

IMPORTANT ASPECTS OF TECHNOLOGY DEVELOPED FOR THE IMPROVEMENT OF RANGELAND PRODUCTION SYSTEMS

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1. INTRODUCTION

The Range lands are those areas of the World which by reason of physical limitations-low and erratic precipitation, rough topography, poor drainage, or cold temperatures- are unsuited for cultivation and which are a source of a forage for free ranging native and domestic animals, as well as a source of wood products, water and wildlife (Miller, 1997). The rangeland in Nepal includes grasslands, shrub lands, forest and other areas often used by grazing animals. Polyculture farming systems have been evolved through centuries by integrating the rangeland, forest, domestic animals and crop production in most parts of the high mountain region of Nepal. The rangelands and forest provide forages, wild life, medicinal plants and sources for water bodies. The domestic animals provide meat, milk, wool, manure and power for transportation and other agricultural operation. The cropped areas provides cereals, pulses, cash crops, fruits and forages and by-product feed to the animals (Shah and Friend, 1992).

2. IMPORTANCE OF RANGELANDS

- Rangeland ecosystem is the originating environment of many water bodies and river system in Nepal. Thus the hydroelectric power, irrigation and drinking water system at lower elevation is related with the rangeland of high mountain region.
- Rangelands are rich in biodiversity of plants, animals, and other important genetic materials for future use.
- The vast rangelands provide forages for grazing livestock. The rangeland unsuitable for growing crops, can be utilized by animals for producing high value animal product.
- Tourism in the mountain rangeland is useful for improving the livelihood of the local people of the mountainous region.

2.1 Distribution of rangelands in Nepal

In spite of the importance of rangeland mentioned above, Nepal lack comprehensive assessment of rangelands. Land resource Mapping Projects (1986) estimate the areas of rangeland of about 1.7 million hectare comprising of 12% of total land Areas of Nepal (Table1). About 37% of the rangeland is accessible to livestock in Nepal (LMP 1993 and Pariyar 1998). The rangeland under national parks constitutes about 34.45% of the total rangeland (Yonzon 1998).

Table 1. Distribution of rangelands in Nepal (km²)

Physiographic Region	Total land (percent)	Rangeland (grazing land)		
		Area	Percent of Total land	Percent of Grazing land
Terai (tropical)	21220(14.39)	496.6	0.34	2.92
Siwalik (subtropical)	18790(12.74)	205.5	0.14	1.21
Mid-Hills	43503(29.50)	2927.8	1.98	17.20

(temperate)				
High Mountain (subalpine)	29002(19.66)	5071.3	3.44	29.80
High Himal (alpine)	34970(23.71)	8315.4	5.64	48.87
Total	147485	17016.6	11.54	100

3. TECHNOLOGY DEVELOPED AND TRANSFERRED TO RANGELAND PRODUCTION SYSTEM

Rangelands in Nepal are mostly in the hills and mountains have been characterized as rocky substratum, low fertile soil with degradation due to overgrazing and vegetation becomes sparse and nutritionally low grade, with unpalatable species stay on and proliferate. It has been observed that protecting a degraded area from grazing provides ample opportunity for indigenous vegetation to regenerate. Poudel and Tiwari (1992) reported that protection of 19.12 ha of community plantation land produced 24 MT of dry matter and could potentially produce 30 MT of matter of grass as well as 100 MT of wood biomass available. Hills Leasehold Forestry and Fodder Development Project strongly suggested that the degraded land not be grazed at all in order to promote rehabilitation and development of indigenous and naturalized exotic species. From the study done at different rangelands of Rasuwa district fenced rangeland produced more Forage (GM and DM) yield than often grazing land.

In subalpine rangeland area the Cocksfoot (*Dactylis glomerata*) established better by transplanting suckers than by seed broadcasting. The cultivation of exotic grass like Rye grass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*) and white clover (*Trifolium repens*) with post monsoon, sowing (broadcasting or strip sowing) have shown good performance in establishment and GM production.

Fodder tree species that are identified for winter feeding at the range of up to 24000 masl. Are *Ficus nerifolia* (Dudhilo), *Morus alba* (Kimbu), *Brasiopsis hainla* (chuletro), *Sauraria nepalensis* (Gogan), *Quercus semi-carpifolia* (Khasru), *Prunus cerasoides* (Painyu) and *Quercus leucotrichophora* (Sano banjh). *Quercus Semicarpifolia* (Khasru) produced maximum biomass up to 130 kg. per tree. For high hills combination of grass and legume in rangeland gave better production yield. To boost the nutritive value of rangeland in high hill and sub-alpine area combination of white clover (*Trifolium repens* cv. Khusal), Cocksfoot (*Dactylis glomerata*) and Rye grass (*Lolium perenne*) is recommended. The combination of 3 species produced 28.7 MT green matter per hectare where as the combination of white clover and Rye grass and white clover and cocksfoot produced 17.01 and 20.64 MT green matter per hectare, respectively.

3.1 Minimum tillage practice

In the degraded sloppy lands of hilly area (mid-hill to high hill) minimum tillage practice was recommended for the cultivation of legumes. This practice reduces input cost of preparing the land for cultivation, and soil erosion due to soil disturbance. Clover and stylo was established in degraded lands of high hills and mid-hills, respectively using minimum tillage practice. Use of Inoculation and lime pelleting for legume establishment and production of Green matter is increased by using inoculation with lime pelleting in degraded acidic soil.

3.2 Productivity of Rangelands:

The estimate of carrying capacity and productivity of Alpine pasture (Table 2) is higher than the steppe and subtropical and temperate pasture land.

Table 2. Productivity of rangelands (Miller 1989, Raj Bhadari & Shah 1981)

Rangeland	Area (km)	Productivity (TDN.t/ha)	Carrying capacity	Stocking rate (LU/ha)
Subtropical & Temperate	6293	0.58	0.54	7.07
Alpine	10141	1.54	1.42	0.64
Steppe	1875	0.06	0.09	1.19

TDN= total digestible nutrient, LU= livestock unit

4. ASPECTS OF TECHNOLOGY DEVELOPMENT AND DISSEMINATION

The Technology development and dissemination should deal with biological, physical and social sciences for efficient use of the rangelands.

4.1 The physical Sciences

The technology development to be effective for rangeland development should consider the following property of rangelands.

Soil: Soil organic matter, soil fertility, soil temperature, structure, depth of soil, physical and chemical properties of soil.

Climate: Temperature, rainfall, relative humidity, their seasonal pattern, radiation, evaporation and water sources.

Physical Nature of the rangeland: Accessibility, remoteness, steepness, rockiness, nearness of water sources, nearness to the village, possibility of fencing & cultivation, exposure of the slope, nearness to the cultivated field or cropland and fragile ecosystem of mountain rangelands.

4.2 Biological Sciences

Technology development for range development deals with plant, animal and human being.

Understanding of pastures species, forage species and fodder tree in association with forest crops and different ecosystem is a complex biological phenomena. Some of the aspects are discussed as follows.

1. Awareness to control rangeland degradation through the regulation of livestock numbers based on carrying capacity of the rangelands has been created and need to test for verification. The number of animals that can safely be allowed to graze without the deterioration of rangeland is not easy to be in operational. The principle is to balance livestock grazing pressure with natural regenerative capacity of range plants. The various factors that affect carrying capacity like slope, steepness, fertility status of rangeland, distance to water sources should be considered for range management purposes. The indigenous knowledge for rotating grazing practices should also be considered for range management system. The assessment of composition of vegetation in rangelands over a period of time is essential for development of range management system.
2. The pressure from population growth forcing to bring arable land into crop Producing land resulting to push livestock production system to move towards marginal & fragile lands.
3. Integration of crop-livestock and agro-forestry is becoming more important to utilize the resources efficiently. Multipurpose uses of crops such as cowpea or pigeon pea that fertilize the soil as well as provide feed to animal and food to human beings.

4. Awareness to improve the environment effects due to livestock through better nutrition by improving pasture by incorporating the legumes to improve soil fertility, and to conserve the soil has been created.
5. The rangeland is rich in ecological and biological diversity.
6. In-situ technologies development should get priority.
7. Income from milk crossbred cow increased substantially than from local cows. This technology can be developed in the forage based production system.
8. The major development challenge for range management is to meet the growing demand of livestock products without degrading the natural resources. The principal should be to increase the livestock products by increasing yield per animal rather than by increasing the numbers. The Chauries production and their use in range land utilization is a good system for this purpose.
9. Agro-horti-pastoral system: The forage production under the apple orchard trees has been a successful practice in Rasuwa district.
10. Sub-subsistence farming system: The people of mountainous region have to adopt the sub-subsistence farming system. The food they produced is not sufficient for their livelihood. They have to depend on other sources.

Men go for job to lower areas and women has to do farming, child rearing and other household works. They have to depend on materials and money brought by men working at other places.

4.3 Social Sciences

Different ethnic people live in the high mountain areas. They have different culture, festival and other social system. The social system will play important role for adoption of range development technologies. The following issues should be considered for technologies development and dissemination.

- a) Community based integrated forestry management of water catchments areas, rangeland, crop-livestock and forestry production system for sustainable mountain development is needed.
- b) The poverty and environmental degradation are the important factors affecting the rangeland dwellers for sustainable development of the rangelands. The technologies generation should be carried out in partnership with the local communities.
- c) Strengthening of local institution is needed for development of rangelands.
- d) Participatory land use management
- e) Community based water catchments management..
- f) Institutional development for promotion of self-help user group of rangeland.
- g) Need of Go/NGO coordination with the self-help CBO.

5. THE FUTURE STRATEGIES

- Legume forage crop incorporation with wheat millet or maize crop for improving the crop residues feeding quality during winter season.
- Intensification of legume forage crops mixed with some grasses under the apple orchard trees.
- Undertaking the in-situ forage production and conservation programme in partnership with rangelands user groups.
- Contour hedge growing sloping agriculture technology for forage production.
- Leasing the land for range land user group with package of technologies.
- Conservation of quality forages in association with farmer groups.
- Development of technology to increase productivity of animal without increasing the livestock numbers in partnership with farmers groups.

- Rangelands development as an integrated watershed areas for hydroelectricity drinking water and irrigation system at lower valley.
- Cultivation of fodder beet or turnip for severe winter supplement feeding.

Sustainable promotion of income generating measures should be undertaken for improving the livelihood of the people. Some of them are as follows:

- Pasture and forage seed production
- Vegetable seed production
- Collection and production of medicinal plants
- Agro-processing (cheese, chutneys)
- Eco farm park, eco-tourism development
- Off- seasonal market led vegetable production
- Apple, walnut production
- Saffron production

"Green road concept" Environmentally compatible expansion of transport net work in association with the user group should get emphasis so that 75% of the construction cost remain with the user group.

Improved management including identification, conservation, and improve use of animal and forage genetic resources.

Farmer group approach for in situ genetic improvement of the existing breed and for management of rangeland to the user group seems to be the appropriate approach for improving the rangeland productivity.

Involvement of donors and concern institutions Go & NGO in partnership with local farmers group for development of technology and dissemination of the developed technology.

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