

Chapter 1

Introduction: The Growing Importance of Traditional Forest-Related Knowledge

Ronald L. Trosper and John A. Parrotta

Abstract The knowledge, innovations, and practices of local and indigenous communities have supported their forest-based livelihoods for countless generations. The role of traditional knowledge—and the bio-cultural diversity it sustains—is increasingly recognized as important by decision makers, conservation and development organizations, and the scientific community. However, there has long existed a lack of understanding of, and an uneasy relationship between, the beliefs and practices of traditional communities and those of formal forest science. This mutual incomprehension has a number of unfortunate consequences, both for human societies and our planet's forests and woodlands, which play out both on solid ground in many parts of the world as well as in international policy arenas. In this chapter, we define traditional forest-related knowledge, and explore the relationships between traditional knowledge systems and scientific approaches. We follow with an overview of the scope and central questions to be addressed in subsequent chapters of the book, and then provide an overview of international and intergovernmental policy processes that affect traditional knowledge and its practitioners. Finally, we introduce some of the major international programmes and research initiatives that focus on traditional forest-related knowledge and its applications for sustaining livelihoods in local and indigenous communities in a world struggling to deal with environmental, cultural, social, and economic change.

Keywords Biocultural diversity • Forest policy • Forest management • Indigenous peoples • Knowledge systems • Sustainability • Traditional communities • Traditional knowledge • United Nations

R.L. Trosper
Faculty of Forestry, University of British Columbia, Vancouver, BC, Canada
e-mail: rltrosper@email.arizona.edu

J.A. Parrotta (✉)
U.S. Forest Service, Research and Development, Arlington, VA, USA
e-mail: jparrotta@fs.fed.us

1.1 Introduction

After being dominated for centuries by the singular purpose to create and maintain the flow of wood fibre from forests, forest management throughout the world has moved in major ways to incorporate other values. This change in the ‘paradigm’ of forestry is widely recognized (Mery et al. 2005) and was mostly driven by pressures from outside of forestry—particularly the increased political power of environmental non-governmental organizations. In the United States, for example, the passage of laws protecting endangered species, combined with a strong judicial system, created a change in orientation for forest management towards species protection. This change occurred at the national level, however, and local values regarding forests are not necessarily fully devoted to preservation of species. The use of forests for other purposes, such as generation of ecosystem services or wildlife, is also considered essential at local levels. Among the ecosystem services of significance are clean water, recreation, and provision of livelihood resources such as firewood, food, and medicine.

Clearly, the concerns at national and international levels for preservation of biodiversity and sequestration of carbon, while contributing to the shifting forest management paradigm, do not necessarily include the concerns of local communities. In some regions, large corporations concerned with timber values and large environmental non-governmental organizations, have agreed among themselves to divide up landscapes between protected areas and areas of timber production, leaving out the other interests that exist in such landscapes. Indigenous peoples and other local forest users have objected (Davidson-Hunt et al. 2010).

These objections by local people raise the vital issue of how the interests and knowledge of all people can be incorporated in forest management. As Fortmann (2008) suggests, both ‘conventional science’ and ‘civil science’ are needed, and the question that applies to both is: How can we learn what we need to know and understand in order to create, sustain, and enhance healthy ecosystems and human communities? The question then arises of how to add such knowledge to the knowledge pool in a mutually beneficial way—that is, in a manner allowing the respectful and appropriate use of traditional forest-related knowledge, and discouraging the extraction of such knowledge without benefitting those who developed it?

Traditional knowledge, innovations, and practices have long sustained the livelihoods, culture, identities, and the forest and agricultural resources of local and indigenous communities throughout the world. Traditional forest-related knowledge (TFRK) is of particular importance to indigenous communities, peoples, and nations, whom Martínez Cobo (1986/7) defined as:

... those which, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing on those territories, or parts of them [who] form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal system....

Indigenous peoples comprise approximately 5% of the world's population (between 250 and 300 million people), representing up to 5,000 different cultures on all continents and throughout the Pacific islands. The Asia-Pacific region is home to the largest number of indigenous peoples, approximately 60–70% of the world's total (Galloway-McLean 2010). These communities account for most of the world's cultural diversity (Gray 1991). Indigenous communities manage an estimated 11% of the world's forest lands and customarily own, occupy, or use, 22% of the earth's total land surface; they protect and manage an estimated 80% of the planet's biodiversity. These communities reside in or adjacent to approximately 85% of the world's protected areas (Galloway-McLean 2010).

Yet the survival of indigenous peoples and the cultural diversity they represent continues to be threatened today, as it has for centuries in most parts of the world. Land dispossession, large-scale development projects, and efforts by governments and the dominant societies they represent to 'assimilate' indigenous peoples are major challenges for these communities and their cultures. Of the some 7,000 languages today, it is estimated that more than 4,000 are spoken by indigenous peoples. Language specialists predict that up to 90% of the world's languages are likely to become extinct or threatened with extinction by the end of the century (UN 2009).

The link between cultural diversity and biological diversity has been increasingly recognized in recent years by the international scientific and policy communities. In 1988 during the First International Congress of Ethnobiology held in Belém, Brazil, scientists and representatives of indigenous and local communities from around the world discussed a common strategy to halt the rapid loss of the world's biological and cultural diversity. These discussions considered the unique ways in which indigenous and traditional peoples perceive, use, and manage their natural resources and how programmes can be developed to guarantee the preservation and strengthening of indigenous communities and their traditional knowledge. The Declaration of Belém, an output of this meeting, outlined the responsibilities of scientists and environmentalists in addressing the needs of local communities and acknowledged the central role of indigenous peoples in all aspects of global planning. In the intervening years the concept of 'bio-cultural diversity' (the total variety exhibited by the world's natural and cultural systems) has emerged as an increasingly important concept through the recent work of a number of scholars (Posey 1999; Maffi 2001, 2005; Harmon 2002; Moore et al. 2002; Sutherland 2003; Loh and Harmon 2005).

Among indigenous communities, traditional knowledge is embedded and expressed in their languages, cultural values, rituals, folklore, land-use practices, and community-level decision-making processes. It is inextricably linked to indigenous peoples' identity, their experiences with the natural environment, and their territorial and cultural rights. In these communities, this knowledge is usually collectively owned and is transmitted orally from generation to generation. Passing this knowledge on to future generations is therefore considered to be very important to sustain their knowledge as well as their cultures and identities (Collings 2009). Developed from long experience and experimentation within local and indigenous communities, traditional forest-related knowledge has historically been dynamic, adapting to changing environmental, social, economic, and political conditions.

The evolution of this knowledge in the face of these changes has enabled traditional communities to manage forest resources to provide tangible (foods, medicines, wood and other non-timber forest products, water, and fertile soils) and intangible (spiritual, social, and psychological health) benefits for present and future generations.

There is a growing appreciation of the value and importance of traditional forest-related knowledge, and of traditional knowledge more generally, not only to local and indigenous communities, but also to broader metropolitan, increasingly globalized, societies. Widely used products such as plant-based medicines and cosmetics, agricultural and non-wood forest products, and handicrafts are derived from traditional knowledge. Traditional forest-related knowledge, innovations, and practices can contribute to sustainable development in several ways. Most indigenous and local communities live in areas containing the vast majority of the world's forest (and agricultural) genetic resources, including most of the world's terrestrial so-called biodiversity hotspots. The traditional knowledge and techniques used to sustainably manage and use these genetic resources and ecosystems can provide useful insights and models for biodiversity conservation practices and policies.

The combined influences of economic and cultural globalization, land-use change, climate change, and increased climate variability have significant implications for the world's forests and their biological diversity (UN 2009). These trends present major challenges, and perhaps opportunities, for the long-term conservation and management of forests for their social, cultural, environmental, and economic values. In the face of these challenges, we maintain that both formal science and traditional ecological knowledge have important, complementary, roles to play in the development of viable, locally adapted forest management approaches and practices.

1.2 Objectives and Scope of This Book

This book is intended to provide readers with an overview of the history, current status, and trends in the development and application of traditional forest-related knowledge (TFRK) by local and indigenous communities worldwide. It will consider the relationship between traditional beliefs and practices and formal forest science, and the often uneasy relationship among these different knowledge systems. It also highlights efforts in many parts of the world to conserve and promote traditional forest management practices to balance environmental, economic, and social objectives of forest management in light of recent trends towards devolution of forest management authority in many parts of the world.

The central issues that this book considers are:

- The relevance and roles of traditional forest-related knowledge for the maintenance of cultural values, livelihood security, and sustainable management of forest ecosystems and cultural landscapes;
- The historical context and current trends regarding relationships between traditional and formal scientific knowledge and practices with respect to forest resource management;

- Experiences related to resolution of conflicts between formal science-based approaches to forest resource management and conservation, and traditional forest-related knowledge and practices, as well as lessons learned from experiences in different parts of the world on ways to foster mutually beneficial collaboration and exchange of knowledge between traditional and formal knowledge systems and their practitioners; and
- Approaches for including both traditional knowledge and formal forest science in natural resource education, research, resource assessments, and forest management activities, based on studies of how this has been done successfully, or how and why attempts have failed.

In this introductory chapter, we define traditional knowledge, explore the relationships of traditional knowledge to different scientific approaches, survey international and intergovernmental policy processes that affect traditional knowledge and its practitioners, and introduce some of the major international programmes and research initiatives that focus on traditional forest-related knowledge and its applications for sustaining livelihoods in local and indigenous communities.

In the following chapters, regional overviews—covering Africa (Chap. 2), South America (Chaps. 3 and 4), North America (Chap. 5), Europe (Chap. 6), Russia and neighbouring countries (Chap. 7), Northeast Asia (Chap. 8), South Asia and the Himalayas (Chap. 9), Southeast Asia (Chap. 10), and the Western Pacific (Chap. 11)—aim to summarize and evaluate the history and current status of TFRK and its relationship to formal forest science and ‘modern’ forest management. Each of these chapters highlights regional trends and key issues pertaining to the preservation, development, and application of TFRK in forest research, education, and management.

Chapters 12 and 13 examine the historical, current, and potential future impacts of two of the major challenges faced by indigenous and local communities in their efforts to preserve, develop, and use traditional forest-related knowledge—economic and cultural globalization and climate change. Discussion focuses not only on the threats posed by economic, social, and environmental change to the survival and development of traditional forest-related knowledge and practices, but also on the opportunities that these changes may present. Examples include the promotion of traditional forest (and related agricultural) management systems for climate change mitigation and adaptation.

Chapter 14 analyzes ethical issues and best practices for the scientific study of traditional forest-related knowledge and exchange of information between holders and users of traditional forest-related knowledge and forest scientists.

Finally, Chap. 15 summarizes the characteristics of traditional knowledge that both distinguish it from other knowledge and also make it vulnerable to disappearance in the modern world. Contributions of traditional forest-related knowledge to forestry science are discussed. The chapter suggests how to promote collaborative activities by forest scientists and professional organizations working with local and indigenous communities seeking to promote bio-cultural diversity and cultural, economic, and environmental sustainability in forest resource management.

1.3 Traditional Forest-Related Knowledge—Definition and Scope

The terms of reference for the task force on traditional forest-related knowledge incorporated the following definition of traditional knowledge, based upon the widely used definition of traditional ecological knowledge provided by Fikret Berkes, which also was adopted by the UN Forum of Forests:

Traditional forest-related knowledge: ‘a cumulative body of knowledge, practice and belief, handed down through generations by cultural transmission and evolving by adaptive processes, about the relationship between living beings (including humans) with one another and with their forest environment’ (UN 2004, adapted from Berkes et al. 2000).

This may be considered as a forest ecosystem-focused variant of the more general term *traditional knowledge* as defined by the Convention on Biodiversity’s Article 8(j):

... the knowledge, innovations and practices of indigenous and local communities around the world. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, proverbs, cultural values, beliefs, rituals, community laws, local language, and agricultural practices, including the development of plant species and animal breeds. Traditional knowledge is mainly of a practical nature, particularly in such fields as agriculture, fisheries, health, horticulture, and forestry.

Applied to forest environments, the scope of TFRK is broadly similar to that described by other commonly used terms, as they apply to forest environments. For example, indigenous knowledge (IK), traditional environmental (or ecological) knowledge (TEK), and local ecological knowledge, all generally refer to the long-standing traditions and practices of certain regional, indigenous, or local communities, and encompass the wisdom, knowledge, and teachings of these communities. While the richest body of traditional forest-related knowledge resides within the world’s indigenous communities, peoples, and nations, there exists in non-indigenous communities throughout the world as well a wealth of traditional knowledge related to trees, forests, and managed forested cultural landscapes.

In substituting ‘forest-related’ for ‘ecological,’ the task force recognized that forests are ecosystems and that knowledge related to forests would be knowledge of ecosystems. Although the terminology has been widely used, each of the terms in ‘traditional forest-related knowledge’ needs to be carefully considered.

The word *traditional*, while it accurately refers to the idea of a cumulative body of knowledge, practice and belief,’ could be interpreted to say that the knowledge is ‘old’ or ‘unchanging.’ The definition emphasizes that traditional knowledge does change and is ‘evolving by adaptive processes.’ Thus, although traditional, the knowledge can also be modern; the emphasis of the word is on local or indigenous knowledge, as opposed to universal knowledge, or knowledge from conventional science. One could use ‘indigenous,’ but not all local knowledge is indigenous in the sense of known by people that have been colonized by outsiders; rather, most

traditional knowledge is held by people who have become ‘indigenous to a place;’ they may not, however, be the original inhabitants.

We use the term *related* to recognize that forests produce more than wood fibre, and that the knowledge applies to all ecosystem processes that relate to forested lands. Many agroforestry and fishery issues depend upon forest-related knowledge. The word *related* has the additional advantage of suggesting other matters, such as issues having to do with human relationships to the forest. This aspect is referred to in the definition given above, which includes relationships among humans as part of traditional forest knowledge, in addition to including relationships between humans and non-humans.

The third word, *knowledge*, might seem at first to be less of an issue, but the breadth of the meaning of the word needs to be considered. Often, knowledge refers only to matters about the nature of the world and how it works, rather than including ideas related to ethics and morality. In considering traditional knowledge, one must adopt a broad concept, as will become clear in the following sections that compare and contrast traditional ecological knowledge to conventional science. Traditional knowledge holders often stress the importance of respecting nature, of being grateful for the generosity of non-humans in allowing themselves to be harvested and used by humans.

The correct words to use for *science* also need attention. Many times science is described as ‘Western science,’ ‘state science,’ or ‘reductionist science.’ Each of these adjectives contains its own issues. While science may have originated in Western Europe, it utilized knowledge from Asia and from Africa, and also may well have included ideas from the Americas. Forest science may have originated in a situation in which foresters worked for an emerging German state, but many others have contributed to forest science in subsequent years. Perhaps science can attribute some of its great success to applying reductionist techniques, particularly through laboratory and field experiments.

1.4 Relationship Between Traditional and Scientific Knowledge Systems

This section considers two aspects about the relationship between traditional forest-related knowledge and science: scientific credibility, and the actual differences and similarities between the two kinds of knowledge systems. The issue of the credibility of science creates a diversion from considering the more fundamental aspects of the relationship. Science and traditional knowledge have different origins and different relationships to their societies. However, differences between traditional knowledge and science have been narrowing in recent years because of differentiation among the different sciences, particularly the ecological sciences. The second part of this section examines the extent to which differing ecological sciences make assumptions similar to those made by traditional knowledge holders.

1.4.1 *The Credibility Issue*

The definition of traditional forest-related knowledge may imply that it is useful to distinguish traditional knowledge from conventional scientific knowledge. While drawing such distinctions is valuable for explaining and identifying traditional knowledge, there is a disadvantage related to recent concerns on the part of those who conduct science to protect the ‘credibility’ of science. Philosophers and social scientists have asked questions such as, ‘what kind of knowledge is science?’ and ‘how do scientists do their work?’ In exploring the answers, those engaged in science studies have appeared to question the objectivity, rationality, and truth of standard science. Defenders of science have responded so vehemently that the ensuing discussion has been labelled the ‘science wars.’ Sociologist Thomas Gieryn (1999) has described the science wars as examples of ‘boundary work’: the utilization of a series of strategies to define what is and is not science, with the goal of protecting the credibility of science.

The stakes in these ‘wars’ have been high. In the United States, the National Science Foundation (NSF) allocates scarce research funds. Fields outside of science cannot be supported by the NSF, which has taken a broad view that includes many social sciences within ‘science.’ As cited by Gieryn, defenders of science identify themselves as expert and credible because their knowledge is tested by nature. “Science is nature, and therefore the very opposite of culture,” wrote Michael Holmquest (quoted by Gieryn 1999, p. 342). Scientific knowledge is said to be better and stronger than knowledge based on discourse, mere talk, because science is based on credible procedures and tests that are judged by the response of nature to identify truth.

Certainly, traditional knowledge holders can make the same claim; as explained by Nadasdy (2003), the test of a hunter’s knowledge of moose is his ability to find a moose. Consequently, defenders of traditional ecological knowledge might be tempted to make the same claim as Holmquest: having successfully lived for years on a particular landscape, an elder recognized by his community as truly expert could also speak authoritatively on behalf of nature. That this may be possible could create a rivalry between the scientist and the elder, and the exploration of the rivalry would involve listing the many different ontological, epistemological, and ethical differences between their ways of knowing, with a goal of determining which methods were more credible. Going down this road, the scientist may dismiss the elder’s knowledge as ‘anecdotal,’ while the elder will dismiss the scientist’s knowledge as ‘not applicable here.’

If a credibility contest proceeds through such comparisons, everyone loses in terms of advancing knowledge, although one or the other may gain with respect to other aspects, such as job security or research support. As the International Council for Science¹ points out, because ‘pseudo science’ attempts to pose as science and attack its credibility, pseudo-science depends on science for its existence; on the other

¹Formerly the International Council of Scientific Unions (ICSU).

hand, traditional knowledge originates independently of science and competition with science is not necessary for traditional knowledge (ICSU 2002, p. 12).

If each respects the other, a trained scientist and a knowledgeable elder can have very productive discussions, as reported by botanist Nancy Turner (2005), ecologists P.S. Ramakrishnan (1992) and Fikret Berkes (2008), and fisheries biologist Robert Johannes (1981), to name a few scholars who have succeeded in establishing good working relationships with holders of traditional knowledge. The two types of experts can inform each other because their systems of knowledge rely on different sources and methods, while addressing similar problems. Traditional knowledge is typically based upon data observed over many, many years, while scientific knowledge usually relies on recent data collected under carefully controlled conditions, as in field experiments. Chapter 14 deals with ethical issues that are involved when scientists, usually connected to powerful institutions, interact with traditional knowledge holders, who usually are not connected to the powerful institutions.

The issue of credibility connects to the issue of epistemic injustice, a topic recently explored by Miranda Fricker (2007). Because traditional knowledge holders are often from groups who do not receive respect from the powerful groups, their testimony regarding events in the world are often discounted. Similarly, their contributions to the existing body of knowledge are not given credit. An example of this is the system of classification of species. The work of Rumphius originated with a classification system originally used by Malay women in Asia, while that of Linnaeus utilized Sami classifications (ICSU 2002, p. 13). Fortmann provides other examples of classification systems originating outside of Europe (Fortmann 2008). Another example is the use of vitamin C as a cure for scurvy: the Huron demonstrated the use of a tonic made from bark to Jacques Cartier in 1535; 200 years later, James Lind, reading of the experience, applied the cure to the British navy (Weatherford 1988, pp. 182–183). Weatherford provides other examples, some of which were credited to Indians—such as the word quinine, which originated in Quechua and remains the name of a drug used to cure malaria.

While contemporary recognition of the contributions of traditional forest-related knowledge can reverse the effects of epistemic injustice, the issue of the credibility of science in comparison to other knowledge systems remains an important barrier to joint learning by scientists and others. The International Council for Science has helped reverse this historical injustice by documenting many contributions of traditional knowledge to science (ICSU 2002, pp. 13–15).

1.4.2 Relationships Between Traditional Knowledge and the Sciences

We should set aside the credibility issue and instead examine methods of learning together, as Fortmann (2008) recommends. Table 1.1 highlights the relationship between many of the tenets of traditional knowledge and the characteristic assumptions of various ecological sciences. Perhaps traditional forest-related knowledge is

Table 1.1 Classification of components of traditional knowledge in relation to the sciences

Level	1	2	3	4	5	6	7
Label	Reductionist science	Ecology	Social-ecological systems	Resilience theory	Sustainability, ecological economics	Actor-network-theory	Sacred traditional knowledge
Connectedness: 'all things are connected'		X	X	X	X	X	X
Humans are part of the system: no society/nature division			X	X	X	X	X
The history of a place matters			X	X	X	X	X
Expect change and emergence at multiple scales; use humility in application of current knowledge				X	X	X	X
Knowledge is transmitted orally through narratives, stories				X	X	X	X
Training needs to focus on development of the capacity to learn and recognize new situations				X	X	X	X
Stewardship of the land is paramount					X	X	X
Generosity, sharing and equity among humans are important					X	X	X
Everything is there for a reason, and deserves respect and the right to live its way (limit the marketability of things; value growing stock for itself)					X	X	X
Practical experience on land is the main source of knowledge						X	X

Level	1	2	3	4	5	6	7
Label	Reductionist science	Ecology	Social-ecological systems	Resilience theory	Sustainability, ecological economics	Actor-network-theory	Sacred traditional knowledge
Doubts exist about the generality of knowledge						X	X
The fact/value distinction is unimportant						X	X
Knowledge, language, and identity are local.						X	X
Reciprocity governs human-prey relationships; humans must give thanks and reciprocate for the gifts given by plants and animals							X
Non-humans have consciousness							X
Humans permanently belong to their place							X

becoming more acceptable because of increasing overlap between the approaches of traditional knowledge holders and the approaches of new branches of science, particularly the ecological sciences. The first column of the table provides some examples of ideas used in TFRK; the remainder of the table shows which of the ideas have become used in the various ecological sciences. The ideas from traditional knowledge are organized in a manner that allows identification of seven levels of increasing consistency between traditional knowledge and different ecological sciences, with the seventh level being ‘sacred traditional knowledge,’ which has ideas that no science as yet has adopted. The list of ideas in the first column summarizes the literature on traditional knowledge, with an emphasis on the Americas. Since the main purpose of this section is to explore the relationships, the ideas in traditional knowledge are not explored in detail here. Many of these are dealt with in the chapters that follow.

1.4.2.1 Reductionist Science

The second column, Level 1 in the comparison, indicates that none of the statements of the first column can be said to be acceptable to that part of science called ‘reductionist.’ By using the experimental method to control for conditions not under study, scientists have become knowledgeable about microscopic or small components of systems. The success of reductionist science has of course contributed to its credibility, as those components are readily observed with the equipment scientists have developed. Traditional knowledge, on the other hand, is based on observations of the operation of whole systems, meaning that they describe relationships among the entities of an ecosystem, rather than the operations of each entity by itself. For instance, scientists understand why Pandora moth populations exhibit cycles in their numbers, due to the interaction between the moths and a small pathogen, but how the forest responds to Pandora moth outbreaks can’t be understood as easily without long-term data. When asked about the effects of moth abundance on forests, Paiute elders reported that sick trees would die and healthy ones would survive. This was consistent with the idea that other disease organisms in trees, such as mistletoe, would suffer from the deaths of their hosts due to moth outbreaks, which would reduce mistletoe infections (Blake and Wagner 1987).

1.4.2.2 Ecology

The importance of connections among components of an ecosystem distinguishes ecology from other biological sciences. Level 2 of the comparison of traditional knowledge to the sciences credits ecology with recognition of the idea that all things are connected. Textbooks such as those of Ricklefs and Miller (2000) and Kimmins (2004) stress such connections, recognizing that interactions among all parts of a system need to be understood, rather than focus upon just the parts. This recognition of ‘holism’ as an important approach has been controversial within scientific traditions, and the development of the disciplines has itself created a path-dependence in the structure of science. According to Paul Nadasdy, a Kluane hunter felt that

‘The government could not effectively manage wildlife . . . because (it) has forestry experts, water experts, and mining experts. . . . sheep biologists, moose biologists, wolf biologists, and bear biologists; and none of these people know anything outside of their own specialty’ (Nadasdy 2003, p. 123). While the hunter may be too harsh in the assertion that specialists know nothing outside of their specialty, that many are not interested in exploring system behaviour is accurate. Some wildlife biologists focus on habitat relationships; others, however, do not. That specialists in particular species should know about forest succession is an obvious statement of the need for interdisciplinary work, and it is no longer that controversial in the field of forestry.

1.4.2.3 Social Ecological Systems

Although ecology emphasizes connections, it differs from traditional knowledge in defining nature as separate from humanity; most ecosystems are described solely in terms of biotic and abiotic conditions, with biotic conditions omitting humans. Level 3 is the new field of social ecological systems, which emphasizes connections, and in addition recognizes the importance of history in understanding the particular configuration present at any one time in a system (Berkes et al. 2003).

The importance of the history of a place, and of human actions in that place, is another potential area of agreement among some conventional scientists and traditional knowledge holders. The concept of ‘path dependence’ captures this concern for the importance of history, a path, in understanding outcomes for complex systems.

This concern for history overlaps with the understanding of evolutionary principles of selection. Ray Pierotti (2010) argues that a 1911 quotation from Okute, a Lakota elder, is a recognition that organisms such as buffalo and people change in their characteristics in response to their specific history. After noting that, in his observations, no animals of the same species are exactly alike, and that variation also exists among plants, Okute observed:

An animal depends upon the natural conditions around it. If the buffalo were here today, I think they would be very different from the buffalo of the old days because all the natural conditions have changed. They would not find the same food, nor the same surroundings. . . . We see the same change in our ponies. . . . It is the same with the Indians (Pierotti 2010, p. 78).

This view of the dynamics of systems, and the importance of individual variation within systems, is consistent with evolution theory and with the ideas of socio-ecological systems, which include humans.

1.4.2.4 Resilience Theory

Resilience theory, Level 4 in Table 1.1, focuses on the concept of ecological resilience originally defined by C.S. Holling (Holling 1986; Gunderson and Holling 2002). Many of the same scholars who have stressed the importance of including humans in the system models are also very interested in the concept of resilience, which has been emphasized by the Resilience Alliance, a loose network of scholars who

founded the journal *Ecology and Society* (originally *Conservation Ecology*). These scholars hypothesize that ecological resilience has to be understood at different scales. Resilience results from successful social learning, which requires knowledge of the history of a system. Thus they have recognized the importance of oral narratives in providing such knowledge to humans in a system. They recognize the unpredictability of most systems, thus adopting humility about human understanding, a characteristic also emphasized by traditional knowledge holders. Given the stress on unpredictability, they see that the capacity to learn is a necessary component of achieving resilience (Berkes and Folke 1998; Folke et al. 2002).

A consequence of stressing unpredictability is a change in what is monitored—scientists create long lists with criteria and indicators, while traditional people use a few key signs. Berkes (2008) is particularly impressed by aboriginal systems of monitoring complex systems. This attention to signals that show results for the entire system is another consequence of the differing metaphors that underlie conventional science and traditional knowledge: attention to the detailed parts compared to attention to the relationships of the entities in the system.

The emphasis on unpredictability also is consistent with an insistence that training should focus on development of the ability to recognize new situations. Many have emphasized that training by traditional knowledge holders emphasizes teaching youth to recognize the signs of the land, and to let them make mistakes in implementation in order to learn how to evaluate what they see (Turner 2005).

1.4.2.5 Sustainability and Ecological Economics

The field of ecological economics, whose origin predates the establishment of the Resilience Network, uses many of the ideas present in the study of resilience but adds other concerns that are not so evident in the resilience literature. Prominent among the ideas of ecological economics is sustainability, and the concomitant idea that stewardship of the land is a paramount concern (Costanza et al. 1997). This stress on stewardship and sustainability marks the move to Level 5 of the table.

The concern for sustainability, broadly defined, is widespread in the literature on traditional knowledge. Attention is now given to the practices of the Menominee Tribe, for instance, as a model of the operation of sustainability goals in a forest environment. The Menominee like to say that they are borrowing their forest from their grandchildren (Pecore 1992; Davis 2000). Turner (2005) has also praised the concern of aboriginal peoples on the west coast of North America for their concern that ‘the Earth’s Blanket’ be protected.

Another key characteristic of traditional systems is their stress on reciprocity and the importance of sharing among humans. This is evident on the Pacific Northwest coast of North America, where leaders are obligated to show their competence through feasting other leaders and their people (Daly 2005; Wa and Uukw 1992; Mills 1994, 2005; Trosper 2009; Turner et al. 2000; Umek 2004; Walens 1981). This stress on equity and concern about unequal distributions of income is typical of writing in ecological economics.

Another characteristic of ecological economics is a vigorous debate about the use of market prices to value everything. While economists advocate the pricing of ecosystem services as a way to bring nature into economics, many ecological economists are far from sure (Norgaard 2010). Geoffrey Heal (1998), in considering the economics of sustainability, values the stock of natural resources for itself, without assigning a price, and derives what he and others call a ‘green golden rule’ by using a social welfare function that values the stock for itself rather than for its flow of services. This approach is what the Menominee Tribe applies in its forest management (Trospen 2007). Indigenous peoples of Mexico also resist full response to market prices, preserving a portion of their production for their own consumption, outside the market (Toledo et al. 2007).

Ecological economists, however, are fully in support of the search for generalizations that apply everywhere. In this they differ from those such as Bruno Latour, who seriously doubt such generalizations, which brings us to Level 6.

1.4.2.6 Latour’s Actor-Network-Theory

Having carefully observed the way that scientists go about their work, sociologist Bruno Latour has challenged many of the epistemological and ontological assumptions that scientist claim to describe what they do. Among the ontological assumptions he has challenged is that of the existence of a single entity, nature, which is constant everywhere while cultures vary. He argues that no distinction should be made between nature and human culture (a division also rejected most clearly by those who advocate social ecological systems as the unit of analysis), arguing that what exists is ‘multinaturalism’: many different combinations of humans and nature (Latour 1993, 2004). As a consequence, he resists generalizations and makes that resistance a focus of his book on actor network theory (Latour 2005). He concludes by arguing that the best work a student can undertake is merely excellent description. This rejection of generalizations is quite evident among traditional knowledge holders, who do not believe that they can tell others what to do with their land using their own knowledge. An example is the strong view of Pikangikum elders to not make decisions for neighbours’ land (O’Flaherty et al. 2008; Miller et al. 2010).

Another major similarity between Latour and traditional knowledge holders is the lack of attention and concern given to keeping facts separate from values. Some Menominee scholars, for instance, reject the term ‘traditional ecological knowledge,’ preferring ‘indigenous wisdom,’ because the term knowledge would seem to exclude ethical concerns about humanity’s duty to care for the non-human world (Fowler 2005). Ethnobiologist Nancy Turner advocates traditional knowledge because of its explicit attention to the importance of taking care of the earth (Turner 2005). Latour centres his book, *Politics of Nature*, on a rejection of the standard fact/value distinction (Latour 2004). The International Science Council (ICSU 2002, p. 10) has also noted that the separation of fact from value leads scientists to misunderstand the depth of traditional knowledge.

A consequence of both the rejection of generalities and the fact/value distinction is an emphasis on the close connections among knowledge, language, and identity; all of these are assumed to be uniquely local characteristics. Part of the distrust of generalizations on the part of traditional knowledge holders is the desire that local applicability has to be demonstrated, an empirical concern that elevates practical knowledge above all other types.

1.4.2.7 Sacred Traditional Knowledge

Level 7 of the table asserts that sacred traditional knowledge has three ideas that are not shared with any of the ecological sciences: that reciprocity should govern human-prey relationships, that non-humans have consciousness, and that humans are permanently connected to their places. Although the sciences may have difficulty accepting these ideas, ecologist Fikret Berkes (2008) is willing to include the sacred in his consideration of traditional ecological knowledge. While other individual scientists may also be willing to accept the sacred, the organizations of science find sacred ideas much more difficult to include.

Another consequence of the rejection of the fact/value and nature/human distinction is that many traditional knowledge holders are very clear that they have standards of correct behaviour towards non-humans, particularly those species that are prey or sources of food and medicine. These entities deserve thanks for their contributions to humans. They also deserve respect and the right to live without undue interference from humans (O'Flaherty et al. 2008). Humans have a duty to act with reciprocity towards their prey, giving thanks for the willingness of these beings to give up their lives for human consumption. The Cree are particularly clear on this point (Tanner 1979; Feit 1992). Nonhumans have consciousness, and care must be taken as a result; even glaciers are recognized as conscious beings (Cruikshank 2005). This view of the consciousness of non-humans is seen as an extension of 'sacred' concepts in a way quite different from evident in other knowledge systems, and for this reason traditional knowledge is on occasion attacked for failing to be objective by bringing religious ideas into its purview.

Another aspect of sacred traditional knowledge is its emphasis on the strong connection between some humans and the land that they regard as sacred. In fact, the connection is so strong that a person cannot sever his bond with the land; humans are permanently connected to their place (Wa and Uukw 1992; Basso 1996; Cajete 1999; Burton 2002; Nadasdy 2003). To accept this link is so contrary to modern concepts of economic organization that no scholars are willing to go so far as to assert such unchangeable connections. In modern terms, humans are said to have to be able to move to places where they can earn good wages.

This brief survey of relationships between various ecological sciences and traditional knowledge reveals that many overlaps exist. Some difficulties also exist; for instance, few scientists are probably willing to give up the desire to find generalizations, or to accept the idea that people are permanently attached to their homelands. But these particular ideas may also be acceptable to some of those who possess

traditional knowledge, which is probably more diverse than the ecological sciences. While traditional forest-related knowledge has become more relevant to the ecological sciences, it has also attracted considerable attention in international arenas. The following two sections summarize recent developments in policy processes such as those of the United Nations, in intergovernmental agreements, and among international nongovernmental organizations.

1.5 Traditional Forest-Related Knowledge in Intergovernmental Policy Processes

The protection, development, and utilization of traditional forest-related knowledge raise important questions about land tenure, ownership of genetic resources, intellectual property rights, and equitable sharing of benefits arising from the use of this knowledge. How these complex legal and ethical issues are resolved at local, national, and international levels has significant implications for cultural and biological diversity, and social justice.

Traditional forest-related knowledge and the constellation of issues surrounding it are increasingly recognized and addressed by the international community through a variety of legal instruments and policy processes. Those that focus on indigenous peoples' rights, including those related to traditional forest-related knowledge, include among others: the 2007 Declaration on the Rights of Indigenous Peoples, the UN Permanent Forum on Indigenous Issues and the Declaration on the Rights of Indigenous Peoples (UNPFII), the UN Working Group on Indigenous Populations, and the International Labour Organization's 1989 Convention 169 on Indigenous and Tribal Peoples.

Policy commitments developed at the international level that urge states to support, protect, and encourage the use of traditional knowledge and customary forest management and use are found in a number of instruments. Notable among these are the agreements negotiated during the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 (the Earth Summit). These include the Rio Declaration on Environment and Development, Agenda 21 (Programme of Action on Sustainable Development), the Convention on Biological Diversity (CBD), the UN Convention to Combat Desertification (UNCCD), the UN Framework Convention on Climate Change (UNFCCC), and the non-legally binding Forest Principles. Traditional knowledge and its importance in education, science, and culture have received considerable attention by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

With respect to access, benefit sharing, and intellectual property protection issues related to TFRK, the World Intellectual Property Organization (WIPO), the World Trade Organization (WTO), the United Nations Conference on Trade and Development (UNCTAD), and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) also have important roles to play (UNU-IAS 2005).

Traditional knowledge, including forest-related knowledge pertaining to the therapeutic value of the thousands of plant species used in traditional systems of medicine, plays a very important role in meeting the health care needs of the majority of people throughout the world. Recognizing this, the World Health Organization (WHO) adopted a Traditional Medicine Strategy in 2002. Among the Strategy's objectives are to support relevant aspects of traditional medicine within national health care strategies and policies; promote the rational use of traditional medicine; and promote the safety, efficacy, and quality of traditional medicine practices (WHO 2002). WHO also supports a network of collaborating centres for promotion of traditional medicine, supports documentation of information on traditionally used medicinal plant species, and has worked with other organizations to develop guidelines for the sustainable collection and cultivation of medicinal plant resources (WHO/IUCN/WWF 1993; WHO 2003).

The commitments made by countries at the 1992 Earth Summit were reaffirmed in the Millennium Development Goals arising from the 2000 UN Millennium Declaration² (particularly Goal No. 7 on Environmental Sustainability), the Proposals for Action arising from the work of the Intergovernmental Panel on Forests and the Intergovernmental Forum on Forests from 1995 to 2000, and the ongoing work of the Rio Conventions and the United Nations Forum on Forests (UNFF, 2000–present). Further details regarding UNCED and the Rio Conventions, the United Nations Forum on Forests, UNESCO, and policies for and organizations dealing with international property rights issues related to TFRK may be found in the [Appendix](#) to this chapter.

Despite the significant progress made in the development of international forestry policy focused on sustainable forest management over the past 20 years, there is widespread concern that progress on the ground has been poor (Collings 2009). The lack of effective coordination among the different government agencies within countries, as well as among the various, largely autonomous, international organizations and processes dealing with TFRK issues from different perspectives, is a persistent obstacle (Rosendal 2001). A review of the implementation of key international commitments on traditional forest-related knowledge in a number of countries in the Americas, Africa, and Asia was conducted in 2004 by the International Alliance of Indigenous and Tribal Peoples of the Tropical Forest (Newing et al. 2005). The study concluded that beyond the production of numerous country-level planning documents and reports to the CBD and UNFF—such as national forest plans (NFPs), national forest action programmes (NFAPs), and national biodiversity strategy and action plans (NBSAPs)—evidence of effective implementation of laws, policies, and related actions on the ground is relatively scarce in most countries (Newing 2005).

²<http://www.un.org/millenniumgoals/bkgd.shtml>

1.6 TFRK in Intergovernmental Programmes, International Scientific Organizations, and Non-governmental Organizations

The growing recognition of traditional forest-related knowledge and its importance for biodiversity conservation and sustainable development in recent decades has encouraged an increased focus on TFRK in a variety of intergovernmental and scientific organizations, as well as in international programmes of non-governmental organizations (NGOs). While an exhaustive survey of these is beyond the scope of this chapter, UNESCO's Man and the Biosphere (MAB) and its Local and Indigenous Knowledge Systems in a Global Society (LINKS) programme, as well as United Nations University–Institute of Advanced Studies' Traditional Knowledge Initiative are excellent examples. Further details on these are provided in the [Appendix](#).

Research in a variety of biophysical social science disciplines related to traditional forest-related knowledge and practices, is currently undertaken by scientists from universities, research institutes, and other organizations worldwide. There is a long history of such research in social science disciplines such as anthropology, and keen interest among botanists and other forest scientists—particularly on traditional knowledge related to forest species of economic value, such as plants used in traditional medicine and other commercially valuable non-timber forest products. However, most research in this field (particularly within the biophysical sciences such as ecology, forestry, and agriculture) is relatively recent. Inter- or multi-disciplinary research, which one could argue is essential for a proper understanding of traditional forest-related knowledge, is even more recent, mostly dating from the 1970s.

Among the many international scientific organizations with research programmes relevant to traditional forest-related knowledge and its practitioners, the Center for International Forestry Research³ (CIFOR, based in Bogor, Indonesia); the World Agroforestry Center⁴ (ICRAF, based in Nairobi, Kenya); and the International Institute of Tropical Agriculture⁵ (IITA, based in Ibadan, Nigeria) are notable. All are part of the network of 15 internationally funded research centres established by the Consultative Group on International Agricultural Research⁶ (CGIAR, established in 1971), and each has strong, integrated, multi-disciplinary programmes oriented towards the practical challenges faced by local and indigenous communities, primarily those in tropical and subtropical regions of the world. While IITA's work is focussed on Africa, with research stations located in ten sub-Saharan countries, ICRAF and CIFOR's research programmes are global in scope (or at least pan-tropical), with major initiatives undertaken in many countries in Asia, Africa, and Latin America.

³<http://www.cifor.cgiar.org/>

⁴<http://www.worldagroforestrycentre.org/>

⁵<http://www.iita.org/>

⁶<http://www.cgiar.org/centers/index.html>

ICRAF's research programmes involve close engagement with local communities and aim towards the development more productive, diversified, integrated, and intensified trees and agroforestry systems to provide livelihood and environmental benefits to communities. One of its better-known programmes—the Alternatives to Slash and Burn (ASB) Partnership for the Tropical Forest Margins (established in 1994)—combines local knowledge, policy perspectives, and science to understand the trade-offs associated with different land uses and the roles of markets, regulation, property rights, and rewards (ASB 2011).

CIFOR conducts research and policy analysis in collaboration with a broad array of partners—research organizations, local communities, NGOs, and others. Through this work, CIFOR aims address the needs and perspectives of people who depend on forests for their livelihoods, as well as improve the management of tropical forests. Much of CIFOR's research is multidisciplinary, and some is long-term work, such as its well-known global programmes on forests and livelihoods, and on adaptive collaborative forest management (Colfer 2005). These and other programmes often involve participatory research with local and indigenous communities. At present, CIFOR's research programmes include a strong emphasis on issues and research questions relevant to climate change mitigation and adaptation and its relation to tropical forests and forest-dependent communities and their livelihoods.

A large number of local grass-roots, national, regional, and international non-governmental organizations work on issues relevant to the preservation, development, and promotion of traditional forest-related knowledge, as well as the protection of the rights and interests of local and indigenous communities whose traditional knowledge, practices, and cultures are under threat. Many international networks, alliances, and individual NGOs promote indigenous and local communities' interests in global policy processes and programmes. Others support projects and other activities related to conservation and development of TFRK, including efforts to build greater understanding and appreciation among the scientific community, decision makers, and the people in traditional communities; or to develop approaches for integrating traditional and formal scientific forest-related knowledge to improve forest management for the benefit of both traditional communities and the broader suite of 'stakeholders' in sustainable forest management.

Two such organizations with somewhat different orientations, but both contributing in important ways towards harmonizing interests among forest stakeholders, are the International Model Forest Network and the Forest Peoples Programme. The International Model Forest Network⁷ is a 'global community of practice' that includes local communities as well as other forest stakeholders. Model forests are voluntary, broad-based initiatives linking forestry, research, agriculture, mining, recreation, and other values and interests within a given landscape. The Network currently includes landscapes representative of most of the major forest ecosystems of the world whose management combines the social, cultural, and economic needs of local communities with the objective of long-term sustainability of these landscapes.

⁷<http://www.imfn.net/>

The Forest Peoples Programme⁸ (FPP), a UK-based NGO actively engaged in international forest policy forums, works with indigenous and local communities South America, Central Africa, South and South East Asia, and Central Siberia, providing support for these communities to secure their rights, and strengthen their own organisations to negotiate with governments and companies as to how economic development and conservation is best achieved on their traditional lands. Among their activities are projects that promote community-based sustainable forest management based on traditional forest-related knowledge, practices, and related traditional governance. The Forest Peoples Programme produces a variety of publications, including useful syntheses of case studies and policy analyses based on scientific literature and other information sources.

1.7 Conclusion

The growing interest in traditional forest-related knowledge among international organizations and in policy arenas is a major indication of its currency and relevance to conservation of biocultural diversity and sustainable use of forests worldwide. The increasingly recognized overlap between traditional knowledge concepts and those of various ecological sciences is another sign of TFRK's growing importance. The following chapters by an international team of authors explore the tremendous pool of knowledge that exists in indigenous and local communities throughout the world. These chapters elaborate the many different ways in which traditional forest-related knowledge is relevant to communities, their livelihoods, and the history of forest resource management. The chapters also document examples of both conflict and collaboration between traditional knowledge holders and formal forest science. We hope that this extensive treatment of the current importance of traditional forest-related knowledge will stimulate further research and support for TFRK throughout the world.

Appendix—Traditional Forest-Related Knowledge in Intergovernmental Policy Processes and Selected Intergovernmental Programs

The UN Permanent Forum on Indigenous Issues and the Declaration on the Rights of Indigenous Peoples

The Permanent Forum on Indigenous Issues (UNPFII⁹), established in 2000, is an advisory body to the UN Economic and Social Council, with a mandate to discuss indigenous issues related to economic and social development, culture,

⁸<http://www.forestpeoples.org>

⁹<http://www.un.org/esa/socdev/unpfii/index.html>

the environment, education, health, and human rights. The Permanent Forum provides expert advice and recommendations on indigenous issues to the Council, as well as to programmes, funds, and agencies of the United Nations, through the Council. The UNPFII also seeks to raise awareness and promotes the integration and coordination of activities related to indigenous issues within the UN system, and prepares and disseminates information on indigenous issues, including traditional knowledge (UNPFII 2005).

The Declaration on the Rights of Indigenous Peoples¹⁰ was adopted by the General Assembly in 2007, the result of more than 20 years of work by indigenous peoples and the United Nations system. The Declaration is the UN's most comprehensive statement of the rights of indigenous peoples, giving prominence to collective rights to a degree unprecedented in international human rights law. Its adoption is a clear indication that the international community is committing itself to the protection of the individual and collective rights of indigenous peoples. With respect to traditional knowledge, Article 31 of Declaration states that: (1) 'Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions,' and, (2) 'In conjunction with indigenous peoples, States shall take effective measures to recognize and protect the exercise of these rights.'

Other articles of the Declaration relate to issues that are fundamental to the protection and development of traditional forest-related knowledge and practices, including the collective and individual right to lands, territories, and resources that they have traditionally owned or occupied; the rights to self-government by their own institutions and authorities within their lands and territories; the rights to the conservation and protection of the environment and the productive capacity of their lands and resources; and the right to determine priorities and strategies for their development. The Declaration also calls on states to prevent dispossession of indigenous peoples from land, territories, and resources; allow indigenous peoples to participate in decision-making in matters affecting their rights; and to protect their right to be secure in their means of subsistence and development (Collings 2009; Lyster 2010).

UNCED and the Rio Conventions

Agenda 21 and the Forest Principles

The Programme of Action on Sustainable Development (Agenda 21) adopted by UNCED in Rio de Janeiro in 1992 includes a number of recommendations, directed primarily to countries with support from regional and international organizations,

¹⁰ <http://www.un.org/esa/socdev/unpfii/en/declaration.html>

concerning the relevance of traditional knowledge for implementation of sustainable development policies and programmes (UNU-IAS 2005). These traditional knowledge-related recommendations address a variety of sustainability issues, including, among others: human health; deforestation; desertification; agriculture; and agricultural, forest, marine, and freshwater resource management. Dealing specifically with the connections between traditional and formal scientific knowledge, recommendation 35.7 (h) (on science for sustainable development) urges countries, with support of international organizations, to:

Develop methods to link the findings of the established sciences with the indigenous knowledge of different cultures. The methods should be tested using pilot studies. They should be developed at the local level and should concentrate on the links between the traditional knowledge of indigenous groups and corresponding, current “advanced science”, with particular focus on disseminating and applying the results to environmental protection and sustainable development.¹¹

The Forest Principles—whose objective is to contribute to the management, conservation, and sustainable development of forests and to provide for their multiple and complementary functions—encourages countries to pursue forest policies that recognize and support the identity, culture, and rights of indigenous and local communities who depend on forests for their livelihoods. They also stress the importance of recognizing, respecting, recording, and developing indigenous capacity and local forest knowledge and the equitable sharing of benefits derived from indigenous forest-related knowledge.¹²

Convention on Biological Diversity

The Convention on Biological Diversity (CBD), which entered into force in 1993, encourages states to:

Protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements¹³ (CBD Article 10c).

Likewise, CBD Article 8(j) emphasizes:

the need to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles for the conservation and sustainable use of biological diversity and [promotion of] their wider application with the approval and involvement of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.

¹¹ http://www.un.org/esa/dsd/agenda21/res_agenda21_33.shtml

¹² <http://www.un.org/documents/ga/conf151/aconf15126-3annex3.htm>

¹³ The CBD Secretariat notes that this implies that governments should ensure that national legislation and policy account for and recognize, among others, indigenous legal systems, corresponding systems of governance and administration, land and water rights, and control over sacred and cultural (CBD 1997).

Since 1994, CBD's Conference of the Parties decisions related to the Convention's thematic areas and cross-cutting issues have routinely emphasized the important role of traditional knowledge and practices towards the achievement of the Convention's three major objectives: conservation of biological diversity, sustainable use of the components of biological diversity, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Traditional forest-related knowledge also is explicitly considered in CBD's expanded programme of work on forest biological diversity adopted in decision VI/22 of the Convention's 6th Conference of the Parties in 2002, and calls on parties, governments, international, and regional organizations and processes, civil society organizations, and other relevant bodies to:

Support activities of indigenous and local communities involving the use of traditional forest-related knowledge in biodiversity management;

Encourage the conservation and sustainable use of forest biological diversity by indigenous and local communities through their development of adaptive management practices, using as appropriate traditional forest-related knowledge; [and to]

Implement effective measures to recognize, respect, protect and maintain traditional forest-related knowledge and values in forest-related laws and forest planning tools, in accordance with Article 8(j) and related provisions of the Convention on Biological Diversity.¹⁴

The CBD's Working Group implementation of Article 8 (j) and related provisions, established in 1998, has sought to raise the profile of indigenous and local community issues throughout the Convention. It has developed and monitored the implementation of the work programme on Article 8(j) and related provisions (adopted by the Conference of the Parties in 2000), as well as a plan of action for the retention of traditional knowledge, innovations and practices, including the development of voluntary Akwé: Kon¹⁵ guidelines (SCBD 2004) for the conduct of cultural, environmental and social impact assessment regarding developments proposed to take place on, or likely to have an impact on, sacred sites and lands and waters traditionally occupied or used by indigenous and local communities (adopted in 2004). The Working Group has also reported on the status and trends of traditional knowledge from all regions of the world and the identification of processes at national and local levels that may threaten the maintenance, preservation, and application of traditional knowledge.

At its 10th meeting in October 2010, the CDB Conference of the Parties (COP-10) adopted the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (SCBD 2011), which includes traditional knowledge associated with genetic resources that is held by indigenous and local communities. Article 9 of the Protocol calls on parties (governments) to not restrict customary use and exchange of genetic resources and associated traditional knowledge within and amongst indigenous and local communities in accordance with the objectives of the CBD, and to take into consi-

¹⁴ CBP COP Decision VI/22: <http://www.cbd.int/decisions/cop/?m=cop-06>

¹⁵ Akwé: Kon is a Mohawk term meaning 'everything in creation.'

deration, and support development of, indigenous and local communities' customary laws, community protocols, and procedures with respect to access to traditional knowledge associated with genetic resources and the fair and equitable sharing of benefits arising from utilization of such knowledge.

COP-10 also adopted a decision (COP/10/L.38) including an ethical code of conduct,¹⁶ and inviting parties and other governments to make use of this code to develop their own models on ethical conduct for research, access to, and use of information concerning traditional knowledge for the conservation and sustainable use of biodiversity, and to undertake education, awareness-raising, and communication strategies on the code for incorporation into policies and processes governing interactions with indigenous and local communities.

Currently under discussion within the CBD is the development of a joint programme of work on biological and cultural diversity, proposed during the International Conference on Biological and Cultural Diversity: Diversity for Development—Development for Diversity,¹⁷ held in Montreal in June 2010. The proposed work program, led by the Secretariat of the CBD and UNESCO (acting as the global focal point on issues related to cultural diversity), would aim to better coordinate closely related activities of the CBD and UNESCO; to broaden the knowledge base on linkages between biological and cultural diversity including, among others, the ways in which cultural diversity has shaped biodiversity in sacred natural sites, cultural landscapes, and traditional agricultural systems; and to raise awareness of these linkages through educational activities and related work with decision makers.

UN Convention to Combat Desertification

The United Nations Convention to Combat Desertification¹⁸ (UNCCD) was adopted in 1994 and entered into force in 1996. The Convention contains a number of provisions related to the protection, development, and use of traditional and local knowledge, technologies, know-how, and practices to combat desertification and mitigate the effects of drought on agricultural and pastoral systems and traditional livelihoods in dryland ecosystems. Since 1997, the UNCCD has been involved in the inventory of traditional knowledge systems through the work of the two ad hoc panels—regional cooperation within the Convention's Thematic Programme Networks, and National Action Programmes. Based on the work of the ad hoc panels, the Convention's Committee on Science and Technology prepared a compilation of official documents and reports focusing on the use of traditional and local

¹⁶Tkarihwaí:ri Code of Ethical Conduct on the Respect for the Cultural and Intellectual Heritage of Indigenous and Local Communities Relevant to the Conservation and Sustainable Use of Biological Diversity. Tkarihwaí:ri is a Mohawk term meaning 'the proper way.' Available via www.cbd.int/doc/decisions/cop-10/cop-10-dec-42-en.doc. Cited 24 March 2011.

¹⁷ <http://www.cbd.int/doc/meetings/development/icbcd/official/icbcd-scbd-unesco-en.pdf>

¹⁸<http://www.unccd.int/main.php>

technologies, knowledge, know-how, and practices relevant to efforts to combat desertification and mitigate the effects of drought (UNCCD 2005).

UN Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) is the principal international forum for negotiations among governments on issues related to climate change, and measures to be taken for its mitigation. Until recently the inclusion of forests, and forest-dependent people, in development of policies and programmes for climate change mitigation under the Kyoto Protocol was constrained until 2007, when the UNFCCC's 13th Conference of the Parties adopted the so-called Bali Action Plan,¹⁹ or 'Bali roadmap,' for a future international agreement on climate change. The Bali Action Plan's overall goal is to develop a 'shared vision for long-term cooperative action, including a long-term global goal for emission reductions, to achieve the ultimate objective of the Convention' The Bali Road Map contains detailed lists of issues to be considered under topics related to climate change mitigation and adaptation actions, among others. There are no specific references to indigenous people or traditional knowledge in these issues. The issues do, however, refer to the economic and social consequences of response measures.

Indigenous peoples' groups (as well as many other key stakeholders in climate change policy) have for many years been disappointed by the limited consideration given to their views, knowledge, and interests within UNFCCC negotiations, and space allowed within the UNFCCC process for their involvement. For example, while indigenous peoples' organizations have been acknowledged as a constituency in climate change negotiations within UNFCCC since 2001, they are still awaiting UNFCCC's approval of an Ad Hoc Working Group on Indigenous Peoples and Climate Change, which would allow them to actively participate in the meetings of the Conference of Parties in the same way they are able to under the Convention on Biological Diversity (Collings 2009, Galloway-McLean 2010). However, recent developments since adoption of the Bali Action Plan should create opportunities within the UNFCCC (as well as the Intergovernmental Panel on Climate Change) processes for indigenous views and traditional knowledge about climate change to be incorporated in the development of future policies and commitments.

United Nations Forum on Forests

The United Nations Forum on Forests (UNFF²⁰) was established in 2000 as a subsidiary body of the Economic and Social Council of the UN together with the Collaborative Partnership on Forests (CPF), comprising forest-related UN agencies

¹⁹ <http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=3>

²⁰ <http://www.un.org/esa/forests/about.html>

and international and regional organizations, institutions, and instruments. Its main objective is to promote the management, conservation, and sustainable development of all types of forests and to strengthen long-term political commitment to this end.

Prior to the establishment of the UNFF, between 1995 and 2000, the Intergovernmental Panel on Forests (IPF), and the Intergovernmental Forum on Forests (IFF), both under the auspices of the United Nations Commission on Sustainable Development, were the main intergovernmental forums for international forest policy development. IPF and IFF examined a wide range of forest-related topics over a 5-year period. The final reports of these processes included 270 non-legally binding proposals for action towards sustainable forest management. These proposals for action include numerous references to traditional forest-related knowledge (TFRK) related to: the use of TFRK for sustainable forest management; development of intellectual property rights for TFRK and promotion of equitable benefit-sharing; technology transfer and capacity-building; and promotion of participation of people who possess TFRK in the planning, development, and implementation of national forest policies and programmes.

Although the UNFF failed to adopt a decision on traditional forest-related knowledge during its 4th meeting in 2004, the Non-Legally Binding Instruments on All Types of Forests (NLBI) adopted by the UNFF in 2007 (United Nations 2007) commits member states to:

Support the protection and use of traditional forest-related knowledge and practices in sustainable forest management with the approval and involvement of the holders of such knowledge, and promote fair and equitable sharing of benefits from their utilization, according to national legislation and relevant international agreements (NLBI, para. 6(f)).

The first inter-governmental instrument on sustainable forest management, the NLBI covers issues ranging from protection and use of traditional forest-related knowledge and practices in sustainable forest management, to the need for enhanced access to forest resources and relevant markets to support the livelihoods of forest-dependent indigenous communities living inside and outside forest areas.

Despite UNFF's recognition of the role that indigenous and local communities play in achieving sustainable forest management, indigenous peoples' organizations and civil society have generally been disappointed with the results achieved by the UNFF (Collings 2009). Many argue that the UNFF does not build on what were seen as the more open and progressive practices of the IPF/IFF and Commission on Sustainable Development (Forest Peoples Programme 2004). The NLBI has also been criticized for its failure to recognize, respect and support the implementation of customary rights of indigenous peoples who live in and depend on forests and for failing to comply with best practices in environment management (Forest Peoples Programme 2007).

United Nations Educational, Scientific and Cultural Organization (UNESCO)

Under the auspices of UNESCO, two conventions have been adopted that are relevant to the preservation and development of traditional forest-related knowledge: the Convention for the Safeguarding of Intangible Cultural Heritage (2003), and the Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005).

However, UNESCO has been criticized for exclusion of indigenous peoples in their drafting, and the inadequate acknowledgement that a large part of ‘cultural heritage’ and ‘cultural expressions’ that these conventions deal with is the heritage of indigenous peoples and indigenous cultures (Kipuri 2009).

TFRK and Intellectual Property Protection

Issues related to access, benefit sharing, and protection of intellectual property rights (IPRs) with respect to traditional knowledge are considered in a number of international agreements and in ongoing policy debates, largely within the UN system. These involve a wide array of international forums and intergovernmental organizations concerned with food and agriculture, conservation, health, human rights, indigenous issues, and development and trade (UNU-IAS 2005). Prominent among them, discussed above, are the UN Permanent Forum on Indigenous Issues, the Declaration on the Rights of Indigenous Peoples, the Convention on Biological Diversity, the UN Convention to Combat Desertification, and the UNFF’s Non-Legally Binding Instruments on All Types of Forests. Traditional forest-related knowledge issues also figure prominently in the work of bodies and processes that deal more directly with intellectual property protection, such as the World Intellectual Property Organization (WIPO), established as a UN agency in 1967, and the World Trade Organization (WTO).

Although international human rights standards since 1948 have recognized the importance of protecting intellectual property (IP), these rights have not yet been extended to the holders of traditional knowledge. Requirements for IP protection under current IP regimes are widely considered to be inconsistent or incompatible with the nature of traditional knowledge (Hansen and Van Vleet 2007). The approaches taken towards traditional knowledge in these organizations and processes, each with their own mandate, are often very different, not very well-coordinated, and at times conflicting. For example, while the Convention on Biological Diversity is generally more open to approaches that recognize collective ownership of traditional knowledge, innovations, and cultural expressions that are more compatible with the philosophical and cultural standards of indigenous and local communities, the emphasis within WIPO and WTO is on promoting existing IPR regimes (i.e., copyright, trademark, and patent systems) that have evolved based on assumptions of individual ‘ownership’ of such knowledge and expressions.

The issue of patenting of life forms (species and varieties of plants, animals, and micro-organisms), relevant to the conservation and development of traditional forest-related knowledge, is a particularly contentious one in all forums dealing with intellectual property protection. It is of particular concern to farmers in traditional communities who, through many generations, have developed and applied traditional knowledge and practices to develop new crop varieties that have created and continue to enrich the world's agricultural biodiversity.

The World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), negotiated in the 1986–1994 Uruguay Round, introduced IPR rules into the multilateral trading system for the first time in its Article 27.3(b), which deals with patentability or non-patentability of plant and animal inventions, and the protection of plant varieties. The 2001 Doha Declaration broadened discussion of IPR issues by directing the TRIPS Council to review TRIPS Article 27.3(b), specifically the relationship between the TRIPS Agreement and the UN Convention on Biological Diversity with respect to the protection of traditional knowledge and folklore.

WIPO's Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC) undertakes negotiations with the objective of reaching agreement on principles for, and an international legal instrument (or instruments) intended to ensure, the effective protection of traditional knowledge (TK), traditional cultural expressions (TCEs), folklore, and genetic resources (WIPO 2010a, b). Standards under development by the IGC focus on protection against misappropriation of TK, and they attempt to complement other international instruments and processes dealing with other aspects of the preservation, safeguarding, and conservation of such knowledge (UNU-IAS 2005). At a recent meeting of the IGC's Second Intersessional Working Group (in February 2011), consolidated, streamlined text on the protection of traditional knowledge was produced (on issues related to a definition of traditional knowledge, beneficiaries of protection, and the scope of rights to be granted, and how they would be managed and enforced). The results of this meeting²¹ were considered by many to be a step towards an international legal instrument to ensure the effective protection of traditional knowledge.

The United Nations Conference on Trade and Development (UNCTAD) also seeks to address the protection of traditional knowledge as part of its work, recognizing the need to harmonize its work in this area with relevant organizations such as WIPO, WHO, and CBD. In 2001, UNCTAD Trade and Development Board's Commission on Trade in Goods and Services and Commodities recommended that international efforts be made to promote capacity-building to implement protection regimes for traditional knowledge, promote fair and equitable sharing of benefits derived from this knowledge in favour of local and traditional communities, exchange information on national systems to protect traditional knowledge, and explore minimum standards for internationally recognized sui generis systems for traditional

²¹The agreed-upon text was scheduled to be considered at the next meeting of the IGC in May 2011.

knowledge protection. UNCTAD's mandate for work on traditional knowledge was reaffirmed at its 11th Conference in São Paulo in 2004 (UNU-IAS 2005).

Intellectual property rights and benefit-sharing issues relevant to traditional forest-related knowledge have been given significant attention by the Food and Agriculture Organization of the United Nations (FAO) and the Consultative Group on International Agricultural Research (CGIAR). FAO's International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA), which entered into force in 2004, focuses on the conservation and sustainable use of plant genetic resources for food and agriculture, and the fair and equitable sharing of benefits derived from their use, for sustainable agriculture and food security (FAO 2009). Closely related to this treaty, FAO's Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture promote a number of specific actions by countries to realize the objectives of the treaty (UNU-IAS 2005).

Within the CGIAR, the Genetic Resources Policy Committee (GRPC) provides guidance to the CGIAR on policy issues surrounding genetic resources in line with the provisions of the PGRFA (SGRP 2010). These include research ethics guidelines that are relevant to the study of traditional knowledge and practices within CGIAR centres and the agriculture and forest science community more generally. These and other guidelines for researchers are discussed in Chap. 14 of this book.

UNESCO's Man and the Biosphere (MAB) and LINKS Programmes

Concerned with problems at the interface of scientific, environmental, societal, and development issues, UNESCO's Man and the Biosphere (MAB) Programme,²² initiated in the early 1970s, aims to improve human livelihoods and safeguard natural ecosystems by promoting innovative approaches to economic development that are socially and culturally appropriate and environmentally sustainable. The programme supports research involving natural and social sciences, economics, and education. Its interdisciplinary research agenda and capacity-building activities target the ecological, social, and economic dimensions of biodiversity loss and the reduction of this loss through empowerment of local and indigenous peoples in various aspects of environmental management. The biosphere reserve concept, developed through the MAB Programme (Batisse 1982), has emerged as a widely used model for integrating conservation of biological and cultural diversity while promoting sustainable economic and social development of cultural landscapes based on traditional values, local community efforts, and conservation science, particularly in the 'buffer zones' of protected areas (Ramakrishnan et al. 2002).

²² <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme/>

In 2002, UNESCO launched the Local and Indigenous Knowledge Systems in a Global Society (LINKS) programme, a collaborative multidisciplinary effort (involving all programme sectors of UNESCO) focusing on local and indigenous knowledge. The programme aims at empowering local and indigenous peoples in various aspects of environmental management by advocating recognition and mobilization of their traditional knowledge. Its goals include exploration of synergies between traditional and scientific knowledge as a means to: enhance biological and cultural diversity; revitalize intergenerational transmission of traditional knowledge within local communities; identify customary rules and processes that govern knowledge access and control; improve dialogue amongst traditional knowledge holders, natural and social scientists, resource managers, and decision makers to enhance biodiversity conservation efforts; and promote active and equitable roles for local communities in natural resource governance (UNU-IAS 2005; Kipuri 2009).

United Nations University–Institute of Advanced Studies (UNU–IAS)

The UNU–IAS Traditional Knowledge Initiative²³ seeks to build greater understanding and facilitate awareness of traditional knowledge to inform action by indigenous peoples, local communities, and domestic and international policy makers. The Initiative supports research activities, policy studies, capacity development, and online learning and dissemination in several thematic areas. These include: traditional knowledge and climate change, with activities including the Indigenous Peoples Climate Change Assessment and Indigenous Perspectives on Climate Change; traditional knowledge and biological resources; and traditional knowledge and natural resources, with a special focus on forests and forest management, marine resources, and water management.

Information services provided by the Initiative include newsletters, reviews of thematic areas (such as the REDD site, available online at: <http://www.unutki.org/redd/>), focusing on indigenous peoples and Reducing Emissions from Deforestation and Degradation (REDD), and the Traditional Knowledge Bulletin (available online at: <http://unu.edu/tk/>). The Bulletin is a weekly review of traditional knowledge issues in the global media and postings on issues of relevance to traditional knowledge at a global level, including issues discussed at international meetings and fora, such as:

- World Intellectual Property Organization’s Inter-governmental Committee on Intellectual Property, Genetic Resources, Traditional Knowledge and Folklore;
- World Trade Organization;
- United Nations Permanent Forum for Indigenous Peoples;
- United Nations Inter-Agency Support Group on Indigenous Issues;
- United Nations Educational, Scientific and Cultural Organization (UNESCO);

²³<http://www.unutki.org/>

- Food and Agriculture Organization of the United Nations (FAO) (e.g., the International Treaty on Plant Genetic Resources);
- Convention on Biological Diversity (CBD);
- United Nations Conference on Trade and Development (UNCTAD);
- processes of the World Bank and regional development banks;
- initiatives such as the Millennium Ecosystem Assessment and the International Assessment of Agricultural Science and Technology; and
- work of regional organizations such as the Organization of American States.

The Initiative's TK and Higher Education project explores the integration of indigenous knowledge in higher education programmes through relevant topics and methodologies in an attempt to gain recognition and valuation for traditional knowledge in academic and scientific circles, an important step in finding points of convergence between Western scientific and traditional indigenous understanding. The International Policy Making project supports research and training to facilitate the participation and empowerment of traditional knowledge holders in relevant policy processes. Initial activities of the project have focussed on information and policy analysis for indigenous and local communities on emerging issues in traditional knowledge discussions in international fora.

References

- Alternatives to Slash and Burn [ASB] (2011) ASB partnership for the tropical forest margins. Available via <http://www.asb.cgiar.org/>. Cited 25 Mar 2011
- Basso KH (1996) *Wisdom sits in places: landscape and language among the western Apache*. University of New Mexico Press, Albuquerque
- Batisse M (1982) The biosphere reserve: a tool for environmental conservation and management. *Environ Conserv* 9:101–111
- Berkes F (2008) *Sacred ecology*, 2nd edn. Routledge, New York
- Berkes F, Folke C (eds) (1998) *Linking social and ecological systems: management practices and social mechanisms for building resilience*. Cambridge University Press, Cambridge
- Berkes F, Colding J, Folke C (2000) Rediscovery of traditional ecological knowledge as adaptive management. *Ecol Appl* 10:1251–1262
- Berkes F, Colding J, Folke C (eds) (2003) *Navigating social-ecological systems: building resilience for complexity and change*. University of Cambridge Press, Cambridge
- Blake EA, Wagner MR (1987) Collection and consumption of Pandora moth, *Coloradia pandora lindseyi* (Lepidoptera: Saturniidae), larvae by Owens Valley and Mono Lake Paiutes. *Bull Entomol Soc Am* 33(1):22–27
- Burton L (2002) *Worship and wilderness: culture, religion, and law in the management of public lands and resources*. University of Wisconsin Press, Madison
- Cajete G (1999) *Native science: natural laws of interdependence*. Clear Light Publishers, Santa Fe
- Colfer CJP (ed) (2005) *The complex forest: communities, uncertainty, and adaptive collaborative management. Resources for the Future*, Washington, DC
- Collings N (2009) Environment. In: United Nations The state of the world's indigenous peoples. Department of Economic and Social Affairs, Division for Social Policy and Development, Secretariat of the Permanent Forum on Indigenous Issues Report No. ST/ESA/328, pp 84–127
- Convention on Biological Diversity [CBD] (1997) *Traditional knowledge and biological diversity. Doc. UNEP/CBD/TKBD/1/2*. Available via <http://www.cbd.int/doc/meetings/tk/wsttkbd-01/official/wsttkbd-01-02-en.pdf>. Cited 5 Mar 2011

- Costanza R, Cumberland J, Daly H, Goodland R, Norgaard R (1997) *An introduction to ecological economics*. St. Lucie Press, Boca Raton
- Cruikshank J (2005) *Do glaciers listen? Local knowledge, colonial encounters, and social imagination*. University of British Columbia Press, Vancouver
- Daly R (2005) *Our box was full: an ethnography for the Delgamuukw plaintiffs*. University of British Columbia Press, Vancouver
- Davidson-Hunt I, Smith P, Burlando C (2010) When a bill passes in the wilderness, does anybody hear? CEESP News 7 September. Available via http://www.iucn.org/about/union/commissions/ceesp/ceesp_news/?5968/When-a-Bill-Passes-in-the-Wilderness-Does-Anyone-Hear. Cited 6 Apr 2011
- Davis T (2000) *Sustaining the forest, the people, and the spirit*. State University of New York Press, Albany
- Feit HA (1992) Waswanipi Cree management of land and wildlife: Cree ethno-ecology revisited. In: Cox BA (ed) *Native people, native lands: Canadian Indians, Inuit and Metis*, vol 142, Carleton Library Series. Carleton University Press, Ottawa, pp 75–91
- Folke C, Carpenter S, Elmqvist T, Gunderson L, Holling CS, Walker B, Bengtsson J, Berkes F, Colding J, Danell K et al (2002) Resilience and sustainable development: building adaptive capacity in a world of transformations. The Environmental Advisory Council to the Swedish Government, Stockholm
- Food and Agriculture Organisation [FAO] (2009) *International treaty on plant genetic resources for food and agriculture*. FAO, Rome. Available via http://www.planttreaty.org/texts_en.htm. Cited 5 Mar 2011
- Forest Peoples Programme (2004) *Briefing on the United Nations Forum on Forests (UNFF) and Collaborative Partnership on Forests (CPF)*. Available via <http://www.forestpeoples.org>. Cited 5 Mar 2011
- Forest Peoples Programme (2007) *The UNFF fails indigenous peoples again*. Briefing Note. Available via <http://www.forestpeoples.org>. Cited 5 Mar 2011
- Fortmann L (2008) Introduction: doing science together. In: Fortmann L (ed) *Participatory research in conservation and rural livelihoods: doing science together*. Wiley, Hoboken, pp 1–17
- Fowler V (2005) Introduction. In: YoungBear-Tibbetts H, Van Lopik W, Hall K (eds) *Sharing indigenous wisdom: an international dialogue on sustainable development*. College of Menominee Nation Press, Keshena
- Fricke M (2007) *Epistemic injustice: power and the ethics of knowing*. Oxford University Press, Oxford
- Galloway-McLean K (2010) *Advance guard: climate change impacts, adaptation, mitigation and indigenous peoples—a compendium of case studies*. United Nations University-Traditional Knowledge Initiative, Darwin. Available via http://www.unutki.org/news.php?doc_id=101&news_id=92. Cited 5 Mar 2011
- Gieryn TF (1999) *Cultural boundaries of science: credibility on the line*. University of Chicago Press, Chicago
- Gray A (1991) *Between the spice of life and the melting pot: biodiversity conservation and its impact on indigenous peoples*. IWGIA document no. 70, International Work Group for Indigenous Affairs, Copenhagen
- Gunderson LH, Holling CS (eds) (2002) *Panarchy: understanding transformations in human and natural systems*. Island Press, Washington, DC
- Hansen SA, Van Fleet JW (2007) Issues and options for traditional knowledge holders in protecting their intellectual property. In: Krattiger A, Mahoney RT, Nelsen L, Thomson JA, Bennett AB, Satyanarayana K, Graff GD, Fernandez C, Kowalski SP (eds) *Intellectual property management in health and agricultural innovation: a handbook of best practices*. MIHR/PIPRA, Oxford/Davis, pp 1523–1538. Available via www.ipHandbook.org. Cited 5 Mar 2011
- Harmon D (2002) *In light of our differences: how diversity in nature and culture makes us human*. Smithsonian Institution Press, Washington, DC
- Heal GM (1998) *Valuing the future: economic theory and sustainability*. Economics for a Sustainable Earth Series. Columbia University Press, New York

- Holling CS (1986) Resilience of ecosystems: local surprise and global change. In: Clark WC, Munn RE (eds) *Sustainable development of the biosphere*. Cambridge University Press, Cambridge, pp 292–317
- International Council for Science [ICSU] (2002) *Science, traditional knowledge and sustainable development*, 4th edn, ICSU Series on Science for Sustainable Development, ICSU, Paris. Available via http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/65_DD_FILE_Vol4.pdf. Cited 11 Feb 2011
- Johannes RE (1981) *Words of the lagoon: fishing and marine lore in the Palau District of Micronesia*. University of California Press, Berkeley
- Kimmins JP (2004) *Forest ecology: a foundation for sustainable forest management and environmental ethics in forestry*, 3rd edn. Pearson Prentice Hall, Upper Saddle River
- Kipuri N (2009) Culture. In: United Nations, *The state of the world's indigenous peoples*. Department of Economic and Social Affairs, Division for Social Policy and Development, Secretariat of the permanent forum on indigenous issues report no. ST/ESA/328, pp 52–81
- Latour B (1993) *We have never been modern* (trans: Porter C). Harvard University Press, Cambridge
- Latour B (2004) *Politics of nature: how to bring the sciences into democracy*. Harvard University Press, Cambridge
- Latour B (2005) *Reassembling the social: an introduction to actor-network-theory*. Clarendon lectures in management studies. Oxford University Press, Oxford
- Loh J, Harmon D (2005) A global index of biocultural diversity. *Ecol Indic* 5:231–241
- Lyster R (2010) REDD+, transparency, participation and resource rights: the role of law. Legal studies research paper no. 10/56. The University of Sydney Law School, Sydney. Available via <http://ssrn.com/abstract=1628387>. Cited 5 Mar 2011
- Maffi L (ed) (2001) *On biocultural diversity: linking language, knowledge, and the environment*. Smithsonian Institution Press, Washington, DC
- Maffi L (2005) Linguistic, cultural, and biological diversity. *Annu Rev Anthropol* 29:599–617. doi:10.1146/annurev.anthro.34.081804.120437. Cited 5 March 2011
- Martínez Cobo J (1986/7) Study of the problem of discrimination against indigenous populations. UN Doc. E/CN.4/Sub.2/1986/7 and Add. 1–4. Available via <http://www.un.org/esa/socdev/unpfi/en/spdaip.html>. Cited 5 Mar 2011
- Mery G, Alfaro R, Kanninen M, Lovobikov M (eds) (2005) *Forests in the global balance—changing paradigms*, vol 17, IUFRO World Series. International Union of Forest Research Organizations [IUFRO], Helsinki
- Miller AM, Davidson-Hunt IJ, Peters P (2010) Talking about fire: Pikangikum first nation elders guiding fire management. *Can J For Res* 40:2290–2301
- Mills A (1994) *Eagle down is our law: Witsuwit'en law, feasts, and land claims*. UBC Press, Vancouver
- Mills A (ed) (2005) *'Hang onto these words': Johnny David's Delgamuukw evidence*. University of Toronto Press, Toronto
- Moore JL, Manne L, Brooks T, Burgess ND, Davies R, Rahbek C, Williams P, Balmford A (2002) The distribution of cultural and biological diversity in Africa. *Proc Royal Soc Lond B* 269:1645–1653
- Nadasdy P (2003) *Hunters and bureaucrats: power, knowledge, and aboriginal-state relations in the southwest Yukon*. University of British Columbia Press, Vancouver
- Newing H (2005) A summary of case study findings on the implementation of international commitments on traditional forest related knowledge. In: Newing H, Pinker A, Leake H (eds) *Our knowledge for our survival*, vol 1. International Alliance of the Indigenous and Tribal Peoples of the Tropical Forest (IAITPTF) and Centre for International Forestry Research (CIFOR), Chiang Mai, pp 11–64
- Newing H, Pinker A, Leake H (eds) (2005) *Our knowledge for our survival*, 2 vols. International Alliance of the Indigenous and Tribal Peoples of the Tropical Forest (IAITPTF) and Centre for International Forestry Research (CIFOR), Chiang Mai. Available via <http://www.international-alliance.org/documents/overview-finaledit.pdf>. Cited 5 Mar 2011

- Norgaard RB (2010) Ecosystem services: from eye-opening metaphor to complexity blinder. *Ecol Econ* 69(6):1219–1227
- O’Flaherty R, Davidson-Hunt I, Manseau M (2008) Indigenous knowledge and values in planning for sustainable forestry: Pikangikum first nation and the Whitefeather forest initiative. *Ecol Soc* 13(1):6–16
- Pecore M (1992) Menominee sustained yield management: a successful land ethic in practice. *J For* 90:12–16
- Pierotti R (2010) *Indigenous knowledge, ecology and evolutionary biology*. Routledge, London
- Posey DA (ed) (1999) *Cultural and spiritual values of biodiversity*. Intermediate Technology Publications, UNEP, London
- Ramakrishnan PS (1992) *Shifting agriculture and sustainable development: an interdisciplinary study from north-eastern India*, vol 10, Man and Biosphere Book Series. UNESCO/Parthenon Publishing, Paris/Caernforth
- Ramakrishnan PS, Rai RK, Katwal RPS (2002) *Traditional ecological knowledge for managing biosphere reserves in South and Central Asia*. Oxford/IBH Publishing, New Delhi
- Ricklefs RE, Miller GL (2000) *Ecology*, 4th edn. Freeman, New York
- Rosendal GK (2001) Overlapping international regimes—the case of the Intergovernmental Forum on Forests (IFF) between climate change and biodiversity. *Int Environ Agree Polit Law Econ* 1:447–468
- Secretariat of the Convention on Biological Diversity [SCBD] (2004) Akwé: Kon—voluntary guidelines for the conduct of cultural, environmental and social impact assessment regarding developments proposed to take place on, or which are likely to impact on, sacred sites and on lands and waters traditionally occupied or used by indigenous and local communities. CBD Guidelines Series, Montreal. Available via <http://www.cbd.int/doc/publications/akwe-brochure-en.pdf>. Cited 5 Mar 2011
- Secretariat of the Convention on Biological Diversity [SCBD] (2011) Nagoya protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization to the convention on biological diversity: text and annex. Montreal. Available via <http://www.cbd.int/abs/doc/protocol/nagoya-protocol-en.pdf>. Cited 24 Mar 2011
- Secretariat of the Permanent Forum on Indigenous Issues [UNPFII] (2005) Background note prepared by the Secretariat of the permanent forum for the international workshop on traditional knowledge, Panama City, 21–23 Sept 2005. Doc. PFII/2005/WS.TK. Available via http://www.un.org/esa/socdev/unpfii/documents/workshop_TK_background_note.pdf. Cited 5 Mar 2011
- Sutherland WJ (2003) Parallel extinction risk and global distribution of languages and species. *Nature* 423:276–279
- System-wide Genetic Resources Programme [SGRP] (2010) Booklet of CGIAR Centre policy instruments, guidelines and statements on genetic resources, biotechnology and intellectual property rights, version III. System-wide Genetic Resources Programme [SGRP] and the CGIAR Genetic Resources Policy Committee [GRPC]. Biodiversity International, Rome. Available via <http://sgrp.cgiar.org/?q=publications>. Cited 5 Mar 2011
- Tanner A (1979) *Bringing home the animals: religious ideology and mode of production of Mistassini Cree hunters*. Hurst, London
- Toledo VM, Ortiz-Espejel B, Moguel P, Ordoñez MDJ (2007) The multiple use of tropical forests by indigenous peoples in Mexico: a case of adaptive management. *Conserv Ecol* 7(3):9
- Trosper RL (2007) Indigenous influence on forest management on the Menominee Indian Reservation. *For Ecol Manag* 249:134–139
- Trosper RL (2009) *Resilience, reciprocity and ecological economics: sustainability on the northwest coast*. Routledge, New York
- Turner NJ (2005) *The earth’s blanket: traditional teachings for sustainable living*. Douglas and McIntyre, Vancouver
- Turner NJ, Ignace MB, Ignace R (2000) Traditional ecological knowledge and wisdom of aboriginal peoples in British Columbia. *Ecol Appl* 10(5):1275–1287

- Umeek ERA (2004) *Tsawalk: a Nuu-chah-nulth worldview*. University of British Columbia Press, Vancouver
- United Nations [UN] (2004) *Traditional forest-related knowledge: report of the Secretary-General, United Nations Forum on Forests 4th session*. Document E/CN.18/2004/7. Available via <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N04/261/74/PDF/N0426174.pdf?OpenElement>. Cited 5 Mar 2011
- United Nations [UN] (2007) *United Nations Forum on Forests, report of the seventh session. Economic and Social Council, Official Records, Supplement No. 22, E/2007/42, E/CN.18/2007/8*. Available via <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N07/349/31/PDF/N0734931.pdf?OpenElement>. Cited 5 Mar 2011
- United Nations [UN] (2009) *The state of the world's indigenous peoples*. Department of Economic and Social Affairs, Division for Social Policy and Development, Secretariat of the permanent forum on indigenous issues report no. ST/ESA/328
- United Nations Convention to Combat Desertification [UNCCD] (2005) *Revitalizing traditional knowledge. A compilation of documents and reports from 1997 to 2003*. Committee on Science and Technology, Bonn
- United Nations University-Institute of Advanced Studies [UNU-IAS] (2005) *Establishing a UNU initiative on traditional knowledge*. Draft report, Traditional Knowledge Initiative, Darwin
- UNPFII (2005) *See* Secretariat of the Permanent Forum on Indigenous Issues
- Wa G, Uukw D (1992) *The spirit in the land: statements of the Gitksan and Wet'suwet'en hereditary chiefs in the supreme court of British Columbia, 1987–1990*. Reflections, Gabriola
- Walens S (1981) *Feasting with cannibals: an essay on Kwakiutl cosmology*. Princeton University Press, Princeton
- Weatherford JM (1988). *Indian giving: how the Indians of the Americas transformed the world*. Crown Publishers, New York
- World Health Organization [WHO] (2002) *WHO traditional medicine strategy 2002–2005*. Publ. WHO/EDM/TRM/2002.1. WHO, Geneva. Available via <http://www.who.int/medicines/publications/traditionalpolicy/en/index.html>. Cited 5 Mar 2011
- World Health Organization [WHO] (2003) *WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants*. WHO, Geneva. Available via <http://apps.who.int/medicinedocs/en/d/Js4928e/>. Cited 5 Mar 2011
- World Health Organization [WHO], International Union for Conservation of Nature and Natural Resources [IUCN], World Wide Fund for Nature [WWF] (1993) *Guidelines on the conservation of medicinal plants*. WHO, IUCN, WWF, Gland. Available via <http://apps.who.int/medicinedocs/documents/s7150e/s7150e.pdf>. Cited 5 Mar 2011
- World Intellectual Property Organization [WIPO] (2010a) *The protection of traditional knowledge: revised objectives and principles*. Secretariat document prepared for the 17th session (December 2010) of the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore. WIPO/GRTKF/IC/17/5. Geneva. Available via <http://www.wipo.int/tk/en/igc/index.html>. Cited 5 Mar 2011
- World Intellectual Property Organization [WIPO] (2010b) *The genetic resources: revised list of options and factual update*. Secretariat document prepared for the 17th session (December 2010) of the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore. WIPO/GRTKF/IC/17/6. Geneva. Available via <http://www.wipo.int/tk/en/igc/index.html>. Cited 5 Mar 2011