Forage Resource Development on Degraded Land in Nepal: A New Approach

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Introduction

Rangeland development was introduced into Nepal in the late 1950s with the establishment of yak and yak hybrid cheese factories in several mountainous regions of the country. At that time, research and development efforts stemmed from species' evaluation and forage production programmes carried out at the Singha Durbar Livestock Farm between 1953-1959. Perennial, short rotational rye grasses were studied in combination with white clover imported from New Zealand particularly for pasture improvement.

Pastoral development programmes brought in by INGOs, NGOs, and government agencies began in 1970. In the early 1980s, the government also introduced the Northern Areas' Pasture Development Programme (NAPDP). This project attempted to offset the fodder crisis facing most of Nepal's northern districts after access to the Tibetan pasture — part of traditional transhumance patterns — was curtailed and the Nepal/Tibet border was closed. The NAPDP concluded in 1992, however, and forage/pasture development became the responsibility of District Agricultural Development Offices. In 1995, the Department of Agriculture and Livestock Services was created and pasture development activities again shifted hands. They are now under the jurisdiction of District Livestock Offices and the Department of Livestock Services (DLS). These frequent organizational changes have weakened forage and rangeland development activities and research and development networking has been inconsistent.

A comprehensive range of fodder and pasture improvement materials (seed, rootstock, etc) has been imported from various countries over the last 35 years and has been used both for research and extension purposes on a sporadic, *ad hoc* basic. Technical support and additional information, however, are very limited. Initiatives need to be expanded in order to improve livestock productivity and, therefore, the socioeconomic status of many Nepalese.

Nepal's Fodder Situation

Over the last 30 years, the human and animal populations have increased at a much faster rate than have food and forage resources. Fifty-six per cent of the 20 million inhabitants of Nepal live in the mid- and high hills. Over 50 per cent of households in these areas have average land holdings of 0.18 hectares. This amount of cultivable land can hardly produce half of the staple foods required to maintain nutritional standards within individual families (FAO 1992), let alone adequately feed livestock.

Nepal's fodder shortage is estimated at 36.25 per cent (Pariyar 1992). This lack of domestic animal forage further limits the availability of manure and other livestock products needed to sustain increased population pressure. Cereal yields are also decreasing (Table 1). Meanwhile, forests and shrublands — the traditional and primary source of livestock fodder — have substantially decreased in area (Table 2). During the 1960s, Nepal's forests covered 6.5 million hectares; in the 1990s, forests only accounted for 5.5 million hectares of the country's land mass.

Table 1: **Trends in Human Population, Animal Population, and Forest Coverage in Nepal**

Decade	Human Population ('000)	Animal Population ('000 head)	Forest Area ('000 ha)
1960s	9413	-	6500
1980s	15023	8226	6000
1990s	18600	8783	5500

Source: DFAMS (1986), MPFS (1988); LMP (1990); Rajbhandari and Shah (1981)

Nepal's overall socioeconomic and environmental situation has continued to deteriorate as a result of a continuous reduction in landholding sizes. Likewise, shortages of traditionally-used forest and animal fertilizer products have resulted in declining crop yields. Off-farm income generation activities and real wage rates have also declined in recent years. Given these adverse circumstances, the poor have become increasingly dependent on exploiting government land as well as community forests and rangelands for the sake of sup-

Table 2: **Yield Per Hectare and Growth Rates of Important Crops in Nepal and Other South Asian Countries in 1961-63 and 1991-93**

Country	Cereals				
	All	Paddy	Wheat	Potatoes	Sugarcane
1961-63					
Nepal yield (kg/ha)	1854	1940	1230	-	1979
Nepal as % of					
India	198	129	146		46
Bangladesh	111	116	198		53
Pakistan	212	140	150		61
Sri Lanka	108	101	-		119
1991-93					
Nepal Yield (kg/ha)	1817	2277	1340	9639	3467
Nepal as % of					
India	92	86	57	73	53
Bangladesh	70	86	75	92	86
Pakistan	84	93	69	85	82
Sri Lanka	61	74	-	89	101
Annual Growth Rates (%) 1961-63 to 1991 - 93					
Nepal	-0.07	0.54	0.29	-	1.89
India	2.71	1.92	3.46		1.39
Bangladesh	1.59	1.55	3.59		0.27
Pakistan	3.27	1.92	2.89		0.92
Sri Lanka	1.75	1.57	-		2.45

Source: Adapted from Agricultural Perspective Plan (1995)
* 1961-65

plying their livestock with fodder (HLFFDP 1996).

New Approaches to Forage and Pasture Development

The Hills' Leasehold Forestry and Forage Development Project (HLFFDP) aims to correct these ecological and socioeconomic imbalances. Its two broad objectives are to raise family incomes of those living below the poverty line, and to help improve the country's ecological conditions. This project is being implemented jointly by four line agencies: the Department of Forests (DOF), the Department of Livestock Services (DLS), the Agricultural Development Bank of Nepal (ADB/N), and Nepal Agricultural Research Council (NARC). During the project's eight-year tenure, HLFFDP aims to involve 14,224 families and in doing so rehabilitate and develop 13,513ha of degraded land by planting timber, multipurpose, and fodder trees. The project also hopes to instigate grassland development activities, as well as comparable activities on adjacent farms (IFAD 1990). Each group involved in this project includes between five and seven families, all of whom own less than 0.5ha of land and whose per capita annual earnings are at most NRs 2,168 ($US 38). These groups will obtain lease rights to one hectare of degraded forest land for 40 years. They have the right to renew this lease.

An Integrated Research Development and Extension Training Programme (IRDET) has now been developed and implemented as part of the HLFFDP in order to further assist poverty alleviation, environmental protection, and sustainable development.

Basic Principles of IRDET

IRDET has been developed as a pilot activity aimed at addressing and resolving constraints faced within HLFFDP. IRDET activities are being conducted with farmers' participation and are focussed on the rehabilitation, management, and development of degraded lands. It is the project's assumption that such activities, with the support of local institutions, will continue well beyond the actual duration of IRDET (HLFFDP 1995, 1996).

IRDET strategies and procedures target individual families as a means of empowering communities at large. This project aims to increase the quality, quantity, and seasonal availability of forage and animal products. IRDET also hopes to develop an environmentally-sound and socioeconomically-viable management structure for the rehabilitation of degraded land.

IRDET Methodology

IRDET plans to realise these goals through the following methodologies: group formation and land sanctioning; group discussion and programme formulation; loan availability for land development; household surveys; site identification; classification; and description. Training on seed treatment, basal fertilizer, inoculation and lime pelleting, line planting of pasture legumes, and the planting and use of fertilizer for nitrogen-fixing trees and shrubs will be offered to both leasehold farmers and JT/JTA of DLS by NARC staff. In addition, the formulation and monitoring of a workplan for leasehold groups will include an initial site questionnaire, botanical descriptions, analysis of land availability, and farmer preference for common fodder species. Description and analysis of farmland and soil quality, as well as a list of inputs and outputs geared towards economic analysis of the project's impact, will also be included. A socioeconomic survey and analysis of locally-perceived constraints and preferences for developing livestock fodder on area

farmland are also included in IRDET's methodology.

Forage and Pasture Interventions

Since 1995, a new non-traditional approach has been used to facilitate poverty alleviation through the rehabilitation of degraded forest land and the development of adjacent arable lands. This two-tiered approach is being led jointly by HLFFDP's Technical Assistance component and NARC as part of the IRDET programme. This initiative includes a farmer-based field network that integrates research, development, and extension work. Training plots for seed and fodder production have been established. A research-based farmer support network has been founded and national and international connections have been fostered to bridge the gap between existing institutional frameworks and the specific needs of the project.

Protection from Grazing to Facilitate Natural Regeneration of Indigenous and Naturalised Exotic Fodder and Pasture Species

Previous project experiences and examples gleaned elsewhere indicate that protecting a degraded area from grazing provides ample opportunity for indigenous vegetation (including naturalised exotic species) to regenerate. Paudel and Tiwari (1992) reported that protection of 19.2 hectares of community plantation land produced 24MT of dry matter and could potentially produce 30MT of grass as well as 100MT of wood biomass annually. On this basis, the project strongly suggested that degraded land not be grazed at all in order to promote rehabilitation and development of indigenous and natural exotic species (HLFFDP 1996).

Site Identification, Classification, and Description

To begin any kind of intervention programme, detailed information about local preferences for common fodder species, land formation and soils composition, vegetation analysis, and socioeconomic conditions must be collected. Farmers' perceived constraints and preferences for developing livestock fodder on their leasehold farmland should also be analysed.

In this context, 128 soil samples, 125 plant samples, and 1,789 farmer interviews have been collected and conducted. Soil status analysis indicates that soils are acidic and nitrogen and phosphate deficient. A large number of plant species has low nutritional status; their productivity is estimated at 0.5-1MT of green matter/ha. However, some species that are present in sample plots, such as *Heteropogon Contortus, Pogonatherum* spp *Desmodium* sp, *Crysopogon gryllus,* and *Flemingia* sp have been said to increase milk and ghee production, therefore indicating that they have substantial nutritional value.

Households were large, consisting of five to ten members. Ruminant livestock populations were also very high (4-19.5 head per household). Landholding sizes varied from 0.28 to 0.92 hectares per family. These land characteristics and socioeconomic structures indicate that project areas suffer from increased pressure on fodder and fuel resources, particularly in areas near forests and on some cultivated areas. Malnutrition is also a problem, as annual area cereal production only meets nutritional requirements for between one and 2.5 members of a household.

Strategic Use of Naturalised Exotic Fodder and Pasture Species on Degraded Land

For the last 10 years, Stylo (*Stylosanthes guianesis*) and Molasses (*Melinis minutiflora*) have proven successful fodder species on degraded land in warmer climates. White clover (*Trifolium repens*), cocksfoot (*Dactylis glomeratai*), and perennial grass (*Lolium perenne*) have shown limited potential in cooler climates. Stylo was used in the low to transitional belt (400-1,800m), while white clover was introduced on high altitude pastures (1,800-2,500m) in areas of minimum tillage. White clover seeding was also combined with line planting inoculation, pelleting, and the use of starter fertilizer. The pasture legume seeds were seeded at three kg/ha after inoculation and lime pelleting with the use of starter fertilizer ($N_{45}P_2O_{5\ 115}\ S_{30}$ kg/ha /DAP 250 kg/ha and Gysum 150 kg/ha).

Primary turf skimming was not deeper than three cm and covered 30cm bands along hill contours at 75cm intervals. Fur was placed on downhill slopes to control run-off. Starter fertilizer was applied on the downhill side and inoculated and pelleted pasture legume seeds were sprinkled on the upper hillside. Care was taken to separate seed from fertilizer and gypsum and to selectively incorporate seed and fertilizer with soil. Local grasses were occasionally cut from between five and ten inches on both sides of the turf in order to increase green fodder production and control competition. This procedure was repeated three to four times each year. Productivity data collected in August 1996 revealed that Stylo had produced 18 to 36MT of green matter/ha in low altitudes and 9 to 15 MT/ha in the transitional belt; white clover harvested in December 1995, under occasional grazing conditions, produced 3 to 4MT green matter/ha in high altitude areas.

Strategic Use of Nitrogen-Fixing Tree Plantations on Degraded Land

The proper establishment of nitrogen-fixing trees in combination with other multi-purpose/fodder trees has been the basis of IRDET's silvipastoral programme. For all species, planting holes of 3 X 50cm were combined with starter fertilizer (DAP 250 gm and Gypsum 150 gm/pt or N_{15}, P_2O_{546}, S_{12} kg/ha). Trees were space planted at 400 ha/ha, and undersown with pasture species. *Bauhinia purpurea*, *Lencaena diversifolia*, and *lencocephala* have been planted in low and transitional belts while *Robinia Pseudocasi*, *B. variegata*, and *Alnus nepalensis* have been established at high altitude locations. *B. purpurea* seedlings planted according to this method have a 52 to 95 per cent survival rate, reaching an average height of 10 feet in 14 months. *L. diversifolia*'s survival rate was 50 to 92 per cent with an average plant height of 4.5 feet in 14 months. *L. pallida* had a survival rate of between 20 and 60 per cent with an average plant height of 2.5 feet in 14 months. These plants are found in low, transitional, and high altitude areas, respectively.

Problems Encountered

White clover (*Trifolium repens* cv. Khumaltar) has not been successfully established on many sites. Mono-species' evaluation has to be combined with other species such as *Lotonomis bainesii cv* miles, *Lotus pedunculatus* Maku, etc. *Anthracnose* might effect stylo cultivation in the future. Resistant cultivars such as CIAT-184 and Graham should be introduced on a large scale.

Occasional conflicts between leasehold forestry and community forestry groups have resulted in the grazing of established plots

at two or three high altitude sites. More training and institutional commitment is necessary to remedy these problems. Likewise, although four institutions are working together on this project, determining norms based on research recommendations, particularly by the DLS, has been difficult. Such activities aim at extending IRDET activities to a number of key locations. More backup support is required for proper research funding, hiring international consultants, and establishing networks with national, regional, and international institutions.

Recommendations and Conclusions

Present degraded land development projects have relied on simple, affordable, and sustainable technological packages. This approach could be replicated — or at least tested — on rangeland ecosystems. Although ranges are fragile environments, improving their productivity is a fundamental component of alleviating Nepal's fodder shortages (Basnyat 1995).

The methodology developed under IRDET can be replicated and tested throughout the Hindu Kush-Himalayas, provided that appropriate institutional support is given. Institutions such as ICIMOD should formulate and support a location-specific demonstration plot. Such a programme could set an example for the ways in which management, institutional, technical, and socioeconomic factors affect the improvement of degraded land. Fodder development and rangeland improvement strategies will only be successful with national, regional, and international cooperation and support.

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