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Abstract. Rangelands are located in the high mountains and Himalayan regions at 2500-5000 m a.s.l. in Nepal. Sevety-eight percent of the existing natural rangelands are located in high altitude regions in northern Nepal bordering Tibet. Limited agricultural production is due to the scarcity of water, lack of proper irrigation, low temperatures for long periods and low rainfall. 1.7% of the land is arable with an average landholding surface area of 0.35 ha in Nepal. Livestock grazing play an important role in the fertility and distribution of plants. It is evident that the livestock sector contributes almost half of total agricultural income i.e. 47.3%. Cattle, yaks, Chauries, dzos, sheep, goats, horses, mules and donkeys are the major livestock species reared in rangelands. Transhumant pastoralism is the major form of livelihood in higher altitude pasturelands. The mobility of the animals follows a routine such that seasonal growth of the grasses is best utilized. Conserving the large area of natural ecosystem and sustainable production of diverse niche products are the best way for supplementing their livelihood and protecting the range species. China, Pakistan, Afghanistan and India have the highest share of rangeland in the region. Tibetan Plateau has rangelands covering nearly 70% of the total Plateau area. The plateau has unique traditional features and scientific rangeland management practices. This paper highlights the current pastoralism and rangeland management practices in Nepal with some reference examples.

Keywords. Pastoralism – Transhumance – Biodiversity.

Conduite des parcours au Népal dans le contexte de l'Asie du Sud

Résumé. *Les parcours des régions himalayennes sont situés entre 2500 et 5000 m d'altitude au Népal. 78% des parcours naturels sont situés dans des régions de haute altitude dans le nord du Népal qui borde le Tibet. La production agricole est limitée par le manque d'eau, d'irrigation, les basses températures pendant de longues périodes et les faibles précipitations. 1,7% de la terre est cultivable dans des propriétés en moyenne de 0,35 ha. Le pâturage joue un rôle important dans la fertilité et la répartition de la végétation. L'élevage contribue pour environ la moitié, 47,3% du total du produit agricole. Les bovins, les yaks et leurs croisements, les moutons, les chèvres, les chevaux, les mules et les ânes sont le principal bétail élevé sur les parcours. Le pastoralimse transhumant est la principale forme d'élave dans les pâturages d'altitude. La mobilité des animaux suit une routine qui permet d'utiliser au mieux la croissance saisonnière de l'herbe. Conserver ces grandes surfaces couvertes de végétation naturelle et la production durable de différents produits de niches, constitue la meilleure façon d'apporter un revenu par l'élevage et de conserver les espèces des parcours. La Chine, le Pakistan, l'Afghanistan et l'Inde partagent les parcours dans cette région. Le plateau tibétain est occupé par des parcours qui couvrent presque 70% de la surface totale du plateau. Ce plateau a des traditions de conduites des parcours uniques. Cet article met en avant les pratiques actuelles de conduite des parcours au Népal.*

Mots-clés. *Pastoralisme – Transhumance – Biodiversité.*

I – Introduction

The Rangelands 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 are a source of forage for free ranging native and domestic animals, as well as a source of wood products, water and wildlife (ICIMOD, 1997). Rangelands in Nepal include grass-

lands, shrub lands, forest and other areas often used by grazing animals. Polyculture farming systems have evolved through centuries by integrating rangelands, forest, domestic animals and crop production in most parts of the high mountain regions 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 operations. The cropped areas provide cereals, pulses, cash crops, fruits and forages and by-product feed to the animals (Shrestha, 2004).

Livestock production supported through the pasture and rangeland area is providing the major support for livelihood in high-hills and mountain regions. The contribution of the livestock sector to total agricultural income of farmers varies from 20% in Terai to almost 50% in mountain regions (NPAFC, 2011). Livestock in high hills and mountains is mostly managed under a migratory system. The hills of Nepal are reported to have the highest concentration of livestock per unit area of cultivated land anywhere in the world (Miller, 1987), with 10 LU/ha in the mid hills and 15 in the high hills. There is an acute shortage of feed in the high lands during winter and dry season. Rangelands besides being rich in agriculture and livestock biodiversity are the sole source for feeding highland livestock.

The contribution of the livestock sector to Agricultural Gross Domestic Production (AGDP) is 26.8 percent and about 12% to National GDP. In the year 2012, the annual growth rate of cattle, buffalo, sheep and goat was 0.3, 2.8, 0.3 and 3.6 percent respectively (DLS, 2013). Similarly, the annual growth rate of livestock products such as meat, milk and eggs was 3.9, 5.6 and 8.9 percent respectively. The live male buffalo calves and goats are mainly imported from India and Tibet. Besides, the processed meat and milk powder from abroad is also imported for fulfilment of daily requirement.

II – Rangeland resources

Rangelands are diverse in structure and composition, ranging from cold, steppe rangeland dominated by Stipa grass to mountain desert shrublands with Ceratoides, Artemisia to alpine valleys and temperate conifer and deciduous forest meadows. Hindu Kush Himalayan (HKH) Region extends 3500 km over all or part of eight countries where ICIMOD works including the Himalaya, the Karakorum, the Pamir and other neighbouring ranges (Table 1). It is the source of ten large Asian river systems and provides water, ecosystem services and the basis for livelihood to a population of around 210 million people. The people of Himalaya have maintained a rich cultural identity and have maintained biogenetic diversity within the parameters of their own tradition (ICIMOD, 2013).

Table 1. Area of rangelands in HKH region (ICIMOD, 1997)

S. N.	Country	Area of rangeland (km^2)	Percent share of total HKH region
1	China (Tibet)	1,250,000	60.80
2	Pakistan	400,000	19.42
3	Afganisthan	200,000	9.71
4	India	180,000	8.71
5	Nepal	20,000	0.97
6	Bhutan	7,000	0.34
7	Myanmar	760	0.04
8	Bangladesh	290	0.01
TOTAL		2,058,050	100.00

Tibetan plateau covers 2.5 million km^2 and is one of the world's major rangeland ecosystems. With rangeland covering nearly 70% of the total land area the Plateau is an important pastoral region. Most of the area is above 3000 meters and climate is harsh. Precipitation varies from about 2000 mm in southern Himalayan ranges to less than 50 mm in the far north-western part of Tibet.

In the Himalayan country of Nepal, LRMP (1986) estimated the areas of rangeland at about 1.76 mil ha comprising 12% of total land areas of Nepal. The Rangeland Policy 2012 (Ministry of Agricultural Development, 2012) included 1.6 mil ha of shrubland into rangeland comprising now 22.6%. 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, 1999). About 50 percent of total grassland is found in high mountains, 29 percent in high hills, 16.7 percent in mid hills and 4 percent in Siwwalik and terai. About 50 percent of rangelands are found in mid western region of Nepal.

1. Rangeland biodiversity

In 1992, Nepal became a signatory to the Convention on Biodiversity (CBD) and added one more feather to its conservation efforts when it approved Nepal Biodiversity Strategy (NBS) in 2002. Nepal has come a long way in terms of biodiversity conservation; 18.33% of its total land area is now under protection. Shrestha (1998) reported that among 5160 flowering plants, some 246 species are known to occur in sub-alpine and alpine rangelands. Accordingly, 41 species of medicinal plants out of 700 species were recorded in Nepal, from which 34% are found in rangelands. Nine mammalian orders out of 12 in Nepalese rangelands have been reported survived, of which eight are major wildlife species. For example: Leopard, Grey wolf, Tibetan Argali, Lynx, Brown Bear, Musk Deer, Red Panda, and Tibetan Antelope are commonly found in the region. Similarly around 413 bird species are reported to occur above 3000 m of altitude, whilst 19 species are known to breed in these high grounds.

Stretching for 3500 km from the desert mountain steppes of Afghanistan in the west to the lush alpine meadows in Yunnan Province of China in the eastern Himalayas, the rangeland ecosystems of the HKH encompass an enormous area, estimated to cover about 2 million km^2. Within such a vast region, rangelands differ considerably in plant community structure, depending on altitude, climate, rainfall, soil and the uses they have been subjected to by people and their animals. Each different range type has its own unique assemblage of plants and animals. Situated at the confluence of five major biogeographical subregions (the Mediterranean, Siberian, West Chinese, Indo-chinese, and Indian subregions), the rangeland ecosystem of HKH are rich in biodiversity (ICIMOD, 2013).

III – Pastoral production system

In Nepal, Rangelands are located in the high mountains and Himalayan regions at 2500-5000 m asl. The existing pasturelands are almost natural. Approximately 78 percent of the rangelands are located in high altitude regions in the northern belt of Nepal bordering Tibet (LRMP, 1986). Grazing animals and wildlife obtain forage from rangelands and the contribution of such areas to environment protection is important as well. Pasture lands vary from subtropical grassland at lower elevation to alpine meadows on ride in the mid-hills, high mountain valleys of the inner Himalayan range. The grazing lands except the alpine meadows are under heavy grazing pressure (Pariyar, 1993). The mid-hills and the open grazing lands are stocked about 13 times more than its carrying capacity and the steppe grazing lands about 19 times, whereas the alpine meadows are under-stocked. The alpine meadows are grazed only three to four months in summer (Table 2). However, the carrying capacity of the above rangelands could be significantly improved by adopting improved management practices, by promoting indigenous species such as Kote, Phurcha, Buki, etc. and by introducing some exotic species.

Transhumant pastoralism is the major form of pastoralism in higher altitude pasturelands of Nepal and Tibet. These en route pastoralists and transhumance make it sustainable through high seasonal mobility. It provides a number of particular transhumant herding, promotes trade of animal products such as milk, meat, wool and provides temporary employment (Miller, 1995).

The animals are moved towards the alpine pasture during monsoon seasons and brought back to the lower altitude forest, shrub-land and croplands for winter grazing. The movement of the animals follows a routine such that seasonal growth of the grasses is best utilized at different altitudes. The animal movement schedule is synchronized with crop harvesting at lower altitude for better utilization of their residues. In general, the movement cycle begins from the highest altitude 5000 m alpine rangelands during summer (monsoon period) to the lowest altitude 1800 m subtropical rangelands in winter. The movement cycle is completed in 365 days.

Table 2. Rangeland Status of Nepal (Miller, 1987)

Types of rangeland	Area (km^2)	Productivity (DM ton/ha)	Productivity (TDN ton/ha)	Carrying capacity (LU/ha)	Stocking rate (LU/ha)
Subtropical & Temperate	6293	2.5	0.58	0.54	7.07
Alpine	10141	1.5	1.3	1.42	0.64
Steppe	1875	1.0	0.06	0.09	1.19

In subalpine rangelands, the cocksfoot (*Dactylis glomerata*) established better by transplanting suckers than by seed broadcasting. The cultivation of exotic grass like ryegrass (*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 green matter production. Fodder tree species that are identified for winter feeding at the rangelands of up to 2400 m asl 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). For high hills a combination of grass and legumes in rangelands gave better yields. To boost the nutritive value of rangelands in high hill and sub-alpine areas a combination of white clover (*Trifolium repens*), cocksfoot (*Dactylis glomerata*) and ryegrass (*Lolium perenne*) is recommended. The combination of 3 species produced 28.7 tm green matter per hectare where as the combination of white clover and ryegrass and white clover and cocksfoot produced 17.01 and 20.64 tm green matter per hectare, respectively (Pariyar, 1998; Shrestha, 2004).

Pastoralists maintain milking and non-milking herds of yak (*Bos grunniens*), yak-cattle hybrids, sheep (*Ovis aries*) and goat (*Capra hircus*) during herding. Yak provides milk, meat, fibre and hides. They are also used as pack and draft animals. It is doubtful if man could survive in Tibet without the yak (Miller, 1986).

IV – Rangeland management strategies

Nepal approved the Rangeland Policy in 2012. It encompasses the inter-sectoral cooperation for management of rangeland. The government of Nepal has recently prepared the Rangeland Policy Implementation Plan. Nepal has adopted the following strategies: Classifying rangeland Inventory; increasing production and productivity; pasture development program; natural disaster preparedness; systematized grazing; renovation; reseeding of pasture forages and cross-border cooperation between Nepal and China.

Rangeland in Pakistan extends over 60% of the area of the country. The trans-Himalayan grazing land, desert rangeland, Baluchistan ranges contribute mostly in Pakistan range areas. Major

range animals are sheep, goat, camel, yak along with some population of cattle and buffalo. Range improvement activities like new plant introduction, natural and artificial reseeding, stock water management, soil and water conservation, rain water harvesting, water spreading, sand dune fixation, range burning and fertilization are carried out.

In Bhutan, permanent grasslands, forest grazing, and the grazing of fallow land contribute over 70% of fodder needs. Bhutan has over 400,000 ha of registered grazing land which belongs to the state and herders have the grazing rights. Over 80% of Bhutanese are engaged in agriculture-related activities contributing 41% to GDP. Bhutan has 4.13 thousand ha registered as grazing land and 1.55 thousand ha as natural grazing land. The predominant exotic plant species are cocksfoot, white clover, red clover, tall fescue, perennial ryegrass and desmodium. Livestock rearing has always been an important source of livelihood, ranging from buffaloes in southern foothills to yaks in the northern high altitude regions.

In China, Sichuan province alone has 20.4 million ha of grassland with the largest ecosystem and biological diversity. The grassland has a productivity of 3.6 ton/ha with ruminant animals accounting for 55%. Vegetation reclamation and improvement of grassland productivity, sustainable animal production systems, decreasing number of herders through enterprise development are the strategies for Sichuan grassland. Similarly Tibet has a total of 82 million ha of grassland. The productivity of Tibetan plateau grassland is relatively low at an average of 1.04 ton/ha. Lhasa-grassland common property, household responsibility system, policies on rural pastoral areas, rehabilitation of traditional cultivation are the rangeland development strategies followed in Tibet along with rejection of agricultural mechanization and providing technologies in close association with farmers.

VI – Conclusions

Since rangelands are often remote, at high elevations, subject to harsh climates and sparsely settled, they have been largely neglected by research and development agencies. This neglect has been further exacerbated by institutional anomalies. The main factor influencing sustainable rangeland management is the productivity, their longevity, palatability and resistance to grazing, and stocking rate of livestock. In many arid and semi-arid rangelands of the tropics with large variations in rainfall from year to year, the stocking rates of livestock cannot be constant. However, a conservative stocking rate can reduce the risks of degradation of rangelands and give better production per animal compared to higher stocking rates. Nevertheless, a major challenge lies ahead to convince pastoral people about the benefits of reducing stocking rates and improving production efficiencies, in order to achieve higher livestock production, an improvement in income and less degradation of the rangeland. However, some basic strategies are common for range management and pastoral development.

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