Chapter 11

Communities, Ecosystems, and Livelihoods

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Main Messages

Community-based assessments are necessary components of multiscale assessments such as the MA. They capture real-life experiences of changes in ecosystems and human well-being. They also give information about existing management systems behind ecosystem services. In addition, a fine-grained look highlights processes and patterns that would not otherwise be evident, such as key resources situated in fine-scaled patches and appropriate times for management interventions. Understanding the co-evolution of knowledge, ecosystems, social institutions, and management practices; their complexity, unevenness in space and time (lumpiness) and nonlinearity; and the feedbacks among them is at least as important as documenting causes and effects.

Local communities are not mere spectators, but active managers of ecosystems' capacities to deliver services. Community management systems are continuously evolving; some disappear while others are revived or created from scratch. Many communities possess local knowledge about the interactions between humans and ecosystems, and affect ecosystem services and human well-being positively. For example, in Xinjiang, Western China, local people have elaborate traditional underground water harvesting structures that maintain both water quality and quantity. However, community-based management in itself does not guarantee proper ecosystem management. In the Eastern Himalayas, for example, national economic incentives have led some communities to cut down indigenous forests. Institutional frameworks that support stewardship of ecosystem services are required. Recognition of the role of communities as stewards of ecosystem services, and their empowerment, is essential to strengthen the capacity to manage ecosystems sustainably for human well-being.

Diversity in ecosystems is important in reducing communities' vulnerability. Most communities seek to maintain a diverse range of livelihood options. This diversity buffers people against shocks and surprises such as climatic and economic fluctuations. In Papua New Guinea and Indian villages, for example, local farmers cultivate a wide variety of crops to avert the risk of crop failure. In Bajo Chirripó, Costa Rica, local communities nurture a mosaic landscape, consisting of sacred places, springs, agroecosystems, and high mountains, thereby creating a diversity of livelihood options at the local level.

Spiritual and cultural values of ecosystems are as important as other services for many local communities. Ecosystems provide a sense of place and identity for local people, in addition to other ecosystem services. These intangible values, including aesthetic and recreational values, provide a rationale for management, and precipitate management practices that enhance ecosystem resilience through caretaking and custodianship. In Vilcanota, Peru, spiritual values and belief systems, including the belief in Pachamama (Mother Earth) that encompasses the view that Earth is a living being, have allowed for the maintenance of a cultural identity among the Quechua peoples of the southern Peruvian Andes. In Kristianstad Wetlands, Sweden, local farmers have again begun to cultivate land previously abandoned, not for economic gain, but for the sense of place and identity that comes with the cultivation of this land. However, in many places, these values and belief systems have been eroded, leading to a shift in community-based management practices. For example, in San Pedro de Atacama, Chile, the erosion of the collective indigenous identity due to economic development has led to the sale of land to outsiders, and a consequent decline in agriculture and related traditional practices.

Communities are affected by larger-scale processes, but their ability to cope with and shape change varies. For example, decisions taken at higher scales often do not take into account the realities of local communities, resulting in negative impacts at the local level. Communities that cope with these external forces have learned to adapt or even take advantage of them by creating horizontal links with other groups, forming alliances with powerful actors at higher spatial scales, and linking with national or global processes such as policy forums, markets, and multinational agreements. When conditions become impossible to adapt to, for example due to inflexible national policies, people are forced to migrate or face a reduced quality of life. In Sistelo, Portugal, for example, a government afforestation program in common property land diminished the locally available livelihood and coping strategies, accelerating the process of rural–urban migration.

Vertical and horizontal collaboration that includes communities can improve ecosystem management and human well-being. Key actors, social networks, trust-building processes, and bridging organizations across scales are important vehicles in this process. In Kristianstad Wetlands, Sweden, for example, local managers are using an international program to strengthen development through the conservation of valuable local wetlands. In Papua New Guinea, trade links between islands ensure ecosystem diversity and enable people to cope with change.

Capturing the complex and dynamic nature of the interactions between ecosystems and humans requires complementary conceptual frameworks. Several community-based assessments adapted the MA framework to take account of more dynamic interplays between variables, capture fine-grained patterns and processes in complex systems, and allow for the integration of worldviews that regard nature as animate entities. In Vilcanota, Peru, and Bajo Chirripó, Costa Rica, for example, other conceptual frameworks were used that incorporated both the MA principles and local cosmologies. In southern Africa, various frameworks were used in parallel to offset the MA framework's shortcomings as a community assessment tool.

11.1 Introduction

The MA community assessments were conducted across five continents in many different settings. The contexts ranged from remote, highly traditional people using ecosystems on a day to day basis, to recently democratized but poor semi-urban people who are forced to rely on ecosystems as safety nets during times of extreme poverty, to urbanized professionals who care about ecosystems and who want to manage them better for biological and cultural values. Apart from being in different countries and on different continents, the community assessments that formed part of the MA varied widely in terms of the livelihoods of the communities involved, the nature of the people's relationship with their natural resources, the cultural characteristics of the community, and the biomes or ecosystems where people were situated.

This chapter is mainly based on examples and emerging insights on the role of local communities in ecosystem management generated by the community-based assessments of the MA, and other MA sub-global assessments that included community perspectives (San Pedro de Atacama, Coastal BC, Bajo Chirripó, Tropical Forest Margins, India Local, PNG, Vilcanota, Laguna Lake Basin, Portugal, São Paulo, SAfMA Livelihoods, Sweden KW, Sweden SU, Northern Range, Downstream Mekong, Western China, Eastern Himalayas, Sinai, and Fiji). The chapter also draws on published studies and theoretical principles. It emphasizes the people-within-ecosystems perspective and the social dimensions of managing dynamic ecosystems at local to regional

scales. It focuses on local communities' influence on the capacity of ecosystems to generate services, and the role of these services in their livelihoods. It also explores the significance of empowering and enhancing the capacity of local communities as custodians of ecosystem services (for example, Johannes 1981; Nabhan 1997).

Community empowerment may help improve livelihood options and the ability to redirect and use external drivers for enhancing community well-being. The empowerment of local communities is increasingly important in a global society where people in one part of the world are dependent on ecosystem services in another part. This requires engaged communities with institutions that provide incentives to respond to and shape change for social–ecological sustainability. It also requires governance systems that allow for and support community processes that improve the capacity of ecosystems to generate services.

By focusing on the peoples' perspectives and their management systems, it becomes possible to address:

- how local users view ecosystem services and incorporate traditional knowledge and practices;
- how the community views indicators of human well-being;
- how local people manage ecosystem capacity behind those services, including management practices, institutions, and governance systems;
- how local people are affected by large-scale processes, and how they shape or cope with the resulting changes; and
- the linkages between communities, institutions (norms and rules), and organizations at other scales, and the role of social networks in the vulnerability or resilience of local people.

Hence, the overall perspective of the chapter is that local communities are not just recipients of ecosystem services, but influence and shape the capacity of ecosystems to generate services. Despite claims of integrative analyses, social systems and ecosystems are often dealt with separately. Here, we attempt to understand the feedbacks between community-level human adaptations and ecosystem change, and are interested in how communities cope with changes precipitated by processes or events operating at different temporal and spatial scales. The chapter highlights the *processes* that characterize human–ecosystem interactions, also called social-ecological systems (Berkes and Folke 1998; Gunderson and Holling 2002).

This section examines the rationale for community-based assessments, including a discussion of the underlying theory. The next section introduces the community-based assessments and highlights the diversity of approaches and methods employed, including alternative conceptual frameworks for assessments of social-ecological systems. The section after that discusses the major findings and insights of the community-based assessments, focusing on ecosystem services and local livelihoods, local management systems, and cross-scale interactions. The overall implications of these findings for ecosystem management are offered in the next section. The examples cited in this chapter are contributions from representatives of the community assessments, who are also authors of this chapter, unless otherwise stated.

11.1.1 Rationale for Conducting Community-based Assessments

Local people shape ecosystems, and ecosystem services should not be assessed without recognizing this. Furthermore, communities are the primary users and managers of most ecosystems, and are aware of their needs and goals in ecosystem management. Including public participation in scientific assessments adds local and indigenous perspectives to scientific knowledge (Functowicz and Ravetz 1990). Assessments with local participation are able to incorporate a more pluralistic perspective, increase public confidence in scientific findings, and ensure representativeness in scientific processes (Bäckstrand 2004). In addition, assessments where traditional societies are involved have the potential to ensure continuous use and transmission of traditional knowledge and practices. The importance of public participation in scientific processes is increasingly being recognized, and the MA community-based process is a step in that direction.

The challenge of improving ecosystem management is to develop institutional structures that are similar in scale to the ecological and social processes they are meant to manage. Such institutions should also, however, establish links with processes and institutions operating at other spatial and temporal scales. Community-based assessments generate information on slow-moving, long-term changes and on more rapid short-term change. They also help identify workable management interventions, by incorporating the knowledge and experience of primary resource users.

Community-based assessments represent an appropriate way to obtain fine-grained information about ecosystem services and processes and their relationship with human well-being for a number of reasons:

- *The community is the most direct link to the ecosystem.* Local people are acutely aware of ecosystem services in their area, which is why the local assessments found many examples where communities were able to identify threatened and valuable resources that distant researchers working at coarser spatial scales were unaware of. In India, for example, local people have been the custodians of local medicinal plants and natural health remedies for generations (India Local). These medicines and health remedies are now being re-discovered by health food producers and pharmaceutical companies. Local people, being closest to the affected area, have the potential to detect and respond to ecosystem change long before remote scientists can. Ecosystems are part of the cosmology of many communities, in particular of traditional societies, and much of their folklore, belief systems, and management practices have co-evolved with ecosystems.
- *Local resource users and managers possess traditional and local ecological knowledge that provide lessons for sustainable development.* (See also Chapter 5.) Local ecological knowledge consists of externally and internally generated knowl-

edge about resource and ecosystem dynamics, generally a combination of scientific knowledge and practical experience. (See Glossary for definitions, and Chapter 5 for broader discussion.) All the community assessments found that traditional and local knowledge play important social functions. Communities also use this knowledge in forecasting ecological events, managing and regulating resource use, adapting to change, and using and combining technology. For example, indigenous farmers in the high Andes of Bolivia and Peru look to the stars toward the end of every June to forecast weather for the next six months. If the eleven-star constellation known as the Pleiades appears bright and clear, they anticipate early, abundant rains and a good potato crop. If the stars appear dim, however, they expect a smaller harvest and delay planting in order to reduce the adverse impact of late and scarce rainfall (Orlove et al. 2000). However, in many communities, traditional knowledge has all but disappeared, existing mostly in the elderly, with young people turning their backs on it. In San Pedro de Atacama, Chile, this erosion of traditional knowledge has been identified as a problem, and some communities are trying to revive it. In areas where traditional knowledge has been preserved, it can contribute to local development, either in its original or in modified form. Pardhi hunters in India, for example, are now using their traditional metal work skills, originally developed to make weapons and hunting traps, to produce commercial cutlery (India Local).

- *Local resource users may detect and respond to early signs of fluctuations in the flow of ecosystem goods and services.* In the Philippines, local fisherfolk detected changes in the fish populations of Laguna Lake in the 1970s, spearheading conservation and mitigation efforts supported by government. In Egypt's Sinai Desert (Sinai) and in Richtersveld National Park, South Africa (SAfMA Livelihoods), nomadic and semi-nomadic pastoralists know when to move with their livestock in advance of dry spells. Communities in the Great Fish River area of the Eastern Cape start preparing for rainfall events before they happen by cleaning water-harvesting structures (SAfMA Livelihoods). People of Hudson Bay, Canada, have knowledge about changes in variables related to climate and link this knowledge to the long history of close interaction with nature (Riedlinger and Berkes 2001). Olsson and Folke (2001) describe how members of a local fishing association in Sweden use indicators at various scales that are critical in detecting fundamental changes in ecosystem dynamics; management decisions are guided by monitoring these indicators to keep track of environmental change. In Peru, farmers have been forecasting El Niño events for at least 400 years by looking to the stars, a capability modern science achieved less than 20 years ago (Orlove et al. 2000). In India's Western Ghats, local villagers noted that potentially valuable rice varieties were on the verge of extinction and started taking special measures to conserve them; if appropriate procedures are followed, these traditional varieties could lead to local economic benefits (India Local).
- *Local knowledge can complement scientific knowledge.* (See also Chapter 5.) The entire MA process has demonstrated how local and scientific knowledge can be combined to improve our understanding of ecosystem services and functioning. In the process, lessons are learned on all sides. A good example is the People's Biodiversity Register in India, where villagers and schoolteachers contribute to biodiversity inventories throughout the country (India Local). The information is incorporated in the Indian National Biodiversity Strategy and Action Plan within the mandate of the National Biological Diversity Act, 2002. Other examples include villagers in Karnataka who brought the decline in endemic fish populations to the attention of biologists (India Local), and local experts in South Africa's Great Fish River valley who helped ecologists improve their understanding of landscape dynamics (SAfMA Livelihoods). The MA process has provided further documentation over a wide range of human and ecological systems of how local knowledge can be combined productively with formal knowledge, including an overview of the many pitfalls associated with this work. (See Chapter 5.) Combining knowledge based on different worldviews is not easy, and there are major ethical and methodological problems that need to be overcome (Cundill et al. 2004).

11.1.2 Theoretical Background

Social-ecological systems are complex, self-organizing systems dominated by nonlinear phenomena, discontinuity, and uncertainty (Costanza et al. 1993; Levin 1999). This means that it is hard to make a distinction between ''drivers'' of ecosystem change (see Chapter 7) and ''responses'' at the local level, since the manager's response is a driver at the scale of the ecosystem being assessed. In this sense, the MA concept of endogenous and exogenous drivers became particularly important in community level assessments. However, the distinction and classification of endogenous versus exogenous drivers can lead to much ambiguity and circularity of argument, and therefore we have chosen not to use these terms, but rather to discuss interactions in social-ecological systems.

Sustainability is a process rather than an end product. The lesson from complex systems thinking is that management processes need to be flexible and adaptive in order to deal with uncertainty and surprise (Gunderson and Holling 2002; Dietz et al. 2003). All sub-global assessments found that governance was a critical component of management, and that weak systems of governance were invariably associated with social-ecological systems that struggled to adapt to change. Sustainable governance therefore requires the active involvement of people and communities that build knowledge and understanding of resource and ecosystem dynamics, develop management systems that interpret and respond to ecosystem feedback, and support flexible organizations, institutions, and adaptive management processes (Berkes et al. 2003). The governance system needs to be adaptive to external influences and change. The challenge

is not to avoid change, but to sustain a desirable social-ecological state in the face of complexity, uncertainty, and surprise (van der Leeuw 2000). Some insights about how to do this can be derived from communities, who have historically adapted their resource management systems and institutions to cope with change and uncertainty in nature (Feeney et al. 1990; Scoones 1999; Pretty and Ward 200; Fabricius and Koch 2004).

Resilience—the capacity to cope with, reorganize, and develop following change—is an important element of how societies adapt to external forces such as global environmental change (Holling 1973; Holling 1986; Folke et al. 2002). Resilience is an important element in efforts aimed at strengthening the capacity to manage ecosystems for human well-being (Carpenter et al. 2001; Gunderson and Holling 2002). (See MA *Current State and Trends,* Chapter 6.) There are many examples of communities whose resilience has been eroded (for example, Ainslie 2003), but there are also examples of those that have enhanced their resilience (for example, Kristianstad Wetlands, Sweden). Such community-based management systems have developed knowledge and practice for how to live with change and uncertainty (Berkes 2004).

The focus in this chapter starts at the level of the community, defined as a social group possessing shared beliefs and values, stable membership, and the expectation of continued interaction. It can be bounded geographically, by political or resource boundaries, or socially as a community of individuals with common interests (Berkes et al. 2001). Furthermore, a community is not a static, isolated group of people. Local responses are influenced by global and national trends and fads, which can lead to changes in incentive structures and the modification, or even erosion, of self-organized community-based systems.

The MA community assessments focused on communities directly involved in resource and ecosystem management, and were conducted in both temperate and tropical regions, including various biomes, from mountains to coastal areas. The sizes and scales of these areas varied, but they were all local in scale relative to national or regional sub-global assessments. The Bedouin in the Sinai desert in Egypt and semi-nomadic pastoralists in Richtersveld National Park, South Africa (SAfMA Livelihoods), for example, manage and use vast areas, but focus their management on key resource areas. In more resource-rich areas such as Sweden KW and India Local, where human density is high, the community-based management units are much smaller, and the assessments not only assessed the use of ecosystem services, but also their management and governance.

In the context of the MA, ''community assessments'' must at least meet the following criteria:

- there is some level of local participation in aspects of data collection and assessment design;
- data are collected at a fine resolution, typically at spatial scales of between 1:10,000 and 1:50,000, and interpreted in the context of local, national, and global factors;
- qualitative, quantitative, formal, and informal information are combined;
- local knowledge is incorporated into the assessment findings and recommendations; and
- the results are useful to *local* decision-makers, for example, those in community organizations, villages, or municipalities.

11.2 Methods

11.2.1 Diversity within and among Assessments

When dealing with communities, researchers and practitioners face a number of pitfalls. One is striving for, or assuming, homogeneity and glossing over differences in needs, cultures, and customs simply because people live in the same area. The other is assuming that only groups that are geographically close together share the same interests. This heterogeneity is illustrated by the communities involved in the MA. Within each community, different groups have different interests, livelihood strategies, demographics, networks, and interactions with ecosystems. Among rural groups living in the Gariep Basin in South Africa, for example, there is considerable variation in people's interactions with and connectedness to ecosystems. For many households, wage labor, remittances, and migration have replaced agriculture as the main sources of income, but most people still maintain a link to ecosystems by owning some livestock, cultivating crops, and harvesting fuelwood for heating and cooking (SAfMA Livelihoods).

Several ''livelihood clusters'' (functional units of people who make their living in similar ways) occur at the village level. These clusters overlap in terms of their geographical distribution, kinship linkages, and institutional affiliations. Individuals can belong to more than one livelihood cluster and the differentiation is more complex than gender or age groupings. In Mala, India, up to 20 castes and more than 25–30 user groups, all with different needs and value systems, comprise a village. Hence, knowledge of changes in medicinal plants is mainly held by medicinal plant collectors, while farmers best understand land use change (India Local).

Gender roles are also an important component of community diversity. In Bedouin society, for example, women are most familiar with the variety of weeds and herbs used for treating infant diseases, and possess knowledge about agro-diversity practices (Sinai). In the Gariep Basin, knowledge about trends in the availability of fuelwood is held mainly by women, whose role it is to collect fuelwood on a daily basis for household use; women are also responsible for collecting water, and have a special interest in maintaining and protecting small perennial fountains and sacred pools (SAfMA Livelihoods). Among many local groups, for example, the Egyptian Bedouin, Nama pastoralists at Richtersveld, and Xhosa villagers in South Africa's Great Fish River basin, men make decisions about livestock management and have a special interest in managing rangelands.

One implication of diversity for ecosystem management is that local governance structures should recognize the various interest groups and their different roles in ecosystem management. The implication for conducting assessments

is that these different groups should all be involved in the assessment process.

11.2.2 Approaches and Methods

The community-based assessments faced a number of methodological challenges. One was the diversity described above, which required MA methods and frameworks to be adapted to the local context. A related challenge was how to engage communities in a process that had to a large extent been pre-designed, in terms of the conceptual framework, which was used to varying degrees to determine both which questions were considered important and how to interpret assessment findings. A third challenge was securing the continued buy-in of potential assessment users; even assessments that had local involvement prior to initiating the assessment process often found that the buy-in was superficial and waned once users realized that the assessments were not able to live up to local expectations of control and benefits; assessment teams had to both ensure a range of long-term and short-term benefits to local users and develop mutual respect. A fourth challenge was cross-scale interactions, which required a multiscale approach. Finally, the assessments had to rely on several types of data, demanding flexible methods for collecting and validating both scientific and oral information.

The methods are described in each assessment, and so this section does not seek to provide the reader with a road map for how to conduct an integrated community-level assessment. Rather, the intention is to highlight the necessity of adapting the assessment process to the local context, and to provide examples from various assessments around the world that illustrate how this can be achieved.

11.2.2.1 Community Engagement and Benefits

The MA community-based assessments emphasized community participation in the assessment process; they were performed in collaboration with local people who are involved in resource and ecosystem management for livelihoods or for other values. (See Box 11.1) Consequently, it would not be appropriate to assess biological resources and ecosystem services of a certain area and afterwards gather stakeholders to become involved in their management. The design of the MA allowed considerable flexibility, and therefore the social dimension of the assessment areas could be assessed through an inventory of the different actors involved in resource and ecosystem management. This has been referred to as a social inventory; examples include Sweden KW, SAfMA, and San Pedro de Atacama.

From the outset, it was essential to plan for long-term benefits to communities that were involved in the assessments. These benefits needed to outlast the short-term involvement of MA practitioners. Potential long-term benefits included: improved ecosystem production and resilience; capacity-building; access to government officials (for example in workshops) to demonstrate local knowledge and desire to initiate projects; availability of all assessment reports to nominated local leaders and to government officials as an information base for future development projects; empowerment of weaker sectors in the community; and the involvement of local schools in capacity development initiatives.

11.2.2.2 Cross-scale Interactions

The community-level assessments were aimed at understanding local level processes. It was therefore necessary for the assessment teams to work across spatial and temporal scales. Local, sub-national, national, and international drivers of change invariably related to political, economic, and biophysical processes at coarser scales, thus forcing the community-level assessments to seek innovative methods of incorporating information from coarser scales into their local level assessments.

In some instances, communities were not aware of the nature and extent of coarse-scale drivers and how these affected their lives, and therefore coarser scale information had to be incorporated by the investigators themselves. But in SAfMA Livelihoods, interactive scenarios (van der Heijden 1996; Peterson et al. 2003) were found to be useful mechanisms to involve communities in identifying and understanding the importance of coarse-scale information linkages. These scenarios were based on an interpretation of information already gathered at the local level by both researchers and local community members, and included national level data on political and economic changes. The scenarios were presented using forum or community theater and digitally enhanced posters summarizing key changes in the relationship between local communities and ecosystems. (See Chapter 10.)

11.2.2.3 Data Collection and Validation

Not all methods of data collection and validation were appropriate in all contexts. One important variable was the level of formal education of the participating community, in other words their literacy and numeracy rates. A second variable was their previous exposure to ecosystem assessments. A third variable was available budget and time. A fourth was the level of direct dependence of communities on ecosystems, and how closely they were involved in ecosystem management, and, correlated with this, their depth of traditional knowledge. To adapt the assessment process to their particular contexts, most community assessments opportunistically combined different methods of data collection.

The methods ranged from low-technology, qualitative interviews (Sinai) to high-technology computerized mapping and Geographic Information Systems (SAfMA and San Pedro de Atacama). Participatory learning approaches were employed to ensure consensus-based interaction with local knowledge. However, this local knowledge alone was not sufficient to gain an understanding of the broad set of processes that affect local social-ecological systems, and therefore had to be combined with a range of formal (historical records, census data, GIS, water and soil quality testing) and informal data (participatory rural appraisal, workshops, in-depth interviews, household interviews). In Vilcanota, Peru, trained local technicians from the communities made observations, did forecasting and back-casting, and dis-

BOX 11.1

Two Methods of Community Engagement: Vilcanota and San Pedro de Atacama

Vilcanota was a community-led assessment with emphasis on indigenous peoples' rights. Methods combined traditional Quechua ecosystem assessment techniques with contemporary participatory enquiry methods that promote equity and social justice through the direct involvement of, and control of the process by, the local indigenous population. Quechua methods included the use of prophecies and myths (where ecosystem processes and practices are communicated through myths); forecasting and backcasting techniques; and memory, writing, record keeping, and coding information traditions (such as the *Khipu* system, a binary coding and knowledge registration system). Contemporary participatory enquiry methods included community-based evaluation, deliberative democratic evaluation, practical participatory evaluation, and empowerment evaluation.

Within this framework, emphasis was given to (1) the goals and interests of the Vilconata communities and (2) equity issues and dimensions of the process. The goals and interests included:

- the problem-solving orientation of the assessment (the assessment was being used to establish a spiritual park in the Vilcanota area);
- the achievement of political goals such as social justice and a voice in decision-making; and
- the incorporation of the Quechua worldview, particularly the importance of cultural and spiritual values.

The equity and process issues included:

- local control of decision-making;
- local control over the selection of participants; and
- significant participation by various members of the community.

The assessment process helped Vilcanota communities gain control over the information produced. By interpreting ecosystem phenomena with a conceptual framework based on their worldview, the communities managed such information and applied it to the establishment of the spiritual park in a manner that responded to their traditional institutions, customary laws, and economic, social, and cultural aspirations.

The ***San Pedro de Atacama*** assessment was a multistakeholder process with an emphasis on engaging all affected parties. The area's social complexity (legitimate demands from the indigenous communities, high concentration of government development initiatives, large-scale mining, an emergent tourism industry, globally relevant astronomical projects and ongoing conflicts between users over water and access to economic opportunities presented considerable challenges. The advisory committee was set up to address these issues and generate dialogue and trust between users and the assessment team. The assessment team proposed the creation of the advisory committee as a forum to:

- share information, knowledge, and experience;
- get to know and integrate diverse perspectives;
- provide a forum for communication among the actors; and
- go beyond institutional limits to express and discuss topics and perspectives in a broad and unconstrained manner.

Seven meetings were held during the process, in which the team and the group went over the assessment steps based on the best information available: conditions and trends (baselines discussions), drivers (plenary dialogue), scenarios and responses (group workshops). Complementary presentations were presented by the same representatives and their organizations and by researchers from other sub-global assessments visiting the area.

This advisory committee became the only forum in which diverse actors could sit together to discuss important development issues from their very different perspectives and interests. Hence, a follow-up of this group was proposed by the users.

cussed the community understanding of ecosystem functioning during village meetings. In India Local, school students spent time with knowledgeable individuals to document their knowledge. Local people also formed study groups by volunteering to address various topics based on their expertise and preferences. During this process they documented their knowledge of birds, grasses, etc. Field visits and long duration stays of external researchers facilitated and added to these efforts.

Difficulty in comparing findings arose from both the conceptual models used (discussed later in this chapter) and the methods employed to communicate among different knowledge systems. All assessments acknowledged uncertainty in findings, and took it to constitute an inherent property both of complex systems and of knowledge systems that cannot be tested using modern scientific methods of validation. Most assessments dealt with this uncertainty through various triangulation methods aimed at validating both scientific and local knowledge. (See also Chapter 5.) However, the techniques used varied significantly among assessments. All the local assessments gave feedback to local communities. The feedback methods used included holding workshops, presentations, or theater (SAfMA Livelihoods), involving communities in carrying out the assessment (Bajo Chirripó), compiling reports and outputs of the assessments (Vilcanota), participatory validation (Portugal, Sweden KW), developing educational modules in the form of videos and booklets (Bajo Chirripó, SAfMA Livelihoods, and San Pedro de Atacama), conducting workshops with advisory committees and users (Sweden KW and Sweden SU), translating reports into local languages and in terms of local people's worldviews (India Local, Vilcanota, and Bajo Chirripó). Some assessments (San Pedro de Atacama, Vilcanota, and India Local) developed ethical and rights-based agreements (such as those that the International Society for Ethnobiology used in Peru) for the use and dissemination of information, recognizing that researchers have specific responsibilities in that regard and that some forms of knowledge are sacred. Many communities saw the documentation of their knowledge as the departure point for facilitating dialogue with other stakeholders. It was, however, necessary for this knowledge to be validated by other local experts and scientists.

While all community assessments, by definition, involved local people, the level of community participation, and community control over the assessment process and the

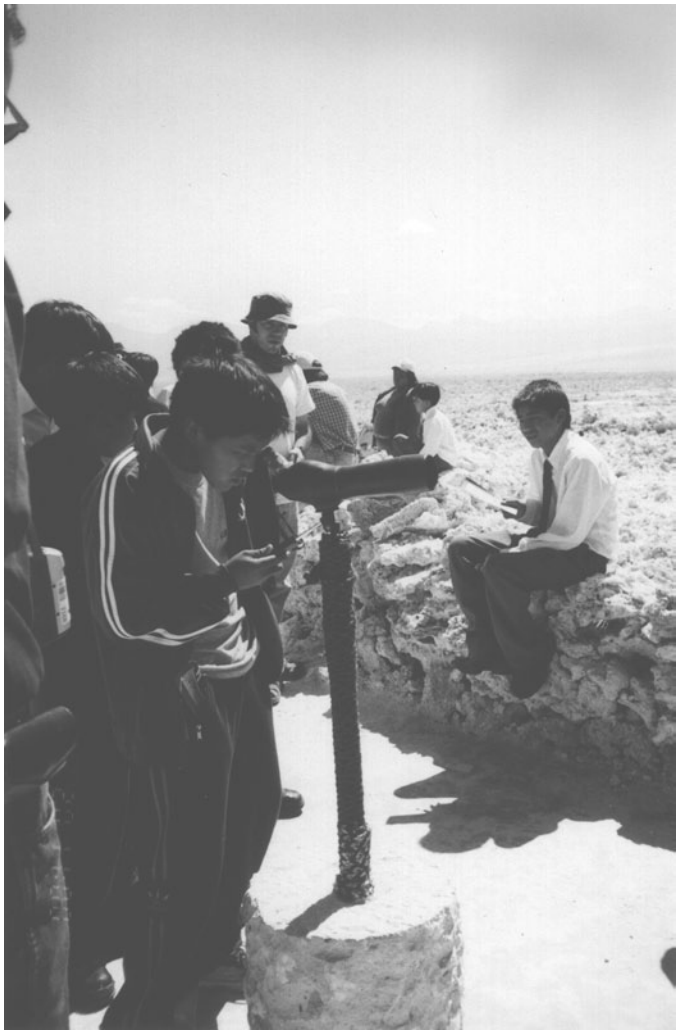

Figure 11.1. San Pedro de Atacama, Chile. Children from local schools visit Laguna Chaxa, most of them for the first time, as part of the educational activities coordinated within the assessment. Chaxa is part of the Flamingo National Park—one of the main tourist attractions in the area. (Photo by Andrés Marín R.)

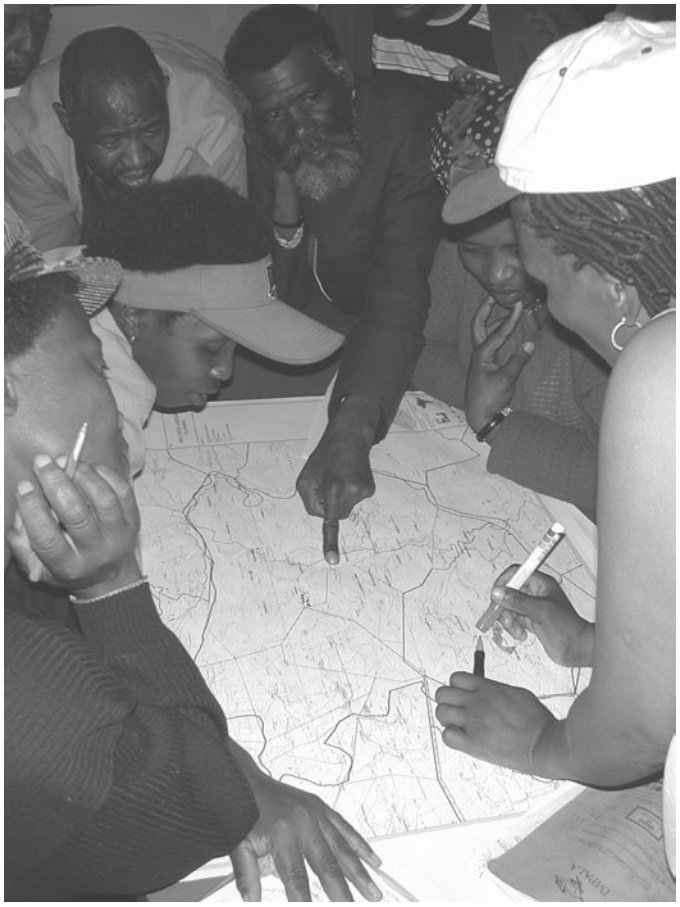

Figure 11.2. Participatory Mapping Exercise at Macubeni Village, Eastern Cape, South Africa (SAfMA Livelihoods). Mapping exercises such as this enable illiterate people to contribute local knowledge about landscape and land use change and changes in political boundaries. Such exercises also make assessments more accessible to people who would normally find them quite daunting. (Photo by Christo Fabricius)

use of their knowledge, varied widely among assessments. Table 11.1 is a typology of the community assessments' knowledge sharing developed as background for this chapter; the indicators used in developing the table include the communities' ability to present assessment results to stakeholders, the use of assessment information by communities in other documentation, and representativeness and level of attendance at workshops. The table shows three broad categories of knowledge sharing: (1) *community-led,* where both community participation and community control of knowledge and the assessment process was strong (Vilcanota and Bajo Chirripó); (2*) collaborative,* where community participation was strong but community control of knowledge and the assessment process was moderate (SAfMA Livelihoods, Sweden KW, and India Local); and 3) *information sharing,* where community participation was moderate, and community control of the assessment process and knowledge was moderate to weak (San Pedro de Atacama, Portugal, and Coastal BC).

11.2.3 Contribution of the MA Framework to Community Assessments

All assessments made use of the MA conceptual framework as a conceptual guide. The framework proved useful in conceptualizing the relationship between people and the natural environment through its appreciation of multiple scales of analysis, and cross-scale linkages. However, as the MA authors recognized from the outset, the framework's apparent linearity did not fully capture the complex interactions among the various different framework elements (MA 2003, p. 26).

11.2.3.1 Opportunities and Challenges Presented by the MA Framework

The MA formalized and gave recognition to the principles of cross-scale interaction in social-ecological systems, as well as the significance of different knowledge systems. This came in response to criticisms that big decisions too often fail to consider local community interests when their feasibility is appraised, and that many interventions, designed

Table 11.1. A Typology of Community Participation and Knowledge Control: Selected Examples

Type of Participation	Assessment	Definition of Research Questions	Conceptual Framework Used	Validation	Feedback	Who Participated
Community-led	Bajo Chirripó	jointly defined by community members and researchers	MA with modifications based on local visions	local people conducted and validated the assessment with scientists	internal feedback, by communities themselves	various groups in the community and facilitators
	Vilcanota	defined by communities	own conceptual framework developed in response to MA	local people conducted the assessments with assistance of specialist facilitators	on-going internal feedback, by community members	various groups in the community and facilitators
Collaborative	India Local	defined jointly, according to local priorities	MA and others	local people provided, validated, and cross-checked most information	on-going feedback and refinement	various village-level stakeholders and scientists, through interviews and interaction
	SAfMA Livelihoods	defined by researchers	MA and others	local people provided and validated most information	on-going feedback, by community in regular community meetings	villagers, facilitators, and scientists, mainly through participatory methods
Information sharing	Coastal BC	community contributed to the formulation of research questions	MA only	investigators validated the data	community received feedback at the end of the process	community representatives participated in the planning phases
	San Pedro de Atacama	defined by scientists, with inputs from community leaders	MA only	findings validated by stakeholders at the end of the assessment	community received feedback at the end of the process	community was one of the participants
	Portugal (Sistelo)	defined by researchers, with some inputs from the community	MA only	local people were asked to comment	local people were presented with information and asked to comment	mainly community members or villagers and some local and regional organizations
	Sweden KW	defined by researchers	MA and others	findings validated by stakeholders continuously during the assessment	continuous	a range of stakeholders were interviewed and consulted

with the local scale in mind, fail to have any impact because they are overshadowed by more powerful coarse-scale drivers. The MA framework therefore directed investigators and communities toward looking at coarse-scale drivers such as sub-national, national, and global policies or economic change, and their effects on fine-grained ecological and social processes. The emphasis on spatial and temporal scale in the MA highlighted the importance of historical and contemporary processes in the design of the community assessments. It also spurred investigators to specifically assess how ecosystem services connect across scales and societal responses operating at local, sub-national, national, and global levels. (See Chapters 4 and 9.) The MA approach in some instances also prompted participants to develop locally relevant scenarios at the local level (for example, SAfMA Livelihoods and San Pedro de Atacama). Locally relevant scenarios were easily understood by primary resource users and managers, and facilitated dialogue between communities and other users with different levels of power. This encouraged all users to confront several possible futures (some of them otherwise inconceivable) in a way that other approaches would not have achieved. Scenarios were excellent tools to evaluate and compare the vulnerability and resilience of management strategies. (See Chapter 10.) Resilient management strategies promote the sustainable use of ecosystem services under many different scenarios, while vulnerable strategies promote sustainable use under few scenarios.

Two major issues concerning the MA conceptual framework arose during the community-based assessments. The first involves the weakness of the framework in portraying the adaptive and dynamic nature of local processes. The framework did well to consider local resource managers (referred to as decision-makers) as part of the system in question, something that has been lacking in traditional approaches to natural resource management. However, the framework did not do justice to the dynamism and interdependence of human and natural systems at the community level. In particular, the MA framework does not allow for consideration of the process of institutional learning, adaptation, and resilience within these systems. Furthermore, communities, since they are ''inside'' the social-ecological system being considered, act both as a *driver* through their management practices and local institutions that shape ecosystem dynamics and as *respondents* to external factors such as technological and policy change. (See MA *Policy Responses,* Chapter 14.)

Second, the conceptual framework represents a particular view of the world, albeit from a combination of various disciplines. Some of the framework's concepts were very difficult to understand in local contexts where different worldviews and epistemologies held sway. Local level assessments therefore married the MA framework with other conceptual models that would help communities and researchers to identify and understand local processes. While some, such as SAfMA Livelihoods and Sweden KW, complemented the MA framework with models that emphasized adaptability and response to environmental feedback, others, such as Vilcanota and Bajo Chirripó, supplemented the framework with indigenous cosmologies to guide their assessments. (See Chapter 5.)

11.2.3.2 The MA Framework ''On the Ground''

The SAfMA Livelihoods assessment team found that local people constantly adjust their livelihood strategies to cope with long and short-term changes in the environment, and that key resources such as water, fuelwood, food, and livestock varied in response to both rainfall and trends in demand. This led to a dynamic interplay between ecosystems and humans, which required that additional conceptual frameworks be used alongside the MA framework. The adaptive renewal model (Gunderson and Holling 2002) enabled the team to conceptualize ecosystems and humans as complex adaptive systems that undergo cycles of collapse and reorganization. The sustainable livelihoods framework (Carney et al. 1999) was useful to conceptualize livelihood strategies as long-term responses to reducing people's vulnerability rather than as short-term coping strategies. The three frameworks were used in a complementary manner, and their combined application helped overcome many of the MA conceptual framework's shortcomings. In the Swedish assessments (Kristianstad Wetlands and Stockholm Urban), the MA framework was enriched by emerging theories of linked social–ecological systems.

Vilcanota took a different approach. Combining the MA framework with complex adaptive hierarchical system theory and, more significantly, a drawing of Incan cosmology created by the Incan chronicler Juan Santa Cruz Pachacuti Yanqui Salccamaygua, the Vilcanota assessment team created an alternative conceptual framework. The pre-Hispanic drawing expresses the specific manner in which Andean peoples perceive, order, and explain their world through time and space and how they understand humans' position and relationship with society, the environment, and the cosmos. The Andean world is believed to be structured into three areas or scales—the *Ukupacha* (the past and the interior world), *Kaypacha* (the world of present and of here), and *Hananpacha* (the future and the supra world) (Milla 1983). The resulting conceptual framework uses these three main hierarchical systems, and expresses space and time as one entity and presents ecological, social, and cultural processes of life as entities. These entities neither exclude each other, nor are they antagonistic, but act as opposites in a complementary manner. The Vilcanota conceptual framework therefore used the cultural conception of *Pacha,* sociocultural processes, and Andean principles such as *Pachakuti* and *Ayni,* which depict cycles of change and resilience, to assess the multiscale processes affecting local ecosystems and local cultures. (See Chapter 5 for further discussion of this framework.)

11.3 Findings: Community Assessment Contributions

From the outset, the community assessments envisaged people, their knowledge and belief systems, and ecosystems as part of the same integrated social-ecological system. Thus

the community assessment participants saw ''drivers'' as factors affecting both people and ecosystems. Human management systems (''responses'') and knowledge are part of the system, and responses, drivers, and services are part of a complex melting pot of internal processes—an amalgam rather than a set of separate building blocks. Feedback between the social and ecological components of the system is continuous and ongoing. Understanding the co-evolution of knowledge, ecosystems, social institutions and management practices, their complexity, variability and unevenness in space and time (''lumpiness''), and nonlinearity, and the feedbacks among them is at least as important as documenting causes and effects.

11.3.1 Ecosystem Services and Local Livelihoods

11.3.1.1 The Importance of History

History is important in understanding people–ecosystem interactions (Fairhead and Leach 1996). In different parts of the world, humans and ecosystems have co-evolved, which has led to the development and refinement of local and traditional knowledge and management strategies through constant adaptation and learning. History is also important to understand the nature and evolution of local institutions. People understand their future by looking at the past, and use the past to reflect on a vision for the future. Historical insights highlight the importance of forecasting, and help to identify key drivers based on reflection. Historical management practices have shaped the current structure and functioning of ecosystems. Therefore, conditions and trends in social-ecological systems need to be assessed over longer periods. In many places, local knowledge is often the only source of such information.

In Peru, the past, present, and future are linked to different landscapes in space, and the whole landscape, and ecosystem processes, are interpreted in terms of that cosmology. Historical events are used to interpret contemporary ecological change such as landscape dynamics and climate change, and even today, people believe that they have to plan for the well-being of future generations (Vilcanota). In Bajo Chirripó, Costa Rica, historical events are linked to ancestral territories, which define the spatial extent of their ecosystems; people recognize historical signs to predict looming disasters such as El Niño events. In San Pedro de Atacama, Chile, traditional knowledge depicts a mythical past of landscapes, spirits, and ecological processes dependent upon each other; this forms the basis of people's cosmology, but waves of colonization and conflict have challenged these belief systems and identities. New state-led initiatives, such as the establishment of the Indigenous Development Area and the Programa Origenes, have, however, led to an enhanced sense of identity amongst indigenous groups (San Pedro de Atacama).

11.3.1.2 The Role of Ecosystems in Reducing People's Vulnerability

A common finding in all the community assessments was that local people living in rural areas cherish and promote ecosystem variability and diversity as a risk management strategy. Diversity of species, food sources, and landscapes serve as ''savings banks'' and ''buffers,'' to enable people to cope with change during adverse times. The diversity of land types and crop types used by different communities living in the same region reduces people's vulnerability by providing livelihood options to fall back on, in case crops or landscapes are negatively affected by catastrophes.

The benefits of promoting ecosystem diversity may not be evident on a day-to-day basis, but they become evident during times of crisis, for example when crops fail, technology breaks down, or during droughts or floods. The Papua New Guinea assessment found that people living on different islands plant different crops, and then trade these between islands to enable them to cope with food shortages due to pest outbreaks or adverse weather conditions (KM–Papua New Guinea). The Vilcanota assessment found that people living at different elevations plant different crops and harvest different biomedicines, using a barter system to exchange tubers, grain, medicinal plants, and other services in a complementary manner; this system conserves genetic diversity, promotes food security, and maintains traditional cultures. In India, local people deliberately conserve sacred groves and, like communities in South Africa's Great Fish River valley, protect sacred pools to enhance ecosystem diversity, as these landscapes act as refuges that nurture indigenous species and their propagules. These propagules form the basis of ecosystem renewal after droughts, when rivers dry up but sacred pools remain water-filled, or after fires, when less dense forests are destroyed but sacred groves remain protected (India Local).

At Qongqota in the Eastern Cape, South Africa, communities have always maintained natural fountains and have been concerned about forest conservation. They do this despite having access to piped water and making their main living from small-scale agriculture, remittances, and urban jobs (SAfMA Livelihoods). These fountains are essential for their long-term survival, and people rely on them when water pumps break or when the government fails to repair broken pipes. The fuelwood from forests and woodlands are essential for wood fires to cook food, especially during economic recessions when workers who send remittances home are made redundant, or when the prices of alternative fuels such as paraffin rise due to currency fluctuations or global fossil fuel shortages. In many cases, biomedicines are used in emergencies, or to supplement conventional medicines.

Around the world, wild fruit provides crucial vitamins and minerals at critical times of the year and at critical stages in infants' physical development. Bushmeat and fish supplement poor people's protein intakes and are sold to supplement meager incomes. Key landscapes such as wetlands, high pastures, sacred forests and groves, and sacred pools provide ''stepping stone'' resources, that is, infrequently used resources that enable people or animals to overcome brief periods of severe food, water, or energy shortages. Biodiversity creates employment and income through sales of ecosystem products and creates jobs from tourism and related economic activities. This further reduces people's vulnerability by increasing their livelihood options. Resource-

rich patches act as safety nets for biodiversity. In India, for example, many sacred groves protect the upper reaches of watersheds, serve as refuges for non-harvested beehives, and provide habitat for many other plants and animals (India Local).

However, ecosystem conservation alone does not guarantee reduced vulnerability in communities—there are many vulnerable communities living in well-conserved ecosystems (for example, in Costa Rica's Cabecar Territories and at Richtersveld, South Africa). In Richtersveld, South Africa, although local ecosystems form part of a national conservancy area to which communities have access, regional and local economic constraints make communities very vulnerable. Therefore additional strategies, other than ecosystem conservation, need to be put in place to make people more resilient (SAfMA Livelihoods).

11.3.1.3. Well-being and Poverty from Different Perspectives

The relationship between human well-being and poverty varies both spatially and temporally among and within communities, based on the broader context of local culture, wealth, access to ecosystems, age, and gender. This complexity often causes conflict in decision-making for communities and ecosystems in policy development (for example, India Local).

Well-being should thus be defined and considered differently in different settings. For example, in Bajo Chirripó, people do not distinguish between their own well-being and that of the ecosystem, while in Sistelo, Portugal, subsistence farmers see ecosystem services as extractable resources and have five dimensions of well-being, consistent with the MA framework. In San Pedro de Atacama, different cultural groups with different uses for ecosystems define well-being differently. In Vilcanota, well-being is spiritually defined through people's relationship with mountains and landscapes. In the Kristianstad Wetlands, Sweden, a perceived crisis in ecosystem condition triggered a transformation of local priorities, leading to a shared community vision of the landscape and the importance of its associated cultural values to community well-being and development. Similarly, in South Africa, people emphasize both the material and cultural values of ecosystem services. In certain settings they would define their well-being in terms of material benefits, security, and provisioning services while in other settings they would define their well-being in spiritual terms.

People co-opt modern technologies and beliefs when appropriate, or when it cannot be avoided, and adhere to a mix of modern and traditional principles. In some cases, individuals and groups are opportunistic in using different value systems to suit them. Therefore, while the relationship between human well-being, poverty, and ecosystem services may appear static when viewed from the outside, the interpretation of this relationship is in fact highly dynamic at the local level.

11.3.1.4 Spiritual and Cultural Values

Most terrestrial landscapes have been influenced by historical or contemporary cultural practices, and few are pristine wilderness areas that are frozen in time. (See MA *Policy Responses,* Chapter 14.) While provisioning services such as water, medicinal plants, fuelwood, and food are very important, spiritual and sacred elements in the local landscape also have specific and important value to local people across all the assessments. In several cases, spiritual values coincided with other values, such as biodiversity, water supply, biomedicines, and fuel. The maintenance of these values results in community-based ecosystem management strategies that enhance landscape patchiness and diversity, thereby promoting resilience.

Rituals and traditions are central to the culture and identity of the Xhosa people of South Africa's Eastern Cape (SAfMA Livelihoods). Key resource areas are fundamental to the performance of these rituals and include sacred pools and dense forests. Each of these sites has particular rituals associated with them, with specific benefits. These sites thus provide a place of direct communication with the spirit world where people can access blessing and health and also provide thanks and veneration through the performance of particular rituals. The sites are thus critical points in the landscape where culture in the form of traditions and connection with the ancestors is maintained. In many cases, they also enhance social–ecological resilience. For example, the sacred pools never dry up; the vegetation surrounding them is denser and provides a protective canopy, thus reducing the effect of evaporation. Sacred pools in the Eastern Cape supply over nine different types of building materials, more than forty medicinal plants, over ten species of fuelwood, a large variety of cultural species, resources with economic value (such as the exotic prickly pear and *Aloe* plants), game meat, honey, clean water, and forage of different densities that attain value at different times in the year and under different drought conditions.

Sacred pools also occur in India. The river pools in the north Indian States of Himachal Pradesh and Uttaranchal are protected because of their religious importance and are called *machhiyal.* Nobody may fish from the *machhiyal* and they thus serve as breeding pools for fishes (India Local).

In Peru, spiritual values and belief systems, including the belief in mountains as living beings and divinities, have allowed for the maintenance of a cultural identity among the Quechua people of the southern Peruvian Andes. This identity manifests itself in a cosmology based on a system of links between the natural, spiritual, and human worlds. Mount Ausangate (6,384 m) is considered to be the main *Apu* (sacred mountain) and protector of all indigenous communities of the southern Peruvian highlands. For the ancient Incas this mountain gave birth to the Urubamba River, the most sacred of all the sacred rivers in Peru, which runs through the Sacred Valley toward Machu Picchu. For contemporary Quechua communities, Ausangate is a powerful Apu that possesses the power of *Camac* (vital energy) and is the lord of all animals, crops, and plants. Its power is recognized beyond the region and it is revered by all Quechua nations in Bolivia, Ecuador, and Argentina. As ecosystem services are diminishing, the spiritual dimensions of the local culture may become the most important mechanism to avert ecological and cultural crisis (Vilcanota).

The practice of nature worship also extends to wooded landscapes. All over India, East Africa, and southern Africa, local people protect patches of forests—sacred groves—dedicated to deities or ancestral spirits. Foresters, travelers, anthropologists, and ecologists have for more than two hundred years described and documented sacred groves—more than 14,000 in India alone (India Local). A single watershed such as the Mala watershed in Karkala Taluk of Dakshina Kannada district of Karnataka state could contain more than 400 such groves. Sacred groves are wooded landscapes containing vegetation and other forms of life and geographical features that are delimited and protected by human societies in the belief that keeping them in a relatively undisturbed state expresses the relationship between humans, the divine, and nature (Hughes and Chandran 1998). Diverse cultures perceive this relationship in different ways, and institutionalize various rules of behavior (taboos) with regard to the sacred space and its elements (Malhotra et al. 2001). Sacred grazing woodland in western Rajasthan, locally called *oran,* are managed and used by local people and constitute almost 10% of the landscape in this semi-arid area (Mitra and Pal 1994). The Bishnoi community in western Rajasthan is known for the conservation practices associated with *orans* such as the protection of *Khejadi* (*Prosopis cineraria*) and the Chinakara deer.

Ecosystem-level conservation efforts like sacred groves and ponds are supported by species-level conservation efforts. In Indian villages, totemic species belonging to subclans, clans, or tribes are only to be hunted by the respective groups, thus contributing to the sustainable use of these species (India Local). In Sweden, institutions originally developed to conserve the Kristianstad Wetlands are spawning other institutions for species conservation; for example, concerted efforts have been made to restore the White Stork population, partly because this species is considered a symbol of the area. Restoration of stork habitats has resulted in an overall increase in biodiversity and also seems to have increased public awareness of natural values in the area (Sweden KW). In the Kat River valley in the Eastern Cape, local people actively conserve valuable species such as *Olea europeae* var. *africana* through local social institutions. These institutions are, however, being eroded leading to a failure of community-based conservation. (See also MA *Policy Responses,* Chapter 14.)

11.3.2 Local Management of Ecosystems

Local management of ecosystems plays an important role in generating services both for local people and for the global good. For example, as described in the previous section, people often manage fine-scaled patches (such as sacred groves and pools, hotspots of soil nutrients and moisture) and narrow corridors that provide critical links between landscapes. In Bajo Chirripó, local communities nurture a mosaic landscape, consisting of sacred places, springs, agroecosystems, and high mountains. Sacred places such as high mountains are a source of faunal biodiversity since indigenous people do not enter unless they have permission from the *awá* (shaman). The Tropical Forest Margins community assessments illustrate how communities manage diversity in tropical forests, thereby contributing to global biodiversity (KM–Tropical Forest Margins). In Trinidad's Northern Range, local people patrol beaches to protect turtle nesting grounds. Whereas previously turtle eggs were harvested for consumption, today protection ensures sustainable income from ecotourism (KM–Northern Range).

Local management, knowledge, and institutions concerning ecosystems are continuously evolving. The community-based assessments illustrate how local management systems can be in various stages of being eroded, adapted, or revived. In Sistelo, Portugal, local ecological knowledge is closely related to agricultural practices. Communities used to harbor extensive knowledge concerning plant species, their medicinal applications, and their effects on soil condition; seasonal and moon cycles and their influence on agricultural crops; and water management techniques. But with improved access to new sources of income, people have become less dependent on local ecosystem services. Most young people in Sistelo now do not have contact with agricultural practices. Today, knowledge that used to be essential for people's survival is almost exclusively possessed by the oldest members of the community (Portugal). In Kristianstad Wetlands, Sweden, farmers' knowledge is being revived through restoration projects of the highly valued flooded meadows and sandy grasslands. Traditionally, these practices were aimed at producing fodder for cattle during winter, but now they are used to enhance biodiversity and other ecosystem services associated with the cultivated landscape (Sweden KW).

Several community assessments illustrate the importance of local people's knowledge to the successful management of ecosystem services. The Sinai Bedouins know exactly how to locate their water harvesting structures, since they know more about the local hydrology than modern engineers (Sinai). Local people in the Laguna Lake Basin know where the best fishing areas are and where to locate rice paddies in relation to the flow patterns of water. Local land tenure systems are adapted to manage these hydrological dynamics (KM–Laguna Lake Basin). In the Eastern Himalayas, local people manage small watersheds and forests and make use of zoning to limit the impact of human populations. In Xinjiang, Western China, local people have elaborate traditional underground water harvesting structures, called *karez*. These 800-year-old systems maintain both water quality and quantity (KM–Western China).

At some critical times, community-based management and local interventions make a big difference. In times of crisis, such as heavy droughts or floods, local adaptations to mitigate the negative impacts of these events provide benefits to the people involved. There are many examples of pro-active local management strategies, many of them based on oral tradition and customs, paying off long after they have been implemented. In that sense, local people both respond to drivers in the short term, and also adopt various adaptive strategies for the long term, for example by implementing management strategies based on long-term learning and experimentation. Such communities increase the

Figure 11.3. Local People Working in the Agricultural Terraces of Sistelo, Portugal (Photo by Henrique Miguel Pereira)

capacity to sustain and manage ecosystems adaptively by learning and constantly developing new responses or reviving earlier experiences.

At other times, however, local management systems have little impact. In several cases, they are dysfunctional, as when local people over-utilize natural resources. In the Eastern Cape province, South Africa, 80% of all medicinal plant species are vulnerable to overexploitation (Dold and Cocks 2002). The PNG, Downstream Mekong, and São Paulo assessments found that many people do not abide by local rules or national laws, and exploit ecosystems for short-term gain (KM–PNG, KM–Downstream Mekong, KM–São Paulo). The bushmeat trade throughout Africa has a major impact on wildlife biodiversity, particularly in forest ecosystems (Barnett 2000). Communities are not always noble managers of ecosystems for the common good. Even if they have the potential to become stewards of ecosystem services and landscapes, they may be overwhelmed by social and economic forces operating at other scales (Lambin et al. 2003). For example, in the Mekong Wetlands, Viet Nam, government policies have promoted the conversion of mangrove swamps to shrimp farms, leading to great losses of biodiversity. In the Eastern Himalayas, economic incentives for private forest owners have led in some instances to deforestation in indigenous forests. As with other user groups, competition, conflict, unequal power relations, and diverging goals and purposes of ecosystem management are common realities.

11.3.3 Cross-scale Interactions and Social Networks

11.3.3.1 There Are No Isolated Communities

No community is isolated from larger-scale processes (MA *Policy Responses,* Chapter 14). These large-scale processes include policies, conventions, funding programs, market forces, tourism, global warming, and mega projects such as large dams and transboundary protected areas. Some have negative impacts; others can be used by communities to improve their well-being.

The ability to cope with, adapt to, and shape change varies among the assessments. In Eastern Himalayas, for example, communities experience a number of negative impacts from external processes. Medicinal plants are overexploited because of the demands created by national and international pharmaceutical interests. Construction of the Teesta Dam Stage IV and the Ramam Hydel Project in the area will result in the submergence of villages and fragmentation of landscapes in Mahanda and Singhalila Wildlife Sanctuaries in India. The Kalikhola Mini Hydro Project in the Singhalila Wildlife Sanctuary may lead to the loss of faunal habitat, causing conflicts between people and problem animals in the villages and subsequent loss of agricultural production, with local people having little influence on this process (Eastern Himalayas).

Bedouin people may become isolated by wars and conflicts, causing them to lose their ability to cope with political and environmental change. The introduction of development projects and factories generates new jobs, but it also affects the Bedouin lifestyle (Sinai). In Papua New Guinea, local people are unable to influence the coral bleaching that is affecting fish stocks (KM–PNG). Communities in the Richtersveld National Park, South Africa, are subject to national and international conservation policies that affect their grazing rights and their ability to move their livestock (SAfMA Livelihoods). These policies, in turn, are influenced by global conservation sentiments and funding. Assessing ecosystems through communities reveals the interconnectedness across scales, as well as the impact on people of decisions and actions taken place elsewhere.

11.3.3.2 The Role of Social Networks

Local communities often lack the capacity to intervene when they are subject to socioeconomic forces that cause ecosystem change. Nested institutions and organizations are therefore important in buffering local people against these forces. Social networks seem to be essential for adaptive management processes; they enhance communities' resilience and well-being. In the Kristianstad Wetlands, collaboration between local steward associations and several administrative levels enables continuous ecosystem management in face of external processes (Sweden KW).

Most communities examined are slowly increasing their networks by linking with NGOs and even government. In the Northern Range assessment, one community successfully resisted a development project by forming a commu-

nity-based organization. At Richtersveld in South Africa, local people successfully incorporated their needs and concerns into the municipality's Integrated Development Plan, started their own conservancy, and eventually claimed back valuable mining land—an accomplishment attributed in large part to their ability to network locally, nationally, and internationally (SAfMA Livelihoods). In Papua New Guinea, communities are being assisted by lawyers and NGOs to sue mining companies for health and environmental impacts (KM–PNG). In Brazil, the Socio-environmental Institute is a good example of a civil movement that has successfully mobilized national and international linkages to achieve its objectives (MA *Policy Responses,* Chapter 14).

Kinship networks also strengthen resilience in several communities. In Lesotho and the Great Fish River, people rely on family members for labor, remittances and social support (SAfMA Livelihoods). Indigenous Fijians have intricate exchange arrangements; sharing with relatives ensures that the resources are efficiently used and that people look after each other in times of need (KM–Fiji). This social kinship system is the safety net that enables people to meet their needs in their sometimes harsh and uncertain surroundings. Bedouins, on the other hand, prefer to live in small groups of five families; this enhances their mobility but has a negative impact on their capacity to cope with external challenges (Sinai).

Key actors that build trust and develop a shared vision are essential for social networks to function (Sweden KW). Opinion leaders in government and in the community can act as agents of change. Where altruistic individuals have catalyzed a community-based process, it has often led to major benefits for ecosystem management. The arrival and departure of these change agents is, however, unpredictable, and many examples exist where charismatic individuals are transferred or promoted by their organizations, or manage to find jobs elsewhere with the skills they gained during their involvement with ecosystem management initiatives. The departure of these key individuals can have unpredictable negative consequences, particularly in cases where no arrangements for succession exist.

Trust is one of the key determinants affecting the ability of local people to create and maintain management functions at the local level. Community assessments in southern Africa found that political upheavals and interventions have affected interpersonal, inter-household, and inter-community trust—and therefore management strategies—over time. These upheavals were precipitated by pre-democratic apartheid (separate development) policies (SAfMA Livelihoods).

11.4 Implications for Policy-making

The community-based assessments illustrate that much more than ecological knowledge and understanding is necessary for strengthening the capacity to manage ecosystems sustainably for human well-being. The social dimension behind management needs to be accounted for as well.

Evidence from the assessments indicates that the effective functioning of community-based management depends on the ability of community members to cooperate with one another toward a common goal, often with a common vision. This ability to organize for collective action has a direct impact on landscape structure and function and the services it generates. However, broader processes of change affect local needs and choices, and thereby community members' activities with respect to ecosystems.

This experience of change in social-ecological systems provides the context for flexible and adaptive responses, particularly during periods of crisis and reorganization (Folke et al. 2003). Adaptive management and governance therefore draws on experience but allows for novelty and innovation. It provides a repertoire of general design principles that can be drawn on by resource users at multiple levels to aid in the crafting of new institutions to cope with changing situations (Ostrom et al. 2002).

A number of examples demonstrate that community-based management is frequently thwarted by creating centralized institutions; it is enhanced by systems of governance that exist at multiple levels with some degree of autonomy, complemented by modest overlaps in authority and capability. A diversified decision-making structure allows for testing of rules at different scales and contributes to the creation of institutional dynamics important in adaptive management and governance.

This is essential in situations where the self-repair and capacity of ecosystems to generate ecosystem services can no longer be taken for granted. A major challenge for management is to develop institutional structures that match ecological and social processes operating at different spatial and temporal scales and addressing linkages between those scales (Holling and Meffe 1996; Folke et al. 1998).

Therefore, an important part of adaptive management and governance is to encourage communities and local organizations to interact with one another and with organizations at other levels (Svedin et al. 2001; Ostrom et al. 2002). Examples from the sub-global community-based assessments illustrate the importance of organizations that bridge communities with other levels of governance, and where social networks and key actors play an important role for successful ecosystem management. Researchers can play an essential role in such bridging processes, as illustrated in the village assessments in India (India Local).

Multi-level governance of ecosystems needs constant adjustment, which requires innovation and experimentation (Shannon and Antypas 1997; Imperial 1999; Danter et al. 2000; Ludwig et al. 2001). Olsson and Folke (2001) describe the development of watershed management by a local fishing association in a multi-level governance system faced with internal and external ecological and social change. The social change included devolution of management rights, which provided an arena for local users to self-organize and to develop, refine, and implement rules for ecosystem management. Not only do these people respond to change, but by doing so, they build adaptive capacity to deal with future change in the multi-level governance system.

Adaptive co-management systems are flexible community-based systems of resource management tailored to specific places and situations and supported by various organizations at different levels (Olsson et al. 2004). They rely on the collaboration of a diverse set of actors operating at different levels, often in networks, from local users to municipalities, to regional and national organizations, and also international bodies. The sharing of management power and responsibility may involve multiple institutional linkages among user-groups or communities, government agencies, and nongovernmental organizations. Adaptive co-management takes place, for example, in the context of the Biodiversity Register program in India (Gadgil et al. 2000; see also Chapter 9) and through the involvement of several local steward associations in the management of the landscape in Kristianstad Wetlands, Sweden.

Threats to co-management include large-scale international programs such as transboundary conservation areas (MA *Policy Responses,* Chapter 14) and top-down development interventions, for example some ambitious agricultural schemes in South Africa's Great Fish River area (SAfMA Livelihoods). Lambin et al. (2001, 2003) provide comprehensive overviews of such interventions and their impacts on resource use patterns and the capacity of ecosystems to generate services.

11.5 Conclusions

Community-based assessments provide lessons for sustainability. Research that carefully records both social and ecological system characteristics, and their interactions over time, will enable role players to develop shared knowledge about the factors that allow some people to sustain ecological systems for long periods of time while others destroy them rapidly.

Community-based assessments should be performed in collaboration with local groups and actors. By conducting assessments in this way, they become relevant to decision-makers at all levels, from the local resource user to people involved in international conventions. While this is not an easy process, it is an essential one. The main incentive for local communities to participate in assessments is improved capacity for ecosystem management at the local level. Most assessments found that this was an adequate incentive for communities to participate, and also that communities that conducted assessments were in a stronger position than before the assessment to raise funds for development projects.

Often ecosystem assessments are done on the biological and ecological aspects first, and then those results are presented to stakeholders for consideration. Community-based assessments bring people and their knowledge and practice into the process as a part of ecosystem management. Here, the experience of communities in resource management is drawn upon as a complement to scientific information.

People generate, accumulate, and store experience and knowledge about resource dynamics. They also draw on knowledge from outside their communities in their resource management. Some communities manage ecosystem capacity, others erode it. Social inventories identify the diversity of actors in the landscape and their use and misuse of ecosystem services.

Communities can act as stewards of ecosystem services and there is potential to redirect incentives and governance to stimulate and enhance this role. Embedded within proper institutional and organizational contexts, rural communities contribute to maintaining the ecological life-support systems on which, for example, urban communities depend. Such stewardship of the landscapes and seascapes needs to be developed, secured, and strengthened.

Therefore, policies and incentives from governmental bodies in urban settings, at county levels, and in municipalities should be implemented to empower such groups and create institutional frameworks that enhance their potential to respond to change without eroding ecosystem resilience. It should be an essential part of any effort aimed at strengthening the capacity to manage ecosystems sustainably for human well-being.

Communities that contribute to managing ecosystems sustainably for human well-being are organized into social networks with trust and a vision for the future and with institutions (formal as well as informal norms and rules) that support and strengthen management. Such communities tend to have social features that make it possible to deal with external drivers and change. One of the most important features seems to be key leaders or stewards who can mobilize trust and incentives among people in the communities. Another factor is organizations that bridge the local community with other scales of organizations. Such bridging organizations serve as filters for external drivers and also provide opportunities by bringing in resources, knowledge, and other incentives for ecosystem management.

Building adaptive capacity in linked social-ecological systems to respond to change now and in the future is a prerequisite for sustainability in a world of rapid transformations (Gunderson and Holling 2002; Raskin et al. 2002). In addition to scientific information, it requires the involvement of resource users, decision-makers, and other interest groups in resource management (Ostrom et al. 1999; Berkes et al. 2003). Ecological knowledge and understanding of resource and ecosystem dynamics among communities, its incorporation into resource-use practices and governance structures, its temporal and spatial transmission and transformation, and its re-creation through cycles of crises and reorganization needs to be nurtured to counteract social-ecological vulnerability. Local communities no doubt play a significant role in this respect.

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