ELSEVIER

Forest Policy and Economics 6 (2004) 205–213

Forest Policy and Economics

www.elsevier.com/locate/forpol

One hundred faces of sustainable forest management

Sen Wang*

Pacific Forestry Centre, Canadian Forest Service, Natural Resources Canada, 506 West Burnside Road, Victoria, BC, Canada V8Z 1M5

Abstract

Compared with conventional forest management, sustainable forest management (SFM) is interdisciplinary, heterogeneous, less hierarchical, and more socially accountable. The analytical framework for the economics of SFM is characterized by a pluralistic and integrative nature. An adaptive, contextualized knowledge approach is desirable for operationalizing SFM principles. This approach would employ knowledge as a major vehicle in a two-tiered system in which economic incentives and trade-offs dictate resource allocation and management decisions when substitutable products are involved, but precautionary principles would prevail when the integrity of ecosystems is at stake. Several dilemmas impede the implementation of SFM principles and restrain the use of standard economics tools, but the knowledge will be able to address some of the problems posed by the dilemmas. SFM has 'one hundred faces', and the multiple dimensions call for an integrated, adaptive learning approach that promotes connectivity among various pieces on the forest landscape.

Keywords: Economics; Ecosystem management; Knowledge; Learning; Sustainability

1. Introduction

The concept of sustainable forest management (SFM) arises from the notion of sustainable development that has gained increasing recognition worldwide since the late 1980s. Encompassing an array of issues, SFM has become an overarching term that captures an unfolding paradigm shift in contemporary forest management. Given its sufficient difference from conventional forest management (CFM), SFM calls for a fresh analytical framework to resolve emerging problems.

This paper identifies a number of distinctive properties associated with SFM, proposes a new approach for examining some economic aspects of SFM, and discusses several dilemmas in implementing SFM principles. The next section explores the meaning of SFM by contrasting the main attributes of SFM with those of CFM. This is followed by an outline of a knowledge approach that may be used in undertaking SFM economic analysis. Then, several dilemmas that impede the implementation of SFM principles and restrain the use of standard economics tools are discussed. The paper concludes that the multiple dimensionality of SFM requires an integrated, adaptive learning approach that seeks to connect various pieces on the forest landscape.

2. The meaning of sustainable forest management

The emergence of SFM was visible in the changes in societal values, principally the notion of sustainable

* Tel.: +1-250-3630726; fax: +1-250-3630775.
E-mail address: senwang@pfc.cfs.nrcan.gc.ca (S. Wang).

1389-9341/$ - see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.forpol.2004.03.004

development that was popularized by the Brundtland report *Our Common Future* (World Commission on Environment and Development, 1987). The concept of SFM derived impetus from several waves of global developments, including the 1992 United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil, the Intergovernmental Panel on Forests (1995–1997), the Intergovernmental Forum on Forests (1997–2000), and the United Nations Forum on Forests that came into being in 2001. The parameters of SFM gained further clarification, thanks to the criteria and indicators initiatives such as the Montreal Process and the Pan-European Process, as well as a host of forest certification schemes (see Söderlund and Pottinger, 2001; Wang, 2001).

Literature on SFM has proliferated since the early 1990s. While still lacking a globally agreed-upon definition, SFM generally refers to the ways and processes of managing forest resources to meet society's varied needs, today and tomorrow, without compromising the ecological capacity and the renewal potential of the forest resource base. Representing a response to changing societal values, SFM has an evolving and experimental nature, which makes it difficult to characterize. However, the past decade has witnessed the unfolding of SFM along more or less three trend lines. As SFM found its genesis in the concerns over tropical deforestation, the first trend is preoccupied with the accountability of forest practices. A greater degree of sensitivity to the impact of logging operations, initially in tropical areas and then in temperate and boreal regions, has played a large role in shaping the understanding about SFM. A case in point is the term 'reduced impact logging' (RIL), which has gained widespread usage since the early 1990s. RIL calls for low intensity practices to reduce the environmental impact of industrial timber harvesting (Dykstra, 2001). In this regard, researchers have made significant progress in determining public acceptability thresholds of clearcutting to maintain visual quality and other desired attributes (Pâquet and Bélanger, 1997; Ribe, 1999). Over time, the focus of attention has shifted from logging to other aspects of forest management. There is a need to distinguish between the expectations for management on public lands from that on private lands. Unlike public forestland managers, private forestland owners may incorporate new considerations for environmental concerns rather than searching for an alternative to the timber-dominant management paradigm.

The second trend is centrally concerned with the state of forest conditions and structure. Recognizing that RIL is an important component of SFM, Leslie (2001) argues that it falls well short of being the complete answer. In analyzing changes over a period of 150 years in forest structure in a central Sweden boreal forest landscape, Ericsson et al. (2000) note the effects of industrial forestry methods and preference for certain species on the decline of ecological health. A consensus has emerged that the integrity of ecosystems and the diversity of species must be maintained. According to Toivonen (2000), one of the main objectives of the newly reformed forest and conservation legislation in Finland is the adoption of a two-track approach, namely, establishment of a large network of nature conservation areas and a set of ecosystem-based principles to guide forest practices. Such a trend is also noticeable in Sweden (Egnell, 2000), and in British Columbia (Wilson and Wang, 1999).

The third trend is characterized by the notion of co-evolution that urges an integration of environmental, economic and social considerations in forest management (Norgaard, 1989, 1994). In addition to conserving forest habitat, the inherent values of forests as carbon sinks and recreational bases are emphasized. As forests are increasingly perceived as diverse overlays of different systems of social interests that interact on the forested landscapes (Jenkins and Smith, 1999), forest management practices are expected to meet a broader matrix of social goals (Shindler et al., 2002).

Being interwoven with one another, these trends have unfolded in parallel as well as in progression. Beneath their surface lie the philosophical lineages of anthropocentric utilitarianism, ecocentric preservationism, and social interdependencies with respect to the forest. Fundamentally, the various schools of thought boil down to how the relationship between Nature and humanity is perceived. Taking an anthropogenic stand, Dasgupta (2001) views the natural environment as a source of human well-being, and this worldview serves as the basis for 'the human development paradigm', which argues that human development has precedence in defining social goals (see Harris and Goodwin, 2001, p. xxviii; Wise

2001, pp. 47–57). In contrast, many ecological theorists, such as Costanza (1997), regard human beings as integral parts of broadly defined ecosystems. It means that the choice of any management regimes must be oriented toward the requirements of ecosystem integrity and species diversity. The ecological worldview has gained considerable ground in policy making concerning the US national forests, as ecological sustainability is widely taken as a necessary foundation for forest resource stewardship (Johnson et al., 1999). Between Dasgupta's and Costanza's positions lies Prescott-Allen (2001) who sees ecosystems and human beings forming an 'egg white vs. yolk' relationship.

Despite their philosophical differences, these schools of thought share one common concern, that is, decision makers must pay closer attention than before to interactions among socioeconomic and ecological considerations across temporal and spatial scales when it comes to forest practices. This is especially the case with forest management on public lands. Analogous to the decline in the significance of agriculture in the social and economic fabric of rural space (McNeil, 2000), timber production no longer reigns in forest management, although it is still the predominant goal for many private holdings. Involving much more than commercial interests arising from timber, SFM serves to make sure that overexploitation is avoided. Further, Lindhagen and Hörnsten (2000) note a major shift from forest-based products to non-commodity values, and one example is the significant drop in the harvest of non-wood products, such as berry picking and a growing demand for forest environments for recreational purposes. Jenkins and Smith (1999, pp. 15–19) succinctly summarize recent developments into a list of transitions: (i) from silviculture toward ecoculture; (ii) from volume toward quality; (iii) from stands toward landscapes; (iv) from ownerships toward councils and communities; (v) from the forest as product toward the forest as capital; (vi) from current income toward natural capital and green finance; and (vii) from blind consumption toward consumer awareness. Schelhas (2003) provides a rather similar synthesis of the new trends in forest policy and management.

A search is underway for an alternative approach to the traditional timber-dominant forest management paradigm. Compared with conventional forest management, or CFM, SFM calls for a diversified mode of activity. In terms of identifiable attributes, while CFM is disciplinary, SFM is trans-disciplinary; CFM is characterized by homogeneity, SFM by heterogeneity. Organizationally, CFM is hierarchical and favors an explicit form of structure, whereas SFM is less hierarchical and more transient. For SFM, the context is more complex, and this evolving context is shaped by a diverse spectrum of social demands. SFM is more socially accountable and reflexive than CFM, involving a wider set of stakeholders. This is evident in the way forest management problems are defined and how priorities are identified. For instance, when it comes to public forestland management, a growing number of interest groups are willing to participate in the formulation of policy agendas and subsequent implementation processes.

The above attributes, when taken together, demonstrate sufficient coherence to suggest the emergence of a new mode of forest management. This new mode takes into account the vast array of life forms, products, services, and functions associated with the forest. Being overlaid and interwoven, the attributes of SFM have sectoral, temporal, and spatial dimensions. SFM connotes multiple situations, the combination of which places the analysis of forest resource sustainability in a more open and inclusive context. SFM goals, expressed or implied, are multi-dimensional, raising the issue of how to balance objectives and how to judge success or failure. This begs the question of how to address the economic aspects of SFM.

3. The economics of sustainable forest management

Conventional forest practices have been criticized for being excessively timber-centric and failing to account for a wide range of economic, social and cultural benefits associated with the forest. Traditional forest economics recognized the notion of sustained yield in timber production, but there is a lot more to managing a forest than timber harvest. A consensus has emerged among forest policy makers and forest management observers that it is no longer appropriate to treat forestry simply as a problem of resource extraction and commodity production. SFM operates according to new imperatives in tension with conven-

tional wisdom of managing the forest. For instance, unless in explicitly designed plantations for pulpwood or sawlog production purposes, the concept of 'normal forest' and plantation monoculture is out of step with the prevailing trends of ecosystem management (Drengson and Taylor, 1997).

A formal theory concerning the economics of SFM is still at the hatching stage. Over the past decade, forest economics has received influence from various sources, principally the emergent discipline of ecological economics (see Turner et al., 1997). Based on the conviction that the world's economies are a function of the earth's ecosystems, ecological economists hold the premise that nature is the economy's 'life support system' (Costanza and Daly, 1987). In exploring a theory of the economics of SFM, advances in two fronts are worth noting. The first development is in respect of investigating the nature of different forms of capital, i.e. natural capital, manufactured capital, human capital and social capital, and the interactions among them. Broadly speaking, natural capital refers to the resources and services that nature provides. Costanza and Daly (1992) highlighted the notion of natural capital by emphasizing the need to respect critical thresholds in ecosystems. As Toman (1994) pointed out, neoclassical economists tend to view capital resources as relatively fungible. While many forest-based products have a high degree of substitutability, ecological functions collectively are complements in nature because there are no practical substitutes for healthy forest ecosystems. The concept of human capital differentiates the role of innovative thinking from pure labor in its conventional sense, while the idea of social capital places management decisions in the context of diverse institutional arrangements and social relations. Under the capital assets approach, analysis may focus on the stock levels of, say, natural vs. produced capital, and the flows over time of the capital stocks in question. Capital certainly varies from one form to another in terms of the means of accumulation and periods of circulation. In the context of forestry, natural capital is about the conditions for conserving the forest rather than its depletion. The quantity and quality of the forest are subject to the ways by which the portfolio of capital assets is managed. Essentially, the capital assets approach boils down to determining trade-off functions of various forms of capital under consideration.

The second advance is, by and large, in line with the ecosystem management approach. From the general public's perspective, tangible proof that a forest is ecologically sustainable lies in maintaining the forest in a functionally healthy and aesthetically agreeable state. There are two essential elements to this approach, one being an exemplar manifestation that a sustainably managed forest is visually recognizable, and the other calling for stewardship measures in maintaining timber, non-timber, and non-commodity values from the forest to address such concerns as biodiversity and habitat supply. The historical roots of this approach may be traced to John Muir and Aldo Leopold's land ethic (Rolston and Coufal, 1991), and this line of thinking was succinctly summarized by Dawkins (1972) that forests ought to be viewed as '. . .highly valued life support systems, rather than as a specialized suppliers of any one type of product or benefit' (p. 335). In effect, the argument demands using precautionary principles as guiding rules to safeguard the integrity of forest ecosystems when undertaking management activities at the landscape level.

Using the analogy of a puppet show, if the capital assets approach would resemble the characters that are attached to strings of operators working behind the scene, the ecosystem management approach may be likened to the stage and the screen on which the play proceeds. In my opinion, neither approach alone is capable of achieving a well-rounded sustainability objective without the aid of the other. McNeil (2000) laments, 'Anglo-American economists (after approx. 1880) took nature out of economics. . .. While economists ignored nature, ecologists pretended humankind did not exist' (p. 336). Economic analysis without adequate ecological underpinnings is misleading, and it is imperative that economics and ecology must take one another properly into account.

Recently, a third approach appears to be gaining prominence. The notion of panarchy offers insights for understanding transformations in human and natural systems and managing the issues that emerge from interactions between humans and nature (see Gunderson and Holling, 2002). Arguing that flux and renewal are nature's way, the framework of panarchy stresses the fact that, over the course of human history since the dawn of agriculture, forests shrank and grew back, depending on socio-political and economic

drivers as well as climatic and other forces. Research findings in the late 20th century reject the notion of a so-called 'natural' steady state (Botkin, 2001). Instead of insisting on the ecological imperative of preserving a forest indefinitely in a certain state, the panarchy theory perceives an eco-cycle comprising four stages, namely, exploitation, conservation, constructive destruction, and renewal. Central to the theoretical world of panarchy are the notions of cyclical changes and resilience. These notions are by no means unfamiliar to foresters whose primary job involves dealing with rotations of timber and cycles of various life forms that arise from forested landscapes. Scholars have long recognized the importance of resilience. According to Clawson (1979) and MacCleery (1995), resiliency is simply the most important trademark of forests.

From the perspective of forest economics, in order for it to be accepted as a useful framework, the theory of panarchy needs to answer several questions. At a general level, what is the nature of the change involving the forest and, more importantly, what constitutes the change, its patterns and impacts? In North American context, local resource production, local historical events, and broad societal trends are identified as three important 'engines of change' (Force et al., 2000). What constitutes the engines of change varies from one jurisdiction to another. At an operational level, the questions of interest to decision makers include management objectives, means of attaining goals, and criteria for assessing outcomes. The panarchy framework justifies timber rotations well beyond the maximum sustained yield age. However, while longer rotations entail such gains as larger sawlog material, lower environmental impacts, and delayed costs for regeneration (Leak, 1999), the foregone benefits caused by a longer wait and possible decline in timber quality may be enormous.

The elements of what constitutes good management change over time, but the bedrock features of forests tend to remain fairly constant (Binkley, 2003). Enlightened by Raup's (1966) classic paper, I dare say that it is human beings' perception of the forest and how the forest resource base is utilized that shifts constantly. Forest economics requires insights from various perspectives and disciplines. In view of the swirling currents of events since the late 1980s, search for guidance is more important now than ever before. Recognizing the severe limitations of the traditional model of economic analysis, Kant (2002, 2003a,b) appeals for extending the boundaries of forest economics. In North America there are some signs suggesting that forest economics is moving in the direction of merging with related subjects to form the basis for an integrated discipline. Specifically, although forest economics is still largely perceived as an investigation into the application of micro-economics principles to forestry and natural resource problems, the focus has expanded to cover a wide range of environmental issues.

In light of the SFM attributes identified earlier, I propose a blended approach—the knowledge approach in support of establishing a viable analytical framework for the economics of SFM. Rapid technological advances have made many industries and sectors knowledge based (Stehr, 1994). As modern societies move into an electronic environment worldwide, knowledge has emerged as an incredibly valuable asset and a primary tool for creating wealth, ensuring healthy ecosystems, and attaining well-being of humankind. The knowledge approach posits that, first and foremost, the constituents of SFM are context dependent. This view is consistent with the notion of co-development of economic, ecological and social systems that Munda (1997) stressed. Since SFM represents a response to the needs of society, it will progress amidst an increased societal contextualization. It follows that the economics of SFM needs to ascribe to an interdisciplinary, pluralistic and integrative orientation. As the elements of what constitutes SFM change constantly, the capacity to keep abreast with new knowledge can profoundly affect how sound forest management is understood and practiced.

While SFM encompasses a number of core elements, the centrepiece is the issue of knowledge. Knowledge entails a web of diffusion mechanisms and feedback loops comprising information, thinking, learning, reflection, and experience sharing. The construct of SFM requires an analytical framework that features pluralistic, adaptive and contextual forms. The knowledge approach acts as a system of several interlinking principles: (1) securing the forest's globally significant functional capacity and maintaining critical threshold levels; (2) pursuing activity that fosters ecological diversity on forest landscapes; (3) managing forests for consumptive and non-consump-

tive purposes, including cultural and spiritual needs; and (4) creating and maintaining forest based employment opportunities, especially for local forest dependent communities.

Following the insight offered by Toman (1994), an effective framework for analyzing economic aspects of SFM needs to consider a two-tiered knowledge approach in which the principles of economic trade-offs guide resource allocation and management decisions when substitutable inputs and outputs are involved, but precautionary principles must prevail when the integrity of ecosystems is at stake. The first tier permits a contextual analysis to determine implications of alternative forest management activities for critical thresholds of ecosystems. At the second tier, standard economic analysis may be undertaken to evaluate trade-offs between alternative management plans and substitutability between different forms of capital. In a way, the knowledge approach has much in common with the concept of multiresource forest management elaborated by Behan (1990).

At the operational level, the economics of SFM needs to address specific management issues, for instance, 'Does SFM mean non-declining timber harvest levels?' A related question is: 'When harvesting rates are on a par with or below regeneration rates in a geographically defined area, is this considered sustainable management?' Answering these questions would entail a chain of assessments, which involves specifying management objectives, determining the means of achieving the objectives, evaluating the costs and benefits of operational alternatives, and developing the criteria to judge the outcomes and their impact.

Essentially, the knowledge approach is in line with the systems view that Behan (1990) urged forest managers to adopt. Taking up the systems view requires foresters to act in ways that are responsive to diverse and changing values associated with the forest. Bengston (1994) made one of the first attempts in identifying the key steps for addressing the issue of forest values. In particular, he appealed for greater attention to the structure of changing forest values and how they are related to each other in systems of values, and what these value systems imply for ecosystem health. Implementing the knowledge approach calls for seeking to maintain a socially desirable state of forest ecosystems by focusing on the connectedness of various forest values. The knowledge approach augments existing approaches of economics mainly in two respects. First, in view of the 'web of life' theory that Capra (1996) elaborated, forest management is seen as an integrated whole rather than a dissociated collection of parts. In other words, management activities are embedded in a complex network of natural processes, social relations, as well as their interactions. Second, the knowledge approach is based on the conviction that the integrity of ecosystems overrides all other management objectives, although 'integrity' needs to be defined in such a way that the concept would allow for constructive destruction and renewal at the landscape level and at the level of distinct forest-based substances and services. Adopting the knowledge approach requires some adaptation of existing economics tools and development of a set of new techniques (Kant, 2003a,b). Involving a continuous process of learning, these techniques will serve two purposes: first, expanding our knowledge of the consequences to ecosystems and society of alternative management activities and policy interventions, and second, updating our understanding about trade-off functions in respect of resource use and output.

However, several dilemmas impede the implementation of SFM principles and, in turn, restrain the use of economics tools. The main dilemmas include: (i) conflicts among stakeholders and the scale-up problem; (ii) ecological and institutional asymmetry; and (iii) the irony of technological advancement. SFM has become an eclectic term in that different people interpret SFM to mean different things. Typically, forest management requires formulating a plan that meets the needs of a client. However, as Clawson (1975) asked: Who is the client in the case of publicly owned forests? Timber industry's interest may differ from that of local communities when it comes to decisions concerning forest harvest scheduling, intensity and renewal. Further, institutional concerns and forest conditions do not necessarily coincide with one another. Often times, administrative boundaries of a particular agency are not the logical decision boundaries. Ellefson et al. (2002) find that as many as 17 state agencies affect forest conditions in the United States. Some of these agencies directly determine forest uses and management activities; others affect forest conditions through programs focused on fish-

eries and wildlife, water pollution, and park management. Meanwhile, technological change and the rise of a digital economy have far-reaching implications. Innovations in production methods have enabled workers to process materials more efficiently, and automation has resulted in fewer workers being required to produce the output. As a result, many people may not be skilled enough to maintain secure employment in communities that traditionally depend on the forest resource base. This irony is a plaguing issue that confronts a significant number of jurisdictions (Hyttinen et al., 2002).

These dilemmas spell out the difficulty of multi-dimensionality. Every individual element makes sense, but the question is how to manage all multiple elements put together. Despite its intuitive appeal, a holistic approach may not be operationally manageable due to the strain of multi-functionality associated with the forest. Given its features of promoting forest management in a progressive, iterative and 'learn as we go' manner (Wang, 2002), the knowledge approach may contribute to addressing some of the problems posed by the dilemmas. The approach emphasizes the need to foster an adaptive learning environment that respects both bioregional considerations and the confines of institutional and cultural norms. Also, SFM implies a judicious use of forest resources, in the sense of striving for economic efficiency and husbanding resources to serve the needs of present and future generations. Perhaps, the knowledge approach is conducive to addressing the issue of social justice and equality. Efforts aimed at achieving SFM for the common well-being of humankind require improved knowledge about the distribution and progression of various kinds of assets on multiple scales.

4. Concluding remarks

In recent years, the discussion about SFM has shifted from identifying attributes to a search for solutions. It is fitting to conclude by recalling Li (1984) book entitled *Cent Visages de Paris*. Despite the grandeur of many sites of tremendous historical and cultural values, such as La Tour Eiffel, Arc de Triomphe, Musée du Louvre, Notre Dame Cathedral, and so on, La Seine is, indisputably, the lifeline of Paris. However, it is the many bridges across River Seine that serve as essential connections among the numerous lively scenes that Paris is famous for. Like the city of Paris, SFM also has 'one hundred faces'. Seeking a balance of nature is of great importance, but it must be recognized that no single condition would last forever for any ecosystem, as ecological systems can persist under a variety of states and variations (Botkin, 2001). Similar to the bridges over the Seine that connect the various attractions in Paris, the numerous connectors in the forest deserve greater attention. It is my conviction that there is no uniform, fit-for-all path to SFM. Anyone looking for a clear-cut solution to SFM will be disappointed, because SFM has many faces, each with its own profile and features. The fundamental question of SFM lies in integrating levels of response and identifying linkages among the various pieces on the forest landscape. Using a knowledge approach, economics is capable of shedding light on our efforts in addressing the problems of SFM. In applying the proposed knowledge approach, one challenge is to maintain, process, disseminate and renew knowledge and protect it as a key asset in the digital space.

Acknowledgements

This paper emerged from discussions and debates with many people, especially, Sulan Dai, Yaoqi Zhang, Shashi Kant, Troy Fuller and William Wagner. It also benefited from comments by participants in a research seminar held at the School of Economics and Management, Beijing Forestry University in December 2002. Critique by two anonymous reviewers and the Guest Editor of the Journal helped improve the clarity of the paper's arguments. The author is solely responsible for the views and any remaining errors.

References

Behan, R.W., 1990. Multiresource forest management: a paradigmatic challenge to professional forestry. Journal of Forestry 88 (4), 12–18.

Bengston, D.N., 1994. Changing forest values and ecosystem management. Society and Natural Resources 7, 515–533.

Binkley, C.S., 2003. Forestry in the long sweep of history. In: Teeter, L., Cashore, B., Zhang, D. (Eds.), Forest Policy for Private Forestry—Global and Regional Challenges. CABI Publishing, London, pp. 1–7.

Botkin, D.B., 2001. The naturalness of biological invasions. Western North American Naturalist 61, 261–266.

Capra, F., 1996. The Web of Life. Anchor Books, New York.

Clawson, M., 1975. Forest for Whom and for What? The Johns Hopkins University Press for Resources for the Future, Baltimore.

Clawson, M., 1979. Forests in the long sweep of American history. Science 204, 1168–1174.

Costanza, R., 1997. Frontiers in Ecological Economics. Edward Elgar, Cheltenham.

Costanza, R., Daly, H.E., 1987. Toward an ecological economics. Ecological Modelling 38, 1–7.

Costanza, R., Daly, H.E., 1992. Natural capital and sustainable development. Conservation Biology 6, 37–46.

Dasgupta, P., 2001. Human Well-Being and the Natural Environment. Oxford University Press, New York.

Dawkins, H.C., 1972. Forestry: factory or habitat? Commonwealth Forestry Review 51, 327–335.

Drengson, A., Taylor, D. (Eds.), 1997. Ecoforestry—the Art and Science of Sustainable Forest Use. New Society Publishers, Gabriola Island, BC, Canada.

Dykstra, D.P., 2001. The old and new of reduced impact logging. Tropical Forest Update 11 (2), 3–4.

Egnell, G., 2000. Silviculture and management of Scots pine in Sweden. Investigacion Agraria Sistemas y Recursos Forestales Fuera de Serie 1, 165–174.

Ellefson, P.V., Moulton, R.J., Kilgore, M.A., 2002. An assessment of state agencies that affect forests. Journal of Forestry 100 (6), 35–41.

Ericsson, S., Östlund, L., Axelsson, A.-L., 2000. A forest of grazing and logging: deforestation and reforestation history of a boreal landscape in Central Sweden. New Forests 19, 227–240.

Force, J.E., Machlis, G.E., Zhang, L., 2000. The engines of change in resource-dependent communities. Forest Science 46, 410–422.

Gunderson, L.H., Holling, C.S. (Eds.), 2002. Panarchy: Understanding Transformations in Human and Natural Systems. Island Press, Washington/Covelo/London.

Harris, J.M., Goodwin, N.R., 2001. Volume introduction. In: Harris, J.M., Wise, T.A., Gallagher, K.P., Goodwin, N.R. (Eds.), A Survey of Sustainable Development: Social and Economic Dimensions. Island Press, Washington, Covelo, London, pp. xxvii–xxxvii.

Hyttinen, P., Niskanen, A., Ottitsch, A., Tykkyläinen, M., Väyrynen, J., 2002. Forest Related Perspectives for Regional Development in Europe. Koninklijke Brill NV, Leiden, The Netherlands.

Jenkins, M.B., Smith, E.T., 1999. The Business of Sustainable Forestry—Strategies for an Industry in Transition. Island Press, Washington, DC.

Johnson, K.N., Agee, J., Beschta, R., Dale, V., Hardesty, L., Long, J., Nielsen, L., Noon, B., Sedjo, R., Shannon, M., Trosper, R., Wilkinson, C., Wondolleck, J., 1999. Sustaining the people's lands: recommendations for stewardship of the national forests and grasslands into the next century. Journal of Forestry 97 (5), 6–12.

Kant, S., 2002. Economics of sustainable forest management. In: Veeman T.S., Duinker, P.N., Macnab, B.J., Coyne, A.G., Veeman, K.M., Binsted, G.A., Korber, D. (Eds.), Advances in forest management: from knowledge to practice. Proceedings of Sustainable Forest Management Network Conference, 13–15 November 2002, Edmonton, Alberta, pp. 286–290.

Kant, S., 2003a. Choice of ecosystem capital without discounting and prices. Environmental Monitoring and Assessment 86, 105–127.

Kant, S., 2003b. Extending the boundaries of forest economics. Forest Policy and Economics 5, 39–56.

Leak, W.B., 1999. Short vs. long rotations. Northern Journal of Applied Forestry 16, 200–202.

Leslie, A., 2001. The trouble with RIL. Tropical Forest Update 11 (2), 32, 27.

Li, G., 1984. Cent Visages de Paris [Bali de 100 zhang mian kong]. Guangzhou: Hua Cheng Publishing House (In Chinese).

Lindhagen, A., Hörnsten, L., 2000. Forest recreation in 1977 and 1997 in Sweden: changes in public preferences and behaviour. Forestry 73, 143–151.

MacCleery, D.W., 1995. Resiliency: the trademark of American forests. Forest Products Journal 45, 18–28.

McNeil, J.R., 2000. Something New under the Sun: an Environmental History of the Twentieth-Century World. W.W. Norton and Company, New York/London.

Munda, G., 1997. Environmental economics, ecological economics, and the concept of sustainable development. Environmental Values 6, 213–233.

Norgaard, R.B., 1989. The case for methodological pluralism. Ecological Economics 1, 37–57.

Norgaard, R.B., 1994. Development Betrayed. Routledge, London.

Pâquet, J., Bélanger, L., 1997. Public acceptability thresholds of clearcutting to maintain visual quality of boreal balsam fir landscapes. Forest Science 43, 46–55.

Prescott-Allen, R., 2001. The Wellbeing of Nations—a Country-by-Country Index of Quality of Life and the Environment. Island Press, Washington, DC.

Raup, H.M., 1966. The view from John Sanderson's farm: a perspective for the use of the land. Forest History 10, 2–11.

Ribe, R., 1999. Regeneration harvests vs. clearcuts: public views of the acceptability and aesthetics of Northwest forest plan harvests. Northwest Science 73, S102–S117.

Rolston, H. I.I.I., Coufal, J., 1991. A forest ethic and multivalue forest management. Journal of Forestry 89 (4), 35–40.

Schelhas, J., 2003. New trends in forest policy and management: an emerging postmodern approach? In: Teeter, L., Cashore, B., Zhang, D. (Eds.), Forest Policy for Private Forestry – Global and Regional Challenges. CABI Publishing, London, pp. 17–28.

Shindler, B.A., Brunson, M., Stankey, G.H., 2002. Social acceptability of forest conditions and management practices: a problem analysis. General Technical Report PNW-GTR-537. Forest Service, United States Department of Agriculture.

Söderlund, M., Pottinger, A., 2001. The World's Forest—Rio+8: Policy Practice and Progress towards Sustainable

Forest Management Commonwealth Forestry Association, Oxford, UK.

Stehr, N., 1994. Knowledge Societies. SAGE Publications, London.

Toivonen, H., 2000. Integrating forestry and conservation in boreal forests: ecological, legal and socio-economic aspects. Forestry 73, 129–135.

Toman, M.A., 1994. Economics and 'sustainability': balancing trade-offs and imperatives. Land Economics 70, 399–413.

Turner, K., Perring, K., Folke, C., 1997. Ecological economics: paradigm or perspective. In: van den Bergh, J., van der Straatan, J. (Eds.), Economy and Ecosystems in Change: Analytical and Historical Approaches. Edward Elgar, Cheltenham, UK, pp. 25–49.

Wang, S., 2001. Towards an international convention on forests: building blocks vs. stumbling blocks. International Forestry Review 3, 251–264.

Wang, S., 2002. Wicked problems and metaforestry: Is the era of management over? The Forestry Chronicle 78, 505–510.

Wilson, B., Wang, S., 1999. Sustainable forestry: the policy prescription in British Columbia. In: Yoshimoto, A., Yukutake, K. (Eds.), Global Concerns for Forest Resource Utilization—Sustainable Use and Management, vol. 62. Kluwer Academic Publishers, Dordrecht, pp. 35–45. Forestry Sciences.

Wise, T.A., 2001. Economics of sustainability: the social dimension. In: Harris, J.M., Wise, T.A., Gallagher, K.P., Goodwin, N.R. (Eds.), A Survey of Sustainable Development: Social and Economic Dimensions. Island Press, Washington/Covelo/London, pp. 47–57.

World Commission on Environment and Development, 1987. Our Common Future. Oxford University Press, Oxford, New York.