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Codes of Forest Practice and Related Research Needs

J.W. Turnbull and J.K. Vanclay
Center for International Forestry Research, Bogor, Indonesia

Codes of forest practice are sets of regulations or guidelines developed by governments or other organisations to assist forest managers select practices to be followed when carrying out forest management and utilisation operations. These practices, when correctly applied, should meet standards for sustainable forest management (Dykstra 1996; Dykstra and Heinrich 1996). A code of practice is also a form of forest policy which typically is used to promote certain environmental benefits (Adams 1996) and the codes are regarded as important measures in moving towards sustainable forest management (SFM).

Several major events in the early 1990s drew attention of the public and governments to the importance of forestry and the global environment. The first of these was the United Nations Conference on Environment and Development (UNCED) in 1992 in Brazil. From this meeting there emerged the guiding principles of the 'Rio Declaration', the 'Forest Principles' covering the sustainable management of forests, the International Framework Conventions on Climate Change and Biological Diversity; and Agenda 21 (Dykstra and Heinrich 1996). All this international activity served to focus critical attention on how forests were being managed. For example, the action plan Agenda 21 included two priority areas in its program which are relevant to Codes of Forest Practice. These are: (1) sustaining the multiple roles and functions of all types of forests and woodlands, and (2) enhancing the protection, sustainable management and conservation of all forests, and rehabilitation of degraded areas.

The major international conferences have highlighted the need for sustainable forest management and while there may be different views about what this means it is generally regarded as a positive move. Codes of Forest Practice have and are being developed as tools to assist policy makers and senior managers determine 'WHAT' to do in the forest together with complementary guidelines for field operators on 'HOW' to do it. The identification of criteria and indicators of sustainable forest management can be used to monitor the recommended or specified practices so that undesirable practices can be rectified and improved practices promoted. The criteria and indicators can also be applied to the auditing function of forest certification and eco-labelling.

It is extremely difficult to be sure if forests are being 'sustainably' managed; rather the questions are: - Are they being 'well' managed? Is forest health improving or deteriorating? Codes of Forest Practice are based on the best knowledge available to ensure forests are well managed. But is this enough? In a world where there is increasing population, greater demands for natural resources, escalating needs for wood products, and increased demands for clean water, biodiversity protection and recreation, we need to respond by making forest management of greater relevance for modern society. There is a shift of focus from stand-level management to management of communities and ecosystems, and we need to have a broader vision to embrace not just forest management but ecosystem management. Lugo (1995) defined ecosystem management as 'using holistic analysis to guide the management of lands and water for products, services and conservation of biodiversity'. This definition includes both the productivity and conservation goals which we as forest managers seek to combine.

In the changing social and ecological context under which forestry operates we must acknowledge the relevance of the ecosystem management approach. There is a need to operate in an adaptive management mode, monitoring the results of our practices, learning from experience and adapting to new conditions through planning and re-iteration (Lugo 1995). Ecosystem management requires more comprehensive analysis before intervention with a suitable mix of technologies and intensity of application.

If we accept ecosystem management is the new and evolving approach to land management then we must look at the dominant social trends affecting protection, management and use of the forests, and evaluate how these trends might affect the context and conduct of our natural resources and forest research programs (Szaro 1995). Clearly it is essential that forest management decisions continue to be science based, and research will need to be framed in a multi-resource, ecosystem context (Lyons 1995). As we consider the research needs for Code of Forest Practice we will need to ensure social and economic questions are treated as comprehensively as technical and biological aspects.

Sustainable forest management has been a basic objective of management in public forests for 200 years or more but values other than wood production were usually not explicit or concealed in terminology such as 'multiple use' forestry (Kanowski 1996). Nevertheless the public perception that the practice of forest management is just about growing and harvesting trees has evolved into a demand that it is a formal part of social decision-making frameworks in governments, and this trend will undoubtedly continue in the future (Pedersen 1996). It is a matter of fact that forestry practices have been changing through this century in response to various pressures and new research findings. Of course in many countries the pressures from environmental activists to improve forest management practices began in the 1970s. Partially in response to these pressures many larger forestry organisations developed internal guidelines especially for the management of forests on public lands. In Australia, CSIRO published environmental guidelines for forest harvesting (Cameron and Henderson 1979) and throughout the 1980s most Australian States developed codes of forest practices, principally directed at logging or harvesting forests (McCormack 1996). Some of these codes were guidelines whereas others, such as the Tasmanian Forest Practices Act 1985, had a prescriptive and legislative basis. The New Zealand Forest Code of Practice was published in 1990 after three years of consultation between the Logging Industry Research Organisation (LIRO), forest industries, authorities and interest groups. This comprehensive code was revised and updated in 1993. It is a very practical document providing information and environmental planning guidelines aimed at facilitating the conduct of forestry operations in a sustainable manner (Visser 1996). In the United States many State forestry authorities published forest practice guidelines and best management practices from about 1988 onwards (Warkotsch et al. 1996) although Oregon developed the first comprehensive forestry practices Act in 1971 (Garland 1996). Not all forest authorities were progressive in developing codes of practice. In South Africa a Harvesting Code of Practice Project Group was set up in 1992 to develop a code despite resistance from the forest industry (Warkotsch *et al.* 1996) and in Canada the British Columbia Forest Code of Practice was passed as legislation in 1994 after intense pressure from environmental groups.

Now that most developed countries have adopted comprehensive codes of forest practice in one form or another, international attention has turned increasingly to improving forest management and utilisation in developing countries. Forest management is not a new phenomenon in tropical forests. Experience in natural forest management is longer, more thoroughly researched and perhaps more successful in Asia than in tropical Africa and America (Armitage and Kuswanda 1989). Management plans and conservative practices were introduced into the drier tropical teak forests of India and Burma last century (Dawkins and Philip 1998), into the evergreen tropical

rainforests of Peninsular Malaysia during the 1920s and into the mixed peat swamp forests of Sarawak in the 1950s and 1960s. Similar regulated yields and harvesting controls were successfully applied in Trinidad, Puerto Rico and Surinam of tropical America (Bruenig 1993) and in Queensland, Australia (Vanclay 1996). Some hold the view that sustainable management techniques for most natural tropical forests are largely known or could be modified to cover most local circumstances (e.g. Wyatt-Smith 1987; Schmidt 1987 in Armitage and Kuswanda 1989). However in recent decades there has been a dramatic increase in tropical deforestation and forest degradation in response to population pressures, the desperate need for foreign exchange and often ill-conceived forestry and extra-sectoral policies. Buoyant world timber markets and weak forest regulatory authorities have led to deteriorating standards of timber harvesting and utilisation in the tropics, and the gap between the principles of sustainable forest management and forest management practices, especially in natural forests, is widening. It appears only a very small area of the world's tropical forests is being managed sustainably for timber production (Budowski 1988; Poore *et a1* 1989) and tropical forest loss and degradation is much less a matter of silviculture than of public policy, economic pressures and social conditions (Johnson and Cabarle 1993). Development of codes of forest practice is underway in several tropical countries, e.g. Indonesia (Masripatin 1997) and India (Thangan 1997).

Definitions of what comprises sustainable forest management and how to measure it differ and have been evolving. The sustained yield of wood was often used by foresters as a surrogate measure of sustainability. It has several advantages including ease of measurement and close relationship to the economic use and potential of many forests, but fails to accommodate forest values other than wood. The International Tropical Timber Organisation (ITTO) defines SFM as 'the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to a continuous flow of desired forest products and services without undue reduction in its inherent values and future productivity and without undue undesirable effects on the physical and social environment' (ITTO 1992). General guidelines for management of natural forests, planted forests and conservation of biological diversity in tropical production forests have been produced by ITTO. While sustainable forest management is seen as an ultimate goal, it is generally recognised as an evolving concept which depends on the environmental, social and cultural objectives society wishes to achieve through the use of forest resources. It has been suggested that 'well managed forests' could be a more practical and pragmatic objective to work towards (Anon. 1996).

Bans and boycotts on tropical timber imports have mushroomed in the United States and Europe. While their effectiveness may be limited they have served to raise awareness amongst timber producers, traders and consumers of their role in tropical deforestation. They have also spawned a number of timber certification schemes. It is at the forest management unit level that the Forest Stewardship Council has attempted to set standards and principles regarding forest management for use by certifiers. However, few of the proposed standards for assessing sustainable forest management or carrying out certification have been independently tested in the field. Initial tests by CIFOR showed criteria and indicators for impacts of forest practices on biodiversity and social sustainability are especially weak (Prabhu *et al.* 1996).

Sustainability continues to be the single most important principle to guide forest management. Perhaps one of the most important lessons learnt in trying to achieve sustainable forest management in tropical forests has been the recognition that there is no such thing as a universal management prescription, even in a regional context. Furthermore initial achievements of a management system are not a guarantee of later success. Over the course of the century our perception of what constitutes sustainable forest management has changed, expanding to encompass social sustainability, and we are now faced with a moving target. It follows that SFM

will need to follow an adaptive management philosophy. Management will need to continuously challenge and evaluate its own codes of forest practices. This implies feedback to management by those responsible for the implementation of codes, and for assessment of the social, economic, and ecological impacts. Relevant, up to date information is essential, and criteria and indicators (C&I) for SFM are the tools which can be used to organize information in a manner useful to evaluate sustainable forest management. It is important to understand that just as it is unlikely that a single set of criteria and indicators will apply uniformly across the globe, it is equally unlikely that a set of criteria and indicators developed for the national level will be meaningful at the forest level.

Somewhat independently of ITTO guidelines, certification schemes and associated criteria and indicators, but stimulated by the same concerns about SFM, -are the international initiatives to assist developing countries to prepare Codes of Forest Practice. In 1993 the Committee on Forestry (COFO), a permanent committee representing FAO member countries, recommended that the FAO Forestry Department prepare one or more model codes of forest practice which could serve as reference documents for developing countries considering the adoption of national codes of forest practices. COFO also suggested the model codes could serve as internationally acceptable guides to promote forest practices that improve standards of utilisation, reduce environmental impacts, help ensure forests are sustained for future generations, and improve the economic and social contributions of forests to sustainable development (Dykstra 1996).

The FAO Model Code of Forest Harvesting Practice (Dykstra and Heinrich 1996) is the first model code to be published by FAO although it is anticipated that additional codes will follow including silviculture, pest management, harvesting and processing of non-timber forest products. The FAO model code assumes technically and economically feasible practices can be identified and that it is possible to conduct the operations in ways that are consistent with the needs of sustainability. Dykstra and Heinrich (1996) emphasize that the development of codes should be an open and participatory process involving all stakeholders including technical experts as well as those depending on the sustainability of forest resources. They also warn of the danger of making codes overly prescriptive, making it difficult for practitioners to react to changing conditions. They also need sufficient flexibility to permit amendment as more is learned about ecosystem function and silvicultural requirements.

Regional codes of practice such as the South Pacific Code for Logging of Indigenous Forests and the Draft Code of Practice for Forest Harvesting in Asia-Pacific have and are being developed.

Research Needs

Two recent statements have highlighted the need for research to support codes of forest practice: ‘A successful code of forest practice requires a solid foundation of research and other comprehensive analyses to accurately identify forest practice problems...’ (Adams 1996) and ‘No barrier is as obvious or intractable to the development of codes of practice to implement the principles of sustainability as the lack of information about forests and the inadequate methods used to improve the quality of information and our understanding.’ (Gordon and McCullough 1996).

It is inevitable that some of the current codes of practice are based on inadequate research and will need revision as new information becomes available. But the question remains as to whether the problem is principally that of synthesising and using existing knowledge, or whether there are new areas of biophysical, social or economic research which have been identified to tackle problems in successfully implementing codes of forest practice.

Bertault *et al.* (1993) state that organised research in the tropics did not really mature until after 1950. Since then research and silviculture has oscillated between artificial regeneration and natural regeneration and improvement of existing stands. Results are sufficient to support large-scale plantation activities, and practical guidelines are available for the silviculture of natural forests. However the level of knowledge is still modest and much remains to be achieved. Wyatt-Smith (1987) and Poore *et al.* (1989) reported that management systems for sustainable production were available in most forest types in the tropics and that technical constraints, although they exist, are much less important than those of a political, economic and social nature. Thus 'although such management systems may exist, their application in practice is rarely guaranteed'. It has been claimed that research needs are probably less for developing new technique than for convincing data on the true cost of malpractice in forestry management (Ball 1992). Wan Razali (1993) recognizes these claims but makes clear that there are still major gaps in knowledge in managing tropical forests as well as situations where forest research results have not been effectively applied. He recognizes that investment in forest research lags behind other sectors, and that the long period between the implementation of research results and observable impact has hampered technological development. He suggests four areas of technological research which are required to support sustainable management of tropical forests, and while recognising that additional information can only be provided by well-planned and implemented research programs also points to the need for better application of existing research results. We agree that the synthesis of existing research information and its application, such as that on site management of fast-growing tropical plantations by Nambiar and Brown (1997), should be a priority and should precede new research activities, but clearly much research will be necessary to improve codes of forest practices. The following sections relate to some research needs but are not claimed to be comprehensive.

Harvesting and Silvicultural Research

The interval between harvesting of timber and the establishment and control of the site by new regeneration is probably the most critical period for site management. Poor management practices at this time may have long-term deleterious effects on site productivity, biodiversity and other ecosystem functions. Logging is damaging no matter how well planned or carefully executed. Dykstra and Heinrich (1992) have drawn attention to the need for good preharvest planning and the selection of appropriate logging technologies. Improper log extraction damages residual trees and can inflict long-term damage on soils. Improving harvesting practices therefore deserves high priority and the combined efforts of engineers, ecologists and foresters. No doubt it is recognition of the potential for great improvement in harvesting that has resulted in Codes of Forest Practice giving priority to developing logging guidelines.

Damage to residual trees and to soils due to forest operations has been reviewed by Abeels (1997) and he concludes that soil disturbance due to these operations is a serious problem worldwide. He recommends research to adapt tools and machines to minimise their effects and especially to determine limits for speed and the forces applied to the soil. This research needs to be complemented by development of techniques to rapidly measure soil conductivity and aeration, bulk density, soil strength and porosity.

There is a greater need for recognition that management does not end when the machines take the logs from the forest. The need to repair roads and drainage channels to minimise erosion, to replant and fertilise severely compacted areas and to undertake other measures to promote effective natural regeneration is critical. Post-logging site restoration is an area which still requires much research.

Even where there are established procedures set out in codes of practice for thinning regeneration, enrichment planting, weeding etc. there needs to be a critical reexamination in the context of their efforts on biodiversity, the hydrological cycle and the broader aspects of sustainable forest management. In the absence of supportive research results there is a need to avoid non-essential silvicultural treatments and to minimise man-made disturbance in forests.

Biodiversity

What are the impacts of harvesting and silvicultural treatments on biodiversity? Even when the impacts of these operations are minimised there are likely to be winners and losers amongst the flora and fauna. A conclusion from a CIFOR project testing criteria and indicators (C&I) for sustainable forest management was the lack of suitable C&I for assessing the impact of management at the landscape, community and species/gene levels of the biodiversity hierarchy (Prabhu *et al.* 1996). Techniques of biodiversity monitoring are needed to determine the type, impacts and ultimate causes of changes so that management practices can be modified or re-designed (Mosseler and Bowers 1998). Of course, low-impact management interventions with small environmental changes may have little effect on biodiversity but severe, extensive or sudden changes, such as logging, grazing, fire and harvesting non-timber forest products could impact severely on the genetic factors of sustainability (Namkoong *et al.* 1996). These authors identified research priorities, e.g. research to improve prediction of relationships between ecological, demographic and genetic processes, that would enable better prediction of the intensity of events that would significantly change genetic parameters. They also nominated specific research areas, e.g. prediction criteria to identify species vulnerable to genetic change. A framework which accommodates both uncertainty and cost in the context of indicators for conservation of biological diversity in managed production forests in the tropics has been developed by Stork *et al.* (1997). Using this framework changes in biodiversity may be assessed indirectly through the processes that maintain and generate biodiversity. The conceptual framework needs research to verify it and such research must be given high priority if we are to monitor the effects of existing codes of forest practice of biodiversity.

Hydrology

Most codes of forest practice address protection of hydrological functions through skid trail planning, restricting logging in wet weather, and restricting logging equipment access on steep slopes and in streamside buffer zones. Nevertheless research which examines the effectiveness of accepted practices is still warranted as some prescriptions may have been based on inadequate investigations. Adams (1996) refers to an instance in Pacific Northwest USA where there was a prescription to remove woody debris from streams. The debris was believed to be a barrier to fish migration as well as a hazard during flooding. Subsequent research showed the opposite, i.e., the wood in the streams helped create a good habitat and often reduced channel erosion. The Code of Practice has now been changed to promote woody debris in streams considered habitat-deficient.

Social Considerations

Codes of Forest Practice must be applied in ways that reflect local, regional and national priorities and policies and must involve all stakeholders. In particular there is a need to identify potentially serious negative impacts of harvesting and silvicultural practice on the welfare of those in and around the forest area. Social criteria and indicators of SFM have often been criticised by certification groups as being least well-developed, the most difficult to apply in the field and the most ambiguous of all C&I to interpret (Colfer, C. personal communication). Much of the literature on community-based management is pertinent; for example Stevens (1997) recognises

the link between the state of the natural resource base and the social and financial indicators that depend on it. Similarly the Ford Foundation and the World Wide Fund for Nature (WWF) have used participatory methodologies involving local people to generate, analyse and apply knowledge (Ford Foundation 1998). Reviewing the C&I on access to forest resources Colfer *et al.* (1998) describe some methods of addressing social issues in SFM but emphasise the need for additional research involving local stakeholders (community managers, logging companies, conservation area managers etc.) to develop a scientifically sound, cost effective and simple monitoring arrangement for these issues. Colfer *et al.* (1998) have adapted a strategy of developing indications and also holistic assessment techniques to assess the state of these indicators to address the complexity and diversity of social systems. In particular, they support Shindler *et al.* (1996) to develop ways of integrating relevant stakeholder subgroups, especially marginalised groups; into management decision making. A key aspect of adaptive management is the mechanism by which managers can monitor the outcome of their interventions and so enable institutional learning. Such adaptive management can depend on having flexible Codes of Forest Practice which can be modified in response to feedback from relevant stakeholders. Prabhu *et al.* (1998) have adopted the term 'Adaptive Co-management', involving the management of the resource by those whose rights and responsibilities are delineated and shared through a negotiation process.

Economic Factors

While it is recognised that Codes of Forest Practice are technical guidelines which are generally based on appropriate biophysical investigations, their successful application will depend very much on their cost and effectiveness and on the cooperation of all stakeholders. Financial research into all aspects of the guidelines is a high priority. Forest operators will be reluctant to implement guidelines which are considered not viable economically. 'Many logging operators believe that environmental protection can only be achieved through costly measures that will drive them to bankruptcy' (Dykstra and Heinrich 1996). It is essential that all practices are as economical as possible and that research should minimise application costs: Environmental impacts need to be reduced at the same time as costs are minimised and profits increased.

Indicators and Thresholds

Evaluation of sustainable forest management requires an appropriate methodology by which reliable and objective assessments can be made. In recent years much research effort has been expended identifying criteria and indicators to provide quick, inexpensive and reliable means of assessing SFM practices. Indicators are used to provide quick and cost-effective information but they are not intended to provide precise statements about the behaviour of complex systems. A threshold provides a baseline for an indicator against which sustainability can be assessed (Syers *et al.* 1995). Thresholds of individual indicators may indicate a change of direction of the ecological, social or economic components of the forest management system or in the extreme case they could indicate that the system is disintegrating. Prabhu *et al.* 1998 suggest *One of the biggest challenges facing researchers is the identification and quantification of thresholds.* This may or may not be the case. Some research has been taking place on thresholds of individual indicators but much of what has emerged so far has been inconclusive. In the context of sustainable forest management it seems simplistic to think that a single indicator and a threshold value will be sufficient to provide an accurate warning of change in the system which can be well buffered. It is more likely that integrating the changes in a number of indicators through simulation modelling will provide a better indication of the direction in which the ecosystem is heading. However, individual indicators may be useful for monitoring particular practices used in the Codes of Forest Practice; for example the extent of damage to soil by logging equipment

may be indicated by the extent of soil compaction using bulk density, porosity or, other measures. However, thresholds of individual indicators are likely to be site specific and not have wide application. The role of indicators will primarily be to indicate direction of change of a particular part of a system. In assessing what is sustainable and what is not sustainable a range of threshold values with trends would be a useful guide. As resource managers we need to know if we are approaching a threshold, or if an irreversible decision is about to be made, so that we can err on the side of caution. This is a real challenge for Codes of Forest Practice and the research which underpins them.

Concluding Remarks

This paper has aimed to set Codes of Forest Practice in the framework of the evolving debate on sustainable forest management. We suggest that most Codes of Forest Practice have been developed primarily from a biological and physical perspective. It would be useful to consider future needs for research for Codes of Forest Practice in the broader context of ecosystem management in which there is a more holistic approach and a greater concern for the aspirations and welfare of stakeholders. It will be essential to recognise people with their needs and values as part of the forest ecosystem we are researching.

What lies ahead is a difficult but not an impossible task. Three centuries ago Isaac Newton (1642-1727) *found science a hodgepodge of isolated facts and laws, capable of describing some phenomena, and predicting only a few. He left it with a unified system of laws, that could be applied to an enormous range of physical phenomena, and used to make exact predictions.* (Anon. 1998).

It seems to us that we could use an Isaac Newton in forestry to improve codes of forest practice, to help to systematize facts, assist us to make accurate predictions and ensure our forest management practices are sustainable.

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