Fodder development for smallholder dairying in Azad Jammu and Kashmir and Nepal

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My talk was based on experiences as specialist in fodder development, range management and ruminant nutrition on an integrated hill farming development project for World Bank in AJK and a livestock development project for Asian Development Bank in the Central Region of Nepal during 1989 -1992. This report summarises a strategy for fodder development worked out for the Middle Hills of Nepal.

Farming systems in the Middle Hills of Nepal revolve around the conversion of fodder from ground and tree vegetation plus litter to manure and compost by traditional livestock, primarily work oxen and dairy buffaloes although some cows are kept for reproduction and goats are kept for meat. The typified farming system is given in Fig. 1, with areas of private and common lands available based on mean values based on survey data from 1970's. These land holdings are most representative of householders at the lower boundary of the upper quartile, that is 75% of farmers have less land than indicated. There is also tremendous variation in the proportion of different types of land, with many households having little access to forests.

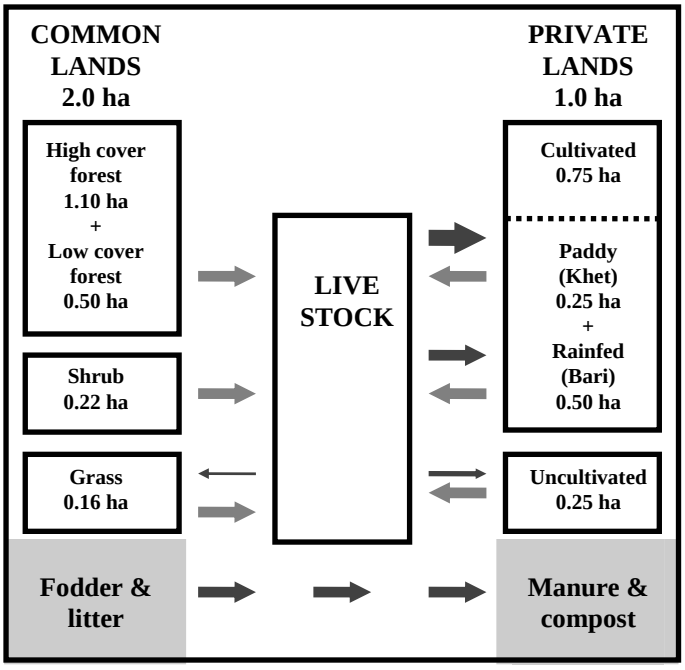

Figure 1. The farming system in the Middle Hills of Nepal: typified for medium - large scale household

Livestock development under the project in Nepal was based on the conversion of subsistence small-holders organised in groups of at least 20 households into semi-commercial dairy farmers. This was linked to development of milk collecting centres and modernisation of the milk industry. At the time it depended solely on the milk market in the major towns of the Region, especially Kathmandu. It was problems concerned with the existing policy that led to the development of the strategy reported here. These problems included: marketing - only 10% of Nepal's population were urban, so the market could easily be over supplied with disastrous consequences for small farmers who had taken out loans for purchase of exotic dairy cows and buffaloes; milk collection - restricted to farmers adjacent to the limited road network; capital and extension staff - farmers had to invest in a package of measures for intensive milk production. While highly successful, only a small proportion of farmers in the region could benefit from the scheme.

In the Middle Hills, relative resources available to farmers for livestock development depends on distance from markets in urban centres (Table 1). This is largely self-explanatory; knowledge is included as a resource, and it is accepted that indigenous farming families will have considerable knowledge of their own particular farming systems.

Table 1. Relative resources available to farmers

Resource	Economic stage of farmer		
	Peri-urban commercial	Semi-rural semi-commercial	Rural subsistence
Land	*	**	***
Labour	*	**	***
Capital	***	**	*
Knowledge	**	**	**
Input supply	***	**	*
Output market	***	**	*

The appropriate level of livestock development will depend on the economic stage or situation of the farmer (Table 2). Peri-urban farmers are in a position to rapidly move to commercial milk production due to ready access to markets and capital, but will suffer high opportunity costs for land and labour; they can base their system on high producing dairy cows or buffaloes fed concentrate rations up to 3 x maintenance according to Western systems of nutrient allowances. Urban markets might be developed for feeds and for green, dry and treated fodders. Crop residues and fodder from common lands will remain the major feed resources for rural subsistence farmers keeping local cows and buffaloes to be fed at 1.25 - 1.5 x M. The animal production system will be matched to available feed resources, with fodder development from improved crop production, fodder trees and management of common lands. Semi-rural semi-commercial farmers with a market opportunity can base the feeding of improved and crossbred cows and buffaloes on cultivated fodder crops with fodder conservation and treatment of crop residues as appropriate, also matching their animal production system to available feed resources.

Critical limiting factors in animal nutrition for subsistence farmers in the Middle Hills of Nepal are listed in Table 3. The main "hungry gap" occurs in Spring during March - May when residues from previous crops have been consumed and before harvest of the winter wheat crop. Traditionally in the hills this gap is met by tree fodder collected from the forests and from private lands. Mixtures of various tree fodders are fed without any other fodders or feeds; and fodder is available from a succession of tree species either before leaf fall or with

Table 2. Appropriate levels of ruminant livestock development

Factor	Economic stage of farmer		
	Peri-urban commercial	Semi-rural semi-commercial	Rural subsistence
Basis of feeding system	Purchased concentrate	Cultivated fodder crops	Crop residues and fodder from common lands
Level of feeding	Maintenance x 3.00	Maintenance x 2.00	Maintenance x 1.25 - 1.50
Basis of feeding system development	Feed budgets to meet nutrient requirements	Match animal production system to available feed resources	Match animal production system to available feed resources
Suitable forms of fodder and feed development	Urban markets for feeds; and for green, dry & treated fodders	Cultivated fodder crops; silage / hay; treatment of crop residues; & molasses / urea blocks	Fodder from crop production, fodder trees, & management & development of common lands
Suitable type of livestock	Pure exotic cows	Crossbred cows and selected buffalo	Local cows and local buffalo
Breeding input required	Artificial insemination	Imported bulls, AI possible	Selected local bulls
Animal health input required	Intensive disease prevention and control of production diseases	High level of disease prevention	Basic disease control

leaf flush as temperatures increase in Spring. For farmers who live away from the forest this period is especially critical.

Table 3. Critical limiting factors in animal nutrition for subsistence farmers

Priority	Limiting factor	Period ONDJFMAMJJAS
0	Total quantity of fodder	XXX
1	Fermentable nitrogen	XXX
2	Minerals:salt & phosphorous	XXXXXXXXXX
3	Digestible green fodder	XXX

A range of technical strategies are available to farmers, which make use of each of their land resources, Tables 4-6. These relate to application or improvement of traditional practices, as well as the introduction of new technologies. The particular nutritional limitations addressed in relation to Table 3 are given, together with the relative cost to farmers - low, medium or high. All interventions have to be targeted to meeting fodder needs during the feed gap.

On croplands (Table 4) emphasis is on increasing yields of the maize crop which provides residues of greatest nutritional value, through agronomic measures of L-M cost. In the hills of AJK, in a cool temperate zone, treatment of home grown maize seed with fungicide doubled grain yield and trebled stover yield; for Rs 1.00 investment the benefit was Rs 67.00. Conservation of green fodders by triple wrapping 5 kg lots in plastic shopping bags, termed Little Bag Silage (LBS), was developed in AJK with farmers and further trialled in Nepal. Little bags were much preferred to large bags (100 kg), as one bag is one feed for one cow or buffalo. Peri-urban dairy farmers in Kathmandu valley keep traditional buffaloes, and have to purchase all their fodder, mainly paddy straw. They found that if they made LBS from green paddy straw, buffalo would eat one bag a day in addition to their normal ration. This resulted in an extra 1 litre milk, that is they got 3 l instead of 2 l milk per day. In Kathmandu the extra litre was worth Rs 20, against a cost for the plastic bags (heavy grade) of Rs 3 in total, while two out of the three bags could be used again. In AJK much of the winter wheat crop in the hills was actually fed as fodder early in spring, rather than using a specialist crop of fodder oats. It was responsive to fertilizer N, and if a fodder cut was taken early the regrowth might still be grown on for grain. Within the livestock project in Nepal, farmers feeding fodder oats in spring to exotic cows were regularly obtaining 12-14 litres of milk from fodder alone. Further, in the Jiri area of Nepal at 2000 m a.s.l. farmers had adopted Brown Swiss cows from a long term Swiss project, but not the way to feed them As a result of our project fodder oats were re-introduced. Farmers were amazed: while local cows gave 2 litres, they had been obtaining 5 litres from grade Brown Swiss cows; when they supplemented their normal rations with bundles of oat fodder, this increased to 10-12 litres...they couldn't believe it. While summer fodder crops can give high yields of quality fodder especially when well manured or fertilised with N & K, to meet the fodder gap they must be conserved. LBS is ideal for this. However to devote crop land specifically to growing fodder is expensive and entails marketing of the milk to cover input costs. One shopkeeper in AJK started to grow all his land to Sadabahar multi-cut sorghum hybrid, specifically to make into LBS that he would sell in the winter. Unfortunately every mouse in the area will smell out LBS, so precautions are needed.

Table 4. Strategies for fodder and feed development in order to overcome nutritional limitations in the Hills. 1. Croplands

No.	Strategy	Nutritional limitations addressed	Relative cost to farmer	Comments
1.1	Increase fodder from maize crop			
1.1.1.	Fungicide seed dressing	0	L	New; also increase grain
1.1.2.	Introduce dual purpose maize cv	0,1,3	L	New; long term; > grain
1.1.3.	N P fertilizer	0,2	M	Also > grain
1.1.4.	Integrated pest control management	0	M	New; also increase grain
1.1.5.	Make LBS from maize tops	0,3	M	New; plastic bags available
1.2.	Grow winter fodder crops			
1.2.1.	Fertilise winter wheat with N, take green fodder cut	1,3,0	M	Grain crop still possible
1.2.2.	Grow oats + peas / vetch on irrig land & rainfed land in West	1,3,0	H	Peas for food; needs co-op of community
1.3.	Grow summer fodder crops for LBS	1,3,0	H	New; in place of food crop

Private uncultivated lands frequently have a cover of poor quality summer grasses, and farmers may have preserved or planted a variety of multipurpose tree species. Possible interventions (Table 5) aim to improve the quantity and or quality of fodder grown and / or conserved. Fodder trees that yield green fodder in the lean period are of particularly benefit, and in Nepal a number of species including Ficus had been identified. Many farmers in AJK 'volunteered' their hillside grasslands for planting to fodder and fuel woodlots of Robinia and Ailanthus. Frequently this was on abandoned or un-economic terraces. Ten years on the present status of these woodlots needs evaluation. In AJK hay making is common, but generally takes place at the end of the rains when nutritive value is low; however wilting or supplementation with sugar is required to make LBS successfully from native summer grasses. Where there had been Swiss projects in Nepal, self-employed teams of hay makers would cut pasture crops with scythes, hang the grass out to dry on stick fences, and finish drying in hay barns. The livestock project imported 500 Swiss scythes, complete with hammers and anvils for sharpening, again a follow up would be of interest. Strip planting of Stylosanthes and other summer legumes into local summer grasslands / bushlands was being adopted in Nepal, and is preferable to growing temperate pasture species at low altitudes as tried in AJK; summer legumes can be made into hay at the end of the rains and still have moderate protein level for supplementing cereal straws.

Table 5. Strategies for fodder and feed development in order to overcome nutritional limitations in the Hills. 2. Private uncultivated lands

No.	Strategy	Nutritional limitations addressed	Relative cost to farmer	Comments
2.1.	Plant additional fodder trees that yield green fodder in lean period	1,3,0	L	May reduce crop yields by shading / competition
2.2.	Grow wintergreen perennial fodders	1,3,0	M	Have not been adopted
2.3.	Harvest surplus green fodder			
2.3.1.	Improve hay making methods	0,3	M	Labour cost, very humid
2.3.2.	Develop LBS	1,3,0	M / H	Low sugar levels in natural grass
2.4.	Grow summer perennial fodders for conservation			
2.4.1.	Strip plant tropical legumes for hay	1,2,3,0	M	New, some success with Stylo's
2.4.2.	Grasses for LBS	1,3,0	H	New, eg Napier hybrids

A prerequisite for improved management and development of common lands (Table 6) is the formation of community based organisations (CBO's). Any one area of forest, shrub or grass land may be utilised by a number of communities each with different traditional access rights, and all must be represented. Considerable progress was made in introducing participatory management through the Community Forestry Project in Nepal, while methodologies have been developed through the Agha Khan Foundation in NWFP and northern territories of Pakistan. To meet the feed gap traditional practices of deferred use of tree and ground fodder need to be re-instated and strengthened. Constraints to traditional range management practices need to be evaluated; where these are based on seasonal movement of livestock the introduction of range management on a "fit - to - graze" basis in order to protect desirable range species is worthwhile. Local livestock keepers and where applicable nomadic herders do have the required knowledge for these interventions, but local social structures need support. In addition sedentary livestock keepers need to build up fodder supplies so that they can keep livestock off the pastures until they are ready for grazing.

Table 6. Strategies for fodder and feed development in order to overcome nutritional imitations in the Hills. 3.Common uncultivated lands

No.	Strategy	Nutritional limitations addressed	Relative cost to farmer	Comments
3.1.	Develop community management of natural resources through CBO's			
3.1.1.	Defer harvest of fodder tree species	1,3,0	L	Traditional
3.1.2.	Defer use of ground fodder	0	L	Traditional
3.1.3.	Develop range management on "fit to graze" basis	0	L	Need to build up private fodders
3.2.	Develop common resource through CBO's			
3.2.1.	Plant trees for fodder in lean gap	1,3,0	M	Long term, protection
3.2.2.	Oversow with summer legumes for hay making	1,2,3,0	M	New, medium term
3.2.3.	Oversow with winter legumes + P for grazing	1,3,0	M / H	New, medium term
3.3	Conserve fodder			
3.3.1.	Dry mature ground fodder as hay	0	L	Traditional in some areas
3.3.2.	Conserve green fodder as LBS	0,1,3	M / H	New

Defined areas of woodland and newly re-afforested land in the lower hills of Nepal were being planted with tropical legumes including Stylosanthes, for harvest as hay after seed production. Both white and red clover were persisting at cool temperate sites in AJK provided high levels of phosphate had been applied at establishment; considerable work is still needed for these temperate legumes to escape from research stations.

Finally there are a range of interventions possible to directly improve nutrition of dairy animals (Table 7). Top priority is to plan feeding programmes over the year so that provision is made for fodder during the gap. Where protein byproducts are available, these should be saved to supplement cereal straws. Salt is always available, but should be mixed with equal parts of bonemeal or mineral P for animals in milk. Urea treatment of roughages was introduced to farmers in AJK, who were enthusiastic to convert inedible rough grasses into fodder for buffaloes. It has the added benefit of killing infective fluke stages on paddy straw. Treated good quality fodders can replace green fodders as substrates for microbial multiplication when used to supplement untreated cereal straws. While urea / molasses blocks can be made locally and strengthened with locally deficient minerals, they are

Table 7. Strategies for fodder and feed development in order to overcome nutritional limitations in the Hills. 4. Animal nutrition

No.	Strategy	Nutritional limitations addressed	Relative cost to farmer	Comments
4.1.	Defer feeding protein byproducts	1	L	Plan feeding programme
4.2.	Feed salt / bonemeal or mineral P mix	2	M	P for animals in production
4.3.	Urea treatment of roughages not fed to convert them to fodder			
4.3.1.	Maize stalks (bottoms)	0,1	M	Converts fuel to fodder
4.3.2.	Millet straw	0,1	M	Needs development
4.3.3.	Wheat straw	0,1	M	
4.3.4.	Coarse dry grass	0,1	M	Compost to fodder
4.4.	Urea treatment of dry fodders: feed as green fodder supplements			
4.4.1.	Maize stalks (tops)	1,3	M	
4.4.2.	Paddy straw	1,3	M	Kills fluke
4.5.	Purchase feeds as CP supplements			
4.5.1.	Urea / molasses blocks	1,2	H	New, short to medium term
4.5.2.	Oilseed cakes	1,2	H	Only if locally available

expensive and locally available oilseed cakes are easier to manage, while also having high levels of rumen degradable protein. Dried leguminous tree fodders/pods are of high value.

The objective of the strategy paper was to assess what development opportunities were available to all farmers in the Middle Hills of Nepal. The distribution of farmers by size of farm taken from farming systems surveys in the 1970's is given in Table 8, to which is added the relative cost of activities that might reasonably be undertaken without

Table 8. Ability of farmers to undertake activities for fodder and feed development in the Middle Hills of Nepal

Farm size class	Proportion of farmers	Area (ha)	Relative cost of activities that might be undertaken
Small	0.54	0.025 - 0.50	L
Medium	0.25	0.51 - 1.00	L,M
Large	0.20	> 1.00	L,M,H

external assistance. Thus over half the farmers can only be expected to take up those activities with the minimum cost. Attention in development programmes for poverty alleviation should focus on this level of activities, with attention also on the formation of self-help groups and other CBO's. However it is still valid to pursue other activities with medium to large scale farmers in order for them to become self-sufficient in fodder production. This would reduce their demand on common land resources, upon which landless households and those with small land holdings are most dependent.

By today's perspective the interventions proposed above may appear too prescriptive. Certainly a far greater understanding of farmers' and herders' traditional practices is required, along with knowledge of their appreciation of the opportunities and constraints under which they live. Major constraints frequently relate to the greater political economy of their village, district and country. It is valid, however, to prepare a menu of technical possibilities as a reference for farmers as to how they might evolve their traditional technologies, and within this to include socio-economic classification.

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