Strategies for the Management of High-altitude rangelands and their Interfaces in the Kailash Sacred Landscape

Gopal S Rawat[1*], Ranbeer S Rawal[2], Ram P Chaudhary[3], and Shi Peili[4]

International Centre for Integrated Mountain Development, GPO Box 3226, Kathmandu, Nepal; [2] GB Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, 233643, India; [3] Central Department of Botany and Research Centre for Applied Science and Technology, Tribhuvan University, Kirtipur, Nepal; [4] Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, PR China

*grawat@icimod.org

The Kailash Sacred Landscape (KSL) extends over an area of approximately 31,000 km² around the trijunction of southwestern China, India's northern state of Uttarakhand, and Far Western Nepal. The most prominent physical feature of this landscape is Mount Kailash or Kang Rinpoche (6,714 masl) in the Gandise mountain range of the Tibetan Plateau in China. The Kailash region is well known for its biological, geo-hydrological, and cultural significance. It is also the source of four of Asia's major rivers – the Indus, the Brahmaputra, the Karnali, and the Sutlej – which irrigate much of the Indian sub-continent, providing essential transboundary ecosystem goods and services. High-altitude rangelands (HARs) constitute nearly 27% of the geographical area within the KSL. These rangelands intergrade into sub-alpine forests towards lower elevations (<3,300 masl); agricultural fields along flat river valleys; wetlands and peatlands in the lake basins; and the sub-nival zone (pioneer habitats) above 5,500 m. A large number of agropastoral and migratory pastoral communities within the KSL depend heavily on the bioesources of HARs for livestock grazing, high-value medicinal plants, agriculture, and religious and other traditional rites. Recent changes in land use practices, including sedentarization of pastoralists, overharvesting of high-value medicinal plants, uncontrolled livestock grazing in sub-alpine forests, and rapid increases in the number of tourists in alpine areas, and the resultant pressure on water and other biomass resources, have led to degradation of HARs. Effective management of HAR ecosystems and their interfaces requires scientific understanding of the way in which they function and their transboundary linkages. This paper discusses the current state of knowledge about the biophysical features of HARs and their interfaces within the KSL, major conservation issues, and management strategies. Under a regional transboundary landscape initiative, ICIMOD has launched a collaborative conservation and development programme in the KSL involving several partner institutions in all three countries.

Keywords: adaptive management; alpine arid pastures; alpine meadows; community-based organizations; comprehensive environmental monitoring; human-wildlife conflict; participatory natural resource management; timberline ecotone; transboundary cooperation

Introduction

The Kailash Sacred Landscape (KSL) is a culturally rich, ecologically diverse, and geologically fragile transboundary region encompassing an area of more than 31,000 km^2 in the remote southwestern portion of Tibet Autonomous Region (TAR) of China, adjacent areas of Uttarakhand State in north India, and Far Western Nepal. Marked by the presence of holy Mount Kailash and several other natural and culturally significant sites, KSL has come to the fore during recent years. Mount Kailash and Lake Manasarovar are revered by millions of people from at least five different religions – Buddhists, Hindus, Jains, Bon, and Ayyazhavi – and attract thousands of tourists and pilgrims each year (Bernbaum and Gunnarson 1997). The region is also the source of four of Asia's major rivers – the Indus, the Brahmaputra, the Karnali, and the Sutlej – which provide water and ecosystem goods and services that are vital for the lives and livelihoods of millions of people in the Hindu Kush Himalayan (HKH) region. Recognizing the global and regional significance of the KSL, the governments of China, India, and Nepal have come together through their nodal ministries and key scientific institutions to collaborate and enhance scientific cooperation for the cause of conservation and development of this transboundary landscape and its communities. This programme is coordinated by the International Centre for Integrated Mountain Development (ICIMOD) as the Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI), which promotes collaboration among partner institutions in each country for the sustainable development of the KSL through the ecosystem management approach, as recommended by several international conventions including the Convention on Biological Diversity (CBD). Together, the participating countries have developed a regional cooperation framework (RCF) setting out the objectives and mechanisms of transboundary cooperation for the conservation and sustainable use of biological and cultural resources and associated indigenous knowledge, as well as for increasing the adaptive capacity and resilience of communities within the KSL. This approach builds on the principles of the landscape approach to biodiversity conservation (Sharma et al. 2007), regional cooperation (Messerli 2009), and sacred cultural and historical linkages of the region, while considering both the risks and opportunities created by various drivers of change.

One of the key features of KSL is its wide eco-climatic variation along an altitudinal gradient of 369 to 7,678 masl, with diverse ecosystems manifested in as many as 22 forest types and many more land use/land cover types, in addition to several scrub and herbaceous formations. The basic biophysical attributes of the KSL are summarized in Table 1. High-altitude rangelands (HARs) form a distinct and significantly large proportion of the various ecosystems, covering about 27% of the KSL. In addition, nearly 15% of the landscape above 3,500 masl is under perpetual snow and glaciers. The HARs intergrade into the timberline ecotone in the sub-alpine area and multiple use zones, such as agroecosystems, towards lower altitudes. The rangelands and their interfaces comprise more than 50% of the geographical area of the KSL, forming a contiguous ecosystem spread across three countries that provides numerous ecosystem goods and services. The most important ecosystem service from the HARs is the regulatory service in the form of watershed functions; they also support

Table 1: **Biophysical attributes of the Kailash Sacred Landscape**

Attributes	Overall	China	India	Nepal
Total area (km^2)	31, 252	10,843	7,120	13,289
Elevation (masl)	369–7678	3,641–7,678	428–6,895	369–7,132
No. of watersheds	12	2	4	8
Key watersheds and area (km^2)		Peacock River basin or upper Karnali (3,062) Manasarovar (7,781)	Saryu (350) Ramganga (1,500) Kali, including subbasins of Gori, Dhauli, and Kali (5,400)	Humla Karnali (600) Seti (1250) Chamelia (700) Tinkar (450) Nampa (350) Tampa (200)
Protected areas in or adjacent to the KSL	6	Manasarovar Wetland Complex	Nanda Devi Biosphere Reserve (part) Askot Wildlife Sanctuary	Khaptad National Park Rara National Park Api-Nampa Conservation Area
Ecologically and/ or culturally significant lakes	8	Lake Manasarovar Lake Rakshastal	Parvati Tal Anchari Tal Chhipla Kund	Chhungsa Daha Chhyungar Daha Rara Khaptad
Forest area (km^2)	8,489	The whole area is above the forested zone	4,965	3,524
Rangelands (%)	27%	49%	13%	18%
Human population	1.1 million	8,800	460,000	630,189

Source: Zomer and Oli 2011

globally significant species of flora and fauna, including plants that provide life-saving medicines, and provide fodder and other biomass resources.

The rangelands of the KSL, besides supporting the livelihoods of local communities, serve as an important habitat for several endangered species, including snow leopard (*Panthera uncia*), blue sheep (*Pseudois nayaur*), Himalayan musk deer (*Moschus chrysogaster*), Himalayan tahr (*Hemitragus jemlahicus*), Tibetan wild ass (*Equus hemionus kiang*), and a variety of resident and migratory birds including the endangered black-necked crane (*Grus nigricollis*). The local agropastoral communities, especially those residing in the alpine valleys of India, Nepal, and TAR, China, have had intimate historical and cultural linkages with each other. Over the millennia, these highlanders have developed and inherited a rich traditional knowledge related to the use of rangelands and their bioresources, and such knowledge has been shared across the region over generations. With the rapid changes in socioeconomic conditions of the local communities, the change in the practice of cross-border winter grazing following new political arrangements between China and Nepal, and the new demands of 'development', it is feared that much of the traditional knowledge on the HARs may be lost and critical elements of this landscape, including important interface areas may further degrade unless the local institutions concerned with natural resource management are revived with technical inputs from the concerned line agencies and scientific organizations (Farooquee et al. 2011).

This paper provides an overview of the biophysical features of the HARs in the KSL and flags some conservation issues and potential management strategies.

Key Features of High-altitude rangelands in KSL

The high-altitude rangelands discussed here refer to all the natural and semi-natural pastures located in the transboundary landscape of the greater Kailash region above an elevation of 3,000 masl. These rangelands are used by both local and migratory pastoral communities for livestock grazing in different seasons. It is estimated that nearly 27% of the geographical area within the KSL comprises high-altitude rangelands. The proportion of rangelands is highest in TAR, China (49%), followed by Nepal (18%), and India (13%). The following categories of rangelands are discernible within the KSL; they are determined by altitude, topography, and precipitation: (i) cool temperate grassy slopes, (ii) sub-alpine pastures, (iii) alpine moist pastures, and (iv) alpine arid pastures and steppe. The characteristic features of the different types of rangeland and their interfaces are described briefly below.

Cool temperate grassy slopes

These rangelands, dominated by grasses, lie on the steeper south-facing slopes in the cool temperate and sub-alpine zones of the greater Himalayas. The sloping grassland has evolved as a result of frequent fires set by pastoral communities during the winter season to increase grass growth. Common grasses on such slopes include *Chrysopogon gryllus*, *Themeda anathera*, *Themeda tremula*, *Adropogon munroi*, and *Cymbopogon distans*. The slopes harbour a rich array of flora and fauna including wild ungulates such as Himalayan tahr and goral (*Nemorhaedus goral*), and a variety of birds, including partridges, pipits, vultures, and a number of raptors. The grasslands intergrade into temperate and sub-alpine forests or into gentler village grazing lands or cultivation.

Sub-alpine pastures

The sub-alpine pastures represent open areas in forested land at elevations of 3,000–3,500 masl resulting from the clearing of forests, especially on the gentler slopes, largely due to anthropogenic pressures (e.g., camping, timber, and cutting of fuelwood). Depending on the exposition, topography, and degree of anthropogenic pressure, these pastures may take the shape of secondary scrub or herbaceous meadows. These areas are usually seral in nature and subject to conversion into woodland and eventually forests, provided anthropogenic pressures are removed. Typical species of plants include *Rhododendron barbatum*, *Piptanthus nepalensis*, *Angelica glauca*, *Triosteum himalayanum*, *Syringa emodi*, and *Calanthe tricarinata*. Typical faunal species found in these pastures (in the absence of heavy anthropogenic use) include Himalayan musk deer, serow (*Nemorhaedus sumatraensis*), Himalayan monal (*Lophophorus impejanus*) and other pheasants.

Alpine moist pastures

The area between the natural timberline (3,500+200 masl) and the perpetual snowline (5,500+200 masl) in the lower part of the KSL (the greater Himalayas) is characterized by treeless vegetation. Typical vegetation types in these pastures include alpine scrub, tall and short herbaceous formations, *Danthonia* grasslands, sedge meadows, and high alpine cushionoid vegetation (Rawat 1998; 2005). The most charismatic species of wildlife representing this habitat is the endangered snow leopard (*Panthera uncia*), which is at the apex of the food chain and regarded as a flagship species for conservation in this zone. Common herbivores sharing the alpine habitat include Himalayan tahr and blue sheep. The moist alpine pastures form an interface with the alpine scrub and timberline ecotone towards lower elevations, and with the sub-nival zone towards higher elevations. Several alpine valleys in the Indian and Nepalese parts of the KSL have been used traditionally for agropastoral purposes by the indigenous ethnic communities.

Alpine arid pastures and steppe formations

The alpine arid pastures of the trans-Himalaya are found mostly towards the inner dry ranges of Humla and Bajhang districts in Nepal and Burang County in TAR, China. Most of the area is characterized by treeless vegetation, except in parts of the upper Karnali. These rangelands include sedge meadows (along the banks of lakes), scrub steppe, desert steppe, and sub-nival cushion plant communities. The scrub steppes are dominated by *Artemisia–Caragana–Lonicera* communities in drier and elevated zones, while the riverine scrub is represented by *Hippophae–Myricaria* associations. The wet sedge meadows along the banks of the Manasarovar merge with the semi-arid steppes and cold deserts of the western part of the landscape. The alpine arid pastures are home to a number of globally threatened faunal species such as the snow leopard, Tibetan wild ass or kiang, Tibetan wolf (*Canis lupus*), Himalayan marmots (*Marmota himalayana*), and Tibetan snow cock (*Tetraogallus tibetanus*). Of these, the snow leopard and wolf are typical transboundary species ranging across all the alpine rangelands. The alpine arid pastures form interfaces with high-altitude wetlands such as the Manasarovar, Rakshash Tal or Langha Tso, and Parvati lakes, the sub-nival zone of the Gandise ranges, and human habitation in the various river basins.

Land Use Practices and Conservation Issues

The high-altitude rangelands in the KSL have traditionally been used for livestock grazing by both local and migratory pastoral communities. Three distinct forms of pastoral practices are prevalent within the upper parts of KSL-India and KSL-Nepal: nuclear transhumance, trans-migratory, and sedentary. The agropastoral communities in several valleys practice nuclear transhumance, in which only a part of the family moves to the summer settlements (alpine villages) together with surplus cattle. Where there is drastic decline in the number of livestock in such valleys, there has been a sign of recovery in the rangelands as well as in biodiversity (Garbyal et al. 2005). In other pocket areas, local agropastoralists, especially from the

middle elevation villages, drive their surplus cattle to sub-alpine and alpine areas for free grazing during the summer monsoon (Chaudhary 2000). This is a rather recent phenomenon and leads to faster degradation of sub-alpine and alpine pastures, including soil erosion, profusion of unpalatable and invasive species, and loss of vegetation cover. Similarly, there are reports of rangeland degradation and desertification, and subsequent reduction of rangeland capacity, in KSL-China, especially in the Manasarovar catchment. Manasarovar is a Ramsar site and degradation of the catchment rangelands has implications for siltation and degradation of the wetlands, leading to loss of biodiversity as well as a reduction in productivity (Harris 2009; Lu et al. 2009).

The influx of large herds of livestock and summer season congregation of scrub cattle around timberline and sub-alpine forests are causes for concern that need to be addressed urgently. Deforestation and degradation of the timberline ecotone is reported in all the KSL-Nepal districts and parts of KSL-India. Overharvesting of timber, especially high-altitude fir (*Abies spectabilis*), blue pine (*Pinus wallichiana*), and Himalayan yew (*Taxus wallichiana*), for illegal trade across the borders has been reported from many pockets of KSL-Nepal. Recent reports from neighbouring sub-alpine areas of KSL-India have provided evidence of a significant impact of intense anthropogenic disturbance on the structural and functional features of forest communities, which is influencing their integrity (Gairola et al. 2009; Rawal et al. 2012). The process of degradation of these important interface areas is further accelerated due to other drivers of change such as extreme weather events, drought, and forest fires (Xu et al. 2009; Singh et al. 2011).

The alpine rangelands are home to a large number of high-value medicinal and aromatic plants (Hamilton and Radford 2007). In recent years, there has been a sudden influx of herb collectors in moist alpine areas of both the Nepalese and Indian parts of KSL. One of the high-value products collected from this landscapes is yarshagumba or caterpillar mushroom (*Ophiocordyceps sinensis*), which fetches as much as USD 16,000 per kg in the local market (Winkler 2008) and has a global market of USD 5–11 billion per year (Qiu 2013). Yarshagumba has provided an opportunity for rather easy earning of huge amounts of cash for the under-employed rural communities in the region. As a result, every year, thousands of herb collectors throng around the timberline ecotone and moist alpine meadows during May and June. Herb collectors also harvest several other high-value species such as *Dactylorhiza hatagirea*, *Picrorhiza kurrooa*, *P. scrophulariifolia*, *Nardostachys grandiflora*, *Jurinea dolomaea*, *Trillidium govanianum*, *Pleurospermum angelicoides*, *Rheum australe*, and *Fritillaria roylei*. Camping and extensive use of fuelwood along the timberline ecotone has its own negative impacts on the wildlife habitat. The possible devastating consequences for the ecosystems and local economy if harvesting regulations are not put in place have recently been highlighted (Shrestha and Bawa 2013; Qiu 2013).

Most of the high-altitude lakes, alpine sites, and meadows are becoming increasingly important as tourist destinations. Unorganized tourism often contributes to degradation of the

fragile landscape due to solid waste pollution, trampling of soil and vegetation, and extraction of fuelwood and other biomass for camping that may negatively affect aesthetic and cultural values (Siwakoti and Basnet 2007). The impact of unregulated tourism on the mountain ecosystems of the Indian Himalayas and their bioresources has been identified as a major concern, particularly in view of the uniqueness of the biodiversity and the environmental sensitivity of the region (GoI 2009). Many tourists, particularly pilgrims, harvest juniper and other woody shrubs at high altitudes to cook food. In particular, the Mount Kailash and Manasarovar areas show significant impacts from the 70,000 or more visitors per year. There are issues of waste disposal, sanitation, and water pollution, and adverse impacts on the wetlands, as well as inappropriate and unaesthetic infrastructural development. KSL-China is mainly inhabited by agropastoral communities. This area has about 6.83 km^2 of cropland as well as 4,500 km^2 of pasture. The main crops are spring barley, spring wheat, rape, peas, and vegetables. The main livestock are yak, cattle, a hybrid of yak and scalper, sheep, goats, horses, and donkeys. Sedentarization of pastoralists and overstocking of pastures have led to pasture degradation in several places. As in many parts of the Tibetan Plateau, the agricultural practices are reported to be disintegrating (see, for example, Yi et al. 2008).

The local communities within the KSL depend largely on the high-altitude rangelands for their livelihoods and for cash income from collection and sale of non-wood forest products. So far, there has been very little effort to manage the ecosystems to sustain the services. Government inputs are limited due to poor infrastructure, lack of adequately trained people, and lack of coordination among line agencies. The ever increasing demand for certain wildlife products in the illegal markets makes this landscape all the more vulnerable to poaching and other illegal activities (Yi-Ming et al. 2000). During recent decades, several consignments of bear galls, musk pods, shahtoosh, and bones and skins of tiger and leopard have been seized within this landscape. Poaching is reported to be particularly high for Himalayan musk deer, Asiatic black bear, snow leopard, and high-value medicinal plants. As there are very few alternate livelihood opportunities for the poor, they resort to the wildlife trade and play into the hands of moneylenders and rich traders who can pay a huge amount of cash in advance for valuable wildlife products.

There are several protected areas of different categories within the KSL, including the newly gazetted Api Nampa Conservation Area in far western Nepal (GoN 2008), the Askot Wildlife Sanctuary in India, and the Lake Manasarovar Ramsar Wetland Complex in China. Most of these areas face challenges due to their remote location, lack of people's participation (Samant et al. 1998; Rawal and Dhar 2001), and human-wildlife conflicts.

The HARs have also emerged as critical areas under the climate change scenario, although the interaction of climate change and land use change in these areas is so intense that it is difficult to identify the main driver of change in ecosystem structure and function. Recently Brandt et al. (2013), while describing regime shifts of alpine meadows (i.e., conversion into shrublands) in northwest Yunnan, China, suggested that such shifts should act as a warning

signal for the greater Himalayan region, where vegetation change could greatly affect livelihoods, hydrology, and climate. Shrub encroachment has major implications for ecosystem structure and function, including reduced herbaceous plant biomass and species richness (Ratajczak et al. 2012), alterations in soil conditions (D' Odrico et al. 2012), and changed net primary productivity and nutrient balances in the ecosystem (Barger et al. 2011). In turn, all of these affect pastoral communities who rely more than others on forest resources (Yi et al. 2007).

Management Strategies

Management of high-altitude rangelands and their interfaces within the KSL requires a strong participatory and adaptive approach. This means that the local agropastoral and pastoral communities need to develop mechanisms to equitably share the rangeland resources in a sustainable manner, and the national and provincial governments need to provide policy back up for use of the rangeland resources. Participatory natural resource management planning for each watershed or sub-watershed would require convergence of government line agencies and community institutions, so that critical landscape elements such as high-altitude wetlands, important biological corridors, biodiversity hotspots, and important watersheds are spared from rapid changes in land use and excessive exploitative pressures. Most of the interface areas serve as important biological corridors for the seasonal movement of high-altitude fauna and also serve as important habitat for a large number of species. Management of the high-altitude rangelands would be incomplete without management of these functional elements of the landscape. We suggest the following strategies for management of the high-altitude rangelands and their interfaces within the KSL:

Institutional arrangements for management of the rangelands

Customary laws and policies related to the use of rangeland resources vary considerably across the three countries within the KSL, but the socioeconomic conditions of the local agropastoral and pastoral communities in the high-altitude regions are similar. In each country, there are a number of stakeholders who are responsible for implementation of government programmes and schemes in the HARs, e.g., Departments of Animal Husbandry and Livestock Production, Departments of Forests and Wildlife Protection, Departments of Rural Development, and district or county administration. However, in the absence of a participatory approach and convergence among these departments and local communities, the rangelands remain neglected and unattended. There is an urgent need to organize and strengthen the local (community-based) institutions, which could then develop comprehensive management plans for these rangelands to sustain the ecosystem services. This would require setting up local rangeland management committees comprising representatives from civil society and community-based organizations, livestock husbandry departments, the district administration, and a rangeland ecologist. Recently, the Ministry of Livestock and Cooperatives, Government of Nepal, has brought out a National Rangeland Policy (GoN 2012). This policy needs to be piloted in some districts so as to learn lessons before

implementing it nationwide. KSL-Nepal has a significantly large proportion of rangelands and thus provides an ideal site for piloting such a policy. Piloting would involve enabling community-based organizations to (i) identify social, economic, and ecological problems related to the rangelands, (ii) prepare management plans to deal with the problems, and (iii) implement the management plans. This would be an important step towards institutionalizing a rangeland management programme in the region and scaling up the good practices across the transboundary landscape.

The traditional knowledge and practices of rangeland management that were prevalent in the KSL are in progressive decline (Sundriyal 2011). It would be worthwhile to document, validate, refine, and replicate these practices at representative pilot sites in the KSL. Further, in view of the changing gender roles in traditional pastoral societies, bringing a gender perspective into rangeland management and its linkages with livelihoods will make a further important contribution to sustainable pastoralism in the Himalayas (Hoon 2011).

Capacity building of community-based organizations

The community-based organizations (CBOs) at high altitudes, especially within KSL-India and KSL-Nepal, need to be oriented in terms of current policy instruments, and their roles and responsibilities both in planning and in implementing the plans. The CBOs will have to be trained in participatory comanagement approaches, social mobilization, user group formation including women's self help groups, conflict resolution, implementation of natural resource management plans, and local governance, monitoring, and support to poorer sections of the society in livelihood improvement. In some parts of KSL-India, the community-based organizations have demonstrated that with a little empowerment and capacity building, participatory management of natural resources and monitoring of endangered species is possible (Virdi et al. 2009). With adequate training, empowerment, and assurance of equitable benefit-sharing mechanisms, particularly by way of exposure to emerging access and benefit sharing (ABS) mechanisms, the local communities would be able to play an active role in the conservation and management of the HARs in the landscape.

Restoration and monitoring of ecologically sensitive sites

Restoration of degraded rangelands and their interfaces, such as wetlands and timberline ecotones, should form part of the comprehensive management plan. However, certain areas within the rangelands such as Ramsar sites, ecologically sensitive sites, biological corridors, and biodiversity hotspots will require special efforts in terms of eco-restoration and scientific monitoring. Riverine and wetland habitats in the KSL are particularly vulnerable and threatened by the increased anthropogenic pressures. These areas need to be designated as biologically significant areas (BSAs) as they serve as important habitat for a large number of local and migratory species and provide watershed functions. It is expected that partner institutions would initiate regular monitoring within HARs of endangered or indicator species and taxa and their habitats, interface areas, BSAs, and other ecologically sensitive sites, as

part of the KSLCDI Comprehensive Environmental Monitoring Plan (CEMP). These activities, especially where they involve local stakeholders, may prove to be effective in identifying human-wildlife conflict areas, evolving mitigation measures, and minimizing conflicts.

Valuation of rangeland ecosystem services

As several partner institutions are involved in the implementation of KSLCDI, it is pertinent to initiate policy dialogues and institutional mechanisms at both national and regional levels to handle access and benefits to and from the rangeland ecosystem services using documented evidence. The rangeland ecosystem services from these areas have not yet been properly inventoried and monitored. These steps would be necessary for valuation and assessment of the impact of various drivers of change. There is a need to generate baseline data on the state and health of the rangeland ecosystems from all classes of HARs to feed into rangeland ecosystem services accounting and to develop suitable policies including gender mainstreaming, value chain development, especially from high-value medicinal plants, and institutional innovation.

High-altitude rangeland management in the KSL also needs to be viewed in the light of historical changes with respect to sociopolitical interventions, which have contributed significantly to the rapid process of socioeconomic transformation in pastoral communities in the KSL areas within Nepal and India. In these areas, social organizations and pastoral practices were transformed in a very short span of time, resulting in loss of trade and pasture dependent traditional livelihoods, and leading to extensive migration from the high-altitude areas. The results of such social change and transformation on the rangelands have not been investigated or understood. Therefore, it is imperative to consider both social and climate change dimensions in rangeland management in the KSL. As for other parts of high Asia, using a holistic approach which includes both dimensions and operates from the perspective of pastoralists might help avoid the fallacies of confusing causes and effects (Kreutzmann 2012). The huge potential for improved livestock rearing and linking with the emerging sector of ecotourism in the rangelands and neighbouring sites needs to be taken up as a priority in the KSL.

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