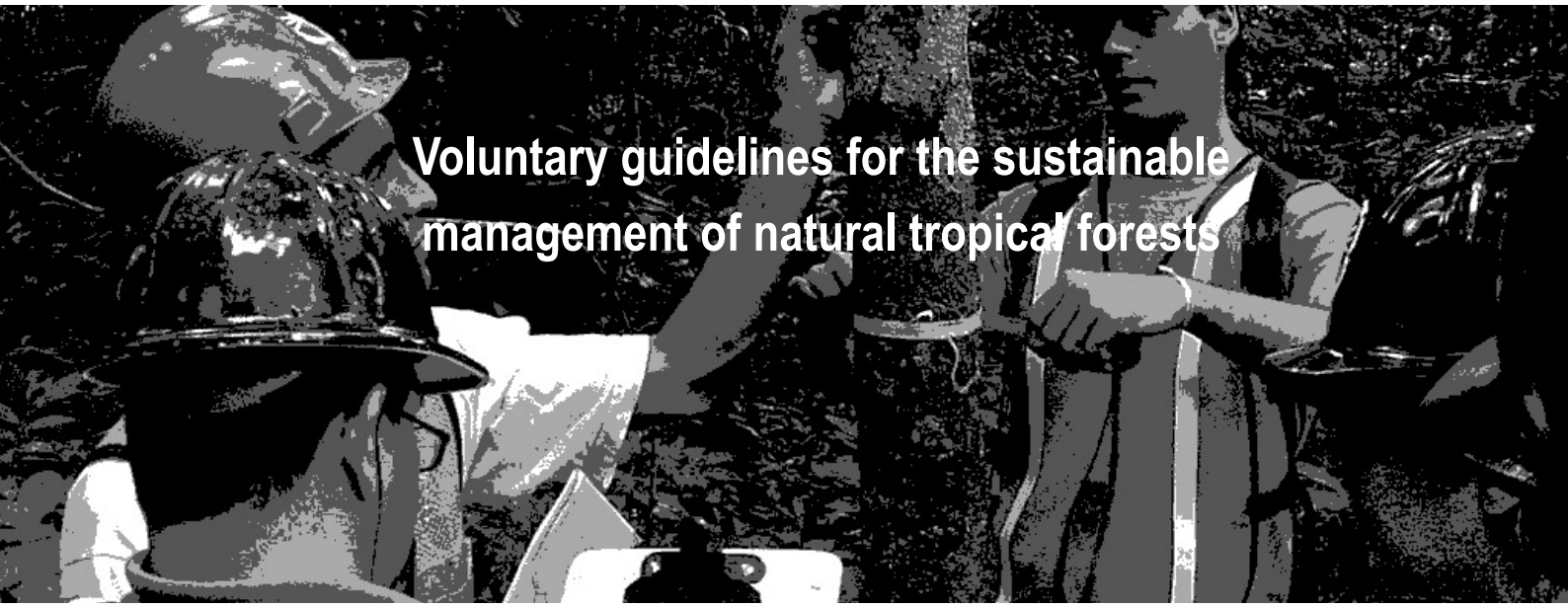
POLICY DEVELOPMENT

20

VOLUNTARY GUIDELINES FOR THE SUSTAINABLE MANAGEMENT OF NATURAL TROPICAL FORESTS

Policy development series 20

International Tropical Timber Organization



Voluntary guidelines for the sustainable management of natural tropical forests

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Revised edition

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The International Tropical Timber Organization (ITTO) is an intergovernmental organization promoting the conservation and sustainable management, use and trade of tropical forest resources. Its members represent the bulk of the world's tropical forests and of the global tropical timber trade. ITTO develops internationally agreed policy documents to promote sustainable forest management and forest conservation and assists tropical member countries to adapt such policies to local circumstances and to implement them in the field through projects. In addition, ITTO collects, analyzes and disseminates data on the production and trade of tropical timber and funds projects and other actions aimed at developing industries at both the community and industrial scales. Since it became operational in 1987, ITTO has funded more than 1000 projects, pre-projects and activities valued at more than US$400 million. All projects are funded by voluntary contributions, the major donors being the governments of Japan, Switzerland, the United States of America and Norway, and the European Union.

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Front-cover photo: Foresters conduct a forest inventory as part of a forest management planning exercise in Brazil. Photo: J. Leigh, ITTO. Back-cover photo: Local stakeholders participate in a forest-policy decision-making process in Veracruz, Mexico. Photo: G. Sanchez Vigil, INECOL

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Foreword

There is increasing recognition of the current and potential contributions of sustainable forest management (SFM) to the conservation of forest biodiversity, climate-change mitigation and adaptation, the livelihoods of forest-dependent people, and the sustainable supply of timber and non-timber forest products. The United Nations Conference on Sustainable Development (Rio+20), held in Brazil in 2012, highlighted the contributions of SFM to a green economy and recognized the social, economic and environmental benefits of forests. The Rio+20 outcome document, *The Future We Want*, reaffirmed that the wide range of products and environmental services provided by forests creates opportunities for addressing many of the most pressing sustainable development challenges, and it supported cross-sectoral and cross-institutional policies that promote SFM.

ITTO has strived for almost 30 years to assist its tropical member countries, through policy and project work, in implementing SFM on the ground, and it has always worked to promote the sustainable supply of tropical forest goods and environmental services.

The International Tropical Timber Council adopted *Guidelines for the Sustainable Management of Natural Tropical Forests* in 1990 as ITTO's first policy guidance document on the management of natural tropical forests. Building on this pioneering work, ITTO has subsequently generated a wide range of policy guidance, including its criteria and indicators for sustainable tropical forest management. In 2007, the Council decided to update the 1990 guidelines in light of increased knowledge and the emergence of a wide range of new challenges and opportunities for tropical forest management.

I am pleased to now introduce the *Voluntary Guidelines for the Sustainable Management of Natural Tropical Forests* (adopted by the Council through Decision 4[XLIX]), which supersede the 1990 guidelines. The new voluntary guidelines are designed to serve as guidance for addressing the policy, legal, governance, institutional, ecological, social and economic issues that need to be taken into account in the planning, implementation and evaluation of SFM in natural tropical forests to ensure the sustainable provision of forest goods and environmental services.

I am deeply grateful to Jürgen Blaser, Cesar Sabogal, James Gasana, Ricardo M. Umali and Shaharuddin Mohamad Ismail, who worked exceptionally hard in the development of the voluntary guidelines, including through drafting, validation and revision, in the period 2011–2014. I also thank Council members and the many other people who provided valuable comments and other inputs to ensure that the voluntary guidelines are comprehensive and applicable in tropical forests worldwide.

An aim in revising the voluntary guidelines was to keep them simple and practical, avoiding unnecessary prescriptions and always bearing in mind their usefulness for forest managers. ITTO member countries may wish to implement the suggested actions provided in the voluntary guidelines in accordance with their own national forest policy objectives, national forest programs, and forest resource situations.

I hope and expect that these voluntary guidelines, when adapted to local circumstances, will guide forest owners and managers in government, the private sector and civil society to implement SFM in the tropics for the benefit of current and future generations. ITTO stands ready to assist in this process.

Emmanuel Ze Meka
Executive Director
ITTO

Acknowledgements

This document benefited from the inputs of many people. Jürgen Blaser and Cesar Sabogal prepared the initial draft in 2011, which was reviewed in two expert meetings (in Switzerland and Brazil) in 2011. Three regional validation workshops were conducted in 2012—in Malaysia, Gabon and Peru—and the document was reviewed by James Gasana in 2012. The document was further reviewed and revised by Jürgen Blaser and Ricardo M. Umali in 2013 and amended by Jürgen Blaser and Shaharuddin Mohamad Ismail in 2014 based on Decision 4(XLIX) of the International Tropical Timber Council and comments received from ITTO member countries. Hwan Ok Ma, Takeshi Goto and Steve Johnson in the ITTO Secretariat guided the overall process to develop the guidelines, and Alastair Sarre and Jürgen Blaser carried out final editing.

All contributions are gratefully acknowledged, including those of national experts and workshop participants, too numerous to name here.

Participants in the second expert group meeting on the revision of the guidelines for the sustainable management of natural tropical forests, held in Antimary, Brazil, in August 2011. Photo: H.O. Ma, ITTO

Acronyms and abbreviations

AAC	annual allowable cut
CBD	Convention on Biological Diversity
C&I	criteria and indicators
FAO	Food and Agriculture Organization of the United Nations
FMU	forest management unit
GIS	geographic information system(s)
ITTO	International Tropical Timber Organization
ITTO C&I for SFM	*ITTO Criteria and Indicators for the Sustainable Management of Natural Tropical Forests*
NGO	non-governmental organization
NTFP	non-timber forest product
PFE	permanent forest estate
REDD+	reducing emissions from deforestation and forest degradation, including the role of conservation, sustainable management of forests and enhancement of forest carbon stocks
SFM	sustainable forest management
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

Purpose of the voluntary guidelines

The *Voluntary Guidelines for the Sustainable Management of Natural Tropical Forests* (hereafter referred to as "the voluntary guidelines") update and replace the *ITTO Guidelines for the Sustainable Management of Natural Tropical Forests*, which were published in 1990 as ITTO's first policy guidance on the management of natural forests in the humid tropics. In 2007, the International Tropical Timber Council decided to update the 1990 document[1] in light of increased knowledge and the emergence of a wide range of new challenges and opportunities for tropical forest management.

The voluntary guidelines constitute an international reference document for the development and improvement of national and subnational guidelines for the sustainable management of natural tropical forests. They also provide a reference on technical issues at the macro (or landscape) and micro (or forest management unit—FMU) scales. They set out seven principles of sustainable forest management (SFM), a total of 60 guidelines within these principles, and implementation actions for each guideline based on best practices and existing tools. The specific objectives of the voluntary guidelines are to:

- identify the framework conditions for the application of forest management guidelines in natural tropical forests for the sustainable provision of forest goods and environmental services;
- provide guidance for addressing the policy, legal, institutional, ecological, social and economic issues that need to be taken into account in the planning, implementation and evaluation of SFM;
- help forest owners and managers to implement SFM at the macro and micro scales;
- stimulate the adoption of appropriate and adaptive management practices to maintain the capacity of natural tropical forests to sustainably provide multiple goods and environmental services; and
- inform international processes that deal with globally relevant issues on the role that the sustainable multiple-use management of natural tropical forests can play in addressing issues such as climate change, water supply, biodiversity, food security, agriculture and desertification.

Scope and use of the voluntary guidelines

The voluntary guidelines are designed to provide a basis for policy decisions and as a technical reference that can be used or adapted to the needs and capacities of users. They present the rationale for action and identify the roles and responsibilities of stakeholders and the actions needed for SFM. The indicative stakeholder groups are: national and subnational producer-country governments, including policymakers and legislators; forest managers; the private sector; civil society; research and education institutions; consumer-country governments; and donors. The voluntary guidelines are voluntary in nature and are not legally binding for ITTO member countries. They may be adapted as appropriate to national and local circumstances.

The voluntary guidelines draw on the *ITTO Criteria and Indicators for the Sustainable Management of Natural Tropical Forests* (ITTO C&I for SFM), as revised in 2005, in setting out both the principles and the specific guidelines. They complement and build on the following and other sets of guidelines on various aspects of tropical forest management[2]:

1 International Tropical Timber Council Decision 2(XLIII) on the 2008–2009 ITTO Biennial Work Programme.
2 All documents listed here can be downloaded at www.itto.int.

- ITTO (1990). *ITTO Guidelines for the Sustainable Management of Natural Tropical Forests*. Policy Development Series No. 1.
- ITTO (1992). *Criteria for the Sustainable Management of Natural Tropical Forests*. Policy Development Series No. 3.
- ITTO (1993a). *ITTO Guidelines for the Establishment and Sustainable Management of Planted Tropical Forests*. Policy Development Series No. 4.
- ITTO (1993b). *ITTO Guidelines for the Conservation of Biological Diversity in Tropical Production Forests*. Policy Development Series No. 5.
- ITTO (1997). *ITTO Guidelines on Fire Management in Tropical Forests*. Policy Development Series No. 6.
- ITTO (1998). *Criteria and Indicators for Sustainable Management of Natural Tropical Forests*. Technical Series No. 7.
- ITTO (1999). *Manual for the Application of Criteria and Indicators for Sustainable Management of Natural Tropical Forests—Part A/National Indicators*. ITTO Policy Development Series No. 9.
- ITTO (1999). *Manual for the Application of Criteria and Indicators for Sustainable Management of Natural Tropical Forests—Part B/Forest Management Unit Indicators.* ITTO Policy Development Series No. 10.
- ITTO (2002). *ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests*. ITTO Policy Development Series No. 13.
- African Timber Organization/ITTO (2003). *ATO/ITTO Principles, Criteria and Indicators for the Sustainable Management of African Natural Tropical Forests*. Policy Development Series No. 14.
- ITTO (2005). *Revised ITTO Criteria and Indicators for the Sustainable Management of Tropical Forests including Reporting Format*. Policy Development Series No. 15.
- ITTO (2006). *ITTO Guidelines on Auditing of Criteria and Indicators for Sustainable Forest Management.* ITTO Policy Series No. 16.
- ITTO/IUCN (2009). ITTO/IUCN *Guidelines for the Conservation and Sustainable Use of Biodiversity in Tropical Timber Production Forests*. ITTO Policy Development Series No. 17.

Target audience

Many actors have interests in forests (Figure 1). While some of these interests are mutually compatible, some are not. For example, some stakeholders aim to preserve forests (although interpretations of the term "preserve" may vary), and others would like to clear the forest to better exploit its soils or subsoils. In between these two extremes is a wide range of actors with a broad set of uses for tropical forests. Therefore, the voluntary guidelines have a wide audience, including the following groups[3] involved in the management and protection of tropical natural forests:

- national and subnational **producer-country governments**, including **policymakers** and **legislators**, such as political parties, government agencies dealing with forests, conservation, the environment, and land-use planning, and development and extension agencies;
- **forest managers**, who may be state or local forestry agencies, forest companies, producer associations, natural-forest smallholders or rural and forest communities;

3 Some bodies may be categorized in more than one of these groups.

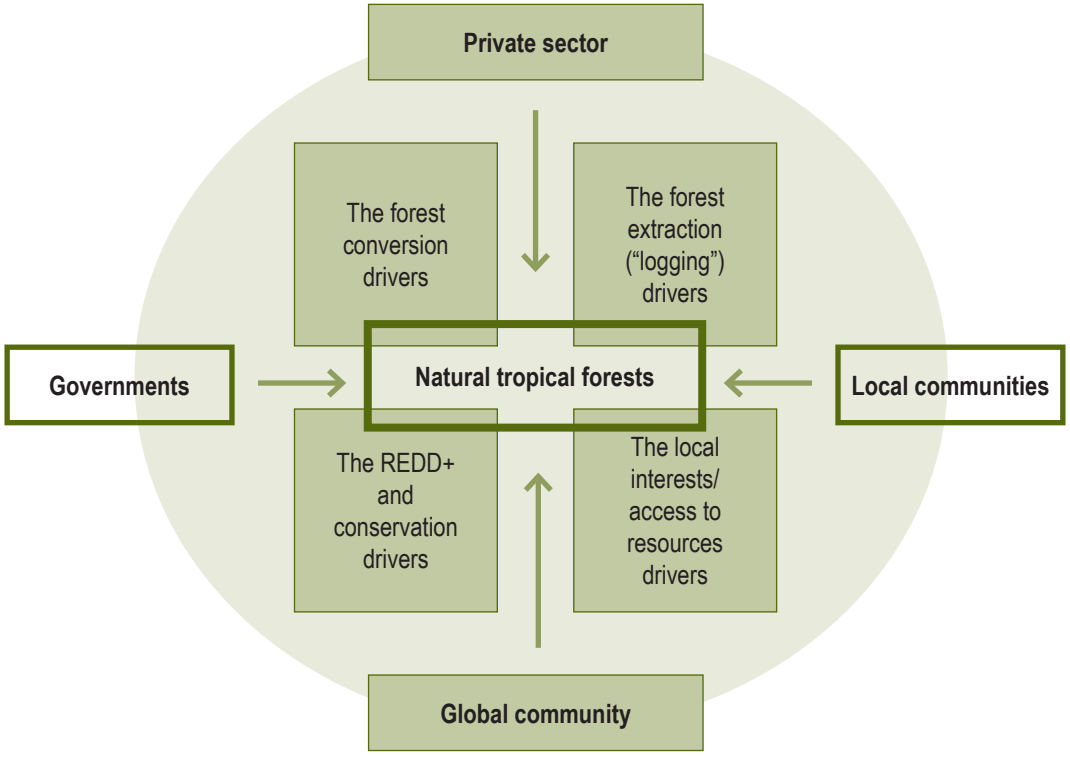
- **private-sector organizations**, such as small, medium-sized and large forest companies and their umbrella organizations, and trading groups;
- **civil-society organizations**, such as environmental and development non-governmental organizations and advocacy groups;
- **research and education institutions**—public and private forest research, education and training institutions and organizations; and
- **consumer-country governments**, as well as **donors** such as public and private international funding and development agencies.

Structure and organization of this document

This document is organized as follows:

- Chapter 2 introduces the context in which the voluntary guidelines were developed.
- Chapter 3 provides an overview of the principles and their relationships with the ITTO C&I for SFM.
- Chapter 4 set outs the guidelines for each of the seven principles, as well as an open-ended list of suggested actions for each guideline.
- An annex provides a list of proposed longer-term research topics generated from the list of suggested actions.

Figure 1: The various sectors with direct influence on the conservation and sustainable management of natural tropical forests



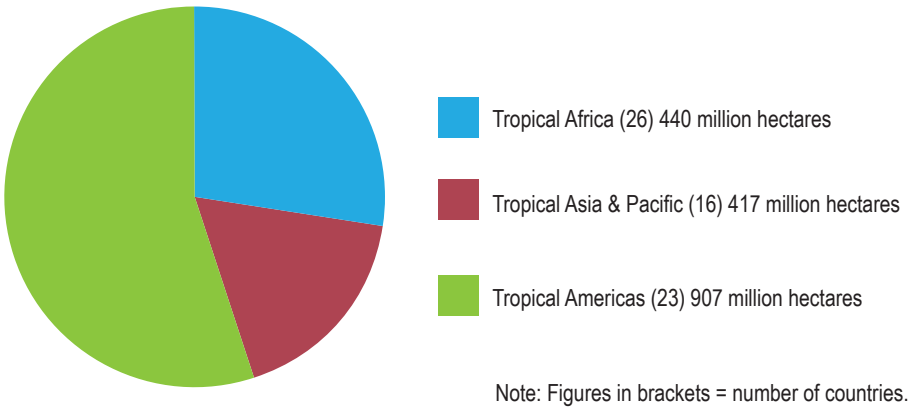
2 The context of sustainable forest management

There have been many significant developments in international policies related to tropical forests and forest management since ITTO's first guidelines on sustainable tropical forest management (*ITTO Guidelines for the Sustainable Management of Natural Tropical Forests*) were published in 1990. These include the adoption, in 1993, of the Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification, and the United Nations Framework Convention on Climate Change (UNFCCC); adoption of the Kyoto Protocol in 1996; various UNFCCC decisions (since 2007) on the development of REDD+ to mitigate climate change; and the 2007 agreement on the Non-legally Binding Instrument on All Types of Forests (which includes four globally agreed objectives on forests that will be reviewed in 2015). In many parts of the tropics there has also been a general shift from natural forest management towards forest plantations and from a focus on timber management in natural forests towards more holistic multipurpose approaches that place increasing emphasis on environmental services. Considering the increasing area of tropical forests subject to disturbance, it is clear that the future conservation of biodiversity and tropical forest ecosystems will take place mostly in what may be called "anthropogenic forests", but only if they are sustainably managed.[4] Box 1 summarizes some of the general developments that have affected the management of natural tropical forests since 1990.

The extent of tropical forests in ITTO member countries

Natural tropical forests extend over about 1664 million hectares in 65 countries (Figure 2), 1421 million hectares (85%) of which are in 33 ITTO producer member countries (Blaser et al. 2011). In total, the area of natural forests in the permanent forest estates (PFEs) of those 33 ITTO member countries is estimated at 761 million hectares, comprising 403 million hectares of production PFE and 358 million hectares of protection PFE (Figure 3). About 165 million hectares are available for harvesting and 131 million hectares are subject to management plans (Blaser et al. 2011).

Figure 2: Total tropical forest area, by region (65 countries)



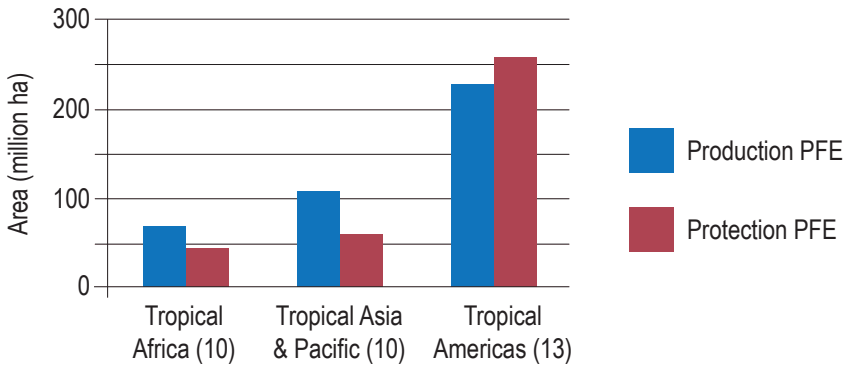
Sources: FAO (2010a); Blaser et al. (2011).

4 Sist et al. (2014).

1 Developments that have affected the use and management of tropical forests since 1990

- Increased competition for forest land.
- Increased societal demands, expectations on forests and environmental and social awareness about tropical forests and the need to manage them sustainably.
- Increased recognition of the role of tropical forests in delivering "global" environmental services, including those related to biodiversity, water, carbon and ecosystem resilience.
- Increased recognition of the rights of indigenous peoples and local communities over forests and forest use, and the need to safeguard those rights.
- Increased decentralization of control over forests, including privatization and the transfer of ownership to indigenous and local communities.
- The emergence of forest certification as an important driver of SFM.
- Increased awareness of illegality and corruption as major impediments to SFM.
- The increased role of the informal sector and its lack of visibility in national statistics and development plans.
- The increased role of non-governmental organizations in forest management and forest policy development.
- The loss of silvicultural knowledge and practice and a lack of research, leading to overly optimistic cutting cycles and a lack of silvicultural management.
- Increased vulnerability of tropical forests to abiotic and biotic threats attributed to climate change and climate variability.
- The development of REDD+ as part of a global climate-change mitigation agenda and the increasing recognition of forests in the climate-change adaptation agenda. The role of tropical forests in climate-change mitigation and adaptation has raised their visibility to the highest political level.
- Increased demand for wood and wood products, including in domestic demand in many tropical countries.
- The increased role of planted forests in meeting demand for wood products and fibre.
- Increased demand for renewable energy, including forest-based energy.
- An increasing trend to proclaim more protected areas and ban harvesting in natural forests.
- An increased focus on urban forestry and forest recreational areas.

Figure 3: Natural tropical PFE, by region, 33 ITTO producer member countries



Note: Figures in brackets = number of countries.

Source: Blaser et al. (2011).

ITTO's management approaches

Influenced by various international developments, approaches to forest management have evolved considerably in most ITTO producer member countries since 1990. This is reflected in the (continued) development of an important spin-off of the original guidelines—the ITTO C&I for SFM. All ITTO member countries have acknowledged the importance of the ITTO C&I for SFM as a tool for defining forest management and its challenges and for monitoring progress in and challenges to SFM.

The voluntary guidelines take these developments and others into account and bring together all the requirements for achieving SFM in natural tropical forests. They are designed to assist forest managers, policymakers and other stakeholders in managing, conserving and sustainably using natural tropical forests.

Sustainability. The 1990 version of the guidelines on sustainable tropical forest management (*ITTO Guidelines for the Sustainable Management of Natural Tropical Forests*) recognized that managing forests sustainably is about achieving a balance among the various uses of forests while ensuring their continued ecological functioning and the provision of benefits and functions into the future. Key ingredients were seen to be knowledge, its application in forest management actions, and the evaluation of practices to assess outcomes compared with expectations.

ITTO (1992) elaborated on this work by defining SFM as: "the process of managing forest to achieve clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services, without undue reduction in the forest's inherent values and future productivity and without undue undesirable effects on the physical and social environment". This definition implies the following objectives of SFM:

- continuously satisfying needs for goods and environmental services from forests;
- ensuring the conservation of forest soils, water and carbon stocks;
- conserving biodiversity;
- sustaining the resilience and renewal capacity of forests, including carbon storage;
- supporting the food-security, cultural and livelihood needs of forest-dependent communities; and
- ensuring an equitable sharing of responsibilities in forest management and of the benefits arising from forest use.

ITTO's criteria and indicators. To assist in the monitoring, assessment and reporting of SFM at the national and FMU levels, ITTO developed in 1992 (ITTO 1992), and subsequently revised in 1998 (ITTO 1998) and 2005 (ITTO 2005), a set of seven C&I for SFM that can be used to guide forest management and assess its sustainability. The ITTO C&I for SFM were not formulated for application in forests managed strictly for protection, where forest goods are usually not extracted, but they can still be applied in such forests. The seven criteria, which have been harmonized with other C&I for SFM schemes, constitute the basis for the assessment of SFM. They are:

1) Enabling conditions for SFM
2) Extent and condition of forests
3) Forest ecosystem health
4) Forest production
5) Biodiversity
6) Soil and water protection
7) Economic, social and cultural aspects.

A researcher field-tests a set of C&I for SFM with stakeholders in Central Africa. Seven criteria constitute the basis for the assessment of SFM. Photo: O. Ahimin

Multipurpose management. Natural forests are the source of a diverse array of products, environmental services and social, cultural and economic opportunities, and they have many stakeholders. Managing a forest for a single product or service may affect its capacity to provide others—for example, a high level of timber harvesting may affect a forest's value as habitat for wildlife. Decisions on tradeoffs in the provision of various goods and environmental services are best made using processes that involve the full range of stakeholders. Forest managers applying SFM must continually balance various management objectives that inevitably will change over time as social and community needs and values change; this is the challenge of multipurpose forest management. Although embedded in the laws of many countries, multipurpose forest management has proven to be a complex endeavour that faces a range of economic, social and institutional barriers. Nevertheless, success stories around the tropics, particularly in community-based initiatives, show that it can be made to work—for the benefit of communities and the forest.

Adaptive forest management. Adaptive management is the process by which research and learning are continuously incorporated in management planning and practice. Specifically, it is the integration of design, management and monitoring to systematically test assumptions in order to adapt and learn. While much knowledge has been accumulated on the composition, structure and dynamics of tropical forest ecosystems and their social and economic roles, there are still many uncertainties; moreover, forests are subject to very rapid social and physical change. Forest management, therefore, must be based on a continuous monitoring and learning process that enables the adaptation of practices as conditions change. In general, the voluntary guidelines advocate an adaptive management approach that implies the:

- analysis of the costs and benefits of SFM practices and to whom (e.g. government, communities, the private sector, forest managers and civil society) they accrue;
- monitoring and evaluation of the environmental, social and economic impacts of management;
- provision of mechanisms for the continuous involvement of stakeholders in decision-making on forest management at an appropriate level;
- documentation and quantification of the tradeoffs between and synergies among multiple objectives (e.g. related to timber, NTFPs, carbon, water and biodiversity); and
- monitoring and evaluation of the incentives and disincentives for SFM and the potential for governance failures.

Issues for the sustainable management of natural tropical forests

SFM in the wider context of landscape management. A landscape perspective should enable a balance to be reached between the development needs of a country or specific subnational units and those of natural resource management, including SFM. The identification of a PFE comprising forests of all ownership types is a fundamental component of national land-use planning.

The objective of producing wood was overwhelmingly important in traditional top-down approaches to forest management. Awareness that forest management decisions and developments in other sectors are closely interconnected has led to landscape approaches to SFM that take broader development realities into account.

SFM in natural tropical forests. In closed natural tropical forests[5] subject to their first timber harvest, the way in which operations are implemented (including the opening-up of areas with access roads) is of great importance in determining the success of SFM. Influencing the way in which the first cut is carried out, therefore, is an important task of SFM proponents. Closed natural forests generally stock more carbon and are biologically more diverse than forest ecosystems subject to human interventions on similar sites. The entry of forest operations to previously intact forests could therefore lead to increased carbon emissions and biodiversity loss, mainly because the provision of access roads is associated with deforestation and the loss of forest fauna through overhunting. For example, deforestation was found to be up to four times more likely in logged forests in the Brazilian Amazon than in non-logged forests because logging was often a precursor of land-clearing for agriculture.[6] In Southeast Asia, roads built by loggers to access high densities of valuable *Dipterocarpus*

5 The term "closed natural forest" is subject to debate. Here it is taken to mean forests of native species in which ecological processes are not significantly disturbed (FAO 2005a); the term "primary forest" is also used in this context. ITTO (2002) defined primary forest as forest which has never been subject to human disturbance, or has been so little affected by hunting, gathering and tree-cutting that its natural structure, functions and dynamics have not undergone any changes that exceed the elastic capacity of the ecosystem, where the "elastic capacity" of a forest ecosystem relates to "dynamic forest processes within a range of changing vertical forest structure, species composition and biodiversity, and productivity normally associated with the natural forest type expected at that site". ITTO (2002) proposed a set of definitions in a continuum of forest use, including, as main categories, primary forests, modified natural forests, and planted forests.

6 Asner et al. 2006.

SFM should be addressed at all scales, from the local to the global and including the landscape scale. Photo: C. Robledo

trees in lowland forests led to deforestation in sparsely populated protected areas.[7] Nasi (2008) concluded that improved access to forests considerably increases the risk of unsustainable hunting for bush meat. Deforestation and overhunting are incompatible with SFM, and broad, well-enforced land-use planning and policies are needed to guard against them in the PFE. In many countries, however, land-use planning is often ad hoc, and even when good planning and policies exist they may not be well enforced. Natural forests, therefore, continue to be converted or degraded at a high rate, often illegally. Controlling road access may be the most effective restraint on deforestation, and this should be taken into account at all stages of SFM at the landscape and national scales.

Some non-governmental organizations (NGOs) have criticized SFM as an excuse for a "business as usual" approach to natural tropical forest management, placing timber values first and giving little consideration to the protective, social or ecological values from forests. For example, in their critique of the World Bank's Forest Investment Program, two NGOs stated that SFM has, in practice, often been misused to legitimize destructive activities.[8] On the other hand, a large group of interested stakeholders have helped advance SFM through forest certification (Box 2).

2 Forest certification

Since the mid-1990s, forest certification in natural tropical forests has been promoted by many non-governmental organizations, private-sector companies involved in timber harvesting, and downstream forest industries and research and educational institutions. A voluntary, market-based instrument, forest certification has helped increase awareness of the need to define standards for good forest management. Forest certification has helped initiate an important capacity-building and awareness-raising process and has provided an incentive for many forest companies—especially those exporting tropical timber to Europe and North America—to improve the standard of their forest management. Although certification has been most successful in temperate and boreal forests—in 2014, more than 90% of all certified forests were in those biomes—it has also been important in promoting the concept of SFM in natural tropical forests.

7 Curran et al. 2004.
8 Greenpeace and Rainforest Foundation (2009).

Forest degradation and restoration. Forest degradation is often considered to be a precursor of deforestation and conceptualized as part of the same process; therefore, it has tended to be coupled with deforestation in considerations by the UNFCCC on the role of forests in climate-change mitigation. But forest degradation is not always followed by deforestation. In most cases, the drivers behind them are not the same, and nor are the actors. Most deforestation is caused by the large-scale commercial conversion of forests for agriculture or ranching, the expansion of urban areas, and infrastructure development, some of which is "governed" (i.e. sanctioned by government authorities) and some of which is ungoverned. On the other hand, most degradation is the result of the unsustainable extraction of forest products by local people as part of their livelihood strategies.[9] The area affected by this kind of degradation has been estimated at 850 million hectares[10], and an area of up to about 0.5 billion hectares would be suitable for the large-scale restoration of closed forests.[11] An additional cause of tropical forest degradation is commercial logging, but this affects a relatively small area.

Most deforestation is caused by the commercial conversion of forests for agriculture or ranching, the expansion of urban areas, and infrastructure development. Photo: H.O. Ma, ITTO

Because the actors and processes are different, it follows that strategies to deal with deforestation may differ from those aimed at reducing forest degradation. Moreover, while a reduction in deforestation will reduce greenhouse-gas emissions, curbing degradation will both reduce emissions and (usually) increase carbon sequestration. This is because reducing degradation pressures and instigating SFM—including through forest restoration programs—will usually lead to forest growth.

SFM and biodiversity. There is a close relationship between ecosystem resilience and forest biodiversity.[12] Resilience is an emergent property of ecosystems that is conferred at multiple scales by genes, species, functional groups of species and the processes within ecosystems. From an ecological perspective, SFM attempts to manage and maintain ecosystem resilience. To accomplish this, biodiversity must be conserved because of its functional roles in maintaining ecosystem processes (as well as for other reasons, such as for its intrinsic, spiritual, aesthetic, scientific and economic values and for ethical reasons). Thompson et al. (2009) suggested that the relationship

9 Blaser and Thompson (2010).
10 ITTO (2002).
11 WRI (2009).
12 Thompson et al. (2009).

There is a close relationship between ecosystem resilience and forest biodiversity. Photo: Sarawak Forestry Department

between biodiversity, productivity and the resilience and stability of forests is a key element of adaptive management, particularly in light of climate change. Therefore, maintaining biodiversity in space and time is a critical aspect of SFM. According to ITTO/IUCN (2009), many tropical forest species require a variety of habitats that they use at different times of the year or for different periods of their life cycles; these habitats should be provided for in forest zoning and harvesting patterns. Methods are available to help achieve a balance among components of a landscape mosaic that will provide optimal conditions for a broad range of species and populations.

SFM and the protection of soils, water, climate and carbon stocks. SFM aims to maintain the productivity and quality of soil, water and carbon stocks in forests. It can also play crucial roles outside forests in maintaining downstream water quality and flow as well as reducing flooding and sedimentation. Quantitative information on the effects of forest management on soil, water and carbon can be difficult and expensive to obtain and is seldom available for more than a limited number of sites; moreover, each site has its own specific characteristics. Monitoring the effects of forest management on these resources may require measures of soil productivity in the forest; data on water quality and average and peak water flows in streams; and data on the rate at which forests sequester carbon and maintain carbon in the five carbon pools (aboveground biomass, belowground biomass, deadwood, litter, and soils).

SFM and REDD+. Forests sequester and store more carbon than most other terrestrial ecosystems and could play an important role in mitigating climate change. When forests are cleared or degraded, their stored carbon is released into the atmosphere as carbon dioxide and other greenhouse gases. Tropical deforestation is estimated to have released 1.5–2 billion tonnes of carbon per year for the past 20 years. The term "REDD-plus" (usually written "REDD+")—reducing emissions from deforestation and forest degradation, including the role of conservation, sustainable management of forests and enhancement of forest carbon stocks—was introduced to the UNFCCC after deliberations on various forest-based climate-change mitigation options under paragraph 1 (b) (iii) of the Bali Action Plan.[13] The aim of REDD+ is to provide tropical forest owners with financial incentives to reduce greenhouse-gas emissions from forests and increase carbon sequestration. By undertaking REDD+ activities, countries could simultaneously increase the resilience of ecosystems

13 UNFCCC (2007).

SFM aims to maintain the productivity and quality of soil, water and carbon stocks in forests.
Photo: R. Carrillo, ITTO

and social systems in the face of climate change, conserve biodiversity, protect environmental services, increase income for forest owners and managers, and help address issues of forest governance. Forest management activities included in REDD+ schemes are likely to be subject to high levels of scrutiny and accountability, and the operationalization of REDD+ will require accurate monitoring and reporting.

SFM and extrasectoral forces. Tropical forestry has been shaped by powerful forces at the global, regional, national and subnational levels in the past two decades. These forces are mainly extrasectoral in nature, and include the following:

- In many tropical countries, increasing demands for food, fuel and land have led to increased deforestation (i.e. the conversion of forests to non-forest land uses), forest degradation and fragmentation and the appropriation of customary lands. Poverty and a lack of livelihood opportunities among upland communities and forest-dwellers aggravate pressures on natural forests.
- Globalized markets and national and international trade and investment contribute to pressure on forested land by providing incentives for, and investment in, the expansion of agriculture, livestock, biofuel production, mining and other extractive activities.
- Poor governance and its associated illegal operations and corruption have been implicated in deforestation and forest degradation in a number of tropical countries. Of particular concern are a lack of clarity on land tenure and a sense of grievance among indigenous and local people about their lack of rights to land. Although progress has been made, poor governance continues to hinder efforts to implement SFM.
- A lack of financial remuneration for the many environmental services provided by natural tropical forests is one reason for their low financial competitiveness against land uses such as agriculture and cattle-ranching.

While forest managers are often powerless to combat such forces, they nonetheless should be aware of them in their efforts to put the voluntary guidelines into effect. A recent survey of SFM in 33 ITTO producer member countries found that only about 30 million hectares (less than 8%) of the tropical production PFE was under SFM in 2010.[14] Douglas and Simula (2010) attributed the slow uptake of SFM to the following two central issues:

1) The economic and social policies influencing forests and forest-dependent people are initiated outside the forest sector and can only be manipulated effectively by mechanisms that also operate outside the sector.

2) Forest sustainability requires the commitment of stakeholders closely involved in forest management—government agencies, forest owners, private-sector operators, local communities and others—not all of whom are convinced of the benefits to them of SFM.

Several constraints to SFM are common to many tropical countries. Probably the most important, and the most generally applicable, is that the sustainable management of natural tropical forests is less profitable than other forms of land use, especially commercial agriculture and cattle-ranching, bioenergy production, mining and urban development. As a result, the sustainable management of natural tropical forests tends to be a low priority for governments, and the private sector often lacks incentives to pursue it. Prices for tropical timber—still the major commodity extracted from natural tropical forests—mostly remain relatively low. It is possible that they will increase in the future due to the scarcity effect for specific uses to better reflect the true costs of production, including the opportunity cost of retaining natural forest, but to date there is no sign of this.

Nevertheless, natural tropical forests are recognized increasingly as an important resource at the local, national and global levels, especially for the environmental services they provide. In some countries, payments are being made for such environmental services, and REDD+ in particular offers a potentially significant revenue-earning opportunity for forest owners. In the long run, the extent to which payments for the environmental services supplied by tropical forests are forthcoming—at either the national or global level—is likely to play a large part in determining the fate of remaining tropical forests. For such payments to achieve their potential to affect forest management, constraints related to governance also need to be overcome. Those governments, companies and communities that have been striving to improve forest management—even if they have not yet been wholly successful—merit the long-term support of markets, development assistance agencies, NGOs and the general public.

Another constraint on SFM is confusion over ownership. SFM is unlikely to succeed without the security provided by credible, just, negotiated arrangements on tenure. In many countries, resolving disputes over land tenure is not easy but it must be done—preferably through a transparent and equitable process—if resource management is to become sustainable.

14 Blaser et al. (2011).

3 Overview of the voluntary guidelines

Definition of key concepts

Sustainable forest management. This document uses ITTO's definition of SFM (as quoted earlier), but there are many other definitions that vary widely, sometimes because of specific field circumstances and sometimes because of the particular purpose to which a forest is put.[15] The concept of sustainability in forest management has evolved from the sustained yield of commercial timber and single-use management of timber to broader silvicultural management reflecting the wide range of forest products, environmental services and values generated or otherwise provided by forests. The term SFM was coined to reflect management for this wider set of purposes and the necessary enabling policy and institutional environments, and the United Nations adopted wording on it in 2007 (Box 3). In general, SFM involves the application of the best available practices based on current scientific and traditional knowledge that allow multiple objectives and needs to be met without degrading the forest resource. SFM also requires effective and accountable governance and the safeguarding of the rights of forest-dependent peoples.

3 The United Nations definition of SFM

"A dynamic and evolving concept [that] aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations."

Source: United Nations General Assembly Resolution 62/98, New York, December 2007.

It is generally recognized that the concept of SFM will change over time in response to the dynamic and evolving needs of society, and this may be one reason for the acknowledged lack of precision in its definition, particularly in regard to:

- what needs to be sustained (i.e. the objectives of SFM);
- the values attached by different stakeholders to various SFM objectives;
- the uncertainties associated with interventions in complex forest ecosystems; and
- the timeframes and spatial boundaries involved.[16]

The World Commission on Forests and Sustainable Development (1999) concluded that SFM "must be a flexible concept that accepts changes in the mix of goods and services produced or preserved over long periods of time and according to changing values signalled by various stakeholder groups" and that it "should be viewed as a process that can be constantly adapted according to changing values, resources, institutions and technologies".

SFM embraces the view that forests yield many products and provide many environmental services. It will therefore produce an array of products and services that may or may not include timber. SFM refers not just to the flow of goods and environmental services but also to maintaining forest ecological processes essential for ecosystem resilience—the capacity of a forest ecosystem to recover following disturbance.[17]

15 Douglas and Simula (2010).
16 World Commission on Forests and Sustainable Development (1999).
17 ITTO (2002).

An important dimension of SFM is the scale at which it is applied, such as the global, national, subnational, FMU or stand scales. SFM should be addressed at all these scales.

- At the **global and national scales**, the concept of SFM has evolved as an approach that balances environmental, social (including cultural) and economic management objectives in line with the Forest Principles adopted at the United Nations Conference on Environment and Development in 1992. The guiding objective is to contribute to the management, conservation and sustainable development of all types of forests and to provide for their multiple and complementary functions and uses. The global environmental services provided by forests, such as those related to the carbon cycle and biodiversity, should be addressed at the international level because all people have an interest in their maintenance; global payment mechanisms for certain environmental services are being discussed in international forums. Policy developments on SFM initiated at the international level, including ITTO's work on C&I for SFM and various guidelines, has influenced policies at the national level.
- At the **subnational or landscape level**, the objective of maximizing wood yields has traditionally been overwhelmingly important. Growing awareness of the broader role of forests, however, has led to new approaches to SFM that give weight to the full range of economic, social and environmental factors. At the landscape scale, tradeoffs will almost always have to be made in the mix of products, environmental services and values offered by forests. Ideally, such tradeoffs are agreed in a planning process involving all stakeholders, who reach consensus on what constitutes SFM in a particular landscape within physical and other constraints. Questions to be addressed in such planning processes include: How much forest do we need or want? What kinds of forests should there be? Where should they be situated? How should they be conserved, linked and managed?
- At **the FMU scale**, SFM has three elements: the management of forests for multiple objectives to meet the needs and demands of stakeholders; achieving a balance among outputs (of goods and environmental services) rather than the maximization of any single output; and designing and implementing management practices that are compatible with the ecological and social processes that sustain forest resources and ecosystems. Within an FMU, the management of **forest stands** may vary (for example, some stands may temporarily have low or no tree cover, while others at different growth stages are fully stocked) and still be compatible with SFM.

In summary, the essential aim of SFM is to maintain and enhance the potential of forests (at all scales) to deliver the goods and environmental services that people and societies require of them over time. Thus, the use of forests should be planned at the national, landscape and FMU levels, and each FMU should be managed sustainably for the purposes for which it is intended in a landscape context. Management should be applied consistently with the aim of maintaining ecosystem resilience, including by emulating natural disturbances, and the effects of management should be monitored so that management can be adapted over time as conditions change.

Permanent forest estate. The notion of permanence is a necessary condition for SFM. Although the voluntary guidelines can be applied to the management of *all* natural tropical forests, the focus is on the PFE[18] and the multipurpose roles of forests, including timber production.

The production PFE comprises those forest areas where timber harvesting and other forms of resource use are permitted, subject to certain conditions. The protection PFE is forest in which such exploitation is generally not permitted. The voluntary guidelines are designed to be applied primarily in the management of the production PFE, although many of the principles, guidelines and suggested actions can and should also be applied in the protection PFE.

18 Some tropical countries have not yet defined their PFEs. In these cases, the voluntary guidelines should be applied especially in those natural tropical forests that are likely to be maintained as forest by agreement (customary, oral or written) between forest owners and forest users.

Framework of the voluntary guidelines

The large-scale implementation of sustainable tropical forest management depends on the extent to which pressures from competing land uses are managed and governed. Forest policies will increasingly need to be part of integrated policy frameworks to secure the provision of forest products and environmental services in multifunctional landscapes and under changing environmental conditions; it will become increasingly difficult to consider production forests in isolation.

Seven principles for managing natural tropical forests are enumerated in this document, organized under four objectives with the aim of:

1. **Providing the enabling conditions for SFM**
- Principle 1: Forest governance and security of tenure
- Principle 2: Land-use planning, permanent forest estate and forest management planning

2. **Ensuring forest ecosystem health and vitality**
- Principle 3: Ecological resilience, ecosystem health and climate-change adaptation

3. **Maintaining the multiple functions of forests to deliver products and environmental services**
- Principle 4: Multipurpose forest management
- Principle 5: Silvicultural management

4. **Integrating social, cultural and economic aspects to implement SFM**
- Principle 6: Social values, community involvement and forest-worker safety and health
- Principle 7: Investment in natural forest management and economic instruments.

Table 1 sets out these objectives and principles and shows the relationship between the principles and the ITTO C&I for SFM.

The seven principles are statements of goals or values that represent requirements for forest policies, processes and practices if SFM is to be achieved; they provide a crucial foundation for SFM. Users should consider these principles as the essential characteristics of SFM in natural tropical forests; thus, SFM will not be achieved if one or more principle is contravened. The underlying expectation is that when the principles are understood, the actors involved in SFM will be able to implement good practices, with assistance as needed.

The seven principles are applicable to SFM in natural tropical forests worldwide, with an emphasis on production forests in the PFE. They are designed to encourage multipurpose forest management practices that, if applied over the long term, will sustain the yields of multiple products from, maintain the provision of services by, and safeguard the values of tropical forests for the benefit of multiple stakeholders. While conceptualizing the sustainable management of natural tropical forests at a broad policy level, the guidelines should also be useful to forest managers working under a variety of management and tenure arrangements.

The principles and guidelines also constitute an adaptive and collaborative forest management concept that can be applied at multiple levels. They particularly provide guidance on tradeoffs in forest management decision-making and on cross-cutting issues such as forest governance, land-use planning, policy and institutional issues and intersectoral linkages. It is intended that the voluntary guidelines form the basis for the development of specific guidelines at the national or subnational levels.

Table 1 The seven principles for managing natural tropical forests and their relationship to seven criteria for monitoring and reporting on SFM

Objective	Principles for managing natural tropical forests		Relationship with ITTO C&I for SFM
	Principle	Observations	
1. Providing the enabling conditions for SFM	**Principle 1: Forest governance and security of tenure**	Political commitment, supportive national policies, strong institutions, laws and regulations, appropriate governance, security of forest tenure and clearly defined access and use rights, including customary and traditional rights, are necessary conditions for SFM	Criterion 1: Enabling conditions for SFM
	Principle 2: Land-use planning, permanent forest estate and forest management planning	Managing tropical forests sustainably requires that land allocation and spatial planning within and outside forests maintain or enhance the economic, social and environmental values of forests at a landscape scale. This requires the adoption of a forest planning framework at the national, subnational or landscape scale	Criterion 1: Enabling conditions for SFM (planning framework) Criterion 2: Extent and condition of forests
2. Ensuring forest ecosystem health and vitality	**Principle 3: Ecological resilience, ecosystem health and climate-change adaptation**	Resilience is a key tenet of SFM in natural tropical forests; it is essential to maintain or enhance it to reduce risks to sustainability. Climate change is likely to affect tropical forests and the people who depend on them. It is essential to identify, prevent, monitor and manage threats to forests and to protect them from destructive agents and stresses	Criterion 3: Forest ecosystem health
3. Maintaining the multiple functions of forests to deliver products and environmental services	**Principle 4: Multipurpose forest management** **Principle 5: Silvicultural management**	The role of natural tropical forests as providers of multiple goods and environmental services should be safeguarded by the application of sound planning and management practices that maintain ecosystem functions and the potential of the forest to yield the full range of benefits to society. In timber production forests, it is essential to have an approved management plan with clearly stated objectives and the silvicultural measures to help meet those objectives	Criterion 4: Forest production Criterion 5: Biodiversity Criterion 6: Soil and water protection
4. Integrating social, cultural and economic aspects to implement SFM	**Principle 6: Social values, community involvement and forest-worker safety and health** **Principle 7: Investment in natural forest management and economic instruments**	SFM needs to accommodate forest-based production (particularly of timber), environmental protection and local development concerns. Natural tropical forests perform a wide range of socioeconomic and cultural functions, which must be recognized and maintained	Criterion 7: Economic, social and cultural aspects

An aim in revising the guidelines was to keep them simple and practical, avoiding unnecessary prescriptions and always bearing in mind their usefulness to forest managers. Another aim was to support recommendations with science to the greatest possible extent. Thus, the voluntary guidelines make full use of the wealth of scientific literature that explicitly or implicitly provides evidence for suggested actions (tasks proposed for implementing the guidelines); anecdotal evidence and field experience from experts and practitioners have also been considered. The suggested actions focus on processes; some may be relevant in some cases and not in others, while there may be circumstances that demand actions not specified in these voluntary guidelines. The application of the voluntary guidelines should be worked out by participants in the implementation of SFM and is bound to vary according to the context. Member countries may wish to implement suggested actions in accordance with their own national forest policy objectives, national forest programs, and forest resource situations.

The voluntary guidelines are evidence-based, outcomes-focused advisory statements intended to assist decision-makers, forest managers and other stakeholders to make informed forest management decisions. When adapted to local circumstances and adequately applied, they can facilitate the continued systematic development of SFM and ensure the application of good practices in a wide range of natural tropical forests.

Table 2 summarizes the seven principles for managing natural tropical forests and the 60 related guidelines.

Table 2 The seven principles for managing natural tropical forests and the 60 related guidelines

Principle 1: Forest governance and security of tenure	
1.1	Reaffirm political commitment and strengthen and implement effective policies and strategies to promote SFM
1.2	Establish coherence, effective linkages and coordination of policies and laws between different levels of governance
1.3	Formulate regulations and procedures for forest law enforcement
1.4	Recognize that it is essential to have appropriate and capable institutions with effective linkages between them
1.5	Transfer authority or responsibility from the central government to subnational governments and empower the private sector, communities and civil-society institutions and women to collaborate efficiently in SFM
1.6	Identify and analyze the impacts that the policies and laws of other sectors may have on SFM
1.7	Foster accountability/transparency and establish mechanisms for stakeholder participation and involvement in SFM
1.8	Identify and integrate relevant emerging issues related to SFM, capture synergies and address possible tradeoffs with existing objectives of forest management
1.9	Recognize the implications for SFM of legally and non-legally binding intergovernmental agreements at the regional and global levels
1.10	Put in place effective formal systems for ensuring the security of forest tenure
1.11	Recognize the importance to SFM of clear rights to forest access and use
1.12	Ensure that traditional use rights are clear and respected
1.13	Make sure that concession/logging rights are clear and transparent

Table 2 (continued)

Principle 2: Land-use planning, permanent forest estate and forest management planning	
2.1	Implement national and subnational land-use planning
2.2	Establish a PFE by laws that define its demarcation, use and management strategies
2.3	Carry out periodic national or subnational forest resource assessments to provide reliable data at the landscape scale
2.4	Prepare and implement a national forest management planning framework
2.5	Support research and education in natural tropical forest management
2.6	Monitor progress in SFM, including through clear and open communication with the public
Principle 3: Ecological resilience, ecosystem health and climate-change adaptation	
3.1	Identify causes and put in place preventative and remedial actions to reduce the vulnerability of forests to biotic and abiotic stresses
3.2	Conserve and use biodiversity in ways that maintain ecological resilience and enable adaptation to change
3.3	Manage forests in ways that maintain their regenerative capacities and ecological resilience
3.4	Restore degraded forest ecosystems to improve habitats for native species, forest structure, biodiversity, productivity and ecosystem functioning
3.5	Assess the impacts of climate change and climate variability on natural tropical forests and evaluate the risks
3.6	Assess the economic and social effects of climate change as they relate to tropical forests
3.7	Manage natural tropical forests for adaptation to climate change
3.8	As appropriate, include carbon storage as a management option in natural tropical forests and monitor forest carbon and safeguards
Principle 4: Multipurpose forest management	
4.1	Enable multipurpose forest management to manage forest products and environmental services
4.2	Ensure effective soil and water management to maintain the productivity and health of forests and their hydrological regulation functions
4.3	Emphasize biodiversity in all aspects of the management of natural tropical production forests
4.4	Provide guidance and take measures to avoid unsustainable levels of NTFP extraction and hunting
4.5	Monitor biodiversity in FMUs to minimize negative impacts
Principle 5: Silvicultural management	
5.1	Conduct preliminary studies and develop a multiresource inventory
5.2	Define management objectives for individual resources (e.g. timber, NTFPs, and carbon and other environmental services)
5.3	Use a reliable method for regulating and controlling yields of timber and NTFPs
5.4	Plan harvests to enable good technical control, minimize costs and reduce environmental impacts
5.5	Manage FMUs according to forest management plans and silvicultural systems

Table 2 (continued)

5.6	Incorporate wildlife and biodiversity concerns into forest management plans
5.7	Enhance the potential for generating income from the environmental services provided by FMUs
5.8	Prepare detailed 10-year working plans and annual operational plans for harvesting and silvicultural management
5.9	Monitor the implementation of management plans and apply adaptive management
5.10	Protect FMUs from illegal and unsustainable activities
5.11	Formulate and implement fire management plans for FMUs and adjacent lands
5.12	Integrate the management of pests and diseases into forest management plans
5.13	Ensure that all waste and pollution derived from, and chemicals used in, forest management activities are stored and disposed of properly
Principle 6: Social values, community involvement and forest-worker safety and health	
6.1	Address the local livelihood needs of people, including indigenous peoples and local communities
6.2	Ensure the effective participation of relevant stakeholders in planning and implementing SFM
6.3	Recognize cultural, archaeological and spiritual sites identified in the PFE
6.4	Consult with local communities on the management of natural forests in the PFE and at the FMU level
6.5	Provide opportunities for local communities to participate in SFM
6.6	Ensure that the benefits derived from community forest management are shared among stakeholders according to their rights, roles and responsibilities
6.7	Provide a framework of rights and responsibilities for forest workers and forest managers on safety and health in forest operations
6.8	Make safety management a top priority
6.9	Introduce best practices in forest operations to ensure safe and efficient operations
6.10	Develop capacity at all levels of the workforce, including by improving working conditions
Principle 7: Investment in natural forest management and economic instruments	
7.1	Enable a favourable environment for investment in natural tropical forest management
7.2	Provide guidelines for optimum efficiency in timber harvesting to reduce log waste
7.3	Monitor the distribution of the costs and benefits of forest management among stakeholders
7.4	Encourage economic instruments to support natural tropical forest management
7.5	Provide preferential access to markets for products from sustainably managed tropical forests

4 Voluntary guidelines and suggested actions for SFM

Principle 1: Forest governance and security of tenure

Political commitment, supportive national policies, strong institutions, laws and regulations, appropriate governance, secure forest tenure, and clearly defined access and use rights, including customary and traditional rights, are all necessary for SFM.

Rationale

Political commitment. A national commitment to conserving the country's forest resources for the benefit of present and future generations is essential for achieving SFM. Such a commitment is normally embodied in provisions for SFM in the country's policies and laws. Another important sign of political commitment is ensuring that adequate resources are available to conserve and manage forests to meet the needs of society without affecting the capacity of future generations to also meet their needs from forests.

Forest policy. A national forest policy is a negotiated agreement between governments and stakeholders to guide present and future decisions and actions on forests. Forest policy goals should be linked to wider national development strategies. For example, challenges related to food security, energy security and climate change, including REDD+, open up possibilities for new forms of forest management. Forest policies should no longer address forestry in a narrow sense; they should take into account the broader needs of, and benefits to, society, as well as the problems arising from increased pressure on a finite resource base. Considerations in deciding on a forest policy include, among other things, the proportion of land under forest cover; the needs of present and future generations for forest goods and environmental services; the place of forestry in national economic planning; and the protection and conservation of forest biodiversity, carbon stocks, soil and water.

Governance.[19] Policies and laws provide incentives and disincentives that affect the behaviour and choices of forest managers, users and other stakeholders. On their own, however, good laws and regulations are insufficient. Political will to provide the means for the enforcement and implementation of laws and regulations is necessary, as is strong leadership to coordinate across sectors.

Legislation and forest law compliance. A forest policy sets out the broad vision, goals and long-term direction for forests and their use but may not specify in detail the instruments or practices to implement it. A key instrument for implementing a forest policy is legislation. While government policies should be consistent with the national constitution and other overarching laws of a country, all laws, including those pertaining to forests, should be aimed at putting policies into practice. Thus, a policy needs to be developed before any aspect of it can be made legally binding. The primary purpose of forest legislation should be the distribution and enforcement of rights and responsibilities to support SFM.

Primary legislation sets out rights and obligations and institutionalizes rules. Secondary legislation—such as regulations, decrees, ordinances and bylaws—may be required to put the primary legislation into effect; indeed, much of the implementation of SFM policies is defined at such a secondary legislative level.

19 See the glossary for the general definition of governance used in these voluntary guidelines.

4 The five factors that give rise to a lack of forest law compliance and good forest governance

1) Failings in the policy and legal frameworks
2) Insufficient enforcement
3) Lack of information
4) Corruption
5) Market distortions

Effective regulations and clear and implementable administrative procedures are keys for SFM. A lack of forest law compliance and good governance (Box 4) has far-reaching economic, social and environmental consequences, both inside and outside forests. Although the extent of illegal forest activities is notoriously difficult to quantify, their economic cost is likely to be high. Problems arise when laws are incoherent, unrealistic and unenforceable and fail to address forest tenure and use rights. Excessive regulation, especially as a result of secondary legislation, can mean that the transaction costs of legal operations are prohibitively high, pushing forest users into illegal practices. Institutional weaknesses often give rise to a lack of enforcement capacity and a lack of transparency and accountability in the implementation of the policy and legal frameworks.

Insufficient monitoring of the forest resource and the supply chain makes it difficult for forest law enforcement agencies to know when illegality occurs. Corruption in the private sector and government institutions and among local decision-makers is linked to a lack of transparency in

Adopt strategies for the control of illegal activities, focusing on preventive actions—suggested action in Guideline 1.3. Photo: Bosques Sociedad y Desarrollo, Peru

policy implementation, the marginalization of rural people, and a lack of public scrutiny. Distortions in domestic and export markets for wood products can occur when there are ready outlets for low-priced illegally harvested products.

Institutional arrangements. Effective governance arrangements require adequate institutions and personnel at all levels to undertake SFM. These include effective public institutions to ensure that forest management is conducted in accordance with scientific and technical knowledge. Nonetheless, such institutions also need to be able to deal appropriately with non-technical issues, because reconciling conflicting interests in SFM is often more a political and social matter than a technical one. The high diversity of public and private stakeholders involved in the implementation of forest policies requires clarity on the division of responsibilities among government institutions and other stakeholders.

Decentralized approaches to SFM are usually pursued because of the potential for greater accountability in local governments, the increased involvement and empowerment of local communities, and the more appropriate use of forest resources. Decentralization is achieved through the delegation of authority and responsibilities to local levels, such as municipalities, community bodies and other local players. It requires considerable collaboration and coordination among government officials, not only across sectors but also across tiers of government, because decentralization implies that more tiers of government share responsibility for the implementation of SFM. Thus, public agencies at all levels need appropriate goals, structures and capacities to discharge their mandates with respect to SFM. For decentralization to be effective, a dynamic balance of authority, accountability, responsibilities and revenue-sharing must be established among the various tiers and sectors of government. Experience in many countries indicates that, to a large extent, this balance determines the effectiveness and efficiency of decentralized systems of forest governance.[20] Generally, the success of decentralization is linked to security of tenure and access to forest resources; adequate financial means and authority at lower levels; commercial rights and market access; and sensitivity to cultural traditions and local knowledge.

Forest tenure is a broad concept that includes ownership, tenancy and other arrangements for the use of forests. It is a combination of legally or customarily defined forest ownership and of rights and arrangements to manage and use forest resources. Forest tenure determines who can use what resources, for how long and under what conditions. While forest tenure is closely linked to land tenure, it concerns not only the land but also the natural resource growing on the land. Secure forest tenure is a fundamental element in improving livelihoods and achieving SFM and in encouraging investment in forest resources and their management. Incompatibility between traditional tenure rights (land, trees and other resources) and formal land allocation have often led to contradictory (and open-access) situations, resulting in the mismanagement of forests. Incompatibilities between customary and statutory tenure must be resolved through multistakeholder participation as well as the adoption of appropriate laws, rules and regulations. The status of women, the landless, tenants and immigrants should be addressed. Forest-tenure reform should be implemented as part of a holistic and integrated reform agenda.

Security of tenure implies that rights are recognized and guaranteed in the long term and cannot be taken away arbitrarily. Tenure security is not necessarily linked to ownership or titling, but some kind of formal recognition is necessary. When undertaking forest-tenure reform, a careful review of current policies and laws is necessary to ensure that these are supportive of the reform and do not present inconsistencies or contradictions to the objectives of the reform. A land-use planning process should take as a starting point the identification of forest user rights and traditional ownership and control of land. Any new tenure system should provide adequate incentives for the new owners/

20 Colfer and Capistrano (2005).

managers to invest human and financial resources in SFM. Incentives can be economic, but they should also encompass an increased sense of ownership, equity and empowerment in decision-making.

Forest concessions are a form of forest tenure. A concession involves a contract between the forest owner and another party that gives rights to harvest specified resources from a given forest area (e.g. "forest utilization contracts"), or a contract to manage certain resources within a specified forest area (e.g. "forest management services contracts"). Formal recognition may also legitimize customary tenure systems that otherwise may be in danger of being ignored or undermined, especially when different interest groups compete for the same resource.

Gender equity. There are often very different concerns between men and women regarding the use and conservation of forest resources. These differences also affect the way in which forests are managed. The activities and knowledge systems of one gender are likely to be complementary to those of the other, meaning that one gender usually depends on the other to develop strategies for efficiently using the forest to produce the livelihood outcomes they desire. This indicates the importance of both women and men in the management process. To achieve SFM, both genders should be involved in the management process, because sustainability requires an understanding of the construction of gender roles as a function of resource use and management. Gender is also central when considering management, extension and law enforcement. Forestry tends to be a male-dominated field that privileges the experiences and knowledge of men. While the male experience is important, it is crucial that women are fully valued and acknowledged in forestry and forest resource management. This shift must occur in both policy and practice; among forestry professionals and in local forest communities; within organizational structures; and at the field level.

Integrating emerging issues. SFM provides a flexible, robust and well-tested framework for addressing emerging forest-related issues. For example, the role of forests in simultaneously reducing carbon emissions and sequestering carbon and thereby serving as a major land-based carbon pool, and the potential of forests to help communities adapt to climate change, are novel challenges for SFM. Forests can simultaneously supply environmentally friendly forest products, protect biodiversity and secure the supplies of a range of essential environmental services.

Principle 1: Forest governance and security of tenure			
Guidelines		**Suggested actions**	**Indicative stakeholder groups**
1.1	**Reaffirm political commitment and strengthen and implement effective policies and strategies to promote SFM**	Develop a formal forest policy statement that includes a shared vision of and shared goals for SFM and sets out strategies for their achievement	Government and legislators, jointly with all stakeholders in the forest sector and in other sectors with a strong influence on forests
		Revise or update periodically the forest policy and allow flexibility in the methods to be used	
		In revising forest legislation, observe the following: avoid legislative overreaching; avoid unnecessary or superfluous licensing and approval requirements; enhance provisions for transparency and accountability; and enhance the role of stakeholders	Government and legislators, forest managers, private sector, civil society, research and education institutions
		Provide avenues for engagement among stakeholders to allow the continuous adaptation of the forest policy and its implementation	

Principle 1: Forest governance and security of tenure (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder groups**
1.2	**Establish coherence, effective linkages and coordination of policies and laws between different levels of governance**	Ensure compatibility between laws, regulations and institutional frameworks at different levels of decision-making and with related sectors (e.g. agriculture, energy, mining and tourism)	Government, jointly with all stakeholders in the forest sector and in other sectors with a strong influence on forests
1.3	**Formulate regulations and procedures for forest law enforcement**	Ensure consistency in the regulatory framework so that rules and regulations do not contradict others in the forest legal framework	Government and legislators, forest managers, private sector, civil society, research and education institutions
		Develop fiscal and economic incentives to encourage actors to work within a legal framework	
		Build institutional capacity for forest law enforcement within the forest administration, and promote interagency linkages and collaboration with the private sector and civil society	
		Adopt strategies for the control of illegal activities, focusing on preventive actions	
1.4	**Recognize that it is essential to have appropriate and capable institutions with effective linkages between them**	Establish or strengthen existing institutions with adequate personnel and other resources at all levels to promote SFM in a transparent manner	Government, forest managers, private sector, civil society, research and education institutions
		Enhance and develop clear rules for an effective administrative structure for SFM	
		Strengthen forest education at the technical and tertiary levels and forestry research, knowledge and skills to support SFM	
		Seek innovative funding mechanisms to finance SFM, including performance-based funding	
1.5	**Transfer authority or responsibility from the central government to subnational governments and empower the private sector, communities and civil-society institutions and women to collaborate efficiently in SFM**	Provide political support in planning, financial resources, capacity building and follow-up to provide, where appropriate, enabling conditions for decentralized forest management	Government, forest managers, private sector, civil society, research and education institutions
		Facilitate the delegation of administrative power from national government to local public institutions and civil-society groups	
		Strengthen the capacities of local constituencies in organizational and managerial skills to develop and implement local forest management and silvicultural practices	Government, civil society, research and education institutions
		When decentralizing forest management, take into account livelihoods and address inequities such as those related to women and gender	Government, forest managers, private sector, civil society, research and education institutions

Principle 1: Forest governance and security of tenure (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder groups**
1.6	**Identify and analyze the impacts that the policies and laws of other sectors may have on SFM**	Identify and analyze the impacts that the policies and laws of other sectors may have on SFM	Government, forest managers, private sector, civil society, research and education, consumer-country governments
		Assess extrasectoral drivers of deforestation and forest degradation at the national and landscape scales	
1.7	**Foster accountability/ transparency and establish mechanisms for stakeholder participation and involvement in SFM**	Adopt regulations that define the mechanisms for public participation in the management of natural forests and that require forest institutions to be accountable to people's needs and aspirations, based on national capabilities and circumstances	Government, forest managers, private sector, civil society, research and education institutions
		Develop pathways for transparent information and communication that are locally accepted and adaptable to stakeholders	
1.8	**Identify and integrate relevant emerging issues related to SFM, capture synergies and address possible tradeoffs with existing objectives of forest management**	Identify, monitor and assess new and emerging issues in SFM, ensuring coordination at all levels	Government, forest managers, private sector, civil society, research and education institutions, consumer-country governments
		Embed new and emerging issues into overall forest management planning and implementation strategies, with due consideration of particular societal needs	
1.9	**Recognize the implications for SFM of legally and non-legally binding intergovernmental agreements at the regional and global levels**	Consider adjusting, as appropriate, the national legal and regulatory frameworks for SFM to incorporate the provisions of international commitments	Government, civil society, research and education institutions, consumer-country governments
		Improve existing information systems to provide data on forests and forestry to meet international reporting requirements, including those of the International Tropical Timber Agreement, the United Nations Forum on Forests, the UNFCCC and the CBD	
1.10	**Put in place effective formal systems for ensuring the security of forest tenure**	Reform laws to provide security of forest tenure as a necessary condition for SFM and to recognize customary and traditional rights	Government, forest managers, private sector, civil society, research and education institutions
		When conducting tenure reform, verify current land ownership and update cadastral and data management systems so as to keep track of who owns and manages forests	
		Harmonize and streamline conflicting issues, where appropriate by incorporating customary laws into formal land allocation laws	
		In ensuring tenure security, address gender equity, including women's tenure security	

Principle 1: Forest governance and security of tenure (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder groups**
1.11	**Recognize the importance to SFM of clear rights to forest access and use**	Define and document the rights to access and use forests and the appropriate duration for use of forest goods and environmental services such as timber, NTFPs, water rights and rights to carbon	Government, forest managers, civil society, research and education institutions
		Define, recognize and incorporate traditional tenure systems and user rights for forest goods and environmental services in the regulatory framework	
		Formulate administrative procedures for tenure access and forest use that are simple, easy to understand and affordable for local stakeholders	
		Strengthen knowledge about forest tenure with accurate, detailed and publicly available information on the ownership and control of forest resources	
		Consider setting specific goals to address gender equity in relation to rights of forest access and use	
1.12	**Ensure that traditional use rights are clear and respected**	Put in place measures to ensure that the recognized tenure, access and use rights of indigenous peoples and local communities to state-owned forests are respected	Government, forest managers, civil society, private sector, research and education institutions
		Provide supportive measures to ensure that smallholders and indigenous peoples and local communities know their rights and responsibilities and have the capacity to obtain the benefits provided by access to and use of forest resources	
		Formulate guidelines to simplify the requirements for forest management plans and adapt them to the capacity and scale of management objectives of local forest owners and managers	
1.13	**Make sure that concession/logging rights are clear and transparent**	Consider extending the tenure of concession/ logging rights to a duration of at least two timber harvesting cycles	Government, forest managers
		Develop and implement conflict management systems to prevent or manage conflicts over the use of forest resources	Government, forest managers, civil society, research and education institutions

Principle 2: Land-use planning, the permanent forest estate and forest management planning

Land allocation to different uses and spatial planning within and outside forests must ensure that the economic, social and environmental values of forests are maintained or enhanced at a landscape scale. This requires the adoption of a forest management planning framework at the national and/or landscape scales.

Rationale

SFM requires good planning that begins strategically with an integrated land-use plan. This plan serves as the backdrop for the allocation and wise use of resources in a particular area of forest and the conservation of the area's ecological integrity.[21] Comprehensive land-use planning and land management are important for creating functional landscapes in which agriculture, sustainably managed forests, conservation areas and other land uses are integrated. To achieve this, cross-sectoral landscape-scale planning and development approaches are needed that simultaneously focus on the various economic activities and social and environmental values that apply over broad areas. To conserve biodiversity and maintain forest environmental services, as well as to ensure the permanence of carbon stocks, efforts are needed to conserve the full spectrum of forest types by applying sustainable management practices and maintaining protected areas. Efforts must be made to reduce forest fragmentation and maintain habitat connectivity through, for example, the provision of biological corridors, which facilitate species' migration and the long-term viability of populations.

Land-use planning. Planning is needed at the landscape scale—that is, over areas large enough to be resilient in the face of environmental change and to maintain ecological integrity. Landscape-scale management is essential for the sustainable management of natural resources, and it requires coordinated inter-institutional action and the effective participation and involvement of diverse stakeholders. A failure to use a landscape approach for natural resource management, and a lack of land-use planning, have contributed to processes of landscape degradation, unplanned deforestation and habitat fragmentation. National REDD+ strategies attempt to address such failures at the national and landscape scales. Effective REDD+ strategies are likely to involve the establishment and maintenance of a PFE to help ensure the permanence of carbon stocks and periodic forest resource assessments at the national and subnational levels.

Permanent forest estate. A key feature of SFM is a commitment by government, endorsed by all stakeholders, to define and protect a PFE based on secure, long-term land tenure for communities, concession-holders and other forest users. Forests designated for productive and other specific purposes nevertheless require a balanced management approach that combines economic, social and environmental aspects. The establishment and maintenance of a PFE must have political commitment at the highest levels. In most countries, such a commitment means protecting public forest lands from conversion to non-forest uses.

Adaptive management. A key aspect of planning is the concept and application of adaptive management, or "learning by doing". Adaptive management involves the use of research results to support best practices, planning and monitoring and then adapting practices to improve outcomes. Management should be responsive and adaptable to changing knowledge and needs. Land-use planning at both the micro and macro scales should use participatory approaches involving all relevant sectors to prevent unplanned and uncoordinated changes in land use. Thus, an overall

21 "Integrated land-use planning seeks to balance the economic, social and cultural opportunities in a specific area of forest with the need to maintain and enhance the health of the area's forest. It is a process whereby all interested parties, large and small, come together to make decisions about how the land and its resources should be used and managed, and to coordinate their activities in a sustainable fashion."—Canadian Council of Forest Ministers (2011).

principle of forest management planning for all kinds of FMUs (from small community forest lots to large concessions) is the application of adaptive management to improve the effectiveness of management interventions in a flexible and responsive way to deal with uncertainty and change. Even the most carefully planned arrangements are likely to require modification as new information becomes available, and good management requires the early recognition of the need for such modification.

Research and education.[22] Effective forest management planning and monitoring requires multiple forms of knowledge. Thus, it is important to consider and link scientific and traditional knowledge in the implementation of SFM. Existing local knowledge, experiences and capacities can enrich and improve forest management and broaden the benefits obtained. The complexity of tropical forest ecosystems and the ever-increasing demands and expectations on SFM pose serious challenges for forest managers in obtaining sound information on which to base decision-making. Research and education (both formal education and on-the-job training) play key roles in informing managers on how to improve planning and actions in the forest to maintain a flow of goods and environmental services.

Continuous forest assessment. To fully understand the role of natural forests at the landscape scale and to designate the PFE, there is a need to continuously monitor the forest resource at the national, subnational and FMU scales. Such monitoring includes the periodic measurement of forest parameters in permanently defined forest areas known as permanent sample plots. Conditions that should be assessed over time include changes in the characteristics of forest stands; variations in species' composition and productivity across sites and under differing silvicultural treatments; the relationships between tree variables, stand variables and increments used for yield forecasting and carbon assessments; and long-term changes at a given site. Data obtained from permanent sample plots should be complemented by other datasets, such as those obtained through remote sensing and social and economic surveys, to provide as complete a picture as possible of the forest resource at the national, subnational and FMU scales and how it changes over time.

Based on initial plans for zoning the PFE at the landscape scale, consult with local people—suggested action in Guideline 2.2. Photo: DGFRN, Benin

22 The sustainable management of tropical forests requires long-term research and development. The annex sets out some specific research needs.

Communication, transparency and public awareness. The active, informed participation of communities and stakeholders affected by forest management decisions is critical to the credibility and sustainability of forest management. Awareness-raising and communication activities are needed to inform and educate the public, thereby allowing stakeholders to participate effectively in SFM decision-making. Successful awareness-raising activities will conform to principles of professional communication, such as honesty, reliability, openness, transparency, fairness and continuity, and forest agencies must also have the capacity to listen to the public and to take its concerns seriously.

Principle 2: Land-use planning, permanent forest estate and forest management planning			
Guidelines		**Suggested actions**	**Indicative stakeholder groups**
2.1	**Implement national and subnational land-use planning**	In collaboration with all relevant stakeholders, formulate land-use policies aimed at the conservation and sustainable use of natural resources	Government, private sector, civil society, research and education institutions
		Enhance the national forest policy as an integral part of the national land-use policy, taking into account the multiple-use nature of forests	
2.2	**Establish a PFE by laws that define its demarcation, use and management strategies**	Allocate sufficient and suitable land, whether public or private, to be kept under permanent forest cover as the PFE	Government, private sector, civil society, research and education institutions
		Encourage the use of remote sensing, geographic information systems (GIS) and other up-to-date techniques for forest mapping and zoning to support decision-making	
		Based on initial plans for zoning the PFE at the landscape scale, consult with local people, taking into account their present and future needs for agricultural land and their customary uses of the forest	
		Determine areas of the PFE to be maintained and managed primarily for the protection of soil and water and for other purposes	
		Consider allocating, to the PFE, land for which the use is uncertain until such time as the need for other uses arises	Government
2.3	**Carry out periodic national or subnational forest resource assessments to provide reliable data at the landscape scale**	Collate all relevant and reliable databases and update maps related to forest resources at the landscape scale	Government, forest managers, civil society, research and education institutions
		Provide mechanisms for assessing and monitoring the PFE based on permanent sample plots and other data-collection methods at the national or subnational scale and periodically monitor and report on the status of forest resources	
		Where applicable, integrate carbon accounting into national forest resource assessments (e.g. through coordination with national REDD+ readiness preparation proposal processes)	

Principle 2: Land-use planning, permanent forest estate and forest management planning (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder groups**
2.4	**Prepare and implement a national forest management planning framework**	Develop a strategic national or subnational forest planning document (e.g. as part of a national forest program) for SFM	Government, civil society, forest managers, private sector, research and education institutions
		Carry out forest management planning and map geographical areas covered by forests and other land uses within the PFE	
		Establish FMUs of appropriate size based on ecological, socioeconomic, forestry and/or land administrative considerations, taking into account the PFE	
		Clarify ownership and other tenure rights (e.g. customary or traditional) in the PFE and clearly demarcate the PFE and FMUs	Government, forest managers, civil society, private sector
		Incorporate climate-change adaptation and mitigation measures into national forest management planning frameworks	Government, forest managers, civil society, research and education institutions
2.5	**Support research and education in natural tropical forest management**	Integrate applied research into forest management plans	Forest managers, private sector, research and education institutions
		Support education—both formal and on-the-job—in natural tropical forest management, with due consideration of gender issues	Government, civil society, private sector, research and education institutions
2.6	**Monitor progress in SFM, including through clear and open communication with the public**	Build trust and understanding among stakeholders through communication, education and public awareness and prepare periodic updates on forest management planning and the status of the PFE	Government, forest managers, private sector, civil society, research and education institutions
		Use the ITTO C&I for SFM to assess and report on progress towards SFM	
		Engage end-users in the design and implementation of the forest monitoring system to increase their confidence in it	Government, civil society, forest managers, private sector, research and education institutions

Principle 3: Ecological resilience, forest health and climate-change adaptation

Ecological resilience is a key tenet of SFM in natural tropical forests, and it must be maintained or enhanced to reduce the risks posed to sustainability by destructive agents, climate change and other stresses and disturbances.

Rationale

The ecological resilience of a forest—its capacity to recover following disturbance—is determined by a wide range of factors. Management interventions in natural tropical forests can either decrease or increase ecological resilience. Thus, due consideration should be given in forest management planning and implementation to strategies and specific measures for maintaining or increasing ecological resilience.

Managing intact natural tropical forests. Ecological resilience can be enhanced by the creation of a network of protected areas containing representative samples of all forest types linked as far as possible by biological corridors or "stepping stones". Well-managed natural production forests can fulfil many of the objectives of protected areas and effectively perform the role of biological corridors and stepping stones. Management measures in production forests can make important contributions to forest quality and biodiversity conservation and thus address ecological resilience. An understanding of forest succession and the gap dynamics of natural forests is essential if interventions to maintain or increase ecological resilience are to be effective. Of particular importance are the habitat requirements of species that are important for production and conservation. Efforts to implement SFM should consider ecological aspects such as pollination, seed dispersal, tree-species behaviour (e.g. with respect to light requirements) and symbiotic relationships.

Restoring degraded forest ecosystems. The aim of forest restoration is to restore the dynamic forest processes, species composition, structure, biodiversity and productivity associated with the forest type occurring naturally at a given site. Forest restoration can restore the productivity, ecosystem functions and carbon stocks of degraded tropical forests. Forest restoration is likely to be an important component of many REDD+ strategies.

A wide range of activities can cause forest degradation, such as high-impact logging (both commercial and subsistence), the extraction of NTFPs, hunting, and the patchy clearance and regrowth associated with shifting agriculture. In such areas, degradation very rarely leads to deforestation; nevertheless, if exploitation exceeds the capacity of the forest to recover it will lead to the loss of carbon stocks and ecological resilience. To deal effectively with forest degradation, it is important to see it not as the beginning of a deforestation process but as a form of poor forest management, which can be improved.

Addressing the effects of climate change on natural tropical forests. Climate change can have a range of biophysical impacts on forests, for example by increasing attacks by herbivores and the incidence and severity of fire, floods and drought; it may also have impacts on plant physiology and metabolism. Over time, climate-related change could have significant impacts on the availability and quality of tropical forest goods and environmental services and on the people who depend on natural tropical forests for their livelihoods. An assessment of the impacts of climate change and climate variability on the physical characteristics of a forest and its productivity, ecological dynamics and ecosystem functions will help forest managers in responding to changing conditions. Forest managers should be aware of such impacts and take early measures to reduce the vulnerability of forests, increase ecological resilience and facilitate the adaptation of forests to changing conditions. The management of forests for the delivery of environmental services, such as the protection of soil and water, could become more important under climate change.

Integrate measures to increase resilience and conserve biodiversity into harvesting and silvicultural operations in natural production forests—suggested action in Guideline 3.3. Photo: L. Rivera-Martin

The implementation of adaptation measures may be costly, however. Forest managers should assess the costs of adaptation compared with the potential financial losses caused by climate change. Demonstrating the benefits of adaptation actions will help leverage financial support for adaptation. Forest managers should modify forest management plans and practices to include adaptation measures, taking into account the biophysical, economic and social impacts of climate change, the costs and benefits of action, and the long-term costs of inaction.

Management of pests and diseases. There has been a significant increase in outbreaks of pests and diseases in forests and woodlands in recent years. Climate change is likely to exacerbate these threats. It is vital that all those involved in forest management take a proactive role in monitoring damage, keeping abreast of emerging threats and deciding when intervention is necessary. The management of pests and diseases should be an integral part of FMU management plans. In some cases, specific management practices may be required to promote natural regeneration and minimize ecological impacts. The introduction in forestry operations of potentially invasive plants, animals, fungi and other microorganisms should be avoided, and prompt action should be taken to eliminate such invasive species where they establish.[23]

Restore, rehabilitate and manage degraded forests, taking guidance from the *ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests*—suggested action in Guideline 3.4. Photo: DGFRN, Benin

23 The issue of pest and disease management is addressed in more detail in the guidelines associated with Principle 5.

Principle 3: Ecological resilience, ecosystem health and climate-change adaptation			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
3.1	**Identify causes and put in place preventative and remedial actions to reduce the vulnerability of forests to biotic and abiotic stresses**	Develop policies and remedial actions, including capacity building, technologies and resources to reduce the vulnerability of forests to biotic and abiotic stresses	Government, forest managers, civil society, research and education institutions
		Strengthen the capacity of forest managers to address new and emerging issues affecting ecological resilience	
		Provide technical support to private and community forest owners to ensure that their activities increase the ecological resilience of forests	
3.2	**Conserve and use biodiversity in ways that maintain ecological resilience and enable adaptation to change**	Identify forests with high conservation value, provide them with legal status, and manage them to maintain and increase their ecological resilience	Government, civil society, research and education institutions
		Improve and apply ecological knowledge to ensure that forest processes such as pollination, seed dispersal and nutrient cycling are maintained	
		Identify and manage species of flora and fauna that are strongly interactive, play key ecological roles or have important influences on the ecological resilience of the forest	Government, forest managers, civil society, research and education institutions
3.3	**Manage forests in ways that maintain their regenerative capacities and ecological resilience**	Manage natural forest landscapes as integrated mosaics that include protected areas, biological corridors and forest production areas	Government, civil society, forest managers, research and education institutions
		Integrate measures to increase resilience and conserve biodiversity into harvesting and silvicultural operations in natural production forests	
3.4	**Restore degraded forest ecosystems to improve habitats for native species, forest structure, biodiversity, productivity and ecosystem functioning**	Identify forms of forest use that are degrading the forest and adapt management practices to reduce such degradation	Government, civil society, forest managers, research and education institutions
		Restore, rehabilitate and manage degraded forests, taking guidance from the *ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests*	

Principle 3: Ecological resilience, ecosystem health and climate-change adaptation (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
3.5	**Assess the impacts of climate change and climate variability on natural tropical forests and evaluate the risks**	Obtain information on recent trends and projected changes in climatic variables and conduct impact assessments for FMUs	Government, civil society, forest managers, research and education institutions
		Assess, at the landscape scale, the impacts of climate change and climate variability on the physical characteristics of the forest and its productivity, ecological dynamics and ecosystem functions	
		Monitor trends in the frequency and severity of climate-change-related impacts on natural tropical forests	
		Monitor the impacts of climate change on forest ecosystem processes such as the hydrological, nutrient and carbon cycles	
3.6	**Assess the economic and social effects of climate change as they relate to tropical forests**	Identify emerging and likely future socioeconomic impacts of climate change on forests	Government, civil society, research and education institutions
		Monitor changes in markets for forest products due to changes in demand for forest-based energy and product substitution	
		Promote and support analyses of the costs and benefits of climate-change adaptation measures in different forest types for various management options	
3.7	**Manage natural tropical forests for adaptation to climate change**	Identify the short-term and long-term risks, costs and benefits of climate-change adaptation measures	Government, forest managers, research and education institutions
		Modify forest management plans and practices to include relevant adaptation measures	
3.8	**As appropriate, include carbon storage as a management option in natural tropical forests and monitor forest carbon and safeguards**	As appropriate, consult with interested parties on the inclusion of REDD+ in the management of FMUs and clarify the rights to carbon in FMUs	Government, forest managers, civil society, private sector, research and education institutions
		As appropriate, integrate carbon management into forest management plans	
		As appropriate, monitor and assess carbon stocks in FMUs on a regular basis as per national procedures or those of voluntary carbon markets	
		As appropriate, update forest inventory procedures to meet REDD+ requirements related to forest carbon measurement, reporting and verification	
		As appropriate, develop reporting systems to meet national requirements for reporting on REDD+, including the actions taken, forest carbon monitoring, and social and environmental safeguards	

Principle 4: Multipurpose forest management

The role of natural tropical forests as providers of multiple goods and services should be safeguarded by the application of sound planning and management practices that maintain ecosystem functions and the potential of forests to yield the full range of benefits to society.

Rationale

Natural tropical forests can be managed for multiple complementary objectives, including the: production of goods (e.g. timber, fibre, fuelwood, non-wood products and carbon); protection of soil and water; improvement of air quality; provision of other environmental services; conservation of biodiversity; provision of sociocultural services; support of livelihoods; and alleviation of poverty. Multipurpose forest management is a balanced alternative to timber-dominated strategies for natural tropical forest use. It can be found in the existing livelihood strategies of forest-dependent peoples and the operations of some forest companies, and in some cases it is supported by forest laws. Although, in practice, multipurpose management is not a dominant strategy in the forest sector, incipient efforts are emerging, ranging from the small scale, such as community forestry regimes, to the large scale, such as national programs to develop REDD+ strategies. Under the right conditions, multipurpose forest management can diversify forest use, broaden forest productivity and provide incentives for maintaining forests. In addition, multipurpose management could provide a means for reducing social conflict over forest resources.

As appropriate, accommodate the existing NTFP harvesting and trade patterns of local communities in the method and scale of timber harvesting—suggested action in Guideline 4.4. Photo: P. Chai

Multipurpose forest management combines three protection-oriented purposes with the productive functions of forests (i.e. the sustainable provision of goods such as timber, fibre and NTFPs). The three protection-oriented purposes are:

1) the conservation of soil and water and the permanence of carbon pools in forests, which have a bearing on maintaining the productivity, health and condition of the forests themselves;

2) the maintenance (at the landscape scale) of downstream benefits, such as water quality and flow and reducing flooding and sedimentation; and

3) the conservation of biodiversity, which is particularly high in natural tropical forests and which is essential as a buffer against changing environmental conditions and as a pool of variation to be used in tree improvement and breeding.

The multipurpose approach applies to the management of primary as well as secondary and degraded tropical forests. In particular, the multipurpose nature of many species growing in tropical secondary forests (for example, a single species might provide edible fruits, fuelwood, timber for local construction and handcrafts, and medicinal products) is an important feature to take into account in managing such forests. Secondary tropical forests are also of great interest in carbon management because of their high rate of carbon sequestration. Conflicts over use can be minimized by clearly defining the main objective of management and legally designating forests for uses that generate the most appropriate economic and social benefits at a given site. Timber might still be the most economically important use in many natural tropical forests; on the other hand, some species are of such major economic and social importance for their non-timber products that they should be protected. For example, *Bertholletia excelsia*, a tree found in the western Amazon, is more valuable to extractive communities for its nut (the Brazil nut) than for its timber. In many cases, the extent of conflict between concurrent uses may be culturally and geographically specific, which complicates the implementation of multipurpose forest management at wider spatial scales.

Minimize mechanical disturbances to forest soils by using reduced-impact harvesting methods—suggested action in Guideline 4.2. Photo: J. Blaser

Biodiversity conservation at the FMU level. Conserving biodiversity will help ensure the healthy functioning of forests. Over time, biodiverse forests are likely to produce more valuable products and be more resilient to environmental change, including climate change. The *ITTO/IUCN Guidelines for The Conservation and Sustainable Use of Biodiversity in Tropical Timber Production Forests* are designed to assist policymakers and forest managers by bringing together the specific actions needed to improve biodiversity conservation in tropical production forests. Monitoring should be in place to ensure that forest management does not have negative impacts on biodiversity. Low-cost monitoring programs for biodiversity in tropical production forests that serve the needs of forest managers should be developed and conducted in ways that facilitate learning and adaptive management and which make information on achievements and failures widely available.

Managing forest carbon in natural tropical forests. Managing forests for REDD+ can contribute to global climate-change mitigation and potentially yield economic benefits. This requires that a country has the appropriate institutional and incentive structures for REDD+ and that rules and regulations for REDD+ governance and management have been operationalized. Many ITTO member countries are developing national REDD+ strategies (generally through readiness preparation proposals) following international procedures, including, among other things, stakeholder consultations, forest carbon assessments and the determination of safeguard requirements for avoiding negative social and environmental impacts. The implementation of an effective forest carbon measurement, reporting and verification system is essential because the REDD+ incentive structure is based on the amount of carbon sequestered and the volume of greenhouse-gas emissions reduced. Defining the potential of, and constraints to, managing forest carbon stocks in natural tropical forests is a major new challenge for multipurpose forest management at the national and FMU scales and needs careful attention in planning and implementation.

As appropriate, involve indigenous peoples and local communities in the establishment and implementation of biodiversity monitoring systems—suggested action in Guideline 4.5. Photo: P. Chai

Principle 4: Multipurpose forest management			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
4.1	**Enable multipurpose forest management to manage forest products and environmental services**	Develop a comprehensive knowledge of forest resources with the aim of boosting the value of forest goods and services and uphold usufruct rights	Government, forest managers, civil society, private sector, research and education institutions
		Complement national, subnational and FMU-level forest resource assessments and inventories with qualitative assessments of timber, NTFPs and environmental and cultural services, using the ITTO C&I for SFM as a basis	
		As appropriate, integrate assessment methods recommended at the international or national level for forest carbon assessments into national forest inventories	Government, forest managers, research and education institutions
4.2	**Ensure effective soil and water management to maintain the productivity and health of forests and their hydrological regulation functions**	Implement measures to conserve soil and water values in FMUs and at wider catchment scales, including by identifying and zoning critical water catchments, soil erosion areas and other special lands	Government, civil society, research and education institutions
		Ensure that adequate procedures are in place in FMUs to protect soil productivity and water-retention capacity	Government, forest managers, research and education institutions
		At the FMU scale, identify areas that are prone to accelerated erosion, such as soils into which water infiltrates with difficulty; areas that contribute to surface flows into streams; and the margins of stream beds	Government, forest managers, research and education institutions
		Minimize mechanical disturbances to forest soils by using reduced-impact harvesting methods	
4.3	**Emphasize biodiversity in all aspects of the management of natural tropical production forests**	Focus conservation efforts on species and habitats with high conservation value. Pay particular attention to the management of species or habitats that are rare, threatened or endangered	Government, forest managers, civil society, private sector, research and education institutions
		Set aside a suitable portion of FMUs for biodiversity conservation	
		In preparing harvesting plans, take into consideration the local occurrence of species or habitats of special conservation concern	

Principle 4: Multipurpose forest management (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
4.3		Improve silvicultural operations to conserve biodiversity, including by retaining hollow trees when harvesting, avoiding the use of arboricides, and other means	
		Implement measures to retain viable populations of seed trees, maintain the genetic diversity of commercial species, and ensure that the silvicultural requirements of target tree species are known and applied	
		Encourage collaboration between conservation NGOs, research and education institutions and timber companies in adapting management practices to suit local conditions and in providing workers with suitable training	
		Take measures to control the harvesting and transport of bush meat and NTFPs	
4.4	**Provide guidance and take measures to avoid unsustainable levels of NTFP extraction and hunting**	As appropriate, accommodate the existing NTFP harvesting and trade patterns of local communities in the method and scale of timber harvesting	Government, forest managers, civil society, private sector
		In forest management plans, consider the potential for human–wildlife conflicts due to logging activities, and take appropriate measures to prevent them	
		Take measures that benefit wildlife species, such as retaining dead standing trees and large fruiting trees, maintaining wide riparian strips to provide wildlife with access to water, and providing migration pathways for large animals	Government, forest managers, private sector, civil society
		When planning the road network, take measures to minimize direct negative impacts on wildlife	Forest managers, private sector, research and education institutions
		Ensure that forest management plans have provisions for biodiversity monitoring and that managers understand and are responsive to the outcomes of such monitoring	Forest managers, private sector, civil society
4.5	**Monitor biodiversity in FMUs to minimize negative impacts**	Consider simple and widely recognized and applicable measures for reducing the impacts of human activities on biodiversity in FMUs	Government, forest managers, research and education institutions
		As appropriate, involve indigenous peoples and local communities in the establishment and implementation of biodiversity monitoring systems	Government, forest managers, private sector, research and education institutions
		Foster partnerships between forest operators, universities and other research and conservation institutions for long-term biodiversity monitoring	Forest managers, civil society, private sector, research and education institutions

Principle 5: Silvicultural management

In timber production forests, each FMU should have an approved management plan, with clearly stated management objectives and measures—including silvicultural measures—for achieving them. Silvicultural measures should be revised periodically in the light of accumulated experience, new information and changing circumstances.

Rationale

This principle focuses on the planning of silvicultural management in larger FMUs for which the main management objective is sustainable timber production. Silvicultural management should be undertaken with due regard for the biophysical setting, the legal and institutional framework, and the economic, social and environmental components of SFM.

Multifunctional zoning and multiresource inventory. Multifunctional zoning (or, more simply, "forest zoning") is a process for identifying areas in a forest where timber and NTFPs may be harvested sustainably and areas for which other objectives (e.g. water catchment protection, cultural heritage, carbon storage or biodiversity conservation) may be prioritized. Once the various priority forest functions have been identified, they can be grouped and mapped according to their compatibility with timber production: that is, whether they preclude logging or are compatible with low-impact logging. Multiresource inventories are data-collection efforts designed to meet information requirements for two or more forest functions.

Annual allowable cut. A prerequisite for SFM is that the removal of forest products does not exceed the capacity of the forest (at specified scales, such as national, subnational and FMU) to provide an ongoing supply of such products at the same rate of removal over time. In commercial forests where the major product is timber, this means calculating a sustainable timber yield, which in turn determines the annual allowable cut (AAC). The AAC is the volume of timber that may be cut in a given area per year, and the aim is to set the AAC at a level that can be maintained over time without

Guideline 5.4: Plan harvests to enable good technical control, minimize costs and reduce environmental impacts. Photo: H.O. Ma, ITTO

Conduct a multiresource forest inventory and collect data on timber, NTFPs, natural regeneration, fauna, flora, soil, hydrology, human activities, etc.—suggested action in Guideline 5.1. Photo: CPAC

losses in forest productivity or other values. Its calculation depends on the standing stock, the rate at which timber species regrow, and the area over which it is calculated. As a practical measure of the sustainable yield, the AAC can be used to monitor forest production and to set limits on forest use. In areas where NTFPs are harvested, similar inventory data and calculations are needed to ensure that harvesting levels remain within the capacity of the forest for replacement. The calculation of a sustainable yield is problematic for many NTFPs, however, because of a lack of information on regeneration and growth rates.

Yield regulation. Yield regulation (or yield allocation) is the practice of calculating and controlling the quantity of forest products removed from the forest each year to ensure that the rate of removal does not exceed the rate of replacement. Information on forest growth is used to construct yield tables and growth models, which can be used in calculating the sustainable yield and the AAC.

Forest management plans. At the FMU level, there are three types of management plan: the strategic or long-term management plan, covering 20–40 (or more) years and reviewable every 5–10 years; the tactical management plan, which is a medium-term expression of the strategic management plan (e.g. covering successive 5–10-year periods); and the annual operational plan through which the tactical management plan is programmed, which is implemented and monitored annually.

Silvicultural systems. A silvicultural system is the process by which forest trees are tended, removed and replaced by new trees. Silviculture comprises all operations used in manipulating forest stands, including harvesting operations. The choice of silvicultural system is determined by the ecological characteristics of the forest for which SFM is being planned (e.g. forest type, site conditions, species composition and the regeneration status of desirable species) and by the management objectives for the forest.

In forests managed for timber production, silvicultural interventions are generally necessary to address the relative depletion of commercial tree species caused by harvesting, to increase growth rates, and to ensure that the forest will continue to produce commercially valuable timber over time.

Incorporate waste/pollution and chemical management in the forest management plan—suggested action in Guideline 5.13. Photo: T.J. Bruder

To guide silvicultural decisions, a simple assessment method called diagnostic sampling can be used to estimate the potential productivity of a forest stand and to determine the need for specific treatments. These treatments, and the overall silvicultural method to be employed, should be specified in the forest management plan.

Model code of forest harvesting practice. The efficiency and sustainability of forest management depend to a large extent on the quality of harvesting operations. If poorly executed, such operations can have far-reaching negative impacts on the environment, for example leading to erosion and the loss of biodiversity, water quality and stored carbon; poorly executed harvesting operations may also jeopardize the viability of the silvicultural system and increase health risks for field personnel. FAO (1996) provided recommendations for developing strategic and tactical harvesting plans, as well as guiding principles and recommended practices for implementing harvesting operations, including on such aspects as forest road engineering, tree-cutting, log extraction, landing operations, transport, harvesting assessment, and the forest harvesting workforce.

Reduced-impact harvesting. The Tropical Forest Foundation (2007) defined reduced-impact harvesting (also called reduced-impact logging) as timber harvest technologies and practices with the following main objectives of:

- minimizing impacts on the environment (including wildlife) and related social aspects;
- minimizing damage to potential future crop trees (including regeneration);
- providing safe working conditions; and
- improving timber use and the recovery of the forest.

Reduced-impact harvesting comprises the entire spectrum of harvesting operations, such as pre-harvest inventory; the selection of merchantable trees; the design and construction of infrastructure (such as roading); felling; the extraction and hauling of logs; and post-harvest operations such as the deactivation of harvested areas and harvesting assessments.[24]

Monitoring the implementation of activities set out in an approved forest management plan is fundamental to SFM and forms the basis for transparent accountability in operational activities. Monitoring in the FMU should be addressed at two levels: operational and strategic. Operational monitoring provides information on whether appropriate procedures are being followed and management objectives are being met. Strategic monitoring provides data on the long-term effects of forest operations so that potential problems can be identified and resolved.

24 See details in FAO (1996) and Applegate et al. (2004).

Identify and describe environmental service(s) that could be the focus of FMU management objectives, based on forest zoning, resource assessments and consultations with local people and other stakeholders—suggested action in Guideline 5.7. Photo: R. Carrillo, ITTO

Post-harvest actions such as the deactivation of harvested areas, erosion mitigation, and the rehabilitation of high-impact areas should be undertaken as required. Measures to rehabilitate harvested areas can help reduce erosion and sedimentation, maintain or increase species diversity for conservation purposes, and restrict unauthorized access to areas. The quality of harvesting operations should be assessed and the need for corrective actions or measures determined. A harvesting assessment provides information on the quality of operations, including the volume cut and the condition of the forest after harvesting.

Protection measures at the FMU level. Fire is a serious threat to forest productivity and environmental quality. Fire risk is likely to increase in areas subject to harvesting, and stringent safety measures are required. A plan for fire prevention and control should be formulated and implemented in the FMU and adjacent lands.

In production forest areas, particularly concessions, the management of waste and chemicals is crucial. All organic and inorganic residues (e.g. fuel, oil and human wastes) produced in forest management activities should be properly handled, stored and disposed of, with adherence to local laws and according to practices and procedures that avoid or minimize the risk to human health and the environment.

Encourage the involvement and participation of local communities in the planning and implementation of fire management—suggested action in Guideline 5.11. Photos: P. Masupa Kambale, ITTO

Principle 5: Silvicultural management			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
5.1	**Conduct preliminary studies and develop a multiresource inventory**	Conduct preliminary studies (socioeconomic, environmental, biodiversity) for the development of the management plan and establish a GIS database for creating forest zoning maps	Government, forest managers, private sector
		Conduct a multiresource forest inventory and collect data on timber, NTFPs, natural regeneration, fauna, flora, soil, hydrology, human activities, etc.	
		Integrate the multiresource inventory and forest zoning by forest function, taking into account customary rights where applicable	
		Create wildlife GIS overlays based on agreed priorities for wildlife conservation and designate wildlife conservation areas as appropriate	
		Analyze management scenarios in accordance with national laws, policies and strategies based on inventory data	
		Develop a clear understanding of the forest values to be maintained and the goals to be achieved, and establish clear medium-term and long-term management objectives, taking into account the tradeoffs needed	
5.2	**Define management objectives for individual resources (e.g. timber, NTFPs, and carbon and other environmental services)**	Define the management objectives for individual resources and the means of achieving them. Adjust these objectives as new information becomes available through the planning process	Government, forest managers, private sector
5.3	**Use a reliable method for regulating and controlling yields of timber and NTFPs**	Carry out sustainable yield analyses for each species, taking into account spatial variations as well as potential tradeoffs and buffer zones, and, where appropriate, specify minimum cutting diameter limits	Forest managers, private sector
		Determine the AAC for each species or species group based on minimum cutting diameter, growth rates, etc.	Forest managers, private sector
		Divide the FMU into blocks or compartments and define annual cutting areas and volumes	Forest managers, private sector
		When a block or compartment has been harvested at the allowable level, close it off until the next felling cycle	Forest managers, private sector
		Maintain records of production levels of timber and NTFPs in each block or compartment	Forest managers, private sector

Principle 5: Silvicultural management (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
5.4	**Plan harvests to enable good technical control, minimize costs and reduce environmental impacts**	Conduct a pre-harvest inventory as a basis for reduced-impact harvesting and other planning processes	Government, forest managers, private sector
		Formulate and apply reduced-impact harvesting guidelines and establish standards for harvesting operations	
		Make and implement arrangements for the effective training of all personnel involved in harvesting operations	
		Locate and demarcate non-harvest areas that must be excluded from harvesting	
		Properly design and construct forest roads and lay out skid trails according to environmentally sound practices	
		Design and implement forest harvesting operations in ways that accommodate and enhance the multiresource character of the forest	
5.5	**Manage FMUs according to forest management plans and silvicultural systems**	Write, implement and keep up to date a forest management plan appropriate to the scale and intensity of operations. Maintain an adaptive approach to silvicultural planning	Government, forest managers, private sector
		Acquire an understanding of the ecology of the forest by using diagnostic sampling as a tool for determining stocking, tree species behaviours and regeneration targets	
		Consider the likely impact that the chosen silvicultural system or treatment regime might have on the sustainable production of NTFPs	
		Consider how the implementation of a silvicultural system might affect the growth rates of harvestable species; seed production; regeneration; and environmental services such as those related to water catchment protection, biodiversity conservation and carbon sequestration	
		Plan silvicultural interventions in combination with harvesting—harvesting should be the first silvicultural treatment	
		Plan silvicultural interventions 1–2 years after harvesting to “liberate” the advanced regeneration of current and potential commercial or useful tree species	
		Use local species with proven silvicultural value for enrichment planting	
5.6	**Incorporate wildlife and biodiversity concerns into forest management plans**	Integrate wildlife management into the FMU management plan	Government, forest managers, private sector, research and education institutions
		Conduct an initial survey of forest animal resources where there is a lack of information on those resources	
		Include wildlife in routine forest inventories to assist in limiting the negative impacts of logging activities on wildlife	

Principle 5: Silvicultural management (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
5.7	**Enhance the potential for generating income from the environmental services provided by FMUs**	Identify and describe environmental service(s) that could be the focus of FMU management objectives, based on forest zoning, resource assessments and consultations with local people and other stakeholders	Government, forest managers, private sector
		Assess the potential for marketing the environmental services of the FMU and, if appropriate, include the provision of such services in the forest management plan	
		Use tools prepared by the CBD, the UNFCCC (on REDD+) and national case studies to support the valuation of forest environmental services	
5.8	**Prepare detailed 10-year working plans and annual operational plans for harvesting and silvicultural management**	Prepare a working plan (or "tactical" management plan) for activities to be conducted in a 10-year period, providing greater detail on these activities than given in the strategic management plan. The working plan should specify, for example, silvicultural activities; the development of the road network and other infrastructure; log-extraction methods and equipment; fire control; hunting; monitoring measures; and data management and reporting	Government, forest managers, private sector
		Each year, prepare an annual operational plan that specifies and schedules all harvesting and silvicultural activities and the resources required	
		Conduct a pre-harvesting inventory in areas about to be harvested, and develop and implement documented procedures to ensure that harvesting operations are carried out to the highest possible standard	
		In the working plan, include guidance on post-harvest assessment and measures, such as inspection and evaluation procedures	
		In the annual operational plan, include the annually conducted silvicultural interventions and carry out silvicultural planning and treatment based on post-harvest assessment data	

Principle 5: Silvicultural management (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
5.9	**Monitor the implementation of management plans and apply adaptive management**	At the appropriate decision-making levels, internalize the results of monitoring and new scientific findings and take them into account to improve forest management	Government, forest managers, private sector, civil society
		Collect and maintain permanent records of forest operations	
		Put a mechanism in place for the periodic collection and use of the information needed (in terms of type, quantity and quality) in the forest management decision-making process	
		Recognize the knowledge and skills of experienced local people and make use of traditional forest-related knowledge and practices in forest management planning and implementation	
5.10	**Protect FMUs from illegal and unsustainable activities**	Ensure that the FMU is protected from illegal activities, especially those that are incompatible with SFM	Government, forest managers
		Demarcate FMU boundaries and identify areas where there is a high risk of encroachment	
		Develop collaborative approaches (e.g. alert systems) with local authorities, communities and other stakeholders for the detection of illegal activities, and facilitate access to the forest by law enforcement personnel	Government, forest managers, civil society
		Develop and enforce local rules on subsistence hunting and ensure that such rules are known and observed by forest workers	Government, forest managers
5.11	**Formulate and implement fire management plans for FMUs and adjacent lands**	Integrate fire management considerations into forest management planning	Government, forest managers, civil society, research and education institutions
		Where appropriate, prepare a fire management plan for the FMU, using the *ITTO Guidelines on Fire Management in Tropical Forests* as a guide, and integrate the fire management plan into forest management planning	Government, forest managers
		Encourage the involvement and participation of local communities in the planning and implementation of fire management	Government, forest managers, civil society
		Monitor the economic, social and environmental effects of fire and fire-control activities	Forest managers, civil society

Principle 5: Silvicultural management (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
5.12	**Integrate the management of pests and diseases into forest management plans**	Where appropriate, integrate the management of pests and diseases into the FMU forest management plan	Government, forest managers, civil society, research and education institutions
		Monitor the incidence of pests and diseases and put contingency measures in place to prevent or limit serious outbreaks	
		Ensure that forestry activities and the use of associated equipment do not aid the spread of pests and diseases or intensify their impacts	Government, forest managers
		Stay alert to the spread of invasive alien species, and take measures to eradicate those that have become established	Government, forest managers, research and education institutions
5.13	**Ensure that all waste and pollution derived from, and chemicals used in, forest management activities are stored and disposed of properly**	Incorporate waste/pollution and chemical management in the forest management plan	Government, forest managers, research and education institutions
		Formulate and enforce procedures and practices to minimize waste generation and chemical use and, where appropriate, recycle residues	Government, forest managers, research and education institutions
		Provide staff with adequate training on procedures and practices for waste minimization and chemical management	Government, forest managers, civil society
		Use appropriate means for storing dangerous inorganic wastes and chemicals	

Principle 6: Social values, community involvement and forest-worker safety and health

Forest management should recognize and aim to meet social needs. Forest management decisions should be participatory and inclusive, and the costs and benefits should be shared equitably among stakeholders. Communities should be empowered to participate in SFM through measures to achieve equity and build capacity among stakeholders. The provision of safe and adequate working conditions is also an essential element of SFM.

Rationale

A range of social aspects must be considered in SFM. Community forest management—embracing various degrees of community involvement, including arrangements such as participatory natural forest management, joint forest management, collaborative or co-management and community-based forest management—can contribute significantly to the livelihoods of rural people while also achieving other forest management goals. Community forest management can be an important generator of employment and income while also strengthening community rights to land and resource use and contributing to sustainable development. Local people usually comprise a wide diversity of actors, such as indigenous peoples, other traditional communities, settlers, migrants and other private smallholders.

Active and informed participation of communities and stakeholders. The active and informed participation of communities and other stakeholders in forest management decisions is critical for the credibility and sustainability of the management regime. Participatory approaches to SFM should link forest stakeholders, empower local communities, strive for gender equity and strengthen the adaptive capacities of communities and local governments. Public awareness-raising and communication activities may be required to enable stakeholders to participate effectively. The right

Identify the livelihood needs of people, including indigenous peoples and other vulnerable forest-dependent people, and incorporate them in national and subnational forest policies and programs related to SFM—suggested action in Guideline 6.1. Photo: T. Yanuariadi, ITTO

Provide all FMU personnel with training on first aid and in safety awareness to enable them to identify hazardous situations in their work environments—suggested action in Guideline 6.8. Photo: J. Malleux

of indigenous peoples and local communities to free, prior and informed consent offers a means for achieving greater equity and a natural pathway to a co-management approach involving local communities in large development projects.

Rights and responsibilities of local communities. It is important that the rights and responsibilities of those concerned about and making use of forests are considered in forest management. This requires taking into account rights to use and benefit from the forest attained by practice as well as through formal laws. The active participation of local stakeholders also makes available useful knowledge on local forest use and management strategies, contributes to efforts to regulate the use of forest resources, and offers a means for conflict resolution and empowerment.

Working conditions for forest workers. Forestry—and especially logging in tropical natural forests—is among the most dangerous of all occupations. Most accidents occur as a result of poor organization and supervision; inadequate equipment; poor planning; and a lack of skills and competency among workers, supervisors and managers.[25] Under SFM, policies should be developed to: eliminate risks; control risks at the source; minimize risks by focusing on the safety of work methods and procedures; provide personal protective gear; and ensure the maximum safety of machinery. Although the training of forest workers has improved greatly in some tropical countries, it is still rudimentary or non-existent in others. Often, training is limited to supervisors and high-level managers and does not adequately address the productivity and safety of unskilled and semi-skilled workers.

Capacity development. Capacity development at all levels of the workforce, including attention to working conditions, is essential for SFM and should be included in strategic and tactical forest management plans. A major constraint on SFM is a lack of skilled personnel (technicians, operators and other workers) to plan and execute management operations, and supervisory and managerial capacity is also often inadequate. Forest managers should consider the critical importance of staff

25 ILO (2011).

training at all levels with the aim of: minimizing damage to the forest and the environment by implementing reduced-impact harvesting; making staff fully aware of the social and environmental impacts of harvesting; increasing work productivity, quality and safety; and reducing harvesting losses and costs.

Develop and strengthen the community's organizational capacity for forest management—suggested action in Guideline 6.5. Photo: F.P. Soriano

Inform local communities of their rights and responsibilities in SFM—suggested action in Guideline 6.4. Photo: WWF

Principle 6: Social values, community involvement and forest-worker safety and health			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
6.1	**Address the local livelihood needs of people, including indigenous peoples and local communities**	Identify the livelihood needs of people, including indigenous peoples and other vulnerable forest-dependent people, and incorporate them in national and subnational forest policies and programs related to SFM	Government, forest managers, civil society, research and education institutions
		Provide guidance and tools on the use of participatory approaches to facilitate the involvement of indigenous peoples and local communities in SFM	
		Ensure there is clear recognition and respect for the rights of indigenous peoples who live in or have a traditional dependence on forests	
6.2	**Ensure the effective participation of relevant stakeholders in planning and implementing SFM**	Put in place a transparent and accountable communication framework and effective conflict-resolution mechanisms	Government, forest managers, private sector, civil society, research and education institutions
		Establish a framework for participatory processes and design multistakeholder dialogues for the management of natural forests	
		Promote gender equity and provide guidance and tools and take steps to enable indigenous and other local women to participate in SFM	
		Develop forest management plans that incorporate traditional forest-related knowledge and practices	
		Recognize and value the forest-management knowledge and skills of experienced local people	
6.3	**Recognize cultural, archaeological and spiritual sites identified in the PFE**	In procedures for forest management planning, provide mechanisms for working with indigenous peoples and local communities in identifying archaeological, cultural and spiritual sites in forests	Government, forest managers, private sector, civil society
		Respect local decisions and practices on the protection and conservation of cultural and spiritual sites	
6.4	**Consult with local communities on the management of natural forests in the PFE and at the FMU level**	Obtain the free, prior and informed consent of indigenous peoples and local communities for forest development initiatives	Government, forest managers, private sector, civil society
		Inform local communities of their rights and responsibilities in SFM	
		Where possible, involve neighbouring communities in management decisions that may affect or benefit them	
		Promote collaboration among local communities and institutions involved in forest management and, to the greatest extent possible, integrate professional skills and traditional knowledge	

Principle 6: Social values, community involvement and forest-worker safety and health (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
6.5	**Provide opportunities for local communities to participate in SFM**	In forest management planning, pay particular attention to community needs, the potential of the forest resource, and the organizational and technical capacities and worker availability in a given community	Government, civil society, forest managers
		Develop and strengthen the community's organizational capacity for forest management	
		Provide guidance on simplifying forest management plan requirements and adapt them to the capacity of local forest managers and the scale of the resource	
		Clearly define the roles and responsibilities of community members in the forest management process, including the processing and marketing of products and environmental services derived from the FMU	
		Encourage diversified and value-added forest production and improve profitability and competitiveness through, for example, greater market access and the use of lesser-known timber species as well as NTFPs and wood residues	
		Support communities so they can identify and measure the products and environmental services produced in the FMU and monitor and assess the impacts of management interventions	
		Strengthen the capacity of local communities to negotiate with outside actors, for example by providing information on timber prices and increasing access to different timber buyers	
		Provide means for overcoming common challenges related to access to capital, technology and commercial opportunities and the integration of small and medium-sized forest enterprises into supply and value chains	
6.6	**Ensure that the benefits derived from community forest management are shared among stakeholders according to their rights, roles and responsibilities**	Prepare communities to manage the benefits derived from their forests and seek assistance from other actors, including in civil society, the private sector and forest administrations	Government, civil society, private sector
		Identify and analyze costs and benefits with the aim of assisting community decision-makers in distributing those costs and benefits on an equitable, efficient and sustainable basis	
		Train local decision-makers to develop transparent and accountable regulations and appropriate legal and procedural support systems	

Principle 6: Social values, community involvement and forest-worker safety and health (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
6.7	**Provide a framework of rights and responsibilities for forest workers and forest managers on safety and health in forest operations**	Establish a framework for the rights and responsibilities of forest workers and forest managers to ensure a positive attitude towards worker safety and health in forest operations	Government, forest managers, private sector
		Make agreements between forest managers and workers on the enforcement of regulations and standards relating to working conditions in forests	
		In situations of equal qualification and experience, give priority to workers from nearby communities and localities	
6.8	**Make safety management a top priority**	Provide safe and healthy working conditions for all personnel according to international occupational health and safety standards	Government, forest managers, private sector
		Provide all FMU personnel with training on first aid and in safety awareness to enable them to identify hazardous situations in their work environments	
		Provide workers with appropriate safety equipment	
		Introduce financial incentives (e.g. a bonus system) to encourage workers to observe safety regulations, reduce negative environmental impacts and maximize timber recovery	
		Record and communicate all work-related accidents and illnesses	
		Arrange regular medical check-ups for all personnel, especially those exposed to occupational risks	
6.9	**Introduce best practices in forest operations to ensure safe and efficient operations**	Provide adequate supervision of personnel and, where appropriate, performance-based incentives for the efficient, safe and careful implementation of forest operations	Forest managers, private sector
		Adopt recommended practices for felling operations, namely directional felling, to reduce damage to vegetation, soils and streams	
		Adopt recommended guidelines and best practices for log extraction	
		Ensure the adequate planning of log landings, including location and layout, and observe safe practices to reduce risks during operations	
6.10	**Develop capacity at all levels of the workforce, including by improving working conditions**	Ensure that forest workers receive adequate training and supervision for the proper implementation of harvesting and silvicultural operations	Government, forest managers, civil society, research and education institutions
		Increase and maintain the professional skills, work performance and work quality of workers, and develop and maintain awareness among the workforce of social and environmental issues	

Principle 7: Investment in natural forest management and economic instruments

SFM only succeeds if it is properly financed. Capturing the full value of forests, including environmental services, and ensuring the equitable distribution of costs and benefits, are essential for SFM.

Promote efficient markets as a way of encouraging SFM, and give preferential access to products from sustainably managed natural tropical forests—suggested action in Guideline 7.5. Photo: Bosques Sociedad y Desarrollo, Peru

Rationale

The values of forests include direct-use values derived from the harvesting of timber, fuelwood and non-wood products; indirect-use values arising from the provision of environmental services, especially those associated with protecting water catchments, sequestering carbon and harbouring biodiversity; and option values related to the willingness of people to pay for the option of using forests in the future.[26] Capturing these values for the benefit of forest owners and other stakeholders and to pay the costs of SFM may be difficult, however. The economic challenge in natural tropical forests is to make SFM a profitable activity that is attractive to investors and competitive with other land uses. For example, most environmental services provided by well-managed forest are unpaid for, and there are only a few functioning mechanisms for collecting payments for environmental services. Another challenge is to reduce the costs of SFM by increasing management efficiency, and yet another is to attract the required investment to sustainably develop forest resources. Inevitably, potential investors in natural tropical forest management will carefully weigh the risks, uncertainties (e.g. in tenure) and overall framework for SFM.

Forest finance and adaptive management. An adaptive approach to forest financing involves the development of mechanisms to guarantee the equitable distribution of costs and benefits among stakeholders; it also requires that markets exist for, and are accessible to, the products and services delivered by forests. Clear incentive structures are needed that can be adapted as conditions change to optimize financial returns to investors and stakeholders and economic returns to society.

26 Pierce (1991).

Economic instruments. Policies and laws provide incentives and disincentives that affect the behaviour and choices of forest managers, users and other stakeholders, including investors. Forest fees and taxes should be considered as tools for encouraging more rational and less wasteful forest use and the establishment of an efficient processing industry and to discourage high-grading and the logging of natural tropical forests that are marginal for timber production. Such fees and taxes should also be related directly to the real cost of forest management. The marketing of forest environmental services is likely to become an increasing important source of financing for SFM.

Principle 7: Investment in natural forest management and economic instruments			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
7.1	**Enable a favourable environment for investment in natural tropical forest management**	Provide framework conditions (e.g. legal, policy, institutional and tenurial) to attract investments in natural tropical forest management	Government, forest managers, private sector, civil society, research and education institutions, consumer-country governments
		Develop instruments to support adequate financial returns for forest use, including mechanisms to provide payments for environmental services	
		Create awareness among forest operators and stakeholders of the value of adaptive management approaches to improving the financial viability of SFM	
		Consider using part of the financial benefit accruing from forest harvesting to help maintain the forest's productive capacity	
		Intensify national and international marketing efforts to obtain the highest possible value for sustainably produced forest products	
		In FMUs, explore options for generating income from environmental services, such as those related to carbon, water, biodiversity and tourism	Forest managers, private sector, civil society
		Identify options for improving carbon management and evaluate their risks, costs and benefits and their implications for other forest management objectives	Government, forest managers, private sector
		Develop effective mechanisms for resolving conflicts among stakeholders	Government, forest managers, private sector, private sector, civil society
		Develop the capacity of rightsholders to obtain fair returns for the use of their forest resources	
7.2	**Provide guidelines for optimum efficiency in timber harvesting to reduce log waste**	Establish a system of incentives and penalties to encourage practices to reduce wood waste in the forest	Government, forest managers, private sector
		Wherever feasible, manage forest (e.g. wood) residues as an additional income source, especially for forest-dependent communities	

Principle 7: Investment in natural forest management and economic instruments (continued)			
Guidelines		**Suggested actions**	**Indicative stakeholder group**
7.3	**Monitor the distribution of the costs and benefits of forest management among stakeholders**	Monitor the distribution of the costs and benefits of forest management among stakeholders to promote SFM	Government, forest managers, private sector
		List the mechanisms available for the distribution of incentives among stakeholders involved in forest management	Government
		Develop effective mechanisms for resolving conflicts among stakeholders on the sharing of costs and benefits	Government, forest managers, private sector, private sector, civil society
7.4	**Encourage economic instruments to support natural tropical forest management**	Encourage SFM through economic instruments such as fees, taxes, incentives and bonds, and support the establishment of efficient downstream industries	Government
		Ensure that effective measures are in place to encourage forest owners and managers to operate legally and sustainably manage the forest	
		Encourage indigenous peoples, local communities and smallholders to invest in SFM by providing long-term tenure and use rights, assisting in effective land-use and forest management planning, and facilitating access to appropriate credit and support services	
		Create incentives for enterprises that operate responsibly and innovatively, such as promotional financing through the private sector and philanthropy	
7.5	**Provide preferential access to markets for products from sustainably managed tropical forests**	Promote efficient markets as a way of encouraging SFM, and give preferential access to products from sustainably managed natural tropical forests	Government, forest managers, private sector, civil society, consumer-country governments
		Support, through adequate policies and, if needed, economic instruments, access to markets for sustainably produced products and environmental services from natural tropical forests	
		Recognize and promote the potential contribution of independent voluntary certification to SFM	
		Encourage public and private procurement policies to source timber only from sustainably managed forests	

Glossary

Adaptive management (also "adaptive resource management")	A structured, iterative process of optimal decision-making in the face of uncertainty, with the aim of reducing uncertainty over time via systematic monitoring. In forestry, adaptive management is a process by which forest managers adjust their strategies for meeting forest management objectives as conditions change
Allowable cut	The volume of commercial timber that may be harvested in a given area (e.g. an FMU) in a specified period
Annual allowable cut	The amount of timber that may be harvested annually in a given area (e.g. an FMU)
Best practices	The methods, processes, incentives, systems and policies that have been demonstrated to achieve superior results in an area of work
Biodiversity (also "biological diversity")	The variability among living organisms from all sources, including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part: this includes diversity within species, between species, and of ecosystems (Convention on Biological Diversity, Article 2)
Biomass stock	Organic material both aboveground and belowground, and both living and dead (e.g. trees, crops, grasses, tree litter and roots)
Carbon stock/forest carbon stock	The amount of carbon held in the biomass of a given area of forest
Carbon pools	Defined places in forest ecosystems where carbon is stored. The Intergovernmental Panel on Climate Change distinguishes five carbon pools in the category of land-use, land-use change and forestry: 1) living biomass above and 2) below ground, 3) dead biomass above ground, 4) litter and 5) organic soils
Civil society	Groups of citizens acting voluntarily to advance common goals and agendas
Collaborative forest management	A working relationship among various stakeholders to manage forest and tree resources
Criterion	A category of conditions or processes by which SFM may be assessed
Deforestation	The conversion of a forest to another land use
Elastic capacity (of forest ecosystems)	A measure of the capacity of a forest ecosystem to return to its equilibrium state after disturbance [closely related to resilience]
Enrichment (planting)	The planting of desired tree species in a natural forest with the objective of creating a forest dominated by desirable tree species
Environmental services	The benefits people obtain from forest ecosystems. They include provisioning services, such as food and water; regulating services, such as the regulation of floods, droughts, land degradation and disease; supporting services, such as soil formation and nutrient cycling; and cultural services, such as recreational, spiritual, religious and other nonmaterial benefits. Forest environmental services perform a range of functions, such as: moderating weather extremes and their impacts; dispersing seeds; mitigating drought and floods; cycling and moving nutrients; protecting stream and river channels and coastal shores from erosion; detoxifying and decomposing wastes; controlling agricultural pests; maintaining biodiversity; generating and preserving soils and renewing their fertility; contributing to climate stability; purifying air and water; and pollinating crops and natural vegetation. Tropical forests provide all these services and are often particularly important for carbon sequestration, biodiversity conservation, the protection of water catchments and the regulation of regional climates
Food security	Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Summit on Food Security, Rome, November 2009)

Forest	Defined at the national level. In general terms, a forest is land containing trees with a minimum specified percentage tree canopy cover, with trees capable of reaching a minimum specified height in situ when mature. Various international bodies have provided generic definitions of forests (see Annex 7 of ITTO 2002)
Forest concession	A tract of forest land under a (usually multi-year) licence agreement, lease or permit with individuals, communities or corporations for the sustainable production of timber and other forest products, usually with obligations for the protection and conservation of the goods and environmental services provided by the forest
Forest degradation	A reduction in the capacity of a forest to provide goods and environmental services. “Capacity” includes the maintenance of the elasticity of ecosystem structures and functions
Forest governance	The process of governance in a forest area
Forest management unit	A clearly defined forest area managed to a set of explicit objectives according to a long-term management plan. It may be a large contiguous forest concession or community forest, or a group of small forestry operations, possibly with more than one owner; the unifying element is a common system of management
Forestry	The art and science of managing forests and trees, embracing a broad range of concerns such as the provision of timber and NTFPs, biodiversity management, wildlife habitat management, watershed management, water quality management, recreation, landscape protection, erosion control, employment, and carbon sequestration
Forest zoning	The classification of an area into production, restricted and protective zones based on the determined functions
Governance	The process of determining the way in which society is managed and how the competing priorities and interests of different groups are reconciled. It includes the formal institutions of government but also informal arrangements. Governance is concerned with the processes by which citizens participate in decision-making, how governments are accountable to their citizens, and how society obliges its members to observe its rules and laws (FAO 2009)
Growing stock	The volume over bark of all living trees more than X (generally 10) cm in diameter at breast height. It includes the stem from ground level or stump height up to a top diameter of Y cm (generally the end of the bole), and may also include branches up to a minimum diameter of W cm
Invasive alien species	A species not native to a particular ecosystem whose introduction causes or is likely to cause economic or environmental harm or harm to human health
Landscape	A cluster of interacting ecosystem types, either pristine or modified by humans
Native species	Species that grow naturally in the wild in a particular region
Non-timber forest products	Goods of biological origin other than timber (i.e. they may include fuelwood), derived from forests, other wooded land and trees outside forests
Non-wood forest products	Goods of biological origin other than wood (i.e. they exclude fuelwood), derived from forests, other wooded land and trees outside forests
Permanence of carbon stocks	The capacity for maintaining existing forest carbon stocks and for continuous carbon sequestration by avoiding deforestation and forest degradation and deploying SFM
Permanent forest estate	Land, whether public or private, secured by law and kept under permanent forest cover. This includes land for the production of timber and other forest products, for the protection of soil and water, and for the conservation of biological diversity, as well as land intended to fulfil a combination of these functions. The main categories of land to be kept under PFE are the protection PFE and the production PFE

Primary forest	Forest which has never been subject to human disturbance, or has been so little affected by hunting, gathering and tree-cutting that its natural structure, functions and dynamics have not undergone any changes that exceed the elastic capacity of the ecosystem
Private sector	For-profit entities not owned by government
Production PFE	That part of the PFE assigned to the production of timber and/or to other extractive uses
Protection PFE	That part of the PFE in which the production of timber (or other extractive uses) is prohibited
Readiness preparation proposal	A working process, endorsed at the national level, to prepare a country for the implementation of REDD+ through multistakeholder consultation processes to define a national REDD+ strategy, including the definition of a forest carbon reference level and the monitoring, reporting and verification process needed to implement the REDD+ strategy. Readiness preparation proposals are promoted by the two main initiatives in REDD+: the Forest Carbon Partnership Facility and the UN-REDD Programme. In early 2014, 23 ITTO member countries were in the process of preparing or implementing readiness preparation proposals
REDD+	Policy approaches and incentives for reducing emissions from deforestation and forest degradation, including the role of conservation, sustainable management of forests and enhancement of forest carbon stocks
Residual stand	Forest that remains after wood harvesting
(Ecological) resilience	The capacity of a forest community or ecosystem to maintain or regain a desired ecological condition following disturbance
Restoration	A management strategy applied in degraded forests with the aim of restoring the forest to its pre-degradation state (e.g. in function, structure and species composition)
Secondary forest	Woody vegetation regrowing on land that was largely cleared of its original forest cover. Secondary forests commonly develop naturally on land abandoned after shifting cultivation, settled agriculture, pasture, and failed tree plantations
Silviculture/silvicultural	Pertaining to the art and science of producing and tending forests by manipulating their establishment, species composition, structure and dynamics to fulfil given management objectives
(Forest) stakeholders	Individuals or groups directly or indirectly affected by, or interested in, a given forest resource and with a stake in it
Tenure	Agreement(s) held by individuals or groups, recognized by legal statutes and/or customary practice, regarding the rights and duties of ownership, holding, access or use of a particular land unit or the associated resources (such as individual trees, plant species, water or minerals) therein
Use rights	The rights to the use of forest resources as defined by local custom or agreements or prescribed by other entities holding access rights. These rights may restrict the use of particular resources to specific harvesting levels or specific extraction techniques
Sustainable yield	The volume of wood or other product that may be removed from a forest annually, which is equal to or less than the rate of replacement in a given area over the long term
Yield regulation	The technique for calculating and controlling the sustainable yield

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Annex

Long-term research and development to support SFM in natural tropical forests

Additional tactical research is needed for the implementation of SFM in natural forests in the humid tropics. The table below summarizes research and development needs, as proposed or implied in the main document. To facilitate such research and development, the international community is encouraged to reflect on the creation of a targeted research fund to support SFM. Strong collaboration between ITTO, research institutions, other international organizations and donor agencies would be needed to develop such a fund.

Suggested actions (as proposed or implied in the voluntary guidelines)
Develop policies, programs and remedial actions, including capacity building, technologies and resources, to reduce the vulnerability of forests to abiotic and biotic effects
Strengthen the capacity of forest administrations and forest managers to address new and emerging issues regarding ecological resilience
Provide technical support to private and community forest owners to ensure that their activities help increase the resilience of forests to negative abiotic and biotic effects
Improve and apply ecological knowledge to ensure that forest management maintains biodiversity and forest functions such as pollination, seed dispersal and nutrient cycling
Identify and manage floral and faunal species that are strongly interactive or play key roles in the ecology of other species or have important influences on forest resilience
Manage natural forest ecosystems using landscape approaches that take into account protected areas and habitat "stepping stones", with well-defined roles for production
Integrate measures to increase resilience and conserve biodiversity into harvesting and silvicultural practices in natural production forests
Assess and classify, at the landscape scale, the various forms of forest use that degrade natural tropical forests
Assess, at the landscape scale, the impacts of climate change and climate variability on the physical characteristics of forests and their productivity, ecological dynamics and ecosystem functions
Monitor trends in the frequency and severity of climate-change-related impacts on natural tropical forests
Monitor the effects of climate change on forest ecosystem processes such as the hydrological, nutrient and carbon cycles
Identify emerging and likely future socioeconomic impacts of climate change in forests
Promote and support research into the analysis of climate-change adaptation costs and benefits in forests
Identify the short-term and long-term risks, costs and benefits of forest-related climate-change adaptation measures
Modify forest management plans and practices to include relevant climate-change adaptation measures
Identify and implement best-practice forest management for climate-change mitigation
Integrate applied research into forest management plans and seek collaboration with research and educational institutions to find solutions to technical and operational problems

Suggested actions (as proposed or implied in the voluntary guidelines) (continued)
Test technological innovations and best practices derived from basic and applied forestry research at the FMU level
Internalize, at the appropriate decision-making levels, the results of monitoring and new scientific findings and technical data so that these are used to improve forest management
Carry out sustainable-yield analyses, with the spatial allocation of yield based on variations in the forest mosaic and taking into account multiple-use constraints, buffer zones, species and minimum cutting diameter limits
Consider how the implementation of a silvicultural system might affect: the growth rates of harvestable species; seed production; regeneration; and forest environmental services related to water, biodiversity and carbon

The *Voluntary Guidelines for the Sustainable Management of Natural Tropical Forests* provide guidance on the policy, legal, governance, institutional, ecological, social and economic issues that need to be taken into account in the planning, implementation and evaluation of sustainable forest management in natural tropical forests to ensure the sustainable provision of forest goods and environmental services.

The voluntary guidelines constitute an international reference document for the development and improvement of national and subnational guidelines for the sustainable management of natural tropical forests. They also provide a reference on technical issues at the macro (or landscape) and micro (or forest management unit) scales for conserving and sustainably managing tropical forests.

The voluntary guidelines set out seven principles of sustainable forest management in natural tropical forests, with a total of 60 guidelines within these principles, and suggested actions for each guideline based on best practices and existing tools to enhance the environmental, social and economic sustainability of tropical forests.

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