Feasibility and Baseline Studies #1

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FOR MOUNTAINS AND PEOPLE

Understanding the Transboundary Karakoram-Pamir Landscape

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Wu Ning, Muhammad Ismail, Srijana Joshi, Faisal M Qamar, Karma Phuntsho, Yang Weikang, Babar Khan, Yi Shaoliang, Rajan Kotru, and Eklabya Sharma

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A Beatrice Murray (Consultant editor)
Amy Sellmyer (Editor)
Sushil Dhungana (Consultant Graphic designer)
Asha Kaji Thaku (Editorial assistant)

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Foreword

The Karakoram-Pamir Landscape Initiative is a regional initiative supporting cooperation between China and Pakistan for biodiversity conservation and sustainable development in the western Hindu Kush Himalayan region. The initiative seeks to conserve and sustainably manage this unique landscape using a transboundary ecosystem management approach. It was conceived by ICIMOD and is being implemented in collaboration with partner institutions in China and Pakistan with the support of ONE UN Joint Programme on Environment (JPE), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and the Austrian Development Agency (ADA).

As in much of the Hindu Kush Himalayan region, this area is facing many challenges as a result of climate change, globalization, environmental degradation, and others. The initiative uses the landscape and ecosystem approach advocated by the Convention on Biological Diversity to directly address these challenges, promoting the goals and approaches described in the Convention's Programme of Work on Mountain Biodiversity.

The present report aims to provide an overview of available information on the major features of the landscape, its ecosystems and biodiversity, and the socioeconomic and cultural situation. It was compiled through the efforts of many scientists and stakeholders in the two countries. The information is intended to support the development of a conservation strategy and associated comprehensive environmental monitoring action plan for the landscape, as well as being useful in the formulation of national strategies and regional cooperation frameworks.

Our heartfelt thanks and sincere appreciation are extended to all the national partners and other stakeholders who contributed to the consultative process and who are helping to build the regional networks that will provide the basis for transboundary cooperation between the two countries. This report provides a valuable example of regional cooperation in action. National ownership and community-based conservation initiatives provide the foundation for the sustainability of the initiative, and it is expected that the participatory process of shared responsibility and differentiated approaches will further evolve as the initiative progresses.

David Molden, Ph.D
Director General, ICIMOD

Contributors

ICIMOD

Core Team: Wu Ning, Muhammad Ismail, Srijana Joshi, Karma Phuntsho, Yi Shaoliang, Faisal Mueen Qamar, Ritu Meher Shrestha, Zhu Dan, Wang Jinniu, Liu Xiao, Rajan Kotru, Eklabya Sharma

Contributors: Gopal Singh Rawat, Abdul Wahid Jasra, Krishna Prasad Oli, Nakul Chettri, Bandana Shakya, Manohara Khadka, Hammad Gilani, Farid Ahmad, Rekha Rasaily, Prabha Shrestha

KPL-China

Core Team: Yang Weikang, Liu Wenjiang, Xu Wenxuan (Xinjiang Institute of Ecology and Geography, CAS)

Contributors: Xia Canjun[1], Xu Feng[1], Qi Changjiang[2], Jiang Zhigang[3], Ma Keping[4], Jiang Jianping[5], Wang Qian[5], Zhang Yongmei[5], Long Ruijun[6]

[1] Xinjiang Institute of Ecology and Geography, CAS; [2]Taxkorgan Nature Reserve; [3]Institute of Zoology, CAS; [4]Institute of Botany, CAS; [5]Chengdu Institute of Biology, CAS; [6]Lanzhou University

KPL-Pakistan

Core Team: Ashiq Ahmad Khan, Babar Khan, Muhammad Jaffar

Contributors: Usman Manzoor, Saleem Ullah, Amanullah Khan, Gul Najam Jamy, Najma Najam, Khadim Hussain Saleem, Walayat Noor, Muhammad Ismail Zafar, Muzaffar Uddin

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This publication is the result of an effort by researchers and practitioners to examine various issues related to biodiversity conservation in the Karakoram-Pamir region, in particular conservation issues and development potential in the context of global change in the two contiguous protected areas on either side of the China-Pakistan border: the Taxkorgan Nature Reserve (TNR) in China and Khunjerab National Park (KNP) in Pakistan.

Collection of field information and secondary data and preparation of the book benefited from guidance, support, suggestions, and sharing of information among a diverse group of academics, practitioners, professionals, and farmers. The International Centre for Integrated Mountain Development (ICIMOD) would like to thank all those who participated in this effort and provided valuable information about conservation and development for this remote and data-poor region. The people who made a significant contribution to the baseline study of this landscape, one of the important bases of this book, are too numerous to be listed here, but their contribution is duly recognized and appreciated.

We are indebted to the One UN Joint Programme on Environment (JPE) for their technical support and funding for the project, and the Austrian Development Agency (ADA), Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ), and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) for additional financial support. We are grateful to the Forests, Wildlife and Environment Department of the Government of Gilgit-Baltistan, Pakistan; the Authority of Khunjerab National Park; Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences (XIEG-CAS); the Bureau of International Cooperation of CAS; the Forestry Bureau of Xinjiang Uygur Autonomous Region, China; the Administration Bureau of Taxkorgan Nature Reserve; the People's Government of Taxkorgan County; and the People's Government of Kashgar Prefecture for their support. We particularly appreciate the continuous cooperation and support for the initiative from all the KPL partner organizations and lead institutions.

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The implementing organizations for this report include the partners in China and Pakistan: in China, mainly the Xinjiang Institute of Ecology and Geography (XIEG-CAS) and other institutions under the Chinese Academy of Sciences (CAS), Forestry Bureau of XUAR, Taxkorgan Nature Reserve, and People's Government of Taxkorgan County; and in Pakistan, mainly the Forest Wildlife and Environment Department of GBP, WWF-Pakistan, IUCN-Pakistan, Karakoram International University (KIU), Aga Khan Rural Support Programme (AKRSP), Khunjerab National Park (KNP), and Central Karakoram National Park (CKNP).

Finally, the views and opinions expressed in this book are those of the individual authors and do not necessarily reflect the official views of the organizations with which the authors and editors are affiliated.

Acronyms and Abbreviations

AKRSP	Aga Khan Rural Support Programme
CAS	Chinese Academy of Sciences
CBD	Convention on Biological Diversity
CIB	Chengdu Institute of Biology, CAS
CITES	Convention on International Trade in Endangered Species
COP	Conference of the Parties
GBP	Gilgit-Baltistan Province
ICIMOD	International Centre for Integrated Mountain Development
IUCN	International Union for the Conservation of Nature
KKH	Karakoram Highway
KNP	Khunjerab National Park
KPL	Karakoram-Pamir Landscape
masl	metres above sea level
NDVI	Normalized Difference Vegetation Index
NDSI	Normalized Difference Snow Index
PA	protected area
TNR	Taxkorgan Nature Reserve
UNEP	United Nations Environment Programme
Unesco	United Nations Educational, Scientific and Cultural Organization
XIEG	Xinjiang Institute of Ecology and Geography
XUAR	Xinjiang Uygur Autonomous Region

Currency exchange rates used in this report:

USD 1 approximately equal to PKR 100.00 (Pakistan rupees) and RMB 6.2 (renminbi, Chinese yuan)

Executive Summary

The Karakoram-Pamir Landscape lies at the junction between the black Karakoram mountains, which mostly lie within Pakistan, and the grey Pamir mountains, which mostly lie within China. It is known for its glaciated peaks, high-altitude wetlands, green pastures, and globally significant biodiversity. Both sides of the transboundary area are protected to conserve the unique biodiversity with a major focus on endangered species. The Karakoram-Pamir Landscape Initiative is a regional initiative supporting cooperation between China and Pakistan for biodiversity conservation and sustainable development in this region. The broad objectives of the initiative are to (1) improve understanding of the region's biodiversity and science on the impacts of climate and other change; (2) assess and enhance the adaptive capacity of and livelihood options for people living in the landscape; and (3) promote transboundary cooperation for the conservation of vulnerable ecosystems, sustainable use of ecosystem goods and services, and creation of an international conservation area connecting existing national protected areas. In order to achieve these objectives, a baseline study was made of the environmental, biodiversity, socioeconomic, and cultural situation in the landscape based on both primary information (expert consultations, interaction programmes, group discussions) and secondary information (mainly a literature review), and focusing on the two contiguous protected areas on either side of the international border (the KPL pilot site).

The KPL target landscape

The Karakoram-Pamir region is a unique example of a near pristine landscape with unique biological and cultural diversity. On the Pakistan side of the border, an area of 4,455 km^2 is protected within the Khunjerab National Park, and on the China side, an area of 15,000 km^2 within the Taxkorgan Nature Reserve. The areas are ecologically contiguous; more than half of the total area lies above 4,500 masl.

The KPL region is heavily glaciated. Glacier cover in the Karakoram range has been estimated to be 28–50%; the range has more than 5,000 glaciers with the 12 largest comprising almost 50% of the total glacier area. The Muztagh Ata in the eastern Pamir is called the 'Father of Icebergs'. More than 20% of the KPL pilot site area is covered by snow and ice.

Water bodies (rivers, lakes, wetlands) play an important ecological, social, and cultural role in the KPL region. The KPL is a watershed for the Indus and Yarkand (Tarim) rivers. The Khunjerab, Gujerab, and Shimshal rivers flow south and drain into the Hunza River towards the Indus, while the Taxkorgan and Chalachigu rivers flow north into the Yarkand (Tarim) River.

The climate of the area is predominantly cold and arid, especially in the high-altitude belts, and temperate at relatively lower elevations. There is a marked climatic variation which is greatly influenced by altitudinal differences.

Biodiversity and ecosystems

The KPL region acts as a major biogeographic barrier between Mediterranean-influenced middle Asia, monsoonal South Asia, and the continental expanses of Central Asia; forms the boundary between two major zoogeographical regions – the Palearctic and Oriental; and lies along the Indus Flyway for migratory birds. Thus it hosts a wide diversity of plant and animal species including a number of endangered and threatened plants and animals, unique plant communities and endemic plant and animal species, and many medicinal plants. The region also supports a rich agrobiodiversity, including traditional cultivars of cereal crops, fruit varieties, and a wide range of traditional livestock breeds.

In terms of ecosystems, the KPL is a complex mountain region with diverse vegetation types generally adapted to arid high-altitude environments. The eastern boundary of the landscape merges into the Pamir Plateau and is dominated by semi-desert and desert, whereas the western boundary, which connects with the high peaks of the Karakoram range, has cold sub-humid alpine conditions. Close to 60% of the area is alpine desert and a further 25% is alpine steppe including alpine meadow (the most important vegetation type for migratory pastoralism), with the remaining 15% comprising bare rock and glaciers.

Environmental changes

Almost all the natural ecosystems in this landscape are vulnerable to climate change and human disturbance. The KPL is a fragile mountain system; geological instability, steep topography, extreme climatic conditions, and turbulent rivers make the area vulnerable to disturbance and prone to natural disasters. At the same time, climate change, population growth, unsustainable collection of natural resources, and unplanned infrastructure development are leading to environmental degradation with fragmentation of habitats, loss of biodiversity, decline of vegetation productivity, soil erosion, and in places desertification. Scarcity of water resources has been identified as one of the major issues resulting from climate change and poorly-planned urbanization. Ecosystems are under threat from overgrazing, habitat destruction, poaching of wildlife, and land cover/land use change. Habitat destruction due to excessive removal of sparse natural vegetation for fodder and domestic energy, construction of infrastructure, illegal hunting, and mining are all having a serious impact on the integrity and sustainability of the landscape.

Cultural heritage

One of the major routes of the ancient Silk Road passes through the KPL and the region has been a hub along international travel and trading routes for centuries. Influenced by a wide variety of cultures and civilizations, it has a rich cultural heritage, with many sites of interest as well as a diversity of mountain cultural traditions.

Livelihoods and livelihood diversification

Traditionally the people of the KPL region are pastoralists and agro-pastoralists who earn their livelihood through livestock grazing with some farming of crops. Pastoralism makes a significant contribution to the national economies of both countries in terms of both subsistence and export earnings. In recent decades, these livelihoods have come under increasing pressure and people are seeking to diversify their livelihood base. Diversification is an important adaptation approach and should be mainstreamed into the development agenda.

The KPL is endowed with many high-value products, including non-timber forest products (NTFPs), animal products, fruit and vegetables, and local cultural products, which offer a potential for livelihood diversification and increased income generation through development of value chains, value addition, and improved marketing. The unique landscape, rich with varied flora and fauna, and diverse cultural heritage offer considerable potential to promote tourism, with opportunities for trekking and mountaineering, adventure, cultural tours, and trophy hunting. Tourism can provide ecological, economic, and livelihood benefits to the local communities and support adaptation to change.

Governance and policies

Conservation and development issues often transcend political boundaries and demand strong cooperation between governments. Transboundary cooperation initiatives can play a major role in the socioeconomic development of communities in the KPL region. The governments of the region are signatories to several international and regional agreements that support the concept of transboundary conservation and regional/international cooperation and highlight integration of the objectives of conservation with sustainable development. They include the Convention on Biodiversity (CBD), Convention on International Trade in Endangered Species (CITES), Ramsar Convention (Convention on Wetlands), and United Nations Framework Convention on Climate Change (UNFCCC). At the national level, the traditional institutions and customary laws which previously governed the natural resources in the KPL region have been largely replaced by central and local legislation related to conservation and development,

sometimes opposed by the local population. Local regulations still need to be improved and integrated plans developed using a participatory approach to ensure local involvement and support for conservation.

Way forward

There is an urgent need to develop a reliable information base for this transboundary region on all aspects related to the conservation and management of natural resources. At present, there is a lack of the information and scientific data required for conservation and sustainable management of the KPL ecosystems. A long-term environmental monitoring system should be established with in-depth information on threatened and flagship species of flora and fauna, and understanding of critical ecosystems such as rangelands and wetlands should be improved.

Communities in the KPL region lack access to quality education and basic health facilities and have limited livelihood options. Economic development of local communities and an increase in livelihood options would reduce the dependence on natural resources and help strengthen wildlife conservation.
Cross-cutting issues of awareness raising, capacity building, and coordination also need to be addressed. Raising awareness about the significance, uniqueness, and irreplaceability of the landscape will help to ensure successful implementation of conservation and development initiatives.

1. Introduction

Background

Biodiversity management within the framework of the Convention on Biological Diversity (CBD) encourages adoption of a 'landscape approach', which entails integrated management of land, water, and living resources across larger landscapes, beyond the confinement of protected areas and even beyond the boundaries of a country. This approach also recognizes human societies with their culture and traditions as an integral component of ecosystems and advocates for economic benefit for the communities who directly depend on the biodiversity. The objectives of the Millennium Ecosystem Assessment (MEA) further reinforce the landscape approach through safeguarding the resources for ecological integrity and continued flow of ecosystem services – the services that benefit people (MEA 2005). The international conservation agencies, now working within the changing paradigm from millennium development goals to sustainable development goals for 2030, have turned to holistic actions for sustaining biodiversity and ecosystems through assessment, management, valuation, monitoring, conservation, and restoration of ecosystems (Griggs et al. 2013). Achieving these goals will require not only the understanding of, and management actions for, biophysical resources, but also involvement and engagement of a large number of institutions and governance mechanisms. The CBD's Strategic Plan for Biodiversity 2011–2020 clearly points to the need for a holistic, integrated, and cross-sectoral approach; transboundary landscapes provide an important platform for implementing this integrated approach to conservation and development.

ICIMOD's 'transboundary landscapes and trans-Himalayan transects' framework was developed in 2008 with the aim of promoting regional cooperation for biodiversity conservation and management (Chettri et al. 2009; Schild and Sharma 2011). Seven representative transboundary landscapes were identified across gradients of precipitation and elevation and in different ecoregions. These landscapes have a combination of characteristics: a unique ecosystem, biodiversity rich areas, culturally rich sites, the presence of globally significant species, the presence of socioeconomically marginalized communities who are highly dependent on natural resources for their livelihoods and are affected by various drivers of change, and historical and socio-cultural linkages across national boundaries. The transboundary landscapes are embedded within four north-south trans-Himalayan transects which provide the geographic basis for long-term climatic, socioeconomic, and ecological monitoring. This report is about the westernmost of the seven transboundary landscapes – the Karakoram-Pamir Landscape.

The Karakoram-Pamir Landscape

The Karakoram mountain range extends some 650 km from the Khyber Pakhtunkhwa Province of Pakistan in the northwest to the Chinese Pamir in the northeast, culminating in the Ladakh range in India to the south (ICIMOD 2012). It is one of the three major mountain ranges in Pakistan, the others being the Himalayas and the Hindu Kush.

The Pamir region was called Bam-i-Dunya or the 'roof of the world' by Persian geographers and the name persists to this day, although now sometimes used for other parts of the high plateau as well. The landscape is known for its glaciated peaks, high-altitude wetlands, green pastures, and significant biodiversity. The elevated massifs surrounding the arid and semi-arid areas of central Asia provide important habitat for unique high-altitude floral and faunal species including the globally threatened Marco Polo sheep and snow leopard. In earlier times, this area provided one of the fortresses on the ancient Silk Road from China through Central Asia to Europe, and it has

been a place of cultural pluralism and witness of geopolitical intrigues and struggles of various kinds from ancient to modern times. The Karakoram-Pamir Landscape falls within Gilgit-Baltistan Province of Pakistan and the Xinjiang Uygur Autonomous Region (XUAR) of China, where it merges with the Chinese Pamir.

The Need for Conservation

The present day landscape is fragmented by human settlements, roads, national border fences (the border between Pakistan and China was fenced in the 1990s), and various poorly-planned and unsustainable development activities which have broken up the natural ecosystems and weakened the socioeconomic systems, leading to loss of the natural livelihood base. Many wildlife populations in the region have been deemed endangered, although some are now recovering due to recently strengthened conservation activities. Factors such as overgrazing, soil erosion, and unsustainable farming-practices, and natural disasters such as landslides and avalanches, have further affected the flow of goods and services from the ecosystems. The productivity of the rangelands and farmland has declined, which has further affected the livelihoods of local people and socioeconomic development.

Conservation of the critical values and key components of the landscape requires the creation of a larger protected area (PA), wiser use of the available land and water resources, constant monitoring of the health of ecosystems and glaciers, and strengthening of the capacities of the local communities and institutions so that they can take care of the fragile ecosystems of the landscape. The natural habitats of many globally significant species are transboundary, and realization has grown that cross-border collaboration is needed to protect the common habitats of wildlife species that frequently use the border zone and cross the border in search of food, water, and other resources. This realization led to the first understanding between the Xinjiang Institute of Ecology and Geography (XIEG), Chinese Academy of Sciences (CAS) and WWF-Pakistan of the need for cross-border collaboration, which developed during a workshop on medicinal and aromatic plants in Islamabad in 1993. These discussions provided the starting point for the development of an initiative to conserve the landscape.

The Karakoram-Pamir Landscape Initiative

The Karakoram-Pamir Landscape (KPL) Initiative is a regional initiative for enhancing cooperation between China and Pakistan for biodiversity conservation and sustainable development in the China-Pakistan border area of the western Hindu Kush Himalayas in the Karakoram-Pamir mountains. The broad objectives of the initiative are to (1) improve understanding of the region's biodiversity and of science on the impacts of climate change and other changes; (2) assess and enhance the adaptive capacity of and livelihood options for people living in the landscape; and (3) promote transboundary cooperation for the conservation of vulnerable ecosystems, sustainable use of ecosystem goods and services, and creation of an international area of conservation connecting existing national protected areas. The initiative began with an agreement for bilateral collaboration between the governments of China and Pakistan signed in Beijing in 1995 to ensure the protection of Marco Polo sheep and other endangered species in two adjacent transboundary protected areas – the Khunjerab National Park (KNP) in Pakistan and the Taxkorgan Nature Reserve (TNR) in China.

The journey towards effective and institutionalized cooperation between the two countries has proceeded through several phases; the major events are summarized in the Annex. An important milestone for the initiative came in June 2008 during an International Workshop on Environmental Protection and Sustainable Development in the China-Pakistan Border Region, held in Kashgar, China, when participating countries discussed improving the local environment and livelihood options and establishing additional connectivity corridors in the region (ICIMOD 2012). After this, people increasingly came to realize the opportunities and challenges in this remote area. ICIMOD, a regional intergovernmental organization with promotion of transboundary conservation as one of its mandates, participated in the workshop organized by WWF and XIEG at Kashgar, and since then has been one of the members of the regional steering committee formed to support China-Pakistan cooperation for conservation and sustainable development in the KPL region.

A series of meetings between 2011 and 2013 have served to strengthen and formalize the initiative (Box 1). The focus is on maintaining the sanctity of the protected areas and creating sustainable economic opportunities for the people in the border region and improving their quality of life by mobilizing them to protect the environment, which will in turn enhance the local community-based economy.

In the wider context, a new concept for a 'China-Pakistan Economic Corridor' was proposed by the country leaders of China and Pakistan in 2013. In the wake of this and the 'Silk Road Economy Belt' proposed by the Chinese President, the KPL area has now become a new economic hotspot, not only due to its importance in transportation and communication between China and Pakistan and even central Asia, but also as a result of its fragility and sensitivity to environmental change, including climate change and human disturbance.

Box 1: **Major regional and national consultation meetings for the KPL**

A 'Regional Consultation to Develop a Future Strategic Programme for Biodiversity Management and Climate Change Adaptation for the Karakoram-Pamir Landscape' was organized by the ICIMOD in Kathmandu on 16–17 December 2011. The meeting provided an opportunity to strengthen the KPL initiative and enabled participants from China, Pakistan, and ICIMOD to develop a long-term programme that could facilitate national and regional efforts towards managing the rich biodiversity resources of the KPL.

An 'Inception Workshop for the Karakoram-Pamir Landscape Initiative between Pakistan and China' was held from 23 to 24 January 2013 in Islamabad, Pakistan. The event was attended by partners from Pakistan and China and provided an opportunity to share relevant information and prepare a roadmap for future activities in the KPL. Gaps and challenges in the KPL were identified through national stakeholder discussions and further recommendations were made for major short- and long-term actions in the KPL.

A 'National Workshop on Cooperation for Conservation and Sustainable Development in the Karakoram-Pamir Landscape between China and Pakistan' was held in Gilgit-Baltistan, Pakistan from 24 to 25 April 2013. The workshop brought together different stakeholders, partners, and policy makers from Pakistan. The consultation provided an opportunity to identify key issues in the area and potential areas for research, and listed options for the restoration of potential areas,

A 'National Workshop and Exposure Visit on Cooperation for Conservation and Sustainable Development in the Karakoram-Pamir Landscape between China and Pakistan' was held in Urumqi, China from 19 to 23 May 2013. The overall objective was to develop a framework for long-term programmatic action and begin the process of developing a regional cooperation framework for the KPL. Key issues and challenges in the area were identified; the platform provided an opportunity to share ideas on potential areas for future research and to prioritize major actions in the short and long term.

The Baseline Study

This publication presents the results of a baseline study of the environmental, biodiversity, socioeconomic, and cultural situation in the KPL undertaken in support of the Karakoram-Pamir Landscape Initiative. The focus is on the two protected areas either side of the international border – the Khunjerab National Park (KNP) in Gilgit-Baltistan Province in Pakistan (Box 2) and Taxkorgan Nature Reserve (TNR) in Xinjiang Uygur Autonomous Region (XUAR) of China (Box 3) – which together form the pilot site for the initiative. The aim is to provide an information base that can be used in the identification of gaps, in the preparation of conservation and development plans, and as a basis for later monitoring and evaluation. The assessment was based on both primary information collection and secondary sources. The primary information was mainly collected through expert consultations, interaction programmes, and group discussions. Secondary information was gathered through literature review and compilation of data from other available sources. The literature review covered published and unpublished reports from government and non-government sources and other local level stakeholders, and interpretation of photographs. Past management plans and strategies for the area, sectoral management plans, master plans, and draft operational plans for other conservation areas were reviewed, as were existing policy, legislation, and institutional arrangements. The information from the various sources was used to prepare a comprehensive database for the baseline assessment in each of the two countries, and then tabulated, analysed, and prioritized.

This report starts with a description of the target landscape and its delineation, the biophysical resource status, the environmental situation, including threats and biodiversity conservation, and climate change and adaptation of local communities. It considers the specific situation in the rangelands, cultural heritage and integrity, and opportunities for livelihood diversification. Finally it looks at the policy environment and governance structures, and outlines a way forward to achieving landscape goals. It is hoped that the baseline information will support future transboundary cooperation in conservation and development and be useful for national strategies and regional cooperation frameworks such as the China-Pakistan Economic Corridor and Silk Road Strategy.

Box 2: **The Khunjerab National Park (KNP)**

The Khunjerab National Park (KNP) is situated in Gojal tehsil, Hunza-Nagar District, in Gilgit-Baltistan Province in the extreme north of Pakistan. The Karakoram Highway runs through the park dividing it in two, starting from Pamarchhi Bridge at 3,660 masl in the Dhee valley, the first major tourist spot in the Khunjerab area, and climbing to 4,934 masl at the Khunjerab pass, where it enters into Chinese territory. The KNP covers an area of about 4,455 km^2. It is Pakistan's third largest national park, and was established in 1975 to protect Marco Polo sheep and other rare and unique species of the Pamir and Tibetan Plateau, including the snow leopard and blue sheep. The northern and eastern boundaries follow the Pakistan-China border, while the southern boundary is delineated by the divides between the upper Shimshal Valley and the Hisper and other glaciers. The western boundary is more irregular: it starts with the Dhi Valley and the mouth of the Ghujerab Valley at the northern end, and then runs eastwards along the divide between the Ghujerab and Shimshal catchments, finally dipping south to the upper Shimshal Valley. The elevation of the core area ranges from about 3,200 masl at the entrance of the park to over 7,700 masl. More than half of the park lies above 4,000 masl (Wegge 1988). The Khunjerab Pass, the gateway to China via the Karakoram Highway (KKH), lies at 4,934 masl. Most of the area can be categorized as dry alpine scrub type vegetation with species like Artemesia spp., Juniper spp., Rosa webbiana, and Polygonum spp. on the dry slopes, and Myricaria germanica and Hippophae rhamnoides along the stream beds. Broadleaved species mainly consist of Salix sp. and Betula utilis, which can be found in moist places. Juniper woodland is mixed with grasslands at high-altitude. Most of the cultivated areas and major settlements lie along the major rivers. The major crops in the area include wheat, maize, and potato, while major fruit trees are apple, apricot, and pomegranate. Olive, rubinia, and poplar plantations are very common within cultivated areas and in separate plantations and provide domestic timber, fodder, and fuelwood.

Box 3: **The Taxkorgan Nature Reserve**

The Taxkorgan Nature Reserve (TNR) was established in 1984 and is situated in the southwest corner of Xinjiang Uygur Autonomous Region (XUAR) in China, at the junction of the China, Pakistan, Tajikistan, and Afghanistan borders. The reserve is in Taxkorgan Tajik Autonomous County, within the jurisdiction of Kashgar Prefecture. The centre of the reserve lies about 265 km south of Kashgar (Kashi) City. The southwestern boundary follows the China-Pakistan border from the vicinity of the Kilik Pass southeast to just beyond Mount Qogir (K2). The northern and eastern boundaries trace various tributaries of the Yarkand river (Schaller et al. 1987). The Reserve has a total area of about 15,000 km^2; the elevation ranges from below 3,000 masl to around 8,000 masl. The highest point in the area is the peak of Qogir (K1) with 8,611 masl further south in Taxkorgan County. This mountainous reserve encompasses the northern flanks of the Karakoram, the western edge of the Kunlun Mountains, and the eastern rim of the Pamir Mountains, with more than half of the area lying above 4,500 masl. Taxkorgan Valley was part of the ancient Silk Road which continues into the Chalachigu Valley and over the Mintaka Pass into Pakistan. The westernmost part of the reserve lies mainly in the Pamirs, with broad valleys and steep rolling hills above 3,500 masl and flanked by rugged ranges. Between the eastern rim of the Taxkorgan Valley and the Yarkand river there is a complex of mountains, broken cliffs, and sharp ridges cut by gorges. The Raskam, Mariang, and other small rivers lie below 3,000 masl near the junction with the Yarkand river and form the lowest part of the reserve, which is bounded by the Taxkuzuke mountains, a discrete rough range to the east of the Yarkand (Schaller et al. 1987). Generally, the climate conditions are cool and dry. Much of the terrain is too high or arid to support much vegetation. Trees such as Salix, Tamarix, Populus, and Betula are found only in low-lying valleys.

Box 4: **Taxkorgan County**

Taxkorgan (or Tashkurgan) Tajik Autonomous County is one of the counties of Kashgar Prefecture in western Xinjiang, China. It is located in the eastern part of the Pamir Plateau, at the borders with Afghanistan (Wakhan Corridor), Tajikistan (Gorno-Badakhshan Province) and Pakistan (Gilgit-Baltistan). The county seat is Taxkorgan Town. The territorial expansion of the county is 178 km from north to south, and 140 km from east to west, the total area is about 24,088 km^2, at an average altitude above 4,000 m. In 1984 the western part of this county was set aside as a protected area, i.e., Taxkorgan Nature Reserve. The total population of Taxkorgan County is 39,662, among them 84% Tajiks, 4% Han and 12% other nationalities (figures from 2013). The GDP in 2013 is RMB 822 million Yuan (about USD 134 million), with the percentage of three sections being: the first industry being 13.4%, the second industry 51% and the third industry 35.6% (http://baike.baidu.com/view/506388.htm).

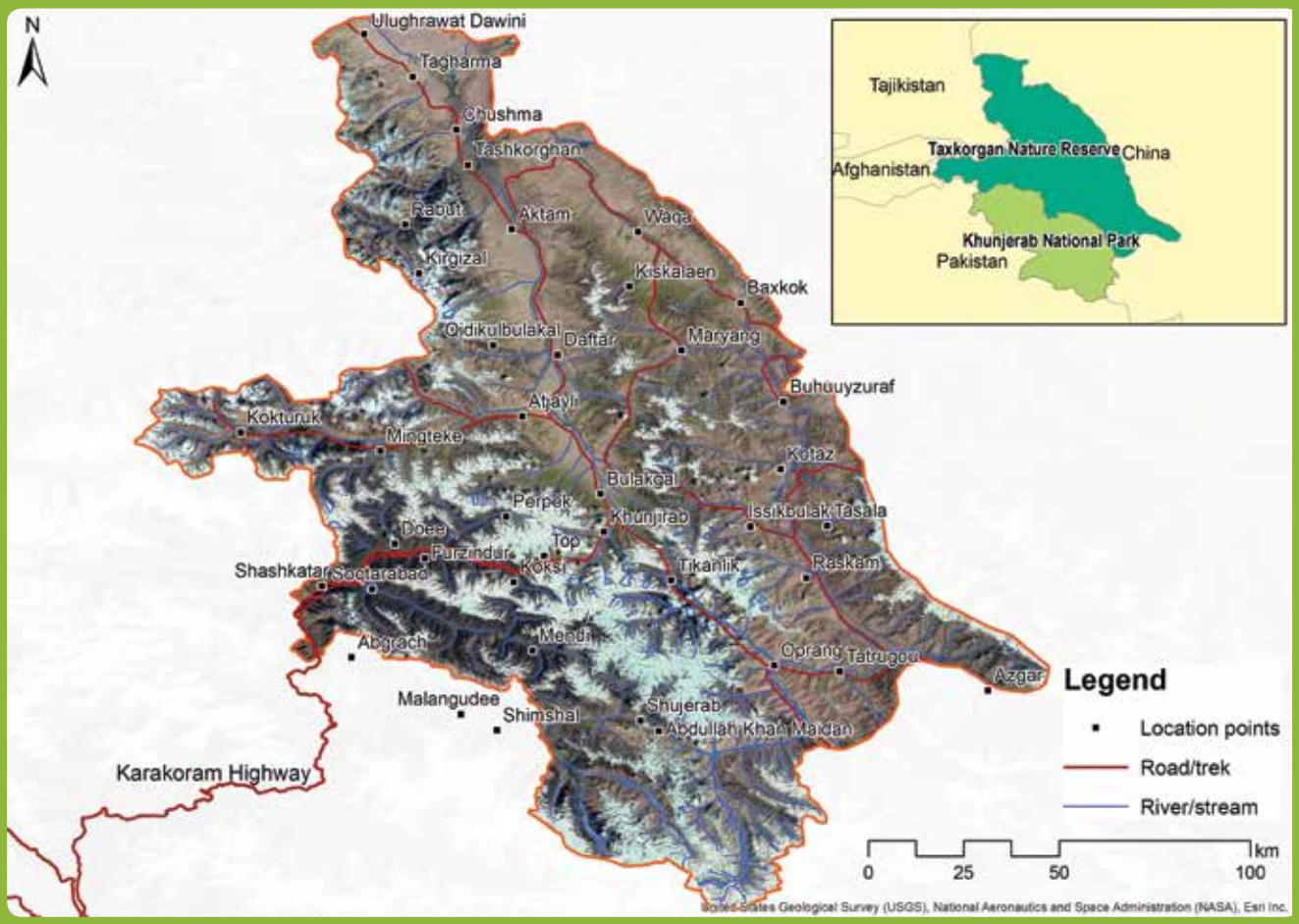
2. Characteristics and Land Cover of the Karakoram-Pamir Landscape

Delineation of the Target Landscape

The technical delineation of the KPL was an essential step to provide a sound geographic basis for the baseline assessment. Based on ICIMOD experience in other transboundary landscapes and the specific situation of the KPL, the following criteria were used for delineating the target area:

- Transboundary ecosystem services and ecosystem contiguity
- Key biodiversity areas, especially migratory habitats and biodiversity corridors
- Endemism of biodiversity and uniqueness of culture
- Indicator or flagship, rare, endangered, and threatened species (and their range)
- Protected areas and other conservation priority areas
- Cultural heritage sites and existing or potential ecotourism sites
- Livelihood linkages of mountain communities
- Vulnerability of the area (globalization, migration, and other change processes)
- Urbanization and infrastructure development
- Demarcation of ecological zones

Figure 1: **Overview of the KPL pilot area**

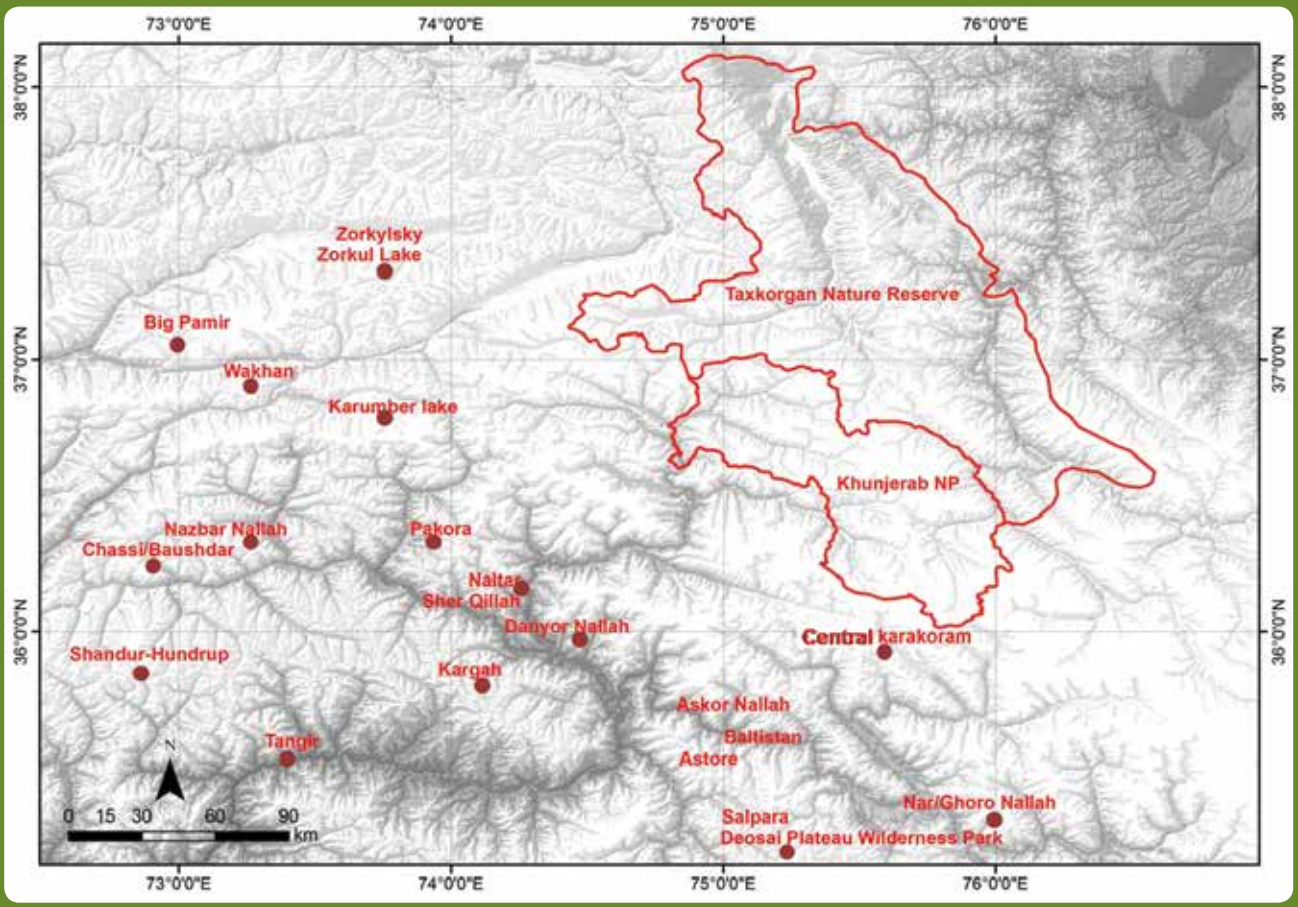


The delineations were shared and discussed with the two countries by ICIMOD and were approved by the stakeholders. The boundary of the KPL follows the boundary of Gilgit-Baltistan Province in Pakistan and Kashgar Prefecture in Xinjiang Province in XUAR, China (Figure 1). As more information becomes available, the possibility of extending the boundary to the Wakhan corridor, to provide landscape connectivity, will also be considered. In the initial stages, the focus is on the pilot area formed by the two protected areas KNP and TNR, as shown in Figure 1.

The Karakoram-Pamir Landscape lies at the point where the black Karakoram mountains, which mostly lie within Pakistan, merge with the grey Pamir mountains, which mostly lie within China. Both sides of the transboundary area are protected to conserve the unique biodiversity with a major focus on endangered species. On the Pakistan side, an area of 4,455 km^2 is protected within the Khunjerab National Park (KNP) (latitude 36°01'–37°02'N, longitude 74°55'–75°57'E), and on the China side, an area of 15,000 km^2 is protected within the Taxkorgan Nature Reserve (TNR) (latitude 36°24'–38°07'N, longitude 74°25'–76°35'E) giving a total area of 19,455 km^2.

The two protected areas are ecologically contiguous and more than half of their total area lies above 4,500 masl. Besides nurturing diverse biological resources, the protected areas provide livelihood sources to around 5,935 Tajik and Brushu people inhabiting the peripheries of the KNP and around 39,662 local Tajik and Kirgiz people (figure of Taxkorgan County in 2013) living in and around the TNR. The Taxkorgan Nature Reserve itself is inhabited by 7,500 people with about 70,000 domestic animals These people's livelihoods depend on ecosystem services and goods from the landscape and any intervention or management of biodiversity and other natural resources in the landscape should fully include all relevant stakeholders, especially the men and women who have a close relationship with and depend on the natural resources for their basic livelihoods.

Figure 2: **Major protected areas in and close to the KPL region**



Source: World Conservation Monitoring Centre (WCMC)
Note: The new Pamir Wetland Nature Reserve established by the XUAR government in 2010 lies outside the boundary of the map to the north.

Protected Areas

There are some 20 protected areas in the KPL (Table 1, Figure 2), including the KNP and TNR. There are also some in the region within Afghanistan and Tajikistan. Although these protected areas are beyond the delineated KPL, they could be very important for future establishment of wildlife corridors and restoration of connectivity across the whole region.

Table 1: **Protected areas in the KPL region**

Protected Areas	Number	Area (km^2)
Karakoram	**18**	**19,778**
National parks	2	14,455
Khunjerab National Park (KNP)		*4,455*
Central Karakoram National Park		*10,000*
Wildlife sanctuary	1	272
Game reserves	3	853
Community-managed areas	12	4,198
Pamir	**2**	**16,530**
Taxkorgan Nature Reserve (TNR)		15,000
Pamir Wetland Nature Reserve		1,530
Total	**20**	**36,308**

Physical Characteristics

Physiography

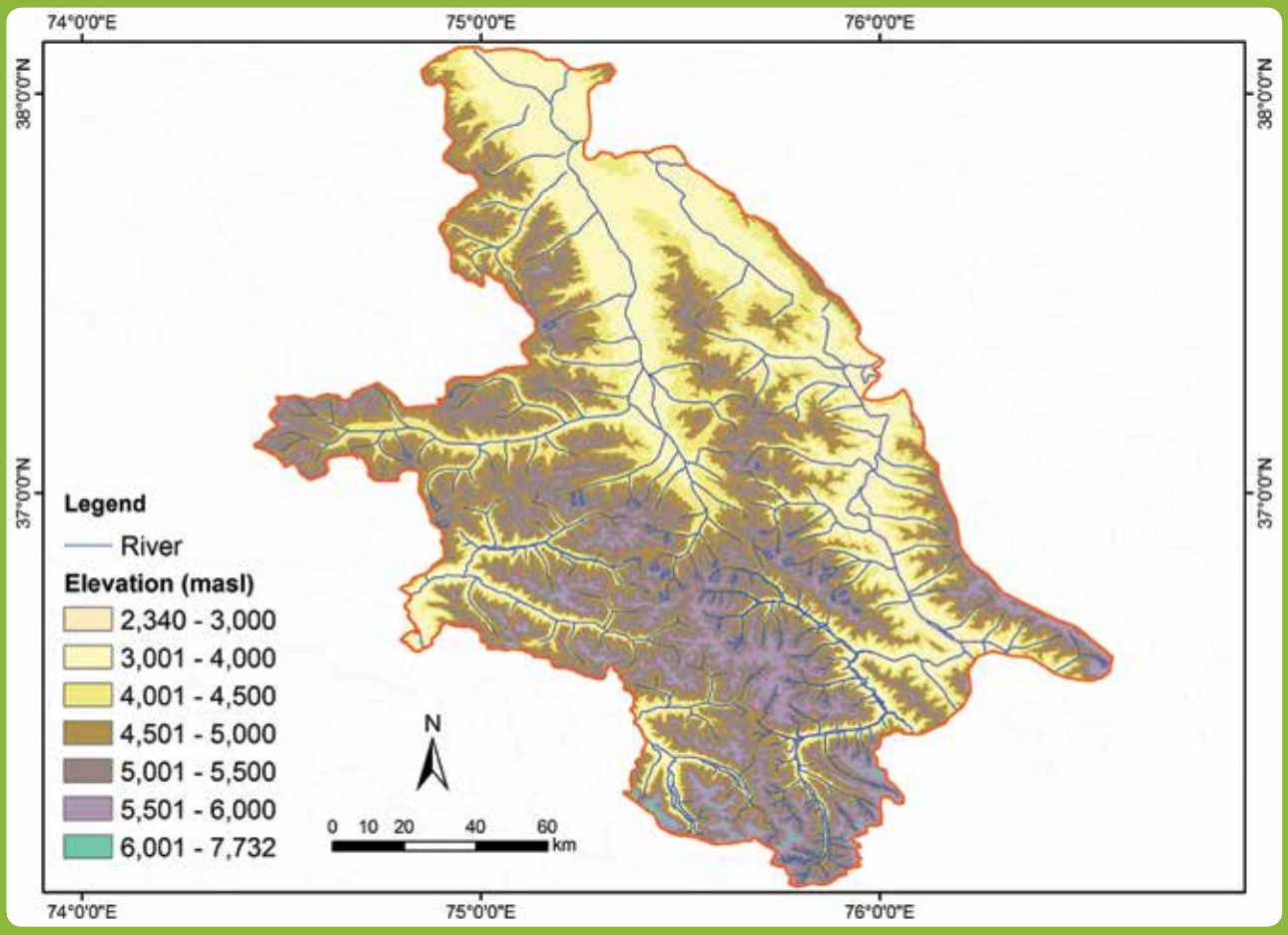
The KPL lies within one of the world's most geologically active areas. Located to the northwest of the Tibetan Plateau, the Karakoram mountains consist of parallel ranges that stretch from the Pamir and Hindu Kush in the northwest to the Qiangtang Plateau in the southwest. In the extreme north, the Karakoram ranges rise to an average height of 6,100 masl. The world's second highest peak Mount Qogir (also known as K2, Chhogori, and Mount Goodwin-Austen), 8,611 masl, is located in this area. More than 90% of the KPL pilot site lies between 3,000 and 5,500 masl; the alpine zone from 4,500 to 5,000 masl accounts for more than a quarter of the total land area (Table 2; Figure 3).

Table 2: **Elevation zones in the KPL pilot area**

Elevation	Area[a]	
masl	km^2	%
2,340–3,000	288	1.5
3,001–4,000	4,432	23.6
4,001–4,500	3,820	20.3
4,501–5,000	4,962	26.4
5,001–5,500	4,189	22.3
5,501–6,000	1,032	5.5
6,001–7,732	58	0.3
Total	18,781	100.0

[a] Calculated from the outer boundary of the whole pilot site area delineated on the basis of the watershed boundaries

Figure 3: **Distribution of elevation in the KPL pilot site**



The KPL presents an excellent example of a near pristine landscape, comparable to any in the world. The Hunza River provides the most accessible transect across the Karakoram and is the only valley that cuts across the entire range in Pakistan (Searle 2006). The Karakoram Highway (KKH) provides easy access along the valley from Gilgit across the Khunjerab Pass to Taxkorgan valley in Xinjiang. On the China side, Taxkorgan County, which includes the TNR, has an average elevation of more than 4,000 masl, with two major peaks – the Muztagh Ata (7,546 masl) and the Kongur Tagh (7,719 masl) and a number of rivers including the Taxkorgan River and the Tiznap (or Tiznef) River.

The extreme differences in elevation lead to a vertical spectrum of different belts of vegetation: lush green fields with agricultural crops, fruit trees, and forest plots along the valley bottoms, followed by green pastures higher up, which are then replaced by steep and rugged mountains at even higher elevations, finally culminating in glaciated mountain peaks.

Glaciers

One of the most significant features of the KPL is its glaciated landscape. The Karakoram is heavily glaciated and the meltwater supports a wide array of typical mountain ecosystems as well as being a major source of freshwater for millions of people living downstream. Glacier cover in the Karakoram range has been estimated at 28–50%, compared to 8–12% in the Himalayas and 2.2% in the European Alps (Dyurgerov and Meier 2005). Glacier cover in the upper Indus and Yarkand (Tarim) basins was reported to be approximately 21,000 km^2 in 1999, with the largest fraction (about 16,500 km^2) distributed in the Karakoram (Gu et al. 1999). Due to the high precipitation above the snowline (800–2,400 mm per annum), glaciers in the Chinese Karakoram may comprise up to 37% of the total mountain area (Gu et al. 1999). Glacier cover in other parts of the mountains was estimated to be 15,417 km^2 in the Tien Shan, 12,260 km^2 in the Kunlun Shan, and approximately 12,200 km^2 in the Pamir (Dyurgerov and Meier 2005). There are more than 5,000 glaciers in the Karakoram, with the 12 largest comprising almost 50% of the total glacier area (Hewitt 2010). The longest glaciers are the Siachen (74 km), Batura (65 km), Hisper (62 km), Biafo (60 km), Baltoro (60 km), and Yengunta (35 km).

Hewitt (2006) observed that the glacier ice is, to a large extent, concentrated along the main crest of the Karakoram range and Rakaposhi peak. Some of the largest valley glaciers outside high altitudes are found here, including the fourth largest in the Karakoram, the Hisper, and one of the longest, the Batura. There are hundreds of small and intermediate ice masses, but the three largest glacier systems represent about one-third of the total cover; they dominate the water yield from the Hunza basin and are an important contributor to the water supply to the Indus plains in Pakistan.

The Muztagh Ata (7,546 masl), also called the 'Father of Icebergs' or 'Kashgar Mountain' and meaning iceberg in Tajik, is located on the border between Taxkorgan County and Aktao County in Xinjiang in the western Kunlun range (or eastern Pamir) and close to the Kongur Tagh ('Brown mountain' in Kirgiz), which is the highest peak in the western Kunlun mountains (7,719 masl). There are nearly a hundred peaks above 6,000 masl, and 50 above 7,000 masl, around the Kongur Tagh and Muztagh Ata which provide ideal conditions for glacier development above the snowline (5,200 masl). The Kongur Tagh is covered by a huge ice cap. The western slope of Muztagh Ata is smooth and flat but the northern and eastern fringes are very steep. There are more than ten glaciers in this landscape, and the largest glaciers – the Qili glacier and Kematule glacier – have cut the mountain into two parts. At the top of the mountain, the glacier depth is about 100–200 m.

Rivers and water resources

Water bodies (rivers, lakes, wetlands) are literally the sinks for water from the landscape and play an important ecological, environmental, social, and cultural role. The KPL region contains the watersheds for the basins of the Indus and Yarkand (Tarim) rivers. The Khunjerab, Gujerab, and Shimshal rivers flow southwards and drain into the Hunza River. All the main waterways are perennial. No major rivers flow through the pilot area, but it is drained by a network of streams (nullahs) (Figure 1). Most of the streams in the KPL freeze in the winter. There are a number of small glacial lakes and peatlands near the Shimshal meadows collectively called the Shimshal Pamir lakes (Khan et al. 2012). The principal feeder of the rivers in the high-altitude zone is meltwater from snow and glaciers.

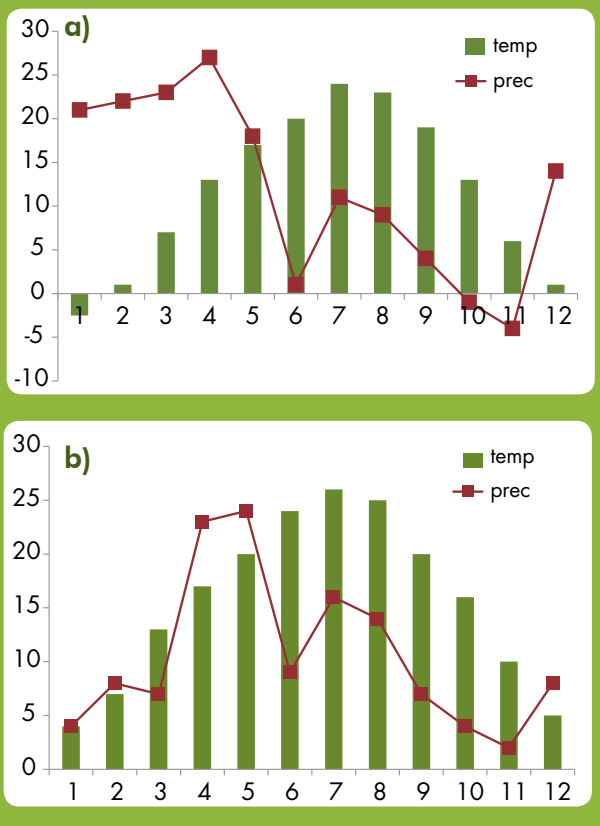
Taxkorgan County is mainly drained by the Yarkand (Tarim) River and its tributaries. This river originates in the north Karakoram and flows north through the eastern part of the reserve with an annual runoff of 2.7 billion m^3. The western part is drained by the Chalachigu River, a tributary of the 240 km long Taxkorgan River which merges into the Yarkand River in the north of the reserve. The Taxkorgan River has an average annual runoff of 1.58 billion cubic metres and is used to irrigate vast areas of pasture (ca. 60,000 ha) and farmland (ca. 3,400 ha) through canals or ditches in its upper watershed. In the north of Taxkorgan County, the Taheman River, which originates from Muztagh Ata, flows for 50 km through the Taheman basin where it irrigates 1,400 ha of farmland. These rivers have supported the development of oasis farming in this dry landscape for thousands of years.

A large part of the KPL is characterized by high elevation and steep slopes with immense geological processes, thus mountain disasters such as avalanches and land and mudslides are frequent in both winter and summer. In general, the seasonal runoff in the rivers changes greatly due to the varied contribution of glacier melt. The highest runoff in most rivers occurs in summer, 60% or more of the annual total, and the lowest in winter. The proportion of runoff in most rivers in spring and autumn is about 10–20% (Gu et al. 1999).

Climate

The climate in the Pakistan part of the KPL is predominantly cold and arid, especially in the high-altitude areas, but there are great differences as a result of the marked variation in elevation. The major part of the landscape within Pakistan is out of reach of the summer monsoon and receives average annual precipitation of only 100–300 mm, mostly from westerly winds during winter and spring. Elevations below 2,300 masl experience marked daily and seasonal temperature variation and have scant precipitation; areas between 2,300 and 3,300 masl receive sufficient snow and enjoy a temperate climate; and areas above 3,300 masl are very cold with a limited growing season. Generally speaking, winters are harsh and cold in all of the KPL. In summer, at lower altitudes the heat is intense during the day but nights are pleasant and at some places very cold, with temperatures even dipping below zero.

Figure 4: **Average monthly temperature and precipitation in a) Skardu and b) Gilgit**



Source: WWF 2009

Climate diagrams (Figure 4) drawn from 36 years of data (1970–2006) for two major towns (Gilgit at 74 25°E and 1,500 masl; Skardu at 75 40°E and 2,226 masl) show the seasonal and spatial variation in climate (data source: WWF 2009). Specific climate information for the KNP is not available.

In Taxkorgan, the major climate is cold desert or semi-desert. Climate data from the Taxkorgan county meteorological station (3,094 masl) between 1971 and 2000 show an average annual mean temperature of 3.6°C; average annual precipitation of 68 mm; monthly mean temperature ranging from -11.9°C in January to +16.4°C in July, and record maximum temperature of 32.5°C and minimum of -39.1°C (Table 3). On average, there are only 113 (70–120) frost-free days per year, but annual sunshine hours can reach as high as 2,831 hours, resulting in a high evaporation rate of 2,300 mm. At the Khunjerab Observation point (3,700 masl) the annual mean temperature is lower, at only -2.1°C, but precipitation is higher at 100 mm. The annual temperature variation in Taxkorgan is extreme, reaching values as high 40°C (Editorial Board 2009).

Table 3: **Climate data for Taxkorgan County (1971–2000)**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Monthly mean (°C)	-11.9	-8.2	-0.5	6.1	9.8	13.3	16.4	16.0	11.4	4.0	-3.4	-10.0	3.6
Avg. high (°C)	-4.2	-1.0	6.0	12.8	16.7	20.5	23.7	23.3	18.6	11.6	4.8	-1.9	10.9
Avg. low (°C)	-18.6	-15.3	-7.3	-0.8	3.1	6.4	9.4	8.8	3.5	-3.8	-10.8	-16.6	-3.5
Precipitation (mm)	3.2	2.6	2.4	4.8	8.0	15.5	11.3	9.6	6.0	2.1	0.7	2.0	68.2
Avg. precipitation days (≥ 0.1 mm)	2.1	2.4	2.2	2.5	5.1	6.8	6.2	4.6	2.9	1.7	0.5	1.6	38.6

Location of meterological station: Lat N 37.5; Long E 75.1; Altitude 3,094 masl

Source: www.weather.com.cn/html/cityintro/101130903.shtml

People and Livelihoods

Population

At the time of the last census in Pakistan in 1998, the population of Gilgit-Baltistan Province was 870,347. The population is thought to be growing at a rate of 2.8% per annum and may have approached 1 million in recent years. There are three inhabited valleys in the area immediately adjacent to the KNP: Ghulkin (149 households with a population of 1,256), Khunjerab (a cluster of seven villages with 364 households and a population of 2,849), and Shimshal (227 households with a population of 1,830).

Taxkorgan County has a population of 38,125 people, of which 83.3% are Tajiks (31,264) (the reason the county was given autonomous status), followed by Han (2,557), Kyrgyz (2,187), and Uygur (2,035). Most live in rural areas (26,202), including 14,619 pastoralists (Statistics Department of Kashgar Prefecture 2012)The majority are Selekur (highland) Tajiks, a fair-skinned group with blonde or brown hair and blue or grey eyes that have lived in central Asia since ancient times. The Tajiks' ancestors were Zoroastrians, but in the late eleventh century they converted to Islam. The Taxkorgan Nature Reserve itself is inhabited by 7,500 people, with about 70,000 domestic animals.

Despite some socioeconomic progress, the region remains poorly developed. In the area within Pakistan, people have very limited access to essential facilities such as health care, education, communication, electricity, and transportation. The majority (90%) live in sparsely scattered remote villages. The communities make a living from a variety of jobs such as herders, farmers, employees, and traders, but the major source of livelihoods remains subsistence farming of wheat, corn, barley, vegetables, and fruit and livestock herding (Khan 2013). Marketing of fresh and dried fruit and nuts such as apples, pears, cherries, apricots, almonds, and walnuts contributes to families' income.

The situation is similar in the area within China. Taxkorgan County remains one of the poorest counties in China. Most daily goods, including grain, have to be transported from Kashgar (about 300 km away), and the price is 40% higher in Taxkorgan than in Kashgar, although local incomes are lower. In 2004, the annual average income of rural people was only 1,150 Yuan RMB (about 180 USD) (Editorial Board 2009). As a result of the frequent natural disasters, poor infrastructure, and limited economic activity, the local government is unable to generate enough revenue to support development of basic infrastructure such as electricity, roads, and post offices.

Traditional livelihoods

Pastoral grazing on rangelands is the main land use in the KPL, sometimes mixed with crop farming in low lying flat areas and valley bottoms.

Pastoralism

Due to the limited livelihood options, almost all the pastures in the KPL have been exploited for grazing of livestock by the local communities. Although there has not yet been a proper scientific assessment, it is believed that the majority of pastures are being overused and that productivity is becoming too low to make animal husbandry profitable. The

estimated livestock population in Gilgit-Baltistan in 2013/2014 was estimated at 176.5 million (based on the 1996 and 2006 local government livestock censuses), mostly large and small ruminants (GoP 2014). These animals are mostly raised in a mixed farming system with a combination of livestock management and crop cultivation, only a small fraction of total domestic stock are kept in a purely pastoral system in which the pastoralists do not own any land or do any farming. In either case, cattle (including yak and its hybrids), goats, and sheep are engaged in seasonal migration in a continuous search for pasture (Khan 2013). In some areas, non-local pastoralists/nomads pay tax to local landowners to graze their livestock for certain periods of the year.

Taxkorgan County is a traditionally pastoral region where animal husbandry forms the pillar of local livelihoods and the major source of income. In 2004, the county had a total of 1,698,000 livestock, and the total income from pastoral production was about USD 4.71 million. The major livestock include Pamir yak, mostly distributed in the eastern mountains above 4,000 masl, Pamir goat in the mid-hills, and Dabas goat raised along riverbeds in the east. Cattle, camels, horses, and donkeys are also kept. Pamir goat and Dabas goat are important local breeds for income generation (Editorial Board 2009).

Agriculture

The KPL pilot site has only 122,293 ha of farmland, 6.5% of the total area. Most of this is within the KNP, only 2,998 ha lie within the TNR. In Gilgit-Baltistan, the cultivated land and settlements mostly lie along the major riverbeds (Hunza, Indus, and Shigar). The major crops include wheat, maize, and potato, with apricot and pomegranate as the major fruit trees. In Taxkorgan county, cultivation is concentrated in a very few patches of farmland. The major crops are barley, wheat, maize, and peas. In 2004, 1,157 ha (39% of the total farmland) was used for wheat cultivation, 143 ha (4.8%) for maize, 31 ha (1%) for barley, and 1,667 ha (55.6%) for peas. The total annual production of grain crops was 56,110 kg (Editorial Board 2009).

Land Cover

Land cover classes

A Landsat TM image from October 2009 acquired from the National Aeronautics and Space Administration (NASA) satellite images archives was used for land cover mapping of the KPL pilot site area. After pre-processing, the image was analysed using supervised classification. The validation of this classification was carried out by comparison with high-resolution satellite Google Earth images. The area of different land cover classes is shown in Table 4, the spatial distribution in Figure 5, and the distribution with elevation in Figure 6. Almost half of the land cover in the KPL pilot site is bare soil or rock, with glaciers, snow, and ice accounting for a further 20%. Close to a quarter of the area is rangeland, which provides the main resource base for local livelihoods. Grasslands, shrubland, and bare rock are most common between 4,500 and 5,000 masl, and glaciers and snow cover at 6,000 to 6,500 masl.

Table 4: **Land cover classes in the KPL pilot site area**

	Area[a]	
Class	ha	%
Grassland/shrubland	442,820	23.6
Agriculture (farmland)	122,293	6.5
Bare soil/rock	914,380	48.7
Glaciers/snow/ice	381,422	20.3
Water bodies	17,880	1.0
Total	1,878,795	100.0

[a] Calculated from the outer boundary of the whole pilot site area delineated on the basis of the watershed boundaries

Figure 5: **Land cover in the KPL pilot site area**

Vegetation phenology

The Normalized Difference Vegetation Index (NDVI) has proven to be a useful proxy for the status of the above-ground biomass at the landscape level as it has a high correlation with green-leaf density, net primary production, and CO^2 fluxes. The NDVI for the pilot area was acquired from the moderate resolution sensor MODIS at 16-day intervals with a spatial resolution of 250 m, a standard product coded as MOD13Q1. Maps and graphs were generated for 2011 showing the change in NDVI values of selected vegetation types over the year (Figure 7) and change in spatial distribution of vegetation overall (Figure 8). Generally, grasses start to grow from the beginning of April to a maximum NDVI in June and July, after which growth declines due to the rapid drop in air temperature after August. This seasonality is one of the most important determinants for the seasonal migration of pastoral herders and their livestock between pastures at different elevations.

Figure 6: **Land cover distribution across elevation zones**

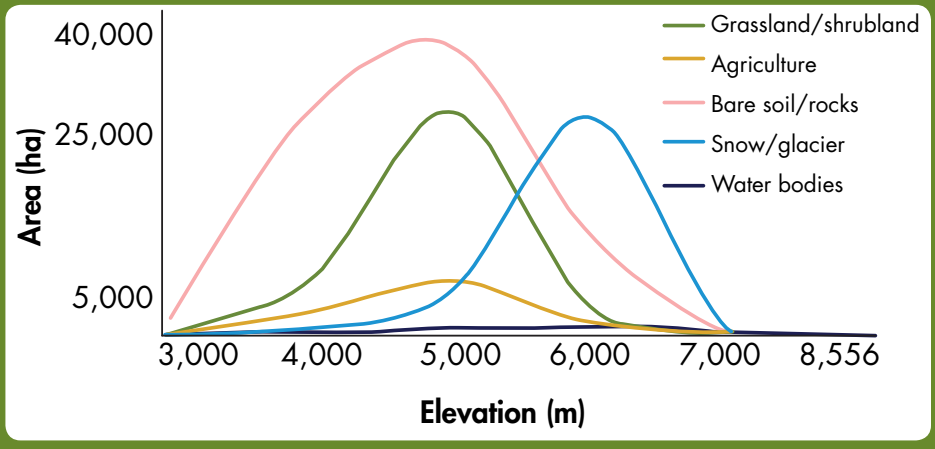


Figure 7: **Change in signature of key vegetation types with time in the KPL pilot site**

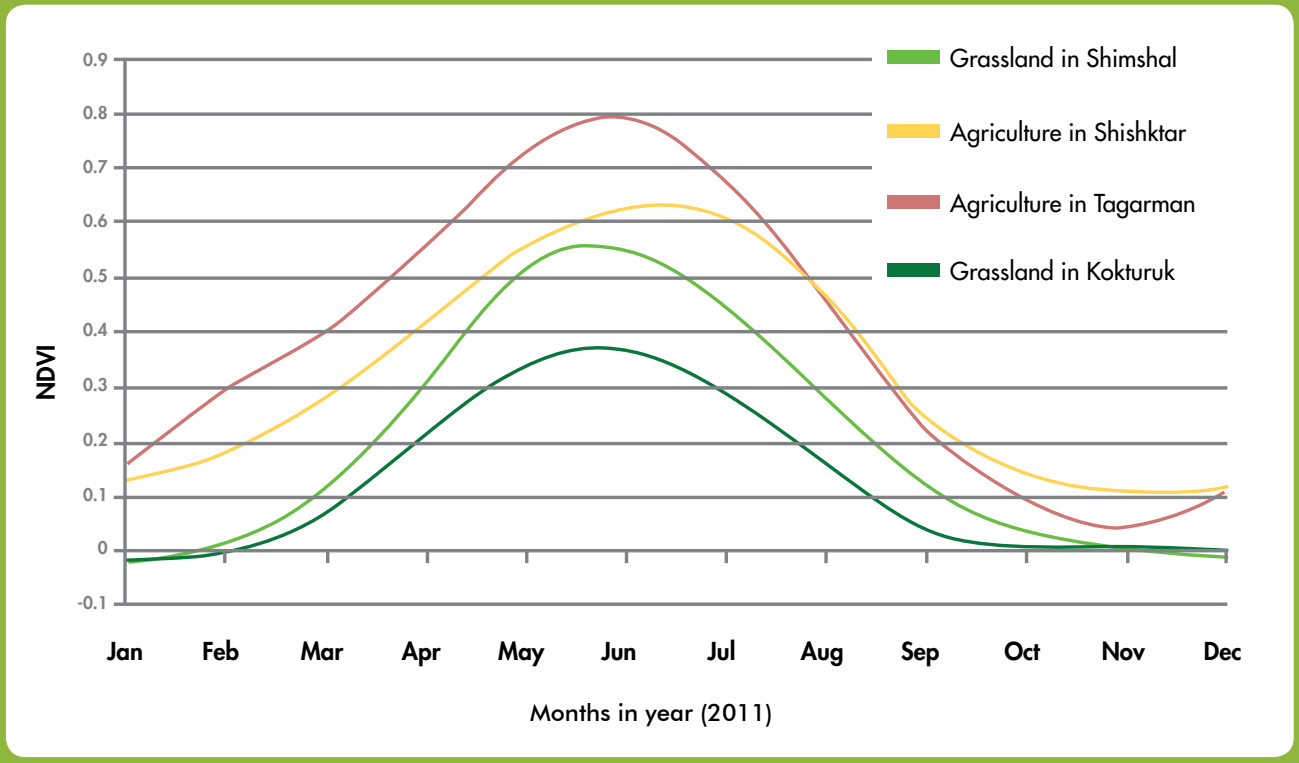
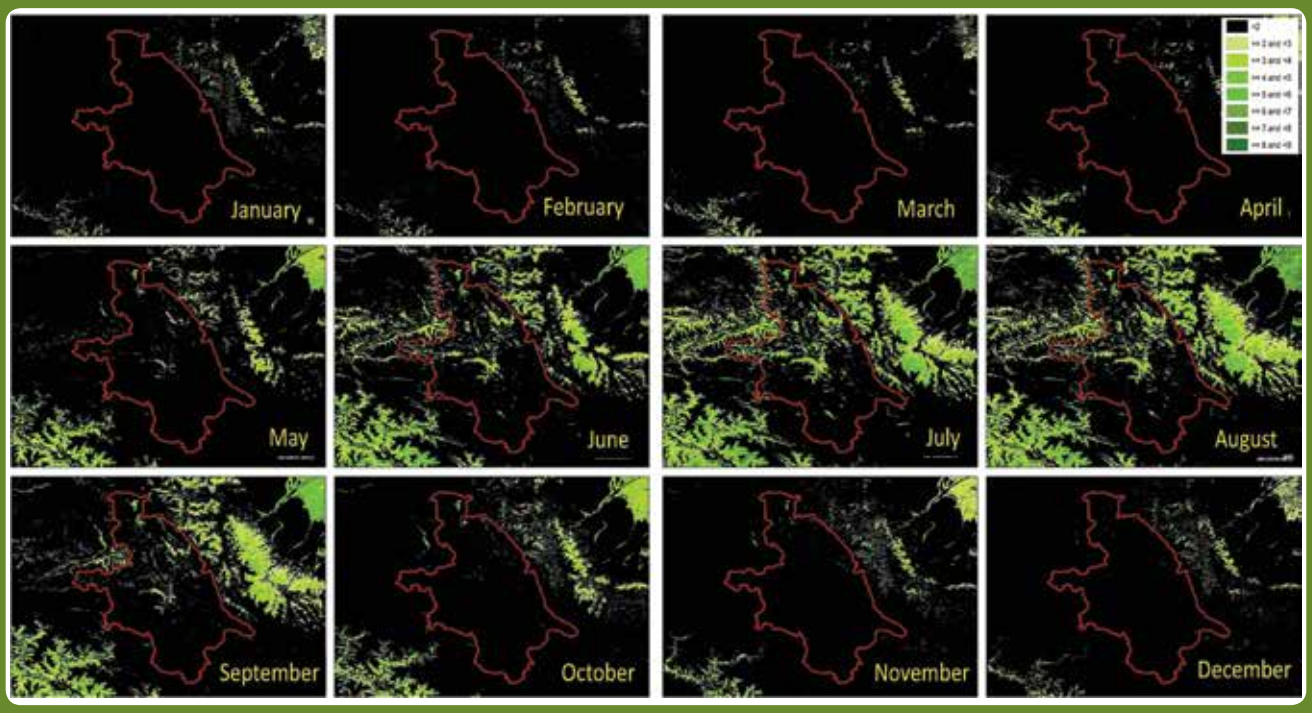


Figure 8: **Spatio-temporal pattern of vegetation across the KPL pilot site and surrounding area in 2011**

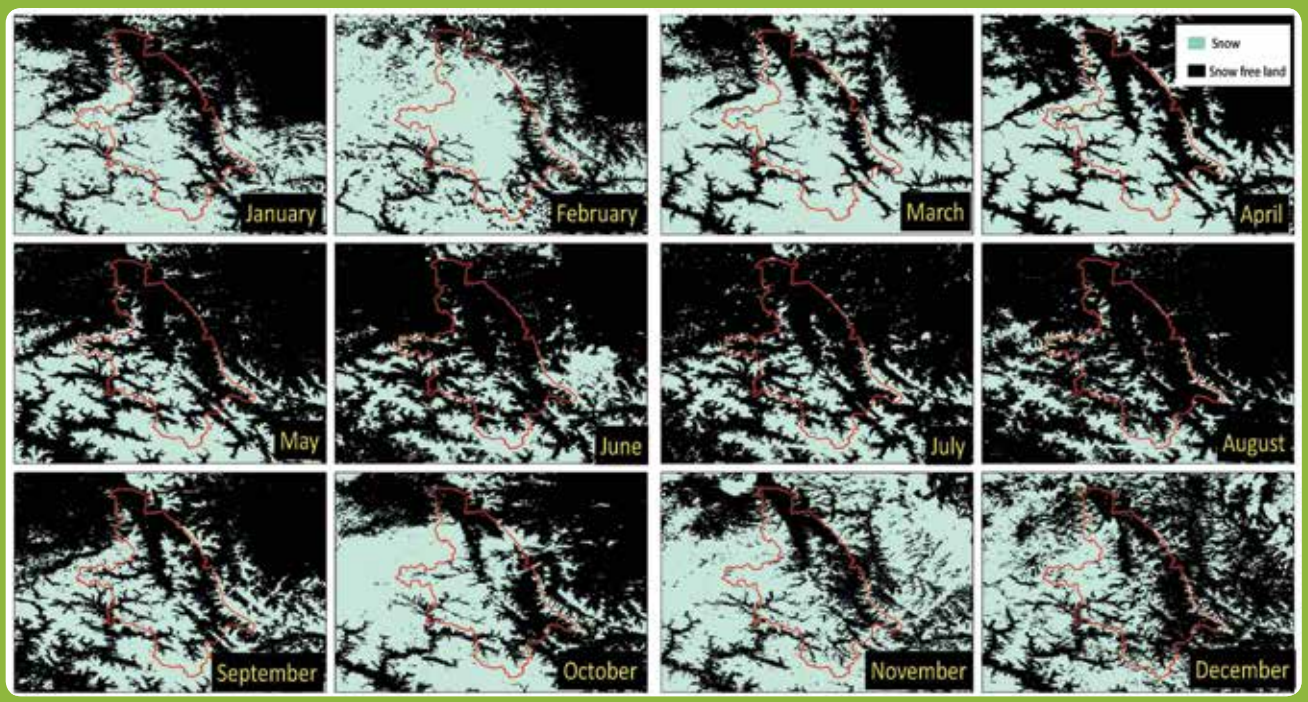


Snow cover distribution

Snow-covered areas around the world have been identified as being especially vulnerable to future climate change (Khan SM et al. 2012). Understanding of snow distribution over time is particularly important in water deficit environments like that of the KPL. The Normalized Difference Snow Index (NDSI) has been widely used for effective snow cover mapping. The NDSI for the KPL pilot site was obtained from MODIS NDSI eight-day composite products (MOD10A2) and used to map snow cover in 2011. The total area of snow cover in each month is shown in Figure 9 and the spatial distribution in Figure 10. Snow cover was highest in February and lowest in August.

Figure 9: **Intra-annual snow cover distribution of the KPL pilot site and surrounding area in 2011**

Figure 10: **Spatio-temporal pattern of snow cover across the KPL pilot site and surrounding area in 2011**



3. Biodiversity

The KPL region lies at the meeting point of the Karakoram and Pamir ranges and acts as a major biogeographic barrier between Mediterranean-influenced middle Asia, monsoonal South Asia, and the continental expanses of Central Asia. As the meeting point of these different systems, the KPL possesses a rich and unique biodiversity and has essential habitats for many endemic and endangered species.

The dominant landscape is alpine with high and cold desert and steppe. In the alpine belt, the flora is similar to that of the western Himalayas and the Tibetan Plateau, with which the KPL region has a close geographic affinity, but with a strong Mediterranean influence. The landscape plays a significant global role in biodiversity protection, while some of the plant and animal species play an important role in the local economy. The region also supports a wealth of agrobiodiversity, including traditional cultivars of cereal crops, many different varieties of fruit, and a wide range of traditional livestock breeds.

Flora

Species richness provides a certain measure of biodiversity, but use of this parameter is limited by the fact that many species, particularly mosses, fungi, and microorganisms, remain unknown. The KPL region has a strong phyto-geographic affinity to the adjoining Tibetan Plateau, although its alpine flora is also influenced by Iranian-Afghan (middle Asian) flora.

Chinese scientists surveyed the flora along the Karakoram Highway in the KNP in 2009 and identified 369 species of wild seed plants belonging to 149 genera in 38 families (Table 6) (Hai et al. 2011). Lower numbers were reported by Pakistani researchers (Qureshi et al. 2011), who identified 62 plant species belonging to 45 genera in 25 families. The plants identified by the Chinese authors included 5 gymnosperm species in 2 genera in 2 families; the remaining plants were angiosperms. The dominant families were Compositae (17 genera, 45 species), Cruciferae (17 genera, 33 species,), Gramineae (16 genera, 51 species), Fabaceae (8 genera, 38 species,), and Caryophyllaceae (8 genera, 17 species) (Table 5).

Table 5: **Seed plants in the KNP**

Family	G/S[a]	Family	G/S[a]	Family	G/S[a]
Compositae	17/45	Papaveraceae	3/10	Onagraceae	1/2
Cruciferae	17/33	Liliaceae	3/8	Plantaginaceae	1/2
Gramineae	16/51	Crassulaceae	3/8	Cupressaceae	1/2
Fabaceae	8/38	Scrophulariaceae	3/5	Geraniaceae	1/2
Caryophyllaceae	8/17	Chenopodiaceae	3/4	Caprifoliaceae	1/2
Ranunculaceae	7/12	Saxifragaceae	2/7	Tamaricaceae	1/1
Boraginaceae	7/10	Gentianaceae	2/7	Betulaceae	1/1
Labiatae	7/10	Rubiaceae	2/7	Capparidaceae	1/1
Polygonaceae	5/17	Salicaceae	2/3	Rhamnaceae	1/1

Family	G/S[a]	Family	G/S[a]	Family	G/S[a]
Rosaceae	5/13	Violaceae	1/4	Elaeagnaceae	1/1
Umbelliferae	5/5	Juncaceae	1/4	Amaryllidaceae	1/1
Cyperaceae	4/18	Orobanchaceae	1/3	Iridaceae	1/1
Primulaceae	4/10	Ephedraceae	1/3		

[a] G/S = genera number/species number
Source: Hai et al. 2011

The flora of KNP is dominated by temperate elements, with North Temperate elements comprising 57% of the total (Hai et al. 2011). Due to the high elevation of the KNP, species diversity of flora is relatively low, but the area is quite rich in alpine plants such as cushion plants adapted to high and dry habitats. Representative species include *Thylacospermum caespitosum, Sibbaldia tetrandra, Androsa cetapete, Psychrogeton poncinsii, Leontopod iumnanum, Saussurea thoroldii,* and *Saussurea subulata*. A number of endemic species have been reported in Gilgit-Baltistan Province (Table 6), but whether any of these are found in the KNP is not known.

Table 6: **Endemic taxa in Gilgit-Baltistan, Pakistan**

Family	Name of taxa	Known localities
Alliaceae	*Allium gilgiticum* Wang & Tang	Gilgit
Asteraceae	*Tanacetum baltistanicum* Podlech	Gilgit and Baltistan
Berberidaceae	*Berberis pseudumbellata* Parker subsp. *gilgitica* Jafri	Gilgit
Boraginaceae	*Mattiastrum karakoricum* Podlech & Sadat	Gilgit
Brassicaceae	*Arabidopsis brevicaulis* (Jafri) Jafri	Karakoram:Hunza
Brassicaceae	*Christolea mirabilis* (Pamp.) Jafri	Karakoram
Crassulaceae	*Rhodiola saxifragoides* (Frod) H. Ohba	Gilgit
Papilionaceae	*Astragalus clarkeanus* Ali	Karakoram
Plantaginaceae	*Plantago baltistanica* Hartmann	Baltistan
Poaceae	*Elymus russellii* (Meld.) T.A.Cop	Gilgit
Primulaceae	*Androsace russellii* Y.Nasir	Gilgit
Ranunculaceae	*Aconiticum violaceum* jacq. Ex Stapf var. weileri (Gilli) H. Riedl	Gilgit and Baltistan
Ranunculaceae	*Consolida schlagintweitii* (Huth) Munz	Baltistan
Rhamnaceae	*Rhamnella gilgitica* Mansf. & Melch.	Gilgit Agency
Rubiaceae	*Asperula oppositifolia* Reg. & Schmal. subsp. *baltistanica* Nazim	Gilgit
Rutaceae	*Haplophyllum gilesii* (Hemsl.) C.C.Townsend	Gilgit
Saxifragaceae	*Saxifraga duthiei* Gandogar	Baltistan

Source: Alam 2009

The TNR supports extensive sedge barrens dominated by *Kobresia* spp. and *Carex* spp. with moisture-tolerant forbs such as *Ranunculus* spp., *Gentiana* spp., *Oxytropis* spp., *Potentilla* spp., *Primula* spp., and *Pedicularis* spp., as well as grassy steppe vegetation (*Festuca* spp., *Stipa* spp., *Poa* spp., and *Ptilagrostis* spp.). A total of 963 species of seed plants (including varieties) belonging to 59 families and 620 genera have been identified in the Chinese Pamir region (Table 7) (Yang et al. 2008). There are likely to be less in the TNR although the list indicates the potential. As yet, there has been no baseline survey of floral diversity in the TNR so the precise figure is unknown, but taking into account the species number in KNP (see below) and the environmental conditions in TNR, it seems likely that TNR may host around 250–350 species of seed plants. Three endemic plants have been recorded in TNR: *Kaschgaria brachanthemoides, Polygonum sibiricum* var. *thomsonii,* and *Tamarix taklamakanensis.*

Table 7: **Spermatophyte life forms in the Chinese Pamir**

	Species	Genus	Family	Phanerophyte		Chamaephyte	Hemicrypto-phyte	Geophyte	Annual/ biennial
				MegaPh/ MesoPh	MicroPh/ NanoPh				
Gymnosperm	12	3	3	3	1	4	4		
Angiosperm	951	300	56	47	13	33	465	30	100

Source: Yang et al. 2008

Medicinal plants

Most medicinal plants in the region around the KPL are found in the alpine belt, far from settlements. These resources have been declining continuously as a result of overexploitation, while the demand for plant-based drugs and products is increasing. Many herders lack awareness about the medicinal importance of these species, which means that not only unsustainable collection but also overgrazing by livestock has resulted in heavy pressure on the resource base, as typified by the collection of *Saussurea simpsoniana* (boshi phonar) by Pakistani locals and Chinese traders. Furthermore, the traditional knowledge on the use of medicinal and aromatic plants is vanishing fast, primarily because of the easy access to allopathic medicine (Khan et al. 2011a).

Although some botanical and medicinal plant surveys have been conducted, most have been restricted to the more accessible valleys. In the KNP, the mountain communities in the Khunjerab, Shimshal, Misgar, and Chipursan valleys have a long history of using local herbs to meet their daily needs, but little is known outside these areas about the local flora and its traditional use (Qureshi et al. 2011). The residents in the KNP were found to use 43 species of common medicinal and aromatic plants from 40 genera and 28 families, often for multiple purposes (Khan et al. 2011a). Thirty species were used in human medicine (29 diseases); 4 in veterinary medicine; 7 for cosmetics and decoration; 10 for food; and 6 for poison, insecticides, and pesticides; while 2 had a high spiritual and cultural value (Table 8).

Table 8: **Medicinal plants used by the inhabitants of KNP**

Family	Scientific name	Parts used	Medicinal or other use
Alliaceae	*Allium carolinianum*	Leaves, bulbs	Flu, fever, cough
Amaranthaceae	*Aerva lanata*	Leaves, flowers	Snakebite, wounds
Amaranthaceae	*Chenopodium botrys*	Flowers, leaves	Stomach and digestive disorders, constipation
Asteraceae	*Anaphalis triplinervis*	Leaves, flowers	Herbal tea for flu, fever and nausea, dressing wounds
Asteraceae	*Artemisia brevifolia*	Leaves, flowers	Veterinary medicine
Asteraceae	*Cichorium intybus*	Flowers, roots	Typhoid, malaria, abdominal pain
Asteraceae	*Taraxacum officinale*	Leaves ,roots	Jaundice, pneumonia
Asteraceae	*Tragopogon dubius*	Flowers	Ear infections and diseases
Berberidaceae	*Berberis lycium*	Root, bark	Fractured bones, joints, wounds, backache, UTI
Betulaceae	*Betula utilis*	Bark	Bark given to children to prevent evil deeds
Capparaceae	*Capparis spinosa*	Fruit	Typhoid, malaria, flu, fever, sunburn
Chenopodiaceae	*Chenopodium album*	Leaves, stems	To treat constipation

Family	Scientific name	Parts used	Medicinal or other use
Cupressaceae	*Juniperus excelsa*	Fruit, leaves	Berries used for abdominal pain; leaves burned to produce smoke
Elaeagnaceae	*Elaeagnus aungustifolia*	Fruit, gum	To treat vitamin C deficiency in children; gum used as shampoo for hair tonic
Elaeagnaceae	*Hippophae rhamnoides*	Fruit	High cholesterol, irregular palpitations, kidney and urinary problems, reproductive disorders in women like infertility.
Ephedraceae	*Ephedra gerardiana*	Leaves, stems	Repellent to prevent livestock debarking young trees, sunburn
Fabaceae	*Astragalus strictus*	Leaves, flowers	Food supplement to increase milk productivity in livestock
Fabaceae	*Medicago sativa*	Leaves	To increase milk productivity in livestock
Fabaceae	*Melilotus alba*	Leaves	Inflammation, joint pains
Fabaceae	*Sophora mollis*	Leaves	Skin allergies; used as an antiseptic, insecticide, and pesticide
Grossulariaceae	*Ribes alpestre*	Roots, fruits	Backache, joint pain, jaundice
Lamiaceae	*Mentha longifolia*	Leaves, flowers	Jaundice, fever, asthma, high blood pressure
Lamiaceae	*Mentha royleana*	Flowers, leaves	Digestive disorders, abdominal pain, backache, maternal deliveries
Lamiaceae	*Nepeta floccosa*	Flowers, leaves	Reduce fat, stop hair loss
Lamiaceae	*Thymus linearis*	Flowers, leaves	Herbal tea for cold, fever, cough
Lythraceae	*Punica granatum*	Fruit, seeds, bark	Jaundice, diarrhoea, nose bleeds, stomach disorders, bronchitis, digestive disorders in livestock
Malvaceae	*Malva neglecta*	Flowers, leaves	Constipation, digestive problems
Nitrariaceae	*Peganum hermala*	Root	Jaundice
Orchidaceae	*Dactylorhiza hatagirea*	Root, rhizome	Sexual debility
Plantaginaceae	*Plantago lanceolata*	Leaves, seeds	Leaves: burns, wounds, infections; Seeds: diarrhoea, fever
Poaceae	*Hordeum vulgare*	Seeds	Jaundice, high blood pressure
Polygonaceae	*Rheum tibeticum*	Stems	Mild laxative to relieve constipation
Primulaceae	*Primula macrophylla*	Flowers, leaves	Eye infections, irritation, disease; cough, asthma
Ranunculaceae	*Clematis orientalis*	Fruit, flowers, leaves	Diarrhoea, dysentery; leaves to treat eczema
Rosaceae	*Comarum salesovianum*	Flowers	Eye infections
Rosaceae	*Potentilla eriocarpa*	Flowers, leaves	Eye disorders and infections
Rosaceae	*Potentilla microphylla*	Seeds, leaves	Wounds and bone fractures in livestock; insect repellent

Family	Scientific name	Parts used	Medicinal or other use
Rosaceae	Rosa webbiana	Fruit, seeds	Digestion, veterinary diseases
Saxifragaceae	Saxifraga hirculus	Whole plant	Fever, diarrhoea, cough, chest complaints, pulmonary disorders
Solanaceae	Solanum nigrum	Fruit, seeds	Throat inflammation
Tamaricaceae	Myricaria squamosa	Flowers, leaves	Injuries in people and livestock
Valerianaceae	Valeriana wallichi	Root	Cough, asthma, and heart disease

Source: Khan et al. 2011a

In the part of the KPL in China, extraction by local traders is now occurring on a large scale, and several valuable medicinal plant species are endangered. The almost depredatory manner of collecting medicinal plants has led to the total destruction of vegetation cover in some places. In Taxkorgan, the main products collected by local people include *Saussurea involucrate*, *Cynomorium songaricum*, *Dracocephalum heterophyllum*, *Radix lithospermi*, *Codonopsis pilosula*, *Angelica sinensis*, *Lycium barbarum*, radix Glycyrrhizae (*Glycyrrhiza korshinskyi*, *G. inflata*), herba ephedrae (*Ephedra sinica*, *Ephedra equisetina,* and *Ephedra intermedia*), and *Apocynum venetum*. Glycyrrhiza (liquorice root) is one of the main herbal medicines produced in Xinjiang. With an annual yield of 60,000 tons, Xinjiang contributes more than 50% of Chinese Glycyrrhiza production and 80% of national exports. The roots are the main parts used in medicine; but digging out the roots frequently destroys the fragile vegetation cover and leads to rangeland degradation or even desertification.

Fauna

The Hindu Kush Himalayas form a boundary between two major zoogeographical regions: the Palearctic region and the Oriental region. In the northwest where the KPL is located, the boundary is blurred and there is a mix of animal species from both regions, which leads to an increase in species diversity. Further, the faunal diversity includes a blend of species from within the biogeographic provinces of the Palaearctic Realm, i.e. the Pamir, Tien Shan, and Tibetan Plateau. Complex dispersal and mingling patterns of biota in this region have resulted in a unique plateau fauna.

Mammals

The mammals in the KPL are composed of a blend of Palearctic and Indo-Malayan elements (Khan 2009) and this blending of elements from different origins makes the fauna very interesting and diverse. The key mammalian species include Marco Polo sheep (*Ovis ammon polii*), blue sheep (*Pseudois nayaur)*, Himalayan ibex (*Capra ibex siberica*), Tibetan wild ass (*Equus kiang*), Tibetan sand fox (*Vulpes vulpes*), Himalayan brown bear (*Ursos arctos*), black bear (*U. thibetanus*), snow leopard (*Panthera uncia*), Tibetan wolf (*Canis lupus*), and lynx (*Lynx lynx*), some of which are endemic to the Karakoram mountain region. Golden marmot (*Marmota caudata*), ermine (*Mustela ermine*), stone marten (*Martes foina*), large-eared pika (*Ochotona macrotis*), cape hare (*Lepus capensis*), and many other small mammals such as Royle's or Indian pika *(Ochotona roylei),* Chinese birch mouse *(Sicista concolor),* house mouse *(Mus musculus),* high mountain vole *(Alticola roylei),* Pamir vole *(Microtus juldaschi), and* migratory/ grey hamster *(Cricetulus migratorius)* are also found in the area.

A total of 14 mammalian species belonging to five orders, 10 families, and 14 genera, have been recorded in the KNP (Qureshi et al. 2011), of which three are critically endangered and two endangered according to the International Union for Conservation of Nature (IUCN) (Sheikh and Molur 2005) (Table 9). Eleven mammals (Marco Polo sheep, cape hare, common pipistrelle, grey long-eared bat, common red fox, field mouse, Himalayan ibex, golden marmot, large eared pika, migratory hamster, and blue sheep) were observed directly during a one-year survey, while three (brown bear, snow leopard, and Indian wolf) were recorded on the basis of indirect observations like pug marks, faecal materials, and territory marking signs (Qureshi et al. 2011).

Table 9: **Mammals observed in the KNP**

Order	Family	Scientific name	Common name	Status IUCN 2005[a]
Artiodactyla	Bovidae	*Capra ibex sibirica*	Himalayan ibex	LC
Artiodactyla	Bovidae	*Pseudois nayaur*	blue sheep	EN
Artiodactyla	Bovidae	*Ovis ammon polii*	Marco Polo sheep	CR
Carnivora	Canidae	*Canis lupus*	Indian wolf	EN
Carnivora	Canidae	*Vulpes vulpes montana*	common red fox	DD
Carnivora	Felidae	*Uncia uncia*	snow leopard	CR
Carnivora	Ursidae	*Ursus arctos*	brown bear	CR
Chiroptera	Vespertilionidae	*Plecotus austriacus*	grey long-eared bat	NT
Chiroptera	Vespertilionidae	*Pipistrellus pipistrellus*	common pipistrelle	LC
Lagomorpha	Ochotonidae	*Ochotona macrotis*	Karakoram pika	LC
Rodentia	Cricetidae	*Cricetulus migratorius*	migratory hamster	LC
Rodentia	Muridae	*Apodemus rusiges*	field mouse	VU
Rodentia	Sciuridae	*Marmota caudata aurea*	golden marmot	LC

[a] CR = critically endangered, DD = data deficient, EN = endangered, LC = least concern, NT = near threatened, VU = vulnerable)
Source: Qureshi et al. 2011

A number of the flagship mammal species of the region have been observed in the TNR, including Ibex, Marco Polo sheep, blue sheep, snow leopard, Himalayan brown bear, black bear and Himalayan lynx. In 2009, 29 mammalian species were reported in Taxkorgan County (Editorial Board 2009). According to Schaller et al. (1987), the last known viable population of Marco Polo sheep in China was confined to the western part of Chalachigu Valley, and around 1,000 individuals of ibex (*Capra ibex*) were found in the west of the reserve. Blue sheep were present in all the eastern and southeastern ranges of the reserve, with distribution overlapping with that of ibex in the north. Among the carnivores, brown bear and wolf (*Canis lupus*) were rare, but some 50–75 snow leopards (*Panthera uncial*) were thought to frequent the reserve (Schaller et al. 1987).

Reptiles and amphibians

The diversity of reptiles and amphibians in the KPL is likely to be low due to the high elevation. A recent survey in the KNP recorded two reptilian species – the agama lizards *Laudakia himalayana* and *Laudakia pakistanica* (Qureshi et al. 2011), with two more species of agama lizard – *Laudakia tuberculata* and *Laudakia badakhshana* – observed a year later at Shimshal Pamir lake (above 4,000 masl) (Khan et al. 2011b, Khan B et al. 2012). As yet, no survey has been carried out specifically in TNR, and both the surveys in KNP were limited in scale and duration; thus the number of herpetofauna in the KPL could be considerably higher. Some indication of the species that might exist in KPL is given by sightings in Gilgit-Baltistan Province and Taxkorgan County.

Although Gilgit-Baltistan Province hosts a unique herpetofauna, knowledge of the amphibians and reptiles is still very limited; only a few areas and species have been thoroughly investigated, and strong uncertainties persist on the distribution and taxonomy of many species (Sindaco and Jeremčenko 2008). Overall, three amphibian families have been recorded (Ranidae, Bufonidae, and Megaphrydae) with six species (two frogs and four toads), including Deosai frog (*Scutiger occidentalis*), Batura toad (*Bufo pseudoraddi batuae*), and Ladakh toad (*Bufo latastii*); and eight reptilian families (Gekkonidae, Agamidae, Scincidae, Varanidae, Boidae, Colubidae, Elaphidae, and Viperidae) with 23 species (nine lizards and 14 snakes) including Pakistani rock agama (*Laudakia pakistanica pakistanica*), Auffenberg's rock agama (*Laudakia pakistanica auffenbergi*), Khan's rock agama (*Laudakia pakistanica khani*), and Batura bent-toed gecko (*Cyrtodactylus baturensis*).

In Taxkorgan County, two amphibian species have been reported in the family of Bufonidae – *Pseudepidalea taxkorensis* and *Pseadepidalea zamdaensis* (Fei et al. 2005) – with two more possibly present at lower elevations– *Pelophylax terentieve* in the family Ranidae and *Pseudepidalea pewzowi* in the family Bufonidae (Jiang Jianping, Chengdu Institute of Biology [CIB], unpublished); while five species of reptiles have been reported in three families – *Phrynocephalus forsythii* and *Laudakin himalayana* in the family Agamidae*, Eremias multiocellata yarkndensis* in the family Lacertidae*, and Asymblepharus alaicus* and *Asymblepharus himalayana* in the family Scincidae (Jiang Jianping, CIB, unpublished).

Avifauna

The KPL has one of the most diverse avifauna in mountain regions in the world. The region is a nesting and staging place for a number of migratory birds and waterfowl along the famous Indus Flyway. The key avifauna species are grey heron (*Ardea cinerea*), Northern shoveler (*Anas clypeata*), common teal (*Anas crecca*), northern pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), marbled teal (*Marmaronetta angustirostris*), and coot (*Fulica atra*) (Khan B et al. 2012). The common resident birds include Himalayan snow cock (*Tetraogallus tibetanus*), chukar (*Alectoris chukar*), rock pigeon (*Columba livia*), snow pigeon (*Columba leuconota*), oriental turtle dove (*Streptopelia orientalis*), booted eagle (*Aquila pennata*), and common kestrel (*Falco tinnunculus*) (Khan B et al. 2012). The landscape provides nesting and staging grounds for the common hoopoe (*Upupa epops*), common cuckoo (*Cuculus canorus*), common swift (*Apus apus*), and Eurasian nightjar (*Caprimulgus europaeus*), typical summer breeding birds in the area; winter visitors include the hen harrier (*Circus cyaneus*), Eurasian skylark (*Alauda arvensis*), Spanish sparrow (*Passer hispaniolensis*), Himalayan accentor (*Prunella himalayana*), Eurasian goldfinch (*Carduelis carduelis*), and pine bunting (*Emberiza leucocephalos)*. Rare birds include the snow partridge (*Lerwa lerwa*), Himalayan monal (*Lophophorus impejanus*), golden eagle (*Aquila chrysaetos*), mountain finch (*Leucosticte brandti*), and Hume's wheatear (*Oenanthe albonigra*). The area also hosts Lammergier (*Gypaetus barbatus*), Himalayan griffon (*Gyps himalayensis*), Eurasian black vulture (*Aegypius monachus*), marsh harrier (*Circus aeruginosus*), Eurasian sparrow hawk (*Accipiter nisus*), lesser kestrel (*Falco naumanni*), saker (*Falco cherrug*), peregrine falcon (*Falco peregrinus*), magpie (*Pica pica*), alpine chough (*Pyrrhocorax graculus*), and raven (*Corvus corax*).

A recent survey in the KNP recorded 48 avian species belonging to nine orders and 21 families (Table 10); of these, 13 were identified in the KNP for the first time (Qureshi et al 2011). A total of 89 bird species have been reported in Taxkorgan County (Editorial Board 2009), but as yet there has been no survey in the TNR itself.

Table 10: **Birds observed in the KNP**

Order	Family	Scientific name	Common name
Accipitriformes	Accipitridae	*Aquila chrysaetos*	Golden eagle
Charadriiformes	Scolopacidae	*Actitis hypoleucos*	Common sandpiper
Charadriiformes	Scolopacidae	*Calidris minuta*	Little stint
Columbiformes	Columbidae	*Columba leuconota*	Snow pigeon
Columbiformes	Columbidae	*Streptopelia turtur*	Eurasian or western turtle dove
Coraciiformes	Upupidae	*Upupa epops*	Hoopoe
Cucliformes	Cuculidae	*Cuculus canorus*	Eurasian cuckoo
Cucliformes	Cuculidae	*Cuculus varius*	Oriental hawk cuckoo
Falconiformes	Accipitridae	*Accipter nisus melaschistos*	Eurasian sparrow hawk
Falconiformes	Accipitridae	*Gypaetus barbatus*	Lammergeier
Falconiformes	Accipitridae	*Gyps himalayensis*	Himalayan griffon vulture
Falconiformes	Falconidae	*Falco tinnunculus*	Eurasian kestrel
Galliformes	Phasianidae	*Alectoris chukar*	Chukor partridge
Galliformes	Phasianidae	*Tetraogallus himalayansis*	Himalayan snow cock
Gruiformes	Rallidae	*Gallinula chloropus*	Common moorhen

Order	Family	Scientific name	Common name
Passeriformes	Alaudidae	*Eremophila alpestris*	Horned lark
Passeriformes	Cinclidae	*Cinclus pallasii*	Brown dipper
Passeriformes	Corvidae	*Corvus corax*	Raven
Passeriformes	Corvidae	*Pyrrhocorax graculus*	Yellow-billed chough
Passeriformes	Corvidae	*Pyrrhocorax pyrrhocorax*	Red-billed chough
Passeriformes	Emberizidae	*Emberiza cia*	Rock bunting
Passeriformes	Fringillidae	*Carpodacus erythrinus*	Common rose finch
Passeriformes	Fringillidae	*Carpodacus rubicilla*	Great rose finch
Passeriformes	Fringillidae	*Leucosticte nemoricola*	Plain mountain finch
Passeriformes	Fringillidae	*Serinus pusillus*	Fire-fronted serine
Passeriformes	Laniidae	*Lanius schach*	Long tail or rufous back shrike
Passeriformes	Motacillidae	*Anthus novaeseelandiae*	Indian pipit
Passeriformes	Motacillidae	*Motacilla alba*	White wagtail
Passeriformes	Motacillidae	*Motacilla alba personata*	Masked wagtail
Passeriformes	Motacillidae	*Motacilla cinerea*	Grey wagtail
Passeriformes	Motacillidae	*Motacilla citreola*	Citrine wagtail
Passeriformes	Muscicapidae	*Erithacus svecicus*	Blue throat
Passeriformes	Muscicapidae	*Chaimorrornis leucocephalus*	White-capped redstart
Passeriformes	Muscicapidae	*Monticola solitarius*	Blue rock thrush
Passeriformes	Muscicapidae	*Myophonus caeruleus*	Blue whistling thrush
Passeriformes	Muscicapidae	*Oenanthe deserti*	Desert wheatear
Passeriformes	Muscicapidae	*Phoenicurus erythrogaster*	White winged redstart
Passeriformes	Muscicapidae	*Phoenicurus ochruros*	Black redstart
Passeriformes	Oriolidae	*Oriolus oriolus*	Golden oriole
Passeriformes	Phylloscopidae	*Phylloscopus collybita*	Eurasian chiffchaff
Passeriformes	Phylloscopidae	*Phylloscopus trochiloides*	Greenish warbler
Passeriformes	Passeridae	*Passer domesticus*	House sparrow
Passeriformes	Prunellidae	*Prunella fulvescens*	Brown accentor
Passeriformes	Prunellidae	*Prunella modularis*	Radde's accentor
Passeriformes	Prunellidae	*Prunella ocularis*	Radde's accentor
Passeriformes	Pycnonotidae	*Pycnonotus leucogenys*	White cheeked bulbul
Passeriformes	Sylviidae	*Sylvia curruca*	Lesser whitethroat
Passeriformes	Sittidae	*Tichodroma muraria*	Wall creeper

Source: Qureshi et al. 2011

Freshwater Fish

The part of the KPL in Pakistan has a wealth of freshwater resources, with numerous tributaries of the Indus River draining the Karakoram range. In general, there are few fish species because of the high turbidity, low water temperature, high water speed, low benthic productivity, and long stretches of narrow river gorges. The fish species in the area are mainly Palearctic, native to the Central Asian Highlands, with a small mix of Oriental Region. The major fish species are *Schizothorax plagiostomus, S. naus, S. esocinus, S. skarduensis, S. longipinnis, Schizopygopsis stoliczkai, Schizocypris curviforms, Ptychobarbus conirostris, Diptychus maculates, Racoma labiata, Glyptostrnum reticulatum, Triplophysa stoliczkai, Triplophysa gracilius, T. yasenensis, T. trewavasae, T. tenuicauda, T. microps, Salmo trutta fario, Oncorhynchus mykiss,* and *Cyprinus carpio* (Virk et al. 2003; Rafique and Khan 2012). Schizothoracines are the major fish of cold-water streams and rivers (genera *Schizothorax* and *Schizopyge*) in the

high-altitude areas of the Karakoram with *Schizothorax plagiostomus* the dominant species (Petr and Swar 2002). Six fish species had been reported In Taxkorgan County (Editorial Board 2009).

Ecological Adaptation

Animals have evolved special ecological behaviour in order to adapt to harsh climatic conditions such as extremes of cold and dryness. This adaptation is one of the important driving forces in the evolution of high-altitude animals and has resulted in the unique biodiversity in high mountain areas. For example, species like brown bear, golden marmot, field mouse, and migratory hamster are common in the alpine zone of the KPL, where snow covers the ground most of the year and the summer season is very short (Khan 2009). These mammals are homoeothermic endotherms and can maintain a constant body temperature with metabolic heat; they hibernate during winter to avoid the extremes of the cold. In contrast, pikas remain active throughout the winter, but they collect and dry vegetation to eat during the cold months. Other mammals like Himalayan ibex and Tibetan red fox have developed a dense undercoat of wool-like hair that interlocks and traps layers of insulating air beneath the protective outer layer of guard hairs to help them withstand prolonged periods of low temperature. Migration is another strategy; hares descend to areas with less snow to search for edible vegetation, while blue sheep and snow leopards descend to lower valleys, only spending the summer season at high elevation (Khan 2009).

Loss of Biodiversity

Mountain areas have been increasingly affected by loss of biodiversity due to expansion and intensification of land use. In recent decades, climate change has emerged as another threat to biodiversity. At present many endemic, rare, endangered, and threatened species of fauna are reported in the KPL. Although no full assessment of floral diversity has been done, it is believed that the region supports some of the richest plant communities, including many endangered plant species. Alam (2009) has listed the endemic flora in Gilgit-Baltistan Province and proposed conservation strategies.

Threatened and Endangered Flora

No substantial work has been done on the threatened plants of Pakistan. The IUCN Red List of Categories and Criteria describes 19 flowering plants with their conservation status, of which 16 taxa are exclusively endemic to Gilgit-Baltistan (Alam 2009). Fahad and Bano (2012) reported 17 species in the Naltar and Karga valleys, adjacent to the KNP, that are endangered due to their endemic nature and high domestic and export demand (Table 11). Alam and Ali (2010) placed *Astragalus gilgitensis* in the Critically Endangered category due to its narrow geographic distribution, single location, and habitat degradation.

Table 11: **Endangered plant species in Naltar and Karga**

Family	Species	IUCN[a]	CITES
Asteraceae	*Artemisia laciniata*	NT	
Asteraceae	*Artemisia maritiama*		
Asteraceae	*Sussurea lappa*		
Berberidaceae	*Podophylum emodi*		
Betulaceae	*Betula utilis var. D. Don*		
Boraginaceae	*Onosma hispidum*		
Elaeagnaceae	*Hippophae rhamnoides*		
Ephedraceae	*Ephedra gerardiana*		
Fabaceae	*Glycyrrhiza glabra*		
Lamiaceae	*Thymus serphylum*		
Ranunculaceae	*Aconitum napellus*	LC	
Saxifragaceae	*Bergenia himalacia*		

Scrophulariaceae	*Picrorhiza kurroa*		II
Umbelliferae	*Angelica glauca*		
Umbelliferae	*Carum carvi*		
Valerianaceae	*Valeriana wallichii*		

[a]IUCN: NT – near threatened; LC – least concern

Source: Fahad and Bano 2012

Threatened Faunal Diversity

The KPL region is home to many endangered and threatened wildlife species. The significant and threatened mammalian and bird species identified in the KNP are listed in Table 12. Several large mammalian species found in the region are either threatened or endangered, including the snow leopard, Marco Polo sheep, Himalayan brown bear, blue sheep, Tibetan grey wolf, and Himalayan lynx. Most of these species require large areas of habitat in order to maintain viable populations. Activities contributing to habitat loss in the KPL region include unsustainable collection of bioresources (e.g. fuelwood, medicinal plants), livestock grazing, large-scale mining, and construction of roads and settlements. All of these actions change landscapes, disrupt natural water flows, and alter the species composition of the affected areas. Indiscriminate hunting is believed to be the major cause of the population decline observed for many of the region's birds and mammals.

Table 12: **Valuable/significant and endangered wildlife species observed in the KNP**

Scientific name	English name	IUCN[a]	CITES[b]
Birds			
Accipiter nisus	Sparrow-hawk	LC	II
Accipiter trivirgatus	Crested goshawk	LC	II
Aegypius monachus	European black vulture	NT	II
Aquila chrysaetos	Golden eagle	LC	II
Aythya nyroca	Ferruginous duck	NT	III
Bradypterus major	long-billed bush warbler	NT	N/A
Bubo bubo	Great eagle-owl	LC	II
Circus aeruginosus	Marsh harrier	LC	II
Falco cherrug	Saker falcon	EN	II
Falco naumanni	Lesser kestrel	LC	II
Falco peregrinus	Peregrine falcon	LC	I
Falco tinnunculus	Common kestrel	LC	II
Ficedula subrubra	Kashmir flycatcher	VU	N/A
Gypaetus barbatus	Bearded vulture	LC	II
Gyps fulvus	Griffon vulture	LC	II
Gyps himalayensis	Himalayan griffon	LC	II
Lerwa lerwa	Snow partridge	LC	N/A
Lophophorus impejanus	Himalayan monal pheasant	LC	I
Milvus korschun (migrans)	Black kite	VU	II
Phylloscopus tytleri	Tytler's warbler	NT	N/A
Rynchops albicollis	Indian skimmer	VU	N/A
Tetraogallus tibetanus	Tibetan snowcock	LC	I
Vanellus gregarius	Sociable lapwing	CR	N/A

Mammals			
Canis lupus	Indian wolf	VU	I, II
Cuon alpinus	Dhole	EN	II
Equus kiang	Kiang	DD	II
Felis lynx	Lynx	N/A	II
Felis manul	Pallas'cat	LR	II
Hylopetes cinereus	Woolly flying squirrel	LC	N/A
Hylopetes fimbriatus	Kashmir flying squirrel	LC	N/A
Ovis ammon polii	Marco Polo sheep	VU& NT	I, II
Pseudois nayaur	Himalayan blue sheep	LC	N/A
Uncia uncia	Snow leopard	EN	I
Ursus arctos	Brown bear	LC	I

[a] IUCN: CR – critically endangered; EN – endangered; VU – vulnerable; LR – lower risk; NT – near threatened; LC – least concern; N/A – not available

[b] CITES: Appendix I, Appendix II, Appendix III (http://www.cites.org/eng/app/appendices.php)

Source: Virk et al. (2003); Wang et al. (2012)

Agrobiodiversity – Threats and Challenges

The part of the KPL in Pakistan is semi-arid as it is situated in the Himalayan rain shadow. Most people are engaged in subsistence agriculture. The farmers and herders divert water from glacial rivers to their fields or pastures through a complex system of irrigation channels to grow crops and fodder (SDPI 2002). The farming system is highly integrated with a high degree of interdependence between cropping, growing fruit, and livestock production. Cultivable land is scarce and only located in lowland areas, while livestock are rotated among seasonal pastures at different elevations (Munir and Adhikari 2003). There is a close interrelationship between livestock production within the village precincts and on the high-altitude pastures. The region has emerged as an important producer of fruit such as apricots, apples, and grapes, and vegetables, mainly potatoes, peas, carrots, and onions. There are large herds of yak, cattle, sheep, and goats, and livestock provide support and sustenance, accounting for almost 35% of household income (Khan 2013). Summer is the main agricultural season when maize, barley, and vegetables are sown and fruit is picked and stored. Wheat only grows up to an elevation of 2,300 masl. The region is deficient in food grain and between a quarter and a third of food grain requirements are met from products brought in from the plains (SDPI 2002).

Agrobiodiversity plays a major role in providing food and ensuring food security. In the subsistence system, traditional cultivars of grain crops, local varieties of fruit, and traditional livestock breeds were developed to suit the specific conditions of the area, and often specific niche areas (Partap and Sthapit 1998). Cultivation of a mix of crops and varieties is used as a risk reduction strategy to ensure that in any one season at least some production is maintained. In Gilgit-Baltistan, agricultural intensification has reduced crop diversity to a few varieties. Globalization of the food system has led to market-oriented agricultural practices slowly replacing the traditional self-sustaining agriculture over the last few decades (Nawaz 2011). Buckwheat was previously grown on a wide scale, but is now rarely seen because farmers are keen to grow potatoes and high-yielding wheat varieties. This agricultural intensification and monocropping has increased susceptibility to pests and disease, for example codling moth and woolly aphid in apples, mulberry, and other fruit trees; Botrytis leaf blight in onions; crown gall disease in cherries; and nematodes in potatoes.

Gilgit-Baltistan's Agriculture Department and the Aga Khan Rural Support Programme (AKRSP) have played an important role in agricultural development in the region, but it remains important to increase agricultural efficiency and productivity by adopting a mix of traditional farming techniques and technological innovation. Support to farmers is required as they play a key role in the protection of precious resources. Within Pakistan, farmers should be

given subsidies to encourage them to grow older, neglected, and underutilized crop species like pearl millet, finger millet, and sorghum. The government should redesign policies and make a strong effort to conserve agrobiodiversity in the area (Nawaz 2011).

In Taxkorgan County, 39% of cropping land is devoted to wheat cultivation. In 1996, two improved wheat varieties (Xinchun No. 2 and Xinchun No. 6) were introduced and successfully popularized on a large scale; only two years later, the yield of wheat in Taxkorgan was the highest ever. Due to this success, many traditional crops were replaced by wheat cultivation. The demand for grain cultivation also led to the expansion of agricultural fields. In 2008, the area of grain cultivation increased to 2,867 ha with a total yield of 6,550 tonnes (Editorial Board 2009).

Invasive Alien Species

Invasive alien species can have a significant negative impact on biodiversity, but the issue has not yet been well researched in the KPL region. Marwat et al. (2010) reported 16 invasive weeds in northwestern Pakistan: *Xanthium strumarium, Ipomoea eriocarpa, Alternanthera pungens, Trianthema portulacastrum, Tagetes minuta, Imperata cylindrica, Amaranthus hybridus* subsp. *hybridus, Robinia pseudo-acacia, Broussonetia papyrifera, Ailanthus altissima, Pistia stratiotes, Phragmites australis, Parthenium hysterophorus, Cannabis sativa, Galium aparine,* and *Emex spinosus*. Of these *Robinia pseudo-acacia, Broussonetia papyrifera,* and *Ailanthus altissima* trees were purposely introduced but later became invasive. A recent review on inventory in China, reported 15 invasive species in Xinjiang: *Albugo tragopogonis, Verticillium albo-atrum, Phoma macdonaldii, Trifolium fragiferum, Lolium persicum, Leptinotarsa decemlineata, Hypera postica, Sitophilus granaries, Mayetiola destructor, Carpomya vesuviana, Laspeyresia pomonella, Bruchophagus gibbus, Urocerus gigas taiganus, Perca fluviatilis,* and *Ondatra zibethicus* (Xu et al. 2012).

4. Ecosystems and Vertical Zonation

Ecoregions in the KPL Pilot Site

The KPL is a complex mountain region with diverse vegetation types specially adapted to an arid high-altitude environment. The vegetation varies in its physiognomy and structure between the western and eastern flanks of the Karakoram pass due to the different climate, exposure, and geomorphological structure. Overall, the climate in the KPL region is strongly continental and extremely arid and the vegetation cover appears rather sparse. The eastern boundary of the landscape merges into the Pamir Plateau and is dominated by semi-desert and desert areas; whereas the western boundary, which connects with the high peaks of the Karakoram range, has cold sub-humid alpine conditions. Broadly speaking, the KPL pilot site can be divided into three main ecoregions, together with a region of snow and ice (Table 13, Figure 11). Close to 60% of the area is alpine desert and a further 25% is alpine steppe including alpine meadow.

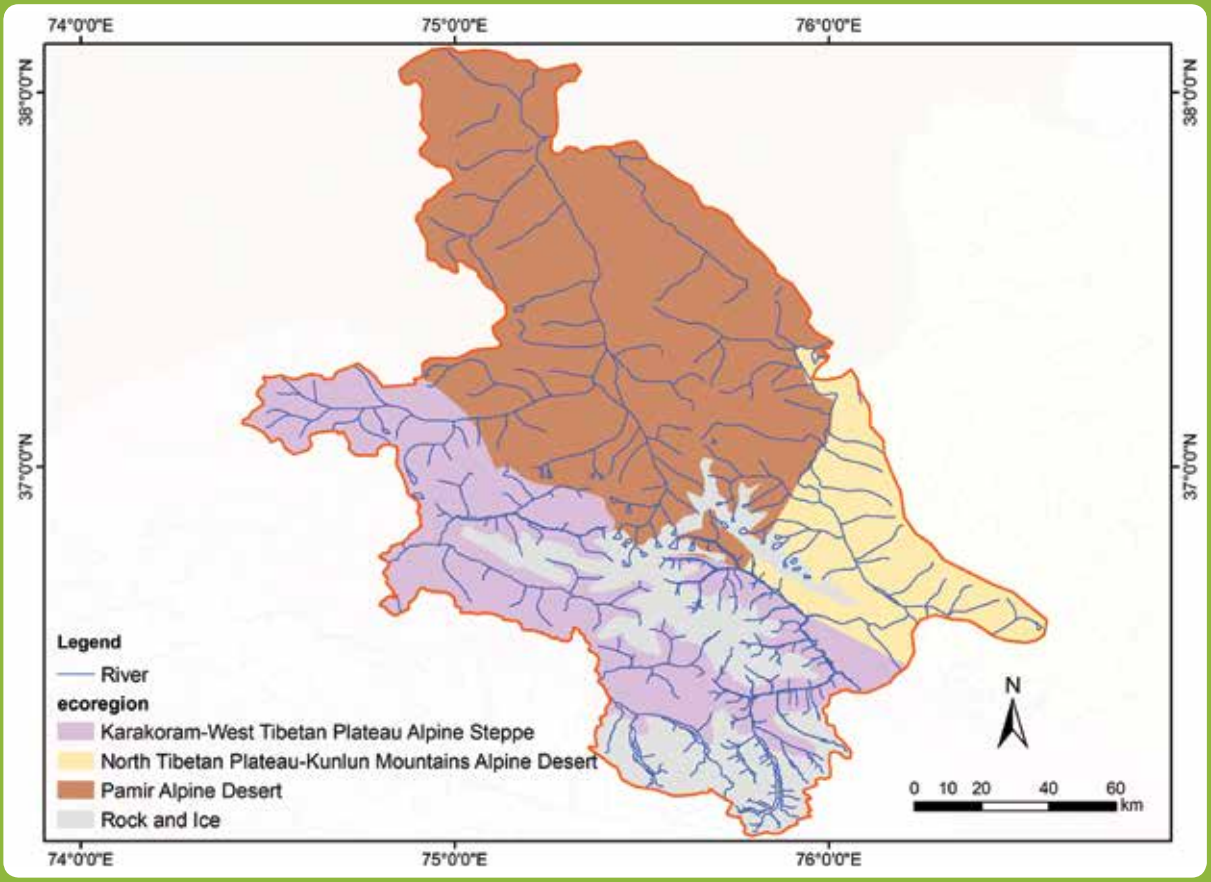
Table 13: **Ecoregions in the KPL pilot site**

Ecoregion[a]	Area[b]	
	ha	% of total
Karakoram-West Tibetan Plateau Alpine Steppe	473,070	25.2
North Tibetan Plateau-Kunlun Mountains Alpine Desert	227,696	12.1
Pamir Alpine Desert	890,755	47.4
Rock and Glacier	286,472	15.3
Total	1,877,993	100.0

[a] WWF 2009

[b] Calculated from the outer boundary of the whole pilot site area delineated on the basis of the watershed boundaries

Figure 11: **Ecoregions in the KPL pilot site**



Vertical Zonation

Although plant species diversity is not high, the flora and vegetation reveal striking distributional and structural patterns as a result of climate and edaphic variation. The plant cover has also been strongly influenced by centuries of land utilization and it is difficult to identify the boundaries of native vegetation in some places. There is a strong vertical zonation which is rather different along the eastern and western flanks of the Karakoram, which are represented by the TNR and KNP. The zonation in the two protected areas is described in more detail in the following sections. The description summarizes what is currently known about the vertical patterns from various publications by the pioneers who have explored the flora in this remote range (Dickore 1991; Dickore 1995; Miehe et al. 1996; Miehe and Miehe 1998; Eberhardt et al. 2006).

KPL within Pakistan

Four main vegetation types can be distinguished in the vertical zonation in the KNP (Qureshi et al. 2011) and the extended area of the KPL within Pakistan; more detailed patterns of distribution can be further distinguished along temperature and humidity gradients (Miehe et al. 1996; Eberhardt et al. 2006).

Subalpine scrub and forest: below 3,600 masl

Scrub and birch forests dominate the landscape in the subalpine belt, the lower part of the KNP, providing 20% of the total land cover in the park. The scrub and birch forests occur as narrow belts along stream beds and ravines; they consist mainly of *Salix alba, Salix pycnostachya, Betula utilis, Myricaria germanica, Myricaria elegans, Tamarix leptostachys, Populus nepalensis, Populus pamirica,* and *Hippophae rhamnoides*. *Poa bulbosa* and *Poa sinaica* are the main grass species, while *Potentilla* spp., *Chenopodium foliosum*, *Chenopodium botrys,* and other forbs are also found (Saqib, Z. Guide book to Flora of Khunjerab National Park, unpublished). Dry scrub is found in drier locations, such as flat or south-facing slopes, with associations of species such as *Artemesia* spp., *Juniperus*

excelsa, Juniperus turkestanica, Rosa webbiana, Ephedra intermedia, and *E. gerardiana*. Some common plants are also found along forest fringes, although they are not so abundant in communities, including *Epilobium latifolium*, *Epilobium angustifolium*, *Papaver nudicaule, Acantholimon lycopodioides, Fragaria nubicola, Potentilla eriocarpa, Potentilla desertorum,* and *Bergenia ciliate*. Poplar trees (*Populus* sp.) are found at lower locations near to villages, for example the dense patches of poplar near Shimshal, Jamalabad, and Sost villages, as are apricot trees, which are generally found close to water channels.

Subalpine steppe: below 3,700 masl

Subalpine dry steppe with 15-20% cover is found at medium and low elevations on south-facing dry slopes not covered by subalpine scrub and forest. These areas are sparsely vegetated with *Juniperus* spp., *Lonicera quinquilocularis,* and *Artemisia* spp (*A. dracunculus*, *A. maricana, A. gmelinii*). Grass species are found in relatively moister places and include *Setaria* spp., *Festuca* spp., *Poa bulbosa*, *P. sinaica*, *Phleum* spp., *Tragopogon dubius*, *Cichorium intybus*, *Carex* spp., *Silene moorcroftiana, Potentilla eriocarpa,* and *Rubia tibetica*. The most prominent plants in rock crevices and on sandy sites are *Lappula patula*, *Chenopodium album*, *Arabidopsis mollissima*, *A. himalaica*, *Primula* spp, and *Plantago lanceolata*.

Alpine meadow: 3,500–4,400 masl

Alpine meadows (20% of total cover) are confined to north-facing slopes, level ground, and depressions above 3,500 masl and along glaciers. They are generally rich in plant biomass due to the sufficiency of moisture and are important habitats for both domestic and wild herbivores. Sedges and grasses dominate, with *Poa bulbosa, Poa pratensis,* and *Poa sinaica* the most prominent, but forbs such as *Primula macrophylla, Potentilla desertorum, Gentiana* spp., *Anemone* spp., *Polygonum* spp., *Sedum* spp., *Plantago* spp., *Saxifraga sibirica, Anaphalis triplinervis, Taraxacum officinale, Eritrichium canum, Dracocephalum paulsenii, Nepeta discolor, Gagea elegans, Lloydia serotina, Potentilla desertorum, Potentilla eriocarpa,* and *Potentilla microphylla* are also common. Some adaptable herbaceous or shrubby plants are found on sunny slopes and in rock crevices where habitats are relatively drier, such as *Lonicera quinquilocularis*, *Thymus linearis*, *Astragalus strictus*, *Astragalus grahamianus*, *Cicer microphyllum*, *Oxytropis cachemiriana*, *O. crassiuscula*, *O. humifusa*, *O. immerse*, *O.microphylla*, *Thermopsis inflate*, *Corydalis crassifolia, C. falconeri, Stipagrostis plumose, Aconogonon tortuosum, Bistorta vivipara, Rheum spiciforme, R. tibeticum,* and *Cystopteris fragilis*. Common species like *Bupleurum gracillimum, Pleurospermum candollei, Ligusticum thomsonii, Arnebia euchroma, Eritrichium canum, Barbarea intermedia, Comarum salesovianum, Pedicularis rhinanthoide,* and *Ajuga bracteosa* can be found along stream banks or wet meadows up to 4,600 masl, while shrub species like *Myricaria squamosal* can be found in sandy places along rivers.

Small herb field communities are found below late-lying snow patches because of the moisture from the snowmelt water. The characteristic species are *Aster flaccidus, Saxifraga hirculis* subsp. *alpine, Saxifraga oppositifolia* subsp. *asiatica, Allium carolinianum, Silene kunawarensis, S. gonosperma, Rhodiola himalensis, Primula denticulate, Saxifraga hirculoides, S. asarifolia, S. saginoides, S. sibirica, S. Stenophylla,* and *Lioydia serotina*. The woody plant *Juniperus communis*, which can grow to a height of 3–7 m, forms patches along the treeline up to 4,200 masl (Saqib, Z. Guide book to flora of Khunjerab National Park, unpublished).

Subnivale vegetation: above 4,200 m

Permanent snow fields and cold desert cover an estimated 25-30% of the park area, lying mainly above 4,200 masl. Vegetation is sparse and most species adopt ecological modifications to cope with the intense sun radiation and low temperatures. The characteristic species of subnivale vegetation include *Saussurea simpsoniana, Allardia glabra, Allardia stoliczkae, Christolea crassifolia, Primula macrophylla* subsp. *moorcroftiana, Oxytropis macrophylla, Oxytropis chiliophylla, Potentilla desertorum, Mertensia tibetica, Potentilla pamirica* subsp. *Pamiroalorica, Cerastium cerastoides,* and *Minuartia kashmirica*. A few typical alpine plants such as *Rhodiola fastigiata*, *Rhodiola heterodonta*, *Rosularia alpestris, Androsace flavescens, A. rotundifolia,* and *Primula buryana* are distributed on rocks, crevices, and grassy slopes.

KPL within China

The part of the KPL within China lies in the Chinese Pamir, with much of the terrain too high or arid to support lush vegetation. In addition to the cold dry conditions, strong and steady winds inhibit the growth of conventional plants, although the habitat is well-suited to plants with a cushion growth form. Large areas are covered with gravel, talus, or rock and ice and are completely or nearly devoid of vegetation. However, several kinds of drought-cold tolerant plant associations have been identified, such as low and branching shrubs, cushion plants, dense turf-forming grasses, and sparse alpine meadows.

Temperate desert: below 3,300 masl

The eastern part of the KPL has a fairly distinct ecological zonation sequence with Mediterranean-type gravel desert at the lowest elevations. The temperate desert is mainly covered with deflation pavements and is exceedingly poor in plant species. Cliffs, scree, sand, and silt are common between 3,000 and 3,200 masl and the habitat is dominated by salt-tolerant taxa, such as *Salicornia*. Chenopodiaceous and Zygophyllaceous (sub-) shrubs (*Haloxylon ammodendron*, *Zygophyllum xanthoxylon*) occasionally dominate in places not entirely devoid of plants. The vast semi-desert vegetation is mainly dominated by dwarf plants, such as *Ephedra* spp., *Artemisia rhodantha*, *Astragalus kuschakevitschii*, and *Potentilla* spp. Native trees, some as tall as 10 m, are found along low-lying valleys or streams and include willow (*Salix*), tamarisk (*Tamarix*), seabuckthorn (*Hippophae rhamnoides*), *Myricaia pulcherrima,* cottonwood (*Populus*), and birch (*Betula*), (Editorial Board 2009).

Subalpine steppe: 3,300–3,900 masl

Higher up in the subalpine belt, the landscape is dominated by steppe-like vegetation with sparse herbaceous plants and dotted shrubs. The vegetation cover rarely exceeds 15% and average species number is only around 4–6/100 m^2 (Dickore 1991). Steppe desert vegetation covers the landscape between 3,300 and 3,600 masl. The sparse vegetation is dominated by prickly cushion plants such as *Acantholimon* spp. *and Artemisia* spp. A few grasses are also distributed sparsely in this belt such as *Stipa plareosa*, *Agropyron pectinatum*, *Festuca* spp., and *Carex* spp. Other typical species include *Ceratoides compacta, Ajania fruticulosa,* and *Oxytropis microphylla*. A few additional shrubs such as *Ephedra intermedia, Berberis ulicina, Rhamnus prostrata, Myricaria elegans,* and *Potentilla salesoviana* are usually confined to special microsites such as walls of bedrock, boulder-rich slopes, gullies, and scree-fans. The gravel bottoms of the large intra-montane valleys are almost devoid of vegetation, or pioneered by single plants of *Arnebia guttata, Elymus nutans, Chamaerhodos sabulosa,* and others. *Myricaria bracteata* thickets and meadow spots (e.g. *Blysmus sinocompressus, Calamagrostis pseudophramites,* and *Leymus secalinus*) only occur in sheltered basins that are less subject to substrate shift by wind, frost, and hydration changes, or flood events. *Ceratoides compacta* dominates the belt between 3,600 and 3,900 masl, resembling semi-shrub desert (Editorial Board 2009).

Alpine meadow: 3,900–4,700 m

There is a rapid increase of humidity in the central part of the north-facing slope of the Karakoram (Dickore 1991). A distinct species-change takes place in the transitional belt from subalpine to alpine (3,900–4,200 masl) associated with a considerable increase in species number and percentage vegetation cover. Within this belt, many desert species continue to higher altitudes and mix with alpine species. Common species include *Ajania tibetica*, *Stipa plareosa*, *Festuca* spp., *Oxytropis* sp., *Potentilla* spp., *Acantholimon hedenii*, *Caragana* spp., *Waldheimia tridactylites*, *Stephania tetrandra*, and *Poa pratensis* (Editorial Board 2009).

Chamaephyte-communities (*Astragalus webbianus, Oxytropis chiliophylla, Ephedra monosperma, Pleurospermum govanianum, Ajania tibetica, Rhodiola fastigiata, Poa poophagorum,* and *Elymus schrenkianus*) grow on the boulder-strewn slopes between 4,200 and 4,500 m (Dickore 1991). These are rich in species, but the vegetation cover is not very dense and interrupted by gullies and rapidly moving rock-streams, which are devoid of vegetation. Tall sedge-meadows such as *Kobresia* spp. and *Carex nivalis,* with many forb species such as *Delphinium brunonianum* and others, cover relatively large areas, similar to the alpine vegetation extending to the Tibetan Plateau and Tien Shan mountains. These species indicate rather sheltered and moist conditions, but true alpine meadow (*Leontopodium*

nanum, Lagotis kunawurensis, Viola spp.) is restricted to very local situations. Granite block-scree vegetation (*Rheum spiciforme, Lonicera semenovii, Rhodiola fastigiata, Nepeta longibracteata, and Cystopteris dickieana*) is dominant between 4,450 and 4,550 masl and chasmophytes on the steep flanks above (*Thylacospermum caespitosum, Saxifraga pulvinaria, Viola biflora,* and *Dolomiaea macrocephala*).

Between 4,500 and 4,700 masl, plant cover generally becomes sparse and consists of hardy perennial forbs like *Rhodiola* spp., *Saussurea* spp., *Tanacetum* spp., and *Saxifraga* spp., many of which have a cushion growth form and a stout, underground caudex, i.e., a woody taproot that stores carbohydrates when the plant dies back to ground level during winter. A few moisture-tolerant forbs like *Ranunculus* spp., *Gentiana* spp., *Oxytropis* spp., *Potentilla* spp., *Primula* spp., and *Pedicularis* spp., are distributed along seepages and rivulets, together with grassy plants such as *Festuca*, *Stipa*, *Poa,* and *Ptilagrostis*. A species-rich flora can be found on small isolated patches of alpine turf at the mouth of glaciers (*Festuca olgae, Stipa purpurea, S. subsessiliflora, Rhodiola fastigiata, Leontopodium nanum, Dracocephalum heterophyllum, Lonicera semenovii, Dasiphora dryadanthoides,* and others). Higher up along the glaciers, there are extensive rock-walls, which have a scattered, but still relatively rich, flora. *Thylacosperum caespitosum* is characteristic of sunny rocks, while *Saxifraga pulvinaria*, which forms dense cushions, is strictly confined to north-facing shaded cliffs. Other species seen between boulders below the rock-walls include *Oxytropis chiliophylla, Nepeta longibracteata,* and *Waldheimia tomentosa*.

Subnivale vegetation: 4,700–5,200 masl

The delimitation of the subnivale vegetation belt is difficult, although the species composition is very characteristic. *Sibbaldia tetrandra* and *Saussurea gnaphalodes* are frequent cushion-like species on superficially thawing permafrost slopes. Usually, plants are confined to slightly inclined (<5°) slopes, only exceptionally can higher plants or lichens withstand the rapid debris movement of the abundant 35° slopes. Although close to the upper limit of vegetation, the plant cover is rather dense. About 37 species of phanerogams have been found here, including nine species not found elsewhere, namely *Oxytropis* sp., *Carex haematostoma, Draba winterbottomii, Lagotis humilis, Potentilla gelida, Saxifraga oppositifolia, Sibbaldia* sp., *Stellaria decumbens,* and *Waldheimia tridactylites* (Dickore 1991). The lichen and moss flora also appears rich. *Sibbaldia tetrandra, Stephania tetrandra, Primula sp.,* and *Saussurea gnaphalodes* are common on slopes with free gelifluction (the seasonal freeze-thaw action upon waterlogging topsoils which induces downslope movement) (Editorial Board 2009). High-alpine or subnivale turf spots with a vegetation cover up to 90% are confined to more gentle slopes and shallow depressions, but they do continue nearly to the top of the slopes. Characteristic species include *Stipa concinna, Carex haematostoma, Viola kunawurensis,* and *Gentianella azurea*. *Carex montis-everestii, Kobresia pusilla,* and *Potentilla pamirica* inhabit the edges of the turf-spots towards the free gelifluction slopes. Cushions of *Thylacospermum* can be found between rocky outcrops and on relatively stable slopes. A few higher plants can be found on south-facing rock-walls, such as *Thylacospermum*, *Nepeta longibracteata, Silène gonosperma,* and *Waldheimia tomentosa*, whereas the north-facing rocks have a fairly rich cover of lichens (Dickore 1991).

Wetlands

The mountainous regions of the Karakoram and Pamir have some of the most picturesque high-altitude wetlands in the world. They include several lakes at 2,500 to 4,600 masl that are fed by streams, snowmelt, glacial melt, and spring water. These wetlands are crucial for maintaining healthy bird populations in the KPL. A number of birds use these sites for staging and breeding (summer breeders) during migration. Particularly waterfowl densities and breeding are related to the number of wetlands.

Shimshal Pamir lake (29 ha), locally called Shuvorth, is located at 4,755 masl in the KNP, along the southern border with China, and is perhaps the highest alpine lake in Gilgit-Baltistan (Khan B et al. 2012b). The lake is fed by glacial meltwater flowing through seasonal and perennial streams and springs and harbours a variety of endangered wildlife species, some of which are endemic to the Karakoram mountains. It lies along the famous Indus Flyway and provides nesting and staging grounds for a number of migratory birds and waterfowl. The key avifauna species are grey heron (*Ardea cinerea*), northern shoveler (*Anas clypeata*), common teal (*Anas crecca*), northern

pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), marbled teal (*Marmaronetta angustirostris*), and coot (*Fulica atra*) (Khan B et al. 2012). Ecologically, the Shimshal Pamir lake area represents an extreme type of alpine zone with no woody vegetation except for a few sparsely scattered prostrate shrubs such as *Potentilla dryadenthoides* and *Sibbaldia tetrandra*. According to the survey by Khan B et al. (2012), the characteristic species along the lakeside are *Saussurea simpsoniana*, *Allardia glabra*, *Christolea crassifolia*, *Primula macrophylla*, *Oxytropis macrophylla*, *Oxytropis chiliophylla*, and *Potentilla pamirica*. Herbaceous communities occur below late-lying snow patches with *Carex stenophylla* as the dominant species, associated with *Carex psychrophilla*, *Aster flaccidus*, *Saxifraga hirculis var. alpine*, *Saxifraga oppositifolia var. asiatica*, *Allium carolinianum*, *Silene kunawarensis,* and *Lloydia serotina*. Fen communities were observed in the lower reaches where depressions are common that have water standing for almost half of the year, which in a high-altitude area indicates peat accumulation. *Carex stenocarpa* and *Carex psychrophilla* are the dominant species in these peatland communities, with *Pedicularis alba* and *Pedicularis oedorei* as infrequent species.

There are a number of other important wetland areas in the KPL region in Pakistan. Rush lake (12 ha) is located at 4,206 masl at the western edge of the Karakoram range near Spantik peak in Nagar valley; Qurumbar lake (263 ha), located at 4,282 masl in Qurumbar National Park in Ghizer, is one of the largest high-altitude lakes in Gilgit-Baltistan. Other important alpine wetlands include Sheosar lake (131 ha) at 4,142 masl in Deosai National Park; Rama lake at 3,550 masl in Astore valley; Satpara Tso, Phoroq Tso, and Katzura Tso lakes in Skardu; and Saiful Malook lake (3,200 masl), Lalusar lake (3,450 masl), and Daudipatsar lake (3,900 masl) in Kaghan Valley (WWF-Pakistan 2013). Peatlands are found in the Deosai Plateau, Langar-Shandoor wetlands (Phunder valley), Fairy Meadows, and Shimshal and Broghil valleys, and cover an estimated area of 25,000 ha in Gilgit-Baltistan (Khan B et al. 2012).

The high-altitude wetlands are valuable ecosystems which provide ecosystem services including biodiversity conservation, carbon storage, water storage and regulation, grazing grounds, and domestic fuel. In the Phunder and Broghil valleys, the peatlands are a major source of domestic fuel as these areas lack natural vegetation that can be used for fuelwood, while the scenic lakes are an important resource for tourism. However, most of these resources are not under any kind of protection or management, resulting in degradation of the rich natural resources. Anthropogenic pressures include extensive grazing, overdependence for domestic fuel, drainage, and diversion of water sources. Degradation and shrinkage caused by anthropogenic activities and climate change are a major threat to the wetlands.

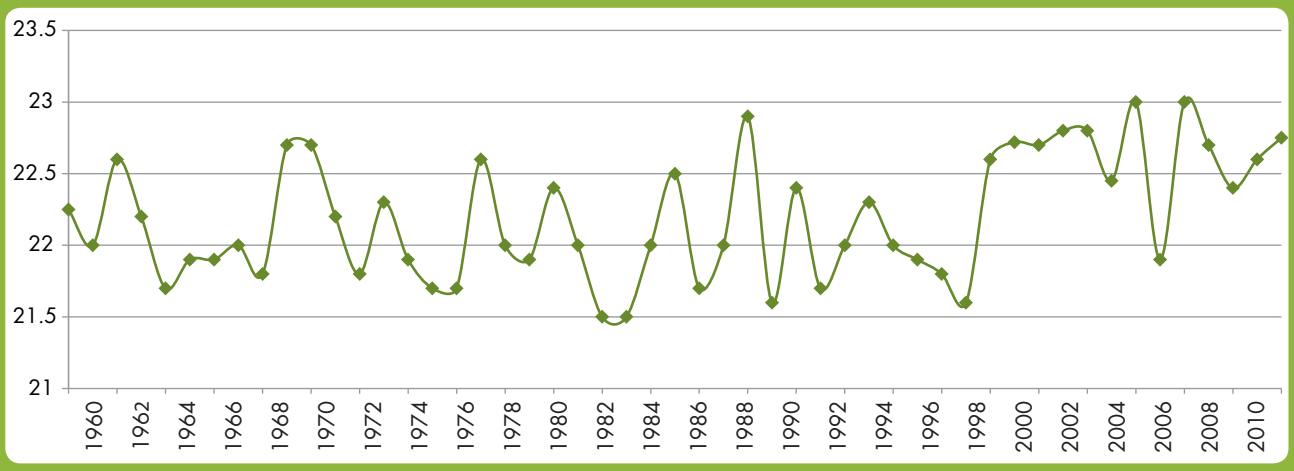
Except for a few seasonal waterlogged ponds at high elevation that are fed by glacier melt, the most important wetlands in the Chinese Pamir lie to the north of Taxkorgan Nature Reserve, and include Kashguli lake, Tahman wetland, Alarkin wetland, and Dabdar wetland, all in Taxkorgan County. Kashguli lake has an area of more than 1,000 ha and lies at 3,600 masl about 90 km from Taxkorgan County Center and near to the Karakoram Highway. 'Kashguli' means 'black lake' indicating the great depth. It has two sister lakes and is the sacred lake of Kirgiz nomads. It has now become an important tourist destination due to its beautiful scenery. Tahman wetland has an estimated area of around 530 ha and lies at 3,050 masl at the foot of the Muztagh Ata, 30 km from the county town. The Tahman wetland is a basin encircled by mountains and recharged by springs; it has the largest and best natural pastures in Taxkorgan. The Alarkin wetland is a 2,000 ha patch of wet meadow along the banks of the Taxkorgan River. The Dabdar wetland is a 14 ha area of peatland located about 60 km from the county town. A Pamir High Altitude Wetland Nature Reserve was established in 2005 with a total area of 1,530 km^2 by the Forestry Bureau of XUAR in the border area between Taxkorgan County and Aktao County. This nature reserve has many lakes and peatlands which provide ideal habitat for over 200 species of migratory birds (Editorial Board 2009). Snow leopard, ibex, argali, blue sheep, brown bear, and other animals are also very common in this region. An observation station has been established by the Forestry Bureau of Xinjiang with a total investment of RMB 14 million yuan (about USD 2.26 million).

5. Threats to the Environment and Biodiversity

Challenges

Geological instability, steep topography, extreme climatic conditions, and turbulent rivers make the KPL area vulnerable to various kinds of disturbance and prone to natural disasters, especially floods, landslides, and landslips in summer and avalanches in winter. In addition to the physical conditions, there are growing anthropogenic pressures, with population growth and concomitant socioeconomic pressures over recent decades placing increasing pressure on the natural resources and fragile ecosystems of the region. Globalization and climate change also have an increasing influence on the stability of the mountain systems and the livelihoods of local people. The vulnerable physical conditions interwoven with anthropogenic pressures are aggravating the already straitened circumstances of the people in this marginalized region. Remoteness and inaccessibility mean that infrastructure, transportation, education, and health facilities are seriously underdeveloped. The lack of livelihood options combined with modern lifestyle aspirations have made the indigenous communities of the landscape extremely vulnerable. Given the global climate change scenario, the landscape, its people, and biodiversity are all likely to face acute threats to their continued sustenance and long-term sustainability.

Figure 12: **Average annual area weighted mean daily temperatures 1960–2010; the graph shows a marked rise in temperature during the first decade of the twenty-first century except in 2005**



Adapted from Rasul et al. 2012.

Climate Change

Climate change is one of the most important driving forces behind environmental change, and its impact on biodiversity is a global concern. Fragile mountain ecosystems and poor human societies as found in the KPL region are particularly sensitive and vulnerable to climate change, especially warming and an increase in localized extreme events.
In Pakistan, there has been a consistent rise in annual mean surface temperature and decrease in precipitation since the start of the twentieth century (Farooqi et al. 2005). In the northern mountains (which include the KPL region) the temperature has shown a generally increasing trend over the last 50 years (1951-2000), with fluctuations around the mean of -1.5 to +1.5°C (Figure 12).

The nature of likely change is not yet fully understood by scientists, and it is thought that it will also vary greatly at the local level without necessarily showing generalized patterns. Changes in glaciers throughout the upper segments of the Karakoram are thought to be a major indicator of climate change. In most parts of the world, glaciers have been retreating for many decades, but in the Karakoram some appear to be advancing (Bolch et al. 2012). Glaciers such as the Ghulkin and Passu lay a considerable distance away from the Karakoram Highway in the early 1970s but are now very close to it. Local people thought this was due to climate change, with the glaciers sliding down gradually from their previous positions (Joshi et al. 2013). The expansion or down-slope redistribution of ice has also been attributed to changes in atmospheric moisture and distribution (Hewitt 2005). Increased winter precipitation over the last decade, with reduced summer temperature, may be the cause of mass gain by glaciers in the Karakoram, as recently confirmed by direct measurement (Gardelle et al. 2012; Bolch et al. 2012). Notwithstanding glacier expansion, glacial lake outburst floods (GLOF) have continued to attracted attention from both scientists and decision makers. The glaciers of the Upper Karakoram have caused more than 60 glacial lake outburst floods over the past 200 years, many of which caused damage in the Indus plains; the Khurdopin glacier in Shimshal is a notable contributor (Hewitt 2006).

The situation in the Eastern Pamir around Taxkorgan is slightly different. This is a plateau-like area; the highest peak is the Kongur Tagh at 7,719 masl and there are more than 1,200 glaciers (Zeng 2012). The glacier area decreased from 1,795 km^2 in 1972 to 1,691 km^2 in 2011, with two glaciers disappearing in the past 40 years (Zeng 2012).

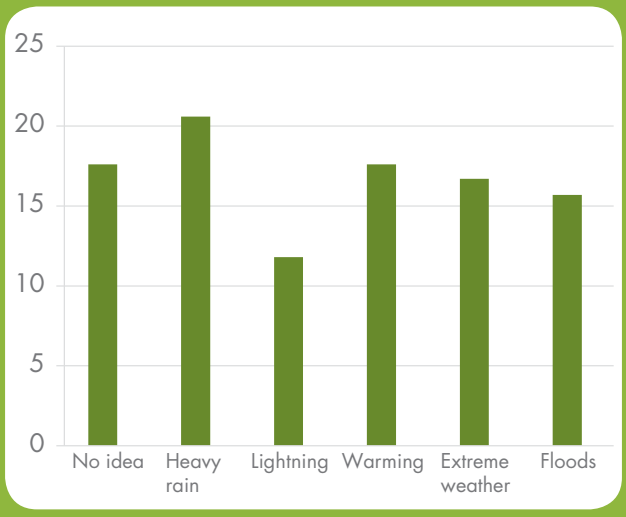
Water resources, both quantity and quality, have also become a major issue in Taxkorgan as a result both of climate change, associated with increasing drought, and population growth, leading to an increase in requirements. In some places in Taxkorgan, drinking water for people and livestock comes from the same open sources, thus the drinking water for people is frequently contaminated. A general survey on drinking water in 2004 showed that of 14 villages and townships, only three villages used underground water, while all others used river water (Editorial Board 2009). Increasing occurrence of drought in the last few decades has led to more frequent shortages of drinking water, and affected the health and livelihoods of local people.

Generally speaking, the impacts of climate change are expected to increase in the coming decades, and this may compound other ongoing threats like habitat depredation and fragmentation of species and ecosystems. Climate-related changes affect the provision of services and goods by ecosystems and will have a significant impact on livelihoods in this remote area.

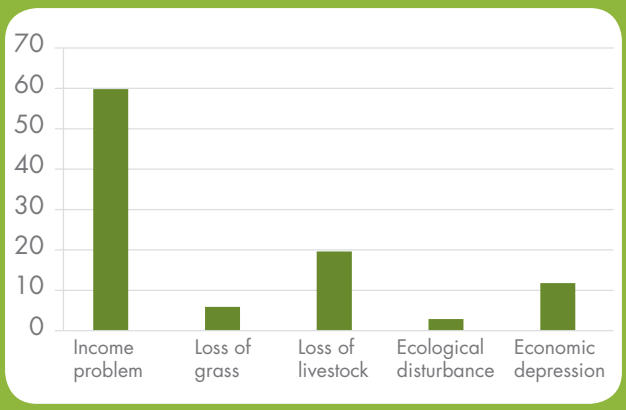
Almost all the natural ecosystems in the KPL region are vulnerable to climate change. The visible local manifestations and consequences of climate change and other impacts that have been noticed in the KPL region include loss of habitat, species extinction, less palatable grasses in pastures, diseases in wild animals, pest attacks on crops, increased frequency and intensity of melting of glaciers, high turbidity in water bodies, heat waves, cold spells, droughts, increased landslides, water born epidemics, avalanches, heavy rainfall, heavy snowfall, glacial lake outburst floods, and soil erosion. Such changes have led to disrupted social infrastructure, limited livelihood options, fragmented habitats and agricultural land, and a poor and moribund economy (Ali 2010).

The likely extent of the impact of climate change is not yet fully understood, particularly in mountain ecosystems like the Hindu Kush Himalayas. ICIMOD recently documented the perceptions of herders in northern Pakistan on climate change (Joshi et al. 2013). The main findings are summarized in Figure 13. The herders generally considered that climate change was already underway. A shorter and warmer winter with more precipitation had led to visible changes in glaciers, and there had been a severe decline in summer rainfall with a trend towards a longer summer period over the last 10–15 years, which had adverse impacts on forage availability at higher altitudes. As summers become longer and drier, vegetation is likely to shift to a more xeric (low moisture) situation that may be less suitable for farming and pastoral development. Respondents also had concerns about changes in wind direction, decline of soil nutrients and changes in plant species and communities in high-altitude pastures. People were using approaches based on indigenous knowledge as a coping and adaptation strategy, including diversification of livelihoods, restricting the number of livestock for each herder family, revival of traditional grazing patterns for rotational grazing, and developing irrigated farmlands at lower elevations. The study stressed the need for collaborative efforts by all stakeholders to take an interdisciplinary landscape level approach for effective mitigation and adaptation to climate change, as well as for greater understanding of herders' indigenous knowledge, which should be incorporated into future research and development plans. The study concluded that "Today, herders need to adapt at a faster rate than previously to avoid the negative impacts of climate change, as well as the effects of other drivers, on the rangelands and on their livelihoods. This requires integration of traditional knowledge with innovative technology. The adaptive changes triggered by the numerous demographic and economic changes that are occurring are likely to transform this system significantly."

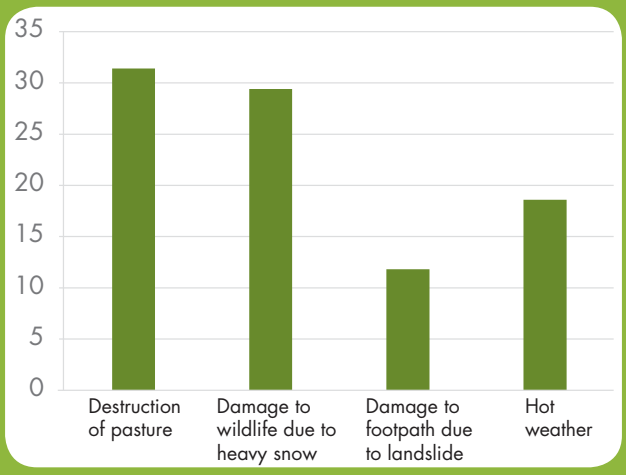
Figure 13: **Response of herders to the questions:**
(194 herders interviewed)



a) Do you feel threatened by different aspects of climate change?



b) What may happen to things you depend upon due to climate change?



c) Why are changes in climate threatening?

Human Disturbance

Ecosystems in the KPL region are also under threat from human activities. In the last few decades, there has been a steady rise in both the human population and numbers of domestic livestock, leading to an increased demand for land and other resources. In many places, the demands have already exceeded the levels that the local ecosystems can sustain. Habitat destruction in this region results most frequently from the effects of overgrazing, excessive removal of sparse natural vegetation, unsustainable collection of bioresources, wildlife poaching (mostly outside the protected areas), and mining. Expansion of settlements, construction of roads, and development of other infrastructure facilities (for example for recreation) in an ill-planned way have also contributed to habitat destruction and fragmentation.

Unsustainable collection of bioresources

Overexploitation of bioresources is one of the major problems faced by the areas around the KNP, with a heavy pressure on bush and scrub due to overharvesting, overgrazing, and uprooting, leading to degradation and desertification of the upland pastures.

Fuelwood and dung

The upper belt of the KPL lies above 4,000 masl and is very cold. Livelihood opportunities are limited and demand for energy is high, especially for heating and cooking. Fuelwood is reported to be the second highest expenditure in the region followed by food (Khudadad et al. 2013). Herders cannot survive the winters without fuel for fire, but collection of scrub and fuelwood is in turn degrading the pasture areas. In the 1950s, many valleys in Taxkorgan were dominated by *Ceratoides lateens,* a bushy plant which provided good pasture for livestock grazing. However, by the 1960s extensive collection of fuelwood to meet the demand of the ever increasing population had led to this type of pasture being replaced by communities of *Peganum harmala*, a kind of degraded vegetation which indicates a trend towards desertification driven by human disturbance (Animal Husbandry Bureau of Xinjiang 1993). Many people also rely heavily on animal dung for cooking and heating, which also causes adverse impacts on the fragile environment as it impacts the nutrient cycle in the rangeland ecosystem and leads to depletion of soil fertility.

Not only is fuelwood and dung collection adversely affecting the environment, women and children also face a disproportionate burden from the energy crisis. They spend long hours collecting animal dung and brushwood, and also face serious health hazards from cooking in a smoky indoor environment. Addressing sustainable energy provision for local communities is thus becoming paramount for sustainable management of the ecosystem. Since 1997, the Aga Khan Planning and Building Service, Pakistan (AKPBS, P) has been working closely with mountain communities in the region to improve their living conditions by introducing a variety of appropriate energy efficient and housing improvement products.

Illegal hunting and trophy hunting

The mountain communities in the KPL region have a long tradition and culture of hunting. But with both an increase in population and improved accessibility, indiscriminate hunting (generally illegal) is now believed to be one of the major causes of population decline of the region's birds and mammals. Mountain ungulates – such as Marco Polo sheep and Himalayan ibex – have been subjected to particularly heavy hunting pressure for trophies, pelts, and meat. Poaching reduced the number of Marco Polo sheep from an estimated 300 in 1975, to about 100 in 1980. The last officially recorded sighting was in 1992, when 52 Marco Polo sheep were observed; in 2011, 38 Marco Polo sheep were also spotted in the Qarchanai area of the park (Khan 2012). The main causes for the decline in number of these sheep are habitat loss (construction of the Khunjerab pass), food competition with livestock (in lambing habitat; Wulughdur), very low incremental growth (perhaps due to excessive predation of lambs by predators); and restricted movement of sheep due to fencing of the international border and stationing of armed forces at several passes. Some carnivore species such as snow leopard, wolf, and lynx are persecuted for their depredations of livestock. It was estimated that there were 30 snow leopards in the KNP in the late 1980s (Chaudhry 1989), whereas a recent study found signs of only three to five (Qureshi et al. 2011). The situation of wolves is similar.

In the KNP and surrounding area, birds such as snow cock and chukar partridge, are hunted for their meat, while migratory waterfowl are often hunted for their feathers. The hunting impact has increased with the spread of modern firearms and the improved access that has come with the construction of roads deep into formerly inaccessible areas. Changing climatic conditions with random shifts in temperature and precipitation have greatly influenced the vegetation and snow cover, ultimately affecting the distribution of species in the area (especially herbivores and carnivores such as snow leopard). In addition, the longer periods of use of high-altitude alpine pastures, and prolonged stay of herders with their domestic animals, has resulted in increased interaction between wildlife and livestock. This has not only increased human-wildlife conflict leading to retaliatory killing of endangered animals like snow leopards, but has also increased the chance of disease transmission from livestock to wildlife and vice-versa. In Taxkorgan, some ungulates such as ibex, blue sheep, and Marco Polo sheep were traditionally hunted to supplement the diet, but this intensified during the construction of the Karakoram Highway. At the same time, predators, particularly wolves and snow leopards, kill large numbers of livestock (partly a reflection of depleted wild ungulate populations and partly an impact of the changing climate) and are in turn killed in retribution (Schaller et al. 1987; Khan 2012). Illegal hunting has been controlled to a great extent following the establishment of Taxkorgan Nature Reserve.

Trophy hunting has been introduced in many places in Pakistan, including the region around the KNP, to reduce illegal hunting activities. As the majority (80%) of the earned money goes to the local communities, their awareness, stewardship, and participation in wildlife conservation initiatives have increased. However, the community-based trophy hunting programme focuses only on species suitable for trophy hunting (e.g., markhor, ibex, blue sheep), with only limited attention given to other charismatic species such as snow leopards, brown bears, and Marco Polo sheep, and no attention paid to the other taxa in the area. Both opponents and supporters of trophy hunting have become increasingly vocal about the systems used to assess population numbers and methods of determining annual hunting allocations. Furthermore, conflict is arising between communities over the distribution of trophy fees, leading to a renewed look at developing a more equitable system of benefit sharing.

Many hunting organizations facilitate trophy hunting of blue sheep. These organizations also facilitate hunters in trophy export documentation from the National Council for Conservation of Wildlife (NCCW) and IUCN. However, with the increase in trophy hunting, some locals have become involved in illegal blue sheep (and other) hunting,

either by themselves or by organizing unauthorized hunting expeditions for outside hunters, which poses a threat for the population of blue sheep (Qureshi et al. 2011). During the late 1980s the population of blue sheep in KNP was estimated to be around 2,000 (Wegge 1988), but this has declined. Although there are multiple reasons behind the decline, trophy hunting is inevitably one of them.

Human-wildlife conflict

The decline in wild ungulates, a key component of the snow leopard diet, due to extensive hunting practices has caused a significant shift in predation pressure towards domestic livestock in some areas of the KPL in Pakistan (Khan 2012). Snow leopard and wolf prey upon domestic livestock, mainly yak, goat, and sheep, causing economic damage and threatening village-level food security. For local people, livestock are an important component of their livelihoods, thus retaliatory killing has become one of the main threats to wildlife in the region. In both KNP and TNR, livestock depredation by carnivores has become a major livelihood concern and an emerging challenge for the conservation managers and park authorities. Livestock depredation rates in KNP in the 1980s were 10% (Wegge 1989), mainly by snow leopard and wolf, while in the TNR it was 8%, mainly by snow leopard (Schaller et al. 1987). A heavy government penalty for killing snow leopards makes farmers or herders reluctant to tell outsiders about any killings, thus making it hard to determine how many snow leopards are actually being killed due to human-wildlife conflict (Rosen et al. 2012). Conflicts between humans and wildlife are escalating across Gilgit-Baltistan and have become an economic issue. Restoration of wild prey through protection and habitat restoration, together with compensation mechanisms for those who lose livestock, would help minimize the negative impacts of predation (Khan 2012). However, this kind of mechanism has not yet proven successful, although many attempts have been made (see example in Box 5).

Box 5: **People-park conflict in the KNP**

The land within the KNP was traditionally used by local communities to graze livestock. After the park was established in 1975, a very small area was declared as protected from all kinds of use including grazing. There was a general understanding between local people and the park administration about the type of compensation to be granted in due course of time. However, the herders claimed that they were not compensated in accordance with the agreement, hence, doubts and mistrust developed. The Shimshalis (the main local ethnic group) refused to recognize Khunjerab as a national park. In 1993, they established an independent organization parallel to the KNP called the 'Shimshal Nature Trust' (SNT). The Shimshalis believe that nature has gifted them with blue sheep and it is their right to make full use of this renewable natural resource. Thus they started trophy hunting of blue sheep to generate funds for the economic and social development of the Shimshali community.

According to the park management plan for KNP, local livestock was to be removed from the potential habitats within the park boundary. But this did not happen, probably at least in part because the affected communities were not paid compensation, and locals continue to graze livestock within the park. This livestock attracts carnivore predators, but when a snow leopard or wolf kills a grazing animal the owner of the herds poisons the carcass to kill the predator. This leads to the death of both the attacking predator and other carnivores that eat the remains, and has led to an alarming reduction in the number of wolves and snow leopards (Qureshi et al. 2011).
It seems unlikely that the exercise of administrative powers to control mountain protected areas will resolve the conflicts resulting from multiple users. It seems equally unlikely that the exercise of private control can resolve the conflicts, or bring to bear the needed resources and expertise to effectively manage these areas. Given the competing interests of today's multiple user groups, a traditional village-based common property regime is also impractical. Rather, joining all user groups and individuals together with the government in a co-management approach that links conservation with development appears to have the best prospects, but will still need a more integrative framework, detailed action plan, and proactive cooperative activities for the multiple stakeholders.

Exploitation of mineral resources

The KPL region is a fragile semi-arid area with livestock grazing as the main traditional productive activity. However, in recent decades, the rich mineral resources of the area have been tapped at an increasing scale for economic development.

The Karakoram range is thought to be abundant in minerals, metals, and precious and semi-precious stones. As yet no detailed survey has been carried out to identify the extent and potential of minerals within the part of KPL within Pakistan, but there are varying amounts of mining in the valleys throughout the Karakoram range. This mining is largely informal and carried out by locals with very primitive equipment and technology. Usually, five to ten men from the same village form groups to mine in areas nearby using explosives and pickaxes. In the Central Karakoram, this type of mining is most common in the Braldu, Shigar, Basha, and Haramosh valleys, with quartz the main focus followed by aquamarine (Nawaz et al. 2009). Other stones and gemstones found in the area include marble, mica, calcite, soapstone, graphite, China clay, granite, sulphur, and topaz. There is also evidence of gold; a Pakistan Mineral Development Company report cited Bagrot valley as a potential gold mine. Uncontrolled mining practices such as blasting with dynamite lead to vegetation loss, soil erosion, and disturbance to wildlife.

More than 24 kinds of metallic minerals and 30 non-metallic minerals with deposits that have an economic value have been discovered in Taxkorgan. The exploitation of these resources only started two decades ago, but mining is now an emerging industry. The development of mining has increased local revenues and jobs, but it has also increased the pressure on the local environment. The exploitation of mineral resources has had a marked environmental impact in Taxkorgan County (Editorial Board 2009). By the end of 2008, there were more than 260 mineral prospecting enterprises; more than 70 of them were outlawed by the government in 2009. Some 27 enterprises have permission to exploit the deposits, 14 of which focus on the mining of iron ore and jade. Impacted by the worldwide financial crisis, the exploitation of lead zinc ore has slowed down since 2008.

Problems with tourism

The KPL has tremendous potential for transborder tourism, but at present poorly managed tourism is posing considerable problems for the environment. For example, large amounts of solid and human waste are left by expeditions along trekking routes and at base camps; waste disposal is also a problem on some of the widely travelled glaciers in Gilgit-Baltistan, including the Baltoro glacier. The waste is not only an aesthetic concern, but also poses a threat to human health and safety, wildlife, and the environment. A number of clean-up expeditions have been carried out by the Gilgit-Baltistan Tourism Department. But in general there is a lack of awareness about environmentally sensitive mountaineering and trekking techniques, proper waste management, and the use of alternative energies. In Taxkorgan some poorly planned or even unplanned infrastructure such as recreational facilities, guest houses, camping sites, and restaurants have also had a negative impact on the mountain environment.

6. Rangeland and Pastoral Development

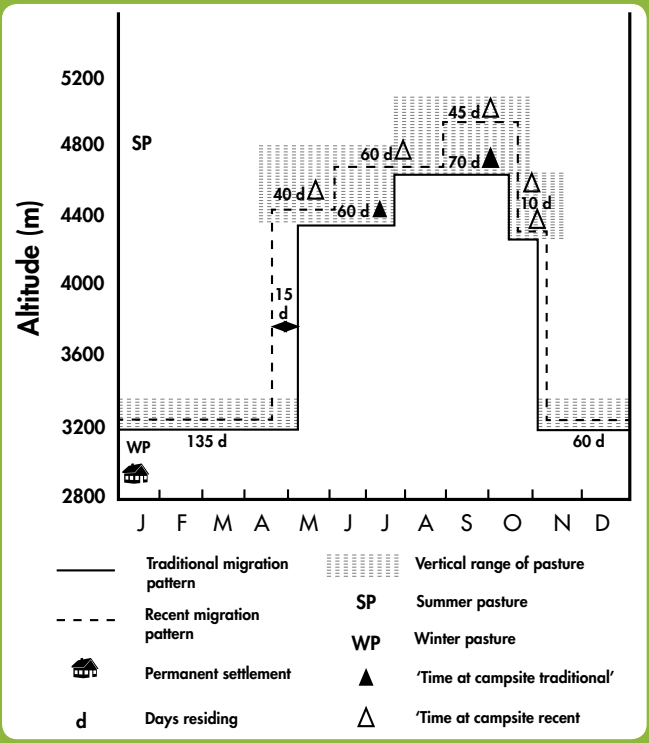
Rangelands are the primary source of feedstuff for livestock in the KPL region and thus play an important role in supporting the local economy and livelihoods. Rangeland covers about 24% (442,820 ha) of the area within the KNP and TNR. Due to the limited livelihood options, almost all the pastures in the KPL have been exploited for grazing by local communities. However, dynamic processes of agro-pastoral change are taking place led by infrastructure development, changes in agro-pastoral production processes, changes in market outlets, demographic growth, and social reform. In the long-term, these processes will continue to reshape the region and will generate further challenges and opportunities for conservation.

Traditional Pastoralism

For centuries, the KPL has been the home of pastoral communities with a way of life based on the raising of livestock for production of meat, milk, butter, and others, using natural grazing and forage. Migration is central to this way of life, and is structured around ecological variables in the location of pasture and water. The herds migrate with the seasons in the search for food and water (Miller 1995, Wu 1997), with survival of both herds and herders dependent on moving from deficit to surplus areas. Their goal – common for all people – is to survive and pass on to the next generation their culture and social organization, as well as the natural resources. This seasonal migration of herders is mainly driven by the climatic factors of precipitation and temperature and represents human adaptation to the harsh climate in arid and winter-cold areas (Wu and Yan 2002).

The vast majority of domestic animals in the Pakistan part of the KPL region (95% of cattle, 99% of sheep, and 97% of goats) are managed under a migratory (nomadic and semi-nomadic) grazing system. Livestock are moved across the

Figure 14: **Pastoral mobility in Gilgit–Baltistan, Pakistan**



vast mountain terrain, utilizing subalpine and alpine pastures in a complex pastoral herding system. Pastoralists maintain a principal home at a lower altitude where they live for approximately seven months of the year in winter while the livestock are kept indoors and fed on maize, wheat straw, and hay (Khan 2013). In the summer, the animals are herded to pastures at higher elevations.

The movement up and down from the mountains usually takes place in stages. In late April or early May, some household members move up with their animals to the edge of the conifer forest where a second house is located. Here they stay for three to four weeks before moving to a third house located within the forest belt. After a further stay of three or four weeks in the forest area both livestock and people move upward to the high-alpine pasture above 4,000 masl, where they remain for up to two months. The return journey begins with the first snowfall in late September or early October.

The Khunjerab Plateau is a traditional grazing ground for the Wakhi people; in Wakhi 'Khunjerab' means 'Valley of Blood' (Knudsen 1999). Among the Wakhi people residing in or near the national park, women take care of the livestock on the alpine pastures in the summer, while men move the yak to lower elevations in late autumn and look after them through the winter (Knudsen 1999). Sometimes, a livestock owner remains in the village in the summer and hires a shepherd to take the animals to the high pastures. Each shepherd is normally responsible for 15 to 40 head of cattle, 100 sheep, or 200 goats, or a mixture of cattle and sheep/goats. Figure 14 shows some of the traditional migration routes in the Gilgit-Baltistan.

In Taxkorgan, Tajik herders, the main ethnic group engaging in migratory pastoralism, traditionally also followed a pattern of seasonal grazing between different pastures, with the length of the grazing season varying according to geographic location and type of pasture. In spring, the Tajik herders migrated from their winter regions through a transition belt, using paths formed over many years by the annual movement of animals, and generally skirting valleys and gullies, to reach an elevation of 3,300–3,900 masl or more. In mid-May, the herders reached the steppe or alpine meadow belt, dominated by grass, sedge, and forbs, and occasionally interspersed with alpine shrubs. Many pastoral families would spend the summer in the alpine belt, but send the herdsmen on to considerably higher altitudes (even to the subnivale belt). They moved back to their winter territory by early winter, and not usually later than October.

However, since the 1990s, the traditional migratory management system in Taxkorgan has been gradually transformed to a more sedentary lifestyle. With the support of local government, many settlements were built with improved infrastructure such as health care and education. Even so, the seasonal pastures have been kept for the rotational use of livestock. The county still has large areas of summer, winter, and transitional pasture, but the animals move with dedicated herders, rather than entire families migrating. Approximately 5% of ruminants in the KPL region are stall-fed year round (mainly around towns) with maize, stover, hay, and grass the principal sources of fodder.

Rangeland Degradation

The increase in the livestock population in the KPL region over the last 40 years has placed increasing pressure on the rangelands. The limited research available shows that the productivity and floral diversity of the Karakoram

alpine pasture is decreasing. The increase in pressure has been shown by Khan (2003), who calculated that the pasture area available per animal unit in Gilgit-Baltistan in 1996 (2.47 ha) was only a quarter of that available in 1976 (9.08 ha). Controlled grazing and management are required to mitigate the situation of overgrazing.
The rangelands in Taxkorgan County mainly comprise desert and semi-desert steppe. Temperate steppe is found in lower valleys to the east, patches of alpine steppe in the Karakoram and southeastern part of TNR, and a few alpine meadows on the shady slopes of high mountains. The total grazing area available is about 424,300 ha, divided into summer pasture (which can be used for 120 days in a year), winter pasture (which can be used for 140 days), and transitional pasture for autumn or spring (Table 14) (Animal Husbandry Bureau of Xinjiang 1993; Editorial Board 2009). Due to the cold, dry climate, the biomass productivity of the rangelands is limited. The average yield of grass is very low (Table 14). Animal husbandry is mainly dependent on natural pastures, and lack of sufficient forage or fodder in winter is one of the main issues facing pastoral development. The carrying capacity of winter pastures is only 37% of summer pastures, indicating an imbalance of seasonal fodder supply (Table 14). Fluctuations in biomass production also lead to problems. Extreme droughts generally lead to a decline in grass yield, with serious loss of livestock in the following year; while winter snowstorms, which are frequent in the whole of the KPL, can cause death of livestock although they can also contribute to grasslands restoration in the subsequent growing season. As in the Pakistan part of the KPL, the main problem remains the increase in livestock population; the number of livestock in Taxkorgan County increased more than five-fold over the last 50 years, from 26,000 in 1949 to 169,800 in 2004 (Editorial Board 2009).

Table 14: **Seasonal pastures and their carrying capacity in Taxkorgan County**

Seasonal pasture	Area (ha)	Forage yield (dry matter) (kg/ha)	Carrying capacity (SUa)
Summer pasture	269,700	1,743	446,200
Spring and autumn pasture	55,100	731	53,600
Winter pasture	99,500	1,154	165,000

[a] SU = sheep unit, 5 SU = 1 AU (animal unit)
Source: Animal Husbandry Bureau of Xinjiang 1993

Forage and Fodder

The quantitative and qualitative shortage of fodder is the principal constraint to livestock production in the KPL region. The situation is particularly acute in late winter and early spring, when crops and hay from the previous season are largely exhausted. During this period the animals are often in advanced pregnancy or early lactation and thus require more nutritious inputs. Pasture degradation contributes further to shortages of fodder. Due to the limited amount of farmland in Taxkorgan, the cultivated forage resources can only support 2.6% of the annual fodder demand. In 2004, Taxkorgan had about 13,400 ha of pasture cultivated for hay. Recently forage cultivation has been developed with the support of local governments in a few valleys below 3,600 masl, but there are not enough research and development programmes for developing improved varieties of forage (Editorial Board 2009). About 20 forage varieties were introduced for testing in Taxkorgan during the last two decades, of which *Elymus dahuricus* and *Puccinellia tenuiflora* were identified as suitable for scaling up. *Medicago sativa* has also been cultivated on a small scale in some low-lying ploughed land. Twelve hay stores have been established by the county government to mitigate livestock loss during in winter and spring; they can provide 1,250 tons of fodder (hay) to herders to overcome the harsh conditions during snowstorms and other problem periods.

Animal Health and Genetic Resources

The lack of fodder has resulted in under-nourishment of livestock, which is a major factor contributing to low milk, meat, and wool production. The Livestock Census in Gilgit-Baltistan in 1996 suggested that the proportion of lactating cows had decreased from 74% to 67% (Khan 2003). The proportion of young sheep and goat stock had also declined significantly. This might be due to high infant mortality resulting from the poor feeding ability of underfed mothers.

Livestock diseases are common in the part of the KPL in Pakistan. For example, endoparasites and respiratory disorders were found to be common in the livestock in the Nomal and Nalter valleys (Navqi and Fatima 2012), with a higher prevalence of disease in winter (34%) than in summer (14%). However, provision of veterinary services is constrained by insufficient staff, equipment, availability of drugs, transportation, the seasonal movement of livestock, and the rugged and inaccessible mountain environment. The Aga Khan Rural Support Programme (AKRSP) has made efforts to train communities in livestock vaccination and has provided them with paraveterinary kits.

In Taxkorgan, lack of sufficient feedstuff in winter has led to weakness of livestock and susceptibility to disease. Since the 1960s, the local government has supported development of a veterinary system, and the loss of livestock due to sickness has been reduced. At present the county has one county-level veterinary station (under Taxkorgan County Animal Husbandry Bureau) with 14 branches and more than 40 veterinarians (Editorial Board 2009).

The genetic production characteristics of yak, sheep, and goat breeds in the KPL region are poor and production of milk and meat is low. There have been only a very few research and development programmes focusing on upgrading the genetic potential of livestock through selection or cross breeding. In the Pakistan part of the landscape, some efforts have been made by the Food and Agriculture Organization (FAO), AKRSP, and WWF to crossbreed the local cattle with jersey bulls to increase milk production. However, other factors, such as proper nutritional input and disease control, have to be considered for real progress; research and development programmes should be carefully planned and executed to make them effective and sustainable.

In Taxkorgan County, a number of varieties have been introduced since the 1960s for cross-breeding sheep, such as the Xinjiang fine-wool sheep, Karakul sheep, Saze sheep, and Altai long-tail sheep, but all efforts have failed due to their inability to adapt to the local climate. The Animal Husbandry Bureau of Taxkorgan introduced three Aktao bulls in 1987, 11 black-white cows from Kashgar in 1988, and 86 Simmental cattle in 1996–1998 for breeding improvement or adaptability tests.

Despite low productivity, local breeds have the advantage that they are well-adapted to the harsh climate and local grass resources. There are some excellent local breeds in Taxkorgan such as Pamir yak, Pamir goat, and Dabas goat which should be protected from any unplanned crossbreeding.

Animal Products

Seasonal livestock production is the main source of livelihood for most of the mountain communities in the part of the KPL in Pakistan. Milk is the most important commodity for local people, while the winter feed deficit is the most significant constraint to livestock production. In spite of the growing demand within the region for meat and milk, only a few livestock owners have started regular marketing of animal products. There are few marketing incentives for local livestock owners, and several policies discourage commercialization in the livestock sector; thus livestock and animal products still remain overwhelmingly within the household economy. Increased off-farm employment and better education are now reducing the availability of labour for tending livestock; in some areas, improved infrastructure appears to have led to a reduction in the use of alpine pastures, and some animals have started to be stall-fed in places near homesteads. Animal products accounted for around one-third of all goods arriving in Gilgit at the beginning of the 1990s. The meat prices are generally fixed by the local administration in favour of urban customers. Imports are highest in winter when the meat consumption of the local population is traditionally the highest (Wright and Duncan 2005). Interestingly, although the number of livestock in Gilgit-Baltistan is high, meat has always been in short supply, with the exception of special occasions when herders bring their stock to local markets and sell off at lower prices than other days. Appropriate value chains regulating the flow of milk, meat, and other dairy products to local markets year-round may help this sector become a viable and profitable business for herders, and ensure a continuous supply of meat and milk products to the local markets.

As in the Pakistan part of the KPL, the economy in Taxkorgan is predominantly based on livestock husbandry. The majority of the population live in rangeland areas, with crop cultivation limited to a few low-lying river basins. There were around 195,500 livestock in Taxkorgan in 2011, with more than 70% of revenue coming from animal

husbandry. Sheep and goats make up more than 70% of all livestock and play a very important role in livelihoods. However, marketing of animal products is still limited due to the remoteness, poor market access, and lack of storage and processing technologies and facilities. Thus, livestock products are largely consumed by the local people themselves, while some surplus is sold at the local markets. Nowadays, wool and its processed products have become one of the main sources of income for local communities. Due to the unique environment of the Pamir Plateau, the livestock in Taxkorgan comprise isolated breeds well-adapted to the high and frigid habitat and with good quality wool. The local government encourages herdsmen to raise sheep in the valleys and goats in the mountains for wool production. The majority of people in Taxkorgan sell their wool in bulk to wholesale buyers for a lump sum for the price of coarse wool. With the development of the mining industry in this region, local herders could also sell meat and wool to miners. With the development of tourism, local women have become actively engaged in making souvenirs, including crafts using wool and hides. However, most herdsmen living in remote areas are still unable to sell any wool in the market. Furthermore, the main processing facilities (wool cleaning and washing) are located far from the wool production areas, and by only selling coarse wool, the income generated from wool production is low.

7. Cultural Heritage and Tourism

The Karakoram-Pamir area is very remote from both populated southern Pakistan and developed eastern China, but it has been a hub along an international travel and trading route for centuries and is endowed with rich cultural heritage sites. At the same time, tourism is one of the most dynamic and controversial elements of development in almost all mountain areas. With careful planning and using sustainable tourism development models that are innovative, responsible, and consider climate resilience, tourism can be one of the most promising alternative livelihood options for mountain people.

Cultural and Religious Heritage Sites

The Ancient Silk Road

The Karakoram-Pamir region has been influenced by a variety of cultures and civilizations during a turbulent history, not least as a result of its position on the path of the ancient Silk Road. The Silk Road is actually a series of branched trading routes between India, China, and Central Asia (see Box 6). One of the main routes passed through the 5 km wide Taxkorgan valley along the northern border of the TNR into the Chalachigu valley and over the Mintaka pass into the area of KPL that lies within Pakistan. The Silk Road was linked to a network of other trading routes on land and across the sea and enabled economic, political, and cultural exchange between Asia and Europe, and even Africa. Thus the KPL region was a meeting place for traders, pilgrims, and explorers, and the route further strengthened the traditionally close linkages between the communities along the Pakistan-China border. Emperors and conquerors from Central Asia and Persia were attracted to the region, and Buddhist monks from India used the Silk Road to travel to China to spread their teaching.

Box 6: **The Routes of the Ancient Silk Road**

The east route of the ancient Silk Road started from Chang'an (today's Xi'an), the capital city of ancient China, and had three branches. One went across Jingchuan to Guyuan, Jingyuan, and Weiwu. Although this route was the shortest, the supply of water was very limited. A second much longer route went from Fengxiang, to Tianshui, Longxi, Linxia, Yuedu, Xining, and Zhangye. The third went towards Pingliang, Huiling, Lanzhou, and Wuwei.

The middle route of the SIlk Road went from Yumenguan, to West Yangguang and Congling, with a southern branch from Yangguang, which skirted the southern edge of the Taklimakan desert, to Ruoqiang, Hetian, Shache, and Congling; a central branch which started from Yumenguan, and skirted the northern edge of the Taklimakan desert, to Loulan (today's Lop Nor), Gaochang (today's Turpan), Weili (today's Yanqi), Qiuci (today's Kuqa), Gumo (today's Aksu), Shule (today's Kashgar and Taxkorgan), and Dawan (today's Fergana Valley); and a northern branch from Anxi, through Hami, Jimsar, and Yining, to Suiye.

The western route started at Congling and went all the way to Europe, passing through Chang'an and Luoyang and the Hexi Corridor (in today's Gansu), to Central Asia, and West Asia, to end at Istanbul on the divide between Asia and Europe.

The southern Silk Road was one of China's oldest international roads. It started from Yibin in Sichuan, and passed through Yunnan towards Myanmar and Thailand along one branch, and to Central Asia and India along another.

The interaction between west (Central Asia) and east (inland China) started about 5,000 years ago, and peaked in the Han Dynasty. At the time of the West Han Dynasty (202 BC–9 AD), Zhang Qian, a Chinese imperial envoy, was delegated to go to the western region bordering China to show goodwill – this was how the Silk Road was developed and exchange between east and west strengthened. Harassed by the Xiongnu (or Hsiung-nu, an ancient nomadic people who formed a state or confederation north of China), the road was interrupted. The Chinese diplomat Ban Chao reopened the road in 73 AD, under the East Han Dynasty (25 AD–220 AD), and extended it to the borders of the Roman Empire in Europe. The first direct interaction between China and Europe took place in 166 AD, and resulted from the convergence of the routes. Many goods were transported from ancient China to nations in Central Asia and Europe along this route. The term 'Silk Road' was first used by the German geologist Ferdinand von Richthofen in 1877. He was referring to the trade route between China and India as it existed from 114 BC to 127 AD, when the trade focused on silk. Later, the term was broadened to include the series of routes connecting Europe with Asia.

After seeing many rises and declines over a period of 2,000 years, the Silk Road has regained attention in modern times. In February 2008, 19 European and Asian countries, including China, signed an agreement in Geneva to restore the Silk Road and the trade between Asia and Europe through more investment. On 7 September 2013, Xi Jinping, the President of China, presented the idea of developing a 'Silk Road Economic Belt' in a speech given at Nazarbayev University in Kazakhstan (see Box 7). In addition to the renewed economic significance, the cultural values of the Silk Road have also been highlighted through its recognition as a World Heritage site. The Silk Road was added to the World Heritage list on 22 June 2014, in a joint declaration by China, Kazakhstan, and Kyrgyzstan for the route network along the Chang'an-Tienshan corridor. The ancient 'road' can be expected to attract many tourists from different countries, which will provide a great opportunity for this remote area.

Box 7: **The Silk Road Economic Belt**

The Silk Road Economic Belt strategy is not a simple rebuild of the Silk Road. The ancient Silk Road was simply a series of trade routes, but the strategy intends to promote the economy in the less developed areas, as well as promoting trade and tourism among countries, and to facilitate the exchange of goods and services, as well as culture and politics, leading to a win-win situation for all countries. The Economic Belt will extend to an area covering Central Asia and even Europe. The Chinese President Xi Jinping listed five guiding principles for the development of the Economic Belt: to enhance policy communication; to strengthen the road connection; to reinforce the flow of trade; to strengthen the flow of currency; and to obtain the support of people and promote mutual understanding. There are some three billion people living in this Economic Belt and the potential market is promising. The development of the Belt will help the economy in this area to grow, thus bringing out a huge demand in Central Asia for goods in the Asia-Pacific circle. Furthermore, as a less developed area, Central Asia can take advantage of the infrastructure that will be built during this strategy so that trade channels expand and the economy is linked with the international market.

The China-Pakistan part of the Economic Belt along the Karakoram Highway will provide a great opportunity for both Kashgar and Gilgit-Baltistan to extend their market and customer base. In addition to the goods exchange, services are also considered by local agencies. For example, the Xinjiang Association of Travel Agencies and the First Teaching Hospital of Xinjiang Medical University have made a cooperation agreement to develop Xinjiang as an attraction for medical tourism, based on the traditional medicine in Xinjiang and serving people from Central Asia. This is an innovative way to provide services and support growth of the tourism industry.

Cultural and heritage sites in the part of KPL within Pakistan

As a result of its varied history, the KPL region possesses a particularly diverse and interesting cultural heritage. The area within Pakistan is home to a number of diverse cultures, ethnic groups, and languages, and has also been settled by people from other areas of Pakistan and beyond. This multi-cultural and multi-lingual mix is reflected in a mix of lifestyles and attitudes within a pluralistic society where people have lived together in peace and harmony for centuries. The region has a diversity of mountain cultural traditions, many of which are endangered. Some of the more prominent cultural and scenic attractions in the KPL area within Pakistan are listed in Table 15.

Table 15: **Key tourist attractions in the part of KPL within Pakistan**

Attraction		
Palaces/forts	Scenic points	Long glaciers
Gilgit Fort, Gilgit Town	Khunjerab valley	Siachen (74 km)
Chalt fort, Chalt	Chapursan valley	Hisper (62 km)
Baltit Fort, Karimabad	Misgar valley	Biafo (60 km)
Altit fort, Altit village	Boibar valley	Baltoro (60 km)
Ondra Fort, Gulmit village	Shimshal valley	Batura (65 km)
Chilas Fort	Duiker view point	Yengunta (35 km)
Rondu Fort	Hopar valley/ Hisper valley	Chiantar (34 km) Bitanmal
Kharpocho Fort, Sakardu	Rakaposhi view point, Ghulmet	Hopper
Shigar Fort, Shigar valley	Nalter valley	Balturo
Kalandarchi Fort, Misgar valley	Kargha Nullah	
	Phander	
	Fairy meadows/ Deosai plateau	

The cultural diversity could provide an attractive base for tourism, but at present remains underexploited. Cultural events and festivals are held in different areas, and could potentially be used as marketing tools for the cultural heritage to provide economic benefit to the host communities and local businesses. However, at present most events are not planned in a way that can be used to attract tourists, i.e., the dates are not fixed in advance and information about the events is not available to domestic and international tourists, thus the potential benefits of these festivals are not yet realized to their full extent.

The Khunjerab Plateau is an ancient grazing ground for the Wakhi. Today, the Karakoram Highway, completed in the late 1970s, runs across the plateau along the route of the ancient Silk Road, linking Pakistan and China. But tourists who travel by bus across the plateau in summer can barely imagine the hardship of living there, nor are they likely to see the rusty signboard which informs passers-by that they are entering the Khunjerab National Park (KNP), or the signs of ancient culture imprinted on the landscape.

The situation is improving, however. The Aga Khan Cultural Services Program (AKCSP) Pakistan has played a leading role in the conservation of the KPL cultural heritage (GoP/ IUCN 2003). In particular, it has been involved in the promotion of community-based conservation activities in Hunza since 1992, including the preservation of architectural heritage and other environmental assets. The UN World Tourism Organisation (WTO) and UNESCO have also been supporting the development of sustainable tourism along the Silk Road for many years through the joint 'Silk Road Heritage Corridors' tourism strategy project, while the Karakoram Area Development Organization (KADO) is implementing several projects in Gilgit-Baltistan related to cultural heritage conservation and development of sustainable tourism in collaboration with the local communities. There are also some concerns. For example, the Karakoram Highway (KKH) expansion project poses a possible threat both to the environment and to sites of cultural and historical heritage, and will require careful planning. The expanded KKH is planned to pass through a number of sites and villages of archaeological and historical importance, for example Ganish village in Hunza. In Haldikish (Hunza), it is planned to pass through the site of the 'Sacred Rocks of Hunza', which are carved with inscriptions and petroglyphs – a record from the pre-Islamic period of history when the culture of Gilgit-Baltistan served as a link between China and the Gandhara civilization. The culture of Gilgit-Baltistan is totally oral and there is no tradition of written history; thus preserving historical monuments like Haldikish will help the region to save a concrete historical memory, while elimination of this record would impoverish the region's cultural history.

Cultural and heritage sites in the area of KPL within China

The KPL area within China has a long history as a stop on the ancient Silk Road; the major caravan routes converged in Taxkorgan leading to Kashgar in the north, Karghalik to the east, Badakhshan and Wakhan to the west, and Chitral and Hunza to the southwest. The unique landscape, Tajik culture, neolithic Xiangbaobao tombs, and historic Gongzhu castle are a living heritage. The Xiangbaobao tombs are a group of ancient tombs built by the Qiang people between 2,500 and 4,000 years ago, found 2 km north of Taxkorgan county town (www.bytravel.cn/Landscape/36/xiangbaobaogumuqun.html [in Chinese]). Gongzhu castle (Princess castle) gives the name to the area: in Uygur, 'Taxkorgan' means 'stone city' and refers to this fortress castle built some 1,500 years ago to the south of the county town at around 4,000 masl on the top of a hill. Tradition says it was the temporary residence of a Chinese princess who was on her way to Persia to marry the Persian king, but who settled in Taxkorgan because of the wars in Central Asia (www.bytravel.cn/Landscape/14/gongzhubao.html [in Chinese]). The fortress protected the Silk Road, and the famous heritage site is now ranked first in the preservation list for historic architecture in Xinjiang.

Every year hundreds of thousands of tourists visit the fantastic Pamir landscape, the so-called 'Roof of Plateaus'. The Khunjerab pass to Pakistan lies about 130 km from Taxkorgan Town and is mainly used for trade and tourism; it was officially opened in 1982 and to tourist groups in 1986. Due to heavy snow, the crossing is generally closed to the general public and tourist groups from 30 November (or earlier) to 1 April (or later), but conditions permitting can be used by officials, traders, and those with special permission.

Opportunities for Tourism Development

As a unique mountainous region, the KPL offers a wide range of opportunities for adventure and nature lovers including trekking, mountaineering, hiking, rafting, trophy hunting of ungulates like ibex and blue sheep, mountain and desert jeep safaris, camel and yak safaris, trout fishing, and bird watching. The landscape is endowed with a rich and varied flora and fauna and a diverse cultural heritage. The Karakoram ranges with their alpine meadows below the permanent snowline, coniferous forests, and sub-montane scrub, offer a remarkably rich variety of vegetation and associated wildlife, including many endemic and migratory birds. The region has immense tourism potential in the areas of mountaineering, culture, religious heritage, environment, mountain sciences, and archaeological sites.

According to the Gilgit-Baltistan Tourism Department, 5,511 foreign tourists and 38,386 domestic tourists visited the area of KPL within Pakistan in 2010 (Table 16). However, political instability, violent events, and natural disasters are affecting the tourism business and the inflow has fluctuated considerably over recent years (Table 16), damaging the livelihood strategies of those who depend heavily on tourism activities to supplement their income. Foreign tourist arrivals remain low as the image of the region is damaged and it will take time and effort to restore the market. Domestic tourism has shown a more rapid recovery but is still very variable.

Table 16: **Foreign and domestic tourist arrivals in Gilgit-Baltistan**

Year	Foreign tourists	Domestic tourists	Total
2007	10,338	22,780	33,118
2008	4,756	50,316	55,072
2009	7,728	55,725	63,453
2010	5,511	38,386	43,897

Source: Karim et al. 2012a,b

In Taxkorgan, tourism has become quite highly developed, with more and more domestic and foreign tourists coming to this border county. More than 103,000 tourists visited Taxkorgan in 2008, generating a revenue of USD 3.5 million (Editorial Board 2009). Since 2000, the local government has focused on tourism as a priority industry for future development. A tourism development plan has been prepared, and a large amount of basic infrastructure constructed. In 2003, the county government invested USD 5 million to develop a Tajik Arts Centre, including a museum and an exhibition hall showing the traditional culture of Taxkorgan. In 2011, protection of the fragile environment and appropriate development of the tourism industry became the key approaches in Taxkorgan's tourism development strategy, and ecotourism was incorporated into the economic and social development plan of the local government. Currently, there are only 20 hotels, including four-star hotels, with only 800 beds, which cannot fulfil the demand during the main tourist season. The fast growing tourism industry in Taxkorgan demands the development of necessary infrastructure such as a new tourist centre, several star-rated hotels, well-connected road traffic, environmentally friendly infrastructure construction, and staff training. According to the Master Tourism Plan of Taxkorgan County (2011–2025), tourist numbers could reach 537,100 in 2015, 1,994,200 in 2020, and 6,588,700 in 2025. Creating and building the different level hotels, enhancing the capacity of travel agencies, and promoting infrastructure will become urgent. However, recent instability in this sensitive area will inevitably lead to the efforts to attract tourists becoming debatable.

The unique landscape of the Karakoram-Pamir offers an opportunity for adventure activities, which have the potential to attract different types of tourists across the entire landscape. The following list indicates some of the potential programmes for adventure tourism:

- **Mountain biking:** Riding along the Karakoram Highway with a mountain bike is a fascinating way to discover the great variety of cultures and ethnic groups that have passed this way and left their mark over the last 2,300 years. The great number of valleys offers the possibility of enjoying innumerable diverse landscapes. Travelling this route is like travelling through dozens of countries.

- **Skiing**: The KPL offers a number of skiing areas for tourists with fine skiing destinations in Naltar, Burzil, Ratu, and Astore. Naltar lies near Gilgit in the Karakoram range and is one of the oldest skiing resorts in Pakistan.
- **Fishing**: The mountain streams offer a wonderful opportunity for trout fishing, another exciting activity in the region. In Gilgit, the streams and lakes are a great source of both brown and rainbow trout; while the Ghizer River and other freshwater lakes offer some of the finest destinations for trout fishing in the KPL.
- **Trekking/hiking**: The mountains in KPL, with their notable absence of commercialization, are among the world's most spectacular and little known trekking and hiking destinations.
- River rafting: River rafting along the Shimshal, Shigar, Ghizer, and Gilgit rivers offers excellent opportunities to both locals and outsiders.
- **Yak safari**: There are dozens of treks crossing many historical passes in the KPL. A yak safari in summer with views of glaciated peaks and watching the 'ice world' is a lifetime experience.
- **Desert camping**: There are a few small and medium-sized deserts in Baltistan and typical high deserts in Taxkorgan where moonlit nights offer a wonderful opportunity for nature lovers to camp in the desert. Local camels can increase the enjoyment.
- **Wildlife watching**: The KPL has a great potential for wildlife with many large mammals both sides of the China-Pakistan border. Several endemic, rare, and threatened species are worth seeing for wildlife lovers. The community-based trophy hunting programme in Pakistan offers exclusive opportunities for ungulate hunters and contributes to nature conservation.

Tourism development in the mountains can provide economic, social, environmental, and cultural benefits, and help support local livelihoods. However, it can also have a negative impact on cultural traditions, lifestyles, and the local environment if there is no integrated plan. In the last few decades, mountain tourism in the KPL has not received as much attention as other sectors and industries. The tourism industry has only been considered as a tool to fill the demand for foreign exchange. Tourism development in the part of KPL within Pakistan is largely unplanned; there are no land-use or zoning schemes in place to guide or control activities. Similarly, carrying capacities have not been calculated for the major tourist destinations across the KPL, and tourism flows at these sites remain unregulated. Although the KPL is rich in tourist attractions, especially in mountain tourism resources, tourism has only a short history. The inflow of tourists is still very limited in comparison with other famous mountain areas in the Hindu Kush Himalayan region (Table 16). Experience, capacity, infrastructure conditions, as well as the security situation, are still not enough to support prosperous tourism. An integrated and environmentally-friendly long-term plan is needed as a basis for ecotourism development before there are any large-scale developments.

8. Livelihood Diversification

Traditionally the people of the KPL region are pastoralists and agro-pastoralists who earn their livelihood through livestock grazing with some farming of crops. Pastoralism makes a significant contribution to the national economies of both countries, in terms of both subsistence and export earnings. In the last few decades, however, these livelihoods have come under increasing pressure. Rangeland degradation has reduced the potential of rangelands to provide goods and ecosystem services, and the acute shortage of pasture is forcing communities to abandon the traditional system of livestock-based livelihoods and engage in alternative options.

The possibilities for livelihood diversification can be divided broadly into internal and external types (Wu et al. 2014). Internal diversification means diversifying the traditional pastoral-based livelihood itself. This is a self-adaptation to environmental changes and a traditional approach to risk management. External diversification means pursuing non-pastoral income-earning activities, whether in rural or urban areas. This is a risk management tool adopted by pastoral communities (Eneyew 2012). Thus livelihood diversification in a pastoral society refers to attempts by individuals and households to find new ways to raise incomes and reduce environmental risk; these attempts differ sharply in the degree of freedom of choice (to diversify or not), and the reversibility of the outcome (Ellis 2000; Elmqvist and Olsson 2006). The causes of pastoral diversification are also multi-faceted and resistant to simple explanations. The motivation varies in different populations, under different cultural and economic conditions, and in different ecosystems. The major possibilities for non-pastoral income-earning activities in the pastoral areas of the KPL are described in the following.

Options for Livelihood Diversification

Outmigration

Although livestock production is the backbone of the local subsistence economy in the KPL region, education and the availability of alternate livelihood activities have led to a decrease in livestock practices. The limited job opportunities at home, population growth, and environmental pressure have led to men migrating to seek employment in urban areas. The trend towards globalization, urbanization, and commercialization in recent decades has facilitated this migration flow. Although out-migration has long been an adaptive strategy used by mountain pastoralists in response to socio-demographic change, climate change, and environmental hazards, it was very uncommon in the KPL before the opening of the Karakoram Highway (Kreutzmann 2012).

In the KPL region, outmigration is used to mitigate economic hardship and deal with the seasonal constraints imposed by the harsh climate. Wealthier herders aim to improve their economic status, while poorer households may rely on migration to fill their basic needs. Access to resources like land, livestock, education, and markets affects the ability to diversify. The financial assets accrued by a family from migration in the form of remittances can also be used to promote further diversification, and/or migration. Generally speaking, better-off households have the opportunity to migrate to farther and richer areas for trade and wage employment. The difference in opportunity was clearly illustrated following the Attabad disaster in January 2010 which blocked the Karakoram Highway. The economy of people in the Gojal valley depends mainly on growing potatoes as cash crop, trade with China, and tourism. All three sectors suffered badly following the blockage, but whereas middle class families could cope by migrating to Gilgit and further away, poorer people simply had to struggle to survive. Disasters generally lead to migration and diversification as adaption strategies.

Outmigration in Taxkorgan is rather different to that in the part of KPL in Pakistan. Seasonal or even yearly migration to waged jobs in urban areas has been encouraged by the local government and has developed rapidly over the last decade. The local government cooperated with inland enterprises to provide training opportunities for local people so that they were qualified for employment. For example, 55 people were employed in the factory run by the Zhongjie Cloth-Making Company in Tianjin City in 2008 after local training was provided by the company in Taxkorgan. These people would migrate to eastern China for a few years, often with their families. With the development of mining and infrastructure construction, an increasing number of people are migrating to jobs in mining areas, at hydropower stations, and in road construction. Most of this migration is temporary or seasonal and is undertaken by men. Remittances from family members working in urban areas have helped improve the economic condition of those living in pastoral areas. In 2008, monetary remittances to Taxkorgan amounted to about USD 133,870 (Editorial Board 2009). Out-migration can lead to a decrease in the local population, as well as the number of livestock, which could reduce the pressure on natural resources and benefit conservation.

Beekeeping

Honeybee flora are present over vast areas of the KPL and estimated to be sufficient to support a million honeybee colonies (Pakistan Agricultural Research Council). Honey produced from Russian olive flowers has a very high quality and is much valued in Pakistan and abroad. Beekeeping has been promoted by many research and development agencies, including the Pakistan Agricultural Research Council (PARC) and AKRSP (who have jointly set up beekeeping units at Gilgit and Nagar), and has become a promising enterprise for off-farm income and employment generation in the mountain areas of KPL within Pakistan (AKRSP 2011a). In many villages, beekeeping is the only cash-earning activity. The honey produced in Hunza is supplied to Gilgit and nearby markets. Beekeeping can also be vulnerable to disasters, however. In the Ishkoman valley, beekeeping and honey production is the sole source of income for the majority of the population, but in 2010 floods destroyed the beehives and beekeepers were left with no way of providing for their families. The Hashoo Foundation, a local non-government organization (NGO), helped some of the beekeepers to recover (Hashoo Foundation 2010); it provided equipment and training to about 52 beekeepers (45 women and seven men) and helped them in honey value chain development.

Cultivation of fruit and vegetables

The KPL region is rich in fruit and vegetables with a wide range of varieties and cultivars. For example, Hunza Nagar in the Pakistan part of the landscape has many different fruits grown for cash including apple, cherry, and apricot. AKRSP has been striving to improve the value chain for selected fruit varieties and has supported a number of development activities over the years including introduction of new and improved fruit trees, homogeneous horticultural practices, commercial fruit production, market linkages, establishment of model orchards and nurseries, and capacity building programmes (AKRSP 2011b). When the value chain was developed for production of apricot in Gilgit-Baltistan and linkage with international markets, it not only benefited a large number of poor farmers, it also added value at different points in the supply chain and helped to introduce new technologies, establish standards, and introduce certification practices for fruit processing and marketing. These activities not only expanded the market but also meant that the actors in the value chain could obtain a premium price, and provided a source of foreign exchange for the country.

Potato is another important cash crop in Gilgit-Baltistan, with a high value for both seed and potatoes in the downstream markets. Currently, more than 131,275 tonnes of potatoes are grown on 8,422 ha of agricultural land in Gilgit-Baltistan (GGB 2009). Peas, tomato, and capsicum are also grown over large areas. There are a number of factors limiting the profitability of this sector for mountain farmers, however, including lack of market access and weak linkages with national markets; lack of facilities for cold storage, processing, and packaging; lack of familiarity with modern farming methods and technologies; insufficient technical, capital, and quality inputs (e.g., seed, organic fertilizers); poor accessibility of production areas; and high dependence on middlemen. Equally, there are a number of opportunities including the high demand in down-country markets for high-altitude agricultural products. Introduction of appropriate value chains for potato could make crop cultivation a really profitable industry. Some progressive businessmen have recently established a small industry for French fries, which if assessed, supported, and integrated into a good value chain could bring enormous revenue to the region.

In the part of KPL within China, many vegetable varieties have been introduced and cultivated in greenhouses in response to the demand for vegetables in local markets in Taxkorgan. With encouragement from the local government, greenhouses for vegetable cultivation have developed very quickly over the last ten years. Cultivation of off-season vegetables has become one of the main sources of income for some local farmers living close to towns. In 2008, the total income generated from vegetable cultivation in Taxkorgan County was about USD 2.4 million. Taxkorgan also has many different types of fruit grown for sale, including apricot, peach, apple, pear, and grapes. Over the last decade, apricot cultivation has been encouraged by the local government and by the development of local markets due to the increased number of mine workers and tourists. In 2008, there were 800 ha of apricot orchards with a yield of 513 tonnes.

Collection of niche products

Many households in the KPL region harvest a wide range of wild plant products, such as medicinal herbs and mushrooms, from mountain areas for subsistence use and local sale (Rao and Marwat 2003). These resources have the potential to bring tangible benefits to the local communities if utilized in a sustainable way, but so far their contribution to average household income is still very low due to the very limited value addition by the collectors. Collection of medicinal plants is not only beneficial for health care but also for income generation. However, overexploitation means that these resources are gradually disappearing from the pastures. At the same time, dependence on and use of herbal medicines is also diminishing, together with the associated indigenous knowledge. Traditional herbal traders have almost disappeared from the area, and the local wisdom, knowledge, and skills related to medicinal plants, their use, and method of preparation is confined to a few village elders and shepherds.

In Taxkorgan, the collection of medicinal plants provides income for the local people, but has also led to the destruction of vegetation and degradation of pastures due to large-scale digging for plant roots. Due to the harsh environmental conditions, the volume of medicinal plants is limited, although there is a considerable diversity of medicinal and aromatic plants in the alpine belt. Several factors have led to the degradation and depletion of medicinal plants in the region including (1) continuous harvesting from the wild by local people; (2) easy access

to allopathic medicine even in remote villages and lack of interest among young people to learn about traditional practices has led to a lack of awareness about the health and conservation values of the plants; and (3) excessive grazing of pastures by domestic herds (Khan et al. 2011a).

A few new products have also been explored and utilized by local people in the KPL for income generation using their indigenous knowledge. For example, seabuckthorn (*Hippophae rhamnoides*) is an important medicinal plant in Gilgit-Baltistan, with the fruit, which is rich in nutrients, particularly vitamin C (Shah et al. 2007), also used to make juice and oil, and as a base for cosmetics. Seabuckthorn is widely distributed in the KPL and local people collect fruit for sale to processing factories. The multi-functional shrub grows at 2,000 to 3,900 masl and is used for erosion control as well as production of oil, food, and fodder. The fodder yield (leaves) is 2,000–3,000 kg/ha. A single bush yields an average of 6 to 13 kg of fruit, around 2 to 50 tonnes per ha (Siddiqui 1997). The seabuckthorn industry could be strengthened in KPL to provide a major source of revenue for communities.

Tourism

As discussed in the previous chapter, the long-term prospects for growth in tourism are very good, notwithstanding the present difficulties which are related, among others, to lack of infrastructure and political instability on both sides of the border. Tourism offers a wide range of possibilities for income diversification, ranging from direct provision of services (e.g. 'homestay', guiding, provision of camping sites, and similar), to employment in service industries (hotels, restaurants, transport, tourist bureau, money exchange), and production and trade (milk, meat, fruit, vegetables, and honey; handicrafts). Maximizing the benefits of tourism for farmers will require careful planning as well as value chain development that ensures that a large part of the benefits actually remain within the KPL.

Prospects for Livelihood Diversification

Overall, the possibilities for income diversification in the KPL region are limited. Resources that can be grown, harvested, and/or processed into high-value, low-volume products are limited because of the extreme environment. Furthermore, the people who collect and produce these products generally receive a relatively low share of the total returns as a result of lack of knowledge about market chains, lack of processing facilities, and inadequate quality control, leading to products that do not meet the requirements of the domestic and international markets. National and regional policies could help local people to obtain greater benefit from a growth of trade in their products, but these need to be developed, adapted, and implemented in the region. Developing a common market for cross-border trade could offer good possibilities for the people of the KPL by opening up much more accessible markets. Development of value-adding processes for local products and services also offers significant scope to increase income generation and the share of collectors and growers in the value chain. Tourism also offers considerable possibilities for livelihood diversification, both through provision of services and as a market for niche products. The easiest option for many is outmigration, either seasonal or long-term. But this brings its own problems for pastoralists. The advantage of having income from remittances can be offset by the problems resulting from shortage of labour and the disruption to the social fabric of these closely knitted societies. The problems of feminization of agriculture and the additional burden borne by women in families in which men are away are being experienced across the wider Himalayan region.

Diversifying sources of income is important for risk reduction in pastoral areas, especially for poor households, as well as being driven by increased ambitions for the next generation, for example paying for schooling. It is particularly important in an area where the population is growing but pastoral resources are limited. For example, poorer farmers in the KPL area in Pakistan, especially those who have lost animals following drought or snowstorms, would like to expand cropland. Diversification does not necessarily mean an end to pastoralism, although some authors suggest that it should be used to encourage pastoralists to exit the pastoral sector (Jillo et al. 2006). There are many forms of diversification that are closely linked to the pastoral sector and actually support pastoralism, while keeping added value in the region: for example milk and meat processing, tanning, trading, retail of input supplies, and gathering/processing of local natural products (Little 2009). These types of activities are complementary to

the central livelihood activity in pastoral and agro-pastoral societies. For example, processing of yak products is now supported by the Taxkorgan government with the aim of providing more niche products for tourists as well as benefiting local communities.

The move towards diversification of livelihoods is not homogeneous across the region or within communities due to the differences in people's needs and capacity, which are determinants in the diversification process. The general trend in this region as elsewhere is that younger people and literate households are diversifying more than others. The level of formal education of a household head increases the likelihood of adoption of improved pastoral or farm production. Differences in education level indicate differences in adaptive capacity and the ability of households to adapt to change, adopt new technologies, and access markets, all of which influence socioeconomic development. Notwithstanding these differences, one important factor supporting income diversification is the presence of a conducive policy environment. However, there is still a lack of appropriate national policies and other institutional arrangements for mainstreaming diversification issues into the food security and development agenda. Even in Taxkorgan, where migration to urban areas is encouraged by the local government, it has not yet been integrated into development strategies.

9. Governance and Policies

It is important to understand the policy and governance environment in the KPL within the context of international and regional cooperation for transboundary landscape management, and the constraints and opportunities offered by this governance framework. The overall policy approach to natural resource management and ecosystem management, relevant international agreements, and national policies and governance structure in the KPL area are described in the following, together with the way in which these promote maintenance of the biological and cultural integrity of ecosystems within the landscape through cross-scale institutions, co-management arrangements, and community participation. Policy needs at the national and regional levels for strengthening ecosystem management in the landscape in the two countries are also addressed.

International and Regional Instruments

Conservation and development issues often transcend the political boundaries of individual countries and therefore demand strong cooperation between governments. Several international and regional agreements support the concept of transboundary conservation and regional/international cooperation and highlight integration of the objectives of conservation with sustainable development. They have a host of provisions that the governments within the KPL region have agreed to and will need to comply with to fulfil their international and regional obligations.

International cooperation and the development of international law to protect rare and endangered species subject to international trade; to protect and wisely use ecosystem goods and services, especially those shared by one or more countries; and to conserve migratory species and species of global concern are an essential part of domestic policy and legislation development in all countries of the region. At the international level, the concept of 'transboundary protection or regional cooperation for conservation' is well-known and well-established. The concept is found in various conventions, bilateral agreements, charters, and principles, and is evident in the international laws established to minimize threats to endangered species. The original impetus for such legislation came from international concern about the overexploitation of wildlife and the widespread loss of biodiversity; this transboundary concern and facilitation for regional approaches has been enshrined in a series of international policies agreed to and agreements signed since the early 1970s.

Internationally agreed principles

Declaration of the United Nations Conference on the Human Environment (UNCHE) (1972)

The concept of transboundary protection first emerged clearly in the principles laid down in this declaration in 1972 in Stockholm. Principle 21 recognizes a state's right to exploit its own resources pursuant to its own environmental policies, subject to ensuring that its activities do not cause any environmental damage. Principle 22 requires states to cooperate in developing laws regarding liability and compensation for damage to habitats that could harm species that cross or reside within the borders of neighbouring states.

UNEP Principles of Conduct in the Field of the Environment for the Guidance of States in the Conservation and Harmonious Utilization of Natural Resources Shared by Two or More States (1978).

Shared natural resources represent an intermediate category; the resources do not fall wholly within the exclusive control of one state, but neither are they the common property of all states. The essence of this concept is a limited form of community interest, usually involving a small group of states in geographical contiguity that exercise shared rights over the resources, which in this case could include international watercourses and migratory species.

World Charter for Nature (WCN) (1982)

Article 11 of the Charter requires that activities within a state's jurisdiction or control do not cause damage to natural systems in other states or in areas beyond national jurisdictions, and that nature within the national borders is safeguarded. Activities causing irreversible damage must be examined beforehand; an environmental impact assessment must be undertaken; and agriculture, grazing, and forest practices must be adapted to the natural characteristics and constraints of a given area.

Report of the World Commission on Environment and Development (WCED) (1987)

This report delineates a set of legal principles for environmental protection and sustainable development. Twelve principles (Nos. 9–20) were grouped together as Principles, Rights and Obligations Concerning Transboundary Natural Resources and Environmental Interferences. As per these principles, states should use transboundary natural resources in a reasonable manner; prevent and abate harmful interference; take precautionary measures to limit risk and to establish strict liability for harm done; apply, as a minimum, the same standards for environmental conduct and impacts concerning such resources as are applied domestically; cooperate in good faith to achieve optimal use and prevent or abate interference with such resources; provide prior notification and assessment of activities having significant transboundary effects and engage in prior consultation with concerned states; cooperate in monitoring, scientific research, and standard setting; develop contingency plans for emerging situations; and provide equal access and treatment in administrative and judicial proceedings to all affected or likely to be so.

Global conventions and regional agreements

There is a wide array of treaties and agreements on conservation at the global, regional, and bilateral levels that are based on the aforementioned principles. Some deal with species protection, while others deal with habitat

protection. The following treaties introduce new approaches to protection; all recognize the need for international and regional cooperation in conservation and development. China and Pakistan are both signatories to all.

Man and the Biosphere Programme (MAB) (1971)

The Man and the Biosphere Programme (MAB) focuses on the reduction of biodiversity loss, improvement of livelihoods, and enhancement of social, economic, and cultural conditions for environmental sustainability. The objective of MAB is to "contribute to minimising biodiversity loss through the use of ecological and biodiversity sciences in policy and decision making; promote environmental sustainability through the World Network of Biosphere Reserves; and enhance the linkages between cultural and biological diversity".

Convention for the Protection of World Cultural and Natural Heritage (World Heritage Convention) (1972)

The Preamble to the Convention declares that the deterioration or disappearance of cultural or natural heritage constitutes a harmful impoverishment of the heritage of all nations, and recognizes the duty of the international community to cooperate for the protection of cultural and natural heritage. This Convention, like the Ramsar Convention, functions on the basis of the listing of World Heritage Sites.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)

CITES states that wild fauna and flora must be protected for future generations, and that people and states are the best protectors of their own wild fauna and flora, noting that international cooperation is essential for protection from overexploitation through international trade. The Convention categorizes wildlife species by their degree of vulnerability. The most endangered species are placed in Appendix 1 and trade in these species is completely prohibited (with declared exceptions). Appendix 2 permits some degree of trade with prior permission if it is not detrimental to the survival of the species. Appendix 3 pertains to those species for which countries voluntarily regulate trade. CITES does not prescribe any specific sanctions for violation; each country needs to execute its own national legislation to implement the necessary provisions and penalties.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (1979)

The Bonn Convention provides a framework within which states can cooperate in undertaking scientific research, restoring habitats, and removing impediments to the migration of species listed in the Convention's Appendix I (endangered migratory species). It also provides for the conclusion of formal agreements among range states of the migratory species listed in the Convention's Appendix II as having an unfavourable conservation status. Mandatory obligations are required for the protection of Appendix I species, whereas only agreements are required for the protection of those in Appendix II.

Declaration on Environment and Development (1992)

This important international document provided the basis for the Action Plan 'Agenda 21', which is particularly relevant for the protection of mountain ecosystems, as outlined in Chapter 13 which emphasizes the need for protection of mountain areas. The importance of mountains was reiterated in the Plan of Implementation of the World Summit on Sustainable Development (WSSD) in 2002.

Convention on Biological Diversity (CBD) (2004)

International recognition was given to the concept of transboundary landscape management as an ecosystem management approach to conservation at the Seventh Conference of the Parties (COP 7) to the Convention on Biological Diversity (CBD) in 2004. The significance of regional cooperation among signatory countries to the Convention was emphasized. CBD COP 7 also adopted a Programme of Work on Mountain Biodiversity for mountain-specific activities, and acknowledged the need for regional cooperation and an ecosystem management approach for biodiversity conservation. Transboundary conservation through enhanced regional cooperation and by facilitating the integration of a network of regional protected areas is an emerging approach rooted in

the CBD (Zomer and Oli 2011). Article 8 (j) of the CBD recognizes the need to respect, preserve, and maintain the knowledge, innovations, and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity, and promotes their wider application with the approval and involvement of the holders of such knowledge, innovations, and practices and encourages the equitable sharing of benefits arising from their utilization. China and Pakistan have both ratified the CBD.

Convention on Wetlands (RAMSAR Convention)

The Ramsar Convention is the only global environmental treaty that deals with a particular ecosystem. The convention mission is "conservation and wise use of all wetlands through local and national actions and international cooperation as a contribution towards achieving sustainable development throughout the world".

United Nations Framework Convention on Climate Change (UNFCCC)

This convention provides a framework for adopting measures towards reduction of greenhouse gasses (GHGs) to a level that would prevent dangerous anthropogenic (human induced) interference with the climate system. It is based on the principle of common but differentiated responsibilities and precautionary action, wherein adverse effects of climate change are addressed as a common concern of mankind.

National Policies and Governance Structure

International laws only become legally binding when they are incorporated into national law by amending existing or enacting new legislation, otherwise they cannot be enforced unless they are accompanied by their own enforcement mechanisms (as is the case with the World Trade Organization). Some conventions explicitly enjoin member states to take legal implementation measures by amending their existing laws or by legislating to incorporate provisions for the agreements. Both the governments who share the KPL have national legislation and policies supporting conservation and development, a number of which aim at fulfilling the obligations under the international agreements. The major policies and legislation are summarized in the following.

Pakistan: National policies and governance structure relevant to KPL

Pakistan has a comprehensive framework of guiding principles, policies, and laws that govern the conservation of its bio-cultural heritage. As a federal country, the law and policy making power is divided between the central authority (Parliament) and the states (State Legislature).

The National Forest Policy was first issued in 1894, and revised for Pakistan in 1955, 1962, 1975, 1988, and 1991. The most recent National Forest Policy was drafted in 2001 (GoP 2001) and covers the renewable natural resources (RNR) – forests, watersheds, rangelands, wildlife, biodiversity, and their habitats. It seeks to launch a process for eliminating the fundamental causes of the depletion of renewable natural resources through the active participation of all the concerned agencies and stakeholders, and to realize sustainable development of the resources. It is designed as an umbrella policy providing guidelines to the federal government, and provincial governments and territories, for the management of their renewable natural resources. The National Policy on Forestry and Wildlife was formulated in 1980 as a part of the 1980 National Agricultural Policy. After stressing the inadequacy of forest area, shortage of fuelwood and timber, and the deplorable condition of watersheds and rangelands, it provided a list of general statements on future forestry; and suggested the creation of national parks, departmental forest harvesting on scientific lines, and production of medicinal herbs on wilderness land (FSMP 2003)

In 2005 the government issued the National Environmental Policy, which provides an overarching framework for addressing the issues related to the overall environment including deforestation, loss of biodiversity, desertification, natural disasters, and climate change. In 2012 the National Climate Change Policy was proposed in order to adapt

and mitigate the climate change that Pakistan faces or will face in future. It covers policy measures to address issues in various sectors such as water, agriculture, forestry, coastal areas, biodiversity, and other vulnerable ecosystems.

The Federally Administered Northern Areas (FANA) were renamed 'Gilgit-Baltistan Province (GBP)' by the government in 2009. The area of the KPL is currently administered under the Gilgit Baltistan Empowerment and Self Governance Order issued by the Government of Pakistan. The Gilgit Baltistan Legislative Assembly (GBLA) has 24 directly elected members, and there is a 15 member Gilgit Baltistan Council headed by the Prime Minister of Pakistan. The council exercises virtual power in important spheres of governance; the Chief Minister is a member of the Assembly. The GBLA may pass laws on certain defined subjects, but the Chief Minister's assent to the bill is required after being passed by the Assembly. The Government of Pakistan may also pass laws with respect to matters outside the purview of the council.

The constitution makes forestry a provincial mandate and the provinces can make and implement their own forest policies within the framework of the national forest policy. The new forest policy of Gilgit-Baltistan (which contains more than 40% of the country's remaining forests) was announced in 2001. In 2002 the **Provincial Forest Ordinance** defined the institutional details for forestry in the province, following the guidelines given by the **Draft National Forest Policy 2001**.

For a remote area such as Gilgit-Baltistan, participation in national decision making is still insufficient, while the capacity of the state apparatus is still weak. The governance approaches being used in practice to manage the natural resources and biodiversity conservation in Gilgit-Baltistan, and especially the pilot area of the KPL, can be divided into three main types: a) government management, b) collaborative management, and c) community conservation management (see Box 8).

Box 8: **Types of natural resource governance in Gilgit-Baltistan**

Government management is the norm in Pakistan and the vast majority of protected areas are managed simply through enforcement of the Wildlife Law. Protected areas are managed both by government and as community conservation areas (CCAs).

Collaborative management involves local communities in management through active consultation, consensus, negotiating, sharing responsibility, and transferring management responsibility to communities or NGOs, and was initiated under the Global Environment Facility (GEF) Protected Areas Management Project (PAMP) project.

Management under community conservation areas (CCAs) is a new approach adopted recently by local communities. The main driving force behind this approach is that a large number of communities are engaged in conserving specific areas in the mountains for sport and trophy hunting programmes.

China: National policies and governance structure relevant to KPL

Faced with problems of high consumption, heavy pollution, and restriction of resources during the period of intensive development of the economy, China began to shift its economic growth model into a more sustainable development form. During the 1980s, the Chinese Government made environmental protection one of its basic national policies. Following the UN Conference on Environment and Development in Rio de Janeiro in 1992, China became one of the leading countries in the world in formulating and implementing a sustainable development strategy. Up to 2007, nine laws on environmental protection and 15 laws on natural resource protection were enacted by the central government; more than 100 regulations were implemented by the State Council, and more than 1,000 local environmental protection rules were formulated by the local legislative institutions. Anyone violating laws on natural and environmental protection has to take administrative or criminal liability. The major laws and regulations governing natural resources and environment management in China are as follows:

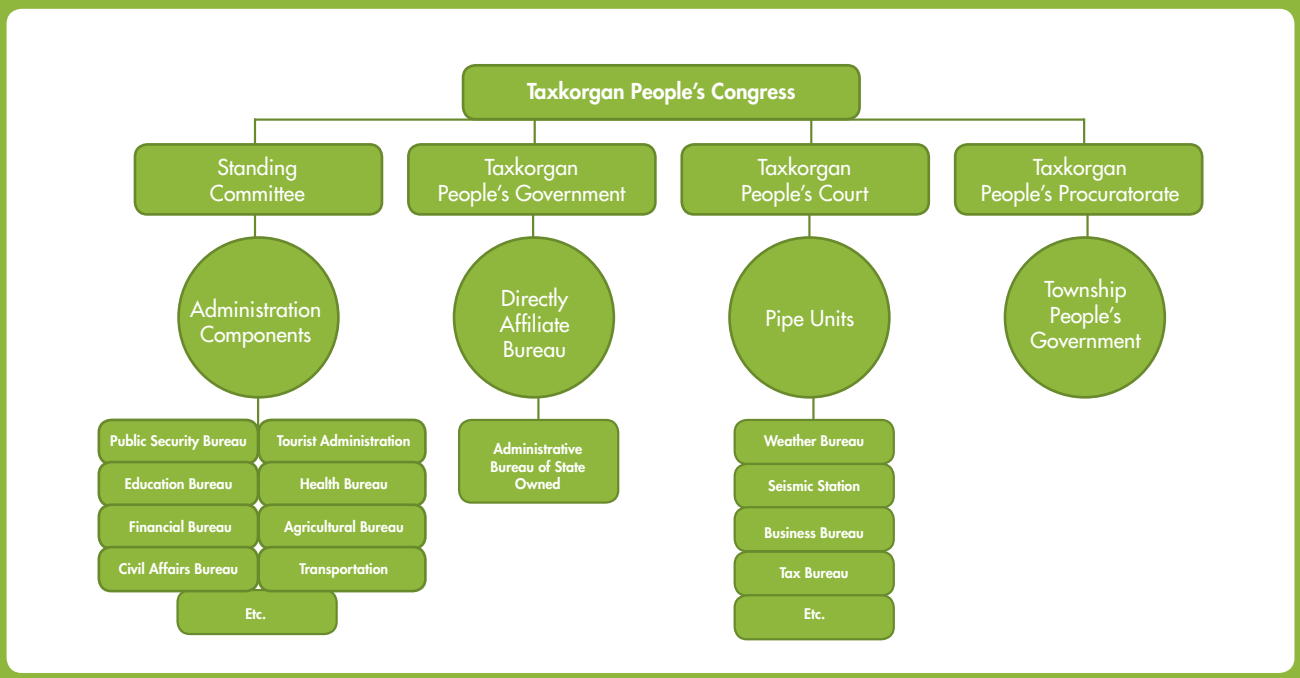
- Law on Heritage Conservation (1982)
- Forestry Law (1984; 2009)
- Grassland Law (1985; 2002)

- Mineral Resources Law (1986)
- Land Administration Law (1986)
- Regulations on the Protection and Administration of Wild Medicinal Herb Resources (1987)
- Environmental Protection Law (1989; 2014)
- Wildlife Protection Law (1989; 2004;2009)
- Implementation Regulations of the Forestry Law (2000)
- Law on the Prevention and Control of Atmospheric Pollution (2000)
- Water Law (2002)
- Law on Environmental Impact Assessment (2002)
- Law on Clean Production Promotion (2002)
- Law on Prevention and Control of Solid Waste Pollution (2004; 2013)
- Regulations on the Administration of Scenic and Historic Sites (2006)
- Law on Energy Saving (2007)
- Law on the Prevention and Control of Water Pollution (2008)
- Law on Soil and Water Conservation (2010)

The first National People's Congress of China, convened in 1954, included a system of regional autonomy for ethnic minorities in the Constitution. The Law on Regional Ethnic Autonomy, which was amended and issued in 2001, explicitly stipulates that "the system of regional autonomy for ethnic minorities is a basic political system of the State". The Taxkorgan Tajik Autonomous County was established on 17 September 1954 as the only autonomous county of Tajik people in China. The main organs of the county are the People's Congress, the supreme organ and responsible for legislation, and the People's Government, the administrative organization (Figure 15). According to the Law on Regional Ethnic Autonomy, the governor of the county is elected by the People's Congress and should be a Tajik citizen. Taxkorgan is a part of Xinjiang Uygur Autonomous Region (XUAR), and is subordinate to the XUAR, and within that to Kashgar City.

In view of the degradation of the rangelands in Taxkorgan, herders in the county have received subsidies for rangeland protection from the central government since 2011. This financial support, as with payments of compensation for ecological services (PES), is used by herders for ecological restoration, forage cultivation, and fencing degraded pastures, under the guidance of local government agencies such as the Department of Animal Husbandry of Taxkorgan.

Figure 15: **Governance structure in Taxkorgan County**



Traditional Institutions and Customary Laws

Historically, traditional institutions and customary laws governed the natural resources in the KPL region. However, governments on both sides of the border adopted policies and passed legislation to change part of the ownership of forests and other natural resources from communal property to state property (e.g., protected areas).
Since independence, the Pakistan state has tried to change the communal and private ownership of natural resources such as forests, rangeland, and wildlife to state ownership, but without much success. In principle, the existing state policies and legislation do not recognize communal or private ownership, but the communities and private owners contest the state's claim to their property. Opposition to forest management by the Forest Department is expressed by violating forest laws. The local population, particularly in forests where there are customary usufruct rights, never accepted the state's control of the forest and rangeland resources. The state has not been able to settle these rights issues with the owners. De facto communal and private ownership of the natural resources persists in many areas, including the province of Gilgit-Baltistan. Traditional institutions and customary laws continue to govern these communally and privately owned forests and other natural resources.

In China, patriarchal-feudal relations predominated among the Tajik people in Taxkorgan during the nineteenth and early twentieth centuries, up until the establishment of the People's Republic of China. These were characteristically in the form of kinship and village-based communal groups. Communal relations coexist with patrilineal relations even now. Agriculture and animal husbandry in the high mountains of this unique region would be impossible without the traditional forms of collective communal mutual aid. Communal law existed among the independent feudal polities and still applies today to some activities, such as haymaking and grazing livestock on pastures.

Policy Constraints and Conflicts

In Pakistan, there are policy constraints and conflicts between the state and local populations, and between the big landlords and small farmers. Tenure disputes persist because of the policy of the state to bring communally and privately owned natural resources under state ownership. The government claims that legal title of all natural resources lies with the government, which the locals contest. This tenure dispute triggers excessive felling of trees. The Department of Forest is not able to implement forestry programmes as per the policy as the local people do not allow trees to be planted where mature trees have been felled. The tenure conflict also manifests in the use of wildlife and rangelands. Local people continue to flout the wildlife legislation and exercise their customary rights. Uncontrolled ubiquitous grazing hinders natural regeneration, and the fencing that is erected cannot be effectively maintained against people's will. Forestry legislation prohibits the clearing of forests for agriculture, but it is not possible to enforce this prohibition and most forest openings that can sustain agriculture are cropped (Khattak 1994).

The National Policy on Forestry and Wildlife of Pakistan (1980) lacked rationale for the policy objectives, was inadequate in suggesting strategies to achieve the objectives, and lacked proper incentives. It was argued that forest resources continued to deteriorate under increasing population pressure and insufficient reforestation efforts, despite the policy. The Forest Policy of Pakistan (1991) retained the state ownership of forests and envisaged creating public forests under the provincial Forest Department. The policy gave vast discretionary powers to the officials of the Forest Department in determining what they deemed 'reasonable forest requirement'. This policy was perceived as reflecting the colonial form of governance and intended to increase the government's income, deprive people of their rights to natural resources, and suppress people's aspirations through centralization of bureaucratic powers (SAFI 2000). The draft National Forest Policy of Pakistan (2001), proposed an umbrella policy, and stipulated that the provincial governments create effectively managed protected area networks in areas under their control, seeking the necessary financial and technical assistance from the federal government. The policy prescribes collaborative management of protected areas with the local communities. However, more than ten years later it is still a draft.
The Provincial Forest Policy (2001) of Gilgit-Baltistan (formerly Northwest Frontier Province) is criticized as too much donor-influenced. It cannot be implemented as there would not be a real change in the attitude of forestry professionals towards local people (Steimann 2003).

Pakistan's Northwest Frontier Province Forest Ordinance (2002) defines the institutional details for forestry in the province, in keeping with the spirit of the draft National Forest Policy (2001). However, the policy empowers the territorial staff of the forest department to carry weapons for self-defence while on duty, which contradicts the philosophy of collaborative management enshrined in the draft National Forest Policy (2001). Several civil society organizations unanimously rejected the ordinance and held public protests against it. The Northwest Frontier Province Forest Ordinance and several other existing laws are punitive in nature. They prescribe only penalties, not incentives as recommended in the National Conservation Strategy and the Forestry Sector Master Plan.

Until recently, most forest policies have viewed people as the prime threat to the forests, and have attempted to exclude groups other than the government from decision making (Ahmed and Mehmood 1998). This approach has not only affected the sustainability of the livelihood strategies of the local people, but has also increased the vulnerability of the marginalized sections of the communities. Suleri (2002) said, "The Forest Ordinance of NWFP contradicts the spirit of different policy measures. It is punitive in nature and tends to increase the policing role of forest departments". Not only are forest department staff given police powers, the forest officers are given discretionary powers to revoke community-based organizations (CBO) and joint forest management committees (JFMCs), which would result in uncertainty and insecurity among the JFMCs and CBOs.

In China, Taxkorgan is a remote and poorly accessible border area, which may limit external investment. In addition, the government border management regulations make development of industry, commerce, and tourism in this area more difficult than in other parts of China. The 'Western development' strategy encouraged by governments has led to accelerated exploitation of the natural resources. But the better opportunities for economic development (e.g., mining) sometimes challenge environmental protection, even though environmental laws place strict controls on unsustainable exploitation. Individualization of previously common pastures, fencing of grazing lands, and development of settlements in pastoral areas have faced herders with new issues, especially adapting to a more sedentary situation. The traditional tenure has been changed, but new policies and legislation on land use and ownership patterns are still insufficient.

Reconciling the Policy Environment

In Pakistan, the 18th Amendment of the Constitution in 2011 mandated the provinces to formulate their own provincial policies and legislation. In keeping with this, the province of Gilgit-Baltistan has to formulate provincial policies, enact legislation, and frame regulations for the governance of natural resources, conservation, environmental protection, and socioeconomic development. In China, the new policy on returning grazing land to grasslands provides a chance for herders to receive compensation from the government for ecological restoration of degraded rangelands, but local regulations at the provincial level on how to allocate benefits among pastoral households still need to be improved. In both countries, policies aiming at poverty reduction, economic development, and resource exploitation need to be harmonized with those aiming at biodiversity conservation and ecological restoration. An integrated plan with a participatory approach should be considered by decision makers together with experts such as conservationists and economists, otherwise, the natural wildlife habitats will be fragmented by infrastructure, fenced pastures, and large scale mining sites.

Institutional innovations are required to resolve issues of ownership of natural resources (forest, wildlife, pasture/rangelands) between governments and local communities, as well as to resolve issues of access and control among the local communities. In many cases, no operational regulations have been prescribed under the existing laws and penalties are of a punitive nature. The existing policies and legislation are based on a 'command and control' principle and do not recognize community-based management of natural resources. As of now, there is no mechanism for stakeholders to collaborate in the management of the social, ecological, and economic issues in the landscape. Cross-scale community-based institutions involving stakeholders at various scales need to be created to govern landscape level conservation and development. In the process of institutional innovation, the local governments should give due consideration to the value of community-based management. Empirical evidence

from elsewhere suggests that the communities who depend on the natural resources for their livelihoods make better stewards of these resources than those who do not have a direct stake in them. As of now, local communities will continue to resist being subordinated to a mass of national policies and legislation for governance of natural resources which they construe as top down and not responsive to their aspirations and needs.

Enhancing Regional Cooperation

There is an urgent need for transboundary cooperation in the conservation of biological diversity, and there are several articles in the CBD that give impetus to regional cooperation. Article 5 affirms the need to cooperate with other contracting parties in relation to areas beyond national jurisdiction and Article 14(1c) alludes to the promotion of regional cooperation in the context of minimizing adverse environmental impacts. Both these articles are supplemented by several other COP decisions such as V/6, VI/12, and VII/11, which support the international framework for increasing regional cooperation. The existing examples for regional cooperation frameworks include the Andean Pact (which came into force in July 1996); the African Model Law (which came into force in 2003); the Central American Agreement (which came into force in 2012); and the Draft Association of Southeast Asian Nations (ASEAN) Framework.

In 2007, Dr George Beals Schaller suggested creating an international peace park in the Pamir at the meeting point of the four corners of Pakistan, Afghanistan, China, and Tajikistan, with the purpose of wildlife protection (National Geographic 2007). The regional cooperation between China and Pakistan can serve as a good model for transboundary cooperation as these two countries have a traditionally good relationship. Such cooperation can create an enabling environment for regional strategic planning as well as for national legislative, policy, institutional, technical, and economic incentives for the sustainable management of the KPL mountain ecosystems.
The transboundary conservation initiative between China and Pakistan for the KPL started in 1993 based on the non-political principle of no interference in the geopolitical and administrative set up of the collaborating countries. An improved local environment for enhanced livelihood options and opportunities was envisioned with the long-term objective of maintaining the sanctity of the existing protected areas on either side of the China-Pakistan border, and creating an international protected area by establishing connectivity corridors from the Karakoram mountains in Gilgit-Baltistan Province in Pakistan, to the Pamir and Kunlun mountains in China.

Research indicates that many of the keystone animal species, especially Marco Polo sheep and snow leopard, move through the contiguous habitats across the borders, and that safeguarding the contiguity of this habitat is essential for their survival. The countries have realized that such a level of protection of the ecosystem will only be possible through joint efforts and action. Since 2011, the transboundary conservation initiative between China and Pakistan has begun to take effect, and has moved forward in a promising manner to the present stage of collaboration in which the two countries are openly discussing the opportunities and a joint plan of action for developing a regional initiative for the KPL region. There is awareness among the stakeholders and willingness on the part of the provincial governments of XUAR in China and Gilgit-Baltistan in Pakistan towards joint responsibility for safeguarding the connectivity of the natural landscape and richness of biodiversity in the KPL region. The strategic framework of the China-Pakistan Economic Belt proposed by the prime ministers of both China and Pakistan also means that a more integrated conservation and development plan with long-term foresight will be required for the coming great-leap forward of economic development in the region.

10. The Way Forward

In order to conserve and sustainably manage the unique and special landscape of the KPL using a transboundary approach, it is necessary first to identify key issues and knowledge gaps, and then to formulate the priority actions for biodiversity and environmental conservation, ecosystem management, and sustainable livelihood options. Some recommendations for future actions for conservation strategies and development plans are outlined in the following.

Environment and Biodiversity

Enhancing the environmental knowledge and biodiversity base

There is a dearth of basic information and scientific data in the KPL region on the environmental conditions, biodiversity situation (especially endangered and rare species), and other information required for scientific conservation of biodiversity and sustainable management of ecosystems. Environmental data is only available from a few scattered sites mostly located outside the protected areas, and at present there is no spatially representative or systematic data collection system on either side of the border. There is an urgent need to develop a reliable information base for this transboundary region on all aspects related to the conservation and management of natural resources. In order to achieve this, a long-term environmental monitoring system should be established as a necessary first step. Within the KPL, the high-altitude deserts, rangelands, and wetlands, and their interfaces (e.g., the timberline) have been identified as priority and critical ecosystems for medium-term research. This requires carrying out a detailed resource inventory (including species diversity, community structure, ecological processes, biomass dynamics, and carbon storage) to establish a baseline information system to support management decisions.

Improving biodiversity conservation and management

Species-specific conservation plans are important conservation tools that must be implemented on a high priority basis for the threatened and endangered species in the KPL region. The conservation initiative prefers to visualize the overall conservation of the high-altitude ecosystem at a landscape level, but it should be remembered that one of the most charismatic mega-fauna, and a major flagship species for the conservation of alpine ecosystems in this landscape, is the endangered Marco Polo sheep. Transboundary cooperation is required in the KPL area from the regional partners to conserve these animals as they migrate across the border. Similar cooperation is required on the conservation of habitats such as rangelands and wetlands for the protection of migratory birds and other important species. Threatened plant species require both in-situ efforts to conserve existing populations, and special ex-situ backup for the multiplication and subsequent reintroduction of some of these into their natural habitats. Although many animal species will continue to decline in abundance and distribution in the wild, the restoration and maintenance of selected species is possible. For example, the Kiang population has been maintained and restored in the Chinese Pamir over the last two decades. Priority actions to conserve native flora and fauna include the control of alien invasive species, restoration of degraded habitats (especially degraded pastures), stabilization of landslide prone areas and eroded slopes (especially on both sides of the newly expanded KKH), and ecological restoration of mining sites.

Enhancing resilience and sustainability of the rangeland ecosystem

Rangeland has the greatest coverage in the landscape and is the most important ecosystem. This ecosystem has been used by local people for centuries and provides them with environmental security, thus degradation is a great cause for concern. Increasing the resilience of rangelands to different kinds of perturbations (human and natural) and enhancing ecosystem-based adaptation are major priorities for local communities, governments, and development agencies. Planning and effective programme implementation for rangeland management and

restoration incorporating effective soil and water management practices are essential for enhancing resilience and sustainability. Studies on the carrying capacity of pastures related to grazing of both wild and domestic animals, sustainable harvesting strategies from the pastoral system, and economic valuation of rangeland ecosystem services, would help in the design of policies and strategies to reduce the ever mounting pressures on the ecosystem and improve the quality of life and livelihoods for local people. Encouraging landscape-level rangeland restoration can contribute to maintaining ecosystem services, reducing fragmentation of natural habitats, mitigating natural disasters, and adapting to climate change in a cost-effective manner. Meanwhile, greater understanding should be developed of the traditional transhumance system using an interdisciplinary field investigation approach. Traditional knowledge and practices such as mixed livestock grazing and seasonal migration to minimize losses from disease and natural disasters should be integrated into adaptation plans and used in harmonizing wildlife-livestock conflict.

Harmonizing human-wildlife conflict

Notification and establishment of protected areas (PAs) under the modern management system often restricts the traditional rights and use of natural resources by local communities, leading to human-wildlife conflict. This is a global trend over the last few decades, which has its roots in the Yellowstone model of protected area management. The government-managed protected area sites are selected for their high existence value and often without consultation with the communities who have lived there for hundreds or even thousands of years. Wildlife and resource tenure are invested legally in the state, resulting in the deterioration of customary – often communal – tenure systems and even expulsion of custodian communities from their ancestral areas. Access to the traditional subsistence resources is impossible without breaking the law. Communities bear the cost of natural resource management and receive few tangible benefits. It is important to bring communities and government agencies together under an umbrella of co-management to look after the protected areas in the landscape and ensure that management is effective. A benefit-sharing mechanism should be developed to jointly address the issues of both wildlife conservation and local people's livelihoods in an integrated conservation strategy, so that the sustainable conservation and management goals can be achieved.

Addressing climate change impacts and adaptation

The impacts of climate change on biodiversity and the environment in the KPL region have not been well documented. The landscape hosts a diversity of ecosystems and presents a significant opportunity for transect-level monitoring of climate change impacts. Early indications show that higher elevations are more sensitive to global warming and changes in precipitation patterns. The trends and the broad array of impacts that climate change can have on biodiversity and livelihoods of mountain communities should be detected. There is a growing recognition of the role that healthy ecosystems can play in increasing resilience and helping people to adapt to climate change through the delivery of a range of services that play a significant role in maintaining human wellbeing. Approaches that take into account the services that biodiversity and ecosystems provide as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change are known as ecosystem-based adaptation. Thus, understanding the impacts of climate change on the resilience of both the ecosystems and human society is a priority for the mid-term programme plan of the KPL.

Sustainable Livelihoods

Communities in the KPL region are economically poor in terms of income and GDP growth. A mix of strategies needs to be implemented for poverty alleviation. Promoting income generating schemes, enhancing social and physical infrastructure, and developing income generating skills among local residents are potential options for the region. Tourism presents one of the highest potentials for income generation. Sustainable community-based tourism, with a focus on adventure and cultural tourism, is proposed so that the community at large can benefit economically. Other potential income-generating schemes include the processing of animal products; off-season vegetable production in situ and in greenhouses; fruit cultivation; beekeeping; and employment opportunities in development programmes such as road construction and mining. Opportunities provided by the rich heritage of

traditional pastoral systems, traditional skills in local craft making, and the diversity of ethnic culture need to be harnessed for optimal benefits. The possibilities for geographical markers (or certificates of origin), premier organic products, value addition to products, and breeding, cultivation, and marketing strategies need to be worked out for the overall development of the landscape. Identification and development of markets should be an important component of income-generating schemes.

Poverty alleviation and alternative livelihoods

A food and energy crisis is threatening the sustainable development of both people and the environment. The increasing population, small landholdings, and scattered farms are some of the major problems. Lack of access to micro-credit, no private sector investment, and weak political status also lead to poverty and injustice in the area. Harsh climatic conditions and lack of infrastructure hinder many major economic activities. Low levels of access to and rights over natural resources and depredation of livestock by carnivores remain major concerns between park authorities and local communities. Technological interventions for providing alternative livelihoods and income opportunities would help to keep young people from emigrating. And additional livelihood options, value addition to products/services, and economic development of local communities would reduce the dependence on natural resources and help strengthen wildlife conservation.

Local products in the KPL region with a potential to help alleviate poverty and provide alternative livelihood options include various indigenous grain crops and animal products, fruit and other cash crops, and medicinal plants. These should first be identified in detail and the dependence of local communities on these resources for food security analysed. Understanding the socioeconomic situation of rural households, changing the trends and their drivers, and developing the traditional options on which local people depend can support efficient and better enhancement of livelihoods and diversification as an adaptation strategy. Local people should be empowered and their capacity for adaptation strengthened using off-farm income generation options and value addition to agro-pastoral products to support sustainable development of mountain society. These require both education and institutional development.

Traditional knowledge and heritage

The KPL region is rich in traditional knowledge of natural resource use and conservation. The outmigration of the younger generation to urban areas, as well as globalization, is resulting in the loss of such knowledge. It is essential that this traditional knowledge and heritage be conserved in the landscape. Moreover, appropriate policies are needed to ensure that intellectual property rights (IPR) are respected; access to genetic resources and benefit sharing is an important priority among communities in the landscape. The traditional agro-pastoral system, which is by default largely organic, is currently facing multiple problems. These traditional systems need to be strengthened and enhanced to provide continuing opportunities for gene pool conservation, and for harnessing the proven adaptive capacity and risk reduction strategies of traditional agriculture and pastoralism. It is very important to explore incentives for farmers and pastoralists to cultivate landraces of crops and to breed pure landraces of livestock.

Sustainable tourism

Tourism is potentially a significant tool for alleviating poverty in the landscape. Transboundary cooperation for sustainable tourism in the KPL region was identified as a priority issue by both countries. Tourism, particularly nature and adventure tourism, will have a great potential in the near future after reconstruction of the Karakoram Highway and development of the China-Pakistan Economic Belt. Cultural heritage such as the ancient Silk Road is also very attractive for tourists from around the world. Promoting and showcasing the unique cultural heritage of the landscape and its rural life, if appropriately implemented, can contribute to cultural preservation and the maintenance of this heritage. Once this is ensured, and transboundary cooperation is developed to encourage and facilitate community-based ecotourism, it is expected that there will be large opportunities for fusing transboundary tourism with transboundary cooperation for conservation. Historical transboundary and cultural routes throughout the region provide potential tourist routes, which can be developed and can be of great value as ecotourism destinations. Some of the present day priority issues related to tourism include tourism infrastructure,

waste management, sanitation and hygiene, and capacity building. In order to achieve progress for tourism in a sustainable way, there is a need to work out plans and programmes in such a way as to increase the benefits flowing to local communities and the private sector. This would require strengthening local capacities and skills to realize and exploit the opportunities offered by the landscape.

Cross-Cutting Issues

Awareness raising

It is necessary to raise awareness on biodiversity and livelihood issues from the community to the policy level. Awareness raising is fundamental to the development of the institutional and community-based networks required to implement transboundary ecosystem management. For raising awareness, the planned programmes should promote a participatory process, which is crucial for achieving the high level of stakeholder buy-in required to successfully implement the various activities of a conservation and development strategy in the KPL region. It is particularly important to disseminate information both within the local areas and among the concerned authorities and stakeholders. Building trust among communities and different levels of government institutions is an essential first step and an absolute prerequisite before proceeding to implementation. Likewise, information dissemination and international outreach can both promote regional cooperation for transboundary conservation and development, and support it by providing an international focus for various efforts within the region, including conservation, research and scientific inputs, stimulating an interest in the preservation of cultural heritage, and the development of ecotourism.

Capacity building

Capacity building of individuals, communities, local authorities, and government line agencies in the KPL region has been identified as a cross-cutting priority across a variety of sectors. Broad areas for capacity building include biodiversity use and management, income generation, community-based tourism, and ecosystem-based adaptation. The capacity of community user groups and local institutions for the conservation of cultural heritage at the local level should be increased. It is important to develop a culture that promotes continuous training and capacity building, experience sharing, and the effective use of modern tools and techniques for the increased participation of skilled local manpower in conservation, sustainable development, and vulnerability reduction.

Policies

Coordination is vital among government line agencies, non-governmental organizations, and communities, both within the KPL region and between the two neighbouring countries, in order to achieve landscape level conservation and ecosystem management. Policies that promote conservation and sustainable livelihoods, ranging from the site-level to the transboundary landscape, are necessary. These include, but are not limited to, the establishment of co-management mechanisms for the two protected areas, the designation of important biodiversity areas and corridors, and the promotion and facilitation of legal transboundary tourism and trade.

Integrated planning

Planning that integrates conservation and sustainable livelihoods is essential for the integrity of the landscape. Holistic approaches that include the integration of ecosystem management into local, national, and regional planning and implementation for sustainable development and environmental conservation are essential to conserve the unique biological and cultural diversity of this region.

Conclusion

Many of the issues identified during the process of this study were found to be common across the whole KPL region. Ecosystem management was identified as essential both for the conservation of biodiversity and for the sustainable use of resources. The home ranges of many wildlife species, such as Marco Polo sheep and migratory birds, extend across the political boundaries and require transboundary cooperation within the landscape. Issues of habitat loss and protection, as well as issues of illegal hunting, wildlife trade, and trade in endangered medicinal plants can only be addressed regionally through transboundary cooperation. In addition, there is a host of other issues including the improved monitoring of biodiversity and the environment, water management and disaster risk reduction, rural development, food security, preservation of the cultural heritage and rural social fabric, and climate change adaptation that may also benefit from transboundary cooperation. Both transboundary tourism and transboundary trade offer alternative livelihood options that can potentially contribute in a significant way to the prosperity of the region while reducing the pressure on natural resources. Ongoing and planned development, and particularly infrastructure development such as the expansion of the Karakorum Highway, and socioeconomic strategies such as the China-Pakistan Economic Belt and Silk Road Economic Belt within or through the region, will require the proper management of transboundary implications if they are not to exacerbate transboundary issues such as environmental degradation and biodiversity decline. Therefore, transboundary cooperation among stakeholders from both sides of the border is now more necessary and critical than ever before to deal collaboratively with the common issues that they are facing.

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Annex: **Timeline of Events in the Development of the KPL Initiative**

Date	Event
June 1989	Possibilities for transboundary collaboration discussed by China and Pakistan
1993	Understanding of the need for cross-border collaboration developed between Xinjiang Institute of Ecology and Geography (XIEG), Chinese Academy of Sciences (CAS) and WWF-Pakistan during a workshop on medicinal and aromatic plants held in Islamabad
December 1995	Agreement to set up an international nature park for the protection of Marco Polo sheep and other endangered species signed in Beijing at the 10th session of the Joint Committee on Economic, Trade, Scientific and Technical Co-operation
December 1996	WWF-Pakistan and XIEG meet to discuss on potential to address conservation and development challenges.
1996	Khunjerab National Park management plan approved
December 2003	First formal discussions held between WWF-Pakistan and a Chinese delegation from XIEG
June 2005	Efforts for the improved management of the Joint Conservation Area along the Sino-Pak Border and in the adjoining protected areas started with signing of an MoU between WWF-Pakistan and XIEG on undertaking a joint field expedition to obtain baseline data, identify common areas for conservation interventions, and work out a joint proposal for establishment of the conservation area
August 2006	UNDP-Pakistan and Xinjiang Wildlife Conservation Association (XWCS), China join hands to develop an action plan to support research and exchange of scientific information
September 2006	Endorsement of the action plan by the Board of Directors of WWF-Pakistan and the Chief Secretary, Northern Areas (now Gilgit-Baltistan [GB])
October 2006	Babar Ali Foundation and UNDP-Pakistan allocate money for implementation of the action plan
January 2007	Endorsement of the action plan by the senior management of the Chinese Academy of Sciences (CAS) in Beijing
April 2007	Meeting between Chinese delegation and senior management of GB to discuss possible approaches and mechanism for transboundary conservation and sustainable development initiative to be adopted jointly
March 2008	Review meeting in Urumqi to formalize collaboration for a transboundary initiative for the Karakoram-Pamir Landscape
June 2009	Kashghar Resolution passed – mentions setting up of a 'steering committee' with relevant individuals/institutions for maintaining contacts and taking forward the conservation and sustainable development agenda, as well as promoting tourism and supervising progress related to the creation and management of a Sino-Pak Conservation and Development Area
September 2010	MoU signed between Xinjiang Uygur Autonomous Regional Forestry Department (XUARFD) and Gilgit-Baltistan Forest, Wildlife Parks and Environment Department (GBFWPED) for the conservation of wildlife species in the Pakistan-China border area by generating and sharing knowledge about wildlife species and their habitats and developing a joint management plan addressing the issues of wildlife species and their habitats, together with suggested measures for minimizing negative anthropogenic influence on the environment and helping socioeconomic development of the local communities
February 2011	ICIMOD commissioned to develop a process document that could facilitate the development of a regional landscape conservation and climate change adaptation initiative in the KPL

December 2011	Regional consultation organized and facilitated by ICIMOD in Kathmandu, Nepal, to jointly develop a draft strategic framework for promoting transboundary collaboration between China and Pakistan in the Karakoram-Pamir Landscape
August 2012	Project on 'Strengthening Transboundary Cooperation between China and Pakistan in the Karakoram-Pamir Landscape: Feasibility Assessment in Pakistan' initiated with the support of the One UN Joint Environment Programme (JPE)
September 2012	Feasibility assessment in China initiated with the support of ICIMOD
24 January 2013	Inception Workshop for the Karakoram-Pamir Landscape Initiative between Pakistan and China held in Islamabad, Pakistan
24 April 2013	National Workshop on Cooperation for Conservation and Sustainable Development in the Karakoram-Pamir Landscape between China and Pakistan held in Gilgit, Pakistan
20 May 2013	National workshop and exposure visit on Cooperation for Conservation and Sustainable Development in the Karakoram-Pamir Landscape between China and Pakistan held in Urumqi, China
June 2013	Management Plan for Khunjerab National Park revised
July 2013	Pre-feasibility Assessment Report on the Karakoram-Pamir Landscape Initiative completed
December 2013	Planning workshop for the Conservation and Development Strategy in the Karakoram-Pamir Landscape held in Kathmandu, Nepal
December 2013	Workshop on Value Chain Review and Investment Potential in the Karakoram Pamir Landscape and Gilgit Baltistan Chitral regions, held in Islamabad, Pakistan
August 2014	Meeting on the Karakoram-Pamir Landscape Conservation and Development Strategy held in Lanzhou, China

About ICIMOD

The International Centre for Integrated Mountain Development, ICIMOD, is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalization and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

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International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal
Tel +977-1-5003222 Fax +977-1-5003299
Email info@icimod.org Web www.icimod.org

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