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FODDER TREES, NURSERIES AND THEIR CENTRAL ROLE IN THE HILL-FARMING SYSTEMS OF NEPAL

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Introduction

This paper highlights the importance of fodder trees to livestock production in Nepal, and discusses the role of village-level nurseries for the supply of fodder-tree seedlings. Trees, forests, and livestock form the cornerstone of Nepalese farming systems, where nutrient inputs for cropland originate largely from animal manure and leaf material. Cropland yields are known to be decreasing in many areas due to inadequate nutrient input, since manure is in short supply and artificial fertilizers are not readily available in Nepal, particularly in the hills. Further, artificial fertilizers are not in their present form an adequate alternative to manure since they are made up of a limited range of the nutrients which are necessary for sustaining fertility. In any case, organic matter in the soil is essential for efficient application and utilization of artificial fertilizers.

Livestock contribute a considerable proportion of the total income of small farmer households. The demand for livestock products (meat, milk, wool, manure) is increasing and yet, in many areas of the Kingdom, livestock numbers have been declining in the last 10 to 20 years without a concurrent increase in productivity per livestock unit for the range of livestock products which are required. The decrease in livestock numbers is due to a combination of factors but usually, in part, to reductions in forest and fodder resources and reductions in labour availability.

The main constraint to improved livestock productivity is the poor quality and insufficient supply of fodder, particularly during the long dry season. An important contribution of fodder trees to the farming system is in providing a store of green and nutritious fodder for the dry season as a supplement to crop residues which usually do not supply sufficient levels of nutrients to meet basic maintenance requirements. Hence, the actual and potential role of fodder trees to livestock production and productivity and to the sustenance of farming systems in Nepal is crucial.

Contribution of Fodder Trees to Livestock Production

There are considerable differences between agro-ecological zones, within agro-ecological zones, and within farming system types between farms of different size in the contribution of fodder trees (private and public) to the total supply of fodder for livestock. In the Hills, Panday (1982) suggests that up to 90% of the fodder supply in some areas may be provided by trees and undergrowth in forests. He suggests that for Nepal as a whole 55% of fodder is supplied by forest trees and 7.5% from private trees. A number of other estimates show private trees and forest trees contributing between 5% and 15% of the annual supply (Heuch, 1986, based on Heuch and Shrestha, 1986). Yet, clearly, in some areas the contribution from trees appears to be higher. Fonzen and Oberholzer (1984) estimated that the fodder contribution of privately owned trees in two villages of Palpa District was 50% and 60% of total supply respectively. The area from which these data were obtained is, however, unusually well-managed by the farmers.

One reason why estimates differ is the high variability in tree resources, both private and common, and differences in amounts of alternative fodder resources available to farmers in the same area. However, another important reason is that the various estimates are based on different assumptions and measurements with the use of imprecise and uncertain methodology. The basic assumptions underlying calculations are often unclear. This makes it impossible to make meaningful comparisons between different sources of data (Heuch, 1986; Robinson 1986a, 1986b).

However, the crucial importance of fodder trees becomes apparent when it is realized that they often provide the only green fodder during the critical times of the dry season. In a village in Western Nepal, Fox (1983) estimated that while 11% and 14% of dry matter supplied to cattle and buffalo fodder originated from trees on a yearly basis, their contribution during the dry season was 25% and 28%, respectively.

The demand for fodder from trees is usually considerably higher than the supply and since the fodder resources are usually said by villagers to be shrinking, clearly their potential contribution could be much higher.

Availability of Fodder Tree Species

From surveys in different areas of Nepal it has been found that farmers are aware of and use a large number of fodder tree species, ranging from between 70-130 species. (Heuch, 1986; Van den Dool personal

communication). It is becoming clear that some species which are identified as single taxonomic units by botanists and foresters do occur as different varieties. These are known by farmers to have distinct site requirements and to vary in their fodder quality, sometimes to considerable degrees (Amatya, 1988; Upton and Robinson, 1988).

The need to identify the fodder species used by farmers is accepted the next step is to ensure that nurseries in the village contain these fodder tree seedlings. Some species may be preferred by farmers, but because these have not traditionally been grown in nurseries, farmers do not request them from the nurseries. It is a problem of nursery workers not being able to find out what farmers need, and farmers not being able to communicate their needs to the nursery worker. The techniques for growing some of these species are already available, although more work needs to be carried out to identify species suitable for high altitude areas (over 2,000 metres).

Constraints to Fodder Tree Development: Nurseries and Species Selection

Given the scarce resources available for research in Nepal, the crucial importance of fodder trees in small farmer production systems, and the obviously far greater impact which fodder trees could make on livestock production in Nepal, it is important to identify what range of factors prevent the further development of fodder tree resources in most areas of the Kingdom.

To say, as some people still do, that farmers are ignorant about the benefits of planting fodder trees, or cannot be bothered to plant seedlings, is, if not totally incorrect, a gross over-generalization. It may be true that farmers who are still close to forest areas where fodder is available have less interest in planting fodder trees on their own land. However, the largest proportion of the remaining fodder-producing forest areas are also found at high altitudes, and it has been found that farmers living at these altitudes see little value in planting fodder trees on private land, believing that trees have adverse effects on crop yields.

As forests have deteriorated or become less productive due to over-utilization, farmers at lower altitudes have, in many areas, been very actively promoting tree development on their private land. In Sindupalchowk and Kavre districts, Carter and Gilmour (in preparation) have found an average of 2- to 3-fold increases in tree vegetation between 1964 and 1987 on farmers cultivated land. Very little of this increase has been due to planting seedlings originating from nurseries, but largely due to encouraged and protected natural regeneration. The species composition of the increased tree population is, in the early phases, usually not of preferred fodder species probably because few of the preferred species produce seed in the early phases when

trees are lopped hard. The Community Forestry Development Project found that the number of small trees on 900 households land in 25 Midhill districts was encouraging (Messerschmidt 1984). Very few of these originated from nurseries while 50% of the small, protected fodder trees had regenerated naturally. The farmers then transplanted naturally regenerated seedlings which had been transplanted from other areas on the farm and also wildings collected from the forests, and this served to diversify their fodder species base.

Robinson and Neupane (1988) found that only 4% of the trees on 30 farmers land in a Panchayat of Dolakha District had been planted and less than half of these had originated from the Panchayat nursery, the rest originating as wildings from the forest. This evidence of farmer use of fodder seedlings from sources other than nurseries must raise certain questions, including whether the species offered in the nurseries are the ones desired by the farmers.

Surveys, done in 1982 and 1983, of the Community Forestry Development Project (CFDP) private seedling distribution programme (Messerschmidt, 1984) show that after fruit trees, fodder trees are the most preferred group of species. Yet, while 15 species were found to be preferred for fodder, CFDP nurseries produced only 3 out of these 15 species in any significant numbers and these made up only 5.3% of the seedlings distributed to farmers. In Mati Panchayat (Dolakha) Gautam (1986) found that while fodder trees were preferred, the panchayat nursery provided only 2 out of the 10 species locally preferred for fodder, and these made up only 17% of the total number of seedlings distributed.

Hence, it is clear that despite the general inability of panchayat nurseries to provide the seedlings farmers would prefer, rural communities are keen to, and able to, increase their tree resources by traditional methods. However, the species they are able to promote may not be those they would prefer.

The evidence therefore suggests that farmers in the Midhills are prepared to plant more fodder trees on private land. The key to the establishment of more fodder trees lies in two directions:

1) establishing user group forests with advice on how to manage these forests for the products people want ie fodder;

2) an increase in the fodder tree population on private land (cultivated and uncultivated) of species which are productive, grow reasonably fast, and which produce fodder quality of above-maintenance requirements. This second case requires that research is carried out on ways to integrate farmer needs and the technical problems of raising a large number of different species in village nurseries.

Table 1. Reasons for farmers not planting seedlings, for failure in establishment, or for poor growth

Reason	Causative factors
Preferred species not available	I
Seedlings too small	I, T
Seedlings of poor quality	I
Seedlings available at wrong time	I
Labour problems at planting time	M
Nursery too far	I
Browsing damage	M
Wrong species for site	E, T
Fear of government authorities claiming ownership of trees and land	I, E
Poor weeding	M, E
Negligence at grass cutting time	M
Poor growth rate	T, E
Improper planting method	E
Negative effects on crops	T, M, E
Theft	

Codes:

I = Institutional factors
T = Technical factors
M = Mgt factors at farm/community level
E = Extension

Table 1. lists the reasons why fodder tree seedlings are either not planted or why, where they have been planted, they have not established well. For each reason, the causes can be categorized into technical problems which researchers should investigate (if the technical solutions are not yet known); institutional problems of the implementing agency; reasons of lack of appreciation by farmers as to the potential for improving the situation; and management factors at the farm or community level.

Seeds, Germination and Nurseries

There are problems with germination and availability of seeds of many fodder tree species. In the case of most fodder trees the trees are lopped too heavily for there to be any seed production. However, this is not an insurmountable problem and several organizations have solved it by paying money or providing materials (e.g. seedlings) to farmers so that a tree or part of a tree is not lopped until seed has been collected.

Nursery research

Valuable research has been done on the technical side of nursery seedling production including work on potting mixtures, growing media, size of polypot, drainage, fertilizer application, and length of time needed for seedlings in the nursery at different altitudes to produce normal-sized seedlings (about 30 cm in height).

Some species have been propagated very successfully from cuttings for generations by villagers, often using special techniques such as air layering. Surveys on such techniques for different species and in different parts of Nepal have been started, the results of which should be incorporated into any future nursery strategies.

The Division of Forest Research, and other organizations have conducted research on the vegetative propagation (by using semi-hardwood cuttings) potential of a number of species (Napier, 1988). For this technique to be applicable under normal field conditions stool beds of suitable species would have to be established in or near nurseries, or on farmer's land.

A more technical option, in vitro propagation, has been successfully developed by the Department of Medicinal Plants for a few species (Raj Bhandary, 1988). The extent to which such a technique can have practical application for distribution of plants to farms in remote regions in Nepal is, however, debatable.

It is clear from experience in a number of districts that farmers usually take very few seedlings from government nurseries and that the survival rates of those taken are low, even though it is known that there is a demand from farmers for more fodder trees (Robinson and Neupane, 1988). There are many non-technical reasons for this such as seed of preferred species not being made available to nursery workers; use of the best seedlings for Forest Department plantations first and only poorer plants being available for distribution to farmers, often only half way through the monsoon; and the timing of the budget release being too late to produce normal-sized seedlings. Research results and common sense experience have already shown that these problems need to be solved if government nurseries are to be able to supply the seedlings farmers want.

It is also becoming increasingly clear through contact with farmers that they often want larger sized seedlings than the 30 cm which has been traditionally accepted as the proper size for Forest Department plantations (Baral 1988 and Napier 1987). The Division of Forest Research is starting research on nursery requirements to produce seedlings 75 to 150 cm tall. Some farmers would prefer to plant a few seedlings well before the monsoon and water them through the dry months because they do not have the labour available to plant trees in the early part of the monsoon. On moist sites and on north facing slopes, particularly at higher altitude, winter planting also may be feasible. It is important to recognise the diverse needs and constraints under

which farmers operate before it is possible to establish a successful nursery programme which can respond to these needs.

The following areas of research are critical to support successful farmer-responsive nurseries:

- # For large seedlings: time of sowing, length of time required in the nursery, establishment success and early growth.
- # Bare rooted stumps: which species can be propagated by this technique and the advantage over normal seedlings in terms of ease of transport and growth rate.
- # Vegetative propagation using semi-hardwood cuttings: time of cutting harvest and insertion and size of cutting.
- # Farmers' knowledge surveys of propagation techniques.
- # Winter and pre-monsoon planting.
- # Ways of reducing seedling time in the nursery at high altitudes e.g. poly tunnels and cold frames.
- # Since distance from nurseries to farmers fields often prevents farmers from collecting seedlings, it is important to review initiatives which have established local nurseries easily accessible to farmers.

From Nursery to Farmers' Lands

Non-cultivated land

In the past mainly non-fodder tree species, and particularly pines, have been planted on non-cultivated land. However, in most areas fodder trees are preferred by rural communities, particularly in the Midhills. Hence, Forest Department research has, in the past few years, been looking at ways to improve the survival and early growth of some fodder species on sites which would normally be planted to pines. Good success has been achieved on the less harsh sites with a number of species.

Cultivated land

We know little about the effect of trees on adjacent crop yields. Farmers have their own opinions, which are often contradictory. The effects can be direct (e.g. shading, root competition) or indirect (e.g. more fodder available, therefore more manure available from more animals being fed). Different farmers in short discussions on this topic may put more or less emphasis on direct or indirect effects. Carter (unpublished)

has found that farmers believe (1) different species have varying effects on crop yields, (2) that aspect can make the difference between positive or negative effects on crop yields, and (3) that altitude influences the effects.

It is often stated, incorrectly, that trees should never be grown on irrigated land as rice is very sensitive to shade. However, in the Phewa Tal Watershed Project area the "galae" rice cultivar is grown with Schima wallichii on poor quality irrigated land, 'khet', while on good 'khet' the "dschouari" cultivar grows well with a reasonable stocking of Artocarpus lakoocha. Appropriate timing of lopping of trees in relation to crop rotation and crop development can reduce significantly the negative effects trees might have on crop yields. Fodder trees which can be lopped more than once a year (e.g. Ficus semicordata, Buddleia asiatica, Leucaena spp.) are therefore particularly suitable for planting on cropland where there is fear of negative impact since canopy management can be more easily matched with crop development.

Natural forest management

The Nepal-Australia Forestry Project (NAFP: Applegate and Gilmour, 1987) and the Integrated Hill Development Project (IHDP: Posthuma, 1988) have examined the succession of broadleaf species in pine plantations. The Division of Forest Research has trials on different management systems in mixed broadleaf forests which will estimate production of fodder and other products.

Forest use by communities is complex and varies with forest characteristics (such as type, area, structure) availability of alternative fuelwood and fodder resources and social characteristics of the community. As an example, 'khasru', Quercus semecarpifolia in Kalinchowk forest, Dolakha, is frequently felled and sold as fuelwood in the nearby Charikot bazaar while in Lespar Village Panchayat, Parbat District, individual trees are allocated to households on an annual basis for fodder lopping. Poor management in Lespar is punishable by a fine.

The main problem in natural forest management is the lack of knowledge on the part of planners and administrators as to the demand and supply situation in regard to fodder and fuel and the trade-off between these products under different management systems. Commercial interests favour fuel, poles, and timber (often of unpalatable species) at the expense of foliage and particularly fodder production. Partial protection results in the less favoured species dominating the forest. Forestry professionals preconceptions of an ideal forest as a closed canopy of long clear boles of timber species is in direct conflict with the Nepalese small farmer whose production system depends on forest nutrients in the tree foliage and undergrowth.

Forests in farming areas must be managed for foliage production as the principal objective; fuel is supplied as a by-product. Village people are meeting their basic needs for forest material often in contradiction to the forest laws. The main task is to gain recognition for this basic usage, legitimize it, and control other more damaging exploitation so that the forests remain in a productive state.

Conclusions

The above discussion suggests that three main types of research must be carried out in a coordinated manner: on station and on farm research and farm surveys. Priorities between these three needs to be established in order to allocate resources to pursue different research topics. A long-term association between the researcher and the farmer enables researchers to learn from farmers' day to day perception of their needs and opportunities. It is the locally perceived needs which should be the primary determinant of external inputs. On farm research, while very demanding in time and manpower, provides the researcher with immediate feedback on the relevance of technologies proposed for farmers' fields and also enables local farmers to be their own extension agents.

The supporting role of village-level nurseries is to ensure that they supply farmers' needs for fodder species, since an increase in fodder-tree planting on private land will reduce the pressures on those forests used to supply fodder. It is essential therefore to establish nurseries which are responsive to farmers' needs and form part of an integrated approach to the role of fodder trees in these farming systems. To achieve this end government and Forest Department initiatives must be directed towards identifying the needs and preferences of the farmers, and to the formation of effective extension systems which link farmer needs with nursery seedling production and appropriate research either on-farm or on-station.

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