Kang Rinpoche གངས་རིན་པོ་ཆེ - Gāngrénbōqí Fēng 冈仁波齐峰 - Kailāśā Parvata कैलाश पर्वत

KAILASH SACRED LANDSCAPE CONSERVATION INITIATIVE

DRAFT

KSL REGIONAL

COMPREHENSIVE ENVIRONMENTAL MONITORING STRATEGIC PLAN (KSL-CEMP)

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Executive Summary

Acknowledgments and Contributions

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Introduction

Background

The Kailash Sacred Landscape Conservation Initiative (KSLCI) aims to promote transboundary biodiversity and cultural conservation, ecosystem management, sustainable development, and climate change adaptation within the Kailash Sacred Landscape (KSL). The KSL complex covers an area of 31,175 sq. km, of which about 10,843 sq. km (34.7% of total area) is in China, 13,289 sq. km (42.5%) is in Nepal, and, 7,120 sq. km (22.8%) is in India. The KSL transboundary landscape spreads across a vast region that includes an area of the remote southwestern portion of the Tibetan Autonomous Region (TAR-China) in China that is the source of four of Asia's most important rivers - the Indus, Karnali, Bhramaputra and Sutlej - and encompasses contiguous areas of northwestern Nepal, and India which have been historically linked and are ecologically and culturally inter-connected. At the heart of this landscape lies the sacred Mt. Kailash, revered by millions of people in Asia and throughout the world.

Mt. Kailash (a.k.a Mt. Kailas) is known, and officially referred to, as *Gāngrénbōqí Fēng (*冈仁波齐峰) in Chinese. It is also referred to as *Kailāśā Parvata* (kEelaz pvRt) in Sanskrit (with similar names in Hindi and Nepali, and other related South Asian languages), and revered as *Khang Rinpoche* (□□□□□□□□□□□□□□□) among Tibetans.

The KSL target area is comprised of a wide range of biophysical and sociocultural conditions, and is considered to be amongst the most revered sacred landscapes of the world. The spiritual and sacred values of this landscape attract tens of thousands of pilgrims every year. It is also amongst the world's most biologically rich, diverse and fragile environments. The region and its people are highly vulnerable to climate change and environmental degradation, as well as threats associated with on-going globalisation processes and accelerating development. As a result, the rich and unique biological diversity, the many ecosystem goods and services, and the value-based cultural heritage of this landscape are severely threatened.

The KSLCI is a collaboration between partner institutions in China, India, and Nepal, with facilitation and support from the International Centre for Integrated Mountain Development (ICIMOD), the United Nations Environment Programme (UNEP), and German Technical Cooperation (GTZ). In consultation with the three countries (China, India and Nepal), the following broad objectives for the KSLCI were formulated:

- Enhance cooperation among the regional member countries through the establishment of a Regional Cooperation Framework (RCF), development of a

strategy for the conservation of KSL, and developing a transboundary regional knowledge base;

- Increase collection of climate change data in the KSL and facilitate coordination among the various actors and stakeholders within the KSL landscape through enhancing transboundary collaboration in ecological and climate change monitoring and information exchange networks; and

- Recognise, and strengthen local capacity efforts for community-based participation in conservation and sustainable development, and enhance cultural-socio-ecological resilience.

The KSLCI, during the current 18-month initial preparatory phase (Phase One) has convened a consultative and participatory process to develop a transboundary Regional Conservation Strategy (KSL-CS), and the Comprehensive Environmental Monitoring Plan (CEMP) for the Kailash Sacred Landscape (KSL), as part of the process leading up to a Regional Cooperation Framework (RCF) for enhanced regional cooperation, through the coordinated efforts of national partners from China, India and Nepal, with technical support from ICIMOD and UNEP.

Overview of the KSL Comprehensive Environmental Monitoring Plan

The purpose of the KSL-CEMP is to build regional and national capacity for environmental monitoring and long term ecological research, to promote the early identification of and response to potential adverse environmental impacts associated with various on-going processes (including climate change) within the KSL, and to facilitate and encourage regional knowledge sharing and transboundary cooperation. The KSL-CEMP will support landscape conservation and ecosystem management approaches, biodiversity conservation and management, and regional cooperation based on better informed decision-making, The development of the KSL-CEMP addresses the expressed concerns of the respective KSL member countries for improved environmental data and information to better implement environmental programmes and make progress toward sustainable development of the region. It is likewise intended that the enhancement of long-term environmental monitoring and data collection within the KSL area will contribute to reducing knowledge gaps that are a serious impediment to improved understanding, modelling, and prediction of climate change impacts and adaptation, across various relevant scales (locally, regionally, and globally), and provide valuable input to the understanding of these processes at both the regional and global levels.

The development of the KSL-CEMP is based, and builds upon on the information developed in the respective KSL Country Conservation Strategy and CEMP Reports. The KSL-CEMP integrates with and supports the KSL-CS which has been developed concurrently. Additionally, the KSL-CEMP provides the basis for \ monitoring and evaluation role of the KSL-CS and the KSLCI as a whole. National partners in each of the respective countries developed national-level KSL Country CEMPs through a consultative process involving local and national partners and other stakeholders. The three KSL Country CEMPs have been summarised and compiled, with the focus on regional elements, harmonized and synthesized through a consultative process led by ICIMOD to develop the regional transboundary KSL-CEMP

The KSL-CEMP is intended to form the basis for regional cooperation and national strengthening for environmental monitoring and long term ecological research in the KSL. The KSL-CEMP lays out a strategy to enhance and strengthen national institutions through regional cooperation and to develop a comprehensive environmental and ecological monitoring capacity in the region, based upon national and regional institutional and scientific networks. These networks will interface with on-going international monitoring initiatives, aimed at providing baseline and trend data on global change. Existing monitoring efforts in the region (currently these are very sparse, with minimal coverage within the KSL) will be enhanced thru the KSL-CEMP to form a geographically and ecologically comprehensive sampling frame able to capture the variability and heterogeneity, spatially and temporally, of this rugged and diverse landscape. The aim will be to provide adequate sampling intensity and spatial distribution to identify and represent the variability within the KSL for a variety of environmentally and ecologically relevant parameters, to establish ecological and climatic baselines, and to identify representative indicators of change, specially with regard to climate and biodiversity.

Process for Developing KSL-CEMP

The KSL-CEMP process builds a common approach and transboundary framework for environmental monitoring and ecological research, with an emphasis on biodiversity conservation and management, as well as local livelihoods and adaptation to climate change. This framework is based on commonly agreed upon and (as far as possible) internationally accepted protocols. Implementation and approach will seek to facilitate regional cooperation, and enhance national capacity, and build local capacity for on-going environmental and ecological monitoring.

1. Each of the Country Partners developed and outlined their respective Country KSL-CEMP for their respective areas of the KSL, based upon guidelines which were agreed upon through a process initiated at the First KSL Regional Workshop held in Almora,India in mid-April 2010.

2. Country Partners considered, discussed and tentatively agreed upon the aim, scope and basic parameters of the CEMP during the First Regional Workshop at Almora, and agreed to a process, timeline, and way forward based on consultation, and joint and interactive collaborative development.

3. A draft CEMP for the each country within the KSL was presented for discussion at the Second Regional Workshop, held in Sept. 2010, in Juizhaigo, China. Country partners agreed upon the approach to compile and harmonize the individual country CEMP's into a draft CEMP for the entire KSL, in order to delineate the common framework and identify the agreed upon specifics.

4. A iterative, participatory and consultative process was facilitated by ICIMOD to synthesize and develop the final draft of the KSL CEMP, which was presented as a draft for discussion (and agreement upon as part of the RCF) at the Third (final) Regional Workshop, to be held in Kathmandu, Nepal in December 2010.

Implementing organisations:

5. In China, the KSL-China CEMP was prepared by the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences as lead institute, in collaboration with the China Tibetology Research Center, the Kunming Institute of Botany, Chinese Academy of Sciences, and the Institute of Tibetan Plateau Research, Chinese Academy of Sciences.

6. In India, the nodal ministry, the Ministry of Environment and Forests (MoEF), Government of India (GoI), having agreed with the project objectives, designated the G. B. Pant Institute of Himalayan Environment and Development (GBPIHED) as the Lead Institute. The Wildlife Institute of India (WII) and Uttarakhand Forest Department (UKFD) were identified as major national partners.

7. In Nepal, the Ministry of Forest and Soil Conservation, and the Nepal KSL Executive Steering Committee commissioned Tribuhvan University as the Lead Institute to coordinate and prepare the CEMP, in collaboration with the GOI Ministry of Environment, Dept. of Forest, Dept. of National Parks and Wildlife, Dept. of Plant Resources, Dept. of Hydrology and Meteorology, and the National Agricultural Research Council.

8. The individual KSL Country CEMP Reports were summarised and synthesised by ICIMOD to prepare this current summary document, i.e. the regional level KSL-CEMP. This document refers to and is wholly based upon the Country CEMP Reports, and associated KSL core documents, submitted by each of the three countries. This KSL-

CEMP is not all-inclusive or comprehensive in reporting the national CEMPs, but instead is focused on the regional aspects and transboundary, dimensions, and opportunities for enhanced regional cooperation which will strengthen national efforts. All references to secondary and original data and information is based on the KSL Country CEMP Reports, plus the KSL Country and Regional Conservation Strategies and Feasibility Assessment Reports ,which have been freely used to compile, summarise, synthesise, and report. The reader is referred to these documents for the description of the respective KSL Country CEMPs, which are the source of information reported here.

Basic Approach and Scope of the KSL-CEMP

Each of the three respective KSL country partners have developed a KSL-Country CEMP which outlines the respective national plan for implementing comprehensive environmental monitoring and promote targeted ecological research to support the KSL-CS within the framework of the KSLCI. Each of these countries will implement both KSLCI-related interventions and the comprehensive monitoring of the environment within their respective national frameworks, that is, each country is solely responsible for implementatioin of their own KSL Country CEMP, based upon the commonly agreed understanding that recoginises the importance of regional cooperation for implementing ecosystem management within the KSL. Within each country, the respective KSL Country CEMP outlines the national efforts, including local and community-based, to implement long-term environmental and ecological research, within the framework of the KSLCI. That is, each country has developed their KSL Country CEMP, based upon the guidelines and the common approach developed cooperatively within the KSLCI framework, and will implement the CEMP on a national basis. The regional-level KSL-CEMP, i.e. this document, provides the framework for coordination among the three KSL countries, regional harmonization of monitoring and environmental research efforts, , and the sharing and analysis of data, information, and knowledge. As well, this framework creates the platform for knowledge dissemination and interactive (i.e. two-way) sharing between both regional partners and the international global science community.

There are a variety of global, international and other regional initiatives that are aimed at improving our understanding of environmental change in mountains and other bio-culturally rich areas. It is proposed that KSL-CEMP process will build upon and utilize these previous and on-going national, regional, and global efforts to provide the basis for a comprehensive approach and to ensure coherence with global standards, efforts, and research networks. In particular, many global organizations and networks including the

World Meteorological Organization (WMO), the Global Climate Observation System (GCOS), the Global Terrestrial Observation System (GTOS), the World Climate Research Program (WCRP), the World Glacier Monitoring Service (WCMS), Global Biodiversity Information Facility (GBIF), provide guidance and standards for the investigation and monitoring of various environmental parameters, as well as networks for information sharing and global databases. DIVERSITAS, GLORIA, GMBA, GISP and others are engaged in assessing, monitoring and predicting biodiversity change. GEO-BON has the goal to create an internationally coordinated, globally integrated biodiversity monitoring system. For mountains in particular, the Global Change and Mountain Regions (GLOCHAMORE) Research Strategy (2005) is available, and has been used, to provide a starting point, with a basic overview of approach, and a extensive delineation of parameters which were evaluated by country partners and through group work, for relevancy to the specifics of the KSLCI and the KSL-CS. The GLOCHAMORE strategy was developed within the context of existing international global change research programs of the Earth System Science Partnership (ESSP), notably the Global Land Project (GLP) of the International Geosphere – Biosphere Project (IGBP) and the International Human Dimensions Project (IHDP), and stress the importance of interfacing with this level of international science efforts.

Among the core concepts of the GLOCHAMORE Research Strategy is the assumption that sustainable management can only be achieved with stakeholder involvement. Likewise, the KSL-CEMP advocates that stakeholder involvement increases the clarity of the research, enhances its relevance and acceptability, and improves the efficiency and impact of the data collected and knowledge developed. Consulting local people and the managers of resources within the landscape in the planning and implementation phase is therefore central to the implementation of the CEMP. Policy relevant information should be available to local stakeholders as well as decision makers and the global research community.

The KSL-CEMP monitoring and research strategy focuses on drivers of change, impacts on ecosystems, on the subsequent impacts on ecosystem goods and services, regional economies, and health. The human dimension emphasizes mountain and lowland people's dependence on mountain goods and services that are affected by both indirect and direct impacts of environmental change.

The KSL-CEMP is a over-arching,holistic and integrated plan to provide the data and information required to conserve, use, enhance and manage physical, biological and cultural resources in the KSL tansboundary landscape. It envisions a participatory, facilitative and coordinating role (i.e. a institutional network) at the regional level, with various different agencies, stakeholders and actors involved in the promotion and

implementation of the various components of the KSL CEMP, and the respective KSL Country CEMP, at the national level. A mechanism (i.e. institutional network) to establish coordination among the governmental, non-governmental and civil society organizations, and other stakeholders for effective implementation of the KSL Country CEMP at the national level will interface, coordinate and harmonise monitoring and research efforts within the transboundary KSL with regional-level coordination of the KSL-CEMP process, i.e., though a participatory and consultative mode.

Among the major roles of the regional coordination function for the KSL-CEMP will be the identification of knowledge gaps, facilitation of regional coordination for environmental monitoring and ecological research, and the delineation of standardized methods and harmonized protocols for sampling, documenting and analyzing ecological, climatic and other environmental data, including socio-economic drivers of environmental change, which will form the basis to facilitate transboundary collaboration and knowledge sharing, based upon on-going national efforts and international guidelines. While considering the scope of KSL-CEMP, it is important to emphasize the crucial supportive role of the KSL-CEMP for meeting the long term goals of the KSL-CS which, among others, emphasizes ensuring availability of systematic reliable datasets to support decisions on conservation and development issues in the KSL target landscape.

Both the KSL-CI and the KSL-CEMP frameworks have the broad objective of promoting transboundary regional cooperation for long-term environmental monitoring, assessment, and ecological research, and to provide a platform to facilitate networking of regional, national, and global research efforts and bring focus to research issues in the KSL region. Development of institutional networks for monitoring of climate, the environment, and biodiversity is a fundamental component of both the KSL-CS and the KSL-CEMP.

The development of institutional networks for the regional coordination of the project is discussed and outlined briefly for each country in the KSL-Country CEMP reports. In India, the Ministry of Environment and Forest (MoEF) is the nodal institution and the G.B. Pant Institute of Himalayan Environment and Development (GBPIHED) leads the KSLCI activities in coordination with the Wildlife Institute of India (WII) and the Forest Department of Uttarakhand State. In China, the working group consists of team members from the Institute of Geographic Sciences and Natural Resources, China Tibetology Research Centre, Kunming Institute of Botany, and the Institute of Tibetan Plateau Research of the Chinese Academy of Sciences. In Nepal, the working group is comprised of Tribhuvan University and the Ministry of Forest and Soil Conservation, along with other departments such as the Department of Hydrology and Meteorology and the Department of National Parks. This working group forms the key component for implementation and initation of the plan, however, national and local

To facilitate coordination and dissemination of information within the KSLCI, an interactive website has been launched (from 2010) for knowledge sharing. It is accessible from the main KSL website (www.icimod.org/ksl). Access to restricted partner-only sections of the website will be provided to the partners in consultation with various national coordinators to facilitate implementation of the KSLCI, and specifically the KSL-CEMP. This platform with play a major role in the data and knowledge sharing, and the facilitation of regional coordination.

Key Areas of Agreement and Basic Principles:

During the First Regional Workshop held in Almora, India in 2009, the following points of agreement were identified as guiding principles by the national partners:

Hierarchical Approach:

Emphasis on the need for hierarchical approach to acquire a holistic picture, similar to multilevel approach, for example taking into account nested approaches such as in situ observations with a larger ecosystems context. At the highest level, Landuse, Land Cover, and Change (LUCC) analysis provides the larger landscape context, within which ecosystem level studies or observation of particular taxa are nested, and thru which drivers of external drivers of change can be identified and monitored.

Integration with National Efforts:

The GLOCHAMORE Research Strategy was identified as a useful starting point for discussion the guidelines, however, the need for a regionally-specific approach and development of a set of guidelines appropriate to the conditions of the KSL was highlighted. General points of the Strategy agreed upon as useful tenets included the strategic framework focusing the three aspects of environmental change, i.e drivers of change, impacts on ecosystems, impacts on ecosystem goods and services, regional economies, and health. On-going national efforts by the three respective countries were identified as the initial entry points for identifying common approaches, and in particular, common standards and protocols. In particular, it was pointed out that the Chinese Ecological Research Network (CERN) has 30 research stations, with various on-going monitoring activities based on a set of common protocols. Monitoring efforts must be linked to national-level efforts, and to other government initiatives, e.g. local administration, state forest depts., etc. The CEMP must harmonize with the national plans of the respective countries.

Transparency of CEMP Process and Stakeholder Involvement:

Stakeholder involvement increases the clarity of the research, enhances its relevance and acceptability, and improves the efficiency and impact of the data collected and knowledge developed. Consulting local people and the managers of resources within the landscape in the planning and implementation phase is therefore central to the implementation of the CEMP. Policy relevant information should be available to local stakeholders as well as local, national and regional decision makers, and the global research community.

Society and Environmental Change

Monitoring of socio-economic parameters, cultural change, and the human dimension of adaptation, focusing on mountain communities, is an essential component of the CEMP, and should be framed within the context of climate change and adaptation.

Integration of CEMP with the KSL Conservation Strategy

The CEMP must fully integrate with the KSL-CS. Further, any interventions by the KSL-CS or the KSLCI should be monitored and evaluated.

Promotion of Regional Knowledge Sharing and Open Data Exchange

The CEMP will promote transboundary knowledge and data sharing, common formats facilitating open data exchange, and develop a common data sharing framework, which will form the basis for development of a KSL knowledge exchange platform.

Environmental and Ecological Indicators

There is a need to identify sets of indicators early in the process that will facilitate long-term comparative analysis, and allow for an overall evaluation of ecosystem health and efficacy of conservation efforts. Indices are needed that are sufficiently robust, representative and sensitive to monitor environmental and ecological change and also fulfill the requirement to communicate complex environmental, ecological and biodiversity data to decision-makers and the pubic. Indicators need to be chosen that not just monitor the conservation status of various taxa, but are also relevant to ecosystem functioning and services, and can easily be incorporated into various models.

Ecosystem-Specific Sampling

A sampling frame should be developed for each set of parameters to be measured that takes into account the spatial and temporal variability of the conditions to be sampled. This implies that there should be an a priori landscape level spatial analysis based on

existing geospatial data to stratify the relevant landscape into a reasonable number of strata relevant to the specific set of parameters being sampled. Depending on the sampling, statistical and analytical needs, sampling sites, permanent plots, or weather stations can be sited either to "represent" the average conditions of that strata, or perhaps can be sited along steep ecotones where early indications of change may be more evident. Bias in sampling, e.g. close to roads for accessibility should be avoided, taking into account the inherent trade-offs of cost and time requirements.

Permanent Environmental Monitoring and Ecological Research Sites

Identification of permanent sites for monitoring of change is a valuable method for establishing baseline conditions, and especially for understanding change processes as related to landuse, land degradation, biodiversity, invasive species, ecosystem function. For long term environmental monitoring, representative sites needs to be identified by each participating country, and with specific records of its location and baseline information. The location map, what is being specifically monitored, geographical information of aspects, altitude, latitude/longitude, and related recording will be the starting point, depending on the purposed of the permanent site. Permanent, long-term monitoring sites can have multi-purpose sampling and monitoring uses, and should be co-located with other efforts to maximize efficiencies and allow for collaboration and data collection synergies.

Key Thematic Areas:

Ten key thematic areas for long-term monitoring and ecological research were identified and delineated by the KSL country partners, using an initial list based upon the GLOCAMORE Research Strategy. These key areas are indicative and not exclusive, and are intended to form the basis for the comprehensive long term monitoring effort. As such, they are broadly inclusive of broad range of important parameters, taking a long term view, even if actual monitoring of specific parameters may need to be phased in over an a period of time, or perhaps initiated in a later phase of the KSLCI. Each country has used these guidelines in the development of their respective KSL Country CEMP, however, targets, objectives and indicators have been formulated following the respective national strategies, approaches, and on-going efforts.

In the following is described the ten key thematic elements identified by the partners as relevant to long-term environmental monitoring and/or ecological research within the specific context of the KSL and the KSLCI. Priorities given to these themes, and the various sub-themes varies among the KSL Country CEMP, as per the varying bio-physical, socio-ecological, and institutional conditions and settings of the KSL are within the respective countries.

Theme 1: Climate

Changes in weather and climate, and the frequency of extreme events, impact mountain ecosystems both structurally and functionally. Understanding the likely impacts of climate change will be important in the KSL, and is dependent on improved climatic information and meteorological data. Climate/weather monitoring sites in the KSL region need to be expanded and developed, with specific relevance to developing and improving regional climate models. Meteorological data are required to assess the potential or actual status of the climate and associated processes. Data collection and monitoring should be coherent with global standards and meet minimum requirements for inclusion into global datasets. Key climatic parameters include basic measurements like *wind speed and wind direction, temperature (ambient air and soil), solar radiation (total and photosynthetically active), humidity, precipitation (rainfall and snowfall), atmospheric pressure, mist, cloudiness and transpiration, and soil temperatures.*

Institutional arrangements are required for sustainability of data collection efforts, based on national ownership, and integrated with on-going and planned national monitoring efforts, programmes, institutions, and networks.

Main Focus and Parameters:

- Data collection will be based upon and coherent with international climate monitoring efforts, in particular WMO, GCOS, and in-country national efforts, e.g. CERN in China.
- Secondary data sources, e.g. NASA data on snowfall, etc., incorporated into climate data base.

Theme 2: Land Use Change

Landcover and landuse change is a major driver, and indicator of environmental and other change, impacting mountain ecosystems and the economic activities of people in the KSL. Land cover and landuse is also subject to external factors such as climate and the global market. In the KSL area, present land cover, land use and historical trends are being developed within the context of the KSLCI, using remote sensing approaches, and will be used as the baseline data for comparative analysis.

Collecting baseline information is a necessary prerequisite for estimating change, prediction of future trends, and identify areas in need of further research. Monitoring landcover change over time can give clear indications of past and current trends within various ecosystems, and give an overview of ecosystems and their management. This requires (a) preparation of maps based on remote sensing and geospatial analysis for the project sites at different spatial and temporal scales, and (b) documenting the typology of landcover and landuses, and analysis of the land cover change dynamics.

Land use changes can have a large impact on ecosystems and the livelihood of the people dependent on the mountain resources. A method to model land use change incorporating biophysical parameters, climate change, population growth and economic change requires improved data and baseline information. Understanding the mechanism of land use change is important, but will be dependent on the development of a substantive information base delineating landcover / landuse change and trends.

Main Focus and Parameters:

- Quantifying and Monitoring Landcover / Land Use Change (Harmonized Legends)
- Historical Trend Analysis
- Overview and Assessment of Impacts of Landcover / Landuse Change
- Modeling and Prediction of Habitat Change and Impact on Biodiversity

Theme 3: Cryosphere

Many specialized agencies, within the region, and outside, are monitoring various aspects of the cryosphere, e.g. ICIMOD has major programme to map glaciers and potential glacial lake outburst flood risk sites (GLOF). It will be especially important to coordinate and integrate KSL cryosphere monitoring efforts with existing national research programmes. Many of the parameters to be measured may be time and expertise intensive, however, the importance of improved information about the cryosphere in terms of understanding future trends in water availability, and by extension food and livelihood security, was highlighted by the country partners. As such, a broad range of essential parameters are listed, even if the monitoring of these parameters might be difficult, might need high level expertise, or may not be feasible to implement in the early stages of the monitoring effort.

Main Focus and Parameters:

- Glacier Extent and Volume
- Glacier Mass Balance
- Melt Water Yield
- Snow Cover
- Snow Melt
- Snow Gauging
- Permafrost

Theme 4: Water Resources

Mountain areas are repositories of fresh water for human consumption, hydropower generation and regulate hydrological cycles both in mountains and downstream. The impact of climate change could have both the positive and negative impacts on water availability. Understanding relationships between the precipitation, soil moisture, evapo-transpiration, runoff and land use within the basins and drainages will help in developing management plans in landscapes.

Water quality and sediment transfer to downstream, e.g. dams and reservoirs, and in river basins, is important for both human health, and the health of aquatic and terrestrial ecosystems. This requires determining the key pollutants in the designated study sites, analyzing the pollutant loads and developing models to predict pollutant loads and simulation for the future change scenarios.

KSL has important wetland areas that will be highlighted in the environmental monitoring effort. Mountain wetlands and streams are quite sensitive to climate change, atmospheric deposition and weather pattern. Physical, chemical and biological characteristics can serve as good indicators to change. Monitoring requires identifying the natural variability of systems and their responses to change by long-term plan. Monitoring should include the response of the aquatic lives (vertebrate, invertebrates, insects, planktons etc) to different threats such as global warming, acidification, pollutant loads, nutrients, water withdrawal and direct pollution.

Main Focus and Parameters:

- Water Quantity
- Water Quality and Sediment Production
- Extent of Water Bodies (including potential GLOFs),
- High Altitude and other Wetlands
- Springs and Water Sources – General condition

Theme 5: Ecosystem Function and Services

Ecosystem functions are central components to the biogeochemical cycling of elements. The biotic part of alpine and other mountain ecosystems modifies biogeochemical and hydrological process particularly affecting storage and cycling of important nutrients such as nitrogen and phosphorus. Nitrogen fertilisaton can enhance the effects of warming in cold environments. Therefore the changes driven by climate change, land use changes, pollution loads have significant impacts for the services provided downstream. This requires understanding of the biogeochemistry changes under different climate change scenarios, land use dynamics, pollution loads and how these changes are affecting ecosystem services.

KSL has important wetland areas that should be included in the environmental monitoring plan. Mountain wetlands and streams are quite sensitive to climate change, atmospheric deposition and weather pattern. Physical, chemical and biological characteristics can serve as good indicators to change. Monitoring requires identifying the natural variability of systems and their responses to change by long-term plan. Monitoring should include the response of aquatic organisms (vertebrate, invertebrates, insects, planktons etc) to different threats such as climate warming, acidification, pollutant loads, nutrients, water withdrawal and direct pollution.

Mountain forest is an important sink for carbon, therefore understanding the amount of carbon sequestrated by different forest types and other land use system will be important for the landscape. This might require setting up experimental plots in rangelands/pasturelands and forested lands' to investigate the carbon balance in the mountain watersheds. This can contribute and provide input to the models which can be applied to investigate both carbon cycling and yields of timber and fuel under scenarios of global change. Forest related resource such as timber, firewood, forage, medicinal and aromatic plants, NTFP's, etc., are potential relevant and/or could be monitored.

More than 60% of the HKH region is under rangelands where transhumance and nomadic livestock rearing is practiced. The KSL similarly has a large portion of area under pastoralism and is likely among the most important economic activities in the landscape. Alpine meadows and pasture lands are critical to both ecological and

economic functions. Climate and land use change impacting vegetation and use of such lands affects the carbon, nitrogen and water cycles and stability of steep mountain slopes. In order to predict the future structure and function of the mountain grazing areas, it is important to monitor existing rangelands. This requires mapping existing grazing lands, identification of the characteristics of such lands, their carrying capacity, forage species, animal species, and stock density in the areas. Monitoring the dynamics of agro-pastoralism systems of the landscape is similarly important in understanding house hold economics. Monitoring and prediction of the likely future characteristics of animal grazing driven by CC, invasive species of plants, alternative use of land and responding to market demands for different livestock products will be useful information.

The mountain ecosystem functioning and productivity of natural resources highly depends on soil quality and fertility. Climate change and land use changes impacts on both the physical and chemical properties of soils. The effects of changes in temperature, precipitation and associated land use changes have impacts on evapo-transpiration, soil organic matter, microbial biomass, carbon storage and soil biodiversity. Monitoring of soil-climate dynamics should be considered.

Main Focus and Parameters:

- High Altitude Lakes and Wetlands
- Role of Various Ecosystems in N and Water Cycles
- Role of Forest in C Cycle and Resource Production
- Role of Grazing Lands in C, N and Water Cycles
- Soil Systems
- Pollution
- Plant Pest and Diseases

Theme 6: Biodiversity and Ecosystems

The KSL region is rich in biological resources, including many rare, endangered, threatened, and economically important species of flora and fauna. Associated with the high degree of altitudinal variation there is a high diversity of habitats engendering species richness. There is a sparsity of information in general regarding biodiversity in the KSL, including a lack of inventory on biodiversity and the loss and gain of species. There is a need to establish a baseline for existing biodiversity in both aquatic and terrestrial species/ecosystems. In order to assess the current biodiversity and to assess future change, a baseline inventory and regular monitoring of key taxa (plants, insects, birds and other) is required.

Biodiversity assessment will be stratified based on bio-climatic zones or ecoregions that have been identified within the landscape and a spatial analysis of variability. Changes in species composition and interaction influence ecosystem functions, therefore it is also important to define functions and services associated with biodiversity, and also then develop scenarios on possible effects of climate change.

Large parts of the KSL area fall above the tree line where ecotones (between sub-alpine and alpine) are still under natural states or at semi natural state. This area is very sensitive to climate change. Monitoring is needed to detect and understand the shifts in species abundances and distribution affected by climate change. For this, one option is

adoption of the GLORIA approach by establishing permanent monitoring sites, or the monitoring of shifting meadow, forest and treeline boundaries.

The KSL has several protected areas, reserves and wetlands of international importance adjacent or included. These areas are declared to protect certain species of plants or wild animals. These species in turn are influenced by the land use change dynamics in the area, currently and in future, and potential impacts of climate change. Within a context of environmental change, how resilient are these important species is relevant to their management. Inventorying of the key species along with the abiotic environmental data and understanding their interaction in terms of management will be crucial. Long term monitoring is required for assessing the biotic interaction while specific studies can be undertaken to assess response and risk of common and rare species in the face of climate change.

Many species in the alpine areas are the result of repeated selection pressure from both herbivores and people, and based on their economic and cultural values. With the wave of modern infrastructure development and globalization there is danger that these species will be threatened. Study on the historical and present land use practices, how these systems determine the landscape and biodiversity components, and how modern agriculture production have influenced the system will be helpful.

Due to global change, alien and invasive plants are increasingly becoming a source of change in the mountains. Understanding how these species colonize new environments, and what are the conditions encouraging their spread are among the key questions that need to be understood for developing control and management methods to address the issue of invasive species. Invasive species brings about substantial changes in the ecosystem structures and function, therefore it is important to monitor this threat and for the development of management strategies. For this element of the monitoring plan there is evident need to develop an improved knowledge base specific to the KSL on the pattern, dynamics and impacts of invasive species.

Sub-Themes and Parameters:

- Biodiversity Assessment and Monitoring
- Biodiversity along Ecotones and in Transitional Zones:
- Ecosystem and Ecological Community Change
- Key Flora and Fauna, and Habitat
- Vegetation Dynamics
- Invasive Species
- Forest Structure / Non-timber Forest Products / Medicinal Plants
- Culturally Dependent Species
- Impacts of Invasive Species
- Agricultural Biodiversity and Genetic Resources

Theme 7: Risks and Hazards

In particular, hazards associated with changes in climate, landuse, and environmental conditions should be considered.

Sub-Themes and Parameters:

- Floods / Potential Glacial Lake Flood Outburst (GLOF)
- Drought
- Wildland Fire
- Mass Movements
- Landslide / Avalanches
-

Theme 8: Health Determinants and Outcomes Afflicting Humans and Livestock

Health issues associated with changes in climate, land use, and environmental conditions will be considered.

Sub-Themes and Parameters:

- Indicator disease(s) of climate change / vector borne

Theme 9: Mountain Economies

Agriculture in the mountains doesn't operate in isolation but is integrated into comprehensive integrated landuse systems, and typically include significant livestock components. Therefore monitoring of forests, rangeland, water and all the resources including biodiversity have impacts and consequences for agriculture and livelihoods. While keeping in mind the ecological and economic functions of other related topics, agricultural monitoring should be developed. Dynamics of existing agro-pastoral systems need to be investigated, including monitoring a recent trend of land transformation into agriculture in high altitude areas. Monitoring of value chains on the mountain products of the landscape for enhancing the livelihood options of the local communities might also be important.

The KSL area is an important destination for religious and nature tourism. With the globalizing context and developing infrastructures in the area, tourism and recreation will be a major industry in the future. It is important to examine the present trend and to project the future tourism development in the area. This requires analyzing the current state of tourism and assessing the impact of global change on different forms of tourism, with a view to protect the future of tourism and the impact of tourism on the landscape. Assessment of both positive and negative impacts needs to be monitored using the past and present trends. Tourism linked with conservation incentives having pro-poor approach should be assessed for long-term benefits.

Sub-Themes and Parameters:

- Agroecosystems and Livelihoods
- Natural Resource-Based Employment and Income
- Forest products
- Mountain Pastures
- Livestock numbers and composition
- Valuation of ecosystem services
- Cross Border Trade

- Tourism and Recreational Economies

Theme 10: Society and Environmental Change

Appropriate methodologies for monitoring the human dimension of environmental change will be utilized, both for improving the knowledge base to allow for ecosystem management, and as a KSLCI monitoring and evaluation approach.. In particular, changes associated with livelihood strategies, the integrity and socio-ecological resilience of mountain communities and their cultural institutions, changes in demographics, settlements, and migration patterns, and the impact of development and associated infrastructure on mountain society.

Sub-Themes and Parameters:

- Governance Institutions
- Rights and Access to Water Resources
- Conflict and Peace
- Traditional Knowledge and Belief Systems
- Urbanization
- Development (Infrastructure)
- Development Trajectory and Vulnerability
- Cross Border Trade / Illegal Trade

Overall Goal and Major Objectives of the KSL CEMP

The major goal of the KSL-CEMP is to strengthen, encourage, focus and build regional and national capacity for long-term environmental monitoring and ecological research in the KSL, within the framework for the KSLCI and the KSL-RCF. The KSL-CEMP supports landscape level conservation of ecosystems, threatened species and habitats, and ensure continuous flow of reliable data on various parameters to help policy planners and decision makers. Long-term environmental monitoring and ecological (including socio-economic and socio-ecological)in this landscape is required to reduce knowledge gaps which are a major impediment to application of improved and ecosystem management approaches, and the understanding, modeling, and prediction of climate change impacts at various scales. The KSL-CEMPs promotes regional cooperation for the collection and analysis of environmental data across the transboundary landscape in a common and compatible format to enhance regional understanding and allow for better informed decision-making.

Specific objectives of the CEMP are as follows:

1. To increase understanding of change and change processes within the KSL, and provide the knowledge base for the application of ecosystem management approaches, biodiversity conservation and management, and the sustainable use of natural resources.

2. To promote the early identification of and response to potential adverse environmental impacts and trends associated with anthropogenic pressures and natural changes (including climatic) within the KSL based upon reliable knowledge base;

3. To detect progressive changes in traditional cropping systems, livestock husbandry practices and agri-biodiversity in the region *vis-a-vis* adaptations by local communities to changing climate;

4. To document and analyse the ecosystem response to improved management approaches, conservation efforts, changed land use practices, or KSLCI interventions within the KSL, providing monitoring and evaluation of the implementation and effectiveness of the KSL-CS;

5. To establish a regional framework and institutional mechanism facilitating regional cooperation for environmental monitoring and the systematic regional monitoring of environmental changes, including climatic variables and the status of biodiversity in KSL.

6. To facilitate and encourage regional knowledge sharing and transboundary cooperation for long-term environmental monitoring and ecological research in the KSL, for the conservation of natural resources, threatened species and sites of ecological and cultural significance;

7. To encourage community participation and the mainstreaming of community-based monitoring efforts into regional monitoring networks and knowledge platforms, and national monitoring efforts, allowing for a full participatory and knowledge based approach and application of an inclusive ecosystems management approach, as outlined in the KSL-CS.

Expected Outcomes of the KSL-CEMP

The KSL-CEMP builds a framework for enhancing regional cooperation for environmental monitoring and long-term ecological research. The KSL-CEMP is developed, and will be implemented by national partners to complement and strengthen on-going, national, and regional efforts, as well as global and international monitoring initiatives. Transboundary approaches include developing regional networks with clearly articulated commitments that encourage national and institutional ownership of long-term monitoring. Existing monitoring will be enhanced so that it can more readily provide the knowledge required to promote conservation, sustainable development, and adaptation to climate change in

the KSL. This monitoring will adhere to international standards in order to both contribute to and benefit from global monitoring efforts. The KSL-CEMP framework and associated regional networks will promote and facilate regional knowledge sharing.

To support, promote, build capacity for, and enhance long-term environmental monitoring and ecological research the KSL, the following regionally relevant **outcomes** for the KSL-CEMP have been identified:

- *Regional Cooperation for Long-Term Environmental Monitoring and Ecological Research:* Ensuring the availability of systematic and reliable datasets and analyses to support decision-making on conservation, adaptation and development issues in the KSL is an essential component for applying an ecosystem approach.

- *Regional Cooperation Monitoring and Evaluation of the KSL-CS and the KSLCI:* Ensuring the availability of systematic and reliable datasets and analyses to support the monitoring and evaluation of the KSLCI, and any intervention thereof, and the implementation of the KSL-CS.

- *Regional Knowledge Sharing:* Developing and improving the regional knowledge base, including traditional knowledge, is essential for facilitating informed decision-making and understanding the nature and direction of change in the region. Improved regional knowledge sharing for the conservation and monitoring of biological resources, rangelands, agro-biodiversity, and other resources in the KSL is essential to effectively apply ecosystem management and develop climate change adaptation strategies.

Implementation of the KSL-CEMP

To achieve the goals and objectives of the KSL-CEMP, the following **specific strategies** will be implemented at the regional level:

i Develop a forum for consensus building in each of the respective countries to facilitate and enable long-tem environmental monitoring and ecological research.

ii Establish a regional forum for transboundary cooperation, knowledge sharing, and promoting and facilitating environmental monitoring, ecological research, ecosystem management and landscape approaches within the KSL.

iii Improve understanding of regional transboundary conservation and sustainable development issues, and global climate change, by implementing comprehensive environmental monitoring (i.e. as per the KSL-CEMP), conducting specific conservation and development analyzes and assessments, including analysis of biodiversity and culturally linked livelihood needs, opportunities and threats, policy and capacity gap analysis, and assessments of data and research needs.

iv Develop and institutionalise knowledge, data and information sharing amongst the respective KSL countries, and conservation and development organisations, as per national legislation and prerogatives, for the purpose of enhanced regional cooperation for biodiversity conservation and environmental management, and for applying ecosystem management approaches within the transboundary KSL region.

v Conduct policy review and develop policy recommendations for facilitating enhanced regional cooperation for environmental monitoring and ecological research through an open consultative process involving a range of stakeholders.

vi Identify opportunities and promote capacity building at national to local level for enhanced regional cooperation for environmental monitoring and ecological research within the KSL.

vii Strengthen and promote capacity building at national to local level for supporting and enabling community-based approaches to effectively institute participatory ecosystem monitoring at the landscape level within the KSL

viii Institutionalise and mainstream national participation in regionally cooperative approaches, and encourage institutional ownership, including participation of national and community-based organisations, through facilitation and mobilization, to support the sustainability of the KSL-CEMP for long-term monitoring and ecological research in the KSL, within the framework of the KSLCI.

The following **mechanisms** will be established, to achieve the goals and objectives of the KSL-CEMP, as facilitated by the KSLCI and ICIMOD as a regional node for transboundary and regional cooperation, through a consultative and participatory process:

i A regional forum will be convened, for the discussion, facilitation, and implementation of the KSL-CEMP (within the context of the KSL-RCF), facilitating enhanced regional cooperation, in support of the KSL-CEMP and its goals and objectives. A nodal institute will be identified by each country, and participation will include stakeholders relevant to implementation of the KSL-CEMP. This process will be supported by a internet-based knowledge sharing and discussion platform.

ii A regional network will be established for the facilitation, and implementation of the KSL-CEMP (within the context of the KSL-RCF), and the associated goals and objectives of the KSL-CS, facilitating enhanced regional cooperation for environmental monitoring and long-term ecological [and sustainable development] research.

iii A regional knowledge, information, and data exchange platform will be established for the facilitation, and implementation of the KSL-CEMP (within the

context of the KSL-RCF), and the associated goals and objectives of the KSL-CEMP, facilitating enhanced regional cooperation for environmental monitoring long-term ecological research, and knowledge sharing.

iv Regional capacity for long-term environmental monitoring and ecological research will be enhanced as appropriate, at regional, to national and local levels, as facilitated and implemented by the KSLCI and other similar efforts.

v Regional collaborations for environmental monitoring and ecological research will be encouraged through awareness and fund raising activities, at the local, national, regional, and international level, as facilitated by KSLCI, ICIMOD, UNEP, and the respective Country Partners, within the context of the KSLCI and KSL-RCF process.

Building the KSL-CEMP Implementation Framework:

Institutional Networks and Detailed Work Plans

Each of the respective KSL country partners has produced a KSL Country CEMP, which includes specific targets, activities, parameters to be measured, sampling frequency and intensity, indicators, capacity needs and so on. These Country CEMP's will be implemented by in-country and national efforts, and coordinated nationally through the development of national level institutional networks, with delineated responsibilities and encouraging ownership of the various monitoring efforts by the relevant and capable national, local, and community institutions. The development of these institutional networks for the implementation of the KSL-CEMP will be facilitated within the context of the implementation of the next phase of KSLCI. Detailed workplans, assigning responsibilities and institutional ownership, resource and capacity needs, and interaction within each country of the various participating institutes and organizations will be delineated. The relevant and specific parameters to be monitored, along with the protocols for their measurement, reporting and analysis (as well as archiving) will be identified and iterated within these detailed work plans. Likewise, these country specific institutional frameworks will interface with the regional institutional network facilitating the transboundary and regional aspects for the KSL-CEMP, and particularly, harmonising and identifying common standards and protocols applicable across the three countries, and facilitating knowledge sharing. Links to the KSL-CS, for the monitoring and evaluation of of the KSL-CS and other KSLCI interventions, will be likewise delineated.

Community-Based Environmental Monitoring (CBEM)

The KSL-CEMP and the respective KSL Country CEMPs all include community based environmental monitoring (CBEM) as a key and central component of the monitoring effort and the implementation of the KSL-CS and the KSLCI as a whole. CBEM promotes full participation and ownership by local communities, and provides cost-effective and sustainable options for conducting long-term environmental monitoring. This is especially true for specific field studies and long-term monitoring in remote areas, and studies on agrobiodiversity, local water sources, wildlife predation. CBEM implies that communities and local inhabitants will be involved in not only data collection, but also in the design and decisions on priority setting and focus of the monitoring efforts. CBEM provides opportunities for effective knowledge sharing and dissemination of information between communities, local and national authorities, and the KSLCI implementation process. CBEM will be highlighted and mainstreamed within the KSL-CEMP and KSL Country CEMP implementation processes, with specific activities, roles and responsibilities to be delineated within the detailed workplans. Likewise, the CBEM approach will be mainstreamed into the institution networks and regional forum, so that information originating from CBEM efforts will be incorporated into the data collection, analysis, and knowledge sharing functions of the KSL-CEMP. Significant capacity building for CBEM is required, so that this will form a major component of the startup and implementation phases of the KSL-CEMP.

Timeframe

The KSLCI is envisioned as a long-term conservation initiative and has been designed according to a programme cycle of phased implementation and a long-term strategic approach for attaining sustainability and effective conservation. The KSL-CEMP is the central component and core document outlining the goals and aims of the KSLCI for long-term environmental monitoring and ecological research in the KSL region. Based upon this KSL-CEMP, the KSLCI will move forward to implement the KSL_CEMP for operationalising long-term environmental monitoring in the KSL. In order to move forward with full implementation, a 'Startup Phase' will build the Implementation Frameworks (i.e. identifying and developing the institutional structures required for implementation), and will develop detailed workplans for implementation, at both the national and regional level. This will be done through a participatory and consultative process that facilitates the development of institutional networks at the national and regional level, within the context and policy enabled environment of the KSLCI and the KSL-RCF. The capacity of national

partners for planning and implementation of the KSL_CEMP will be enhanced and regional networks developed.