



**EASING
SEASONAL FODDER SCARCITY
FOR SMALL RUMINANTS
IN NORTH WEST INDIA**

INTRODUCTION

A large area of North West India is semi arid, subject to a long dry season. From March to June, the period before the onset of monsoon rains, the region is intensely hot and dry. Ground vegetation has mainly died down and, away from any irrigated areas, trees and bushes may be the only green vegetation to be seen. Tree leaves and pods are important fodders at this time of year, but even these may become limited in supply at certain times. Every third or fourth year is a drought year, when feed scarcity becomes particularly acute. During the dry season milk production can cease and livestock lose weight as the feed available is inadequate to fulfill their requirements, both in terms of quantity and quality. Weakened animals are susceptible to disease so that while rain can bring some relief as regards feed supply, the wet season may also exact a heavy toll in terms of mortality due to disease. Droughts can reduce livestock numbers severely, particularly large ruminants. Alleviation of these seasonal feed shortages could help to increase the production of milk for home consumption and sale, and



decreasing mortality could enable farmers to sell more animals to generate income. Many rural livelihoods in this region are based on mixed farming systems which produce crops and livestock products. Livestock provide draught power and manure to the cropping system as well as milk and meat. Large ruminants are particularly important for draught power and milk, goats and sheep for milk, meat and wool (from sheep). Small ruminants may be used as assets that can readily be sold for cash for special purchases or events. Goats are often kept in small herds by poorer farmers to augment their food supply and provide income. Communal lands are often important sources of grazing and tree fodders. However, many such communal lands have been poorly managed and are now seriously degraded.



While previous research has indicated that a major constraint to increased livestock production is the shortage of feed, particularly in the dry season, there is relatively little published information on how farmers utilise locally available feeds. Similarly, little literature is available concerning optimum ways to utilise locally available feeds in the existing

livestock production systems and methods of increasing supply and production of the most advantageous foods.

THE PROJECTS

The Livestock Production Program (LPP) is supporting two complementary projects aimed at alleviating problems caused by seasonal feed shortages in semi-arid North West India; both started in October 1997 and are due to end on 30 September 2000. The projects are being jointly implemented by the BAIF Development Research Foundation (BAIF), India, and Natural Resources Institute (NRI) of the University of Greenwich, UK.

The LPP is funded by the British Department for International Development (DFID) under its Renewable Natural Resources Research Strategy. The goals of this strategy are poverty reduction, the promotion of economic growth and of economic reform, and the mitigation of environmental problems. Both projects are contributing to the following objective of LPP: the improvement of seasonal availability and utilisation of local feed resources for livestock production and the promotion of appropriate feed management strategies in semi-arid crop/livestock production systems.

The projects are focussing primarily on goats, for two reasons: first, goat feeding systems and means of improving them have been relatively neglected by research to date; second, goats tend to be particularly important to poorer people, increasing the likelihood that the research will contribute to poverty reduction.



A major concern of the projects is to understand the goat production systems, local feed resources, constraints and priorities of goat keepers (both men and women) so that technologies developed will address their needs and be appropriate to their circumstances, and hence are likely to be adopted by them.

The title of the first project is "Easing seasonal feed scarcity for small ruminants in semi-arid crop/livestock systems through a process of participatory research".

The planned outputs are:

1. a better understanding of farmers' current feeding systems for small ruminants, and the rationale for them;
2. development of a set of recommendations for improving local feed resources and feed management strategies;
3. development of participatory methodologies for the analysis of feed resources and constraints, and for the testing of interventions;
4. dissemination of the project's findings and recommendations on feed resources and strategies, and participatory methodologies.

The second project is the "Application of laboratory feed evaluation to identify methods of easing feed scarcity in North West India". The key outputs are essentially similar to those of the first project, but a different range of techniques is used. This project is reviewing the scientific and technical literature to obtain information about the feed resources available in the project areas. Important feeds which have been poorly researched will be sampled and characterised using laboratory techniques. These techniques will include conventional chemical analyses together with more recently developed techniques which indicate the digestibility of the feeds (in vitro gas production) and the presence of any anti-nutritive or toxic factors (bio-assays). A goat feeds monitoring study has also been initiated in which goats are closely observed on selected days to obtain detailed information on the way they are managed and what they are eating. This study is intended to provide semi-quantitative and qualitative information on the total diet of the animals.

THE PROJECT AREAS

It is envisaged that the projects will be implemented in five semi arid districts of North West India, each of which has been selected to represent different small ruminant production systems:



these are summarised in the table below. This breadth of coverage will help to ensure that a wide range of situations is addressed by research, and that a basket of feeding technologies or systems is developed. The districts and their production systems are described in the table below

District (State)	Livestock Type	Production System*	Main Product(s)
Bhilwara (Rajasthan)	Goat	Semi-intensive, commercial	Meat
Udaipur (Rajasthan)	Goat	Extensive, semicommercial	Meat
Bhavnagar (Gujarat)	Goat	subsistence, commercial	Milk
Vidisha (Madhya Pradesh)	Goat	Extensive, Liquid asset	Meat
Tonk (Rajasthan)	Sheep	Extensive, commercial	Wool, Meat

* Note: Nearly all production systems are grazing systems with little or no stall feeding.

METHODOLOGY

Participatory Research Project

This project is aiming to develop a collaborative participatory approach, in which goat-keepers and researchers have roughly equal influence in the design, monitoring and evaluation of trials to test ways of reducing problems arising from seasonal feed scarcity. Participatory research projects have been around for a decade or more, but until now the vast majority of them have been concerned with crop production: participatory research on livestock production issues has been relatively limited. One of the project's planned outputs, therefore, is the development of guidelines on the application of the participatory methods in livestock research projects generally, and feed related ones in particular.

The project is working primarily with poor people, who belong to scheduled castes or tribes. In all of the villages covered the majority of the inhabitants are below the official poverty line. The project is also working mainly with women, since it is they who tend to be primarily responsible for goats.

In each district where it works the project begins by conducting surveys in three or four villages where BAIF has an operational presence.

The surveys seek to obtain a general picture of people's livelihood systems, and contribution of livestock to them;



and to gain an understanding of goat production and feeding systems, and goat-keepers' problems and constraints. In most of the villages surveyed goat-keepers have indicated that they have feed-related problems.

The surveys rely mainly on semi-structured group interviews, combined with a variety of informal visualization techniques. Goat-keepers prepare maps indicating the spatial distribution of the principal feed resources, and seasonal calendars showing how feed resources vary over a year, by type and quantity. The calendars also show other aspects of goat production, such as breeding times and the temporal distribution of disease. Separate group interviews are held with men and women, so that women can express their views more freely.

Following the surveys the project offers to work with goat-keepers to develop and test various interventions to address problems related to feed scarcity. It is



(Above) Groups of farmers participating in the preparation of a seasonal feed calendar. (Below) PRAWith Women



planned to organise trials in each year of the project. In the first year, the trials are limited to one or two villages in each district, for practical reasons; but it is envisaged that the number of villages per district will be slightly higher in subsequent years. Interventions used in the first season may be modified in subsequent seasons, or replaced with different ones, depending on how they are evaluated. The treatment and control (normal feeding practice) groups are in the same village, and animals in the two groups are from herds of similar sizes. The sample size takes account of the minimum number of animals required to enable statistical tests to be applied in a meaningful way. The trials involve fortnightly monitoring of biophysical production parameters,

such as milk production or weight gain by kids; recording is done by a trained person from the trial village. The participating goat-keepers are also being encouraged to keep records of the data: most of them (women) are illiterate, so the project is developing recording forms based on symbols rather than words and numbers. Another component of the monitoring is holding of monthly group meetings in each village, involving researchers and trial participants, to obtain subjective or qualitative information as to how the trials are progressing.

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Laboratory methods

Conventional chemical analysis for crude protein, fat, fibre and ash will be used to help characterise feed samples. Laboratory (in vitro) digestibility methods will also be used to estimate the extent of digestibility. Laboratory digestibility methods use rumen microbes to mimic some of the digestive processes found in the animal, and



Laboratory (in vitro) gas production method. Feed samples are fermented by rumen microbes in glass bottles sealed with rubber stoppers. The mixtures are incubated at 39°C in an incubator or water bath. The picture shows the gas pressure and volume being measured using an electronic pressure meter. Gas is removed from the bottles after measurement and the bottles returned to the incubator.



Extracted tannins assayed using the radial diffusion technique. Tannins diffuse into the agarose gel plates which contain protein. The tannins bind the protein to form dark rings which can be measured to give a quantitative measure of the activity of the tannins.

give valuable information on the interactions between feeds and biological digestive processes. These analysis will be conducted in the BAIF laboratories at Pune. Additionally a laboratory gas production technique will be used at the laboratories of NRI to obtain data on the rates of fermentation of feeds by rumen microbes, and on the balance between fermentable



carbohydrates and protein in feeds and feed mixtures. NRI has been developing this technique particularly to investigate the supplementation of ruminant diets.

A common qualitative problem in ruminant diets, particularly in the dry season, is that diets can be deficient in rumen degradable protein. This prevents the efficient working of the rumen microbes which is responsible for the degradation of the fibrous diets eaten by ruminants. Supplementation of deficient diets with protein rich feeds can considerably improve animal performance. Unfortunately, crude protein measurements by themselves are not always reliable indicators of the potential supply of protein from the feeds. This is particularly the case for tree fodders which often contain tannins. Tannins bind protein and may make it unavailable to the rumen microbes, and indeed make it completely unavailable to the animal. However the laboratory methods can be used to indicate the availability of the protein, tannins can be assayed to indicate the extent of tannin binding.

Tree fodders often contain a range of anti-nutritive or toxic compounds, in addition to tannins mentioned above. This project will use two bio-assays used in an earlier NRI project, the brine shrimp technique and a Thin Layer Chromatography (TLC) / Mould inhibition technique as screening tools to identify the presence of biologically active compounds. These techniques can provide semi-quantitative data on the toxicity of the active compounds. Feeding strategies should include the avoidance of excessively large quantities of anti-nutrients which can inhibit performance and, in extreme cases, cause health problems and death.

Goat feed monitoring

A simple protocol in which a monitor follows a selected animal has been adopted. Monitors note any feed given to the animal, then follow the animal to the grazing areas noting the activity of the animal every 5 minutes. If the animal is eating, the name of the feed is noted (if known). This is continued until the animal returns to its overnight resting place and no more feed is given. In this way a detailed picture of the overall diet and management of the animal is obtained. Monitoring is being conducted on two goats in each selected herd. Goats are monitored for two days each during a monitoring period of four consecutive days and this process is repeated at two monthly or two weekly intervals for the herds collaborating with the project.

The monitors are recruited from within the goat-keeping communities themselves to ensure that they are participating in the conduct of the research.

PROGRESS TO DATE

The projects are still in their first year at the time of writing, investigating current feeding systems and identifying and testing possible improvements. Surveys have been conducted in Bhilwara, Udaipur and Bhavnagar districts, and trials have begun there. Understanding of the nature of feed scarcity problems has greatly increased. The surveys have shown that feed situations are extremely diverse. Availability of fodder resources varies substantially from village to village, even within a small area; and from household to household. Feeding systems vary from block to block, and even more so from district to district, depending on the differing resources available, farming and cropping systems, and access to markets; they also sometimes differ by ethnic group.

The surveys have also shown that the ways in which fodder scarcity represents a problem for farmers (where it is a problem) are numerous (e.g. migration, decreased milk production, mortality, abortions, high cost of purchased feed), and vary with farming and goat production systems. The main problem in three of the districts, and associated animals, are summarised in the following table. The trials are targetting different groups of animals in each district.

District (State)	Main Product	Feed- Related Problem	Principal Target Group for trials
Bhilwara (Rajasthan)	Meat	Condition of pregnant does & effect on foetus and kids	Pregnant does
Udaipur (Rajasthan)	Meat	Disease-related mortality in kids	Kids
Bhavnagar (Gujarat)	Milk	Low milk production	Lactating does

A range of possible interventions has been identified during discussion with farmers. Three of these are the subject of trials in four villages in the first year. They all involve the use of supplements namely *Prosopis juliflora* pods mixed with barely (in Bhilwara), urea-molasses granules (in Bhavnagar and Udaipur) and barely (in Udaipur)

The major tree fodders used in the dry season in Rajasthan have been identified in the project districts, but literature



information on nutritive value is patchy and there is lack of detailed information on the total diets of goats. Preliminary data from the pilot goat feed monitoring exercise indicate that dried tree leaves are an important component of the diet, but little information is available about their nutritive value.

Possible interventions can be grouped under a number of different categories, as follows:

Interventions that increase tree fodder

- * Tree planting on private land.
- * Increased natural regeneration of trees on private land (through better protection or husbandry).
- * Improved management/lopping practices of trees on private land.
- * Silvopasture development on common land.
- * Protection of trees/bushes on common land.

Interventions that increase fodder crop production

- * Water resources development (e.g. check dams) to enable fodder crops to be grown during the dry season.
- * Technologies for increasing yields of forages (barley, lucerne etc.)

Interventions involving improved management and use of feed materials

- * Making more pala (stored dried leaves) from currently used sources (e.g. *bordi*, *Ziziphus nummularia*).
- * Making dried leaves from sources not currently used (e.g. cotton).
- * Overcoming dried leaf storage constraints.
- * Better preservation/treatment of dried leaves.
- * Storage of tree pods and other high protein feeds for use as strategic supplements.
- * Improved feeding strategies to balance protein and energy supply.

Purchase of feed

- * Supply of potentially more cost-effective types of feed suitable for use in dry season situations (e.g. urea /molasses granules or oil seed cakes).

Access to new or better markets for goat products

This may make it financially worthwhile for goat-keepers to purchase feeds during times of scarcity of local feed materials.

To date the laboratory evaluation project has concentrated on Bhiwara and Udaipur Districts where the survey work has been completed. Initial feed samples have been obtained from project villages in these districts for laboratory evaluation. These should indicate if there are major nutrient imbalances and give information on the toxicity of arunjia (*Acacia leucophloea*) pods. After the first

season of testing interventions in these districts has been completed, it is envisaged that the laboratory analysis and goat feed monitoring will be extended to the other districts.

Which intervention, if any, is appropriate will depend on the nature of the feeding system, and the goat-keepers' production objectives and feed-related constraints. For example urea/molasses granules are only likely to be appropriate in situations where there is a shortage of crude protein (available fermentable nitrogen) in the diet, such as in situations where there is a shortage of green fodder, particularly a shortage of tree fodder.

FUTURE WORK

Choice of Interventions

It is already clear from discussions with goat-keepers that different interventions will be appropriate in different villages and for different ethnic groups. The list above is not exhaustive and goat-keepers may identify additional interventions as part of the ongoing dialogue with them. More detailed knowledge of the feed constituents of diets throughout the year will be provided by the laboratory analysis, and this may suggest other possible interventions: such information will be available towards the end of 1998.

Dissemination

The projects are directly disseminating the results of the various studies to collaborating farmers in the study regions. It is intended to brief extension services on progress from an early stage. A workshop will be held in India towards the end of the projects to present and discuss findings with local scientists and extension workers. Two extension manuals will be drafted as outputs of the first project and an information pamphlet on laboratory methods drafted by the second project. Further dissemination will be achieved via the extension activities of BAIF itself and other organisations in India. The projects will also produce technical reports and papers for the wider scientific community.



FURTHER INFORMATION

The BAIF Development Research Foundation is a public charitable trust established by Late Dr. Manibhai Desai, a disciple of Mahatma Gandhi. BAIF's mission is to create opportunities of self-employment for the rural families, especially disadvantaged sections, ensuring sustainable livelihood, enriched environment, improved quality of life & good human values. This will be achieved through development research, effective use of local resources, extension of appropriate technologies and upgradation of skills capacities with community participation. BAIF will be non-political, secular & professionally managed organisation. BAIF programmes include livestock development, tree based farming systems, watershed development, womens empowerment, health & many other relevant areas. These programmes are spread over six states in the country. The development activity of BAIF are supported by appropriate research at its campus and through training for different aspects of development at Pune and other states. The Natural Resources Institute (NRI) is an institute of the University of Greenwich, based in the United Kingdom. The NRI was formerly a scientific and technical organisation of the British Overseas Development Administration (now the Department for International Development). NRI is an internationally recognised centre of expertise on renewable natural resources research and development, with a long history of working in less developed countries.

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