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LIVESTOCK FEEDS OF BANGLADESH: AVAILABILITY & NUTRIENT COMPOSITION

Bangladesh Agricultural Research Council

LIVESTOCK FEEDS OF BANGLADESH: AVAILABILITY & NUTRIENT COMPOSITION

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Foreword

Although the per-unit productivity of livestock and poultry in Bangladesh is less than in other South Asian countries, the resourcefulness of Bangladeshi farmers and their lack of reliance on fossil fuels makes our livestock and poultry production more efficient than most of our neighbors. The richness of the country's soils and diversity of its crops results in enormous potential for further increases in this efficiency. This publication effectively calls attention to the fact that there are large quantities of under-utilized and currently wasted sources of livestock feed which, if properly used, will make major contributions to the nations's livestock sub-sector.

The availability of meat, milk and eggs to the average Bangladeshi is very meager compared to other parts of the world. Yet livestock and poultry are enormously important to the farmers as well as to the national economy. In addition to contributing to the nations' food supply, the role of livestock in land cultivation, providing manure as fertilizer for crop production and fuel for cooking, rural transportation, and threshing makes livestock a lifeblood for Bangldesh's agriculture. Moreover, livestock provides the critical cash reserve and cash income for rural farmers, who grow crops essentially for subsistence purposes.

In the past, a shortage of feed and fodder — both in terms of quality and quantity — has been identified as a serious constraint to livestock and poultry development in the country. This study has demonstrated that, although local supplies of feed commonly used in other countries are insufficient to feed the nation's animals, there is a wealth of non-conventional feed resources that if properly exploited, will fill the gap and remove the major nutritional deficiencies that our livestock and poultry face.

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Bangladesh's feed resources include traditional feeds and crop residues, non-conventional agricultural products, by-products and wastes. The majority of the non-conventional feeds represent high value protein and non protein nitrogen sources which help balance rations and increase feed utilization efficiency. The nutrient values provided in the back of the book will be valuable to technical people and livestock officers by assisting them to make more balanced ration recommendations to Bangladeshi farmers. Proper utilization of feeds that are available is commonly constrained by a failure to use a balanced ration formulation and can frequently result in nutritional deficiencies that are otherwise preventable.

Since no publication on livestock feeds that is adopted to local conditions is currently available to those who advise livestock producers, this publication will serve to provide ready information on nutritive values of feeds found in Bangladesh. It should ultimately be helpful to promote higher per-unit livestock and poultry production in the country. By proper use of these nutritive values, the amount of feed needed for any level of production can be reduced. This could have an important impact on smallholder livestock and poultry agribusiness.

Dr. M. S. U. Chowdhury
Executive Vice-Chairman
Bangladesh Agricultural Research Council

PREFACE

With the ever-increasing expansion of the human population in Bangladesh, the demand for high-quality animal protein products will continue to rise. To meet this challenge, livestock and poultry management systems must be encouraged to more efficiently utilize feed resources without compromising land and other resources, which may be better used to produce agricultural crops for human consumption. With rich natural biodiversity and an enormous number of crops, Bangladesh is particularly well-suited to effect significant increases in livestock production by utilizing non-conventional feed sources and agricultural crop by-products, which are currently under-utilized or wasted.

Feed costs represent more than 70 per cent of production costs of livestock and poultry production. By proper utilization of non-conventional feed resources, the costs of livestock feed inputs can be reduced significantly, resulting in increased per-unit production at decreased costs. Since most of the non-conventional feeds discussed are highly nutritious and contain significant amounts of by-pass proteins, soluble protein or non-protein nitrogen, not only do they make up for quantitative deficiency in livestock feed, but they can eliminate the qualitative deficiencies as well.

The information available in this publication will provide ready-made nutritive values to farmers and livestock officials, permitting improved ration formulation and increasing overall production efficiency. Data contained in this publication reflects the results of direct field-level observations, research and experience and, in addition, represents a compilation of information found in current literature and gleaned through personal correspondence with local and international scientists.

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The book has been divided into two sections. The first is a profile of available livestock and poultry feed resources of Bangladesh — both traditional livestock feeds and non-conventional feeds. The second section of the book is a compilation of the nutritive values of the various feeds described in the first section. Although there is some controversy as to the merits of using nutrient composition as the basis to balance rations for ruminant animals in the tropics, this information is provided as a general indication to professional technicians who are involved in ration formulation and providing recommendations to farmers and agribusiness entrepreneurs.

To fulfil the purpose for which this publication has been designed, it is hoped the information here will be used by farmers, extension workers, researchers, students and feed-agribusiness entrepreneurs. We trust that this book will generate further innovations in the identification and utilization of the wide range of non-conventional livestock and poultry feed resources, which are a result of Bangladesh's agricultural and natural diversity. In this way, as production is increased, per- unit costs will decrease and resources, which were otherwise going to waste will become the basis for significant growth in the livestock sector.

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Profile of the Feed Resources in Bangladesh

Serious livestock nutritional deficiencies are commonplace throughout Bangladesh. These problems may be addressed through increased production of livestock feeds, adoption of non–conventional agricultural products, by–products and wastes as livestock feeds and through more balanced ration formulation to promote increased feed utilization efficiency. To this end, feedstuffs discussed in this report include conventional livestock feeds, agro–industrial by–products and non–conventional agricultural products, which may be used as livestock feed.

The limited amount of land available for fodder production and the absence of forage cultivation are important reasons for limited quantities of conventional animal feeds in the country. It has been recently recognized that significant opportunities for increasing fodder production and promoting forage production exist along roadside and irrigation canal embankments. These areas are generally not used for agricultural cropping practices and, therefore, can make important contributions to livestock feed supplies.

In Bangladesh, livestock and poultry — including cattle, buffalo, goats, sheep, chickens, and ducks — frequently subsist on low-quality roughage, in particular rice straw along with other crop residues, weeds from crop fields, road side grass and agro–industrial by–products through milling processes.

Processing is important to improve the value of feeds, particularly of low quality feedstuffs. Several methods of processing roughage can be undertaken: (i) chemical treatment, which is based on a delignification process involving crop residues such as straw (rice and wheat) and

stovers; (ii) physical treatment including chopping, grinding, and pelleting and explosion methods; and (iii) biological treatments, which involve seeding microorganisms including yeasts and bacteria and fungi on straw and grasses.

Cereal grains may be processed by using pressure, moisture, heat, and chemicals. Soaking, germination, grinding, dry rolling, cracking, and crimping are cold-grain processing methods. Pelleting, roasting, micronizing, popping, extruding, steam rolling, steam flaking, and exploding are hot-grain processing methods. Chemical treatment of crop by–products create ***by–pass proteins***, which permit ruminants to take direct advantage of proteins, rather than exposing them to rumen microbes.

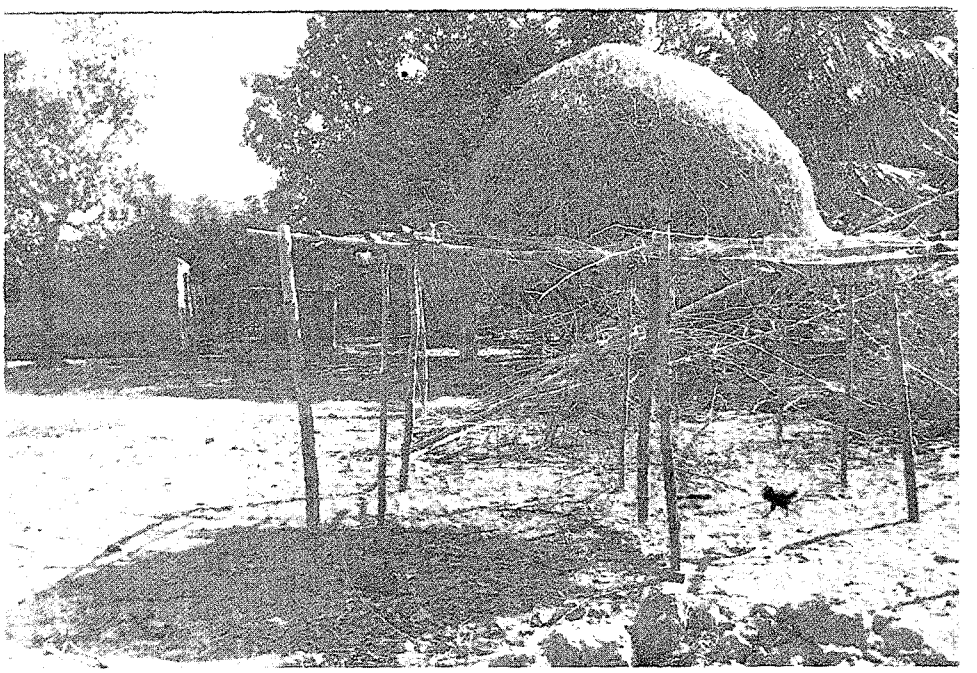
This manuscript provides a brief description of the more common raw and processed feed resources of Bangladesh. Some are widely available and frequently used in many countries, whereas others are available in varying quantities in Bangladesh and offer good promise as livestock feed, but at the present time are little used.

CONVENTIONAL FEED RESOURCES IN BANGLADESH

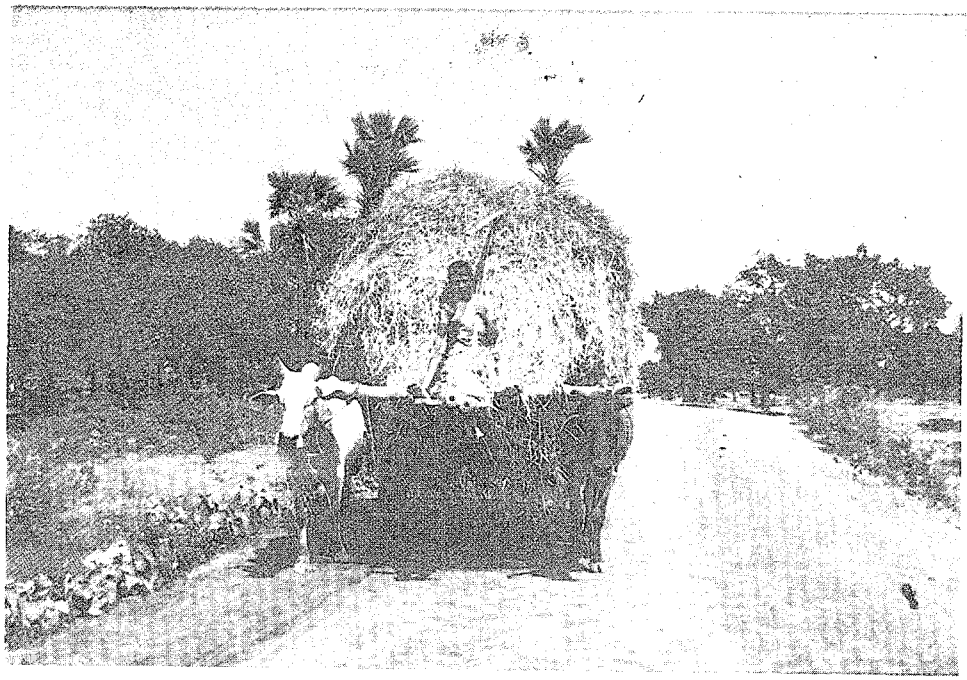
Rice Straw

Rice straw is the most abundant and most widely used forage as cattle feed in Bangladesh. However, the nutritive value of rice straw is relatively low. It is low in protein and total digestible nutrients and high in crude fiber content. Well-documented studies conducted abroad, which were duplicated here, showed that the nutritive value of rice straw could be improved with the addition of urea and storage under aerobic or facultatively anaerobic conditions. However, widespread adoption of this technique has yet to occur in Bangladesh, perhaps due to the expense and labor demands that the process places on farmers.

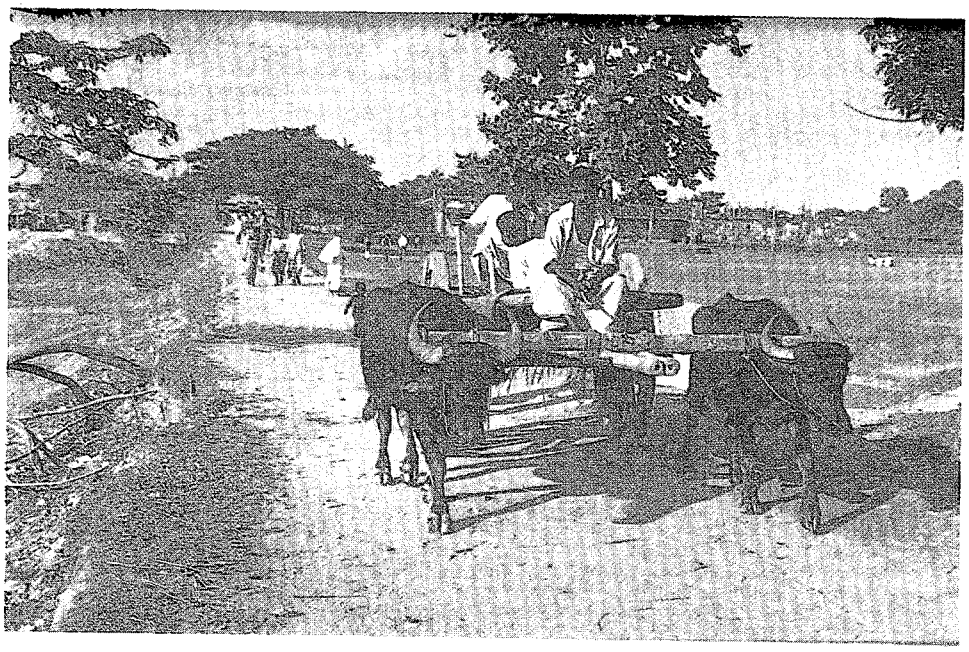
Chopped rice straw can increase profits by improving palatability and reducing wastage, Naogaon.



Preservation of rice straw can reduce losses due to rats and other vertebrate pests, moisture induced rotting, and insects.



A cart full of rice straw for cattle feed



Buffalo are important for rural transportation.

Given the extent of the country's rice production (17.86 million metric tons in 1989–90), rice straw is available throughout most of the year. The adoption by farmers of technologies that will improve the nutritive value and utilization of rice straw would have a significant impact on the country's cattle and buffalo population.

However, increased use of rice straw for livestock feed is not without opportunity costs. It is estimated that 35 to 40% of the total straw is used as fuel and other purpose (ADP, 1985). Straw is also used as building materials and for soil improvement. With the rapid growth in the nation's population and ever-increasing pressure on energy for cooking purposes, the demands on rice straw for household energy and construction uses will likely increase, making less straw available as livestock feed.

There are also indications that the straw production from high-yielding varieties (HYV) of rice are of inferior nutritive quality (Haque et.al, 1981). Digestibility is decreased and straw production is often less than with non high–yielding varieties.

Some reports indicate that as much as 25 to 30% of the straw produced is not used for feeding purposes. It often rots in the field due to excessive moisture of the monsoon season and, once it dries sufficiently, it is frequently burned. This is particularly true for Boro and Aus rice harvested between mid–July — mid–September. Wet straw could, however, be preserved with ammonia treatment, which would significantly increase the feeding value and digestibility. However, once again, these techniques require some investment and considerable extension activities to reach significant levels of sustained adoption by farmers.

Wheat Straw

Wheat straw, at present, is not used as livestock feed by the farmers in Bangladesh. It is mostly used as fuel, and for roofs and partitions of thatched houses.

Given the amount of wheat production (1.47 million acres in 1989–90 with 0.89 million metric tons wheat), about one million metric tons of wheat straw was estimated to be available in the country Generally, rice straw is preferred by farmers for livestock feeding. In Bangladesh, wheat straw is occasionally burned after harvest. However, in many other countries, wheat straw is widely used as fodder for cattle and other large ruminants (e.g. water buffaloes). There is clearly potential for development of its use as a feed resource in Bangladesh.

Rice Bran and Polish

Rice bran is a very valuable by–product which can provide a major locally produced energy supplement source in concentrated feed. Rice polish, fine particles of rice bran, is an excellent source of energy in poultry rations.

About 17.86 million metric tons of rice grain were produced in 1989–90 in Bangladesh. Rice bran is the most abundant rice by-product, accounting for about 10% of total rice grain production. There are nearly 250 mechanized rice mills in the country, with a total milling capacity of about 4,066 metric tons per day. Depending on the variety and the process of milling, crude protein, crude fat, and crude fiber in local rice bran ranges from 4.0 to 6.5, 6.5 to 10.5, and 14.5 to 24.8% (DM basis), respectively. Because of its relatively

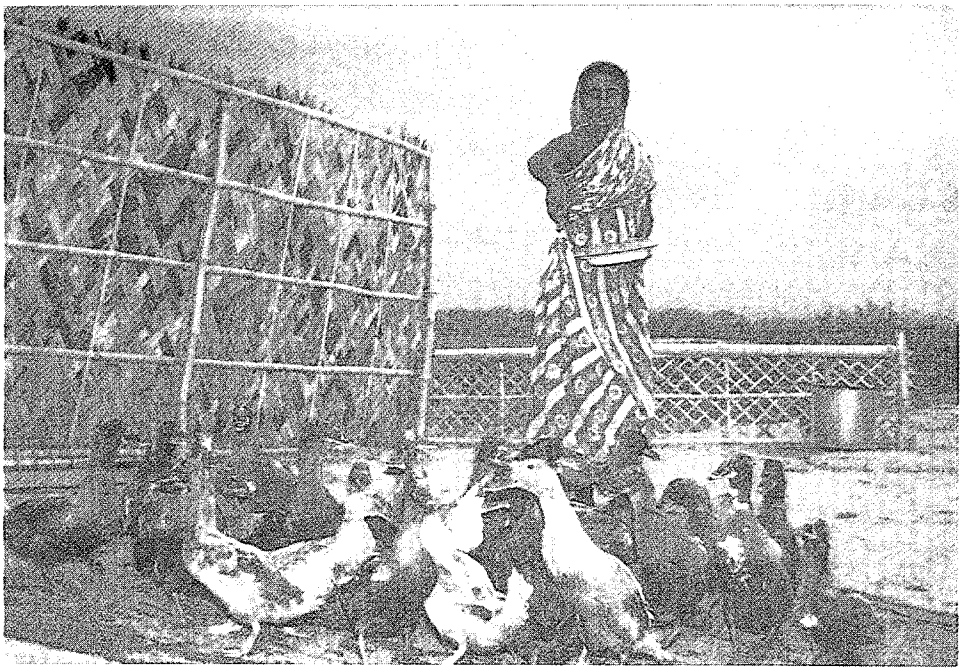
high oil content, rice bran is a good energy source. However, it is also prone to rancidity if not properly handled. It is used extensively in livestock and poultry rations.

Commercial extraction of oil from rice bran is done by Dhaka Vegetable Oil Mill, and two private oil companies based in Dinajpur and Chittagong. Production of de-oiled rice bran is estimated at 1,000 metric tons annually. De-oiled rice bran has a normally higher percentage of crude protein than regular rice bran (8.5 to 9% vs. 4 to 6%), and because of the absence of oil, which is the major cause of rancidity over time, de-oiled rice bran has longer storage and shelf life.

Rice polish is produced mostly in automatic rice mills in the country with an extraction rate of 6% of total rice milling. Rice polish contains 13.5% crude protein, 14.5% crude fat, and 3 % crude fiber. It is mostly used in poultry ration.

Wheat Bran

Nearly one million metric tons of wheat are produced in the country annually and, in addition, two million metric tons of wheat are imported every year to support domestic consumption. Rangpur, Comilla, Jessore, Kushtia, Dinajpur and Rajshahi regions are the major wheat-producing regions. Although mainly used for humans, wheat is also the major source of energy in poultry rations. Wheat bran is a main by-product of wheat milling and is used extensively in livestock and poultry diets. Depending on the process of milling, there are fine and coarse wheat brans. Fine wheat bran has a higher percentage of crude protein (14.5 vs. 13%) and lower percentage of crude fiber (9.5 vs. 10.5%) than coarse wheat bran. Fine wheat bran is mostly used in poultry ration and coarse bran is used in cattle feed.



Supplementation of wheat and wheat bran as shown here can significantly increase egg production in scavenging ducks at Gokulnagar village, Savar.

Village women feeding locally available concentrates (wheat bran, rice bran, khesari, pulse dust, mustard oil cake, molasses and salt), Bogra.

Rape and Mustard Oil Cake

Rape and Mustard are the most widely cultivated oil seeds in Bangladesh. Nearly 217,000 metric tons of rape and mustard oil seed was produced in 1989–90. Dhaka, Comilla, and the northern regions are the major producers. Oil cake is a main by-product in the extraction of oil. Depending on the method of processing, oil cake is roughly 59 to 70% of the entire mustard seed.

Two methods of extraction are used in the country: the mechanical pressing and the *ghani*, or traditional method. The *ghani* technique is a traditional grinding method powered by draught animals. The "ghani" method of oil extraction is more frequently used in rural areas. In 1989–90, some 75,506 metric tons of mustard oil cake were produced. The four oil mills under the Bangladesh Sugar and Food Industries Corporation (BSFIC) produce nearly 2,100 metric tons of mustard oil cake annually. Most of the oil mills are located in Narayanganj district.

On a DM basis, percent crude protein, lipid and crude fiber of mustard oil cake ranges from 25 to 30, 12.5 to 13.5 and 9.5 to 12% respectively, depending on the method of extraction. Mustard oil cake is widely used as a source of protein in livestock feeds. It is only rarely used in poultry rations. The majority of mustard oil cake is used as fertilizer for crops.

Til Oil Cake or Sesame Oil Cake

Til production in 1989–90 amounted to 49,000 metric tons. It is harvested from July to December. Sesame oil cake production from sesame seeds averages 56%. In 1989, oil cake production was about

27,440 metric tons. The oil cake contains roughly 34% crude protein, 8.7% lipids and 8% crude fiber (DM basis). It is mostly used as a source of protein in poultry rations. The northern regions, particularly Rangpur and Dinajpur are the major producers. Most of the oil mills are located in Narayanganj, Manikganj and Dhaka.

Linseed Oil Cake

In 1989–90, linseed production in the country amounted to 48,000 metric tons. Linseed oil cake is about 65% of the entire seed. March to May are the peak production periods. Roughly 31,200 metric tons of linseed oil cake was produced in 1989–90. The oil cake is about 33% crude protein, 6.7% crude fat, and 9.5% crude fiber (DM basis). Linseed oil cakes produced under low temperature are known to be toxic to livestock and poultry and cannot be used any more than 2 to 3% in poultry feed. The cake can be rendered non–toxic by boiling in water.

Coconut Oil Cake or Copra Meal

Copra meal is the main by-product in the extraction of coconut oil. In 1989–90, coconut production amounted to about 82,000 metric tons. The Khulna and Barisal regions are the major areas of production. Local data indicate that from 200 to 250 kg of copra, about 33% of coconut oil cake is produced. The coconut oil mills in the Bagerhat district produce between 10-12 metric tons a month of coconut oil cake or copra meal. Availability of copra meal is year-round. Coconut oil cake is not commonly used in livestock and poultry ration in Bangladesh due to lack of awareness on the part of the farmers.

In coconut-producing areas of Southeast Asia, copra meal or coconut oil cake is used extensively as a source of protein in livestock and poultry rations. Although its amino acid balance is not very ideal for poultry, it is widely used in dairy cattle rations. On a DM basis, coconut oil cake has about 18 to 22% crude protein, 11 to 13% crude fiber and about 10% crude fat.

Fish meal

Roughly 650 metric tons of fish meal are produced annually by the fish processing plants of Bangladesh Fisheries Development Corporation (BFDC) in Chittagong, Cox's Bazar, and Khulna. The fish meal produced in these areas are from fish not used for human consumption. Three grades of fish meal are produced in these plants. Grades A1, A2, and B are determined by crude protein and contain approximately 60%, 50%, and 45% on a DM basis, respectively. However, poor quality control of the protein content results in a great deal of variability within and between the various grades. About 250 metric tons of A1 fish meal is produced annually in Chittagong, while nearly 200 metric tons of Grade A2 is produced in Cox's Bazar. The BFDC plants in Khulna and Dhaka produce about 200 metric tons of Grade B fish meal a year.

In addition, a total of about 500 metric tons of fish meal is produced by the private sector. However, fish meal available in the country is mostly adulterated with low quality fish, head and tail of shrimp, and sometimes with dried blood and urea. Fish meal is the major source of protein for poultry in Bangladesh. Many of the private poultry entrepreneurs use *chewa* fish to produce fish meal through grinding the fish at their own premises as a way of ensuring the quality of the meal.

However, oil is not extracted from these fish meals and, as such, their protein value and keeping quality are not comparable to oil-extracted fish meal (e.g. Chilean or Peruvian fish meal). Also, the level of silica in local fish meal is relatively high because the fish are left to dry on the sand. When gathered for grinding, a substantial amount of sand is included. The addition of sand reduces the nutritive value of the fish meal. This should be a major concern to fish meal producers because the ingredient is a very important protein source for livestock and poultry. Given the extent of its use and promising business potential, more quality control should go into the production of local fish meal.

Chick Pea or Bengal Gram (*chola*) — *Chola* bran

Chick pea grains (*chola*) are normally consumed by humans although they are also used by livestock. The bran, which is the main by-product, is about 15% of the grain. The major producing areas are Kushtia, Jessore, and Faridpur districts. Approximately 10,000 metric tons of *chola* bran was produced in 1989–90, with February to April as peak periods of production. Chick pea bran contains almost 13% protein and about 22.5% crude fiber (DM basis).

Grass Pea (*khesari*) — *Khesari* Bran

Grass pea or *khesari* is the most widely cultivated pulse in Bangladesh. About 25% of the entire seed is bran. Most *khesari* bran is used in livestock rations. An amount of nearly 42,500 metric tons of *khesari* bran was produced in 1989–90 with Pabna, Barisal, Noakhali and Faridpur being major areas of production. *Khesari* bran is roughly 12% crude protein but it is high in crude fiber (37.7%). The bran is available throughout the year.

Khesari, a leguminous vetch, is cultivated mostly in the low-lying northern part of the country. It is a highly succulent, palatable, and rich fodder for dairy cattle. However, excessive consumption of the fodder can cause bloat in cattle. The plant can be dried as hay and fed to cattle. On a DM basis, *khesari* plant has about 19 to 21% crude protein, and 27 to 35% crude fiber.

Khesari is grown for forage as relay crops in Aman paddy. The legume is normally planted after the flood waters have receded. It is a native species, short-duration winter legume that supplies green forage from November to February. Its production is about 5 metric tons of green matter per acre in Aman paddy-legume relay system, and about 10 tons per acre in *bathan* land or improved pasture. It is widely used and cultivated as green forage throughout the country during winter.

Split pea or Lentil (*masur*) — *Masur* bran

Lentil seeds are used for human consumption. *Masur* production amounted to 155,000 metric tons in 1989–90. *Masur* bran constitutes about 20% of the entire seed. The Faridpur region has 25% of the country's production. Kushtia, Pabna, Jessore, and Rajshahi are also major producing areas. In 1989–90, about 31,000 metric tons of *masur* bran was produced. Availability of the bran is year-round, although January to March is the peak production period. Crude protein of *masur* bran is roughly 19.5%, and crude fiber is about 25.8 % (DM basis). *Masur* bran is used as cattle feed in the country.

Green gram (mung) — Mung bran

Mung bean is basically grown for human consumption. Total mung production in 1989–90 amounted to 31,000 metric tons, although the figure includes production data for black gram. Patuakhali, Barisal, and Faridpur are the major production areas of green gram, accounting for about 50% of the country's production. The peak period of availability is from February to April. The bran, which is used in livestock rations, is about 15% of the pulse. In 1989–90, about 4,650 metric tons of mung bean bran were produced. On a DM basis, mung bran is about 14% crude protein, and 23% crude fiber.

Black gram (*mashkalai*) — *Mashkalai* bran

Faridpur, Pabna, and Rajshahi are the major production areas of *mashkalai* bran in Bangladesh. Availability of the pulse is from November to January. The bran is about 15% of the entire pulse. In 1989–90, about 7800 metric tons of *mashkalai* bran was produced. The crude protein of *mashkalai* bran is nearly 19% while crude fiber is close to 23% (DM basis).

Mashkalai is traditionally grown for forage as relay crops in Aman paddy. It is also grown in low-lying *bathan* lands of Tangail and Pabna districts after the flood water has receded in October. *Mashkalai* is a native legume that provides green forage from November to February. With the current management system, it is estimated that about 5 metric tons of green matter per acre are produced in Aman paddy-legume relay system. In *bathan* land, about 10 metric tons of green matter can be produced. It is the second-most abundant green forage traditionally cultivated for cattle in the country.

Molasses

In 1989–90, some 7.4 million metric tons of sugarcane was produced. Besides bagasse, molasses is the other major by-product in the milling of sugarcane. Approximately 3 to 5% of molasses is obtained from the production of sugar. Molasses production was estimated at 85,000 metric tons in 1989–90, of which over 30,000 metric tons was exported. The demand for molasses as an industrial raw material was about 85,000 metric tons in 1989. For molasses-based feeding systems to increase, suitable transport mechanisms have to be developed.

Molasses is principally used as a source of energy in livestock and poultry feeds. Its use as a cattle feed supplement is well-documented. It is low in protein (4.0%, DM basis) but high in TDN. The amounts of lipid and fiber are negligible. It is, however, an excellent source of trace minerals and elements. If fed in sufficient quantities it can obviate the need for mineral supplements in livestock feeds.

About 90,000 metric tons of molasses was produced in 1988. The Bangladesh Sugar and Food Industries Corporation (BSFIC) operates 16 sugar mills in the country. Sugar production mostly occurs from October to April. On the other hand, bagasse, which is about 35% of the sugarcane, is mainly used as fuel in sugar mills.

However, one should take into account that the presence in the diet of soluble carbohydrates, such as molasses, tends to change the rumen environment to one that is not favorable to cellulitic bacteria. Molasses, therefore, should not be overfed in diets high in roughage

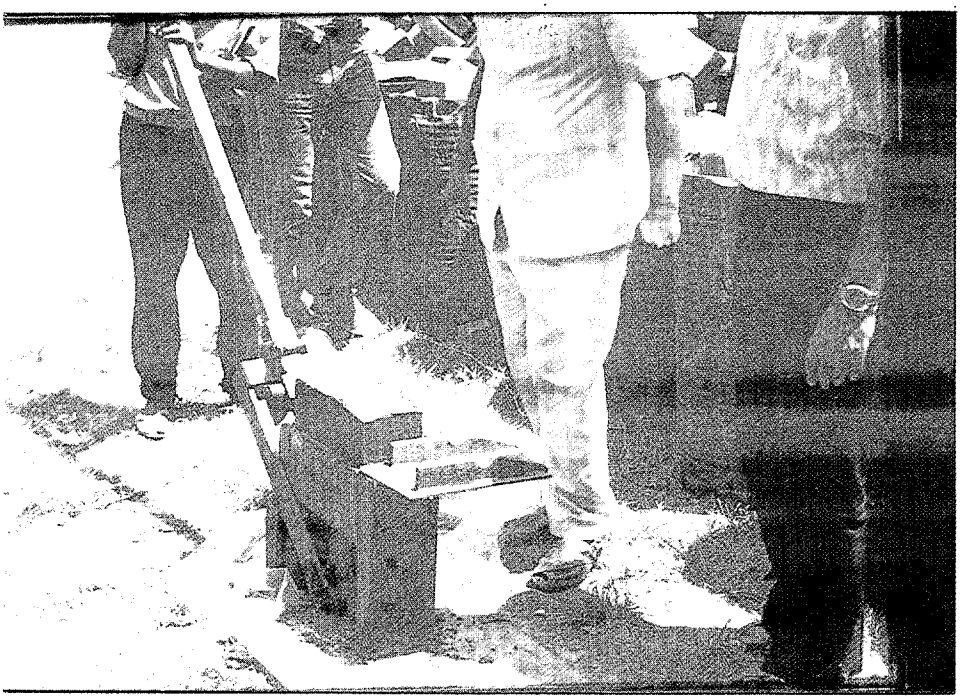
Stillage

Stillage is a distillation by–product containing the liquid remains after yeast fermentation and distillation of molasses for alcohol production. It can be a good ruminant feed and, when concentrated, it can be used to make multinutrient blocks or fed directly to cattle and goats (about 1 liter per day of dilute material per cow).

Currently in Bangladesh, there are five distilleries, all of which face the problem of stillage disposal in an environmen-tally sound manner. Generally, stillage is dumped into open lagoons adjacent to the distillery. This represents a significant unutilized livestock feed, resource which can easily be incorporated into farmer's feeding programs and, at the same time, solve the disposal problem for distilleries. Those who reside adjacent to distilleries can feed liquid stillage and, for those some distance from the distillery, stillage can be incorporated into multi–nutrient blocks as described above.

Molasses Multi–Nutrient Blocks (MNB)

The primary objective of the manufacture of Molasses Multi–Nutrient Blocks (MNB) is to meet the requirements of the ruminant animal by supplying nitrogen, energy, and minerals for increased utilization of readily available low-quality roughage. Incorporation of molasses into blocks also helps to increase its quality and facilitate its transportation. Ruminant animals in Bangladesh, like those of other developing countries, are fully dependent on crop residues and by–products of agriculture. Because these by–products are generally low-quality roughage, a primary constraint to increased production is the resulting inefficiencies in the digestive system of these animals. In addition to providing ammonia for the rumen, the molasses component of MNBs is an inexpensive source of minerals that are likely to be lacking in local feeds. MNBs have been demonstrated to make significant contributions to increased animal production in Bangladesh.



An open-air stillage Lagoon in Shampur. Stillage, a distillery by-product, can provide supplemental energy and minerals to livestock. Moreover, it can be used as a replacement for molasses in multi-nutrient blocks.

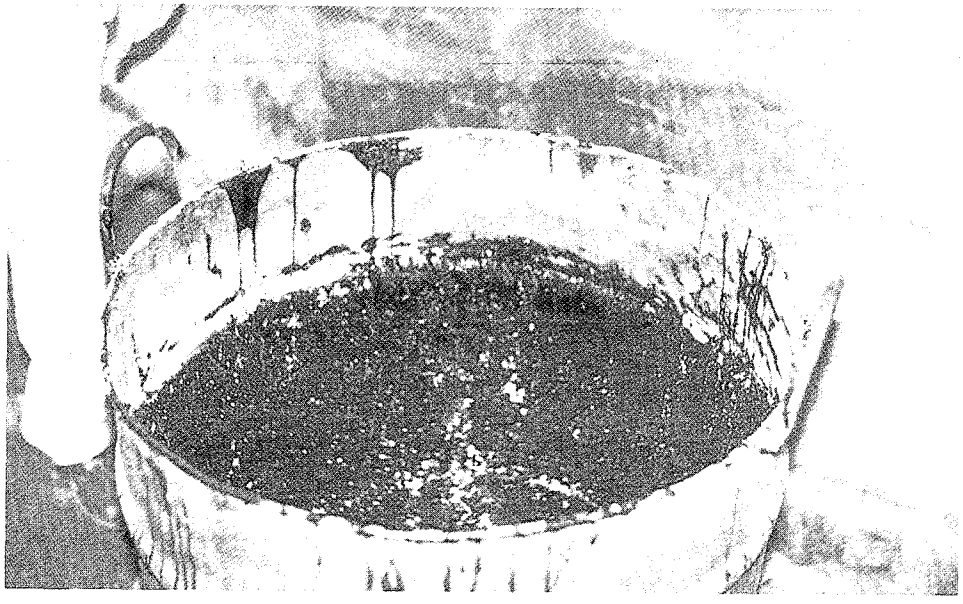
Studies at Bangladesh Agricultural University have demonstrated that when MNBs are combined with protected protein meals (bypass protein), which provide high levels of protein that are undigestible by rumen microflora and therefor permit direct and more efficient utilization in the small intestines, an improvement in both the level of production and the efficiency of forage utilization by ruminant animals results (Saadullah et.al. 1985). This research has concentrated on the use of fish meal and vegetable oil meal by–products. The benefits of the use of these protein meals, however. are not well known by extension agents or at the farmer level.

Bypass proteins that are presently used include til (sesame) oil cake, mustard oil cake, rice polish, and wheat bran. These are fed largely to improved crossbred cattle, predominantly for milk production.

It is quite possible that, even with indigenous cattle, the use of MNB bypass protein could have major catalytic effects in lifting the level of animal production of a large number of unproductive animals owned by village farmers. Results in India have shown that such feeding practices among indigenous cattle have resulted in average increases in milk production of 50%, a decrease in length of time to sexual maturity from approximately 40 months to 24, and a reduction of the calving interval from 18–24 months to 12–15 months.

There are four private entrepreneurs producing MNBs in Naogaon district, which cover the market areas of Naogaon, Bogra, Joypurhat, and part of Rajshahi district. One private businessman has also started to produce MNBs at Bogra. These are primarily being used in these areas as feed supplements for high-yielding crossbred dairy cattle. In general, farmers are of the opinion that their animals are receiving high benefits from these blocks. MNBs

A locally made press for molasses urea blocks (MUB) at the RDRS field station at Thakurgaon. MUBs, when properly used, can greatly increase the rate of weight gain and milk production in livestock.

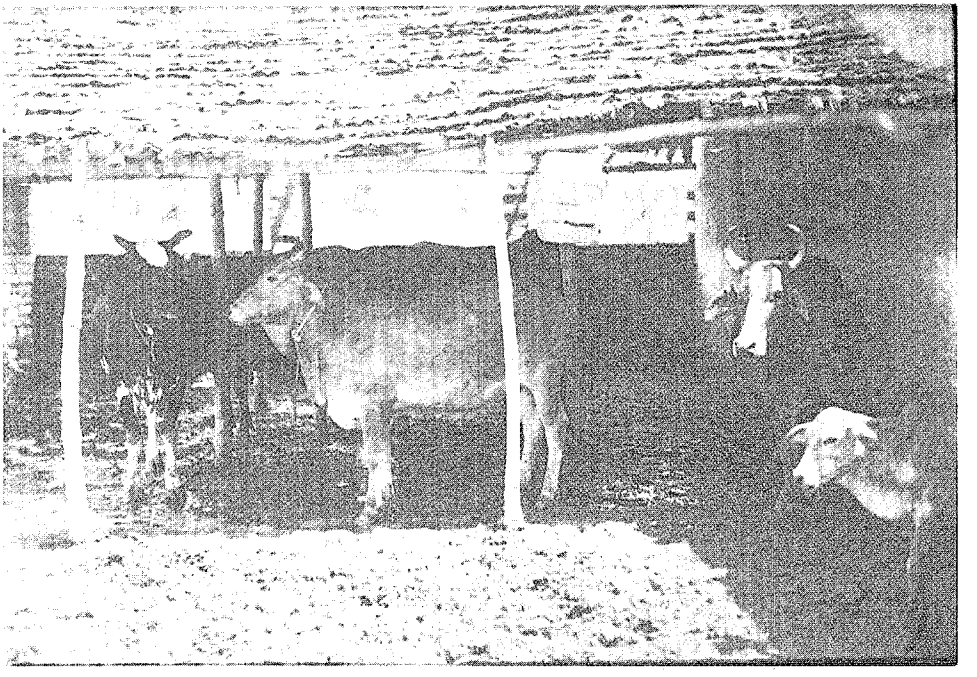


Mixing ingredients for the preparation of Molasses Urea Blocks at Naogaon. A recommended formula for block is. Molasses 50%, Urea 10%, Lime 10%, Salt 5% and Rice bran 25%. Sufficient water is added to permit mixing of the ingredients. Once pressed, blocks are sundried. Rice bran may be reduced to 15% composition by the addition of 10% cotton seed cake or 10% coconut oil cake.

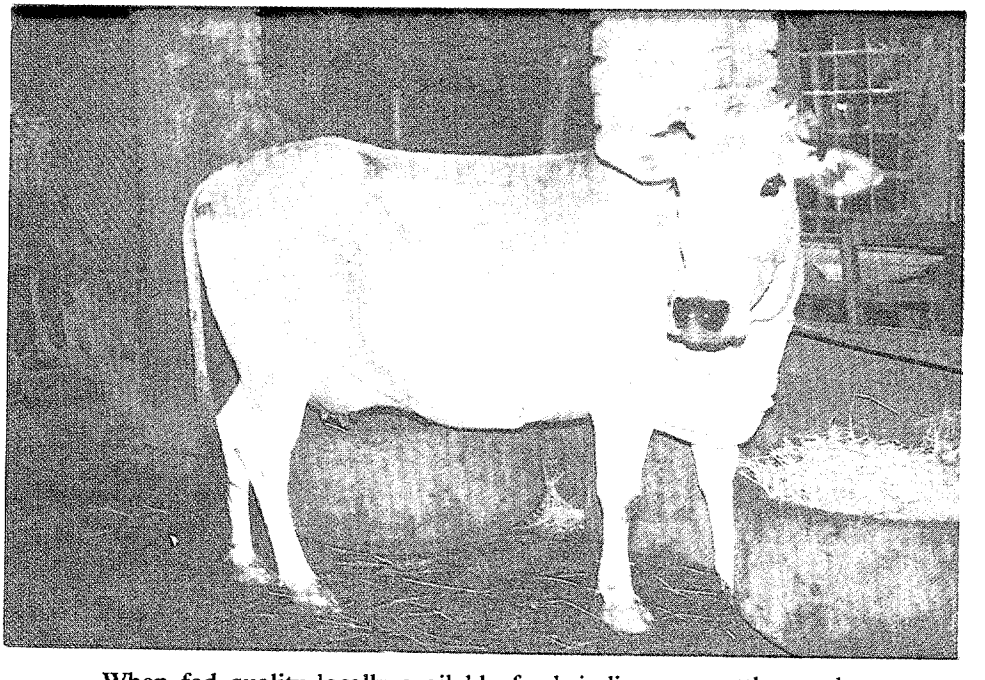
are also being used by farmers of Thakurgaon, where they are manufacturing the block for themselves. Most of the manufacturers of these regions are producing 1-kg. blocks. A 1-kg. block costs about Tk. 4 to produce, and is sold in the local market for about Tk. 10. An adult cow licks up to 250 g/day of block, while an adult goat requires only 50 g/day. Goat raisers need to be encouraged to use this block for goats. If provided to indigenous dairy cattle prior to calving or soon after and then continued throughout the lactation period, the extra milk produced and sold at Tk. 10/liter will provide a minimum profit of Tk. 5/day per cow (assuming milk production is increased by a conservative .75l lt/day).

Different entrepreneurs are using different compositions for their blocks, which are shown in Table 1. It is observed that the composition used by the *Tripti* entrepreneurs is very low in urea. Production responses attributed to this block may not be due to urea, but to minerals in the mineral mixture and molasses. At least 3% urea is necessary to provide sufficient nitrogen to utilize other block components. It is only when the urea component of blocks surpasses 3% is it able to contribute to increased feed utilization of other dietary components. For optimal protein production by rumen microflora, it is suggested, therefore, that blocks contain at least 10% urea. (Leng, 1992; Allen, 1992).

The salt content of blocks 1, 2, and 3 used by the farmers is also very low. Several authors (Leng, 1992; Allen, 1992) suggested that 5% salt in the block is useful as a means to deter livestock from ingesting too much of the block at any given time. Cottonseed oil cake may also be used as an ingredient in the block as a bypass protein in the rumen. Wheat and rice bran can be used as additional sources of bypass protein. It should always be remembered that multinutrient blocks are used as a supplement to other feeds.



The provision of thatched shade to indigenous high producing cows increases milk production during the hot season. (Bogra)



When fed quality locally available feed, indigenous cattle can be productive and highly profitable, producing as much as 1,000 to 3,000 liters of milk. (Bogra)

There is an urgent need to encourage private entrepreneurs to use formulas that are well- balanced and cost-effective. In addition, this technology needs to be extended to greater numbers of users. Attention should be given to the training of *thana* and district level livestock officials on MNB production and feed supplement technology. Further research should be undertaken to develop a suitable method of block preparation to achieve more balanced, locally available ingredients which are economical, including stillage and rice bran. In addition, the technology of cold block manufacture needs to be further evaluated and promoted.

Cottonseed Cake

In 1991, about 58,500 bales of cotton were produced in Bangladesh. During extraction, about 60 to 65% of the cottonseed remains as the byproduct cake. Approximately 35,000 metric tons of cottonseed cake was produced in 1991. Commercial cultivation takes place mainly in the Jessore and Kushtia regions. BSFIC produced 210 metric tons of oil cake in 1989. Oil extraction mills under the Bangladesh Cotton Development Board (BCDB) produce the oil for industrial use (paints, grease and varnish). Recently, four extraction mills have been established by private entrepreneurs in Kushtia, Jessore, and Pabna regions, and are producing cottonseed cake.

Cottonseed cake which is nearly 20% crude protein, 10% crude fat and 27% crude fiber (DM basis), is used as cattle feed in areas close to oil mills. It is also used as fertilizer in fields, which is unfortunate since it is an excellent source of bypass proteins, which are increasingly becoming recognized as important in promoting increased tropical livestock production.

POTENTIAL AND NON-CONVENTIONAL FEED RESOURCES IN BANGLADESH

Maize

As a crop, maize is not really new to Bangladesh. Maize has been grown in this country for decades, although its potential as human food, livestock and poultry feed, and industrial use has only recently been given attention. The value of maize as a source of feed is well established. Because it is highly palatable and digestible, maize is an excellent source of feed and fodder for poultry and livestock. In many countries it is a main source of energy for poultry feeds and cattle concentrates. However, recently it has been recognized that the use of maize as livestock or poultry feed is inefficient from an energy standpoint.

Other important by-products are corn bran, corn gluten and germ meal, which could be used as protein supplements. Maize is low in lysine, an amino acid essential for poultry. Maize stalks can also be dried and used as fuel.

Unknown to many, the demand for maize grain in the country is relatively high. It is very difficult to estimate maize production in Bangladesh. It is estimated that about 15,000 tons of grain are produced, most of it consumed as green cobs. Maize is grown mostly in Chittagong, Chittagong Hill Tracts, Dhaka, Mymensingh, Jessore, Kushtia, Bogra, Jamalpur, Pabna, Rangpur, Dinajpur and Rajshahi. At present maize is grown on relatively small–sized plots.

No accurate estimate is available concerning the use of maize in poultry feed in Bangladesh. It is assumed that a very small amount of maize is currently used by poultry entrepreneurs. Estimates show that presently, about 50,000 to 60,000 metric tons of the grain are needed

annually for the organized poultry industries in the country. The demand could even be higher if the use of maize as a poultry feed is popularized in the countryside. Currently, wheat is used as the main source of energy among poultry producers. However, the use of wheat for poultry conflicts directly with the need for wheat for human consumption. This is a very sensitive issue, given the country's precarious food situation and population pressure. On the other hand, maize is not considered as a food grain for human consumption, except for its acceptance in urban centers as green cobs.

The potential of maize as a raw material for industry is also very high (oil, starch, pharmaceutical industries and confectioneries). However, due to the limited supply (3,000 metric tons in 1989), a significant portion of the maize needed (mostly for poultry) is imported. In addition to limited domestic production, markets for maize in Bangladesh are poorly developed, and there have been reports of farmers unable to market all of their maize.

Constraints to increased maize production in Bangladesh are: distorted pricing policies; lack of knowledge about its multiple uses; lack of motivation of farmers for its cultivation; no organized marketing; and limited access to mechanical husking and shelling.

However, despite these obstacles, there are indications that maize could become the third largest grain crop, after rice and wheat, in Bangladesh.

Shrimp waste

Shrimp waste is a by-product of the shrimp processing industry. It is composed mainly of heads, tails, and shells, which are sun — or oven-dried and later ground to a powder. Khulna and Chittagong

regions are the major areas of brackish-water shrimp production. In 1991 the shrimp harvest was estimated to be approximately 60,000 tons. In addition, approximately 4000 metric tons of shrimp are harvested annually from the Bay of Bengal. About 18,000 to 20,000 metric tons of raw shrimp waste is available annually, with an extraction rate of 30%. Depending on the variety of shrimp grown or captured, the crude protein content varies from 26 to nearly 36% (DM basis). Crude fiber ranges from about 16 to 24.5%, whereas the mineral content ranges from 29 to 34%.

Shrimp waste has great potential as a source of protein in broiler, layer and duck rations, especially in areas close to processing plants, where further treatment to prevent spoilage is unnecessary. At present, shrimp waste is greatly under–utilized as an animal feed in the country.

Bone meal

Bone meal, a by–product of the slaughtering industry, is produced in Chittagong, Khulna, Faridpur, Syedpur, and Comilla. Bones are collected from slaughter facilities by local agents and sold to milling factories. Estimates show that about 5,000 metric tons of crushed bone is produced annually as a non–conventional export item. The bone crushing factory in Chittagong (BEXIMCO) produces 2,000 metric tons of crushed bone per year. Other factories that produce bone meal for export are: Ahmadia Bone Meal; Monir and Siraj Bone Meal; Premier Bone Meal; and, Exco Bone Meal. During crushing about 10% of small particles of the crushed bone is sedimented and termed as bone meal. Bone meal is a good source of calcium and phosphorus and other trace minerals for poultry and livestock.

Currently, most of the bone meal is used as fertilizer. Bone meal has not been intensively used as a mineral source for the livestock and poultry industries in Bangladesh as it is not sterilized and thus poses a disease risk. In addition, it contains about 6% sand/silica by weight.

While ground oyster shells are readily available as a source of calcium, bone meal has not been tapped as a source of phosphorus. This is especially important as phosphorus deficiency has severe adverse effects on the reproduction of ruminants. With proper processing, bone meal could be an excellent and inexpensive supplement to livestock.

Blood meal

Slaughter houses throughout Bangladesh are the major sources of fresh blood. Blood is currently wasted and not used for any purpose. A study estimated that about 374 metric tons of blood is discarded annually (Uddin, 1985). It is likely that the estimate did not include the amount of blood discarded during the animal sacrifices that mark the Eid-ul-azha festival. Although the protein content of dried blood is relatively high (73 to 88%, DM basis), its poor amino acid balance is not ideal for poultry, limiting its use to 3 to 4% in poultry rations. In addition, blood meal has good potential as supplemental feed for ruminants.

Water hyacinth

In times of fodder shortages farmers sometimes feed water hyacinths to their cattle. Water hyacinths, however, are not very palatable. In addition, their dry matter content is very low (15%) and

ash content is relatively high. Due to the high moisture content in water hyacinth, the cattle that feed on it ingest very little dry matter, resulting in a negative energy and protein balance, and weight loss. Therefore, if water hyacinths are fed, they should only be used to supplement other supplements of higher value.

Like most aquatic plants, water hyacinths collect and accumulate chemicals (e.g. herbicides. insecticides and heavy metal) found in polluted water. This is an area of concern not only because of its potential effects on livestock production and health, but because of the potential effect on humans who consume livestock and livestock products.

Azolla

Azollas are water ferns, which form in thick greenish/reddish-green layers on the surface of small water bodies and paddy fields, especially during January–Februaryand August–September. As a nitrogen-fixing plant, azollas require less fertilizer than other similar aquatic plants and may, therefore, be more economical as a feed supplement for livestock and poultry. In India, azollas have been used as feed supplement to straw-based diets for rearing cattle. There are indications that dried azolla could be used in broiler finisher rations. There are many ponds, lakes, and swampy areas in the country that contain water all year round. These conditions are ideal for azolla culture and propagation. Some reports indicate that about 0.35 kg. of azolla is produced per square meter (Majid et.al. 1980).

The study of Shahjahan et. al. (1981) on the use of aquatic weeds and algae as poultry feed indicates that a mixture of azolla, spirodella and lemna can be used at 10% in chick rations, replacing cereal grain components of the diets.

Table 2 shows the performance of cattle-fed basal diet of wheat straw and sugarcane tops supplemented with azolla, compared to cereal-based supplementation.

Duckweed

Duckweed species are small, fast-growing plants that inhabit the surface layer of water bodies. They are monocotyledons belonging to the botanical family Lemnaceae. The family consists of four genera, Lemna, Spirodela, Wolffia, and Wolffiella. They are often mistaken as algae. Duckweed is common in most o f the country, including moderately saline environments. Duckweed reproduction is primarily vegetative. Duckweed fronds can double their mass in two days under ideal conditions of nutrient availability, sunlight, and temperature. Yields of fresh material from commercial–scale cultivation of Spirodela, Lemna, and Wolffia species at the experimental site of Kumudini Hospital at Mirzapur, range from 0.5–1.5 metric ton/ha./day.

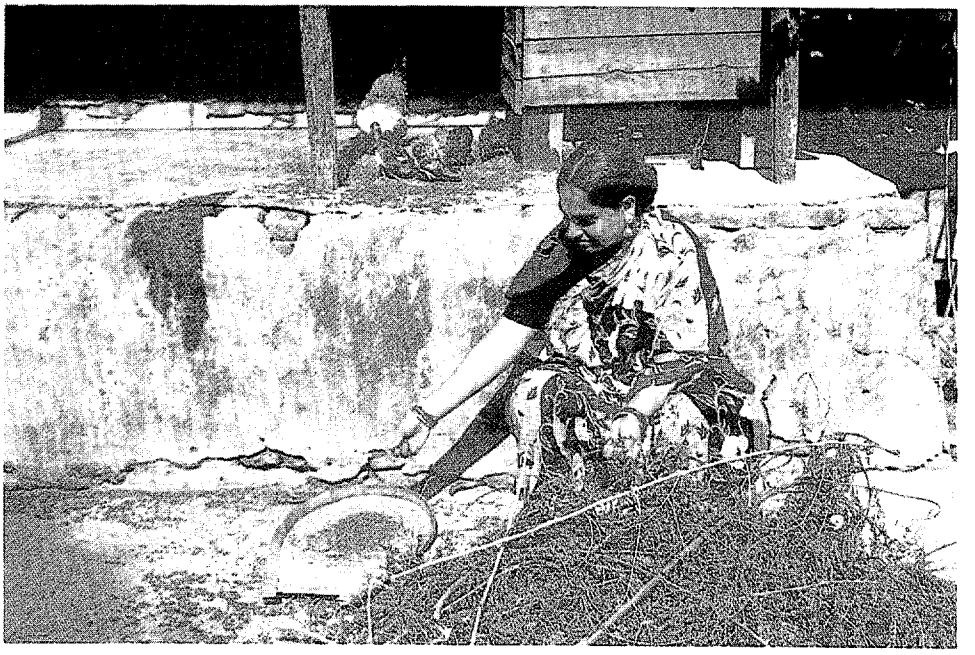
Fresh duckweed contain 92 to 94% water. Duckweed from natural colonies (natural pond) ranges 14 to 25% protein and 11 to 30% fiber. Duckweed grown under ideal conditions and harvested regularly will have a fiber content of 5 to 15% and a protein content of 35 to 45%.

Feeding trials in Peru have demonstrated that duckweed can be substituted for soybean meal and fish meal in poultry rations. Cultured duckweed meal can be used up to 40% in layer diet and 15% in broiler diet (Journey, et. al. 1990). Duckweed is also a good source of protein in ruminant diets. In addition, with its high fat content (15% DM) duckweed can be an excellent feed supplement

for dairy animals. If the high protein content of duckweed can be protected, for example with xylose, it has the potential to become the preferred supplemental feed for high-producing dairy animals. Duckweed is available abundantly in the ponds and paddy fields, especially during the monsoon season in Bangladesh. However, duckweed production requires intensive management and care. Over–harvest of duckweed ponds, or ponds exposed to high winds that tend to remove the duckweed mat, causes sunlight to enter the water, provoking algae blooms, robbing valuable nutrients that duckweed rely on.

Leucaena (*Ipil-ipil*)

The leaves of leucaena, or *ipil-ipil*, are rich sources of protein. Together with the stems they are used extensively as cattle feed. There is no data as to the extent of *ipil-ipil* cultivation in the country. Availability is year-round and the trees are mostly found in homesteads and road embankments. The Departments of Livestock Services and Forestry are mainly involved in promoting this plant throughout the country. With their initiative, the cultivation of this tree is widespread throughout the country. However, due to a lack of effective extension efforts, ipil-ipil has yet to find common use as a livestock feed supplement. Dried *ipil-ipil* leaves have about 21 to 24% crude protein. Although it is an excellent source of protein, its inclusion rate in poultry ration is normally limited to 3 to 5% of the diet because of the presence of a toxic compound (mimosine)



When leucaena leaves (ipil-ipil) are hand ground, they are an excellent protein source for rural poultry. (Savar)

Goat browsing on leucaena leaves (ipil-ipil), an important source of protein supplementation.

Pigeon pea or Red gram (*arhar*) - *Arhar* bran

About 3,000 metric tons of pigeon pea or *arhar* was produced in 1989–90. The northern districts account for roughly 60% of the country's total *arhar* production. Production is seasonal, with the harvest season ranging from April to June. Pigeon pea is sometimes used in poultry rations.

About 840 metric tons of *arhar* bran was produced in 1986. *Arhar* bran makes up about 28% of the entire pulse. The bran, on a DM basis, has about 11% protein and 42% crude fiber. *Arhar* bran is used in animal feed and, where available, can be a good-quality supplement.

Cow pea

Cow pea is a multi-purpose crop for grain, green pods, and fodder. It has early to medium maturity and is drought tolerant. The grain yield ranges from 1 to 2 metric tons per ha. with residue yields of 3 to 7 tons/ha. (DM basis). Normally, grain and residue yields are negatively correlated. However, there are varieties of cow pea, which have high residue and grain yields. On a DM basis, the crude protein and crude fiber levels of cow pea fodder at pod-filling stage are about 18% and 26%, respectively. Cow pea is abundantly grown in the Chittagong region. As traditional green forage in Bangladesh, it ranks third and, as in many other regions of the world, has good potential as a livestock feed supplement.

Soybean seeds - Soybean oil meal

Soybean is an excellent source of both protein and lipid. Soybean oil meal can be a major substitute for fish meal. At present, a soybean production program is being undertaken in Bangladesh by the Mennonite Central Committee (MCC), an NGO. Soybean is sometimes available in local markets in a limited quantity. In 1989, soybeans were profitably produced on over 2,000 acres by over 6,000 farmers. Soybean production is primarily concentrated in and around Lakshmipur, Noakhali, and Comilla districts, where farmers planted 1,071 acres in the 1988–89 Rabi season. Seed for this crop is produced in and around Chuadanga district, where farmers planted 152 acres in the 1988 Kharif season. Soybeans are grown in Tangail, Mymensingh, Sylhet, Rangpur and Dinajpur districts. MCC's forecast of soybean acreage in 1992 is 19,000 acres. In addition, a limited amount of soybean is also grown by the Bangladesh Agricultural Research Institute, Bangladesh Agricultural Development Corporation, Bangladesh Agricultural University, and by some private farmers. Harvesting of crops normally takes place from November to January. Raw soybeans have toxic factors (trypsin inhibitors) that have adverse effects on protein digestibility, but these toxic compounds are normally destroyed by heat treatment (e.g. cooking). Thus, processing is needed in order to eliminate the trypsin inhibitors before it may be used as feed.

When oil is extracted from the seed, soybean oil meal or cake is produced. At present there is no soybean oil extraction factory operating in the country (although there reportedly are two such plants in the country that are currently doing other oil extractions). This product has a high protein content (40 to 44%) and its amino acid balance complements corn very well in poultry rations. If available, soybean oil meal can substitute for the more expensive fish meal. It is an excellent protein source and it has high lysine content. However, the limiting amino acid is methionine.

In 1988, Taka 3.8 billion Taka worth of soybean oil (338 thousand metric tons) was imported by Bangladesh. It might be worthwhile to review this policy because a significant amount of soybean oil meal could be made available to the local livestock and poultry industry if, instead of soybean oil, soybean seeds were imported and processed here. In addition, due to Bangladesh's inexpensive labor, it may be more economically viable to take such an approach.

Sunhemp

Sunhemp is traditionally used as a green manure in countries such as India and Indonesia. In Bangladesh, it is usually broadcast in the flooded marginal lands, bunds, and homesteads for seeds and fuel purposes. Its cultivation is concentrated in Tangail, Sirajganj, and Jamalpur. It is drought resistant and can be ratooned 3 to 6 times. The leaves are used as fodder and are highly palatable. Forage yield (DM) ranges from 2.5 to 6 tons/ha. depending on water conditions and time of cutting. On a DM basis, the forage crude protein and crude fiber are about 30% and 15%, respectively.

Napier or Elephant grass

Napier is an ideal green fodder. The grass can be established within three months with properly prepared soil. It can be managed for a cut-and-carry system for a period of 3 to 5 years. Bangladesh Livestock Research Institute field studies indicate that, with fertilizer application, 30 tons of green matter per acre can be easily harvested. On a DM basis, napier grass has a 9 to 11% crude protein, and 19 to 33% crude fiber content. It is generally grown in different parts of the country by smallholder dairy entrepreneurs.

Para grass

Para grass is another established fodder that is very palatable to cattle. With fertilizer application, the first cuttings can be expected in two months. Cowdung and slurries from compost ponds can replace commercial fertilizers. Para grass contains about 10 to 11% crude protein, and roughly 27 to 30% crude fiber on a DM basis. It is grown mostly in organized public and private dairy farms in Bangladesh.

Dal grass

Dal is a native perennial and semi-aquatic grass, frequently grown in the low-lying areas of the country. Farmers usually collect it and feed it to their cattle. With fertilizer application, average yield per acre is estimated at 1.48 tons per cutting. Up to six cuttings per year can be managed. The grass is very palatable, and on a DM basis, Dal grass contains 6 to 8% crude protein and about 27 to 28% crude fiber.

Sugarcane tops

Sugarcane tops are used by farmers all over the country as cattle feed. About 1,600 metric tons of sugarcane tops were available in 1988. The average crude protein and crude fiber of cane tops are 5.6% and 33.3%, respectively. Sugarcane tops are more efficiently utilized if fed free — choice to ruminants (as opposed to being chopped whole). It has been shown that ruminants can select more nutritional areas of the stalks if permitted free choice, and thus achieve far greater feed utilization efficiency. In sugar-producing areas this is a vastly under–utilized resource for supplemental livestock feeds. It has been demonstrated that the removal of 50% of the leaves and non–millable water-shoot 2–3 months ahead of harvest did not have any significant effect on the cane yield and sugar content (Anon, 1987). Therefore, approximately 2 tons

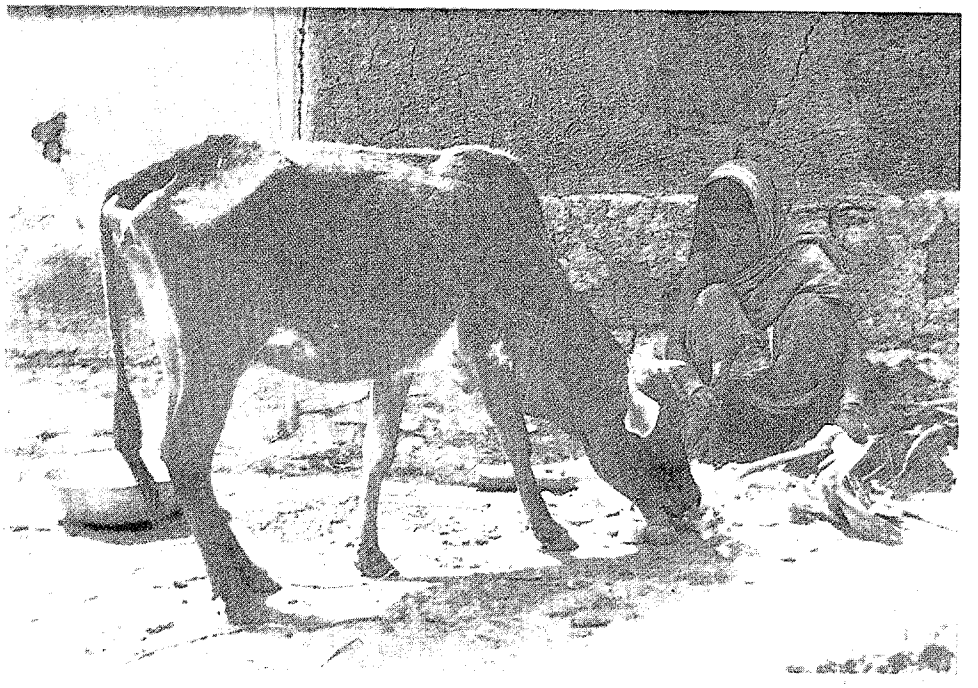
of green cane leaves and 0.2 tons non–millable water shoots/hectare are available for use as cattle feed.

Banana leaves

In 1989, approximately 637,000 metric tons of bananas were produced on 97,255 acres. The average extraction rate of leaves and stems is 85% and 30% respectively. Major areas of production were Barisal, Chittagong Hill Tracts, Khulna, Jessore, Patuakhali, Bogra, Rangpur, and Narshindhi regions. Banana leaves have normally been used by farmers to supplement straw diets. They are also used intensively during periods of livestock feed scarcity. In general, stems are not used as cattle feed. On a DM basis, banana leaves have about 10% crude protein and 21% crude fiber. Both leaves and stems appear to be an under–utilized feed resource in Bangladesh. In particular, pseudostems are rarely fed to livestock and should be promoted as an excellent feed resource for Bangladesh cattle.

Poultry Droppings

Poultry droppings can be used in cattle rations as a concentrate substitute. In an experiment conducted at Bangladesh Agricultural University, it was found that the droppings can safely and economically be used to replace up to 15% of crude protein of the ration, which is equal to 20.47% concentrate dry matter or 18.86% sundried poultry dropping in the concentrate mixture. It is also believed to be a good source of B–complex vitamins. However, poultry droppings should be properly cleaned, sundried, and sterilized prior to feeding cattle because of possible bacterial contamination. Poultry droppings contain about 12 to 20% crude protein and 10 to 12% crude fiber. Although the composition will vary depending on the type of feed, poultry droppings are generally high in calcium. It has been found in different laboratory results that the droppings can be used at a maximum limit of 20% in the cattle diet.



An indigenous cow enjoying chopped banana stem, an under-utilized feed resource.

Silkworm pupae

Spent silkworm pupae are by-products of the silk industry. The pupae is rich in protein (52 to 59%) and lipid (23.3%). About 50 tons of silkworm pupae were available in 1991. The country's silk industries are located in Rajshahi region. They are mostly cultivated in Nowabganj, Rajshahi, Bogra, Rangpur, Thakurgaon, Kushtia, Jessore, Mymensingh, Dhaka and Comilla. Their high protein and fat content make them an excellent supplemental feed resource.

Frog waste

In the commercial processing of frog legs, about 35% of the total body weight is considered useless. The collection centers or processing plants are located in Mymensingh, Noakhali, Khulna, and Chittagong districts. About 8 metric tons a day of frog waste is available at the collection centers. No estimate of frog waste is available from the processing centers, but there are twelve of these plants in the Chittagong district alone. Another 5–6 processing centers operate in Khulna. At present, frog harvesting is prohibited in Bangladesh, so none of the factories can legally operate.

Dried frog waste is an excellent source of protein (62%) and lipids (18%). If available, it could replace fish meal as a source of protein in feed rations.

Jackfruit waste

Jackfruit is available throughout the country. It is a non-conventional feed for ruminants. Nevertheless, all farmers usually feed the waste to animals. The extraction rate of waste in comparison to the whole fruit is an estimated 50% by weight. In

1987-1988, the total production of waste was estimated at 107 thousand metric tons (fresh basis). The CP content of jackfruit husks, seeds, and stems are 9.2, 15.3, and 9.5%, respectively. Jackfruit should be promoted as a livestock feed supplement. Jackfruit leaves are commonly used for feeding goats.

Mango waste

Mango is one of the more popular fruits grown all over the country. Major areas of production are Rajshahi and Dinajpur regions. In 1989-1990, the total production was estimated at 175 thousand metric tons. With an estimated extraction rate of 20% by weight, this amounted to 35 thousand metric tons on a fresh basis. Mangoes contain 4.6% crude protein, 10.5% crude fibre, 3.6% crude fat, 0.09% ash and 81.3% NFE.

Mango seed kernels (*gudhi*) are available in large quantities as by-products of the mango canning and processing industry (India, Philippines) and as discards after consumption. Extensive work has been done in India on mango waste as a potential livestock feed. Adding 40% ground seed kernel to bullock ration did not produce any detrimental effect. Seed kernels contain 14 to 16% DCP, and 60 to 70% TDN when dehulled. Seed kernels are potential seasonal feeds for cattle and buffalo. The accumulated mango waste available in fruit processing plants is not utilized in Bangladesh. Utilizing this waste can increase the present feed resources in the country.

Pineapple waste

Pineapples are grown mostly in Rangamati, Bandarban, Khagrachari, Tangail and Gazipur regions. In 1989-1990, the total production was estimated at 157 thousand metric tons. The

extraction rate of waste is estimated at 25% by weight. This amounted to 39 thousand metric tons of peeling waste (fresh basis). The CP content of pineapple peelings, leaves and fruit spindles are 5.5, 7.0, and 5.2%, respectively. This amounts to about 288 thousand metric tons of crude protein as potential livestock feed. The pineapple fruit processing plants located at Chittagong are not under operation due to management problems. Pineapple waste can be used as cattle feed, and thus can increase the feed resources in the country.

Kans

This weed is grown in the villages of Bangladesh. The mature plant is used for thatching purposes. Kans can form a maintenance ration for cattle at the pre-flowering stage, and can be given as a single feed. It has a DCP content of 0.3% and a starch equivalent of 20%. No adverse effect was found after prolonged feeding. Silage and hay can be prepared from Kans.

Tamarind seed

A small fraction of the available tamarind seed is utilized in the textile industry. It is a good source of protein and energy. To make the seed palatable to cattle it should be ground and soaked in water an hour before feeding.

Babla pods

Babla tree (*Acasia arabica)* grows extensively in Jessore, Kushtia, Khulna and other parts of the country. The pods contain about 14% protein, 10.5% DCP, and 75% TDN. They are not commercially utilized although they can be used as cattle feed. A good quantity of

pods can be collected and preserved for cattle feeds which can increase feed resources. Many of the farmers in the Jessore region feed Babla pods to their cattle after soaking the pods overnight in water.

Neem Leaves and Seed cake

The *neem* tree grows well in Bangladesh. The crude protein and crude fiber contents are about 12 and 15% respectively. *Neem* has 6.2 digestible crude protein, and a total digestible nutrient value of 52.5%. About 7 kg. of *neem* leaves (DM basis) can maintain an adult buffalo.

Neem cake seed meal contains about 13% crude protein. In a study with cross–breed calves, it was found that 12.5% digestible crude protein of the concentrate mixture could be replaced with *neem* seed meal. It is not used as cattle feed in the country although it has good feed value.

Rubber seed cake

Rubber seed is available in fairly large quantities in the regions of Chittagong, Chittagong Hill Tracts, and Tangail. Chittagong and the Chittagong Hill Tracts have the maximum concentration of rubber plantations. The quantity of seed is estimated to be 50,000 tons annually during the months of July and August. However, the entire quantity available in the country is being wasted in the rubber plantations. The seed cake contains 25 to 28% crude protein, and TDN values from 54 to 78%. It can easily be utilized in cattle and poultry rations.

Table 1. Composition of different Urea Molasses Block presently used in Bangladesh

(in percentage)

Ingredient in the block	B–1	B–2	B–3	B–5
Molasses	56.0	60.0	60.0	50.0
Wheat bran	20.0	30.0	25.0	–
Rice bran	12.0	–	–	25.0
Til oil cake	–	–	–	10.0
Mineral mixture	–	3.75	–	–
Salt	1.0	0.35	–	5.0
Embavit	–	0.10	–	–
Lime	6.0	5.0	6.0	7.0
Urea	5.0	0.80	9.0	7.0

B–1 = Bangladesh Livestock Research Institute's composition used by "Mohona" Block manufacturer in Naogaon.

B–2 = "Poshu Pakhir Audhinik Chikissha's" composition used by 'Tripti' Block manufacturer in Naogaon and. The book is written by Dr. Sultan Mohiuddin, Deputy Director, DLS.

B–3 = Used by farmers in Bogra, Formula received from Dr. M. Saadullah, BAU, Mymensingh.

B–4 = Used by farmers under RDRS project area in Thakurgaon, as reported by Farming System Agribusiness, 1992. Vol. 3. No. 2. p6.

Bamboo Leaves

Bamboos grow in many parts of Bangladesh. About 90 to 150 metric tons of leaves could be obtained from one ha. of bamboo forest. The leaves are rich in protein. DCP and TDN values are 9.4 and 48.9%, respectively. The leaves are relished by animals, and can

form an important source of roughage for livestock. Farmers use bamboo leaves during feed scarcity periods to feed cattle.

Table 2. Comparison of supplements of Azolla (Azolla anabaena) and a cereal–based concentrate on the performance of Crossbred Heifers fed a basal diet of wheat straw and sugarcane tops.

	Concentrate[1]	Azolla[2]
Live weight gain, g/d	140	330
Organic matter digestibility, %	45	59
Feed intake, Kg DM/d		
Forage	2.1	2.1
Supplement	1.5	1.5
Feed/gain conversion ratio	26	9

Source: Singh, 1980.

1. Contain (g/kg); Maize, 650; rice bran, 150; Groundnut cake, 160; and Minerals, 40.

2. Collected from village ponds and dried. Protein content and nylon bag digestibility were 29% and 81%, respectively.

Table 3. Composition of Commonly Used Potential Livestock and Poultry Feed Resources in Bangladesh

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
Alfalfa (Lucerne)	As fed	21.20	4.28	5.29	0.66
(Medicago satifa)	Dry	100	20.19	24.95	3.10
Arhar (Pigeon pea)	As fed	88.25	19.47	8.08	1.53
(Cajanus cajan)	Dry	100	22.06	9.50	1.73
Arhar Bran[2]	As fed	90.9	10.03	38.33	0.59
	Dry	100	11.04	42.17	0.65
Azolla[2]	As fed	5.05	0.97	0.48	0.18
(Azolla pinnata)	Dry	100	19.29	9.50	3.49
Bamboo leaves	As fed	31.24	4.70	7.46	0.69
(Bambusa tulda)	Dry	100	15.05	23.88	2.21
Banana leaves	As fed	19.00	1.91	3.98	1.05
(Musa Sapientum)	Dry	100	10.03	20.95	5.53
Banyan Tree leaves	As fed	27.20	2.87	6.13	0.81
(Ficus bengalensis)	Dry	100	10.55	22.54	2.98
Barley grain	As fed	86.80	11.10	4.84	1.07
(Haraela vulgare)	Dry	100	12.79	5.58	1.23
Barseen	As fed	19.71	3.37	4.01	0.61
(Trifolium alexandrium)	Dry	100	17.10	20.35	3.09
Black gram (Mashkalai)	As fed	88.30	27.41	6.33	3.27
(Phaseolus Mungo)	Dry	100	31.04	7.17	3.70
Black gram plant	As fed	22.04	2.89	4.60	0.82
(Phaseolus mungo)	Dry	100	13.12	20.87	3.72
Black gram bran[2]	As fed	87.07	16.44	19.88	0.48
	Dry	100	18.89	22.83	0.55
Blood meal	As fed	89.30	79.01	0.50	1.41
	Dry	100	88.48	0.56	1.58
Bone meal[2]	As fed	92.51	16.19	3.27	4.80
(Cow)	Dry	100	17.50	3.53	5.19
Broiler offals[6]	As feed	90.00	56.39	2.16	19.8
	Dry	100	62.65	2.40	22.0
Bottle gourd leaves (Lau)	As fed	15.30	2.91	1.64	0.50
(Lagenaria vulgaris)	Dry	100	19.02	10.72	3.27

Table 3. **Composition of Commonly Used Potential Livestock and Poultry Feed Resources in Bangladesh**

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminant[1] ME Mcal/kg
8.66	2.31	0.74	0.06	3.2	13	384	0.53
40.85	10.91	3.49	0.28	15.1	60	1811	2.50
55.34	3.53	0.11	0.43	12.3	64	-	2.25
62.71	4.00	0.12	0.49	14.5	72	-	2.55
37.11	4.82	-	-	-	-	-	-
40.83	5.31	-	-	-	-	-	-
2.53	0.89	-	-	-	-	-	-
50.19	17.55	-	-	-	-	-	-
14.69	3.70	0.14	0.04	2.6	15	-	0.65
47.02	11.84	0.45	0.13	9.8	47	-	2.08
9.75	2.31	0.24	0.05	0.90	11	-	0.42
51.33	12.16	1.26	0.27	4.74	59	-	2.19
13.64	3.75	0.41	0.04	0.6	12	-	-
50.14	13.79	1.51	1.15	2.1	43	-	-
61.77	3.02	0.08	0.31	8.9	71	2580	2.58
76.93	3.47	0.09	0.36	10.3	82	2973	2.97
9.13	2.59	0.61	0.08	2.5	13	-	0.45
46.32	13.14	3.09	0.41	12.8	64	-	2.30
47.59	3.70	0.22	0.18	15.5	56	2493	2.81
53.90	4.19	0.26	0.20	17.6	64	2829	3.18
11.21	2.52	0.21	0.07	-	-	-	-
50.86	11.43	0.95	0.32	-	-	-	-
43.76	6.50	-	-	-	-	-	-
50.26	7.47	-	-	-	-	-	-
3.88	4.50	0.26	0.22	56.8	58	2790	3.24
4.34	5.04	0.30	0.25	63.7	65	3125	3.63
7.45	60.81	22.12	9.92	-		-	-
8.05	65.73	23.91	10.72	-		-	-
5.18	6.48	-			-	-	-
5.75	7.20	-	-	-	-	-	-
7.84	2.41	0.35	0.07	-	-	-	-
51.24	15.75	20.29	0.46	-	-	-	-

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
Cabbage (Outer leaves)	As fed	10.70	2.23	1.30	0.23
(Brassica Oleracea)	Dry	100	20.84	12.15	2.15
Carrot leaves	As fed	21.40	2.28	3.35	0.70
(Daucus carota)	Dry	100	13.19	15.66	3.26
Cassava Roots	As fed	36.70	1.07	1.87	0.35
(Manihot esculenta)	Dry	100	2.93	5.10	0.95
Cauliflower leaves (Brassica	As fed	13.80	2.80	1.81	0.57
oleracea var botrytis)	Dry	100	20.26	13.12	4.16
Chola/Gram/Chick pea/Bengal	As fed	91.71	20.15	9.23	2.71
gram (Cicar ariatenum)	Dry	100	21.97	10.06	2.95
Chola/Gram Bran (Fine)[2]	As fed	86.47	11.13	19.51	0.45
	Dry	100	12.87	22.56	0.52
Chola/Gram bran (coarse)[2]	As fed	86.47	11.13	28.08	0.45
	Dry	100	12.87	32.48	0.52
Chrishnachura leaf[8]	As fed	43.88	6.35	7.01	2.74
(Delonix regia)	Dry	100	14.46	15.98	6.25
Coconut oil cake	As fed	90.83	20.01	12.34	9.01
(Cocos nucifera)	Dry	100	22.03	13.59	9.92
Cotton seed oil cake[2]	As fed	90.51	18.01	24.11	8.91
	Dry	100	19.90	26.64	9.84
Cowpea plant	As fed	15.02	2.71	3.92	0.38
(Vigna unguiculata)	Dry	100	18.01	26.10	2.51
Cowpea seed	As fed	88.40	23.83	4.16	1.70
(Vigna unguiculata)	Dry	100	26.95	4.71	1.92
Crab meal[2]	As fed	29.32	9.37	3.26	2.28
	Dry	100	31.97	11.13	7.79
Data Shak	As fed	7.35	1.61	1.09	0.47
(Amaranthus ganeticus)	Dry	100	21.90	14.83	6.40
Dhancia leaves	As fed	25.60	6.62	3.51	1.15
(Sesbenia aculeata)	Dry	100	25.86	13.71	4.49
Duckweed (Kudipana)[2]	As fed	8.00	1.12	0.89	0.15
(Lemna minor)	Dry	100	14.02	11.08	1.92
Fish meal[2]	As fed	86.85	51.77	1.97	9.74
- A1 grade	Dry	100	59.61	2,27	11.22

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminant[1] ME Mcal/kg
5.53	1.41	0.06	0.04	1.5	7	294	0.23
51.68	13.18	0.56	0.37	14.4	67	2750	2.18
11.30	3.22	0.44	0.06	1.8	12	-	-
52.84	15.05	2.10	0.31	8.6	57	-	-
31.40	2.01	0.05	0.04	0.6	29	1222	1.14
85.54	5.48	0.14	0.11	1.7	79	3330	3.10
6.54	2.08	0.52	0.10	1.5	10	345	0.33
47.40	15.06	3.77	0.72	9.5	73	2496	2.37
56.62	3.00	0.20	0.37	13.3	73	2354	2.87
61.75	3.27	0.24	0.40	14.5	84	2578	3.13
42.20	4.61	-	-	-	-	-	-
48.80	5.33	-	-	-	-	-	-
42.20	4.61	-		-	-	-	-
48.80	5.33	-	-	-	-	-	-
25.21	2.57	-	-	-	-	-	-
57.46	5.85	-	-	-	-	-	-
43.36	6.12	0.24	0.69	17.6	75	1723	2.61
47.72	6.47	0.26	0.75	19.4	83	1897	2.87
34.58	4.89	0.20	0.28	12.4	71	1675	2.76
38.21	5.41	0.22	0.31	13.7	78	1850	3.05
5.92	2.09	0.19	0.03	2.0	9	-	0.35
39.40	13.98	1.29	0.20	13.4	60	-	2.33
54.93	3.78	0.12	0.37	19.0	75	2625	2.86
62.14	4.28	0.14	0.42	21.6	85	2970	3.24
2.69	11.71	-	-	-	-	-	-
9.18	39.94	-	-	-	-	-	-
3 0	1.08	0.10	0.02	-	-	-	-
42.18	14.69	1.36	0.27	-	-	-	-
12.36	1.98	0.20	0.09	1.15	15	-	0.56
48.20	7.73	0.90	0.35	4.51	59	-	2.19
4.87	0.97	-	-	-	-	-	-
60.88	12.10	-	-	-	-	-	-
3.26	19.77	5.08	2.77	48.20	66	2905	2.70
3.74	22.76	5.86	3.19	55.5	76	3345	3.11

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
- A2 grade	As fed	82.37	41.85	1.27	6.28
	Dry	100	50.81	1.54	7.62
- B grade	As fed	81.36	36.40	1.41	6.40
	Dry	100	44.74	1.73	7.87
Fish meal[3]	As fed	83.45	34.62	0.40	22.57
- A1 grade	Dry	100	41.49	0.48	27.05
- A2 grade	As fed	84.53	34.23	2.18	16.09
	Dry	100	40.50	2.58	19.04
Fish meal[3]	As fed	86.88	34.19	2.02	11.17
- B grade	Dry	100	39.35	2.32	12.86
Fish meal	As fed	88.00	54.43	0.60	9.82
(Superior quality)	Dry	100	61.85	0.68	11.16
Fish meal[3]	As fed	88.06	40.02	1.00	15.35
(Chewa + Fufa) 50% + 50%	Dry	100	45.45	1.14	17.43
Frog meal (Rana tigrina)[2]	As fed	82.20	57.27	1.48	13.54
	Dry	100	62.12	1.61	14.69
Grass, Bajra Napier	As fed	18.55	1.59	5.84	0.56
(Hybrid)	Dry	100	8.57	31.48	3.02
Grass, Baksha	As fed	23.09	2.08	7.33	0.47
(Digitaria spp.)	Dry	100	9.01	31.75	2.04
Grass, Dal	As fed	19.90	1.32	5.02	0.48
(Hymenachne pesudointerrupta)	Dry	100	6.65	25.22	2.41
Grass, Durba	As fed	22.95	2.03	5.47	0.52
(Cynodon dactylon)	Dry	100	8.85	23.83	2.27
Grass, Guinea	As fed	22.40	1.31	8.10	0.44
(Panicum maximum)	Dry	100	5.85	36.16	1.96
Grass, Jhora	As fed	23.50	1.10	6.80	0.51
(Oryza sativa var fatua)	Dry	100	4.68	28.94	2.17
Grass, Napier	As fed	19.71	2.00	6.51	0.47
(Pennisetum purpureum)	Dry	100	10.19	33.03	2.38
Grass, Pangola	As fed	23.21	2.24	7.31	0.52
(Digitaria decumbens stant)	Dry	100	9.65	31.50	2.24
Grass Para	As fed	22.22	2.40	6.50	0.52
(Brachiaria mutica)	Dry	100	10.80	29.25	2.34

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminant[1] ME Mcal/kg
11.65	21.33	-	-	-	-	-	-
14.14	25.89	-	-	-	-	-	-
13.68	23.46	-	-	-	-	-	-
16.82	28.84	-	-	-	-	-	-
13.95	11.90	0.65	0.02	-	-	-	-
16.72	14.26	0.78	0.03	-	-	-	-
13.09	18.93	1.74	0.25	-	-	-	-
15.49	22.39	2.06	0.30	-	-	-	-
17.65	21.86	2.67	0.56	-	-	-	-
20.31	25.16	3.08	0.65	-	-	-	-
5.14	18.01	5.19	2.82	49.1	68	2963	-
5.84	20.47	5.90	3.21	55.7	77	3367	-
12.99	15.47	3.22	1.36	-	-	-	-
14.75	17.57	3.66	1.54	-	-	-	-
9.56	10.34	-	-	-	-	-	-
10.37	11.21	-	-	-	-	-	-
8.40	2.16	0.06	0.08	0.8	10	-	-
15.39	11.64	0.31	0.42	4.5	56	-	-
10.33	2.88	0.09	0.06	-	-	-	-
44.74	12.47	0.39	0.26	-	-	-	-
9.90	3.18	0.14	0.07	0.6	10	-	-
49.75	15.97	0.70	0.35	2.9	52	-	-
12.00	2.93	0.12	0.07	0.89	11	-	0.42
52.28	12.77	0.52	0.30	3.86	49	-	1.82
9.50	3.05	0.10	0.07	0.7	11	-	0.38
42.41	13.62	0.45	0.31	3.3	51	-	1.74
11.09	4.00	0.08	0.06	-	-	-	-
47.01	17.02	0.34	0.26	-	-	-	-
8.54	2.19	0.09	0.06	1.2	11	-	0.39
43.28	11.11	0.46	0.30	6.3	55	-	1.98
11.41	1.73	0.09	0.08	-	-	-	-
49.16	7.45	0.39	0.34	-	-	-	-
10.43	2.37	0.07	0.08	1.3	12	-	0.46
46.94	10.67	0.32	0.36	6.1	56	-	2.06

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
Grass Road side (mixed)	As fed	20.75	0.95	7.64	0.44
	Dry	100	4.60	36.83	2.13
Ground nut cake	As fed	91.41	40.12	11.91	7.63
(Arachis hypogaea)	Dry	100	43.89	13.03	8.35
Guava leaves[8]	As fed	40.37	4.67	6.78	1.28
	Dry	100	11.57	16.80	3.18
Hatchery waste[6]	As fed	82.00	21.32	6.97	7.38
	Dry	100	26.00	8.50	9.00
Halencha Shak	As fed	10.90	1.46	1.56	0.20
(Enhydra Fluctuans)	Dry	100	13.39	14.31	1.83
Ipil-ipil leaves	As fed	26.39	6.53	3.79	1.50
(Lucuaena leucocaphala)	Dry	100	24.25	14.07	5.07
Jiga tree leaves	As fed	24.30	3.08	3.46	1.12
(Odina wodier)	Dry	100	13.25	7.97	6.29
Jackfruit tree leaves	As fed	30.30	3.68	4.85	0.95
(Artocarpus haterophyllus)	Dry	100	12.24	19.46	3.16
Jackfruit waste[7]	As fed	44.97	4.12	9.66	0.92
(without stem)	Dry	100	9.25	21.49	2.05
Kata Note (Khure kata)	As fed	13.05	2.55	2.50	0.40
Amaranthus spinous)	Dry	100	19.54	19.16	3.07
Khesari grain	As fed	91.10	27.91	7.48	1.15
(Lathyrus sativus)	Dry	100	30.64	8.21	1.26
Khasari bran[2]	As fed	87.83	10.60	33.17	1.01
	Dry	100	12.07	37.77	1 15
Khesari plant	As fed	18.20	3.50	4.67	0.30
	Dry	100	19.23	25.66	1.65
Khol-khol leaves	As fed	13.04	3.07	1.76	0.45
(Brassica Oleracea)	Dry	100	23.54	13.50	3.45
Kitchen waste[6]	As fed	89.80	21.40	8.76	12.57
	Dry	100	23.84	9.75	14.00
Kul leaves[6]	As fed	91.40	17.37	16.63	2.63
(Zyzyphus tajuba)	Dry	100	19.0	18.20	2.88
Lal Shak	As fed	10.02	3.01	1.28	0.19
(Amaranthus mangostanus)	Dry	100	33.03	12.77	4.89

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminant[1] ME Mcal/kg
8.94	2.78	0.10	0.01	0.6	12	-	-
43.04	13.40	0.48	0.05	2.7	56	-	-
25.91	5.34	0.19	0.60	36.6	76	2475	3.12
28.34	6.39	0.21	0.66	40.1	83	2708	3.42
24.89	2.74	-	-	-	20	-	0.74
61.66	6.79	-	-	-	50	-	1.84
38.13	8.69	-	-	-	-	-	-
46.50	10.60	-	-	-	-	-	-
6.57	1.11	0.09	0.04	-	-	-	-
60.28	10.18	0.83	0.37	-	-	-	-
12.45	2.66	0.70	0.08	4.1	15	-	0.77
46.23	9.88	2.60	0.30	15.1	56	-	2.93
14.22	2.42	0.39	0.07	-	-	-	-
61.87	10.62	1.44	0.26	-	-	-	-
16.13	3.69	0.21	0.04	2.57	13	-	0.55
52.86	12.28	1.67	0.17	8.51	43	-	1.48
2.70	27.5	-	-	-	-	-	-
6.01	61.2	-	-	-	-	-	-
5.31	2.29	0.40	0.12	-	-	-	-
40.68	17.55	3.07	0.92	-	-	-	-
51.35	3.21	0.11	0.56	20.8	69	-	-
56.37	3.52	0.13	0.61	22.9	76	-	-
36.19	6.85	-	-	-	-	-	-
41.21	7.80	-	-	-	-	-	-
6.68	3.05	0.20	0.09	-	-	-	-
36.70	16.76	1.10	0.49	-	-	-	-
6.39	1.37	0.46	0.09	-	-	-	-
61.80	10.51	3.53	0.69	-	-	-	-
23.72	23.35	-	-	-	-	-	-
26.41	26.00	-	-	-	-	-	-
43.05	11.70	-	-	-	-	-	-
47.10	12.80	-	-	-	-	-	-
3.63	1.91	0.26	0.04	-	-	-	-
30.25	19.06	2.60	0.40	-	-	-	-

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
Linseed oil cake (Linum usitatissimum)	As fed	90.52	30.45	8.61	6.08
	Dry	100	33.64	9.51	6.72
Maize grains (Zea mays)	As fed	90.21	9.27	2.50	3.52
	Dry	100	10.28	2.77	3.90
Maize plant	As fed	22.10	1.57	5.95	0.35
	Dry	100	7.10	26.92	1.58
Mander tree leaves (Erythrina spp.)	As fed	16.13	4.51	2.23	1.27
	Dry	100	27.94	13.18	7.93
Mango tree leaves (Mangifera indica)	As fed	31.09	2.91	8.26	1.02
	Dry	100	9.36	26.57	3.28
Mango seed kernel[7] (Waste)	Dry	100	4.56	10.44	3.56
Masur bran[2] (Lens cultnaris)	As fed	84.33	16.40	21.81	0.40
	Dry	100	19.45	25.86	0.47
Meat meal	As fed	92.02	62.33	0.71	18.22
	Dry	100	67.73	0.78	19.80
Meat of Snail	As fed	19.26	11.65	0.0	1.75
	Dry	100	59.38	0.0	8.92
Meat of Oyster	As fed	19.48	11.40	0.0	1.17
	Dry	100	58.52	0.0	6.01
Milk, Skim dehydrated	As fed	93.96	33.40	0.0	1.00
	Dry	100	35.55	0.0	1.06
Molasses (Cane)	As fed	74.81	3.10	0.0	0.0
	Dry	100	4.14	0.0	0.0
Mung bran[2] (Vigna mengo)	As fed	88.93	12.50	20.52	0.59
	Dry	100	14.06	23.07	0.66
Mung bean/Green gram[3] (Vigna radiata)	As fed	88.93	12.50	20.51	0.58
	Dry	100	14.06	23.07	0.66
Mung bean dust[3]	As fed	91.40	17.27	18.21	2.48
	Dry	100	18.90	19.92	2.71
Mustard oilcake	As fed	89.51	32.02	8.24	11.34
	Dry	100	35.76	9.21	12.67
Mustard oilcake[2] - Mill (Brassica spp.)	As fed	85.54	25.94	10.37	11.50
	Dry	100	30.33	12.12	13.44

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminant[1] ME Mcal/kg
35.28	10.10	0.39	0.09	26.5	73	1648	2.18
38.97	11.16	0.43	0.10	29.3	81	1821	3.11
73.23	1.69	0.20	0.10	7.1	83	3335	3.01
81.18	1.87	0.22	0.12	7.9	92	3697	3.34
12.59	1.64	0.12	0.06	1.0	15	-	0.50
56.97	7.42	0.54	0.27	4.4	66	-	2.24
6.32	1.88	0.60	0.05	-	-	-	0.45
39.19	11.13	3.74	0.34	-	-	-	2.80
14.77	4.13	0.49	0.05	1.89	8	-	0.22
47.51	13.28	1.58	0.16	6.0	26	-	0.70
81.33	0.09	-	-	-	-	-	-
39.54	6.18	-	-	-	-	-	-
46.89	7.33	-	-	-	-	-	-
7.76	3.00	0.01	0.17	58	89	2287	3.32
8.43	3.26	0.01	0.18	63	97	2485	3.61
4.01	2.21	1.21	0.12	-	-	-	-
20.44	11.26	6.17	0.61	-	-	-	-
3.69	2.95	0.64	0.19	-	-	-	-
20.33	15.14	3.28	0.98	-	-	-	-
51.75	7.81	1.27	1.02	30.1	86	3009	2.06
55.08	8.31	1.35	1.08	32.0	92	3202	2.52
63.98	7.73	0.91	0.09	1.0	63	1952	2.67
85.52	10.33	1.22	0.12	1.4	84	2610	3.57
49.04	6.29	-	-	-	-	-	-
55.14	7.07	-	-	-	-	-	-
49.03	6.28	-	-	-	-	-	-
55.14	7.07	-	-	-	-	-	-
47.09	6.35	1.03	0.52	-	-	-	-
51.52	6.95	1.12	0.57	-	-	-	-
28.31	9.60	0.67	0.19	22.4	64	1969	-
31.63	10.73	0.75	0.21	25.0	72	2200	-
29.41	8.32	0.64	0.18	18.13	62	1924	2.59
34.38	9.73	0.75	0.21	21.20	72	2250	3.03

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
- Ghani	As fed	86.07	21.74	8.17	10.91
	Dry	100	25.26	9.49	12.67
- Oats	As fed	87.10	9.59	11.02	4.24
(Avena sativa)	Dry	100	11.02	12.65	4.87
Oyestershell (Clam)[2]	As fed	98.91	2.09	4.14	2.86
(Lamellidens Corrianus)	Dry	100	2.11	4.19	0.29
Paddy	As fed	90.42	7.20	9.09	1.90
(Oryza sativa)	Dry	100	7.96	10.05	2.10
Pea bran[3]	As fed	88.83	9.31	36.54	0.94
(Pisum sativum)	Dry	100	10.48	41.14	1.06
Pea (Motor)	As fed	86.50	21.14	5.80	1.50
(Pisum sativum)	Dry	100	24.44	6.17	1.73
Pineapple Peelings	As fed	10.73	0.51	2.06	0.12
(Ananas comosus)	Dry	100	4.71	19.20	1.15
Pineapple waste[6]	As fed	80.00	4.36	12.82	3.48
	Dry	100	5.45	16.06	4.35
Potato, fresh[2]	As fed	29.84	3.28	1.12	0.11
-White	Dry	100	11.31	3.86	0.38
_ Red	As fed	24.68	1.93	0.53	0.25
	Dry	100	7.80	2.13	1.00
- HYV	As fed	22.94	2.55	0.53	0.10
	Dry	100	11.10	2.31	0.45
Poultry Droppings[6]	As fed	89.06	17.99	10.69	1.60
	Dry	100	20.21	12.00	1.80
Pui Shak	As fed	9.30	2.20	1.67	0.12
(Basella rubra)	Dry	100	23.66	17.96	2.26
Pulse Husk (mixed)	As fed	88.70	8.61	37.49	0.26
	Dry	100	9.51	42.27	0.29
Radish leaves	As fed	9.20	2.64	1.52	0.46
(Raphanus sativus)	Dry	100	28.70	16.52	5.33
Rice	As fed	89.03	8.10	0.92	1.23
(Oryza sativa)	Dry	100	9.10	1.03	1.38

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminants[1] ME Mcal/kg
38.55	6.70	0.61	0.17	15.40	61	1962	-
44.79	7.79	0.72	0.20	17.90	71	2280	-
58.31	3.94	0.12	0.30	7.3	66	-	2.59
66.94	4.52	0.14	0.34	8.4	76	-	2.97
1.19	91.20	-	-	-	-	-	-
1.20	92.21	-	-	-	-	-	-
66.67	5.56	0.04	0.24	-	-	-	-
73.74	6.15	0.05	0.27	-	-	-	-
39.14	2.90	-	-	-	-	-	-
44.06	3.26	-	-	-	-	-	-
55.40	2.66	0.08	0.35	18.2	74	-	-
64.05	3.07	0.09	0.04	21.0	86	-	-
7.66	0.38	0.02	0.01	-	-	-	-
71.43	3.51	0.17	0.12	-	-	-	-
54.34	5.00	-	-	-	-	-	-
67.93	6.25	-	-	-	-	-	-
32.21	1.32	0.03	0.18	-	23	-	0.91
79.92	4.53	0.12	0.60	-	79	-	3.05
20.96	1.03	-	-	-	-	-	-
84.91	4.16	-	-	-	-	-	-
18.56	1.21	-	-	-	-	-	-
80.87	5.72	-	-	-	-	-	-
44.17	14.61	-	-	-	-	-	-
49.60	16.40	-	-	-	-	-	-
3.70	1.52	0.12	0.07	-	-	-	-
39.78	16.34	1.29	0.75	-	-	-	-
38.61	12.73	0.41	0.11	-	-	-	-
43.53	14.20	0.46	0.13	-	-	-	-
2.83	1.72	0.25	0.05	-	-	-	-
30.75	18.70	2.72	0.54	-	-	-	-
77.78	1.00	0.05	0.24	6.1	72	2669	2.70
87.37	1.12	0.06	0.27	6.8	80	2998	3.03

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
Rice polish	As fed	89.50	12.12	3.10	13.10
	Dry	100	13.54	3.46	14.64
Rice Bran	As fed	91.49	12.01	11.97	13.10
	Dry	100	13.13	13.08	14.32
Rice bran[2]	As fed	90.71	4.40	21.73	5.91
- Aus	Dry	100	4.85	23.96	6.52
- Pajam	As fed	88.33	5.53	21.95	9.23
	Dry	100	61.26	24.85	10.45
- Boro	As fed	91.53	5.10	19.09	7.36
	Dry	100	5.57	20.86	8.04
- Irri 8	As fed	89.47	5.54	16.64	9.15
	Dry	100	6.19	18.60	10.23
- Irri 20	As fed	89.47	3.67	12.87	9.49
	Dry	100	4.10	14.38	10.61
Rice bran[2]	As fed	87.03	7.78	20.39	0.81
(De-oiled)	Dry	100	8.94	23.44	0.94
Rumen ingesta[6]	As fed	88.00	6.54	29.92	5.50
	Dry	100	7.43	34.00	6.25
Sajna leaves (Drumstick)	As fed	22.65	2.93	4.08	0.58
(Moringa oleifera)	Dry	100	12.96	18.01	2.58
Salseed meal[3]	As fed	90.40	9.40	3.10	2.60
(Shorea robusta)	Dry	100	10.40	3.40	2.90
Sal tree leaves[8]	As fed	39.39	3.19	12.08	1.04
	Dry	100	8.11	30.64	2.63
Sesame (Til) oil caka	As fed	91.30	31.47	7.39	7.96
(Seeamum indicum)	Dry	100	34.47	8.09	8.72
Shirmp meal[2]	As fed	21.76	6.93	4.70	0.28
(Golda)	Dry	100	31.85	21.61	1.28
Silk worm (Bombyx mori)[2]	As fed	31.53	16.54	1.95	7.32
(Pupae)	Dry	100	52.46	6.17	23.23
Slaughterhouse waste[2]	As fed	18.53	9.56	0.31	3.92
(Cow)	Dry	100	51.60	1.69	21.14

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminants[1] ME Mcal/kg
51.73	9.45	0.05	1.40	9.2	81	2864	3.03
57.70	10.56	0.06	1.56	10.3	91	3201	3.38
42.36	11.45	0.08	1.82	8.2	60	1482	-
46.95	12.52	0.09	1.99	9.0	66	1620	-
42.55	16.11	0.13	2.54	3.02	50	1400	1.99
46.91	17.76	0.74	2.81	3.33	56	1544	2.19
37.13	14.43	0.13	2.52	3.00	53	1600	2.44
42.04	16.40	0.15	2.85	3.40	60	1811	2.76
42.49	17.40	0.16	2.61	2.84	51	1449	2.01
46.42	19.11	0.17	2.85	3.10	56	1583	2.20
42.10	16.04	0.11	2.52	2.95	54	1500	2.08
47.05	17.33	0.13	2.82	3.30	60	1677	2.33
47.88	15.57	0.14	2.51	2.51	55	1500	2.08
53.51	17.40	0.16	2.80	2.81	62	1677	2.33
42.05	15.97	-	-	-	-	-	-
48.32	18.36	-	-	-	-	-	-
32.62	13.42	-	-	-	-	-	-
37.07	15.25	-	-	-	-	-	-
12.15	2.91	0.39	0.06	2.5	14	-	
53.59	12.86	1.72	0.26	11.3	61	-	-
72.00	3.30	0.22	0.14	-	-	2799	-
79.60	3.70	0.24	0.16	-	-	3096	-
21.15	1.94	-	-	-	27	-	1.00
53.70	4.53	-	-	-	69	-	2.55
31.88	12.60	2.08	1.12	28.3	69	1937	3.03
34.92	13.80	2.28	1.23	31.0	75	2122	3.32
2.45	7.40	-	-	-	-	-	-
11.26	34.00	-	-	-	-	-	-
3.41	2.31	-	-	-	-	-	-
10.81	7.33	-	-	-	-	-	-
2.42	2.32	-	-	-	-	-	-
13.04	12.53	-	-	-	-	-	-

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
Slaughterhouse waste[2] (Goat)	As fed	20.40	9.28	0.44	2.85
	Dry	100	45.50	2.16	13.98
Slaughterhouse waste[2] (Chicken)	As fed	22.71	13.53	0.43	4.04
	Dry	100	59.58	1.91	17.78
Snail meal Mussels[2] (Pila spp.)	As fed	43.36	9.11	0.75	0.53
	Dry	100	21.00	1.75	1.22
Sorgham (Joar) (Sorghum vulgare)	As fed	89.30	10.18	3.40	3.08
	Dry	100	11.40	3.81	3.45
Soybean seed (Clycine max G. Soya)	As fed	89.20	37.52	5.61	14.45
	Dry	100	42.06	6.29	16.20
Soybean meal extracted	As fed	89.42	43.13	6.10	4.87
	Dry	100	48.23	6.83	5.45
Soybean meal (salvent, non-dehulled)	As fed	89.60	44.0	7.0	0.50
	Dry	100	49.11	7.81	0.56
Soybean meal (dehulled)	As fed	89.30	48.0	3.5	1.0
	Dry	100	53.75	3.9	1.1
Soybean meal (Expeller)	As fed	89.00	42.0	6.5	3.5
	Dry	100	47.2	7.3	3.9
Soybean Meal[5] (Indian)	As fed	89.9	37.48	5.7	19.06
	Dry	100	41.70	6.3	21.2
Soybean oil[5]	As fed	-	0.0	0.0	0.0
	Dry	-	0.0	0.0	100.0
Spinach (Spinacia oleracea)	As fed	7.90	2.43	0.80	0.23
	Dry	100	30.75	10.13	2.91
Stillage[3]	As fed	10.45	1.22	-	-
	Dry	100	11.64	-	-
Straw, Paddy (Local) (Oryza sativa)	As fed	89.50	3.50	32.15	1.23
	Dry	100	3.91	35.92	1.37
Straw, Paddy[4] (Urea treated)	As fed	85	5.53	20.4	0.85
	Dry	100	6.50	24.0	1.00
Straw, Paddy (HYV)[9]	As fed	90.00	2.83	36.76	1.24
	Dry	100	3.14	40.84	1.38

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminants[1] ME Mcal/kg
6.62	1.21	-	-	-	-	-	-
32.45	5.91	-	-	-	-	-	-
3.17	1.54	-	-	-	-	-	-
13.94	6.79	-	-	-	-	-	-
15.50	17.47	-	-	-	-	-	-
35.74	40.29	-	-	-	-	-	-
70.54	2.10	0.03	0.30	7.5	79	2362	2.86
78.99	2.35	0.03	0.38	8.4	89	2645	3.21
26.17	3.45	0.28	0.67	33.4	84	3131	3.46
29.33	3.87	0.31	0.75	37.4	94	3510	3.89
29.00	6.30	0.31	0.65	36.1	76	2657	3.03
32.44	7.05	0.35	0.73	40.4	85	2971	3.39
32.10	6.0	0.25	0.60	-	81	1760	2.96
35.83	6.7	0.28	0.70	-	90	1964	3.30
30.8	6.0	0.20	0.65	-	-	2400	-
34.5	6.7	0.22	0.73	-	-	2688	-
31.0	6.0	0.29	0.68	-	-	2440	-
34.8	6.7	0.32	0.76	-	-	2742	-
23.37	4.31	0.32	0.80	-	-	2421	-
26.0	4.80	0.36	0.90	-	-	2694	-
0.0	0.0	0.0	0.0	-	-	-	-
0.0	0.0	0.0	0.0	-	-	8000	-
2.73	1.71	0.11	0.03	-	-	-	-
34.56	21.65	1.39	0.38	-	-	-	-
-	2.68	-	-	-	-	-	-
-	25.60	-	-	-	-	-	-
39.33	13.29	0.30	0.12	0.2	38	-	1.75
43.95	14.85	0.34	0.13	0.3	43	-	1.96
-	10.2	0.29	0.11	2.55	38	-	1.75
-	12.0	0.34	0.13	3.0	45	-	2.06
39.31	9.86	0.31	0.13	0.22	37	-	1.67
43.68	10.96	0.35	0.15	0.24	42	-	1.85

Name	Average Chemical Composition in Percent				
	Basis	Dry matter	Crude Protein	Crude Fiber	Ether Extract
Straw wheat	As fed	90.20	3.37	35.09	1.41
	Dry	100	3.74	38.90	1.56
Sugarcane tops	As fed	27.09	1.52	9.02	0.46
(Saccharum officinarum)	Dry	100	5.60	33.30	1.70
Sugarcane bagasse (wet)	As fed	66.60	1.97	27.03	0.43
	Dry	100	2.96	40.59	0.65
Sunhemp leaves	As fed	18.50	5.17	2.74	1.10
	Dry	100	30.86	15.03	5.95
Sweet potato plant	As fed	20.00	0.92	4.29	0.67
(Ipomoea batatas)	Dry	100	14.60	21.45	3.85
Tea waste[6]	As fed	82.00	14.76	10.41	17.22
	Dry	100	18.00	12.69	21.00
*Urea 45 Nitrogen, 281%	As fed	99	281.7	0.0	0.0
protein equivalent	Dry	100	285.0	0.0	0.0
Water hyacinth	As fed	7.86	0.72	1.26	0.16
	Dry	100	9.16	16.03	2.04
Water hyacinth - Dwarf size	As fed	14.27	1.53	2.60	0.31
(Whole plant)	Dry	100	10.73	18.20	2.20
(Eichhornia crassipes)					
Water hyacinth	As fed	16.73	1.78	3.22	0.44
- Tall size	Dry	100	10.62	18.04	2.61
Wheat (grain)	As fed	89.40	12.80	3.01	1.60
(Tritioum aestisum)	Dry	100	14.32	3.37	1.79
Wheat bran[3]	As fed	89.33	13.02	8.67	3.69
- Fine	Dry	100	14.57	9.71	4.43
- Coarse	As fed	87.32	11.28	9.24	3.94
	Dry	100	12.92	10.58	4.51

N.F.E. = Nitrogen Free Extract; Ca = Calcium;
P = Phosphorus; ME = Metabolizable Energy;
Kcal = Kilocalorie; Kg = Kilogram;
DCP = Digestible Crude Protein; TDN = Total Digestible Nutrients;
Mcal = Megacalories

				Nutritive value			
N.F.E.	Ash	Ca	P	DCP %	TDN %	Poultry ME (Kcal/Kg)	Ruminants[1] ME Mcal/kg
43.87	7.76	0.20	0.10	0.3	40	-	-
48.63	8.60	0.22	0.11	0.3	44	-	-
14.48	1.61	0.14	0.06	0.7	15	-	0.50
53.45	5.49	0.52	0.22	2.7	56	-	1.86
30.95	6.21	0.23	0.18	-	43	-	1.77
46.47	9.33	0.35	0.27	-	65	-	2.66
6.69	2.22	0.19	0.06	-	-	-	-
36.16	12.00	1.03	0.32	-	-	-	-
9.20	2.93	0.26	0.11	-	14	-	0.51
45.96	14.65	1.30	0.55	-	68	-	2.57
32.17	7.45	-	-	-	-	-	-
39.23	9.08	-	-	-	-	-	-
0.0	0.0	0.0	0.0	-	-	-	-
0.0	0.0	0.0	0.0	-	-	-	-
4.56	1.16	0.12	0.03	0.2	4	-	-
58.02	14.75	1.53	0.38	2.2	50	-	-
8.27	1.56	0.25	0.10	-	9	-	0.32
57.98	10.89	1.72	0.68	-	60	-	2.27
9.77	1.72	0.28	0.110.66	-	10	-	0.39
58.41	10.32	1.70		-	61	-	2.31
70.00	1.92	0.08	0.44	10.0	79	2968	2.75
78.37	2.15	0.09	0.49	11.2	88	3320	3.08
59.28	4.40	0.13	1.01	10.63	63	1172	2.24
66.36	4.93	0.15	1.13	11.90	71	1313	2.51
58.32	4.54	0.13	1.04	8.70	61	1178	2.17
66.79	5.20	0.16	1.20	10.00	70	1350	2.48

N.F.E.= Nitrogen Free Extract; Ca = Calcium;
P = Phosphorus; ME = Metabolizable Energy;
Kcal = Kilocalorie; Kg = Kilogram;
DCP = Digestible Crude Protein; TDN = Total Digestible Nutrients;
Mcal = Megacalories.

- Data not available

Sources: All unreferenced data are from Mahatab, et.al. 1980.

1. Adopted from "Nutrient Requirements of Ruminants in Developing Country," Kearl, 1982, by applying local values obtained through proximate analysis.

2. Adopted from "Survey of potential fish feed ingredients of Bangladesh on the basis of their availability and biochemical composition" Fisheries Research Institute and Bangladesh Agricultural Research Council, Dhaka. (Bhuiyan et.al. 1989) As fed basis derived by calculations.

3. Huque and Ukil, 1990, and BLRI (unpublished sample analysis).

4. Tareque, A.M.M. (Personal communication).

5. Feed Reference Standards, 1990. Philippines Society of Animal Nutritionists.

6. Hossain, et.al. 1989.

7. Tareque and Haque, 1986.

8. BLRI, 1991.

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