

## **Dairy Development (Cattle Nutrition and Fodder Crop Production)**

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## Executive Summary

### **Dairy Development (Cattle Nutrition and Fodder Crop Production).**

Bangladesh is a small country of 143,999 square kilometres with a large population, 122 million, mainly, 65%, dependent on agriculture. Much of the land is flooded in the wet season, and where possible the land is cropped two or rarely three times annually. Cropping intensity is 180%.

There are about 25 million cattle and 10 million small ruminants, dependent mainly on crop residues, fallow grazing and grazing, browse or cut fodder from waste, public and fallow lands.

BRAC has, for some years, been providing credit to landless and poor people, principally women, to purchase cattle for milk production and goats for meat production. Presently there are about 70,000 of each. All are "landless" ie. owning less than 0.5 acres of land. This number should continue to increase at 16,000 per year.

Grazing is generally restricted to the dry season. Few fodder crops are presently grown. No improved management of common lands is practised. Crop residues are fed with some "concentrates," usually unmodified agro-industrial by-products.

Most animals [ 21.5 million cattle] are local Desi, unproductive but undemanding. Traditionally livestock are kept for draft, as a hedge against disaster, for slaughter and for domestic milk production.

There is a deficit of fodder, there is certainly evidence of malnutrition in the traditional herds and flocks. Some potential fodder is used as fuel, for buildings or wasted because it is not possible to collect and conserve it.

If cattle are to be used for milk production they will need to be of genetically improved type [including *bos indicus* ] these will need a higher standard of nutrition and management than the Desi. The policy for the use of improved breeds should be the subject of a separate consultancy.

The main potential for improvement of fodder production and use is treatment of straws and stovers. Second potential is the planned and proper use of concentrates and supplements including urea / molasses blocks. The third is the improved use and conservation of straws and stovers.

The potential for the production and use of fodder crops is limited by existing land use, land type and availability. There is scope for the planting of small fodder banks in homesteads and on boundaries. There is some scope for the production of short term fodder crops in seasonal fallows. There is limited scope for the improvement of waste land used for grazing, both through planned management and through the introduction of improved species.

Finally there is scope to improve production from ruminant livestock through stimulating the interest of the owners in better management practices through demonstration and discussion. This will be best achieved by forming local producers associations of 40 to 50 people to act as a focus for the introduction of better management and feeding practices and using participatory planning to define aims for development of the subsector.

It is proposed that BRAC ;

Forms producers groups

Demonstrates improved use and storage of the available feed stuffs

Purchases, stores, demonstrates the uses of, and ultimately, if demand exists, compounds concentrate feeds; it is understood that there are already plans to increase the capacity of the BRAC feed mills for this purpose

Obtains, demonstrates, multiplies and distributes seed, vegetative material and saplings of different varieties of seasonal and permanent fodder crops, and demonstrates their husbandry, management and use, over a four to five year period, taking into account the wishes of the farmers with relation to their aims.

BRAC should also, establish base line data so that progress can be quantified and impact assessment carried out. Send technical and professional staff for appropriate training, probably overseas, in fodder production and small scale milk production in the tropics. Train local staff and volunteers in the techniques of production and management to be demonstrated. Continue to provide an expanding and secure market for the milk produced by small rural producers, so that they can compete with producers serving urban markets for raw materials.

The above initiatives, if constantly monitored for acceptability and viability should ensure that BRAC can continue to support a sustainable livestock production enterprise among the homeless and poor of Bangladesh; enabling them to generate income and improve their economic status.

## Main Report

### **Background / introduction.**

During the mission, in addition to various meetings in BRAC and IFDC for briefing and to meet the different interested persons.

*Field visits were carried out to Manikganj, Mizrapur, Balirtek, Kwalipura and the Bangladesh Livestock Research Institute, the state owned dairy farm, Bangladesh Agricultural University, a regional fodder crop seed production station, one of the BRAC owned feed mills and the BRAC milk processing factory. Between the 14th and the 26th of February small demonstrations of the Ammonia / urea treatment of straw and silage preparation from green maize were mounted at Manikganj. Plots of vegetatively propagated Napier grass, Para grass and German grass [ *Pennisetum purpureum*, *Brachiaria mutica* and *Echinochloa crusgalli* ] were planted at Manikganj in order to demonstrate the multiplication of planting material. Unfortunately the site is not very suitable for the propagation of German grass but is, apparently, the only one available at short notice. Subsequently visits were made to the south of the country in the areas of Barisal and Patukhali, and to the north including Berna, Pabna, Rangpur and Nilphamary, and in the north to Rajshahi. A demonstration of urea/ammonia treated straw was mounted at short notice at Kishorigange. After returning to Dhaka a subsequent visit was made to BARC to meet Dr Shahjahan. The regional fodder crop multiplication centre at Rajshahi was also visited.*

In the field BRAC offices BRAC supported model cow rearers and model goat rearers were interviewed. Paravets [ BRAC ] and AI stations [ BRAC ] were also visited. An anti anthrax vaccination campaign at village level was seen. Some farmers were seen who are cultivating Napier grass, Para grass and forage oats. All professed to be satisfied with the fodder grown and said that milk yields with cultivated fodder are improved.

## **Present situation.**

Country wide there are about 70,000 each of cow and goat rearers supported by BRAC credit schemes. Typically in the Thanas [ areas ] visited there have been about 175 of each, from a total population of 250 to 500,000 people [ 50,000 to 100,000 families] and a total cattle population of in the region of 100,000 and goat population of 40 to 50,000 per thana. [ Obviously the range is large but these numbers are typical] .

The criteria for BRAC support are basically indicators of poverty. Less than 0.5 acre of land per capita or family member and the sale of labour by the beneficiary for a minimum of 100 days per year.

About 98 % of the credit for livestock ownership is requested and given to women. 15% interest is charged [ which is in line with commercial rates] and the loan, including interest is repayable in 46 weekly instalments, in just under a year. Once the initial loan has been repayed a further loan may be requested.

The climate of Bangladesh makes the production of fodder and forage crops all the year round feasible, although growth in the winter will be less rapid than growth in the summer season. The lack of land of the BRAC target groups makes it unlikely that they will ever be able to produce sufficient fodder to meet their own requirements.

The high rainfall and warm, humid conditions which are met with during much of the year makes the conservation of green fodder crops, especially on a small scale, problematic.

There are, however, fertile crop lands, in the main producing more than one crop per year of pulse and grain crops. Cropping density is about 180%. Some of the crop residues and aftermaths are presently used as a major source of fodder, but up to half the rice straw is either burned as fuel or used for construction, it is proposed that it will be better used as fodder. This can be achieved both by using more straw as fodder and by treating the straw to improve its feeding value.

## Livestock.

Cattle are very mixed. Local [ Desi ] cattle are small and have little potential as dairy animals. They are used for draft, meat and milk production, where it is estimated that they will yield about 2 to 300 litres in a 200 day lactation, with the calf being allowed to suckle part of the time. If the calf is not suckled, there is a let down problem. That is the animal will not release its milk to a milker. The calving interval in the Desi is reported to be about 2 years and often longer. Poor nutrition may be a cause of such protracted interval between calves, as may suppression of oestrus whilst lactating, and seasonal oestrus. Examples of cows seen will seldom exceed 200 kg live weight, the rule being less than 180 kg in the Desi, with the mature males being about 200 to 250 kg in weight, generally at the lower end of this range. A number of dairy breeds are being introduced through AI, the semen reportedly being from F1 crosses of Sahiwal, Sindhi and Fresian / Holstein being used on the Desi. Many of the cows seen obviously have some exotic blood, and are often very much larger than the Desi, the progeny frequently appear to contain an uncertain mixture of breeds. Farmers express preferences for various dairy breeds, but the AI stations are often unable to supply the first preference of semen on a specific day. Some farmers interviewed did not know the type of bull of which the semen has been used, having only a reference number on the inseminators receipt. [ It is estimated that from a cattle population of about 25 million 3.5 million are " improved and cross bred". ]

By and large the conventional wisdom is that, if properly fed, the *bos indicus* crosses [ quarter bred] yield in the region of 800 litres per lactation and the Holstein crosses are reported to yield in the region of 1,500 or more. Both these estimated quantities are derived from word of mouth reports from small samples. It is evident that there is awareness and desire to use dairy breeds to improve income generation through milk sales. The perceived disadvantages of the use of the Holstein cross semen are high preweaning calf mortality and dystocia. The Holstein cross is also perceived to require more fodder. The lack of a hump on the *Bos Taurus* and its crosses is disadvantageous for traditional draft harness. Advantages are perceived to be higher value of female progeny and higher potential milk yield.



No mention was made of the value of male progeny, though if reared for slaughter the larger carcass must command a higher price in urban markets. No mention was made of the quality of milk from different breeds. Twice a day milking is the rule, with calves being allowed to suckle at certain times. Lactations are from [ about ] 200 days to 300 or more days duration depending on the breed, and on feed availability. Calving intervals are reported to be 13 to 15 months, by BRAC beneficiaries and other milk producers, this seems over optimistic. Cows are dried off for 3 months or more before parturition, although some owners reported a shorter period.

The goats seen are Desi or Black Bengal breed. The Desi breed is small, if not a dwarf breed, and prolific, twins and triplets are common and singletons and quadruplets less so. Typically breeding is reported to be about three litters every two years. They are kept exclusively for meat and skin production, though on rare occasions when progeny are lost before weaning, they may be milked, yielding up to a reported 1 litre daily.

The proposal of the possible introduction of milk goats aroused some professed interest. However the relatively low prolificacy and long interval between litters will have to be seen to be offset by the value of the milk, and the greater carcass size of the majority of milk breeds.

Some sheep were seen, sometimes with goat flocks, but BRAC is not at present promoting sheep production, and they are less popular than goats.

## Fodder.

Few of the target farmers have sufficient cultivable land to produce significant quantities of fodder crops. Many have only "homestead" land which, in general, is not cultivated.

At certain times of the year crop aftermaths are grazed, and the information obtained is that aftermaths left in the field are "free for all" to graze, irrespective of the ownership of the land.

Unimproved road and riverside grazing is also available at some times of the year. Because of the limited area, these areas are overgrazed and the natural grass species are generally relatively unproductive. In some areas Khash land [ government owned waste and unused land ] is also available for grazing. The seasonal overgrazing situation also obtains here.

Many areas are flooded in the Monsoon season, restricting the availability of grazing, and in the cropping seasons grazing is very restricted, partly because of the risk to crops and partly because of lack of labour to supervise the livestock.

Most of the BRAC supported rearers [ both cattle and small ruminant ] rely on limited seasonal grazing, availability of cut forage from public lands, availability of straws and stovers and the purchase of straw, green fodder and "concentrate" feeds which are in fact crop by-products. Both straw and green feed is purchased if, as is usual, their own production is insufficient. The by-products mentioned are rice bran, rice polishings, wheat bran, sesame seed cake [ expressed oil cake ], expressed mustard seed cake, cotton seed cake, linseed cake, different straws, stovers, pulse haulms and molasses. Salt [ sea salt ] is given by most owners, but quantity and frequency are uncertain. Leguminous by-products and plants are also fed; these include the fresh or dried plants after harvesting a wide variety of leguminous crops [ pulses, peas, beans etc ] and pulse pods. A limited amount of soya cake is also available.

Some cattle rearers, though not commonly those met who are supported by BRAC, are cultivating fodder crops. These are maize, oats, Napier grass [ *Pennisetum purpureum*, ] Para grass [ *Brachiaria mutica* / *B. brizantha* ] and Kashari [ *Lathyrus sativa* ] and Mung [ *Vigna mungo*

It, in addition to some other species. The Kasbari is grown primarily as a human food crop. Livestock feeding is an important secondary use.

Principally in the case of the of the BRAC supported dairy farmers the fodder and concentrates are purchased. Prices vary seasonally and depending on local demand. Goat owners mainly obtain their feed through allowing the goats to browse and cutting fodder on roadsides and in fallow land. At some times of the year scarcity may force the purchase of fodder.

Milk is, in general, sold to the local market. Prices again vary with season and location. BRAC, in January 1998, opened a milk processing plant with a capacity of 100,000 litres per day. The intention is to provide cooling and collection points, and to purchase milk to serve the plant. This should stabilise prices in the catchment area. Presently it is too early to judge the effect. The plant is a sound one. Milk prices at the cooling stations are based on butter fat content and are currently T 15.5 per kg at 4.5 % butter fat, with an increase or reduction of T 0.3 per 0.1% increase or decrease of butter fat. Presently there are 9 cooling / collection centres each serving an area with a radius of 10 km. Currently about 8,000 kg of fresh milk per day are being collected. Processing includes standardisation [ to 3.2% bf and 8.2% sf, pasteurisation and packing. Butter, Yogurt, and flavoured drinks are also produced by the plant.

BRAC has trained para-veterinarians to provide an animal health service. The majority are women, this is universally acceptable. The para-vets purchase inputs and sell their service at a mark up which provides their livelihood. Some para-vets produce urea/molasses blocks which are sold to livestock owners, again the paravet purchases inputs in the market and sells the product at a small profit to help earn a living.

In the following document the use of a number of fodder species is recommended. It is not exhaustive, but all the species recommended are thought to be suitable for use in Bangladesh. All the grasses except the Napier grass hybrid [ BN1 and BN2 ] and most of the legumes [ Except *Citraria*, *Chenopodium* S. *serban* and *L. lanceolata* ] have been seen and are growing well in Bangladesh. Farmers need to be shown the value of their use.

## **The Problem**

Presently the target groups have inadequate resources to produce fodder crops. This problem is widespread and not peculiar to BRAC target groups.

The supply of bought feed is seasonal and the price governed by the availability and demand. There is considerable regional and seasonal variation.

Milk prices, presently, are lower in rural than in urban and peri-urban areas where demand is higher.

The present regime of small scale milk production, using cattle of variable quality and potential and relying to a large extent on purchased fodder of uncertain quality and availability presents an increasingly high risk enterprise. The risk being the uncertain fodder supply and price both of the fodder and of the milk.

As more families are targeted or as the existing beneficiaries aspire to increase the size of their livestock enterprise the availability of fodder will tend to decrease in proportion to the number of livestock.

## **Proposed Solutions.**

Increase the quality of the available feed.\*

Increase the quantity of the available feed\*

Increase the efficiency of use of the available feed.\*

Stabilise prices and supply throughout the year.\*\*

Improve the method of exploiting the market for milk.

Improve production from the goat flock by planned marketing and considering dairy goat production.

Consider different systems of milk production. Intensive milk production in urban and periurban areas. Semi intensive milk production in rural areas. Commercial production of in calf heifers to meet the demand from peri urban dairies. Commercial keeping of dry and in calf cows on behalf of peri urban dairy farmers in areas where fodder may be more available or less costly. Commercial production of fodder and fodder crops. Commercial production of affordable concentrates. Improved exploitation of the potential of the dairy herd.

## **Immediate proposals.**

Firstly it must be stressed that Bangladesh is a small country with a high and growing population most of whom are employed in Agriculture. Cropping is intense and agricultural land is exploited at a cropping rate of about 180 %. Much of the land is flooded during the rainy season. Much land is very dry during the dry season. Therefore the opportunity for growing fodder crops on any significant scale is limited. Fodder will, in general, only be produced in small fodder banks in homesteads and as a catch crop in between traditional food and cash crops.

If the production of the country's 25 million or so cattle and 10 million or so small ruminants is to be significantly increased, it will be mainly through better and more efficient use of existing sources of crop residues and agro-industrial by-products as feed, and the use, where possible, of seasonal fallow lands to produce fodder catch crops.

The estimate of BARC is that there is insufficient fodder in the country to provide for more than 60% of the maintenance ration of the existing animals. The ADB report for the Third Livestock Project estimates that there is sufficient potential fodder to maintain the present national herd from crop residues and by-products. The same source suggests that up to half of the former are either wasted or used for fuel and construction.

An estimated 32 million tons of crop residues are produced. An estimated 16 million tons are used as fodder.

The emphasis should be on the increased and improved use of crop residues and the production of fodder crops where their production will not prejudice in any way the production of food crops.

It must also be taken into account that the use of "improved" crossbred or grade cattle for milk production rather than the traditional Desi for a multipurpose animal principally for draft, will necessitate higher levels of feeding and management for the dairy herd, possibly at the expense of the traditional herd, if fodder is a constraint.

To this end the following proposals are made.

[1] That BRAC stimulates the formation of animal owners associations, each comprising about 40 to 50 members which will act as the focus for discussion, participatory planning and extension work associated with the improvement of output and marketing of livestock and their products.

[2] That BRAC will, as far as possible develop, demonstrate and promote the better and increased use of crop and agro-industrial residues and by-products as ruminant fodder. Especial

emphasis should be placed on the Urea / Ammonia treatment of straw, the use of urea / molasses blocks, the planned feeding of concentrates and the planting of fodder and protein banks.

[3] BRAC will demonstrate the use of seasonal fodder crops to utilize seasonal fallow lands in order to increase the availability of good quality fodder and to provide a productive rotation in the farming system.

[4] BRAC will procure, multiply and provide the seed, planting material and technical advice to farmers, through their associations to benefit from the improved techniques and planting materials available.

Although a number of interventions are proposed in the following pages and in the attached 4 year plan and extension manual, it cannot be over stressed that the eventual success of such initiatives must depend on farmer participation. Participatory planning is essential, as the "top down" approach is not usually successful. Demonstrations will give the target groups an awareness of the alternatives. They must then choose the different alternatives which they wish to adopt.

It is considered necessary, if BRAC is to continue to expand its interest in small scale ruminant livestock owners, it must encourage their production through the improved use of existing fodder resources based on crop and agro-industrial residues and by-products, natural and fallow grazing and the improvement and expansion of protein and fodder banks and fodder crops, grown on the homesteads, boundaries, seasonal fallow lands and other waste and communally used lands.

Some BRAC senior technical staff should be sent for training in the production of fodder crops, the production of fodder crop seed and the nutrition of ruminant livestock in the tropics. Universities in Australia, India, the USA, Holland and UK give some suitable courses. For the fodder crop related courses India is suitable for a short training course [ 2 to 3 weeks ] and courses are available in the Philippines, Australia for a Masters or Diploma course and Holland, Australia or UK suitable for a course [ either 6 weeks to 2 months or Diploma or Masters, in tropical ruminant production. In UK Reading, Cambridge, Aberdeen and Edinburgh Universities

or Wye College can provide suitable courses, the British Council should provide details on request. In Australia the University of Queensland or CSIRO and possibly the University of Western Australia can provide information, In the USA there are numerous possibilities, the University of North Carolina and the Universities of Arizona and Hawaii may be able to give information but USIS in Dhaka should provide any information needed.. Also suppliers of tropical forage seeds in Australia may be asked to give short courses of instruction in fodder production and management and seed production and treatment.

It is proposed that a BRAC agronomist may visit appropriate institutions in Pakistan and India to see improved fodder varieties *in situ*, and to obtain planting material for multiplication. It is also proposed that an appropriate person be selected from BRAC senior staff to be trained either in Australia or in the USA in fodder crop production and another in ruminant nutrition in the tropics. For the former a one to three month course should suffice and for the latter a taught diploma or masters degree is suggested, this will involve a course of about 9 months.

It is also proposed that the consultant makes a return visit in about a year, this will be to monitor progress and to modify proposals in the light of the experience of the intervening year and the contributions of the target farmers through the participatory planning in the production associations.



### **Improved fodder production and use.**

The technique of urea / ammonia treatment of cereal straws and stovers is proven. It has been previously proposed in Bangladesh, but, apparently until now, rarely adopted. About 32 million tons of crop residues annually are produced. The majority is Rice straw. Much is not saved for livestock feed. That which is fed can be improved by urea / ammonia treatment. This will increase the feed value of such high fibre feeds by up to 25%. Wide spread adoption of this technique will potentially be the greatest single advance in improving the possibilities for feeding ruminant livestock in Bangladesh. Increased conservation and use of straw and other crop residues is potentially the second greatest possibility of increased fodder production in the country.

There are some museum plots of fodder grasses and legumes at BLRI, at least one regional fodder seed producing station at Rajshahi and some farmers are producing fodder. It is proposed that suitable fodder species are chosen, and at selected BRAC area offices multiplication plots are established to produce vegetative planting material, seed and where appropriate seedlings. The possibility, once the methodology is established of BRAC "volunteers" taking charge of fodder variety multiplication and selling planting materials to meet demand should be considered.

The immediate use of Napier grass, Guatemala grass, Signal grass, Para grass, German grass and Guinea grass plus Ipil ipil, Sesbania, Siratro, Desmodium, Clitoria and Lablab and fodder types of Cow pea is proposed. All the above with the exception of Desmodium, Clitoria and Centrosema may be obtained in limited quantities from BLRI and Rajshahi if they will approve. In addition commercial suppliers of other fodder crop seeds such as fodder maize, sorghum, and forage oats, and fodder hybrids [ Sorghum x Sudan grass and Napier grass x millet for example ] should be asked to supply seeds for trials in various areas. It cannot be overstressed that where graminaceous fodder crops are cultivated, whether seasonal such as fodder maize, or perennial such as Napier grass, appropriate forage legumes should be mixed with the crop. Firstly the legumes will improve the quality of the fodder, and secondly the nitrogen fixation by the legumes will reduce the fertiliser requirement of the crop, and enrich the soil for subsequent crops.

Properly managed the mixture of legumes in grass crops will extend the length of their useful season for exploitation.

Some fodder crops, presently not used in Bangladesh should be introduced. Some of the fodder legumes are mentioned in the previous paragraph, others such as Berseem [ *Trifolium alexandrinum* ] will be used as a catch crop between rice crops. In the main it is proposed, where possible seed and planting material are procured in the region [ Bangladesh, India, Nepal and Pakistan ] and those not locally available be procured from Australia. Names of possible suppliers will be supplied as will a more detailed list of recommendations. [ This list is incorporated in the manual ].

As it is intended to launch an ambitious programme, catering for the establishment of 4,000 or more ha of fodder crops in year 1, and increasing this quantity by at least a further 4,000 ha annually over 5 years, it is thought that the cost of purchase of seed from overseas could be prohibitive. It is therefore proposed that seed is imported with the intention of BRAC bulking the seed through a programme of seed multiplication using either BRAC farmers or if their land holdings are insufficient, using farmers who have some other connection with BRAC to produce seed under contract to BRAC. The national seed producing organisation and should be consulted.

As mentioned the principal fodder used for both cattle and goats is crop residues. Cereal straws and stovers can be improved in quality and digestibility by treating them with a strong alkali to break down lignin in the material. A simple process using urea / ammonia treatment of straw is possible. It has been successfully practised in several countries. It is proposed that initial demonstrations are established while the consultant is here [ on or about the of February in Manikganj ]. BRAC should initiate a country wide campaign of demonstrations of the preparation and use of Urea / Ammonia treated straw, molasses / urea blocks and the planned and proper feeding and preparation of simple concentrates.

Additionally, preparation of silage in silos and in plastic bags, when there is suitable material available, should be demonstrated.

Other methods of improving fodder quality such as the preparation of molasses / urea blocks and molasses / urea treatment of dried fodder and supplementary feeding with molasses should also be demonstrated. The need for supplementation of the diet of all ruminants with salt and minerals, and routine treatment for endo and ecto parasitosis will be included in the training paravets and of target farmers by BRAC.

As land is at a premium, and good quality fodder is scarce, all the target livestock owners who are able will be encouraged to plant fodder banks or protein banks on some of their homestead land. Initially it is proposed that fodder banks are composed of Guatemala, Guinea or Napier grass, *interplanted with climbing legumes such as Siratro, Centro, Desmodium, Clitoria, Lablab etc.* Protein banks will, initially be composed of Leucaena [ Ipilipil ] or Sesbania close planted and coppice cut, later tree lucerne [ *Chamaecytisus prolifera* ] will be added to the selection. Even a small area will provide some cut fodder in times of scarcity, but it is proposed that fodder and protein banks should be at least 49 square yards in extent [ or one decimal ].

Where there are publically used lands such as Kharsh land and road and river side sites suitable for the cultivation of fodder crops it is recommended that the consent and agreement of the authorities and of the traditional users is sought and obtained to plant suitable fodder crops, *in the same way as the fodder and protein banks are planted, to provide cut fodder for members of the community.* Leasing of this land by target farmers or associations may be feasible. If it is the matter should be further pursued in order that the best benefit for the most people can be obtained. If roadside land or other land is leased for fodder production by a group or by an individual, it must be made plain that fodder is to be treated as a crop and given the same kind of protection from damage by animals or other people who may imagine that their traditional right of access for grazing is being eroded, that other cash or food crops receive. Well managed fodder areas whether grazed or cut will produce between 4 and 5 times the amount of fodder than poorly managed natural pastures or volunteer growth in fallow land. If an association is the lease holder for land for fodder or other crops the allocation of the crop must be fair, and either based on the contribution to the cost both in terms of labour or cash for rent and inputs or upon other criteria to be decided and mutually agreed by the participants.

Where there is a proportion of the agricultural land left in fallow, or where there is a significant period between crops it is proposed that demonstrations are mounted, by BRAC, to show that fodder crops or catch crops may be planted. Maize is already grown in some areas either as stock feed or as fodder. Maize and legume mixtures, Egyptian clover, Kashari, Cow pea, forage oat, fodder Sorghum, Sorghum X Sudan grass hybrid, Napier grass, and Napier grass X Millet hybrid or a variety of legume crops may be suitable depending on the kind of land, and the period of the fallow.

*If the fodder crops are not required by the grower or land owner, they could be sold or shared with livestock owners. The details will need to be worked out in accordance with local custom and practice.*

It must be remembered that a very large proportion of small cow and goat rearers have insufficient land for significant areas of fodder production. Only a relatively small proportion of crop land is available as seasonal fallow for fodder crop production, and even less is truly suitable. There is increasing pressure on all agricultural land for the production of food and cash crops. Although there is a place for the cultivation of fodder crops on seasonal fallows, it must be born in mind that much of the potential will be exploited by larger farmers to supply the requirements of their own herds. *The production of fodder crops in fallows for sale to livestock owners, especially those operating in urban and peri-urban areas may also be significant. The small rural milk and goat producers will need to compete in the open market to purchase fodder or will need to be able to lease or share crop seasonal fallow lands if they are to be able to cultivate seasonal fodder crops.*

In view of the variation in availability and price of "concentrates" i.e. crop and agro-industrial by-products which form a very major part of the ration fed by small livestock owners, it is recommended that BRAC considers intervention to stabilise the situation.

*As BRAC is already involved in the production of poultry feed, and obtaining local grain supplies for this purpose, generally at a lower price than that for which the same grain is sold in*

the market, it is suggested that BRAC investigate the following possibilities. The purchase direct from processors and producers of rice and wheat bran and suitable expressed oil cake or meal. These would be mixed and with added salt and minerals, would be sold at a uniform price throughout the country as a general concentrate for ruminant feed. A higher proportion of DCP [ digestible crude protein ] could be included or used in a specific concentrate for dairy cattle. A number of possible formulations are included in the manual. Each of them will require to be fed at the rate of 400 grams per litre of milk produced in addition to the basic ration, which can be expected to give maintenance plus 2 litres if recommendations are followed.

As maize is already grown to provide a part of the high input for poultry feed, the possibility of harvesting the whole dry maize plant, and rough milling it, plus added salt and minerals and possibly a little molasses [ though the latter is not necessary] for a complete high volume cattle feed should be explored, such a fodder could be expected to contain in the region of 9 % CP [ crude protein ]. Though such a feed would not be very high quality it would provide a dry feed adequate for maintenance and production of 2 to 3 litres of milk per day.

It must also be stressed that though the Desi cattle and goats are very well adapted to the local conditions and traditional management they will neither attain a large size or produce large quantities of milk irrespective of improvement in their diet. With goats it is possible that the Desi may outperform "improved" breeds in terms of biomass production of body mass per unit of biomass intake of feed. This is a potential line for future research by BLRI. The cattle however are not genetically capable of producing large milk yields. Cross breeding with exotic dairy breeds will produce mixed breed animals with a greater potential for milk production. It will also produce animals which are less suited to the traditional kind of management and which will, because of their greater size and enhanced performance, demand more feed and higher levels of management. This will be acceptable to people who desire higher levels of production to generate income. It will, however, alter the traditional role of cattle in the rural economy. Traditionally cattle have been multipurpose animals, supplying a mobile form of wealth, a form of insurance against crop failure due to natural disaster, traction for cultivation and transport and both milk and meat. They are small, not very prolific and yield little milk, but they survive adequately on the traditional low level of management and the fodder available from road sides, Kharsh lands

and fallows plus untreated crop residues. Dairy animals will be more demanding of management and feed, and less able to provide the traditional draft function. Their higher prolificacy and often greater size will make them more valuable, but fewer will be able to be fed from the same traditional resources. The decision the farmers will eventually have to make is what is the main purpose of the cattle, to be high value dairy animals requiring high levels of inputs or to be traditional, low out put, multipurpose creatures which survive with minimal management. Both are suitable for the Bangladeshi system but the owner must choose her or his own priorities. Goats, at present do not create the same potential conflict of interest. They are a way of converting otherwise low value crop and field wastes into a saleable animal. Milk production from goats is not yet an issue, and neither, apparently, is size. Better management will be related to increased fertility and survival, and will be directly equated with financial worth. Increased goat and cattle ownership, while increasing the potential cash income of the owners, and helping the poor to increase their income, will also increase the pressure on potential fodder resources.

The above proposals, that is improved use of crop residues and better use of waste and fallow lands producing fodder, will help support an increased population of livestock, but care must be taken to ensure that the best use is made of these very limited resources. Treat animals as a crop and dispose of the surplus rather than build up excessive herds and flocks. Meanwhile consider the draft requirement, and ensure that it is not neglected in the enthusiasm to produce more milk as a cash crop. Power tillers are increasing in numbers, but how many owners of cattle used for traction can afford to change ?