

Pastoralism as a Contributor to Niche Production and Services

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Abstract:

In the context of increasingly globalized mountain economy, Tibetan Plateau region - influenced by a successful agriculture and tourism sectors - is harnessing the potentials of niche products using its pristine range and pasture landscape by the nomadic farmers. Pastoralism, especially its good practice, is vital for conserving large areas of natural eco-systems in this region. Accessing markets by sustainably producing diverse niche products and services for supplementing their livelihood means is one such practice. With a trend of rapid increase in global demands for natural products, production and marketing of niche products and services contributed by diverse systems, pastoralism has good prospects for increasing the income of pastoralists and foragers in the region. The nomadic life-style helps widespread sharing of good practices and refinement of traditional knowledge which now has become internationally recognized. Livestock grazing play an important role in the fertility and distribution of plants, by scarifying seeds in their guts, transporting them over great distances and fertilizing the ground where they are deposited. As a result, pastoralism has created environments that are favourable to specific plant and animal species to produce quality products.

Pastoral niche production covers both plants and animal-based products including meat and meat products, dairy products, raw woolen products, and harvesting and primary processing of medicinal herbs. Medicinal plants not only play a pivotal role in providing primary healthcare for pastoralists, increasingly these niche products are being gathered, processed and sold in national and international markets. Prominent examples of high value medicinal plants that are commonly used in the Tibetan system of traditional medicine (*Soya Rigpa*) are: *Ophiocordyceps sinensis*, *Neopicrorhiza scrophulariiflora*, *Picrorhiza kurrooa*, *Nardostachys grandiflora*, *Dactylorhiza hatagirea*, *Podophyllum hexandrum*, *Aconitum* spp. etc. Experience gathered to date suggests that technical, socio-economical, institutional and policy inputs are required to develop niche production in pastoral systems. This paper analyses and recommends the following actions in future: a) raising awareness through different formal and informal education means; b) skill development in sustainable harvesting as well as grazing management; c) production of organic and sustainably managed niche products; d) integration of agricultural and pastoral livelihoods with off-farm activities through value-chain development of major niche products that have high value capturing potential. e) improvement of degraded pasture lands to enhance productivity of niche products and services; f) conservation through sustainable-use oriented policy and legal reforms to implement integrated strategies of linking conservation of wild fauna and flora with sustainable pastoral production systems; and g) expansion of ecologically sensitive low-input high-return tourism, using pastoralists to provide services, particularly through their indigenous knowledge and improved local production practices.

Key words: *globalized economy, medicinal plants, Soya rigpa, natural ecosystems, organic niche products, value-chain, pastoralism*

Background

Human well-being is strongly dependent upon ecosystem services provided freely by nature and its vast biodiversity wealth. Many of these goods and services are public property, and as such they do not have a market price as the market system mainly rewards resource owners and suppliers for the benefits of ecosystem conversion and use. As a result, ecosystem degradation and biodiversity loss is often not detected by our current market system. Currently, a variety of pressures resulting from population growth, globalization of economy, changing diets, urbanization, acculturation and climate change is causing additional strain on ecosystem conservation and management of natural resources further accelerating ecosystem degradation and biodiversity decline (Bhattarai and Karki 2010). It is, therefore, topical to study and evaluate the various goods and services provided by the ecosystem and the natural resources therein and the possible adverse effects caused by various human activities to maintain a balance between resource utilization and economic growth within the particular ecosystem.

Against this background, the present paper aims to address the status and key issues concerning pastures, pastoralism and niche products and services in the Himalayas and recommend few action points.

The HKH region and the Tibetan Plateau

The Hindu Kush Himalayan (HKH) region is one of the world's richest ecosystems in terms of biodiversity, with about 12,500 species of higher plants (Dobremez 1996) and four out of 34 biodiversity hotspots in the world. Grasslands occupy a large portion of the region's land surface and are important as a feed source for livestock, as a habitat for wildlife, a regulator for environmental protection and for the *in situ* conservation of genetic resources. Rangelands cover two million square kilometers of the Hindu Kush Himalayan region that include large parts of Afghanistan, Pakistan and the vast expanses of the Tibetan Plateau, which reaches out into India, Nepal and Bhutan. These rangelands have great influence on the welfare and economy of the rangeland dependent pastoral societies. This vast area is supporting the livelihoods of millions of pastoral population and their livestock.

Pastures, Pastoralist and Pastoralism in the Himalayas and the Tibetan Plateau

Pastoralism is often the dominant livelihood of the diverse human communities occupying the Himalayan and the Tibetan plateau regions. Subsistence agriculture supplemented by livestock and rangeland and nearby forest products continues to be the main occupation of the Himalayan and Tibetan pastoralists. Pastoral livestock are an integral part of the environment in which they are reared, and in most cases they have played a major role in the development of their environment. Those environments are often highly diverse, and both livestock and livestock managers have contributed to that diversity through systematic resource use and management techniques, such as burning and pollarding by livestock keepers, and grazing and trampling by livestock. Rangelands play an important role in determining the socio-economic condition of rural people (NPC 1993), but rangelands in this

region are under heavy grazing pressure, thereby causing the depletion of the resource which has resulted into feed shortage and hence the livestock productivity (Jha 1991).

Pastoralism is vital for conserving large areas of natural habitats. In rangeland environments, mobility is a pre-requisite for effective natural resource use as pastoralism is also a resource conservation and management strategy. Livestock grazing play an important role in the fertility and distribution of plants, by scarifying seeds in their guts, transporting them over great distances and fertilising the ground where they are deposited. The selective grazing and browsing of livestock and the active management by herders influences the distribution of plants and enables a wide diversity of plants to thrive. As a result pastoralism has modified grasslands and created environments that are favourable to certain kinds of wildlife species.

Promotion and Management of Pastures and Pastoralism

Well managed rangelands have diversified grass species and higher carrying capacity (Hermans and Verejken 1995) and well managed pasture is the most cost effective feeds that could be produced and utilized in the region. A very significant proportion of the region's rangelands have been brought under protection in the form of national parks and conservation areas. This has increased the roles and responsibilities of the pastoralists in the conservation and sustainable management of the area. For example, the Department of National Parks and Wildlife Conservation (DNPWC), Nepal has developed a new approach to protected area management through changing its management regime from 'traditional' park management to 'participatory' park management. Consequently there has been a shift from traditional 'wildlife-centered' to more 'participatory people-oriented' management regimes. In line with the new approach, 'protecting park against the people' has been shifted to 'involving people in park management'; 'standard park management' approaches have been replaced by systems that build on 'local management systems'; and 'wildlife protection' has been shifted to 'integrating resource management and biodiversity conservation'. This approach has motivated the traditional herders and pastoralists in many rangeland areas to organize themselves into grazing user groups (GUG) with declared rights and responsibilities. The committees of the GUGs have their own funds and the objective is to promote local-level networking for promoting collaboration, maintaining health of the ecosystems and promoting biodiversity conservation and management of their sites. In principle, the objective and procedures of formation and functioning of the GUGs are the same as for the community forest user groups (CFUGs).

Pastoralism-based niche products and services

The Himalayan and Tibetan pasturelands are rich repositories of bio-diverse resources and contain many niche products of high market values. A range of mountain high value products and services (HVPS), such as medicinal and aromatic plants (MAPs), different types of wild mushrooms, nuts, berries, indigenous honey-bees, eco-tourism, and ecological services are attracting the attention of range managers as well as development planners due to their high economic values and often low volumes, examples include different types of mushrooms including *Ophiocordyceps sinensis* and morels.

Pastoral productions include both animal and plant-based products. Animal products include cattle hides and pelts, and yak's tail - locally called "chamar" is considered sacred and highly traded for use in Tibetan monasteries and Hindu temples during worships. Other animal products include meat and meat products, and dairy products. Dairy products include curd (fermented milk), butter (obtained from diluted churned or stirred-up curd), different types and grades of raw cheese prepared from yak-milk based curd, and 'chhurpi' and other milk products. Carpets and rugs weaved from sheep wool are the major raw wool-based products. Plant-based products include various edible wild plants, spice and condiments and medicinal plants.

Food plants

Due to their inhabitation in remote areas accompanied by nomadic lifestyle, the pastoralists have acquired extensive knowledge and experiences on wild spices, condiments and food plants available in their rangelands and pastures. These are used regularly by the pastoralists to supplement their diet while some of these constitute their major food item. Major wild spices and condiments include plants like *Allium* spp., *Carum carvi*, *Heracleum nepalense*, *Mentha longifolia*, *Ferula aasa-foetida*, *Oxalis corniculata*, *Thymus linearis*, etc. Many of these are also used in traditional medicines.

Many species of *Allium* are dried and sold or bartered in the villages and markets in the name of 'Jimbu' largely used to flavor curry and pickles. While majority of *Allium* species are endemic to the Himalaya, *Allium hypsistum*, the most preferred 'Jimbu' is endemic to Central Nepal. *Carum carvi* and *Ferula aasa-foetida* are also items of regular collection, use and trade.

Majority of the wild food plants collected by the pastoralists belong to the under-utilized wild crop category. Some of the wild edible plant, notably *Allium* species, *Aconogonum molle*, species of fern including *Diplazium stoliczkae*, *Dryothyrium boryanum*, *Dryopteris cochleata* and *Polystichum squarrosom*, are also brought to the local markets for sale. Annex 1: Table 1 includes a list of frequently used spices, condiments and wild food plants by the pastoralists and nomads.

A number of wild plants are also preserved after some primary processing and fermentation. A prominent example of fermented plant-based niche product includes 'gundruk' which is produced after fermenting leafy vegetables. 'Gundruk', mostly consumed as a soup, can also be made into fresh pickle (Bhattarai 1991). While almost every leafy vegetable can be made into 'gundruk', a number of wild leafy vegetables, notably *Gerardiana diversifolia*, *Rheum australe*, *Phytolacca acinosa*, *Capsella bursa-pastoris*, *Chenopodium album*, *Arisaema flavum*, *Urtica dioica*, *Malva verticillata*, etc., are also fermented and made into 'gundruk'. In the same trend, chipped tender bamboo shoots are fermented to prepare 'tama' that can also be dried for future uses. Both 'gundruk' and 'tama' have their own typical flavor and taste that can be preserved for two or more years depending upon the storage conditions (see Annex 1: Table 1).

Medicinal plants

The rangeland specific medicinal plants have been providing health care services and facilities to thousands of the local pastorals and their families. Many of these medicinal plants species are specific to the rangeland habitats and a number of them have high commercial demands in adjoining countries as well as abroad. High altitude rangelands, pastures and adjoining forests and shrub-land are the most suitable habitats for a large number of medicinal plants that are widely used in almost all systems of traditional medicines including Tibetan system (*Soya Rigpa*), traditional Chinese medicines, Ayurvedic system, Unani system, and many others. Some of these, notably *Ephedra gerardiana*, *Podophyllum hexandrum*, etc., are also used in the modern systems of medicines or allopathy. Annex 1: Table 2 provides a list of important medicinal plants available in the high-altitude pastures and rangelands while considerable details on some commercially valued medicinal plants such as *Ophiocordyceps sinensis*, *Nardostachys grandiflora*, *Neopicrorhiza scrophulariiflora*, *Picrorhiza kurrooa*, *Dactylorhiza hatagirea*, *Delphinium himalayai* and *Aconitum* spp.

***Ophiocordyceps sinensis* (Berk.) G.H.Sung, J.M.Sung Hywell-Jones & Spatafora (Yarsagumba)**

Ophiocordyceps sinensis (Yarsagumba) is one of the high-value low volume organic medicinal products with increasing international markets and reported only from parts of 4 Himalayan countries along the Tibetan plateau – China, Nepal, Bhutan and India. It is the result of a parasitic relationship between the fungus and larva of the ghost moth (*Thitarodes* spp.). Both the moth and fungus are endemic to the high altitude pastures of the Himalaya and Tibetan plateau regions. Initially collected and used by the herdsmen in the areas of its occurrence, *O. sinensis* has recently become one of the most valued natural medicinal materials.

Till date, attempts to propagate *O. sinensis* have not been successful. Although China and some western countries have succeeded in developing asexual culture of the fungal mycelium in various media that does not include the host caterpillar, this has not been successful to replace the natural products demand and hence *O. sinensis* continues to be the most expensive rangeland specific niche product. China's annual production is estimated at about 100 ton followed by Nepal (4-5 ton), Bhutan (1 ton) and India (500 kg), respectively (Bhattarai 2010).

The price paid by the local traders to collectors in Nepal in 2008 was NRs. 350,000/kg (about 4,700 US\$) while the same in 2009 was 250,000. (Chhetri 2010). The high-altitude pastoralists have long been the major collectors of the fungus that have been vital for improvements in their livelihoods.

***Nardostachys grandiflora* DC.**

Nardostachys grandiflora is endemic to the Himalaya occurring in Uttarakhand (India), Nepal and Tibet (south-west China) between 3600-4800m altitudes. The roots and rhizomes

constitute the drug ‘spikenard’ used in almost all systems of traditional medicines to treat a large number of health problems including hysteria, epilepsy, heart diseases, colic, etc. Apart from medicinal uses, recently the product has entered into the European markets for the perfumery products. Nepal is believed to be the largest supplier of the medicinal raw material to the international markets with the production of about 200 ton per annum (IRG 2006) followed by China and India, respectively. Being a rangeland product its collection has contributed high to the pastoralists to improve their livelihoods.

***Neopicrorhiza scrophulariiflora* (Pennell) D.Y. Hong**

Neopicrorhiza scrophulariiflora is endemic to the Himalaya distributed in Uttarakhand (India), Nepal, Bhutan, Myanmar and Tibet (China) between 3500-4800m altitudes. The rhizomes constitute the drug material used in all systems of traditional medicines. Major diseases treated are fevers, jaundice, anemia, dropsy, bile disorders anorexia, etc. Bhattarai and Olsen (2000), while investigating the national importance of medicinal plant trade in Nepal, recorded the legal trading of Kutki from the country to be 260 tons in 1997/98 (Olsen 2001). Bhattarai (2007) also reported that about 26 tons of dried raw materials were illegally exported to Tibet (China) from the Taplejung district (east Nepal) alone in 1998/99. This and many other medicinal plant species are also recorded to have been unofficially exported to Tibet from the western districts of Nepal, the focal destination being the town of Taklakot in Tibet (Bhattarai 2007). Nepal is the largest producer of the species, almost all collections being exported legally or illegally. Being a rangeland product its collection has contributed high to the pastoralists to improve their livelihoods.

***Picrorhiza kurrooa* Royle ex Benth.**

Picrorhiza kurrooa is the west Himalayan species distributed in Pakistan to Uttarakhand (India) and Tibet between 3300-4300m altitudes. The roots and rhizomes constitute the drug material and are used in all systems of traditional medicines. Its therapeutic properties are recorded to be identical with those of *Neopicrorhiza scrophulariiflora*. This is a CITES-listed species with limited area of production but with high commercial demand, the collection and trade of which has long been supporting the livelihoods of the nomads and pastoralists.

***Dactylorhiza hatagirea* (D.Don) Soo**

Dactylorhiza hatagirea is endemic to the Himalaya distributed in Pakistan, India, Nepal and south-east Tibet along 2800-4000m altitudes. The rhizome constitutes the drug material used in all systems of traditional medicines and are used to treat urinary and bowel complaints. It is also used as a tonic, expectorant, and astringent.

Although legally protected in Nepal, the species is regularly collected and illegally traded and hence its collection and trade has always been secretive. Nepal is thought to be the largest producer of this species; almost all collections are exported illegally. In addition to being used in the various codified systems of traditional medicines, a significant proportion of the collection from Nepal reaches the Arabian countries where it is used to prepare the drug ‘salep’ considered to be an aphrodisiac. Being a scarce rangeland product its market

value is high and hence its collection has contributed high to the pastoralists to improve their livelihoods.

***Delphinium himalayai* Munz.**

Delphinium himalayai is endemic to Nepal and occurs at 3000-4500m in the western and central parts of the country in sub-alpine and alpine grasslands. Popularly known as 'Nepali atis', it is a well-reputed medicinal plant. The rhizome is used in various Ayurvedic medicinal preparations as well as local healing procedures. It is said to have astringent properties and is used in dyspepsia, diarrhea, dysentery, cough and cold, and as a tonic. Being an endemic species having limited range of distribution and increasing commercial demands, the pastoralists and nomads have been benefited from the collection and trade of this valuable medicinal plant.

***Aconitum* spp.**

Various species of *Aconitum* are used in all systems of traditional medicines and, like many other medicinal plant species, are the niche products of the high-altitude rangelands. *Aconitum* of commerce is usually a mixture of dried roots of a number of *Aconitum* species. At least ten species of *Aconitum* are collected from different altitudes of the rangeland for commercial purposes. Three species of commercially valued *Aconitum* (*A. angulatum*, 3800-4200m; *A. balangranse*, 3800-4000m and *A. nepalense*, 4000-6000m) are endemic to Nepal while others (*A. balfouri*, 3700-4000m; *A. bisma*, 3000-4000m; *A. ferox*, 2100-3800m; *A. gammiei*, 3300-4300m; *A. heterophyllum*, 3200-3700m; *A. lacianatum*, 3800-4600m; and *A. spicatum*, 1800-4200m) are endemic to different regions of the Himalaya and the Tibetan plateau. Due to their availability in very high altitude localities, accompanied by increasing price of the raw material, the pastoralists have been benefited high from its collection and trade.

Discussion

Rangelands have great influence on the welfare and economy of pastoral society. In the Tibetan plateau region the linkage between rangelands and the people is more intense due to higher dependence of the people for their livelihoods. In general, use of rangeland for enhancing the animal production is viewed as a means of improving the quality of rural life although managing rangelands and planning for sustainable pasture development in high altitude regions like the Himalaya and Tibetan plateau are challenging.

Major issues faced by pastoralists and farmers involved in production and marketing of niche products are: a) lack of market information and market infrastructure to manage their products, b) lack of skill and capacity to produce marketable products in increasingly competitive and globalised markets, c) lack of the capacity and capability to organise, negotiate, and sustain pastoral community's comparative advantages in producing and marketing niche products and services to distant markets, d) lack of the knowledge to develop a sustainable livelihood systems, e) lack of access to simple technologies and credit, and d) absence of supportive policies and institutional framework to promote niche products.

Value chain development strategies of select products need to start with a focus on the mobilisation and organisation of collectors, producers, and service providers to participate in different value chain development pilots. Such pilots can provide a regional platform for developing and sharing knowledge and information on value chains, build the capacities of local and national partners, develop good practices in value chain development for a range of niche products and services, and highlight the significance of regional cooperation in harnessing the potential of mountain niches.

As the baseline element of the ecosystem approach it has to be recognized that humans, with their cultural diversity and traditional knowledge and practices, are an integral component of ecosystems. Sustainable use of rangeland for enhancing animal production can be considered as a means of improving the quality of rural life. Pastoralists often move their herds to better grazing areas before the current area is completely depleted, because the likelihood of obtaining higher foraging returns elsewhere seems more economical. Nomads and pastoralists have been the pioneer collectors and traders of various niche products including medicinal plants in the Himalaya and the Tibetan plateau region. In the rangelands, where biological resources are relatively abundant and other income generating opportunities are limited, medicinal plants offer a good prospect for enhancing the livelihood and income of local communities. Yet, the opportunities are tapped on a limited scale due to lack of entrepreneurial capabilities, marketing knowledge, and financial resources.

Technical problems are not the main ones facing pastoralism and transhumant herding; the major ones are socio-economic. Although the pastoral system in the region has remained functional for a long period of time, it cannot always serve as a model for the future. Sustainable livelihood approaches should be central to understanding and addressing the diverse factors that influence poverty and general well-being of the pastoralists. Livelihood enhancement and diversification has been recognized, by conservationists and development practitioners alike, as a mechanism to promote rural livelihood development. It is obvious that there is an increasing tendency of the pastoralists to become more diversified and settled. Use of pasture land for rain fed agriculture is an increasingly widespread phenomenon in most parts of the Tibetan plateau. In the hope of getting a quick return, the pastures are ploughed up that destroys the indigenous vegetation, paving ways to ecosystem alteration. This practice has led to significant degradation of pasture land, both quantitatively as well as qualitatively. While this is an important coping or risk mitigation strategy, this however, needs to be improved with scientific knowledge or good practices prevalent elsewhere. The aim would be to continue building on and maintaining their traditional good practices but remain adaptive to the climate and socio-economic changes which are occurring in the Tibetan plateau and Himalayan regions.

Another point to make is that both men and women play important roles in the conservation and management of pasturelands including its use of niche production systems. Cultural practices and societal norms, prevalent in the Himalaya and Tibetan plateau region impact on rural women's mobility, their access to market and information and thus their capacity to get better economic benefits. Indigenous knowledge and experience of both men and women are important in framing strategies and hence there should be clear understanding and improvement of gender roles and responsibilities in the sector.

While environmental adversities such as change in weather pattern have always existed, they are now aggravated by climate change. Livelihood diversification and creating increasing options for income enhancement is central to helping pastoralists and transhumant herders to cope with natural hazards and adapt to climate change. As climate change becomes more obvious and part of the ecosystem factors, there is a need for doing a more dynamic analysis of ecological and socio-environmental systems in an integrated and scientific manner recognizing both the constraints and opportunities.

The activities, previously conducted by and limited to pastoralists, have now been conducted by other land users and outsiders as well. As international trade in medicinal plants has grown to a multi-billion dollar industry, the local harvesting patterns have shifted from subsistence local collection to commercial mining without regard to the regeneration of species for future yields in most cases including not only quantitative increase in harvesting but also destructive harvesting, unscientific harvesting, pre-mature harvesting, etc. (Bhattarai and Croucher 1996). In other words, the wild collection system that was previously sustainable has now been threatened – an example being that of *Ophiocordyceps sinensis*. The growth in the alternative medicine market in industrialized nations is a significant contributor to this trend (Bhattarai and Karki 2004b). With the rise in income of the urban population, the demand for natural products has gone up domestically as well.

Pastoralism is vital for conserving large areas of natural habitats. Where pastoralism is practiced effectively, and where local knowledge and institutions are effectively mobilised, the environmental outcomes are positive. However, where local institutions are undermined, and traditional knowledge is limiting, pastoral environments are easily degraded. The future of pastoralism has been shaped by many distinctive twentieth century influences, which confound a return to some prior or imagined conditions. Such influences include, for example, losses of prime grazing land to cultivation, gazetting of pastoral lands for conservation and political, economic and social marginalization and simple conversion of rangeland for urban settlement and recreation. It is possible nonetheless to ensure that appropriate policies, legal mechanisms, and support systems are in place to enable pastoralists to enhance the economic, social and ecological sustainability of their livelihoods which includes but not only limited to conservation and management of mountain specific niche products including medicinal plants.

Lessons learned and suggested way forward:

It is often argued that economic growth, especially pro-poor growth indicated by increased annual household income provides a reasonable indicator of development. However, economic development in pasture lands has to go beyond the fulfillment of basic needs by including the element of bicultural conservation and individual economic freedom to decide what is best livelihood pursuit for the pastoralists and their society. The protection of cultural heritage is quite important for pastoralists. Therefore, it can be argued that promotion of niche products and services not only provides cash income but also promotes diversified livelihood options and cultural preservation.

Experience gathered to date suggests that the sustainable development of mountain niche products and services requires a holistic and multi-disciplinary approach. Integration of technical, socio-economical, institutional and policy inputs are needed to develop niche production in pastoral systems. Some of the lessons learned are as follow:

Pastoral livelihood development by adapting to changes: Awareness raising, skill development and knowledge sharing through both the formal and informal education means are necessary to understand the potential value of niche resources and transferring new knowledge and practices. Hands-on training and capacity development in range resource development, sustainable harvesting as well as systematic grazing management can lead to sustained and quality products including of organic niche products. Since nomadic system is declining, integration of agricultural and pastoral livelihoods with off-farm activities should be promoted through value-chain development of major niche products.

Niche products Marketing: The concept of value chain development and application is new to the range and pasture lands. Here also, awareness raising and capacity building play the key role. Global and regional experience indicates that the promotion of value chains for pastoral niche products with a pro-poor vision calls for mixed institutional collaboration with governmental institutions as the regulators of the policy and legal framework, knowledge and applied research institutions such as ICIMOD for back-stopping and technical expertise, and community-based enterprises and small businesses to equitably integrate small-scale producers and service providers into the value chain.

Conclusion and recommendations: This paper has analysed various constraints and opportunities that exist in Tibetan pastoralism. The overriding conclusion is that Tibetan pastoralism is undergoing transformation and diversification while maintaining traditional and cultural values and systems seem to be a clear trend. Therefore the authors recommend the following actions for improving the changes already happening with a view that these changes are dynamic and adaptive to rapid climatic and socio-economic changes: a) raising awareness through different formal and informal education means; b) skill development in sustainable harvesting as well as grazing management; c) production of organic and sustainably managed niche products; d) integration of agricultural and pastoral livelihoods with off-farm activities through value-chain development of major niche products that have high value capturing potential. e) improvement of degraded pasture lands to enhance productivity of niche products and services; f) conservation through sustainable-use oriented policy and legal reforms to implement integrated strategies of linking conservation of wild fauna and flora with sustainable pastoral production systems; and g) expansion of ecologically sensitive low-input high-return tourism, using pastoralists to provide services, particularly through their indigenous knowledge and improved local production practices.

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Annex 1: Table 1. Rangeland specific edible wild plants, spices and condiments

Botanical name and family	Part used	Use/s
<i>Aconogonum molle</i> (D.Don) Hara (Polygonaceae)	Tender shoot	Vegetable, pickle
<i>Aesculus indica</i> (Colebr. ex Cambess.) Hook. (Hippocastanaceae)	Cotyledons	Edible
<i>Allium carolinianum</i> DC. (Amaryllidaceae)	Leaves	Vegetable, condiment
<i>Allium fasciculatum</i> Rendle (Amaryllidaceae)	Leaves	Vegetable, condiment
<i>Allium hypsistum</i> Stearn (Amaryllidaceae)	Leaves	Vegetable, condiment
<i>Allium oreoprasum</i> Schrenk (Amaryllidaceae)	Leaves	Vegetable, condiment
<i>Allium prattii</i> C.H. Wright apud Forbes&Hemsl (Amaryllidaceae)	Leaves	Vegetable, condiment
<i>Allium tuberosum</i> Rottl. ex Sprengel (Amarylladaceae)	Leaves, bulb	Vegetable
<i>Allium wallichii</i> Kunth (Amaryllidaceae)	Leaves	Vegetable, condiment
<i>Arisaema costatum</i> (Wall.) Mart. ex Schott (Araceae)	Rhizome	Vegetable
<i>Arisaema flavum</i> (Forsk.) Schott (Araceae)	Tender shoot, rhizome	Vegetable
<i>Arundinaria falcata</i> Nees (Poaceae)	Tender shoot	Vegetable
<i>Benthamidia capitata</i> (Wall.) Hara (Cornaceae)	Ripe fruits	Edible
<i>Berberis aristata</i> DC. (Berberidaceae)	Ripe fruits	Edible
<i>Berberia asiatica</i> Roxb. ex DC. (Berberidaceae)	Ripe fruits	Edible
<i>Cannabis sativa</i> L. (Cannabinaceae)	Seeds	Pickle, edible oil
<i>Capsella bursa-pastoris</i> (L.) Medikus (Cruciferae)	Tender leaves	Vegetable
<i>Carum carvi</i> L. (Umbelliferae)	Seeds	Spice
<i>Chenopodium album</i> L. (Chenopodiaceae)	Tender shoot	Vegetable
<i>Coraria nepalensis</i> Wall. (Coriariaceae)	Ripe fruits	Edible
<i>Dactylorhiza hatagirea</i> (D. Don) Soo (Orchidaceae)	Rhizome	Edible
<i>Dioscorea deltoidea</i> Wall. ex Griseb. (Dioscoreaceae)	Rhizome	Edible
<i>Diplazium stoliczkae</i> Bedd. (Aspidiaceae)	Tender fronds	Vegetable
<i>Dryoathyrium boryanum</i> (Willd.) Ching (Aspidiaceae)	Tender fronds	Vegetable
<i>Dryopteris cochleata</i> (D.Don) C. Chr. (Aspidiaceae)	Tender fronds	Vegetable
<i>Elaeagnus parvifolia</i> Wall. ex Royle (Elaeagnaceae)	Ripe fruits	Edible
<i>Fagopyrum dibotrys</i> (D.Don) Hara (Polygonaceae)	Tender shoot	Vegetable
<i>Fagopyrum tataricum</i> (L.) Gaertn. (Polygonaceae)	Tender shoot	Vegetable
<i>Ferula assa-foetida</i> L. (Umbelliferae)	Gum resin	Spice, condiment
<i>Girardinia diversifolia</i> (Link.) Friis (Urticaceae)	Tender shoot	Vegetable
<i>Heracleum candicans</i> Wall. (Umbelliferae)	Seeds, Root	Spice
<i>Heracleum nepalense</i> D. Don (Umbelliferae)	Seeds	Spice
<i>Hippophoe salicifolia</i> D.Don (Elaeagnaceae)	Ripe fruits	Edible
<i>Hippophoe tibetana</i> Schlecht. (Elaeagnaceae)	Ripe fruits	Edible
<i>Houttuynia cordata</i> Thunb. (Saururaceae)	Tender shoot	Vegetable
<i>Holboellia latifolia</i> Wall. (Lardizabalaceae)	Ripe fruits	Edible

<i>Juglans regia</i> L. (Juglandaceae)	Cotyledons	Edible
<i>Lilium nepalense</i> D. Don (Liliaceae)	Bulbs	Eaten boiled
<i>Lindera pulcherrima</i> (Nees) Benth. ex Hook.f. (Lauraceae)	Ripe fruits	Edible
<i>Malva verticillata</i> L. (Malvaceae)	Tender leaves	Vegetable
<i>Meconopsis grandis</i> Prain (Papaveraceae)	Seeds	Pickle
<i>Mentha longifolia</i> (L.) Hudson (Labiatae)	Leaves	Pickle, spice
<i>Ophioglossum nudicaule</i> L.f. Ophioglossaceae)	Leaves	Vegetable
<i>Osyris wightiana</i> Wall. ex Wight (Santalaceae)	Leaves	Tea
<i>Oxalis corniculata</i> L. (Oxalidaceae)	Leaves	Pickle
<i>Phytolacca acinosa</i> Roxb. (Phytolaccaceae)	Tender leaves	Vegetable
<i>Podophyllum hexandrum</i> Royle (Berberidaceae)	Ripe fruits	Edible
<i>Polystichum squarrosus</i> (D.Don) Fee (Aspidiaceae)	Tender fronds	Vegetable
<i>Prinsepia utilis</i> Royle (Rosaceae)	Seed oil	Edible
<i>Prunus cerasoides</i> D.Don (Rosaceae)	Ripe fruits	Edible
<i>Pyracantha crenulata</i> (D.Don) M.Roemer (Rosaceae)	Ripe fruits	Edible
<i>Pyrus pashia</i> Buch.-Ham. ex D.Don (Rosaceae) (Schisandraceae)	Ripe fruits	Edible
<i>Rhododendron arborem</i> Smith (Ericaceae)	Flowers	Pickle
<i>Rheum australe</i> D. Don (Polygonaceae)	Petiole	Pickle, curry
<i>Rorippa nasturtium-aquaticum</i> (L.) Hayek (Cruciferae)	Tender shoot	Vegetable
<i>Rosa macrophylla</i> Lindl. (Rosaceae)	Ripe fruits	Edible
<i>Rosa sericea</i> Lindl. (Rosaceae)	Ripe fruits	Edible
<i>Rubus calycinus</i> Wall. ex D. Don (Rosaceae)	Ripe fruits	Edible
<i>Rubus ellipticus</i> Smith (Rosaceae)	Ripe fruits	Edible
<i>Rubus fockeannus</i> Kurz (Rosaceae)	Ripe fruits	Edible
<i>Rubus foliolosus</i> D. Don (Rosaceae)	Ripe fruits	Edible
<i>Rumex hastatus</i> D.Don (Polygonaceae)	Tender leaves	Vegetable
<i>Schisandra grandiflora</i> (Wall.) Hook.f. & Thoms.	Ripe fruits	Edible
<i>Stellaria monosperma</i> Buch.-Ham. ex D. Don (Caryophyllaceae)	Tender shoot	Vegetable
<i>Thymus linearis</i> Benth. (Labiatae)	Leaves	Spice, condiment
<i>Urtica dioica</i> L. (Urticaceae)	Tender leaves	Vegetable

Annex 1: Table 2. Rangeland specific commercially valued medicinal plants

Plant species and family	Plant part/s
<i>Aconitum angulatum</i> Tamura (Ranunculaceae)	Root
<i>Aconitum balangranse</i> Lauener (Ranunculaceae)	Root
<i>Aconitum balfouri</i> Stapf (Ranunculaceae)	Root
<i>Aconitum bisma</i> (Buch.-Ham.) Rapaics (Ranunculaceae)	Rhizome
<i>Aconitum ferox</i> Wall. ex Seringe (Ranunculaceae)	Rhizome
<i>Aconitum gammiei</i> Stapf (Ranunculaceae)	Rhizome
<i>Aconitum heterophyllum</i> Wall. ex Royle (Ranunculaceae)	Rhizome
<i>Aconitum lacianatum</i> (Bruhl) Stapf (Ranunculaceae)	Rhizome
<i>Arnebia benthamii</i> (Wall. ex G. Don) I.M. Jognston (Boraginaceae)	Root & rhizome
<i>Berberis aristata</i> DC. (Berberidaceae)	Root bark
<i>Berberis asiatica</i> Roxb. ex DC. (Berberidaceae)	Root bark
<i>Dactylorhiza hatagirea</i> (D.Don) Soo (Orchidaceae)	Rhizome
<i>Delphenium himalayai</i> Munz. (Ranunculaceae)	Root
<i>Dioscorea deltoidea</i> Wall. ex Griseb. (Dioscoreaceae)	Rhizome
<i>Ephedra gerardiana</i> Wall. ex Stapf (Ephedraceae)	Stem
<i>Ephedra intermedia</i> Schrenk & Meyer (Ephedraceae)	Stem
<i>Ephedra sinica</i> Stapf. (Ephedraceae)	Stem
<i>Ferula aasa-foetida</i> L. (Umbelliferae)	Gum resin
<i>Juglans regia</i> L. (Juglandaceae)	Root bark
<i>Lilium nepalense</i> D. Don (Liliaceae)	Bulb
<i>Maharanga emodi</i> (Wall.) A. DC. (Boraginaceae)	Root and Rhizome
<i>Maharanga bicolor</i> (Wall.) A. DC. (Boraginaceae)	Root and Rhizome
<i>Nardostachys grandiflora</i> DC. (Valerianaceae)	Root and Rhizome
<i>Neopicrorhiza scrophulariiflora</i> Pennell (Scrophulariaceae)	Root
<i>Ophiocordyceps sinensis</i> (Berk.) G.H. Sung, J.M.Sung, Hywell-Jones & Spatafora (Clavicipitaceae)	Whole plant
<i>Parnassia nubicola</i> Wall. ex Royle (Parnassiaceae)	Root
<i>Paris polyphylla</i> Smith (Liliaceae)	Root and Rhizome
<i>Picrorhiza kurrooa</i> Royle ex Benth. (Scrophulariaceae)	Root
<i>Podophyllum hexandrum</i> Royle (Berberidaceae)	Root and Rhizome
<i>Rheum australe</i> D. Don (Polygonaceae)	Root
<i>Rhododendron anthopogon</i> D.Don (Ericaceae)	Leaves
<i>Swertia chirayita</i> (Roxb. ex Fleming) Karsten (Gentianaceae)	Aerial parts
<i>Valeriana jatamansii</i> Jones (Valerianaceae)	Rhizome



Morel (*Morchella conica*)



Cordyceps (*Ophiocordyceps sinensis*)



Spikenard (*Nardostachys grandiflora*)



May apple (*Podophyllum hexandrum*)