Improving Communication for Management of Social-ecological Systems in High Mountain Areas

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Introductory Essay

Improving Communication for Management of Social-ecological Systems in High Mountain Areas

Development of Methodologies and Tools—The HKKH Partnership Project

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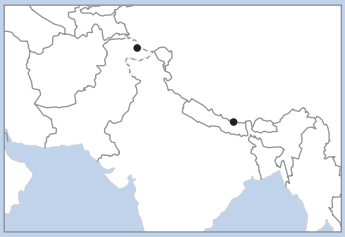

The planning and sustainable management of complex social-ecological systems (SESs) in high mountain areas such as the Hindu Kush–Karakoram–Himalaya (HKKH) region requires an approach that takes account of both environmental issues and local population needs. The HKKH Partnership Project developed methodologies and tools for systemic planning and management of social-ecological systems at local, regional, and national levels in the HKKH region, with a special focus on 3 protected areas in Nepal, Pakistan, and China. The adopted approach brought together researchers, policy-makers, and managers; it bridged the gap between research and management priorities and enabled communication to address the needs of communities while promoting conservation. Lessons learned are described and conclusions made on appropriate methods for the management of SESs in other regions.

Keywords: *Hindu Kush–Karakoram–Himalaya (HKKH) region; protected areas; social-ecological system management; partnership; communication; participatory modeling process.*

Introduction

The Hindu Kush–Karakoram–Himalaya (HKKH) region is the largest mountain system in the world, spreading over 8 countries: Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. This mountain system hosts the highest peaks on Earth including the 2 tallest, Everest and K2. These high mountains are sensitive social-ecological systems (SESs) marked by fragility, complexity, and marginality (Wymann et al 2006; Tartari et al 2008). Many developing countries, as well as countries with economies in transition, have required assistance for the formulation and implementation of management programs and strategies to protect mountain ecosystems and improve the wellbeing of local people. Currently, major gaps exist in the knowledge of critical SES dynamics in the HKKH mountain complex, and no clear mechanism has been established linking research with management priorities. Sound scientific knowledge to support management processes in mountain ecosystems is one of the necessary conditions to achieve sustainability, along with effective participation of stakeholders directly depending on and managing these ecosystems (Messerli and Messerli 2008).

New approaches and methodologies are emerging to address these issues, but only a few of them have been applied for operational management. We propose a mix of methods using soft participatory processes and hard science as well as computer-based tools that enable scientists and decision-makers to better understand the complexity of SESs in the HKKH and to identify suitable opportunities for the future rather than use the methods in isolation (Salerno et al 2010a, in this issue). The present article gives an overview of methodologies and tools that couple science (research, data collection, and experience), technologies (software, databases, remote sensing, and geographical information systems), and human resources for supporting bottom-up mechanisms for the management of natural resources in mountain areas, developed against the background of the United Nations Conferences on Environment and Development in 1992 and 2002. Our case studies were conducted in 3 protected

BOX 1: Major recent milestone events devoted to the management of natural resources in mountains

- The 2002 Johannesburg World Summit on Sustainable Development (WSSD), an important complementary outcome of which was about 300 "partnership initiatives" for sustainable development: voluntary, multi-stakeholder initiatives aimed at implementing sustainable development in mountain regions (http://webapps01.un.org/dsd/partnerships/public/welcome.do). Among these initiatives is the HKKH Partnership Project (UNSG Report 2008).
- The Millennium Ecosystem Assessment (MA) (findings formally approved in 2005) aimed at contributing to improved decision-making concerning ecosystem management and human welfare and to building capacity for scientific assessments of this kind (www.millenniumassessment.org/en/Index.aspx). One component of the MA led by ICIMOD was aimed at "providing credible, salient, and legitimate information and knowledge of mountain ecosystem services to facilitate trade-off and incentive (compensation) mechanisms for poverty alleviation and environmental enhancement in the Hindu Kush–Himalaya (HKH) mountains."
- An exhaustive list of other events and dialogues relevant to the HKKH Project is available on the Global Mountain Partnership portal (http://www.mountainpartnership.org/issues/resources/keydoc.html#1).

areas (PAs) in the HKKH mountain region. The policy context in which the proposed methodologies and tools were conceived is evoked here, followed by a description of the HKKH Partnership Project. The Project approach, methodologies adopted, and tools developed are presented, followed by lessons learned as they relate to SESs globally.

The international policy background

Awareness of the importance of mountain ecosystems and communities has increased since the adoption of Chapter 13 of Agenda 21 at the United Nations (UN) Conference on Environment and Development in 1992. Since then, significant progress in sustainable mountain development worldwide has been made, ranging from increased awareness about the global importance of mountains to the strengthening and creation of institutional arrangements at national, regional, and international levels, as well as more extensive collaborative actions by the international community to address specific issues of mountain areas. Commitments were especially strengthened during the International Year of Mountains in 2002, as proclaimed in Resolution 53/24 adopted by the UN General Assembly, which acted as a catalyst for long-term, effective action to implement Chapter 13 (UNSG 2007).

There is a continued need for improved planning, implementation, and evaluation of comprehensive management programs to protect fragile mountain ecosystems while overcoming mountain communities' economic and social vulnerability. There is also a clear requirement for higher levels of funding and investment in mountain areas, enhanced coordination and collaboration, and a stronger enabling environment with more supportive policies and institutions. Numerous global, regional, and local symposia have created the background for the establishment of multiscale international partnership initiatives for mountain regions. Among these, major recent milestone events devoted to the management of natural resources are reported in Box 1.

Against this background, the HKKH Partnership Project was initiated and first presented by the Italian Government in 2002 at the World Summit on Sustainable Development (WSSD) in Johannesburg. The Project was configured as a Type II Partnership Initiative developed in accordance with the priorities defined in the WSSD Draft Plan of Implementation (see Chapter IV, Paragraph 42 of the Draft Plan at http://www.un.org/esa/sustdev/documents/WSSD__POI__PD/English/POIToc.htm) and considering the recommendations made for achieving successful implementation of the priorities identified in Agenda 21. It is included within the Global Mountain Partnership (Hurni 2003).

The HKKH Partnership Project

The 3-year (2006–2009) HKKH Partnership Project (www.hkkhpartnership.org)—funded by the Italian Development Cooperation of the Ministry of Foreign Affairs (MAE) and executed by the International Union for Conservation of Nature (IUCN), the International Centre for Integrated Mountain Development (ICIMOD), Ev-K2-CNR, and Cooperazione e Sviluppo (CESVI) (Table 1)—was designed as a Partnership Initiative under the umbrella of the Global Mountain Partnership for the HKKH region and aimed at consolidating institutional capacity for systemic planning and management of mountain resources at regional, national, and local levels.

The Project's goals were to create and provide methodologies and tools to facilitate the planning and management processes of complex SESs in the HKKH

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TABLE 1 Executive partners of the HKKH Partnership Project, with their fields of expertise and specific roles in the Project. (NGO, nongovernmental organization; UN, United Nations; HKKH, Hindu Kush–Karakoram–Himalaya.)

Partners	Field of expertise	Role in the Project	Website
International Union for the Conservation of Nature (IUCN)	IUCN is a global environmental network that helps the world find pragmatic solutions to the most pressing environment and development challenges. It supports scientific research, manages field projects, and brings governments, NGOs, UN agencies, companies, and local communities together to develop and implement policy, laws, and best practices to better manage natural environments.	IUCN was the implementing agency providing expertise related to the management of the protected areas.	www.iucn.org
International Centre for Integrated Mountain Development (ICIMOD)	ICIMOD is an independent regional knowledge, development, and learning center based in Nepal, whose mission is to facilitate and improve the living standards of mountain populations of the Hindu Kush–Himalaya (HKH) by supporting sustainable mountain development through active regional cooperation.	ICIMOD's role was primarily to provide scientific input and expertise related to the application and development of new technologies.	www.icimod.org
Ev-K2-CNR Committee	The Ev-K2-CNR Committee is an autonomous, non-profit Italian association for the promotion and advancement of science and sustainable development in mountain areas, placing particular emphasis on the HKKH region.	Ev-K2-CNR contributed by promoting scientific research and environmental monitoring of high mountain areas.	www.evk2cnr.org
Cooperazione e Sviluppo (CESVI: Cooperation and Development)	The Italian NGO CESVI is an international humanitarian organization working in 30 countries for global solidarity. It is dedicated to the reduction of suffering and poverty in the world's poorest countries, through the mobilization and active participation of the recipients of aid.	CESVI involved local communities in the conservation and management of natural resources.	www.cesvi.org

region and to establish a process for building local capacities in using and applying these tools. It was a multiscale initiative, active at regional, national, and local levels with a special focus on 3 PAs: Sagarmatha (Everest in Nepali) National Park and Buffer Zone (SNPBZ) (1400 km^2) in northeastern Nepal, the Central Karakoram National Park (CKNP) (10,000 km^2) in the Northern Areas of Pakistan, and Qomolongma (Everest in Tibetan) National Nature Preserve (QNNP) (34,000 km^2) in Tibet Autonomous Region (TAR) of China (Figure 1). These fragile and remote mountain areas embody sociopolitical and ecological systems characterized by differing governance institutions, ecological significance, and scientific understanding; they are at different stages of evolution, from initiating the preparation of management plans to the implementation of revised management plans. The Project holistically considered how to best address the study areas' needs and constraints and was intended to integrate environmental sustainability in decision-making processes.

Approach, methodology, and tools

Communication is a crucial element in planning processes, especially when the involvement of stakeholders and decision-makers is required for a better understanding of a local SES and for sustainable management of natural resources. Successful communication can transform the ability of stakeholders to fully manage local natural resources and to enable community control over their environment

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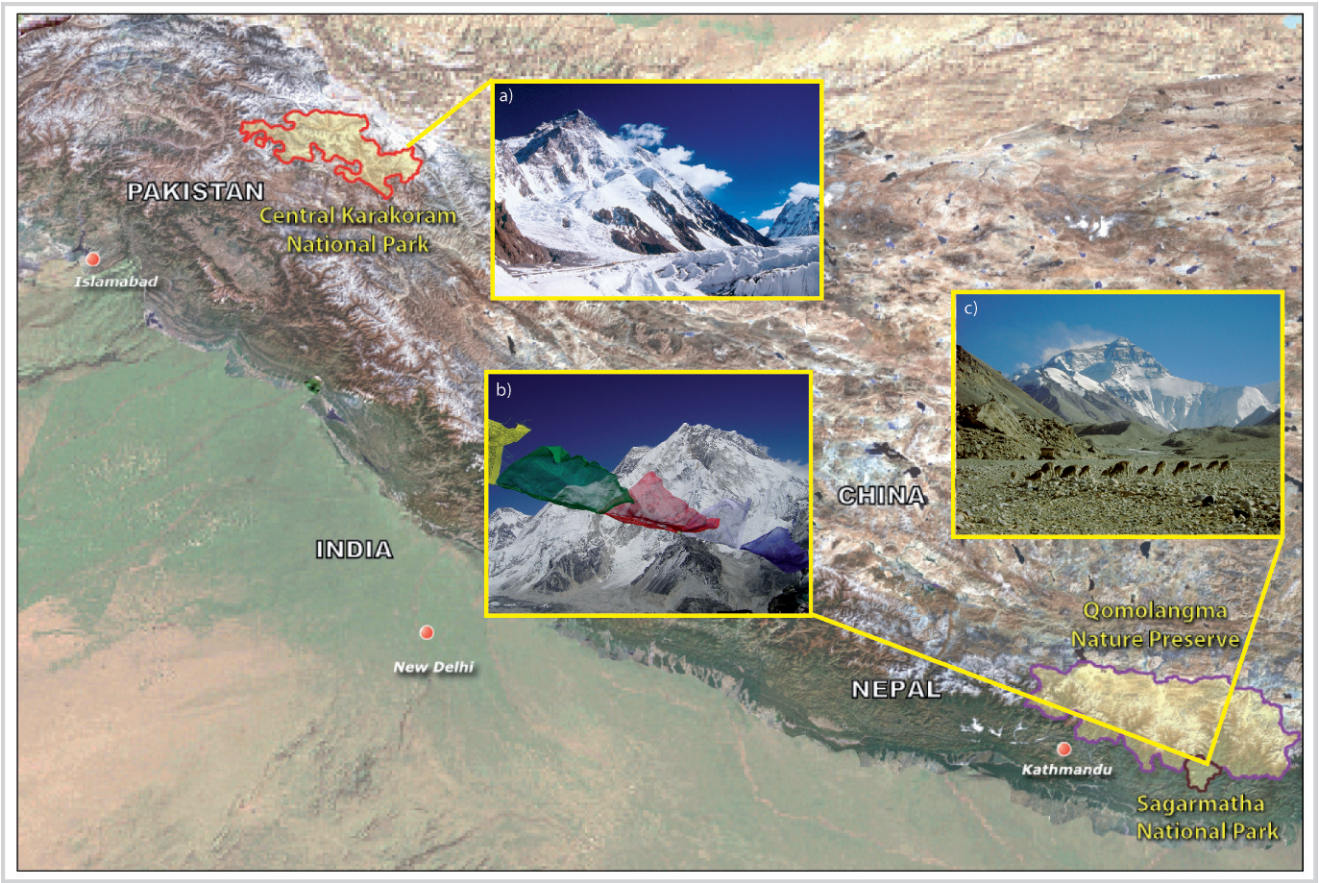
FIGURE 1 The Project's areas of intervention in the HKKH mountain protected area context: Central Karakoram National Park (CKNP) in Pakistan, Sagarmatha National Park and Buffer Zone (SNPBZ) in Nepal, and Qomolongma National Nature Preserve (QNNP) in Tibet Autonomous Region (TAR) of China. The figure inserts show (a) Mount K2 in Pakistan; (b) Mount Everest from the north side in TAR of China; (c) Sagarmatha (Mount Everest) from the south side in Nepal. (Map by IUCN; photos A and B courtesy of Ev-K2-CNR archive; photo C by Laxmi K. Amatya)



(Feek and Morry 2003). As shown in Figure 2, communication can be considered as a 2-way iterative process consisting of conveying or spreading information (message and feedback), which entails a relationship and interaction between 2 interlocutors (encoder and decoder) through an adequate means (channel) and a common language (code) to ensure mutual understanding (Schramm 1961). According to Schramm's model of communication, the sender can encode and the receiver can decode only if both parties work within the overlapping area of their fields of experience.

Translating this concept for our Project, an approach was adopted to focus on promoting and improving the communication capacity among encoding and decoding subjects (decision-makers, stakeholders, and researchers) involved in the management of natural resources. The objective of these interactions was to exchange knowledge (ie fields of experience), requiring a suitable methodology (rules, ie codes) and the development of tools (means of communications, ie a channel). Improved communication was deemed necessary to reduce the existing gap between research and management priorities. Stakeholders at the decision-making level decried a lack of access to crucial information on SES dynamics (Salerno et al 2009a). It was felt that this gap could be reduced by adopting methodologies and developing tools where both environmental issues and local people's needs were considered, and interventions would be calibrated to the specificities of each targeted site, including their different environmental, social, and economical features and constraints.

Organized along 4 different geographical scales, the following sections propose the methodologies considered adequate for sustainable management of SESs at each scale and the tools developed accordingly. The experience of the HKKH Project with these tools and methods is also briefly presented.

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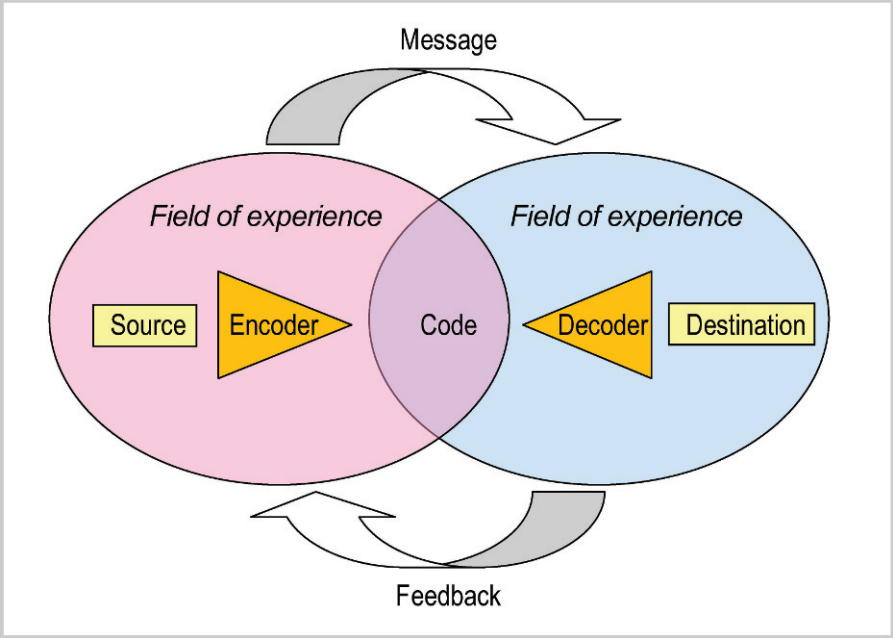
FIGURE 2 Model of the 2-way communication process, based on Schramm (1961). Effective communication is possible when the 2 parties (encoder and decoder) have an overlapping field of experience and use a common code.



The regional level

Adoption of international standards

Effective communication between stakeholders and researchers with different knowledge and skills is a crucial issue, because everyone adopts their own system of signs, notations, and languages tailored to their own culture (Hanisch and Churchman 2008; Meyer 2009). Scientific communication requires standards and a shared vocabulary to avoid misinterpretations. This need for international standards is especially important in high-altitude areas such as the HKKH, where remoteness and the complexity of SES makes it even more necessary to have communication tools that allow the sharing of knowledge (eg ISO metadata standards).

In the HKKH context, the need for a common vocabulary in the field of land cover occurred during a review of past land cover initiatives and existing data at global, regional, and national levels, which revealed major differences between methodologies and definitions, making them incompatible for applications across the region. Land cover legends were therefore developed using the FAO/UNEP Land Cover Classification System (LCCS) to harmonize and take into account the different nomenclatures and legends existing in the region's countries. A uniform methodology was then applied for land cover classification, using object-based image analysis in all 3 national parks with Project activities (Bajracharya et al 2010b, in this issue).

Sharing of knowledge and data

A crucial component in PA research and management is the dissemination of existing knowledge and data. There is a need to link research with management priorities by establishing mechanisms to make findings available to all parties with the goal of SES sustainability. Communicating knowledge can be promoted through networking platforms and integrated web-based systems, and the development of metadata systems can help to facilitate the understanding, use, and management of data.

For the HKKH Project it was recognized that a "research gateway" could serve as a data repository and as a means of disseminating knowledge and information on SES dynamics. The Project restricted these efforts to the development of an Integrated Web Portal (IWP) (www.hkkhpartnership.org) as the primary tool to host and disseminate information and data for the 3 pilot PAs, as well as promote interdisciplinary collaboration and communication among concerned stakeholders and the general public (Bajracharya et al 2010, in this issue). The IWP was built with the capability to integrate a wide variety of data, associated metadata, and information resources including Project documents, bibliographic citations, spatial data for geographic information systems

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FIGURE 3 Regional workshop on "Innovative tools and experiences in mountain ecosystem management" held in Kathmandu, Nepal, in August/September 2009. The participants (stakeholders, researchers, Project partners) were expected to share the most relevant and innovative experiences in their region and to gain familiarity with the tools developed by the Project. The event also served as a tool to strengthen the communication process among decision-makers and managers and to collate their different ideas, needs, and perspectives in the planning and management of their protected areas. (Photo by Emanuela C. Manfredi)

(GIS), data for system dynamics models, interactive maps, satellite images, and other research data.

Fostering participation of stakeholders

To ensure that user needs are addressed and a sustainable process of improved natural resource management is established, key stakeholders and decision-makers should be involved in the iterative process of system conceptualization, development, and implementation. This participatory process supports the development of a systemic decision-making framework through promotion of knowledge sharing, an improved understanding of environmental processes, and availability of effective decision support tools (Salerno et al 2010a, in this issue).

The HKKH Project conducted regional workshops (Figure 3) as a tool to bring together stakeholders and other Project actors (researchers and modelers) for developing a common management process and for the establishment of effective communication (eg IUCN 2007; Pradhan and Amatya 2009).

The national level

Promotion of transboundary cooperation and research

Mountain ranges are often shared among several countries but international cooperation can be limited or hampered by national legislation. The increasing relevance and awareness of transboundary international cooperation is due to several factors (UNESCO–EABRN 1997) including the need to (1) improve management of shared natural resources and effectiveness in protecting the habitats and species of cross border ecosystems, (2) bring long-term benefits to the countries through improved conditions for local sustainable development, and (3) reduce boundary disputes (Agrawal 2000; Zbicz 2003; Hewlett et al 2004; Danby and Slocombe 2005). Through such cooperation, communication, exchange, and understanding among people can be enhanced and national level dialogues facilitated, as these are crucial ingredients toward regional security and appropriate environmental practices.

In the HKKH complex, the SNPBZ and QNNP are adjacent and located at the national borders between Nepal and TAR-China. Therefore, a Memorandum of Understanding (MoU) with the Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Science (IGSNRR/CAS) was signed to initiate transboundary cooperation between the north and south sides of Mount Everest for the comparative analysis of meteorological trends and limnological conditions to assess the status of glacial lake water quality in both countries (Giardino et al 2010, in this issue).

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Facilitation of exchange visits among decision-makers

For SES management in mountain areas that spread over diverse countries, exchange visits among decision-makers are a useful and important means to promote dialogue and the exchange of knowledge and competencies. Exchange visits also provide an opportunity to share experiences and good practices, as well as improve the twinning of countries, long-term partnerships, and networks, thus establishing the way for cooperation.

The HKKH Project included North–South and South–South exchange visits between the participating countries, along with national training programs, international research collaborations, and support for higher education. The exchange visits were specifically aimed at sharing of knowledge about the HKKH complex and involved both local and international scientists (eg visits from Kathmandu University, Tribhuvan University, Chinese Academy of Science) as well as stakeholders (Flury et al 2009; Zhang et al 2009).

The local level

Participatory modeling

Participatory analysis and modeling is an excellent methodology for the study of SES dynamics, (Salerno et al 2010a, in this issue). This process consists of diverse steps, from the identification of the problem to the application of qualitative and quantitative modeling, and resulting in management proposals for the sustainable use of natural resources. The feasibility of fully completing the participatory modeling process depends upon several factors, including local political stability (Salerno et al 2009a), the availability of local communities and decision-makers willing to openly discuss and remain involved in management options, and the level of knowledge adequate for the implementation of SES models (Pirot et al 2000).

To facilitate the implementation of participatory modeling by stakeholders, it is necessary to offer a tool such as a Decision Support System (DSS) capable of assisting stakeholders in modeling phases. A Decision Support Toolbox (DST) was developed to address the needs of involved stakeholders (assessing, planning, managing, and monitoring) and support them in decision-making processes for the management of SES at different spatial and temporal scales (Bajracharya et al 2010a, in this issue). Integrating the outputs of the participatory modeling process, the DST is composed of both hard and soft system components, including Scenario Planning (Daconto and Sherpa 2010, in this issue), and qualitative and quantitative system dynamics models. To support analysis of the SES, the DST has multiple functions, including a knowledge base, a GIS, and system dynamics models.

In the HKKH Project, the DST was developed for the SNPBZ both as a functioning decision support system and as a demonstration for other PAs. This was possible based upon the existing extensive knowledge of the social-ecological dynamics of the park and its well-developed management capacity and history. Different scenarios were developed to analyze and simulate diverse management proposals related to the main issue of the SES, that is, tourism (ICIMOD and Ev-K2-CNR 2009). The primary issues include forest conservation, energy management, and impacts of fuelwood use on the environment and human health (Salerno et al 2010b, in this issue) and solid waste management and water quality (Manfredi et al 2010, in this issue). In Pakistan's CKNP, because of the national political constraints and the remoteness and harsh conditions of this mountain area, as well as the scarcity of knowledge of the park and its resources, the DST has had limited development to date. An explorative Scenario Planning exercise and qualitative analysis of the CKNP's SES were performed to identify major issues and management priorities. In addition, a draft Management Plan for the CKNP was developed, which addresses a number of key issues such as what conservation model should be adopted, and establishes baseline data for monitoring, community involvement, definition of park boundaries and development of a zoning system (Salerno et al 2009b; Mayer et al 2010, in this issue).

Management-oriented research

When science is requested to support the management of natural resources, information needs to be obtained on management priorities and the concerns of the local communities; this, in turn, determines the research design itself. It is often difficult to distinguish between basic and applied research and give the latter a management-oriented component. The management-oriented aspect should not be perceived as an attribute of the research, but it should become its objective. A participatory process with the involvement of concerned stakeholders should establish the management goals or options, define the objectives, and determine the data that need to be collected. Permanent environmental monitoring sites (ie meteorological and hydrological) may be very appropriate in SES sites. Data of interest for management aims can thus be monitored over time, and the effects of management interventions on the environment can be assessed.

All HKKH research in the 3 PAs was designed to be management-oriented to provide appropriate information and a knowledge base on SES issues for decision-makers. To date, field activities conducted in the SNPBZ include forestry, waste, energy, water quality, and tourism management, while research programs undertaken in the CKNP have focused on glaciology, forestry, biodiversity, and wildlife (Figure 4). Suitable environmental monitoring schemes were initiated and permanent environmental monitoring sites established to collect key management data in the SNPBZ (eg on water quality, reduction of solid waste generation, forest condition and fuelwood consumption).

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FIGURE 4 Management-oriented research on biodiversity conducted in CKNP-Pakistan: local students from Karakoram International University (KIU) collect samples of macro-invertebrates. (Photo by Leonardo Latella)

The cross-scale level

Building the capacity of resource people

Human capacity building is an essential element to strengthen people's abilities and skills to study, analyze, and manage an SES. Priorities for human capacity building can be determined by analyzing the gap between the existing capabilities of resource people and institutions, their potentials, and the needed SES management expertise. Developing capacities of decision-makers, researchers, and the local communities is also important to increase their understanding of available development and management opportunities.

For the HKKH Project, a capacity-building framework was prepared with specific actions at all levels including a series of workshops, training courses, and on-the-job training for the use of scientific information and tools developed by the Project (Figures 5, 6). Capacity-building initiatives also included exchange programs for young researchers and involvement of local mountain communities. Participation of local stakeholders during qualitative systems analysis, scientific research processes, and the revision of DST design enabled them to better understand the existing SESs (Bhandari et al 2009; CESVI 2009).

Lessons learned and the way forward

From the 3 years of the HKKH Partnership Project the following major lessons emerged:

- *Institutionalization of new methodologies and tools:* The proposed new methodologies and tools for the management of natural resources should be coupled with a subsequent phase for their institutionalization.

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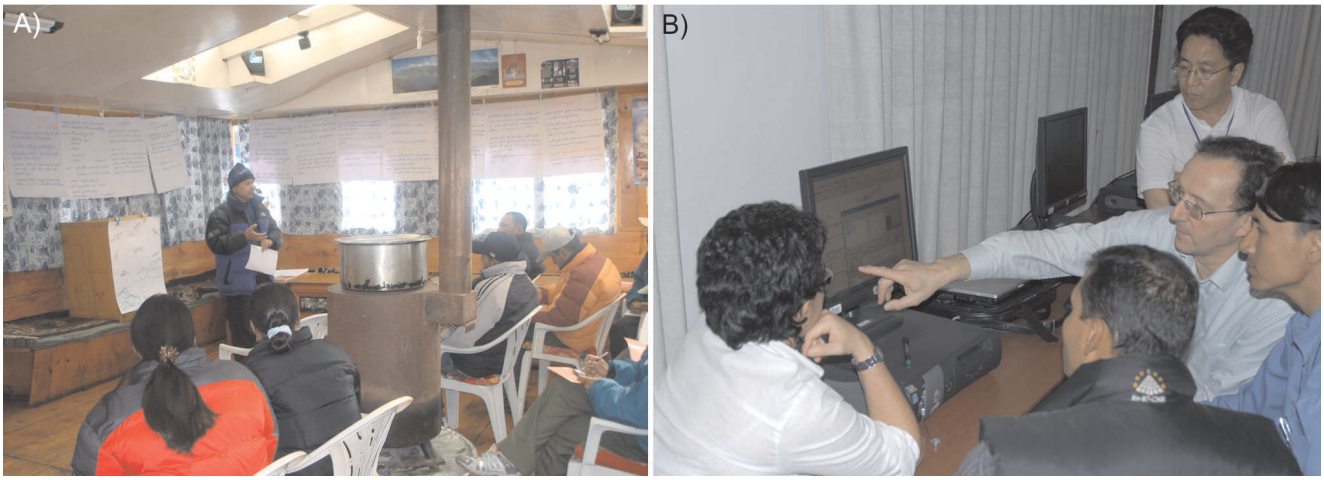
FIGURE 5 (A) Orientation training for SNPBZ management for the local stakeholders in Khumjung, Solukumbu, Nepal; (B) on-the-job training on System Dynamics Modeling for local researchers and stakeholders. (Photos by Sudip Pradhan and Emanuele Cuccillato)



However, real institutionalization often requires considerable time for a perspective change in SES management (El Sherif 1990; Kanungo et al 2001). For instance, a project such as the one described in this paper should be followed by another initiative primarily focused on strengthening capacity to use the tools among concerned users such as community managers, policy-makers, and researchers.

- *Increasing the participation of concerned stakeholders:* The participation of local stakeholders in the HKKH Project was extensive and active, especially in the implementation phase of each subproject's activities, which is the crucial time when problems are analyzed and the qualitative model established (Salerno et al 2010a). However, their involvement decreased in the course of the Project's lifetime; this needs to be avoided in similar efforts. Participation should be cultivated more intensely during the final development of the management scenarios for improved evaluation and validation. This involvement may be maintained by encouraging stakeholder groups to be assigned more decision-making power during the planning of the project's activities (eg in the approval of project working plans), thus ensuring that they will participate in the entire decision-making process.
- *Steering the research more toward the management priorities:* Scientists are often not inclined to give their research a management priority. Unfortunately, the scientific community does not sufficiently reward research oriented toward management or applied issues (Hatchuel 2001; van Aken 2004). It is important to encourage both applied and basic science.

FIGURE 6 Workshop on participatory 3-D modeling of SNPBZ, Monjo, Nepal. A 3-D model of the park was constructed with participation of local communities and stakeholders to provide local people and visitors with a physical model of the physiographic structure of the Park. (Photo by Birendra Bajracharya)

Conclusions

In general, as a partnership initiative, the HKKH Project has demonstrated a model for organizations with similar mandates, but different foci and cultures, to work collaboratively toward a common goal that can be achieved only through the combination of expertise, viewpoints, and techniques, rather than working individually and often in a single thematic area. The synergies developed among the Project's executive partners should be maintained and additionally supported to build an extensive network of local, national, and international organizations, including private, nongovernmental, governmental, research, and community organizations.

Based on the HKKH Project's experience, the following additional observations can be made:

- It is critical to develop common standards and promote the establishment of points of contact for knowledge exchange. This requires improving and consolidating an effective research gateway.
- It is important to establish and maintain MoUs for transboundary cooperation initiatives. Transboundary initiatives conducted in the Everest region were the foundation for the HKKH Project and offer a potential for replication in other neighboring countries.
- The HKKH Project established one of the very few applications of a DST to SES and natural resource management in mountain environments. It was developed at the local level for the SNPBZ but has the potential of being replicated and applied in other mountain PAs. It can also be further improved and refined and eventually expanded to a regional level.

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