and rice bran is the main concentrate feed which are used by 100% farmers and 95.56% farmers respectively. The use of commercial pellet feed is limited which is used by only 12.78% farmers.

CHAPTER-I

INTRODUCTION

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INTRODUCTION

1.1 General Character

Bangladesh is an agriculture-based country. Agriculture employs 40.6% of total employed person, followed by service employed 39.00% and the smallest proportion was the industry sector which employed 20.4 percent (BER, 2019). Agriculture contributes 13.60% of total GDP (BER, 2019).

Livestock is one of the most important sub-sectors of agriculture which plays a vital role in promoting national economy of the country (Sarma *et al.,* 2014). GDP of livestock subsector in current market price is Tk. 46,673 crore and contributes 1.43% of total GDP and 13.44% of agricultural GDP and the GDP growth rate of livestock at constant price is 3.04%. At the same time, this subsector employs 20% of employed person directly and 50% of employed person indirectly (DLS, 2020). Though the share of the animal farming sub-sector in GDP is small, it makes immense contribution towards meeting the requirements of daily essential animal protein (BER, 2019).

About 80-85% of the households keep livestock in the rural areas and most of them are marginal and small farmers (Hossain *et al.,* 2004). Livestock is considered as "Cash Income" to rural farmers that is instantly available for sale or barter (Hossen *et al.,* 2008). Cattle rearing for milk and meat production have become an important business for the small farmers in Bangladesh. More than 70% of dairy farmers are smallholder and produce around 70-80% of the country's total milk (Uddin *et al.,* 2012).

Bangladesh has 24.39 million cattle (DLS, 2020). According to WHO, Bangladesh is 12^{th} largest cattle populated country and holds 1.64% of world cattle population (beef2live, 2020). The country has one of the highest cattle densities of 145/km^2 compared with 90 for India, 30 for Ethiopia, and 20 for Brazil (Karim 1997). Global distribution of cattle is shown in figure 1 according to Robinson *et al.* (2014) and cattle production zones on Bangladesh based on the average number of cattle per 1000 people (C:10^3H) is shown on figure 2 according to Huque and Khan (2017).

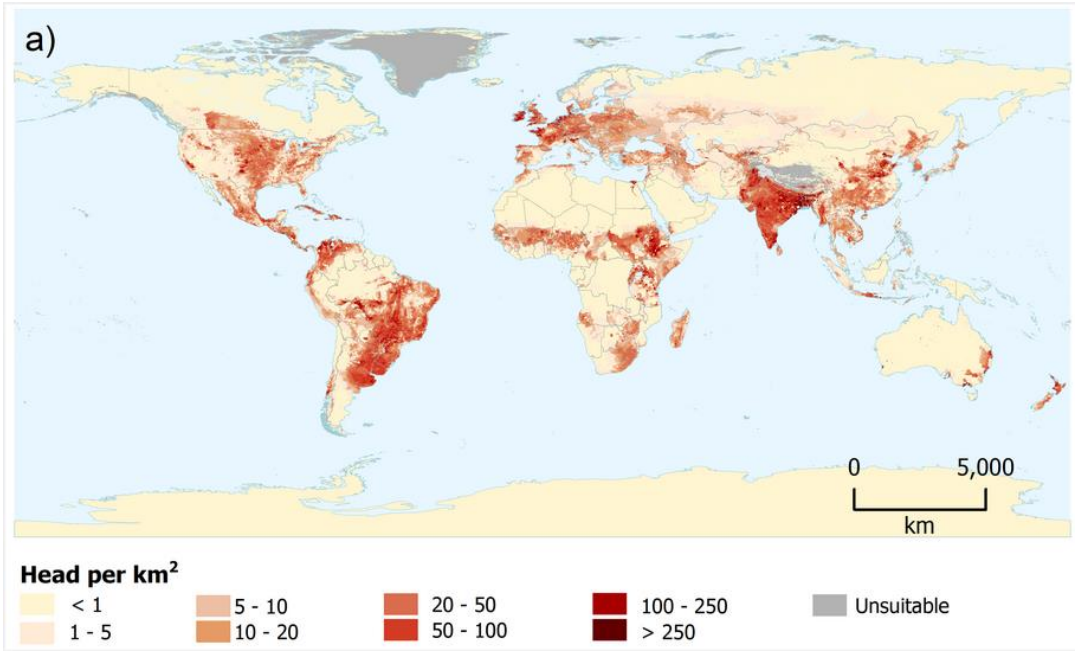

Figure 1: Global distribution of cattle (Robinson *et al.*, 2014)

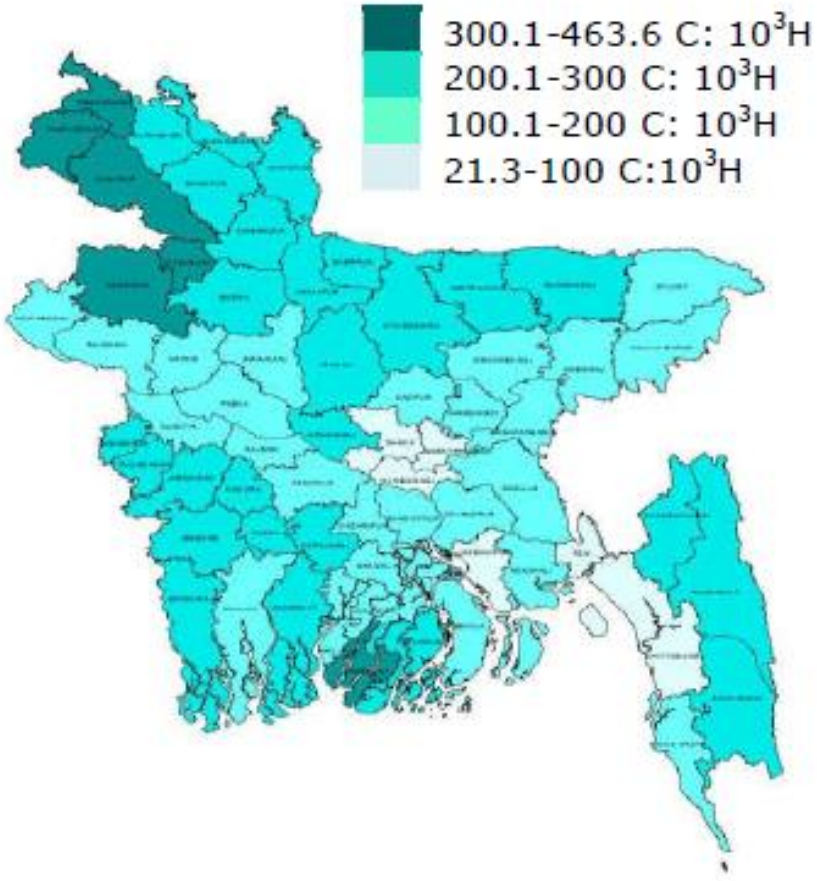

Figure 2. Cattle production zones on Bangladesh (Huque and Khan, 2017)

In 2018-19, 106.80 Lakh MT milk and 76.74 Lakh MT meat were produced in Bangladesh (DLS, 2020). The cow is the main source of milk. About 90% of the produced milk in the country comes from cows and about 60-65% of the supplied meat is beef (UNIDO, 2019).

1.2 Scope of the Research

Bangladesh has a large number of cattle populations. But, the productivity of our cattle is very low. Hussain (2013) found dairy farms an average yield 200-250 liter per 305-day lactation, i.e., 0.66-0.82 liter per cow per day having 3.5 head of cattle. The average live weight of slaughtered local breed cattle ranges from 200 to 250 kg whereas full grown male Pabna cattle weight is 350 to 400 kg each and female cattle is smaller in size (UNIDO, 2019).

Bangladesh requires 152.02 lakh metric ton milk yearly as per person require 250 ml whole milk per day. We gain 175.63 ml milk per person per day. Therefore, the total deficient of milk is 45.22 lakh MT (DLS, 2020).

Bangladesh is self-sufficient in meat production. We gain 126.20 gm meat per person per day whereas our daily demand is 120.00 gm meat (DLS, 2020). Whereas, the amount of meat consumed in different countries varies enormously with social, economic and political influences, religious beliefs and geographical differences. The top three meat consuming countries are USA, Kuwait, Australia consuming 120, 119.2, 111.5 kg meat per person per year (Telegraph, 2018).

As cattle supply 90% of total milk and 60-65% of total meat produced in Bangladesh (UNIDO, 2019). Therefore, it is necessary to find out the limitations and scope of existing milk and beef production system to make it more sustainable at farmer's level.

The acute shortage of quality feed and fodder is one of the single most important obstacles for low productivity in livestock development in Bangladesh (Tareque and Chowdhury, 2012).

According to Khan *et al.* (2009) without improvement of feeding management animals are incapable to fully express their potential genetic superiority. Therefore, supplying good quality and sufficient amount of diets is mandatory to maximize production. But

in the country, there is acute shortage of feed both in quantity and quality. The traditional feeding system for dairy cattle is based on the use of rice straw, natural grasses supplemented with a little or no concentrates. The quantity and quality of fodder available from natural pasture show seasonal fluctuation. There is an acute shortage of feed supply during the dry season and the available feed during this period is of very poor quality. Poor nutrition results in low production and reproductive performance slow growth rate, loss of body condition and increased susceptibility to diseases and parasites.

Thus, understanding the available feed resources (agricultural and agro-industrial byproducts, natural pastures and browse) and coping strategies used by farmers to overcome feed shortage is important in order to identify appropriate research and development interventions to enhance health and performance of cattle.

Thus, the aim of this study was to identify the available feed resources, feeding practices and farmers' coping strategies with feed scarcity, nutritional evaluation of available concentrate feed & use of commercial cattle pellet feed under smallholder farming system of Bangladesh.

1.3 Objectives of the Research

In view of above situation, the present study was undertaken with the following objectives:

1. To know the available feed resources that are used for cattle ration in selected area
2. To determine the nutrient composition (DM%, CP%, CF%) of available concentrate feed items through proximate analysis
3. To know the frequency of using readymade market available feed

CHAPTER-II

REVIEW OF LITERATURE

CHAPTER-II

REVIEW OF LITERATURE

It is very important to review the past research works which are related to the proposed study before conducting any type of survey or experiment. Literature on available feed resources and feeding practices for cattle, impact of moisture & dry matter, crude protein and crude fiber on feed quality, productive and reproductive performance of cattle. The literatures reviewed here have been limited to those which are considered pertinent and related to the objectives of the present study.

2.1 Available Feed Resources and Feeding Practices for Cattle

Ahmed *et al.* (2010) conducted a study on beef fattening throughout the country and reported that rearing systems and seasons effected on feeding practices of cattle. In extensive system farmers grazed their cattle to their own croplands after harvesting crops and grazing on roadside grasslands. Semi-intensive system included cut and carry and stall-feeding system. Farmer used rice straw, green grass, rice polish, wheat bran, mustard oil cake and molasses in rainy season (March to August) and rice straw, green grass, mustard oil cake, wheat bran, rice polish, molasses, water hyacinth, tree leaves, weeds and kitchen waste during dry season (September to February). Rice straw was the main feed source. Many farmers had knowledge on some of the feeding technologies and high-quality fodder cultivation. 12.7% farmers used Urea Molasses Straw (UMS) to fatten their cattle. About 45% farmers reported shortages of animal feed, 50% reported lack of credit and 95% reported high cost of feed as the major problems of small-scale cattle fattening. 85% farmers mentioned that lowering the feed cost was main solution to overcome the problem.

A similar study was conducted by Rahman *et al.* (2012) in Dinajpur district and they also reported same feeding practices by the farmers. Moreover, they found that many farmers had knowledge on high quality fodder cultivation but none of them was found to cultivate fodder crops. More than 34.7% farmers used beef fattening tablets, 28.0% used urea molasses straw (UMS), 26.7% used urea molasses block (UMB) in beef

fattening. 93.3% farmers reported high cost of feed, 66.7% percent reported shortages of animal feed, 50% reported lack of credit as the major problems of small-scale beef fattening. 85% farmers mentioned that lowering the feed cost was main solution to overcome the problem.

Bhuiyan (2007) reported that smallholder farmers maintained the majority of the animal adjunct to crop agriculture as having significant dependence on livestock which were generally maintained on crop residues and other agricultural by-products. Rice straw was the basic feed item satisfying over 80% roughage needs throughout the country. Farmers allowed cattle to graze on roadside, fallow land, riverbank or on crop harvested lands for partially fulfilling the green roughage requirement. Rice polish, wheat or pulse bran etc. as concentrate sources had played important role in livestock enterprises throughout the country in variable level.

Khan *et al.* (2009) stated that paddy and wheat were the most important cereal crops grown in the country which occupied 80% of the total cropped area and byproducts were fed to the dairy animals. Rice straw was the main roughage for dairy cows which is low in nutritive value and palatability whereas it contributes 90% of the roughage feed to animals. The amount of green fodder fed to the cattle each day depend on the time given by the farmers to collect the grass or weeds from roadsides, agricultural land or weeds harvested from the crop fields, rather than the requirement of the cattle. Most of the time of the year, the cattle did not get adequate feed. Rice polish, wheat bran and oil cakes were common concentrate feed. Farmers who had low milk production could not afford to buy required amount of concentrate. Farmers having high yielding cross breed cows fed concentrate regularly to their animals and grew fodder crops in limited amounts.

Das *et al. (*2003) stated that although legume fodders were available in the Baral river for the bathan animals the farmers also provided a concentrate mixture of rice polish, mustard oil cake and common salt once a day while the fodder were replaced by straw during stall feeding.

Zaedi *et al*. (2009) stated that farmer of Pabna & Sirajganj fed napier, jambo, local durba and carpert green grass, khesari and matikalia from bathan. They also added that

cattle were housed in temporary shed and allowed to graze daily about 6-8 hours and provided concentrate feed twice daily (11 am and 3 pm).

Rashid *et al*. (2007) observed that concentrate feed of dairy cattle was prepared by rice bran, wheat bran, pulses bran, mustard oil cake, till oil cake, crushed rice, molasses and salt.

Hossain *et al*. (2016) reported most of the farmers (83%) of Sirajganj district used cultivated fodder and only 17% farmers used cultivated fodder and roadside grass during rainy season. About 37% farmers used commercial vitamin mineral supplement in feed for beef cattle production.

Shahjahan *et al.* (2017) reported that the feeding management system in Pabna and Sirajganj districts at household levels revealed that ad libitum fodder and straw supplying was practiced based on the availability of fodder in 60% and 40% households, respectively.

Talukder *et al.* (2019) conducted a study to investigate the available feed resource of dairy cattle in rural villages of Pabna district. Results showed that highest number of farmers (82%) used rice straw for cattle feeding as roughage source while 76% farmers used jamboo and 44% farmers used napier grass. Beside these 54% farmers used maize crush, 46% used wheat bran, 26% used til oil cake, 24% used til bran and 44% used mixed feed for cattle feeding.

Kamal *et al.* (2019) reported that, 96.3% farmers gave both roughage and concentrate and 3.8% farmer gave only concentrate. They did not use any total mixed ration (TMR). 61.3% farmer gave roadside grass as the source of roughage, 8.8% gave straw and 30% gave cultivated fodder as the source of roughage. As a source of concentrate, 18.8% used commercial pellet feed, 33.8% used hand mixed feed which was made by different raw materials found locally and 47.5% gave both pellet and hand mix feed. Among the farmers only 30% farmer treated straw with urea and rest of the farmers didn't follow any treatment. Most of the farmers (72.5%) did their ration formulation by own and the rest from the technical person. For this reason, maximum animal didn't get proper nutrition for maintenance and production.

Sarker *et al.* (2017) reported about river basin area of Bangladesh that rice straw and naturally grown green grasses were the main roughages for cattle. About 95% farmers fed rice straw and about 81% farmers fed cut and carry green grasses to their cattle. There were no seasonal variations on feeding rice straw but variations occurred for supplying cut and carry green grasses. Rice polish, wheat bran, broken rice, pulse bran and mustard oil cake are commonly used concentrates, among which rice polish and wheat bran were supplied by more farmers (about 93% and 75%, respectively). The variation of supplying concentrates among seasons were very negligible. Although, there were about 1.14% farmers who cultivated some fodder crops, they harvest grains for human consumption and residues for their cattle. However, high yielding varieties of fodders were rarely cultivated by the farmers for feeding cattle in the riverside regions. They obtained 48 different native green grasses among which most available native green grasses were durba, badla, kawn, shama, khesari, gamma, ura, gobra, shama and maskalai.

Sarker *et al.* (2016) reported about coastal area of Bangladesh that the management system of animals depended basically on type of cattle, availability of grazing or communal land and green grasses and also on farmer's solvency. Rice straw and naturally grown green grasses were the main roughages for feeding their cattle. About 87% farmers fed rice straw and about 66% farmers fed cut and carry green grasses to their cattle. Rice polish, wheat bran, broken rice and mustard oil cake are the commonly used concentrates. Rice polish was the most available concentrate feed ingredient fed by about 84% farmers. They also stated that 12% farmers cultivated fodder and 38% farmers had opportunity to cultivate fodder. About 20% farmers did not cultivate fodder due to shortage of land and 9% had no training or experience. Farmers fed 75 different types of green grass to the animals conventionally.

Islam *et al*. (2002) found that the major constraint of fodder cultivation was shortage of land. Other constraints realized by them were lack of farmer's awareness, lack of technologies, geographical hazards etc. They also studied on identification, screening and nutritive value of forages available throughout Bangladesh and identified more than fifty different type of local green grass from different AEZs in Bangladesh. They noticed that durba, baksha, lota, poa, khesari, beju, mati kalai, kolmi, gamma, badam, durba, chailla, helencha, shama were mostly common and more potential native grass.

Rahman *et al.* (2014) analyzed chemical composition of available uncultivated grass and tree forages of Noakhali districts (table 1). Various types of locally available uncultivated grass were durba, asamilata, chaila, bothoua, gamma, alias grass, shon, bontil, khesari, pakistani lata, bean leaf, ipil Ipil, mayahagoni, kadam, boroi leaf, jackfruit, babla, mango leaf etc.

Table 1: Chemical composition of uncultivated grass (Rahman *et al.*, 2014)

Available Grasses	**DM**	**DM Basis (%)**			**ME (MJ/ kg DM)**
		CP	**ADF**	**Ash**	
Durba grass	32.44	8.51	35.54	14.11	7.11
Chaila grass	24.97	6.48	30.32	9.5	8.98
Khesari grass	22.76	20.53	28.43	12.43	9.56
Bontil grass	23.36	7.43	31.78	12.13	7.80
Pakisthani lata	26.54	7.80	32.23	13.12	8.20
Bean	28.32	19.65	35.32	13.56	7.32
Boroi	32.44	11.76	34.23	8.98	6.98
Kadam	29.78	16.89	33.45	10.32	10.98
Ipil ipil	28.44	24.22	34.32	10.21	12.20
Mango	44.62	6.87	38.11	9.6	4.44
Babla	27.23	19.21	32.54	6.80	8.87
Jack fruit	28.32	11.87	44.23	11.56	6.8

Rahman *et al.* (2017) also conducted a study to identify the naturally occurring forage species in three different agro-climatic zones of Bangladesh, named saline prone area (Satkhira), flood plain/river basin areas (Pabna), semi-arid/drought prone areas (Chapainobabgonj). In saline area commonly used year-round local grasses were tale shapna, durba, nona shapna, khud gate/ khud khachra, shama, full paira, bass pata, math pora/ khata shak, ghimee shak and baksha etc. Whereas, nona shapna, tale shapna and baksha were more available compared to other species of the natural grass. In the

drought prone area, different types of native grass e.g. durba, shama, mutha, katla, kausha/ kannar, binna, datuloka, shanchi, shunshue, bash batari, ulo and binna pati were identified and utilized by the farmers in different seasons whereas durba, katla and mutha were found more. In flood prone area, kolmi, shanti, baksha, arail, dubla, bokma, vadail and bolenga etc. were found and kolmi, baksha & arail were more suitable in this area. Farmers were also reported that fodder tree like dumur/khoksha also survived in water logging situation and or flood prone area. Among different types of local grass 2-3 locally available common natural grass were found in saline, drought and flood prone areas. In addition, certain fodder crops like khesari, chickpea, doincha, cowpea, and mushur were cultivated flood prone and drought areas. Mash kalai, khesari, jambo, and napier grass were cultivated after recedes of flood water in flood prone areas of Bangladesh. They also calculated DMI and milk production. Total DMI (Kg/h/day) was the highest (14.14±1.06) in flood prone followed by drought (13.80±1.30) and saline areas (4.43±0.20), respectively. Similarly, the milk production was also higher (12.06±1.19 liter/head/day) in flood prone area followed by drought (4.47±0.60 liter/head/day) and saline (1.83±0.11 liter/head/day) areas, respectively.

Huque & sarker (2014) stated that ruminant animal in Bangladesh was mostly raised on fibrous crop-residues and cereal milling by-products. The total roughage production in the country was estimated to be $51056x10^3$ MT in 2012 of which $5781x10^3$ MT comes from cut and carry and road side grazing and about $27316x10^3$ MT (53.5%) was used as animals feed. Major types of concentrate are cereal milling by-products, grains and oilcakes. The annual availability of the three types concentrate was about $2916x10^3$ MT (58.0%), $2042x10^3$ MT (40.6%) and $67.6x10^3$ MT (1.34%), respectively. The country produced around $72.0x10^3$ MT of molasses every year and a major part of it was exported and used for ethanol production locally. The country produced $6.54.0x10^3$ MT of cotton seed cake and around $96.5.0x10^3$ MT of fruit and vegetable wastes.

According to Alltech (2018), Bangladesh produced 5.610 million metric tons of manufactured feed. For cattle 0.3 million metric tons were produced which was 5.35% of total manufactured feed production. Among these 0.3 million metric tons, 0.15 million metric tons produced for beef cattle and 0.15 million metric tons for dairy cattle.

According to Databd (2019), Bangladesh produced 3.13 million metric tons of manufactured feed. For cattle, 0.5 million MT was produced which was 14% of total manufactured feed production. Among these 0.5 million MT, 0.35 million MT produced for beef cattle and 0.15 million MT for dairy cattle. They forecast that, in 2024 total manufactured feed production will be 5.26 million MT and for cattle the production will be 0.97 million MT which is 18.44% of total manufactured feed production. Among these 0.97 million MT, 0.68 million MT for beef cattle and 0.29 million MT for dairy cattle.

Kamal *et al.* (2009) reported that feeding of crushed maize increased milk production and net income. The maize-based ration proved cost-effective in promoting milk production in small-scale dairy farms. Replacement of wheat bran with crushed maize enhanced the energy level, which could have contributed to higher milk production (Sampath *et al*., 1999).

Hasanuzzaman *et al.* (2014) conducted a study to compare rice gruel (kitchen waste) and molasses as a source of readily fermentable energy. They obtained rice gruel was less effective than molasses as fermentable energy source, however in situation where molasses was not available or costly, rice gruel could be an alternative as readily fermentable energy source. Additionally, rice gruel diet ensured a bit better rumen metabolite for growth and multiplication of rumen bacteria, protozoa because their number was slightly higher than molasses. Rice gruel contains 4.10% dry matter and 4.06% crude protein (DM basis).

Angulo *et al.* (2012a) reported that fruit and vegetable waste from marketplace contained 9.1% to 11.6% CP, 32% to 43% NDF, 14.7 to 15.9 MJ/kg ME (DM basis) with the rumen degradability of 82.94% to 89.82% at 24 hr of incubation. Supplementation of lactating diets with 1.0 kg concentrate daily containing 18.0% fruit and vegetable waste from marketplace was also reported to produce milk with a higher proportion of a-linolenic acid and cis-9, trans-11conjugated linoleic acid (CLA) without affecting daily milk yield (Angulo *et al.*, 2012b).

Das *et al.* (2018) reported that the vegetable waste from both households and marketplace in Bangladesh was safe, because levels of commonly used pesticides (metalaxyl, carbofuran, organochlorine and organophosphorus pesticides), heavy

metals (lead and total chromium) and total aflatoxins were below the threshold that could cause adverse effects. Moreover, the nutritional parameters of vegetable waste were equal to some commonly used feed ingredients, such as wheat bran and groundnut hay. They contained 14% to 17% CP, 37% to 41% NDF, 63% to 67% total digestible nutrients (TDN) with rumen degradability of 80% to 85% at 72 hr of incubation, respectively.

Das *et al.* (2019) also reported that the processed vegetable waste could replace conventional concentrate by 30% without affecting daily gain, dietary intake, digestibility and health status of bulls. It could be fed to bulls up to 9.7% of the DM of the diet, or at 0.30% of LW.

Datta *et al.* (2019) reported that feed cost was the main cost items capturing 61% shares in total variable cost. Islam *et al.* (2010) observed that feed cost for indigenous (96%) and crossbred (95.76%) cows was almost similar. The cost of a dairy cow was Tk. 2025/cow/month in the country which included feed cost is about 58.7% of total cost (Khan *et al*., 2013)

Uddin *et al.* (2010) reported that the feed cost in smallholder farms were lower than large-scale farm because of the access to larger public land for periodic grazing and use of high amount of concentrate feed than smallholder farm.

Duguma and Janssens (2016) conducted a study to assess feed resources, feeding practices and farmers' perceived causes of feed shortage and coping strategies to feed scarcity in smallholder dairy producers in Jimma town, Ethiopia. They identified twenty major feed types that were used by dairy farmers and categorized into five classes: natural pasture grazing, green feeds, hay, concentrate (commercial mix and agro-industrial by-products) and non-conventional feed resources. Green feeds- fresh or succulent grasses and legumes (mean rank = 0.361), concentrate (0.256), hay (0.198), non-conventional feeds (0.115) and natural pasture grazing (0.070) were ranked as the main feed resources in that order of importance. Green feed (94.4% of the respondents) was found to be the main basal diet of dairy cattle. Overall, wheat bran (85.2% of the respondents), commercial concentrate (55.6%), noug (*Guizotia abyssinica*) cake (20.4%), cotton seed cake (7.4%) and molasses (7.4%) were the main concentrate supplements used ($p > 0.05$). Local brew waste (*attela*) (77.8% of the

respondents), bean and pea hulls (42.6%) enset (*Ensete ventricosum*) leaf and pseudo-stem (37%), sugarcane tops (33.3%), banana leaf and stem/stover (16.7%) and papaya stem (16.7%) were the dominant non-conventional feed resources in the survey area ($p>0.05$). Most farmers (90.7%) offered concentrate supplements to milking cows. All the farmers (100%) offered common salt to their cattle as mineral supplement. The majority (98.1%) of the farmers experience feed shortage in the dry season. Land scarcity (55.6% of the respondents) was reported as the most important cause of feed scarcity followed by a combination of land scarcity and poor feed availability (42.2%). Increasing use of agro-industrial by-products and commercial concentrate mix (87% of the respondents), increasing use of hay (74.1%), increasing use of non-conventional feeds (50%), purchasing green feeds (19.8%) and reducing herd size (2.7%) were the strategies adopted for coping with feed scarcity.

2.2 Impact of Feed Moisture & Dry Matter

Concentrate feed used by the farmers are agricultural products or by-products. Feeds are stored for future using. Respiration occurs spontaneously during storage of feed. Many cereal grains show a rapid increase in respiration during storage when the moisture content is increased beyond 14 percent (Lynch, 1972) & damage of stored feed occur.

When the feed is too dry, they absorb moisture from ambient humid or give off moisture to dry ambient air when too wet. So, for storage a safe moisture content should be maintained. And for grains the moisture level is 13%.

Gowda *et al.* (2003) reported that feeds stored in air-tight containers at 0% moisture level showed no fungal growth and at below 7.5% moisture level there was minimum fungal growth. The aflatoxin (B_1) production was maximum between 12.5-17.5% moisture level up to 14 days of storage. The average aflatoxin (B_1) production was highest ($p<0.05$) at 15% moisture level and 28 days of feed storage. They suggested that the moisture level in feeds should be less than 10% for safe storage and feeds with above 12.5% moisture level should be used within a week period or should be dried for safe storage.

New (1987) reported that high levels of moisture content and relative humidity caused direct losses by making it difficult to use the material in its original form. The ingredient became too wet to mix or its physical structure could be destroyed if it was in pelleted form. More serious was the effect that high levels of product moisture and relative humidity have on insect infestation and the growth of fungi. Fungal growth caused weight loss, temperature and moisture increment, off-flavor, discoloration and perhaps worst of all some common species produced mycotoxins. He suggested to store feeds for much shorter periods before use in tropical areas than in temperate zones and cereals should be stored at 10-12% moisture.

Kellems (1991) stated that milk production was directly related with DMI; therefore, formulating ration for lactating cow should be accurate to predict feed consumption. Feed consumption had been shown to be regulated by chemostatic sensors that monitor the amount of energy being absorbed or physiological sensors based on gastrointestinal tract fill or a combination of both types of sensors.

Lahr *et al.* (1983) reported that cow consumed more DM produced more milk and had greater body weights in first lactation. DM intake of cows increased linearly as ration DM content increased. Cows fed the 78% DM diet consumed 1.8 kg/day more DM ($p<0.05$) than cows fed the 64% DM diet and 2.9 kg/day more DM than cows fed the 52% diets during the 28 weeks trial. Cows fed the 78% DM diet consumed more CP ($p<0.05$) than cows fed the 52% DM diet because of the greater DM intake of cows fed the 78% DM diet. Also, because of greater DM intake and higher ADF analysis, cows fed the 78% DM diet consumed more ADF ($p<0.01$) than cows fed any of the other diets. They also stated that high moisture in diets may be advantageous for a variety of reasons. Adequate moisture in complete diets may prevent or reduce separation of ingredients. High moisture diets would allow liberal use of wet byproducts and liquid ingredients. Silages or high moisture grains might be favored over drier feeds because of ease of preservation, reduced harvest losses and increased quality. Higher moisture contents increased palatability by improving texture or diluting undesirable flavors. In contrast, high moisture in dairy cattle diets had several disadvantages; it possibly could prevent cattle from achieving maximum intake and production.

2.3 Impact of Crude Protein

According to NRC (2001) underfeeding or overfeeding CP to dairy cows had detrimental effects on milk production, efficiency of nutrient utilization, reproduction, the environment and the overall profit of the dairy operation. NRC Dairy Committee resulted in an equation that predicts responses in milk production of 0.75 kg/d when CP increased from 15 to 16% and 0.35 kg/d when CP increased from 19 to 20%. Maximum milk yield was achieved at 23% CP in the diet.

Mutsvangwa *et al.* (2016) reported that for the low CP diets, cows fed the high RDP diet had a greater DM intake compared with those fed the low RDP diet, but the opposite trend was observed for cows fed the high CP diets. On the low CP diet, both DM and OM digested in the rumen were greater in cows fed the high RDP diet as compared with those fed the low RDP diet, but no differences in DM and OM digested in the rumen were observed between cows fed the low- and high RDP diets on the high CP diet. Milk yield was unaffected by dietary treatment. For milk component yields, protein and lactose were unaffected by dietary treatment; however, on the low CP diets, milk fat yield was greater for cows fed the low RDP diet compared with those fed the high RDP diet but was unaffected by RDP concentration on the high CP diets ($p=0.05$).

Ghorbani *et al.* (2011) reported that increasing dietary CP from 19.5 to 21.4% significantly increased milk production and protein. However, increasing CP had no effect on milk fat, lactose and SNF. Dietary crude protein levels had significant effects on DMI and digestibility of NDF, ADF and CP ($p<0.05$). Increasing dietary CP limited DMI and increased NDF, ADF and CP digestibility in diets with 21.4 and 23.4% CP compared to 19.5% CP. The highest digestibility of NDF, ADF and CP was observed for treatment with 21% CP.

Colmenero & Broderick (2006) reported that only a few production traits were affected by CP content of diets. Intake of DM, yield of milk and FCM were not significantly affected. However, milk and FCM yields showed trends for quadratic ($p=0.10$) and linear ($p = 0.10$) responses to dietary CP, respectively. Milk yield increased from 36.3 kg/d at 13.5% CP to 38.3 kg/d at 16.5% CP, then declined to 36.6 and 37.0 kg/d at 17.9 and 19.4% CP, respectively. Protein and fat yields also showed quadratic ($p=0.09$) and linear($p=0.06$) trends; both traits reached maximum at 16.5% CP, with no further

improvement at higher dietary CP. Fat content of milk increased linearly ($p<0.01$) and SNF showed a linear trend ($p=0.08$) with increasing CP content of the diet but there was no effect of dietary CP on milk protein content, lactose content & yield, SNF yield, BW change or feed efficiency (milk/DMI).

Broderick (2003) reported a linear increased in DMI when dietary CP was increased from 15.1 to 16.7 and 18.3%; milk yield increased from 33.0 to 34.1 Kg/d only with the first CP increment, with no further change at 18.3% CP, resulting in lower feed efficiency (milk/DMI) at the highest CP. He also reported that yields of fat and protein improved when the dietary CP increased from 15.1 to 16.7 but with no further increased at 18.4% CP.

Leonardi *et al*. (2003) reported no effect of dietary CP content on DMI and milk yield of dairy cows when dietary CP was increased from 16.5 to 18.5% and from 16.1 to 18.9%, respectively. They also found that protein yield was unaffected (1.35 and 1.34 kg/d) and milk protein content actually decreased (3.25 and 3.18%) when dietary CP was increased from 16.1 to 18.9%; however, fat content and yield increased significantly in response to dietary CP.

Gleghorn *et al.* (2004) reported that increasing CP concentrations from 11.5 to 13% slightly increased ADG and carcass-adjusted ADG. Dry matter intake was not affected by CP concentration. Increasing CP concentration quadratically affected HCW with a maximum at 13% CP. Marbling score and percentage of carcasses grading USDA choice was not affected by CP concentration. Serum urea nitrogen concentrations increased with increasing CP concentration. CP concentration above 13% seemed detrimental to ADG and HCW.

Amaral *et al.* (2014) reported that there was no effect of the protein levels (11% and 13%) in the initial (1-36th days of treatment) and final phases (37-72nd days of treatment) on intake of dry matter, organic matter, CP, non-fiber carbohydrates, and total digestible nutrients. No differences were observed among treatments ($p<0.05$) for average daily gain and carcass traits. They also suggested using a fixed level of 11% CP during the entire feedlot period, and this diet is economically viable and environmentally sound.

Vasconcelos *et al.* (2009) reported on nitrogen and phosphorus utilization that fecal nitrogen (g/d; p=0.03), urinary nitrogen (g/d; p<0.01), urinary urea nitrogen (g/d; p < 0.01), apparent nitrogen absorption (g/d; p<0.01), and serum urea nitrogen concentration (mg/dL; p<0.01) increased linearly as dietary CP concentration increased. Nitrogen retention (g/d) was not affected (p=0.61) by dietary CP concentration. Phosphorus intake (g/d; p=0.02), fecal phosphorus (g/d; p=0.04) and urinary phosphorus (g/d; p=0.01) increased linearly as dietary CP increased. These data suggested that changed in dietary CP and urea levels, as well as stage of the feeding period markedly altered nitrogen and phosphorus utilization by feedlot cattle.

Sasser *et al.* (1988) conducted a study to evaluate the effect of a deficiency in dietary crude protein intake on postpartum reproductive performance of first-calf beef cows. 89% of those fed adequate protein showed estrus, whereas only 63% of protein-restricted heifers exhibited estrus (p<0.05). First-service conception (p<0.05) and overall pregnancy rates (p<0.05) were lower in protein-restricted heifers. Compared with those fed adequately, protein-restricted heifers had a tendency for longer intervals to first estrus(p<0.08), first service(p<0.09) & conception(p<0.09). These data show that reduced protein intake increased the postpartum interval to first estrus, to first service and to conception and decreased the number of animals that showed estrus and conceived.

2.4 Impact of Crude Fiber

Colorado State University categorized animal feeds on the basis crude fiber content into two major categories: concentrates and roughages. Concentrates are high energy feed which contain less than 18% crude fiber. Roughages are lower energy feed which contain over 18% crude fiber.

According to AFFCO (2017) crude fiber is indigestible fraction of carbohydrate. When CF content is high, the energy content of the feed is low. Measuring CF is very important to know the digestibility of feedstuffs. CF accounts for most of the cellulose, a portion of the hemicellulose and lignin and no ash. Though is considered as indigestible, some of these components are partially fermentable by microorganisms in the animal. Now a days, ADF and NDF are more used to measure digestibility of

roughage used as ruminant diets. CF still is used today as the legal measure of fiber in grains and finished feeds.

Mccullough and Sisk (1971) reported that the high fiber rations were higher ($p<0.01$) in digestibility of crude fiber, cellulose and ether extract and lower in digestibility of crude protein and nitrogen-free extract. Meanwhile, these differences did not result in significant differences in the ration content of digestible dry matter, digestible organic matter, total digestible nutrient. They suggested total crude fiber would be between 16 and 20% of the total ration.

Schaik (2019) stated that fiber inclusion in a ruminant ration was important to rumen health. Fiber stimulates saliva production which buffers the p^H of the rumen. Inadequate inclusion of fiber in the diet was a risk factor for acidosis. Acidosis is associated with reduced rumen motility, impaired fiber digestion, decreased nutrient absorption, inflammation and damage to the rumen wall. Volatile Fatty Acids (VFA's) are produced through ruminal fermentation and represent a significant energy source for cattle.

Luthfi *et al.* (2018) reported that crude fiber had low and positive correlation with A:P ratio. The higher the crude fiber, the higher the A:P ratio. A:P ratio is important indicator of feed energy efficiency. The optimum A:P ratio for fattening beef cattle is 3 or less. They also reported that every increase 1% of crude fiber increased A:P ratio as much as 0.039. They suggested that the ration of beef cattle should contain at least 15.38% crude fiber.

Lofgren and Warner (1969) reported that, fat per cent of milk increased significantly ($p<0.001$) and protein and SNF per cent decreased significantly ($p<0.02$) when CF% increase.

Rock *et al.* (1974) reported that milk production response was minus 0.39 kg/day for each percentage increase in crude fiber. Milk fat percentage also responded to crude fiber. Milk fat test increased 0.072 per unit increment of crude fiber.

Donker and Macclure (1981) reported that the correlation between CF content of consumed DM and milk produced was highly negative. Milk production increased on the average 102 kg FCM per lactation when CF% decrease from 22.0% to 17.5%.

CHAPTER-III

METHODS AND MATERIALS

CHAPTER-III

METHODS AND MATERIALS

A survey under the experiment was conducted at selected area to find out the feeding practices for cattle and then nutrient composition of available concentrate feed was evaluated through proximate analysis.

3.1 Description of the Experiment

A single-visit-multiple-subjects formal survey method (ILCA, 1990) was applied to collect data from the farmers including personal information of farmers, feed resources used by the farmer, feed shortage faced by the farmer, challenges regarding cattle feeding and farmer's suggestion to overcome the problems. The survey was done during the period from September 2019 to October 2019. There are two assessment system were followed during the experimental period. These are-

1. To conduct a survey to find out the feeding practices for cattle
2. Assessment of nutrient composition (DM%, CP%, CF%) of available concentrate feed used in the study area

3.2 Methodology for Survey Work

3.2.1 Survey Location

The survey was conducted in 4 districts of south-west part of Bangladesh (Figure 2). Those districts are- Rajbari, Chuadanga, Jhenaidah, Magura. Rajbari lies in AEZ 12 which is low-lying and has a typical meander floodplain landscape. Soil fertility level is medium. Chuadanga, Jhenaidah, Magura lies in AEZ 11 which is predominantly highland and medium highland. Soil fertility level is low.

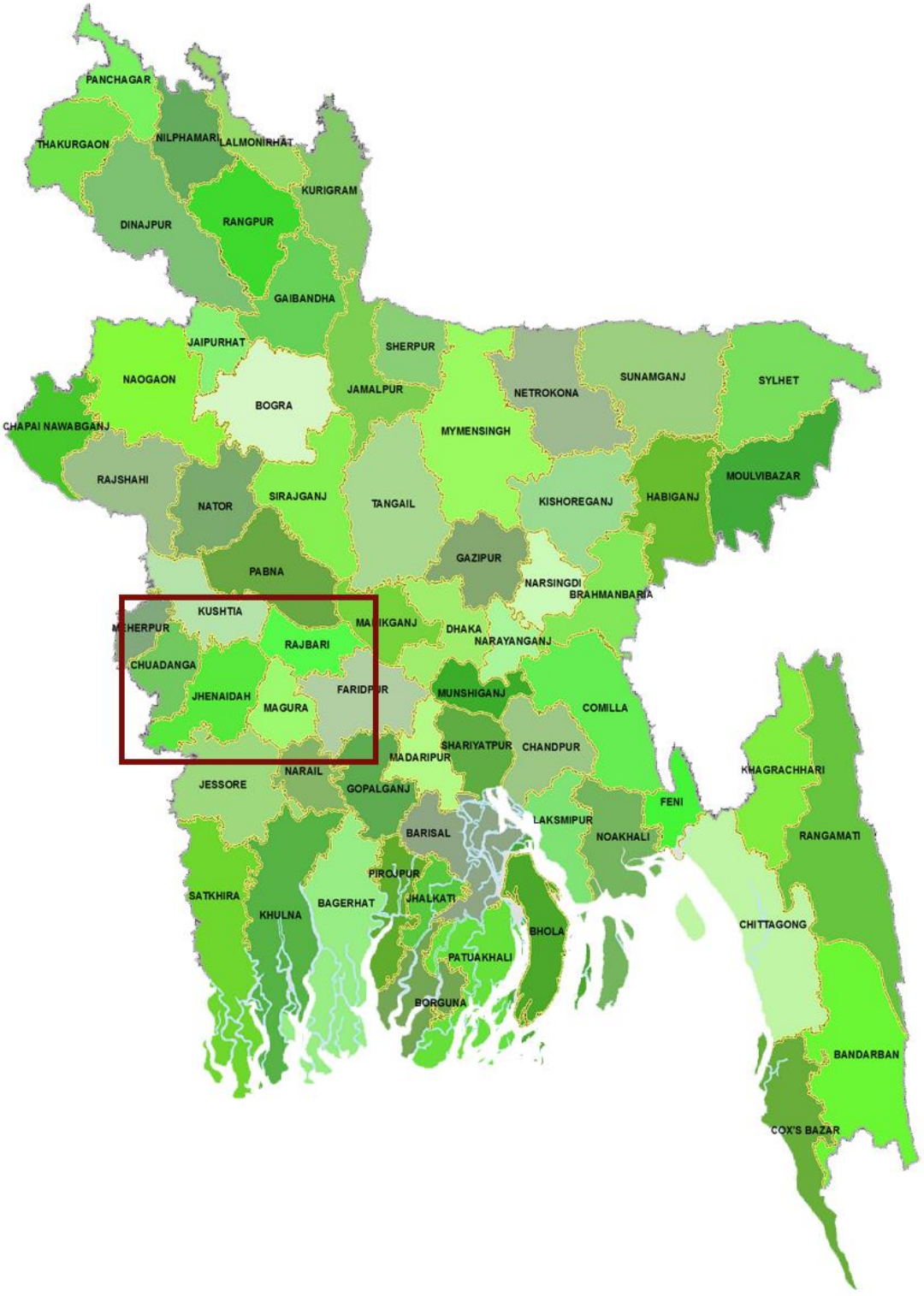

Figure 3. Mapping of survey area

3.2.2 Sampling Unit

A sampling unit can refer to any single person, animal, plant, product or thing being researched. In this case sampling unit or respondent was a smallholder cattle farmer.

3.2.3 Sample Size

The required sample size was determined based on confidence level and precision rate to be followed. The advantage of this approach is that the statistical validity of a sample does not depended on its size relative to the population being investigated. Rather what matters is the required level of probability (confidence level), required degree of precision and variability of the population. The following formula (Lwanga & Lemeshow, 1991) was used to estimate the required sample size.

$$n = \frac{Z^2\, p(1-p)N}{E^2\,(N-1) + Z^2\, p(1-p)}$$

where,

n= Required number of sample size = 180

Z= Confidence level 95% =1.96

p= 0.5

E= Design Effect (0.073)

N= Number of household rearing cattle in the selected area= 102039

3.2.4 Distribution of Sample

One Upazila of each district was selected randomly. Selected upazilas are Pangsha, Jibonnagar, Kotchandpur, Mohammadpur respectively. The number of samples were distributed evenly. 45 farmers were chosen from each upazila as sampling unit. Total distribution of sample is given below in table 2.

Table 2: Distribution of sample

District	Selected Upazila	Sample size
Rajbari	Pangsha	45
Chuadanga	Jibonnagar	45
Jhenaidah	Kotchandpur	45
Magura	Mohammadpur	45
Total		**180**
Total Number of household rearing cattle in the sampled area= 102039 (BBS, 2013)		

3.2.5 Survey Instrument

This research is a survey based exploratory as well as explanatory. The statistical information was collected via questionnaire survey from farmers. The total sample was 180 smallholder cattle farmers in the study area.

- **Questionnaire for farmer:** Questionnaire was developed to collect all relative data from the farmer. The questionnaire was prepared in English. Before starting of field survey, the questionnaire was pre-tested by interviewing some farmers and was subsequently refined and shared with supervisor. Conversation with the farmer was done in Bangla Language.

3.2.6 Data Collection

- Personal information of the sampled farmer
- Available cattle feed resources used by the sampled farmer
- Source of cattle feed
- Price of purchased cattle feed
- Challenges faced by the sampled farmer regarding cattle feeding
- Farmer's suggestions to overcome the challenges

- Frequency of using commercial readymade feed by the sampled farmer
- Time (months) of cattle feed shortage faced by the sampled farmer

3.3 Proximate Analysis of Available Concentrate Feed

Available concentrate feed items were collected from each of four districts. All determination (DM%, CP% & CF%) was done in triplicate and the mean value was reported.

3.3.1 Sample Collection

Concentrate feed items used by the farmers were collected for proximate analysis. Feed sample was collected in plastic bag from farmers or retailer during survey period with proper labeling.

Procedure of sample collection:

- Firstly, hand gloves were worn
- Then the sample was homogenized in its stored bag or container.
- Spoonful amount of sample was taken from the middle area of container in plastic bag. Re-homogenized the sample and take repeatedly up to quarter kilogram.
- The plastic bag was tightened up with rubber band
- Then the plastic bag was labelled with permanent marker

3.3.2 Preparation of the Samples

Collected feed samples were preserved in refrigerator until proximate analysis was conducted. Before lab test, the samples were taken from the refrigerator and kept in room temperature for few hours. Then the required amount of sample was kept in airtight container for subsequent proximate analysis.

3.3.3 Sample Analysis

The analysis of feed was carried out in the Animal Nutrition Laboratory of the department of Animal Nutrition, Genetics and Breeding in the Faculty of Animal Science and Veterinary Medicine, Sher-e-Bangla Agricultural University (SAU), Dhaka, 1207. The laboratory had available facilities for the determination of dry matter, crude protein and crude fiber of the feed sample.

3.3.3.1 Determination of Dry Matter

Procedure for moisture determination:

- Firstly, a porcelain crucible was cleaned, dried and weighed
- 2-3 Gram sample was weighed in the pre-weighed porcelain crucible
- Then the crucible was placed in a hot air oven at 103^0 C for about 4 hours and cooled in a desiccator and weighed.
- Re-dry for 30 minutes and repeat the process until constant weight was achieved.

The percentage of dry matter was calculated using the following equation:

$$\text{Moisture\%} = \frac{\text{Dried sample weight (gm)}}{\text{Sample weight (gm)}} \times 100$$

3.3.3.2 Determination of Crude Protein

Crude protein of the samples was estimated by using Kjeldahl nitrogen determination method. This method includes three steps such as digestion, distillation and titration.

Digestion:

- 1gm of prepared sample was weight out on a N_2 free paper and placed it into a kjeldahl flask
- About 2g of catalyzer mixture and 20ml conc. H_2SO_4 were added to the content of the flask
- The flask was heated and turned occasionally until a colorless solution was obtained

- The flask was removed after digestion; cooled and 100 ml of distilled water was added

Distillation:

- 20 ml 2% H_3BO_3 solution was taken in a conical flask and 2-3 drops of mixed indicator was added and placed on the collection arm of the distillation apparatus
- 90 ml of 40% NaOH solution was poured into the kjeldahl flask and also few Zn and glass pieces were added placed quickly on the distillation set and fitted with condenser

Titration:

- About 90-100 ml of distillate was collected in the conical flask containing H_3BO_3 solution
- The conical flask was removed with the distillate and titrated against standard 0.1N HCl solution

The percentage of crude protein was calculated using the following equations:

$$\text{Nitrogen\%} = \frac{\text{Titration value (ml)} \times 0.014 \times \text{Normality of HCl (0.1N)}}{\text{Sample weight (gm)}} \times 100$$

$$\text{Crude protein\%} = \text{Nitrogen\%} \times 6.25$$

3.3.3.3 Determination of Crude Fiber

FibroTRON Automatic Fiber Analysis system was used for determination of crude fiber.

Procedure for crude fiber determination:

1. Firstly, crucible was cleaned, dried and weighed
2. 1-2 Gram sample was weighed in the crucible
3. The crucible was placed into rubber adaptors of FibroTRON extraction unit and ensured proper sealing of crucible against the adaptor rubber

4. Acid wash-
    - 25 ml of 1.25% H_2SO_4 was poured into the extractors from top of the system
    - The sample was boiled at 380°C for 30 minutes in acid and then the acid was drained out
    - The sample was washed twice or thrice with distilled water
5. Alkali wash-
    - After that 25 ml of 1.25%NaOH was poured into the extractors from top of the system
    - The sample was boiled at 380°C for 30 minutes in alkali and then the alkali was drained out
    - The sample was washed twice or thrice with distilled water
6. After alkali wash the crucible was taken out and dry in hot air oven until the crucibles are free from moisture
7. The crucible was cooled down to room temperature using a desiccator and weighed
8. The crucible was placed in the muffle furnace at 600°C for 4 hours for ashing then cooled down to room temperature using a desiccator and weighed

The percentage of crude fiber was calculated using the following equation:

$$\text{Crude Fiber\%} = \frac{\text{Weight after oven dry (gm)} - \text{Weight after ashing (gm)}}{\text{Sample weight (gm)}} \times 100$$

3.4 Statistical Analysis

3.4.1 Data of Field Survey

A Microsoft Excel program was developed for data entry. Different types of statistical tools like number, mean, median, mode, standard deviation and percent were used. A singular tabular technique was presented in the study to classify the data into meaningful categories.

3.4.2 Data of Proximate Analysis

Total recorded data (dry matter, crude protein, crude fiber) were subjected to statistical analysis by applying one-way ANOVA using Statistical Package for Social Sciences (SPSS version 16.0) in accordance with the principles of completely randomized design (CRD). Differences between means were tested using Duncan's multiple comparison test and significance was set at $p<0.05$.

3.5 Quality Control

In order to ensure the highest level of quality data following measures was adopted-

- Taking advice from supervisor to get highest quality of information from farmers
- Day to day checking of collected data to ensure proper filling and recording of data
- Preserving contact number of the farmers to recheck if it was required at the analytical stage

CHAPTER-IV

RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

The results of the survey contain available feed resources, cost of feed, feed shortage & challenges faced by the farmers & farmer's suggestion to overcome the challenges of selected area. Dry matter, crude protein & crude fiber of available concentrate feed items were also determined. The results have been presented and discussed with the help of table and graphs. From the study the following results were obtained.

4.1 Smallholder Cattle Farming Condition

Smallholder farming has been characterized by low productivity which is partly attributed to lack of capital and uses poor farming technologies by smallholder farmers and lack of market for the product (Mwankemwa, 2004). Cattle farming in rural Bangladesh are constituted mainly from smallholder farming system being managed in traditional ways. Average number of cattle in smallholder farming system in selected area was 3.51 (Table 3).

Table 3: No. of cattle per farmer in the study area

Mean	Median	Mode	Standard Deviation
3.51	3	3	1.18

About 70-80% of national milk output was produced by smallholder owing an average 1 or 2 local cows giving 1-2 liters of milk per day (Pathan, 2011). Smallholder dairy production is very important and it contributes magnificently to the improvement of the livelihoods of rural people. It also helps in poverty alleviation, food security, improved family nutrition, income and employment generation.

4.2 Roughage Feed Resources

4.2.1 Available Roughage Feed

Available roughage feed items are described in two terms. One is ever used feed that is used by the farmers around the year other is currently used feed that is used by the farmers during the survey period. Available roughage feed items in the survey area are shown in figure 3. For ever used feed, it was observed that highest number of farmers (100%) used rice straw & different types of uncultivated grass followed by vegetable waste (77.78%), napier grass (74.44%), tree leaves (36.11%), sugarcane top (36.11%), fruits peel (28.33%), maize leaves (26.67%), urea molasses straw (19.44%), water hyacinth (11.67%) and sorghum (2.22%). For currently used feed highest number of farmers (100%) used rice straw followed by different types of uncultivated grass (96.67%), vegetable waste (63.33%), napier grass (46.11%), tree leaves (15%), water hyacinth (8.33%), sugarcane top (6.67%), fruits peel (2.78%) and urea molasses straw (0.56%). There was currently no use of maize leaves and sorghum.

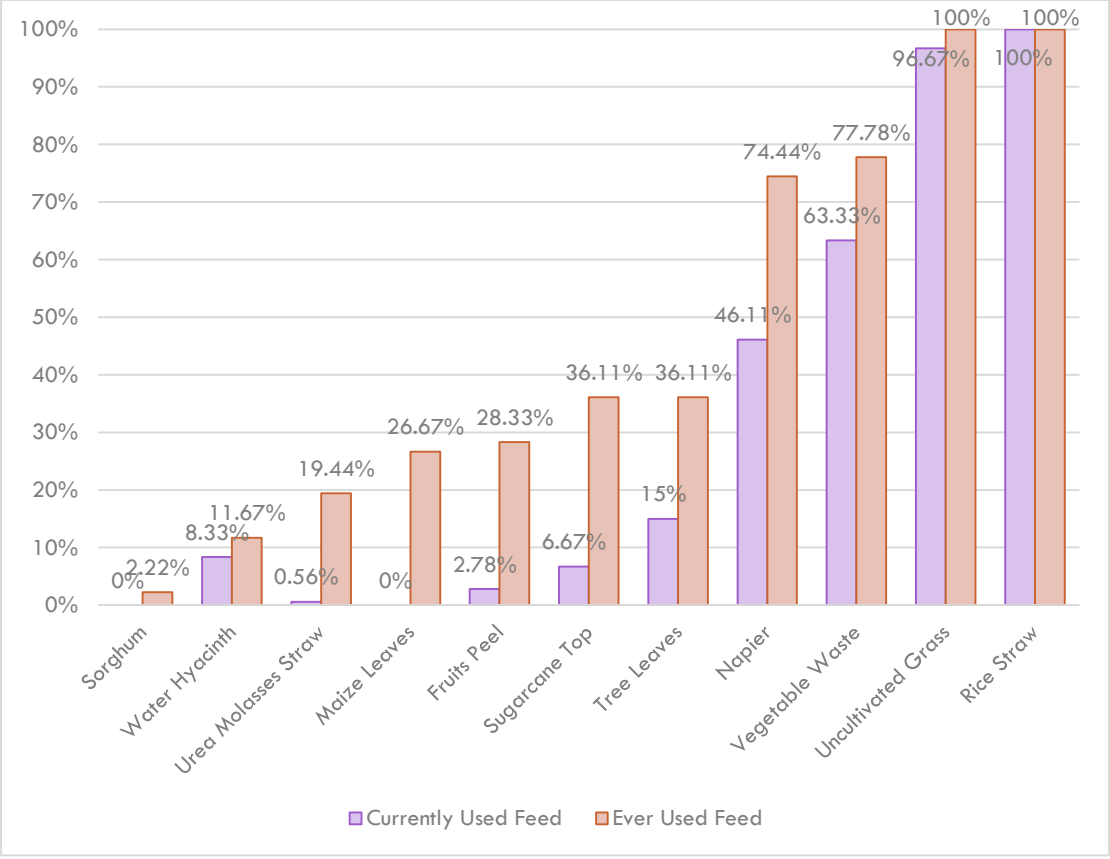

Figure 4. Available roughage feed in the study area

Rice is the main agricultural crop in Bangladesh and that's why rice straw was most available and used roughage feed for cattle in the study area. Uncultivated green grasses grow on roadsides, fallow lands, river banks. Farmers cut and carry the grass for the cattle. Feeding of green grass largely depended on collection of grass. Tree leaves, sugarcane top, maize leaves & water hyacinth are unconventional roughage source. Mainly these feeds were used when feed scarcity occurred and when these could be collected for cattle. Vegetable waste & fruits peel are kitchen waste however all farmers were not willing to fed these to their cattle. Cultivation and use of napier grass increasing day by day and it became popular in study area. Use of sorghum was not yet popular in the study area. Urea molasses straw feeding is a modern technology of cattle feeding that were not also popular therefore very few farmers fed urea molasses straw to their cattle. The variation between ever used feed and currently used feed occurs due to unavailability of feed, rise of price, unable to collect the feed, availability of more suitable feed, unwilling to use different feeds at a same time etc.

Rice straw is the main feed source for cattle in the selected area, this result is also similar with Ahmed *et al.* (2010) & Rahman *et al.* (2010). They also reported that most of the farmers compulsorily bought rice straw as their cattle feed.

These findings can relate with Talukder *et al.* (2019) who reported that highest number of farmers (82%) in Pabna used rice straw for cattle feeding as roughage source while 76% farmers used jamboo and 44% farmers used napier grass. Sarker *et al.* (2017) reported that rice straw and naturally grown green grasses were the main roughages used in river basin districts. About 95% farmers fed rice straw and about 81% farmers fed cut and carry green grasses to their cattle. Sarker *et al.* (2016) also reported that in coastal regions rice straw and naturally grown green grasses were the main roughages for feeding their cattle. About 87% households fed rice straw and about 66% households fed cut and carry green grasses to their cattle. Rahman *et al.* (2012) reported that rice straw and green grasses were used during rainy season (March to August). On the other hand, during dry season (September to February) rice straw, water hyacinth, tree leaves, weeds and kitchen waste were used by the farmers. In contrary, Shahjahan *et al.* (2017) reported that 60% famers of Pabna and Sirajganj used ad libitum fodder whereas 40% famers used ad libitum straw. Simul *et al.* (2012)

reported that farmers of Chittagong supplied 4.93 kg rice straw and 8.35 kg green grass per day to each red Chittagong cattle.

There are various types of uncultivated grass found in our country. Reza and Salim (1992) identified and described about 52 different species of grass under 12 families. Sarker *et al.* (2016) reported 75 different types of local green grass in coastal regions & 48 different types of local grass in the river basin areas (Sarker *et al.*, 2017). Rahman *et al.* (2017) reported about 40 native grass in saline, drought and flood areas. According to these researchers durba, badla, kawn, shama, khesari, gamma, maskalai, kolmi, helencha, chailla, beju, bontil, bothoua, pakisthani lata etc. were the most common and available uncultivated green grass throughout the country. Among them durba was the most common and popular grass available in every area and grown in all season.

Bakshi *et al.* (2016) reported that a number of vegetable wastes including baby corn, cabbage, carrot, cauliflower, cucumber, jackfruit, peas, potato, sweet corn, tomato and radish leaves were rich in energy and protein (more than 20%). Das *et al.* (2019) reported that the processed vegetable waste may replace conventional concentrate by 30% without affecting daily gain, dietary intake, digestibility and health status of bulls. It may be fed to bulls up to 9.7% of the DM of the diet, or at 0.30% of LW. Das *et al.* (2018) also reported that vegetable waste from both household and marketplace were safe. Moreover, the nutritional parameters of vegetable waste were equal to some commonly used feed ingredients, such as wheat bran and groundnut hay. They contained 14% to 17% CP, 37% to 41% NDF, 63% to 67% total digestible nutrients with rumen degradability of 80% to 85% at 72 hrs of incubation. Angulo *et al.* (2012a) reported that fruit and vegetable waste from marketplace may contain 9.1% to 11.6% CP, 32% to 43% NDF, 14.7 to 15.9 MJ/kg ME (DM Basis) with the rumen degradability of 82.94% to 89.82% at 24 hrs of incubation.

Ahmed *et al.* (2010) reported that 12.7% of farmers used urea molasses straw (UMS) technology to fatten their cattle. Rahman *et al.* (2012) reported that in Dinajpur district, 57.3% the farmers using UMS technology to fatten their cattle. Kamal *et al.* (2019) reported that in Gazipur, Mymensingh, Sirajgonj and Rajshahi, 30% farmer used treated straw with urea and rest of the farmers didn't follow any treatment.

According to extraction rates of by-products of different cereals shown by Huque and Amanullah (2009) and production of annual cereal yield by BBS (2019), yearly straw, sugarcane tops, fruits peel, vegetable waste & fodder production in Bangladesh is 47.163, 0.728, 0.352, 0.692, 0.242 million MT (Fresh basis) respectively and 40.088, 0.328, 0.053, 0.055, 0.060 million MT (DM basis) respectively.

4.2.2 Source of Currently Used Roughage Feed

The source of currently used roughage feed items is categorized into two such as produce and purchase. Produce means feed items that are produced by the farmers or obtained by free of costs. Purchase means feed items that are purchased from local market and which costs the farmers. The source of same feed items may vary round the year. Therefore, the source was calculated for currently (survey period) used feed.

The source of currently used roughage feed items are shown in figure 4. 63.13% farmers produced rice straw where as 36.87% farmers purchased and 59.04% farmers produced napier grass where as 40.96% farmers purchased. Straw and napier grass produced by farmers were not sufficient for their cattle year-round feeding. Therefore, some farmers used produced rice straw & napier and some farmers used purchased rice straw & napier grass. Uncultivated grasses were harvested from roadsides, agricultural land or weeds of the crop fields. Vegetable waste and fruits peel were kitchen waste that were unused for family consumption. Tree leaves and water hyacinth were obtained from natural sources. Sugarcane top was found from farmers own sugarcane field. Farmers produced urea molasses straw by themselves. Therefore, uncultivated grass, vegetable waste, tree leaves, sugarcane top, fruits peel, urea molasses straw and water hyacinth were categorized as produced.

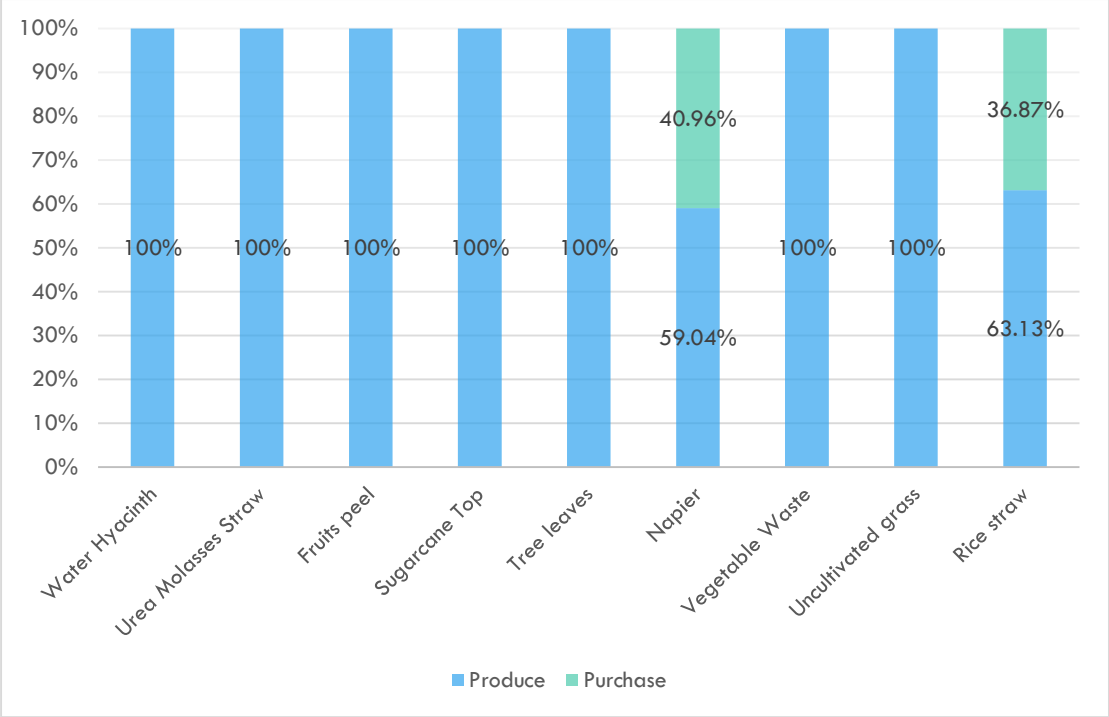

Figure 5. Source of currently used roughage feed in the study area

These findings can relate with Islam *et al. (*2002) who stated that naturally grown green grasses were mostly available in the fallow land, playground and waysides which were major sources of green forages for ruminants in Bangladesh.

Simul *et al.* (2012) reported that 38% farmers of Chittagong wanted to grow fodder and 62% farmers were reluctant to grow fodder due to lack of land. Sarker *et al.* (2016) reported that 12% farmers in coastal regions cultivated fodder and 38% farmers had opportunity to cultivate fodder. Fodder cultivation varied among different coastal districts such as in Satkhira, about 54% households cultivated fodder, however there were some regions fodder was not cultivated at all. Important constraints regarding fodder cultivation are scarcity of land, scarcity of seed/cutting and lack of knowledge, lack of awareness, lack of demand, shortage of land, lack of technologies, geographical hazards etc.

4.3 Concentrate Feed Resources

4.3.1 Available Concentrate Feed

Like roughage feed items available concentrate feed items are described in two terms. Available concentrate feed items in the survey area are shown in figure 5. For ever used feed, it was observed that highest number of farmers used rice bran (95.56%) followed by wheat bran (68.33%), broken rice (48.33%), broken maize (29.44%), mustard oil cake (10%), broken wheat (7.22%) & molasses (3.89%). For currently used feed the sequence was same as ever used feed and the percentage was 91.11%, 48.33%, 33.33%, 20.56%, 6.11%, 5.00%, 2.22% respectively.

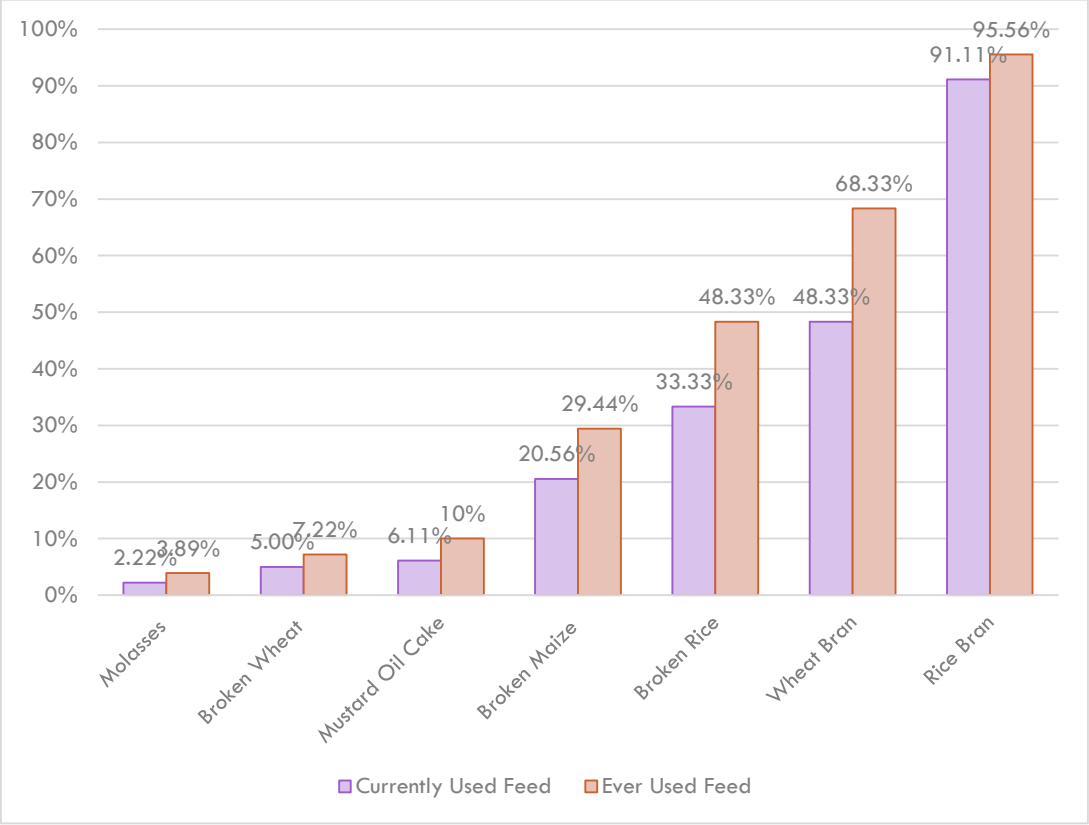

Figure 6. Available concentrate feed in the study area

Rice is the staple food in Bangladesh. Rice bran and broken rice are byproduct of rice hulling process. Rice bran is mainly used for cattle feed and it was the main concentrate feed in study area. Broken rice is mainly used for backyard poultry. And sometimes famers used broken rice for cattle. Wheat is second major cereal crop as yearly production. Wheat bran is byproduct of wheat grinding process and used for feeding

their cattle. Some farmers crushed maize and wheat for feeding of cattle. Mustard is major oil seed produced in Bangladesh. Farmers used de-oiled mustard cake for feeding of cattle after extraction of mustard oil. The use of molasses was not popular in the study area. The variation between ever used feed and currently used feed occurs due to unavailability of feed, rise of price, availability of more suitable feed, unwilling to use different feeds at a same time.

These findings can relate with Sarker *et al.* (2016) who reported that concentrate feed items used by the farmers in the coastal region were mainly rice polish, wheat bran, broken rice and mustard oil cake. Rice polish was the most available concentrate feed ingredient fed by about 84% farmers followed by wheat bran (52.3%), mustard oil cake (25.2%) and broken rice (16.7%). Sarker *et al.* (2017) reported that concentrate feed items fed by the farmers in river basin districts were mainly rice polish, wheat bran, pulse bran, broken rice and mustard oil cake. Rice polish was the most available concentrate feed ingredient fed by about 93% farmers followed by wheat bran (74.84%), broken rice (50.22), mustard oil cake (11.25) and pulse bran (3.50%). Das *et al. (*2003) reported farmers provided a concentrate mixture for the bathan animals were of rice polish, mustard oil cake and common salt once a day with legume fodder that are available in the Baral river. Rashid *et al.* (2007) reported that concentrate feed of dairy cattle was prepared by rice bran, wheat bran, pulses bran, mustard oil cake, till oil cake, crushed rice, molasses and salt. Ahmed *et al.* (2010) reported that farmers used rice polish, wheat bran, mustard oil cake and molasses in both rainy and dry season. In contrary, Talukder *et. al.* (2019) reported that for concentrate source 54% farmer of Pabna districts used maize crush, 46% used wheat bran, 26% used til oil cake, 24% used til bran and 44% farmer used mixed feed for cattle feeding.

Annual production of concentrate (cereal byproducts) in Bangladesh is given in table 5 based on the extraction rates of by-products of different cereals shown by Huque and Amanullah (2009) and production of annual cereal yield according to BBS (2019).

According to extraction rates of by-products of different cereals shown by Huque and Amanullah (2009) and production of annual cereal yield by BBS (2019), yearly rice bran, broken rice, corn, wheat bran, rape & mustard oil cake, molasses in Bangladesh is 2.902, 3.627, 1.644, 0.088, 0.246, 0.075 million MT respectively.

4.3.2 Source of Currently Used Concentrate Feed

Like currently used roughage feed items, source of currently used concentrate feed items is categorized into two such as produce and purchase. The source of currently used concentrate feed items is shown in figure 6.

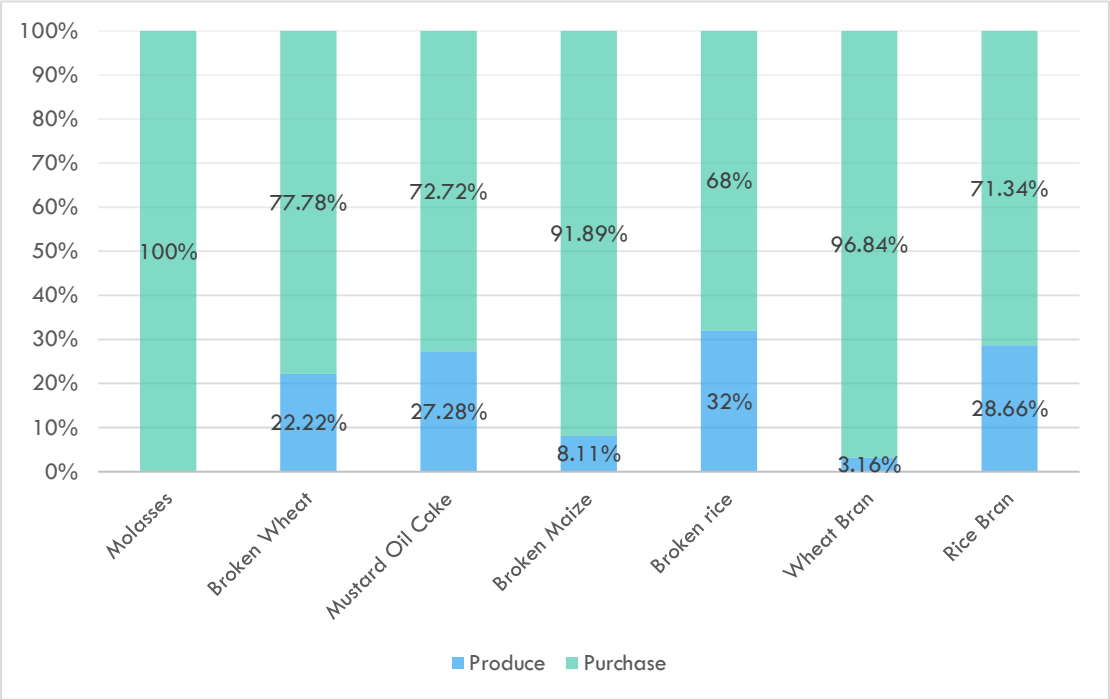

Figure 7. Source of currently used concentrate feed in the study area

Rice bran was purchased by 71.34% farmers where as 28.66% farmers produced it. 96.84%, 68%, 91.89%, 72.72%, 77.78% farmers purchased wheat bran, broken rice, broken maize, mustard oil cake and broken wheat respectively. On the other hand, 3.16%, 32%, 8.11%, 27.28%, 22.22% farmers produced wheat bran, broken rice, broken maize, mustard oil cake and broken wheat respectively. Rice bran, wheat bran, broken rice, broken maize, mustard oil cake and broken wheat produced by the farmers were not sufficient to meet the demand of their cattle. Therefore, they purchased these feeds for feeding their cattle. 100% farmers purchased molasses for feeding their cattle as it is a byproduct of sugar or treacle production and sugar or treacle processing plant could not be afforded by smallholder farmers.

4.4 Other Feed Resources

4.4.1 Available Other Feed

Feeds except roughage and concentrate are categorized into available other feed. Like roughage & concentrate feed available other feed items are described in two terms. Available other feed items in the survey area are shown in figure 7. For ever used feed, boiled rice water was used by 72.78%, vitamin mineral premix was used by 67.78% and commercial cattle pellet feed was used by 12.78% of farmers. For currently used feed, boiled rice water was used by 55%, vitamin mineral premix was used by 26.11% and commercial cattle pellet feed is used by 8.89% of farmers.

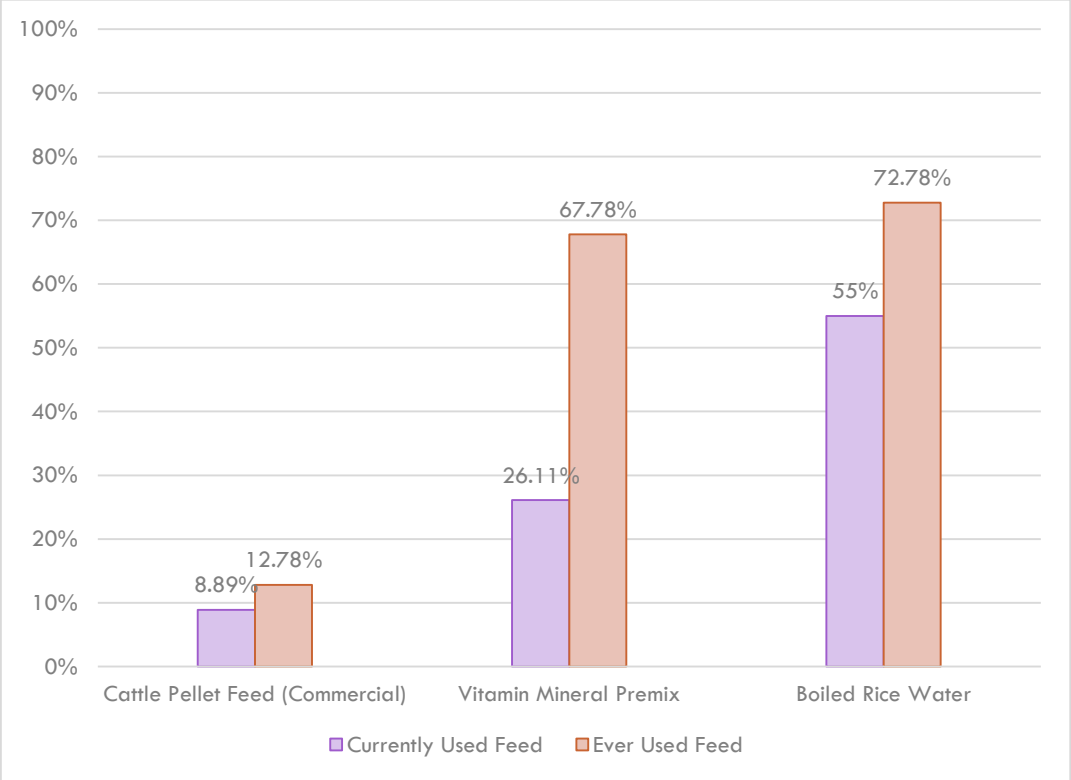

Figure 8. Available other feed in the study area

Farmers used boiled rice water for feeding of cattle after cooking of rice. All farmers were not interested to use it. Farmers used vitamin mineral premix as medicine suggested by veterinarian or quack. Use of commercial cattle pellet feed was limited in the study area.

Hasanuzzaman *et al.* (2015) reported that boiled rice water (rice gruel) was less effective than molasses as fermentable energy source, however in situation where molasses is not available or costly, boiled rice water could be an alternative. Boiled rice water contains 4.10% dry matter and 4.06% crude protein (DM basis).

Hossain *et al.* (2016) reported that in Sirajganj districts among organic cattle producer 37% farmers used vitamin mineral supplement and 63% farmers did not use.

Kamal *et al.* (2019) reported that in Gazipur, Mymensingh, Sirajgonj and Rajshahi18.8% farmers used commercial pellet feed, 33.8% used hand mixed feed and 47.5% gave both pellet and hand mix feed. According to Alltech (2018), Bangladesh produced 0.3 million MT commercial pellet feed for cattle. According to Databd (2019), Bangladesh produced 0.5 million MT commercial pellet feed for cattle.

4.4.2 Source of Currently Used Other Feed

Like currently used roughage & concentrate feed items source of currently used other feed were categorized into two such as produce and purchase. The source of currently used other feed items are shown in figure 8. Boiler rice water was produced by 100% of farmers as kitchen waste. 100% of farmers purchase both commercial cattle pellet feed and vitamin mineral premix.

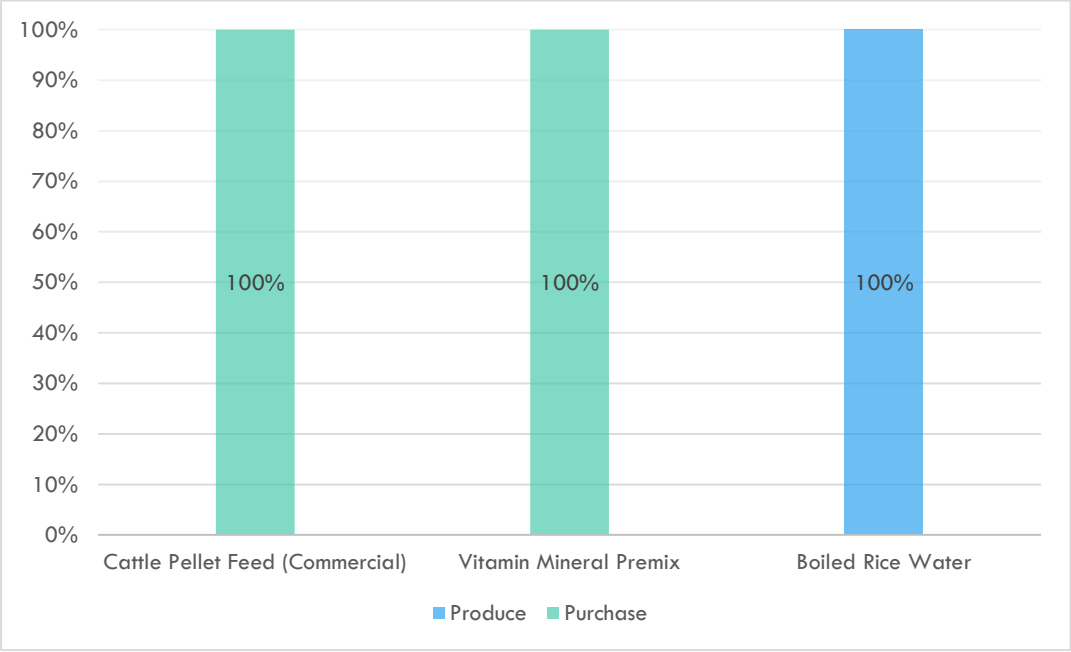

Figure 9. Source of currently used others feed in the study area

4.5 Market Share of Commercial Cattle Pellet Feed

In survey area commercial cattle pellet feed of 8 companies and one locally formulated concentrate mixed feed was found. Market share of ACI, Aftab, Aman, Local, Mega, Nourish, Sajeeb, Suguna and Teer feed was 8.70%, 4.35%, 13.04%, 4.35%, 17.39%, 8.70%, 17.39%, 8.70%, 17.39% respectively (Figure 9). The market share of many large companies was lower than many small companies. This may be happened due to small companies are prominent only in this region or large companies did not expand their market in study area or improper marketing channel of large companies.

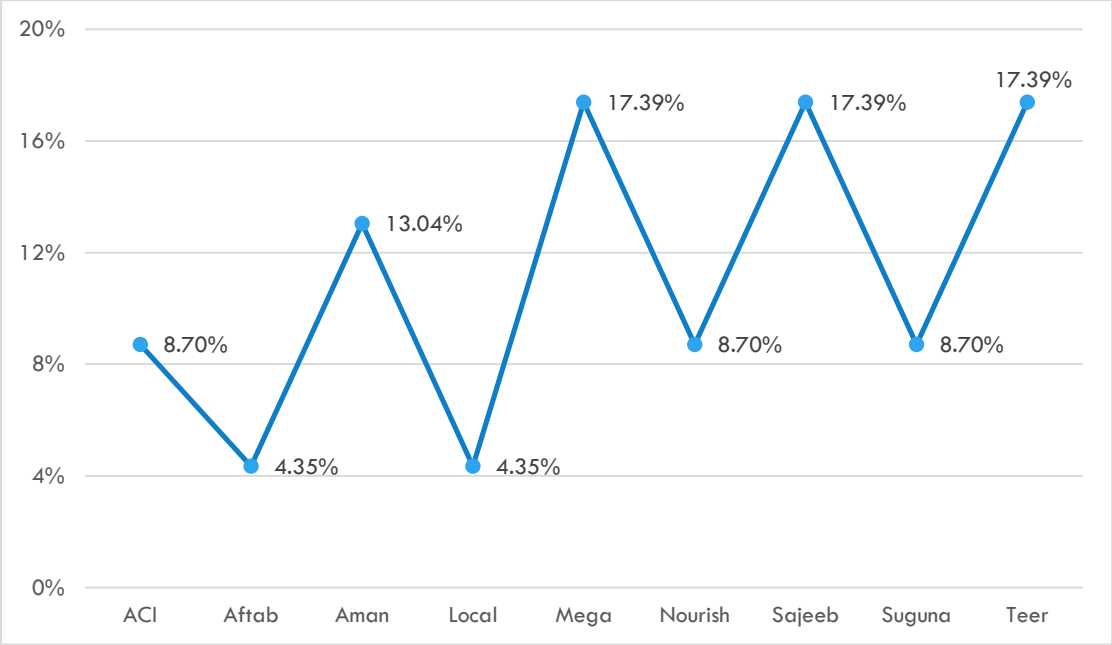

Figure 10. Market share of commercial cattle pellet feed in the study area

DLS (2018) reported that total registered feed mill in Bangladesh is 193, among them only 62 feed mills renewed their registration in 2018. BBD (2018) reported that there were 61 feed mills in Bangladesh. Feed mills included poultry feed, cattle feed, sinking fish feed, floating fish feed and shrimp feed.

Fuad (2017) reported that demand for readymade feed was highest in metro area than rural area because of the farmer's affordability and consciousness of nutrition.

According to Alltech (2018), Bangladesh produced 0.3 million MT feed for cattle. Among this 0.3 million MT, 0.15 million MT produced for beef cattle and 0.15 million

MT for dairy cattle. According to Databd (2019), 0.5 million MT manufactured feed are for cattle in Bangladesh among which 0.35 million MT for beef cattle and 0.15 million MT for dairy cattle. They forecast that in 2024, manufactured cattle feed production will be 0.97 million MT among which 0.68 million MT for beef cattle and 0.29 million MT for dairy cattle.

4.6 Shortage of Cattle Feed

The acute shortage of feed & fodder is one of the most important obstacles to livestock development in Bangladesh (Sarker *et al.*, 2017). The demand and supply gaps of feed & fodder and seasonal & regional variations in biomass availability often limit ruminant production (Huque and Sarker 2014). According to a published report the average availability of green grass per cattle was only 2.5 kg/day (Sarker *et al.*, 2016). The months in which farmers faced shortage of cattle feed are shown in figure 10.

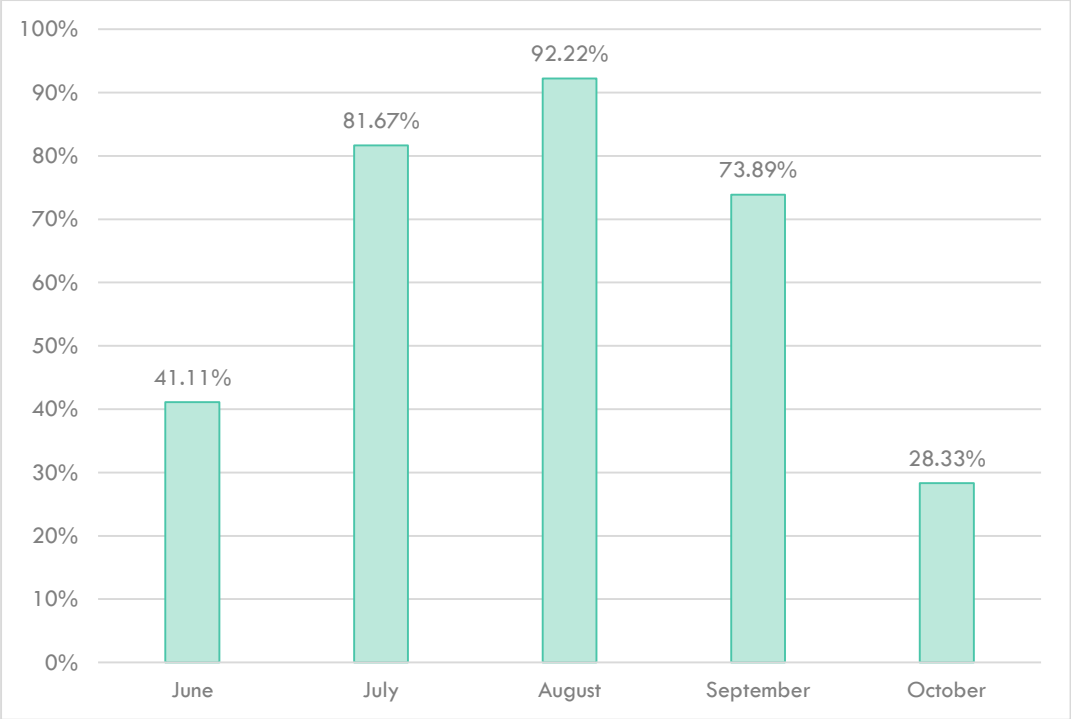

Figure 11. Time (Months) of feed shortage in the study area

Highest number (92.22%) of famers faced shortage of cattle feed in August. 41.11%, 81.67%, 73.89% and 28.33% farmers faced feed shortage in June, July, September, October respectively. Rainy season starts in mid-June and lasts till mid-August. The

effect of rainy season lasts till September or October due to weather change. The study area is medium highland and low-lying land therefore, flood occurs in this area. Due to rainfall or flood farmers could not collect feed for cattle and straw became wet therefore straw became unusable for cattle feeding. On the other hand, price of concentrate feed increased due to insufficient supply or illegal activities of businessman.

According to DLS, around 1537.01 lakh MT of granular and fiber-type animal feed was required in the country whereas only 783.32 lakh MT of animal feed was currently being produced locally in the country. The annual production of granular feed, straw & green grass was 131.24 lakh MT, 159.16 lakh MT, 492.92 lakh MT respectively against a demand of 186.1 lakh MT, 259.26 lakh MT, 1,091.65 lakh MT respectively and the shortage was 54.86 lakh MT, 100 lakh MT, 598.73 lakh MT respectively. (Independentbd, 2018).

4.7 Cost of Currently Used Purchased Feed

The feed cost is the major financial expenditure of the total cost of cattle production (Duguma and Janssens 2016; Belachew *et al.*, 1994). Shamsuddin *et al*. (2006) found that the range of feed cost was 52.5% to 92.1% of total cost. Other results showed that feed cost for the smallholder dairying represent 58.72% (Hossain *et al.* 2005), and 50% (Alam *et al.* 1999). Uddin *et al.* (2010) reported that the single most important driver of milk cost was the purchased feed cost which varies between 19% to 66% depends on scale of dairy farming. The price of currently used purchased feed is shown in table 4.

Table 4. Price of currently used purchased feed in the study area

Feed Item	Price (Tk./Kg)	
	Range	Average
Rice straw	3-4	3.44
Napier Grass	2.5-3	2.78
Rice Bran	13-10	10.69
Wheat Bran	36-28	30.81
Broken rice	20-25	23.21
Broken Maize	30-25	26.47
Broken Wheat	25-28	25.89
Mustard Oil Cake	40-42	40.75
Molasses	26-28	26.75
Vitamin Mineral Premix	500-1050	722.34
Cattle Pellet Feed (Commercial)	26-40	32.93

The price of rice straw varies 1.5-2.5 Tk./Kg and average price was 1.86 Tk./Kg. In this region rice straw was sold in two ways such as land size and small bundle. The price of napier grass varies 1.5-2.0 Tk./Kg and average price was1.73 Tk./Kg. Napier grass was sold as small bundle.

The average price of per kg rice bran, wheat bran, broken rice, broken maize, broken wheat & mustard oil cake was 10.69, 30.81, 23.21, 26.47, 25.89 & 40.75 taka respectively. Rice bran, wheat bran, broken rice & mustard oil cake were purchased from local market and price was calculated as per kg or bag. Sometimes broken maize & broken wheat were purchased from local market in broken or crushed form and sometimes farmers purchased maize and wheat grain then crushed for cattle. The price of molasses varies 26-28 Tk./Kg and average price is 26.75 Tk./Kg.

Farmers generally did not use vitamin mineral premix. They fed vitamin mineral premix to cattle by the concern of doctors or quack when the cattle were ill or during

fattening and milk production by the concern of doctors or quack. The composition of vitamin mineral premix varies a great such as some contain few vitamins and minerals, some contain all vitamins and minerals, some contain all vitamins and minerals along with amino acids. The price of per kg vitamin mineral premix varies 500-1050 and according to my findings the average price of per kg vitamin mineral premix was 722.34 taka.

Mainly two types of commercial cattle pellet feed are found one was for beef cattle and other was for dairy cattle. The price of commercial cattle pellet feed varies 26-40 Tk./Kg and average price is 32.93 Tk./Kg

4.8 Challenges and Suggestions Regarding Cattle Feeding

Challenges regarding cattle feeding are shown in Figure 11. Highest number (91.67%) of farmers claimed that higher price of feed was the key challenges for cattle feeding. Other challenges were shortage of cattle feed, scarcity of green grass, shortage of land for fodder cultivation, unavailability of high yielding fodder that were claimed by 73.33%, 36.11%, 12.22%, 7.78% of farmers respectively.

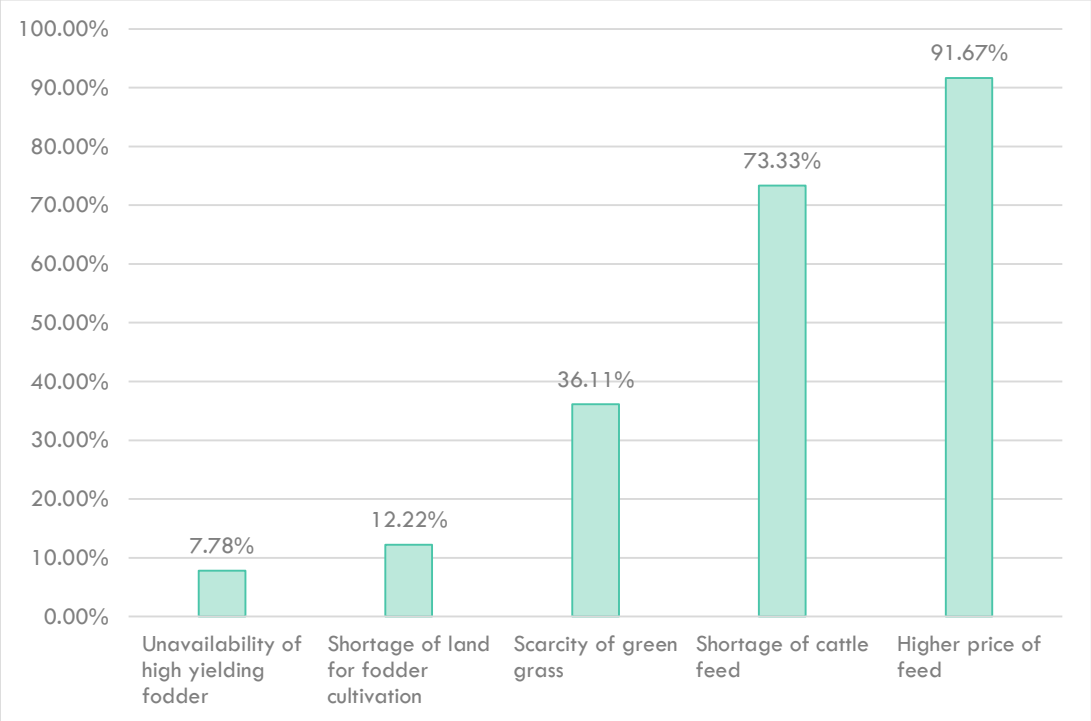

Figure 12. Challenges regarding cattle feeding in the study area

Solutions for overcoming the challenges regarding cattle feeding are shown in table 5. 87.78% farmers suggested that reducing feed cost was the primary solution to overcome challenges regarding cattle feeding. 73.33% farmers wanted government help such as subsidy on cattle feed, supply of cattle feed during scarcity, training on cattle feeding etc. to overcome the challenges. 41.667% farmers wanted high yielding grass and 12.22% farmers realized that they should use more land to cultivate grass. Commercial cattle pellet feed was not popular as broiler and layer feed and many farmers are unaware about using it. Some farmers used broiler or layer feed for cattle. Due to these reasons 22.22% farmers said setting more dealer point of commercial cattle pellet feed would be helpful for overcoming the challenges. 15.56% farmers wanted low interest bank loan for cattle rearing and to cope up with these challenges.

Table 5: Solutions for overcoming the challenges regarding cattle feeding in the study area

Solutions	Percentage
Reducing feed cost	87.78%
Need government help	73.33%
Supply high yielding grass	41.67%
Setting more dealer point of commercial cattle pellet feed	22.22%
Low interest bank loan	15.56%
Use more land to cultivate grass	12.22%

The result of this study was similar with Rahman *et al.* (2012) and Ahmed *et al.* (2010) where 93.3% and 95% farmers respectively claimed higher prices of feed was the main problems and in both study 85% farmers said that lowering feed cost was the main solutions. On the other hand, Ali and Anwar (1987) reported that shortage of animal feed was the greatest problem of the farmers for cattle rearing.

4.9 Nutrient Composition of Available Concentrate Feed

Comparative proximate composition (DM%, CP% and CF%) of rice bran collected from the survey area is shown in table 6. DM% of rice bran from different district showed insignificant ($p>0.05$) difference. Mean value of DM% of rice bran from different district was 89.23±0.26. CP% and CF% of rice bran from different district showed significant ($p<0.05$) difference. CP% of rice bran was significantly ($p<0.05$) higher in Rajbari (8.16±0.20) followed by Chuadanga (7.50±0.19), Jhenaidah (6.91±0.17) & Magura (6.43±0.16). CF% of rice bran from Magura (21.55±0.29) was significantly ($p<0.05$) higher than from Rajbari (19.94±0.24) and CF% of rice bran was significantly ($p<0.05$) lowest in Chuadanga (17.94±0.24) & Jhenaidah (17.28±0.15).

Table 6. Comparative proximate composition of rice bran collected from the survey area

District	DM%	CP%	CF%
Rajbari	89.51±0.42	8.16±0.20^{a}	19.94±0.24^{b}
Chuadanga	89.18±0.53	7.50±0.19^{b}	17.94±0.24^{c}
Jhenaidah	88.51±0.78	6.91±0.17^{bc}	17.28±0.15^{c}
Magura	89.73±0.15	6.43±0.16^{c}	21.55±0.29^{a}
Mean ± SE	89.23±0.26	7.25±0.21	19.18±0.52
Level of Significance	**NS**	*****	*****

^{a,b,c}, values with different superscripts in the same column differ significantly ($p<0.05$)
Here, values are Mean ± SE, one way ANOVA (SPSS)
SE= Standard Error
NS =Non-Significant
*** means significant at 5% level of significance ($p<0.05$)**

Comparative proximate composition (DM%, CP% and CF%) of wheat bran collected from the survey area is shown in table 7. DM%, CP% and CF% of wheat bran from different district showed significant ($p<0.05$) difference. Wheat bran from Chuadanga (87.36±0.48), Rajbari (87.13±0.29) and Jhenaidah (86.80±0.07) showed significantly higher DM% than Magura (85.21±0.08). CP% of wheat bran was significantly ($p<0.05$) higher in Chuadanga (15.84±0.19) and Jhenaidah (15.61±0.13) followed by Rajbari (15.06±0.16) and Magura (12.58±0.18) district. CF% of wheat bran was significantly ($p<0.05$) higher in Chuadanga (10.52±0.16) followed by Rajbari (9.29±0.19), Jhenaidah (8.96±0.10) and Magura (8.52±0.10) district.

Table 7. Comparative proximate composition of wheat bran collected from the survey area

District	DM%	CP%	CF%
Rajbari	87.13±0.29^{a}	15.06±0.16^{b}	9.29±0.19^{b}
Chuadanga	87.36±0.48^{a}	15.84±0.19^{a}	10.52±0.16^{a}
Jhenaidah	86.80±0.07^{a}	15.61±0.13^{a}	8.96±0.10^{bc}
Magura	85.21±0.08^{b}	12.58±0.18^{c}	8.52±0.10^{c}
Mean ± SE	86.60±0.28	14.77±0.40	9.32±0.23
Level of Significance	*	*	*

^{a,b,c}, values with different superscripts in the same column differ significantly ($p<0.05$)
Here, values are Mean ± SE, one way ANOVA (SPSS)
SE= Standard Error
*** means significant at 5% level of significance ($p<0.05$)**

Comparative proximate composition (DM%, CP% and CF%) of broken rice collected from the survey area is shown in table 8. DM% of broken rice from different district showed insignificant ($p>0.05$) difference. The average DM% of broken rice from different district was 87.55±0.33. On the other hand, CP% and CF % of broken rice from different district showed significant difference ($p<0.05$). Broken rice from Magura (9.43±0.18) & Chuadanga (9.29±0.18) showed significantly ($p<0.05$) higher CP% than broken rice from Jhenaidah (8.21±0.18) & Rajbari (8.22±0.16). Broken rice from Jhenaidah (0.69±0.03) & Rajbari (0.64±0.07) showed significantly ($p<0.05$) higher CF% than broken rice from Chuadanga (0.42±0.05) and Magura (0.41±0.05).

Table 8: Comparative proximate composition of broken rice collected from the survey area

District	DM%	CP%	CF%
Rajbari	87.10±0.60	8.22±0.16^{b}	0.64±0.07^{a}
Chuadanga	87.69±0.10	9.29±0.18^{a}	0.42±0.05^{b}
Jhenaidah	87.91±0.73	8.21±0.18^{b}	0.69±0.03^{a}
Magura	87.50±0.59	9.43±0.18^{a}	0.41±0.05^{b}
Mean ± SE	87.55±0.33	8.78±0.19	0.54±0.04
Level of Significance	**NS**	*****	*****

^{a,b}, values with different superscripts in the same column differ significantly ($p<0.05$)
Here, values are Mean ± SE, one way ANOVA (SPSS)
SE= Standard Error
NS =Non-Significant
*** means significant at 5% level of significance ($p<0.05$)**

Comparative proximate composition (DM%, CP% and CF%) of broken maize collected from the survey area is shown in table 9. DM% of broken maize from different district showed insignificant ($p>0.05$) difference. Mean value of DM% of broken maize from different district was 88.04±0.36. on the other hand, CP% and CF% of broken maize from different district showed significant ($p<0.05$) difference. Broken maize from Jhenaidah showed significantly ($p<0.05$) higher CP% (8.83±0.11) compared to Rajbari (8.07±0.14), Chuadanga (7.81± 0.16) and Magura (7.80±0.14). CF% significantly ($p<0.05$) higher in broken maize of Magura (4.50±0.09), Chuadanga (4.39±0.20) and Rajbari (4.22±0.11) followed by Jhenaidah (3.55±0.29).

Table 9: Comparative proximate composition of broken maize collected from the survey area

District	DM%	CP%	CF%
Rajbari	88.41±0.70	$8.07±0.14^{b}$	$4.22±0.11^{a}$
Chuadanga	87.72±0.70	$7.81±0.16^{b}$	$4.39±0.20^{a}$
Jhenaidah	87.20±0.43	$8.83±0.11^{a}$	$3.55±0.29^{b}$
Magura	88.82±0.97	$7.80±0.14^{b}$	$4.50±0.09^{a}$
Mean ± SE	88.04±0.36	8.13±0.14	4.16±0.14
Level of Significance	**NS**	*****	*****

^{a,b}, values with different superscripts in the same column differ significantly ($p<0.05$)
Here, values are Mean ± SE, one way ANOVA (SPSS)
SE= Standard Error
NS =Non-Significant
*** means significant at 5% level of significance ($p<0.05$)**

Comparative proximate composition (DM%, CP% and CF%) of mustard oil cake collected from the survey area is shown in table 10. DM%, CP% and CF% of mustard oil cake from different district showed significant ($p<0.05$) difference. Mustard oil cake from Magura (88.77±0.14) showed significantly ($p<0.05$) higher DM% followed by Rajbari (87.67±0.27) and Jhenaidah (86.62±0.21). Significantly ($p<0.05$) higher CP% was found in mustard oil cake from Jhenaidah (33.22±0.18) compared to Magura (31.93±0.49), Chuadanga (31.55±0.18) & Rajbari (29.94±0.26) district. CF% of mustard oil cake significantly ($p<0.05$) higher in Rajbari (11.61±0.20) than Jhenaidah (10.50±0.09) and Chuadanga (10.39±0.20) district.

Table 10. Comparative proximate composition of mustard oil cake collected from the survey area

District	DM%	CP%	CF%
Rajbari	87.67 ± 0.27^{b}	29.94 ± 0.26^{c}	11.61 ± 0.20^{a}
Chuadanga	88.36 ± 0.22^{ab}	31.55 ± 0.18^{b}	10.39 ± 0.20^{b}
Jhenaidah	86.62 ± 0.21^{c}	33.22 ± 0.18^{a}	10.50 ± 0.09^{b}
Magura	88.77 ± 0.14^{a}	31.93 ± 0.49^{b}	11.05 ± 0.34^{ab}
Mean ± SE	87.85±0.26	31.66±0.38	10.89±0.18
Level of Significance	*	*	*

^{a,b,c}, values with different superscripts in the same column differ significantly ($p<0.05$)
Here, values are Mean ± SE, one way ANOVA (SPSS)
SE= Standard Error
*** means significant at 5% level of significance ($p<0.05$)**

Comparative proximate composition (DM%, CP% and CF%) of broken wheat collected from the survey area is shown in table 11. DM% of broken wheat from different district showed insignificant ($p>0.05$) difference. The average DM% of broken wheat from different district was 88.82±0.33. CP% and CF% of broken wheat from different district showed significant ($p<0.05$) difference. CP% of broken wheat was significantly ($p<0.05$) higher in Chuadanga (12.11±0.15), Rajbari (12.05±0.18) and Magura (12.03±0.19) compared to Jhenaidah (10.82±0.22) district. CF% of broken wheat was significantly ($p<0.05$) higher in Chuadanga (3.39±0.20) compared to Jhenaidah (2.50±0.10), Rajbari (2.46±0.13) and Magura (2.11±0.11).

Table 11. Comparative proximate composition of broken wheat collected from the survey area

District	DM%	CP%	CF%
Rajbari	89.39±0.66	12.05±0.18^{a}	2.46±0.13^{b}
Chuadanga	87.97±0.40	12.11±0.15^{a}	3.39±0.20^{a}
Jhenaidah	88.25±0.65	10.82±0.22^{b}	2.50±0.10^{b}
Magura	89.66±0.56	12.03±0.19^{a}	2.11±0.11^{b}
Mean ± SE	88.82±0.33	11.75±0.18	2.61±0.15
Level of Significance	**NS**	*****	*****

^{a,b}, values with different superscripts in the same column differ significantly ($p<0.05$)
Here, values are Mean ± SE, one way ANOVA (SPSS)
SE= Standard Error
NS =Non-Significant
*** means significant at 5% level of significance ($p<0.05$)**

Talukder *et al*. (2019) conducted a study to compare nutrient value of feedstuff used by farmers community and used in regional BLRI station. Proximate component of maize (except DM) as CP% (8.44±0.32 vs 13.72±0.16), CF% (2.72±0.03 vs3.98±0.13), Ash% (1.78±0.02 vs 2.86±0.02) from on-station and community had a highly significant ($p<0.001$) relation. There was no significant difference ($p>0.05$) of DM%, CP% between on-station and community wheat bran but had a significant ($p<0.002$) difference between CF% (6.30±0.69 vs 6.30±0.69) on-station and community wheat bran.

Kamal *et al.* (2020) conducted a study to investigate quality of feed ingredients used in Bangladesh through proximate analysis. They found that DM% of wheat bran, maize, mustard oil cake, de-oiled rice bran & straw was (90.85±0.36), (88.90±0.58), (90.91±0.47), (91.74±0.00) & (93.98±0.12) respectively. CP% of wheat bran, maize, mustard oil cake, de-oiled rice bran & straw was (7.12±0.03), (4.44±0.12), (16.07±0.04), (4.61±0.05) & (2.66±0.04) respectively. CF% of wheat bran, maize, mustard oil cake, de-oiled rice bran & straw was (0.40±0.029), (4.67±0.01), (3.18±0.10), (21.92±0.04) & (32.89±0.06) respectively.

CHAPTER-V

SUMMARY AND CONCLUSION

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The outcome of conducted survey provided us a detailed information about available feed resources, source of available feed items, price of purchased feed items, feed shortage faced by the farmers, challenges regarding cattle feeding and farmers' suggestion to overcome the challenges of selected area. Nutrient composition (DM%, CP%, CF%) of available concentrate feed was also determined.

From the study we can summarize that the average number of cattle in smallholder farming system in selected area was 3.51. Farmers used roughage feed items such as rice straw, uncultivated green grass, vegetable waste, napier grass, tree leaves sugarcane top, fruits peel, maize leaves, urea molasses straw, water hyacinth and sorghum round the year based on their availability. They also fed their cattle various type of concentrate feed such as rice bran, wheat bran, broken rice, broken maize, mustard oil cake, broken wheat & molasses round the year based on their availability. Other feed items such as, boiled rice water, vitamin mineral premix & commercial cattle pellet feed are also used by the farmers. Farmers obtained the feed by two means such as produce & purchase. Purchase of some produced feed depend on availability of farmers' stock. Price of the purchased feed also varies throughout the year. Farmers faced various challenges regarding cattle feeding. Highest number of farmers claimed higher price of feed as key challenge followed by shortage of cattle feed, scarcity of green grass, shortage of land for fodder cultivation, unavailability of high yielding fodder. Farmers identified reducing feed cost as core solution to overcome challenges followed by need government help, supplying high yielding grass, setting more dealer point of commercial cattle pellet feed, low interest bank loan, use more land to cultivate grass. Use of commercial cattle pellet feed is limited in this area. Readymade feed of 8 companies and locally formulated concentrate mixed feed were found. Mega, Sajeeb & Teer feed were more popular commercial cattle pellet feed in the study area. DM% of rice bran from different district showed insignificant ($p>0.05$) difference whereas CP% and CF% of rice bran from different district showed significant ($p<0.05$) difference. DM%, CP% and CF% of wheat bran from different district showed

significant ($p<0.05$) difference. DM% of broken rice from different district showed insignificant ($p>0.05$) difference whereas CP% and CF % of broken rice from different district showed significant difference ($p<0.05$). DM% of broken maize from different district showed insignificant ($p>0.05$) difference whereas CP% and CF% of broken maize from different district showed significant ($p<0.05$) difference. DM%, CP% and CF% of mustard oil cake from different district showed significant ($p<0.05$) difference. DM% of broken wheat from different district showed insignificant ($p>0.05$) difference whereas CP% and CF% of broken wheat from different district showed significant ($p<0.05$) difference.

From the results of the present study we can conclude that rice straw is the main roughage source and rice bran is the main concentrate source of cattle. Higher feed price is main challenges for cattle feeding and reducing feed cost is the key solution to overcome the challenges. Commercial cattle pellet feed is not popular in the study area and limitedly used. Composition of concentrate feed varies area to area that may affect to proper ration formulation.

More research should be conducted so that an economic ration can be formulated with locally available feedstuffs which will be helpful for farmers.

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APPENDICES

Appendix-I (Questionnaire of the survey)

Department of Animal Nutrition, Genetics & Breeding

"Feeding Practices for Cattle in Smallholder Farming Systems of South-West Part of Bangladesh"

Questionnaire

Survey Code: ☐☐ ☐☐

Farmer's Information			
Name		Phone	
District		Upazila	
Village/Mauza		Union/Pouroshova	
No. of Cattle			

Q.1. Do you ever face feed shortages for cattle? (If yes, continue to Q.2.) □Yes □No
Q.2. Which month of the year? □January □February □March □April □May □June □July □August □September □October □November □December

Q.3. List of feed item:

Sl no.	Feed Item	(a) Do you ever use _____ as animal feed? (if yes, go to b, if no, go to next feed item)	(b) Is it currently available?	(c) Do you currently purchase/produce it? (if purchase, go to d)	(d) If purchase currently cost per kg (Tk/-)
1	Rice bran	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
2	Wheat bran	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
3	Khesari bran	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
4	Maize broken	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
5	Wheat broken	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
6	Cotton seed meal	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
7	Soybean meal	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
8	Till oil cake	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
9	Mustard oil cake	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
10	Rice straw	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
11	Wheat straw	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
12	Maize leaves	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
13	Napier	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
14	Para	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
15	German	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
16	Jumboo	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
17	Sorghum	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
18	Matikalai grass	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown

19	Khesarikalai grass	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
20	Cowpea grass	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
21	Hydroponic grass	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
22	Uncultivated grass	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
23	Sugarcane top	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
24	Tree leaves	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
25	Water hyacinth	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
26	Vegetable waste	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
27	Silage	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
28	Molasses	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
29	Urea Molasses straw	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
30	Boiled rice water	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
31	Boiled broken rice	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
32	Fruits peel	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
33	Gram	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
34	Vitamin mineral premix	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
35	Cattle feed (Readymade)	□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
		□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
		□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
		□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
		□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown
		□Yes □No	□Yes □No	□Purchase □Produce	Price_____ □Unknown

Q.4. Mention the readymade cattle feed brand-

□ACI Ltd. □Aftab Ltd. □Fresh feed Ltd. □Others (Specify_____)

Q.5. What is your biggest challenge regarding feeding your cattle?

Q.6. What solutions do you have?

Q.7. Additional comments if any-

Signature of Student:	**Signature of supervisor:**
Student name: Md. Shafiqur Rahman **Student phone number:** 01754684235	

Appendix-II (List of sampled farmers)

Code No.	Name	District	Upazila	Mobile No.
01.01	Bishwanath Ghosh	Rajbari	Pangsha	01709-080349
01.02	Kamrul Islam	Rajbari	Pangsha	01734-821411
01.03	Zillur Rahman	Rajbari	Pangsha	01720-800447
01.04	Monirul	Rajbari	Pangsha	01782-981439
01.05	Alam Sheikh	Rajbari	Pangsha	01755-921955
01.06	Alam Ali Khan	Rajbari	Pangsha	01738-414035
01.07	Abed Ali Sheikh	Rajbari	Pangsha	01713-547802
01.08	Sonu Sheikh	Rajbari	Pangsha	01761-544675
01.09	Md. Mizan	Rajbari	Pangsha	01727-224974
01.10	Md. Arshed Ali	Rajbari	Pangsha	01729-774830
01.11	Harun-Or-Rashid	Rajbari	Pangsha	01759-056072
01.12	Sahadat Sheikh	Rajbari	Pangsha	01918-694333
01.13	Sadar Sheikh	Rajbari	Pangsha	01927-574270
01.14	Mohor Ali Mondol	Rajbari	Pangsha	01788-795990
01.15	Md. Nayem	Rajbari	Pangsha	01317-573426
01.16	Saheb Ali Khan	Rajbari	Pangsha	01745-834408
01.17	Alam Mondol	Rajbari	Pangsha	01776-159076
01.18	Liakat Sardar	Rajbari	Pangsha	-
01.19	Jalal Hossain	Rajbari	Pangsha	01703-208997
01.20	Faruk Hossain	Rajbari	Pangsha	01738-642228
01.21	Monser Sheikh	Rajbari	Pangsha	01776-584507
01.22	Kalam Biswas	Rajbari	Pangsha	01746-723368
01.23	Rana	Rajbari	Pangsha	01630-324026
01.24	Sukur Ali Mondol	Rajbari	Pangsha	01757-842802

01.25	Azad Mondol	Rajbari	Pangsha	01777-365499
01.26	Rahman Mondol	Rajbari	Pangsha	-
01.27	Azid Mondol	Rajbari	Pangsha	01717-345084
01.28	Badsha Mondol	Rajbari	Pangsha	01709-395068
01.29	Hannan Mondol	Rajbari	Pangsha	01935-815653
01.30	Amin Mondol	Rajbari	Pangsha	01309-995982
01.31	Shihab Ali	Rajbari	Pangsha	01754-332024
01.32	Azit	Rajbari	Pangsha	01779-815457
01.33	Majnu Mondol	Rajbari	Pangsha	01713-514841
01.34	Md. Sukur Ali	Rajbari	Pangsha	01766-368013
01.35	Billal	Rajbari	Pangsha	-
01.36	Mamun	Rajbari	Pangsha	01929-263957
01.37	Sumon	Rajbari	Pangsha	01948-991380
01.38	Asadul	Rajbari	Pangsha	01714-366158
01.39	Sahin	Rajbari	Pangsha	01926-468541
01.40	Kanchon Mondol	Rajbari	Pangsha	01726-495409
01.41	Sattar Mondol	Rajbari	Pangsha	01815-036177
01.42	Ratan Dafadar	Rajbari	Pangsha	-
01.43	Rashid	Rajbari	Pangsha	01739-633176
01.44	Montu Mondol	Rajbari	Pangsha	01878-042933
01.45	Ukil Mondol	Rajbari	Pangsha	01845-649255
02.01	Dil Mohammad	Chuadanga	Jibonnagar	01998-743871
02.02	Jaher Ali	Chuadanga	Jibonnagar	01914-580446
02.03	Jakir	Chuadanga	Jibonnagar	01711-303292
02.04	Abul Kalam	Chuadanga	Jibonnagar	01783-345088
02.05	Abdul Barek Mondol	Chuadanga	Jibonnagar	-
02.06	Abdul Gaffar Munshi	Chuadanga	Jibonnagar	01913-488229
02.07	Afsar Ali	Chuadanga	Jibonnagar	01716-685210

02.08	Md. Abdul Sattar	Chuadanga	Jibonnagar	01718-444291
02.09	Abul Kashem	Chuadanga	Jibonnagar	01715-856256
02.10	Yusuf Ali	Chuadanga	Jibonnagar	01924-769874
02.11	Nur Hossain	Chuadanga	Jibonnagar	01904-869811
02.12	Mohidul	Chuadanga	Jibonnagar	01918-944691
02.13	Osman	Chuadanga	Jibonnagar	01920-435057
02.14	Sohidul	Chuadanga	Jibonnagar	01780-495634
02.15	Rup Mia	Chuadanga	Jibonnagar	01920-264032
02.16	Mofiz Uddin	Chuadanga	Jibonnagar	01727-903428
02.17	Md. Ansar Ali	Chuadanga	Jibonnagar	01722-897823
02.18	Motaleb	Chuadanga	Jibonnagar	01929-195627
02.19	Md. Sahajahan	Chuadanga	Jibonnagar	01939-730121
02.20	Sujon	Chuadanga	Jibonnagar	01996-006554
02.21	Siddik	Chuadanga	Jibonnagar	01930-546421
02.22	Kakoli	Chuadanga	Jibonnagar	01748-462539
02.23	Moagreb Sardar	Chuadanga	Jibonnagar	01902-732051
02.24	Salauddin	Chuadanga	Jibonnagar	01812-344084
02.25	Saiful	Chuadanga	Jibonnagar	01925-541736
02.26	Alia	Chuadanga	Jibonnagar	01925-679442
02.27	Jony	Chuadanga	Jibonnagar	01865-497119
02.28	Julhas Biswas	Chuadanga	Jibonnagar	01735-804052
02.29	Abdul Kuddus	Chuadanga	Jibonnagar	01964-473218
02.30	Md. Habibullah	Chuadanga	Jibonnagar	01907-845815
02.31	Mannan Gazi	Chuadanga	Jibonnagar	01743-031448
02.32	Sohidul Mondol	Chuadanga	Jibonnagar	01930-783825
02.33	Takbir Hossain	Chuadanga	Jibonnagar	01725-849201
02.34	Safiuddin	Chuadanga	Jibonnagar	01952-548601
02.35	Shariful	Chuadanga	Jibonnagar	01792-315989

02.36	Rashed	Chuadanga	Jibonnagar	01954-613345
02.37	Abu Sayed	Chuadanga	Jibonnagar	01793-597368
02.38	Liton	Chuadanga	Jibonnagar	01739-604665
02.39	Abul Kalam	Chuadanga	Jibonnagar	01823-137115
02.40	Abdul Kader	Chuadanga	Jibonnagar	01739-732524
02.41	Sujit	Chuadanga	Jibonnagar	01317-900110
02.42	Rahaj Uddin	Chuadanga	Jibonnagar	01729-922820
02.43	Harun	Chuadanga	Jibonnagar	01926-626837
02.44	Shajahan	Chuadanga	Jibonnagar	01405-297791
02.45	Ali Hossain	Chuadanga	Jibonnagar	-
03.01	Abu Hossen	Jhenaidah	Kotchandpur	01737-792506
03.02	Ripon Khan	Jhenaidah	Kotchandpur	01777-291259
03.03	Tota Mia	Jhenaidah	Kotchandpur	01917-150706
03.04	Milon	Jhenaidah	Kotchandpur	01753-104877
03.05	Amirul	Jhenaidah	Kotchandpur	01719-457541
03.06	Nasir Uddin	Jhenaidah	Kotchandpur	01925-534302
03.07	Zohurul Islam	Jhenaidah	Kotchandpur	01736-485227
03.08	Abul Hossen	Jhenaidah	Kotchandpur	01919-872732
03.09	Mizan	Jhenaidah	Kotchandpur	01931-445122
03.10	Khokon	Jhenaidah	Kotchandpur	01946-849937
03.11	Rezaul	Jhenaidah	Kotchandpur	01813-041468
03.12	Asrot	Jhenaidah	Kotchandpur	01948-085079
03.13	Atiar Rahman	Jhenaidah	Kotchandpur	01319-793475
03.14	Shirazul Islam	Jhenaidah	Kotchandpur	01959-370425
03.15	Rafiqul	Jhenaidah	Kotchandpur	01965-556941
03.16	Md. Habibur Rahman	Jhenaidah	Kotchandpur	01919-226397
03.17	Moshiur Rahman	Jhenaidah	Kotchandpur	01729-825824
03.18	Aminul	Jhenaidah	Kotchandpur	01943-890586

03.19	Rashid	Jhenaidah	Kotchandpur	01966-098618
03.20	Nur Alam	Jhenaidah	Kotchandpur	01723-003205
03.21	Md. Sumon	Jhenaidah	Kotchandpur	01730-161900
03.22	Mizanur Rahman	Jhenaidah	Kotchandpur	01753-104964
03.23	Liton	Jhenaidah	Kotchandpur	01960-954516
03.24	Sentu	Jhenaidah	Kotchandpur	01948-085961
03.25	Tarik Rahman	Jhenaidah	Kotchandpur	01771-759545
03.26	Sahabuddin	Jhenaidah	Kotchandpur	01767-823515
03.27	Mofizur Rahman	Jhenaidah	Kotchandpur	01831-306041
03.28	Anisur Rahman	Jhenaidah	Kotchandpur	-
03.29	Pulok	Jhenaidah	Kotchandpur	01643-636365
03.30	Sarowar Jahan	Jhenaidah	Kotchandpur	01713-925983
03.31	Sahidullah	Jhenaidah	Kotchandpur	01626-558183
03.32	Nur Islam	Jhenaidah	Kotchandpur	01634-568050
03.33	Asmat	Jhenaidah	Kotchandpur	01937-223863
03.34	Aynal Haque	Jhenaidah	Kotchandpur	01679-127132
03.35	Nazrul Islam	Jhenaidah	Kotchandpur	01961-652628
03.36	Razab Ali	Jhenaidah	Kotchandpur	01773-263352
03.37	Delowar	Jhenaidah	Kotchandpur	01636-649937
03.38	Reajul	Jhenaidah	Kotchandpur	01904-562164
03.39	Md. Liakat Ali	Jhenaidah	Kotchandpur	01993-423223
03.40	Shoriful Islam	Jhenaidah	Kotchandpur	01868-979564
03.41	Sayed Ali	Jhenaidah	Kotchandpur	01754-441093
03.42	Mobarak Mondol	Jhenaidah	Kotchandpur	01746-102257
03.43	Ahad	Jhenaidah	Kotchandpur	01931-435675
03.44	Ismail Hossain	Jhenaidah	Kotchandpur	01736-421946
03.45	Nazrul Islam	Jhenaidah	Kotchandpur	01921-721343
04.01	Fazar Ali	Magura	Mohammadpur	01302-469466

04.02	Pad Banu	Magura	Mohammadpur	01762-855128
04.03	Taslima	Magura	Mohammadpur	01875-320695
04.04	Iqbal Hossain	Magura	Mohammadpur	01789-123346
04.05	Modasser Molla	Magura	Mohammadpur	01969-240078
04.06	Mostofa	Magura	Mohammadpur	01785-503186
04.07	Liakat Ali Molla	Magura	Mohammadpur	01739-923848
04.08	Shariful	Magura	Mohammadpur	01713-916167
04.09	Akidul	Magura	Mohammadpur	-
04.10	Nowaer Sikdar	Magura	Mohammadpur	01867-414833
04.11	Bablu Biswas	Magura	Mohammadpur	01837-333298
04.12	Wahab Mondol	Magura	Mohammadpur	01739-116237
04.13	Badol Sheikh	Magura	Mohammadpur	01745-092187
04.14	Ator Ali	Magura	Mohammadpur	-
04.15	Kuddus Sheikh	Magura	Mohammadpur	01924-770642
04.16	Azizur	Magura	Mohammadpur	01943-167606
04.17	Monjur Hossain	Magura	Mohammadpur	01718-375789
04.18	Abul Hossen	Magura	Mohammadpur	01832-348538
04.19	Bacchu Molla	Magura	Mohammadpur	01996-236147
04.20	Usman Molla	Magura	Mohammadpur	01980-749947
04.21	Mahfuzur Molla	Magura	Mohammadpur	01957-252193
04.22	Saiful	Magura	Mohammadpur	01995-449149
04.23	Md. Abdul High	Magura	Mohammadpur	01921-236594
04.24	Togor Molla	Magura	Mohammadpur	-
04.25	Nasim Molla	Magura	Mohammadpur	01928-187576
04.26	Farida Begum	Magura	Mohammadpur	-
04.27	Nipul Molla	Magura	Mohammadpur	01936-624365
04.28	Zahidur Rahman	Magura	Mohammadpur	-
04.29	Md. Abdullah	Magura	Mohammadpur	01777-428020

04.30	Alauddin Molla	Magura	Mohammadpur	01916-945704
04.31	Wadud Sheikh	Magura	Mohammadpur	01957-543452
04.32	Sohid Sheikh	Magura	Mohammadpur	01780-079389
04.33	Abdul Gaffar	Magura	Mohammadpur	01756-238069
04.34	Rafiq Molla	Magura	Mohammadpur	01986-671780
04.35	Mazid Molla	Magura	Mohammadpur	01961-969713
04.36	Dulal Molla	Magura	Mohammadpur	01998-287436
04.37	Sekendar Matubbar	Magura	Mohammadpur	01993-809241
04.38	Md. Ali	Magura	Mohammadpur	01687-476980
04.39	Moznu Rahman	Magura	Mohammadpur	01743-183473
04.40	Fazlu Rahman	Magura	Mohammadpur	01755-108164
04.41	Badsha Molla	Magura	Mohammadpur	01925-478580
04.42	Abul Bashar	Magura	Mohammadpur	01710-989561
04.43	Mizanur Rahman	Magura	Mohammadpur	01964-586178
04.44	Riazul	Magura	Mohammadpur	01627-713531
04.45	Sirazul Islam	Magura	Mohammadpur	01990-900620

Appendix-III (Chemical analysis of rice bran collected from the survey area)

District	DM%	CP%	CF%
Rajbari	88.93	7.81	20.00
	89.27	8.50	19.50
	90.33	8.17	20.33
Chuadanga	88.20	7.17	18.00
	89.34	7.82	18.33
	90.00	7.50	17.50
Jhenaidah	87.08	6.63	17.00
	88.67	7.20	17.50
	89.78	6.91	17.33
Magura	89.71	6.18	21.00
	89.48	6.73	21.66
	90.00	6.37	22.00

Appendix-IV (Chemical analysis of wheat bran collected from the survey area)

District	DM%	CP%	CF%
Rajbari	86.69	14.79	9.00
	87.02	15.34	9.22
	87.67	15.06	9.66
Chuadanga	86.42	15.51	10.22
	87.65	16.18	10.56
	88.00	15.82	10.78
Jhenaidah	86.92	15.39	8.78
	86.82	15.83	9.00
	86.67	15.60	9.11
Magura	85.07	12.33	8.33
	85.23	12.93	8.56
	85.33	12.49	8.66

Appendix-V (Chemical analysis of broken rice collected from the survey area)

District	DM%	CP%	CF%
Rajbari	86.35	8.20	0.66
	88.29	7.95	0.75
	86.67	8.50	0.50
Chuadanga	86.48	9.29	0.50
	86.92	8.98	0.43
	89.67	9.59	0.33
Jhenaidah	86.92	8.21	0.66
	87.47	8.52	0.75
	89.33	7.89	0.66
Magura	86.80	9.41	0.50
	87.02	9.13	0.33
	88.67	9.74	0.40

Appendix-VI (Chemical analysis of broken maize collected from the survey area)

District	DM%	CP%	CF%
Rajbari	87.25	7.86	4.00
	88.30	8.34	4.33
	89.67	8.01	4.33
Chuadanga	86.61	7.59	4.00
	87.56	8.11	4.66
	89.00	7.73	4.50
Jhenaidah	86.53	8.63	3.00
	87.06	9.02	3.66
	88.00	8.83	4.00
Magura	87.00	7.61	4.33
	89.12	8.06	4.66
	90.33	7.73	4.50

Appendix-VII (Chemical analysis of mustard oil cake collected from the survey area)

District	DM%	CP%	CF%
Rajbari	87.13	29.48	11.50
	87.87	30.38	11.33
	88.00	29.96	12.00
Chuadanga	88.75	31.29	10.00
	88.32	31.89	10.66
	88.00	31.47	10.50
Jhenaidah	86.29	32.93	10.50
	86.57	33.56	10.66
	87.00	33.17	10.33
Magura	88.79	31. 79	11.00
	88.53	32.68	11.66
	89.00	32.12	10.50

Appendix-VIII (Chemical analysis of broken wheat collected from the survey area)

District	DM	CP	CF
Rajbari	88.12	11.74	2.50
	89.72	12.37	2.22
	90.33	12.05	2.66
Chuadanga	87.29	11.85	3.50
	87.94	12.38	3.00
	88.67	12.11	3.66
Jhenaidah	87.07	10.48	2.50
	88.34	11.24	2.33
	89.33	10.73	2.66
Magura	88.61	11.71	2.00
	89.85	12.35	2.33
	90.53	12.04	2.00