REVISED ITTO GUIDELINES FOR THE SUSTAINABLE MANAGEMENT OF NATURAL TROPICAL FORESTS

FULL REPORT

Prepared by

Jürgen Blaser and Cesar Sabogal

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Introductory remarks and acknowledgement

Acronyms

AAC	Annual Allowable Cut
ARM	Adaptive Resource Management
C&I	Criteria and Indicators
CBD	The Convention on Biological Diversity
CBFiM	Community Based Fire Management
CEPA	Communication, Education and Public Awareness
CFM	Community Forest Management
CIFOR	Center for International Forestry Research
CPF	Collaborative Partnership on Forests
DBH	Diameter at Breast Height
FAO	Food and Agriculture Organization
FMPs	Forest Management Plan
FMU	Forest Management Unit
FPIC	Free, Prior, and Informed Consent
GIS	Geographic Information Systems
IAC	International Agricultural Centre
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
MDH	Minimum Diameters for Harvesting
MRI	Multi-resource Inventory
NGOS	Non-governmental organizations
NLBI	Non-Legally Binding Instrument
NTFPs	Non-timber forest products
NWFP	Non-wood forest products
PCTs	Potential (or Future) Crop Trees
PFE	Permanent Forest Estate
PSPs	Permanent Sample Plots
REDD+	Reduced Emissions from Deforestation and Forest Degradation
REL	Reference Emission Level
RIL	Reduced Impact Logging
RL	Reference level
SFM	Sustainable Forest Management
UNCCD	The Convention to Combat Desertification
UNFCCC	The Framework Convention on Climate Change

PART I The sustainable management of natural tropical forests

Rationale

This publication updates and replaces the original *ITTO Guidelines for the Sustainable Management of Natural Tropical Forests*, published in 1990 as ITTO's first policy guidance document on the management of the natural tropical forest estate. In 2007 the International Tropical Timber Council decided to update these guidelines[1] in the light of increased knowledge and the emergence of a wide range of new challenges and opportunities for tropical forest management.

There have been many significant developments in international policies related to tropical forests and forest management since 1990. These include the adoption, in 1993, of the Convention on Biological Diversity (CBD), the Convention to Combat Desertification (UNCCD) and the Framework Convention on Climate Change (UNFCCC); adoption of the Kyoto Protocol in 1996; the UNFCCC 'Cancun' decision on REDD+[2] in 2010; and the 2007 agreement on the Non-Legally Binding Instrument on all Types of Forests (NLBI; Resolution 62/98 of the United Nations General Assembly), which includes four globally agreed objectives on forests. There has also been a general shift in tropical forest management from a focus on timber towards holistic multi-purpose approaches that place increasing emphasis on forest services. Box 1 summarizes some of the general trends that have affected the management of natural tropical forests since 1990.

BOX 1 Trends that have affected the management of natural tropical forests since 1990

- Increased societal demands and expectations on forests and environmental and social awareness about tropical forests.
- Increased recognition of the role of tropical forests in delivering 'global' ecosystem services, including those related to biodiversity, carbon and water.
- Increased recognition of the rights of indigenous peoples and forest communities over forests and forest use, and the need to safeguard those rights.
- Increased decentralization of control over forests.
- Emergence of forest certification as an important driver of SFM.
- Increased awareness of illegality and corruption as major impediments of SFM.
- Increased role of the informal sector and its lack of visibility in national statistics and development plans.
- Increased role of non-governmental organizations (NGOs) in forest management and forest policy development.
- Loss of silvicultural knowledge and practice and a lack of research, leading to over-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
- Development of REDD+ as part of a global climate change agenda, which has raised the visibility of tropical forests to the highest political level.
- Increased demand for wood and wood products, even as the international market for tropical timber diminishes.
- Increased role of planted forests in meeting demand for wood products.
- Increased demand for renewable energy, including forest-based energy.

Influenced by such trends, approaches to forest management have evolved considerably in most of ITTO's producer member countries since 1990. This is reflected in the (continued) development of an important

[1] Decision 2(XLIII) - ITTO Biennial Work Programme for the years 2008-2009

[2] Policy approaches and positive incentives on issues related to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. *From the Bali Action Plan of the UNFCCC.*

spin-off of the original guidelines—criteria and indicators (C&I) for sustainable forest management (SFM). All ITTO member countries have acknowledged the importance of C&I as a tool for defining forest management and for monitoring progress in and challenges to SFM.

These revised guidelines for the sustainable management of natural tropical forests take all 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 to manage, conserve and sustainably use some of the planet's most valuable resources—natural tropical forests.

Scope

These revised guidelines constitute an international reference document for the development or 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 scale and the micro or forest management unit (FMU) scale.

The notion of permanence is a necessary condition for SFM. The permanent forest estate (PFE), as defined in ITTO (2005), comprises land, whether public or private, secured by law and kept under permanent forest cover. It 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 fulfill a combination of these functions. Although the guidelines can be applied to the sustainable management of all natural tropical forests, the focus is on the PFE and the multiple-use roles of forests, including timber production.

The production PFE is PFE where timber harvesting and other forms of resource exploitation are permitted, albeit subject to certain conditions. The protection PFE is PFE where such exploitation is generally not permitted. These guidelines are designed to be applied in the management of the production PFE, although many of the principles, guidelines and recommended actions can and should be applied in the protection PFE.

BOX 2 ITTO policy documents with implications for the sustainable management of natural tropical forests

- ✓ ITTO (1990). ITTO Guidelines for the Sustainable Management of Natural Tropical Forests. ITTO Policy Development Series No 1.
- ✓ ITTO (1992). Criteria for the Sustainable Management of Natural Tropical Forests. ITTO Policy Development Series No 3.
- ✓ ITTO (1993). ITTO Guidelines for the Establishment and Sustainable Management of Planted Tropical Forests. ITTO Policy Development Series No 4.
- ✓ ITTO (1993). ITTO Guidelines for the Conservation of Biological Diversity in Tropical Production Forests. ITTO Policy Development Series No 5.
- ✓ ITTO (1997). ITTO Guidelines for Fire Management in Tropical Forests. ITTO Policy Development Series No 6.
- ✓ ITTO (1998). Criteria and Indicators for Sustainable Management of Natural Tropical Forests. ITTO Technical Series No 7.
- ✓ ITTO (1999). Manual for the Application of Criteria and Indicators for Sustainable Management of Natural Tropical Forests. ITTO Policy Development Series No 9.
- ✓ 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. ITTO Policy Development Series No 14.
- ✓ ITTO (2005). Revised ITTO Criteria and Indicators for the Sustainable Management of Tropical Forests including Reporting Format. ITTO Policy Development Series No 15.
- ✓ ITTO (2009). ITTO/IUCN Guidelines for the Conservation and Sustainable Use of Biodiversity in Tropical Timber Production Forests. ITTO Policy Development Series No 17.

All documents can be downloaded at www.itto.int.

These revised guidelines complement other ITTO guidelines on various aspects of tropical forest management (Box 2), especially the *Revised ITTO Criteria and Indicators for the Sustainable Management of Tropical Forests* (2005) and the *ITTO/IUCN Guidelines for the Conservation and Sustainable Use of Biodiversity in Tropical Production Forests* (2009).

These revised guidelines are designed to encourage multi-purpose 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 SFM at a broad policy level, the guidelines should also be useful to a wide diversity of forest managers working under a variety of management and tenure arrangements. The guidelines also present an adaptive and collaborative forest management concept that can be applied at multiple scales. They particularly provide guidance on tradeoffs in forest management decision-making and cross-cutting issues such as forest governance, land-use planning, institutional issues and inter-sectoral linkages. It is intended that these guidelines form a basis for the development of specific guidelines at the national or sub-national levels.

Objectives

The objectives of the *Revised ITTO Guidelines for the Sustainable Management of Natural Tropical Forests* are to:

- *Identify the framework conditions* for the application of forest management guidelines in natural tropical forests for the sustainable delivery of forest goods and ecosystem 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 local and landscape levels*.
- *Stimulate the adoption of appropriate and adaptive management practices* to maintain the capacity of natural tropical forests to sustainably deliver multiple goods and ecosystem services.
- *Inform international processes* that deal with globally relevant issues, such as climate change, water, biodiversity and desertification, about the role that the sustainable management of natural tropical forests can play in such issues.

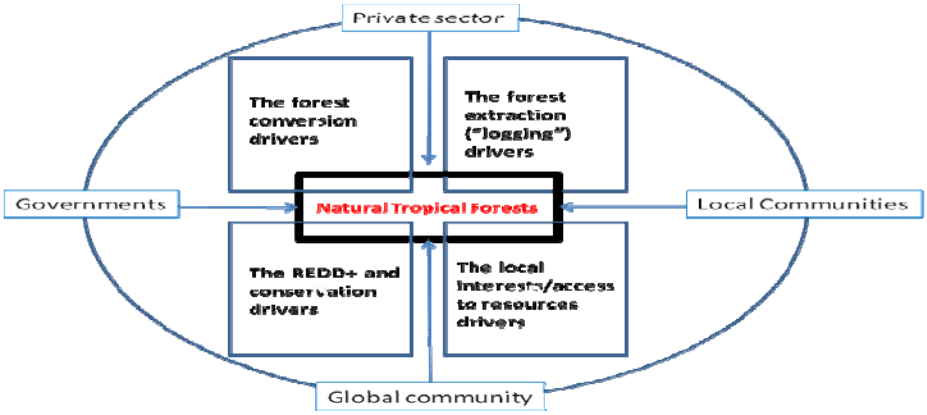
Who should use these guidelines

Many actors have interests in forests (Figure 1). While some of these interests are compatible, some are not. At one extreme, there are stakeholders who aim to preserve forests (even though interpretations of the term 'preserve' may vary), while, at another, there are stakeholders who would like to clear the forest to better exploit its soil or sub-soil. In between these two is a wide range of actors with a broad set of uses for tropical forests.

The **target groups** of these guidelines are those involved in the management and protection of tropical natural forests, including:

- Forest managers, such as state and local forestry agencies, timber companies, producer associations, natural-forest smallholders and rural and forest communities.
- Policymakers, such as political parties, government agencies dealing with forests, conservation, the environment and land-use planning, development and extension agencies, and civil-society organizations.
- Agencies, institutions and firms interested in the ecosystem services provided by natural tropical forests.
- Forest research, education and training institutions.
- International funding and development agencies.

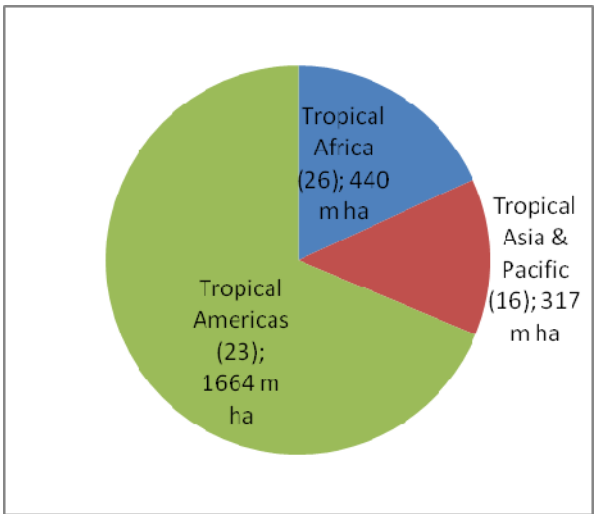
Figure 1 The various influences on the use and management of natural tropical forests



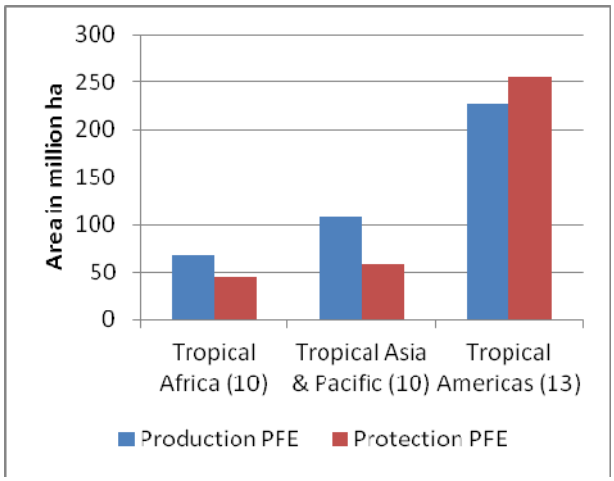
Background

Natural tropical forests extend over about 1664 million hectares in 65 countries, 1421 million hectares (85%) of which are in the 33 ITTO producer member countries (ITTO 2011). In total, the 33 ITTO producer member countries have an estimated natural-forest PFE of 761 million hectares, comprising 403 million hectares of production PFE and 358 million hectares of protection PFE (Figure 2).

Figure 2 Distribution of natural tropical forests worldwide, and PFE in ITTO producer member countries



Total tropical forest area, 65 countries, by region (figures in brackets = number of countries)



Natural tropical PFE by region, 33 ITTO producer member countries (figures in brackets = number of countries)

Source: FAO (2010), ITTO (2011).

Sustainable forest management

Defining SFM

A definition of sustainability is elusive, but it involves ways of using biological systems that do not impair their capacity to meet the needs of future generations. Sustainability has become a political priority globally and, for forests, SFM has developed into an essential tool.

This document uses ITTO's definition of SFM (see below). Nevertheless, there are many other definitions that vary widely, sometimes because of specific field circumstances and sometimes because of the particular purpose to which a user believes a given forest should be put (Douglas and Simula 2010). The concept of sustainability in forest management has evolved from sustained yield and single-use management for timber, to one reflecting the wide range of goods, ecosystem 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 enabling policy and institutional environments, and wording on it was adopted by the United Nations 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.

BOX 3: United Nations definition of SFM

The Non-legally Binding Instrument on All Types of Forests defines SFM as "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".

United Nations General Assembly Resolution 62/98, New York, December 2007. Available at http://www.un.org/esa/forests/pdf/session_documents/unff7/UNFF7_NLBI_draft.pdf.

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 partly the reason for the acknowledged lack of precision in its definition, particularly in regard to (WCFSC 1999):

- 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
- the timeframes and spatial boundaries involved.

WCFSC (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 signaled 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 provides many ecological services. It will therefore produce an array of products and services that may—and may not—include timber. SFM therefore relates to the *multiple use* of the forest (Pearce et al. 1999). SFM refers not just to the flow of

goods and services but also to maintaining forest ecological processes essential for maintaining ecosystem resilience—the capacity of a forest ecosystem to recover following disturbance (Thompson et al. 2009).

An important dimension of SFM is the scale at which it is applied—global, national, sub-national, FMU and stand. SFM should be addressed at all levels.

- *A*t the ***global and national levels,*** the concept of SFM has evolved in the past 20 years 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 ecosystem 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 such services are now being discussed in international forums. Much of the policy development on SFM initiated at the international level, including ITTO's work on C&I and various guidelines, has influenced policies at the national level.
- At the ***sub-national or landscape level,*** the objective of maximizing wood yields has traditionally been overwhelmingly important. Growing awareness of the broad role of forests, however, has led to new approaches to SFM that give weight to the full range of environmental, social and economic factors. At the landscape scale, tradeoffs will almost always have to be made in the mix of products, ecosystem services and values offered by forests. Ideally, such tradeoffs are agreed in a planning process involving all stakeholders and express a consensus view on what constitutes SFM in that particular landscape within physical and other constraints. Questions to be addressed in such processes include: How much forest do we need or want? What kinds of forest should there be? Where should it be situated? How should it be conserved and managed?

- *At* ***the FMU level***, SFM has three elements: the management of forests for multiple objectives to meet the needs and demands of concerned stakeholders; achieving a balance among outputs (of goods and ecological services), rather than the maximization of any single one; 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 full 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 services that people and societies require of them over time. Thus, the use of forests should be planned at the national, landscape and FMU scales, and each FMU should be managed sustainably for the purposes for which it is intended in the landscape. 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 (see 'adaptive management' below).

ITTO's definition of SFM

The original (1990) version of the *ITTO Guidelines for the Sustainable Management of Natural Tropical Forests* recognized that managing forests sustainably is about achieving a balance among the different uses of the forest while ensuring 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 discussion 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 the needs for goods and services provided by forests
- ensuring the conservation of forest soils, water and carbon stocks
- conserving biological diversity
- sustaining the resilience and renewal capacity of forests, including carbon storage
- supporting the food security and livelihood needs of forest-dependent communities
- assuring an equitable sharing of the benefits from forest uses.

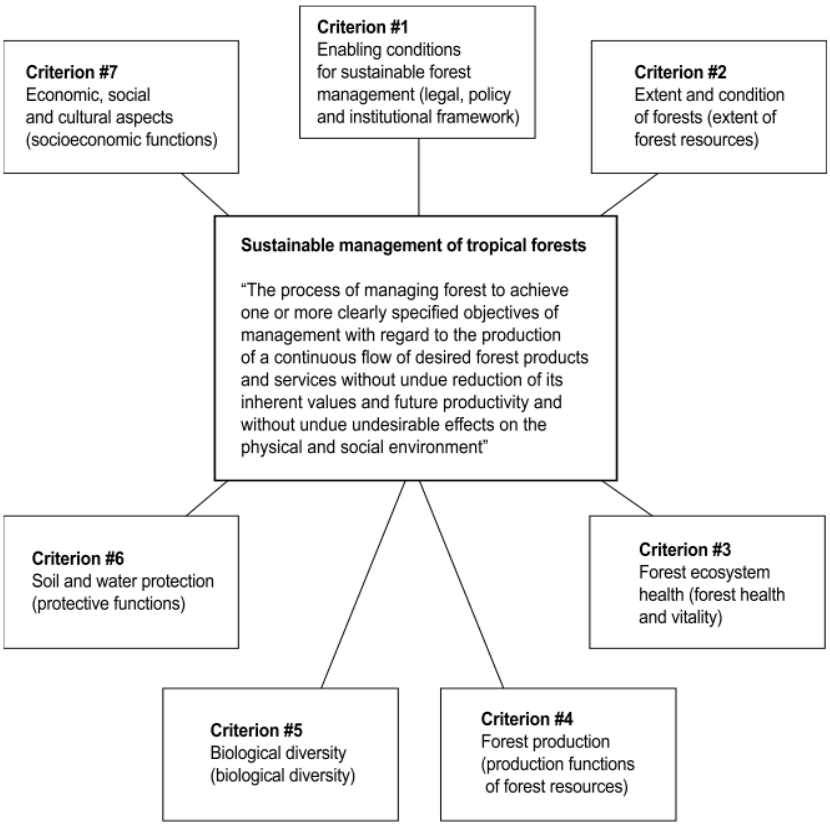
ITTO's criteria and indicators

To assist in the monitoring, assessment and reporting of SFM at the national and FMU levels, ITTO developed in 1992, and subsequently revised in 1998 and 2005[3], a set of seven C&I for SFM that can be used to guide forest management and assess its sustainability (Figure 3).

The ITTO C&I were not formulated for application in forests managed strictly for protection, where forest goods are usually not extracted. Nevertheless, they can still be applied in such forests, even though the extraction of timber and non-timber forest products (NTFPs) should be zero, or close to zero.

Figure 3 Schematic representation of the revised ITTO criteria for the sustainable management of tropical forests

[3] ITTO (2005). *Revised Criteria and Indicators for the Sustainable Management of Natural Tropical Forests.* Policy Series No 15. ITTO, Yokohama, Japan.



Note: Text in parentheses refers to the corresponding internationally agreed common thematic areas of SFM.

The seven criteria, as described in Table 1, have been harmonized with other C&I schemes and constitute the basis for the assessment of SFM. The *Revised Guidelines for the Sustainable Management of Natural Tropical Forests* use the ITTO C&I, as revised in 2005, as an important reference document and draw on them in the development of both principles and specific guidelines.

Table 1 ITTO criteria for monitoring and reporting on progress towards SFM

Criterion and description	Observations related to the present guidelines
1. Enabling conditions for SFM Addresses the legal, policy and institutional arrangements necessary to achieve and maintain SFM, including participatory decision-making, governance and law enforcement, and monitoring and assessment of progress.	Applies mainly at the national, provincial and local government levels. There is often a gap between economic and trade policies and environmental policies. In many tropical countries, providing an overarching legal framework for SFM and a comprehensive institutional framework for knowledge-sharing, incentive systems and compliance arrangements remain major challenges for SFM.
2. Extent and condition of forests Addresses forest cover and stocking, including trees outside forests, to support the social, economic and environmental dimensions of SFM. Encompasses	Applies at both the national and FMU levels. There is no consensus on the optimal extent of forests at a local, national or global level. As circumstances change, so too do the demands for goods and services from forests. The emergence of an

objectives to reduce deforestation and to restore and rehabilitate degraded forest landscapes.	agenda for payments for reduced emissions of greenhouse gases from deforestation and forest degradation (REDD+) has added urgency to the need to improve assessments of forest biomass, carbon stocks, biological diversity, etc.
3. Forest ecosystem health Addresses the need to manage forests to minimize the risks and impacts of unwanted disturbances such as wildfires, airborne pollution, storms, invasive alien species, pests and diseases (such disturbances have impacts on the social and economic as well as environmental dimensions of forests and associated communities).	Applies mainly at the FMU level. The effects of pollution, climate change, fire and other disturbances are often insufficiently known or managed. Generally, natural forests are resilient; forests with low genetic or species diversity, such as plantations, are less resilient and more at risk to disturbance by pests and diseases.
4. Forest production Addresses the capacity of forests to provide a wide range of timber and non-timber forest products and services, and the need for information on resource use and trade.	There is an ambition to maintain a high-volume and valuable supply of forest products and ecosystem services from natural tropical forests while, at the same time, ensuring that production is sustainable and dos not compromise the management options of future generations. Quantitative indicators are important for monitoring.
5. Biodiversity Linked directly to forest resilience, health and productivity. Addresses concerns about the conservation and management of biodiversity at the ecosystem (and landscape), species, and genetic levels.	The *ITTO/IUCN Guidelines on the Conservation of Biological Diversity in Tropical Timber Production Forests* are helping to close the gap between policy and implementation in tropical forests. Nevertheless, a range of issues, such as the lack of data on the extent of forest protected areas, the lack of knowledge of key ecological processes in tropical forests, and issues related to endangered species, genetic resources and forest-based genetically modified organisms, still need to be addressed.
6. Soil and water protection *A*ddresses the role of forests in moderating soil, hydrological, atmospheric and aquatic systems. Includes the production and conservation of soil, the cycling of carbon and oxygen, the maintenance of clean water and aquatic systems, and reductions in the risk or impacts of floods, avalanches, erosion and droughts (the protective functions of forests also contribute to ecosystem conservation efforts).	The protective functions of forests have strong cross-sectoral aspects because they provide immense benefits to agriculture and to both rural and urban livelihoods. Forests are an essential element in emerging green economies and debates over water, and can help ameliorate land degradation and desertification. A comprehensive holistic approach based on SFM has not yet been developed, however, at any scale.
7. Economic, social and cultural aspects Addresses the economic contributions of forests (e.g. employment, revenue and foreign exchange generated by the production, harvesting, processing and marketing of forest products and services, and investments in the forest sector). Also addresses the social functions of forests and aspects such as land tenure, indigenous and community management systems, and traditional knowledge.	SFM needs to bridge forest-based production (in particular of timber), environmental protection and local development concerns. Tropical natural forests are important in subsistence livelihoods and poverty alleviation; they are associated with customary rights that, in many countries, are not recognized under the law. SFM can play a vital role in promoting local participation, rights and the use of traditional knowledge and use.

Multi-purpose management

Natural forests are the source of a diverse array of products, ecosystem services and social 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 production may affect a forest's value as a habitat for wildlife. Decisions on tradeoffs in the provision of various goods and ecosystem 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 multi-purpose forest management. Although embedded in the laws of many countries, it 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—to the benefit of communities and the forest itself.

Adaptive forest management

Adaptive management is the process by which research and learning is 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, they 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, these guidelines advocate an adaptive management that implies the:

- Analysis of the costs and benefits of SFM practices and to whom (e.g. government, communities, 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 continued involvement of stakeholders in decision-making on forest management at the appropriate scale.
- Documentation and quantification of the tradeoffs between and synergies among multiple objectives (e.g. related to timber, NTFPs, carbon, water and biodiversity).
- Monitoring and evaluation of incentives and disincentives for SFM and the potential for failures of governance.

Issues for the sustainable management of natural tropical forests

SFM and extra-sectoral forces

Over the past two decades, tropical forestry has been shaped by powerful forces at the global, regional, national and subnational levels. These forces are mainly extra-sectoral in nature.

- In many tropical countries, the demands of growing populations for food, fuel and land have led to increased deforestation (i.e. the conversion of forests to a non-forest land use), forest degradation and fragmentation and the appropriation of customary lands.

- Globalized markets and national and international trade and investment are contributing to pressure on forested land by providing incentives for and investment in the expansion of agriculture, livestock, biofuel production, mining and other extraction 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 is a lack of clarity on land tenure and a sense of grievance among many 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 ecosystem services provided by natural tropical forests is one of the reasons for their low financial competitiveness against other 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 these guidelines into effect.

A recent survey of SFM in its 33 producing member countries (ITTO 2011) found that only about 30 million hectares, or less than 8% of the tropical production PFE, is under SFM. Douglas and Simula (2010) attributed the slow uptake of SFM to two central issues, as follows:

- The economic and social policies influencing forests and forest-dependent people are initiated a long way from the forest sector itself and can only effectively be manipulated by mechanisms that operate well outside the sector (without having a close relationship or concerns to forests).
- 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 have been convinced of the benefits to them of SFM.

ITTO (2011) recognized several constraints to SFM that frequently recur in tropical countries. Probably the most important, and the most generally applicable, is that the sustainable management of natural tropical forests is less profitable as a land use than other ways of using the land, especially some forms of agriculture and ranching but also urban development and mining. As a result, SFM tends to be a low priority for governments and the private sector often lacks incentives to pursue it. In general, prices for tropical timber, still the major commodity extracted from natural tropical forests, remain relatively low. It is possible that they will increase in the future 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 ecosystem services they supply. In some countries, payments are being made for such ecosystem services, and REDD+ offers a potentially significant revenue-earning opportunity for forest owners. In the long run, the extent of payments for the ecosystem services supplied by tropical forests—made at either the national level or the global level—is likely to play a large part in determining the fate of remaining tropical forests. In order 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 when they have not yet been wholly successful, merit the long-term support of markets, development assistance agencies, NGOs and the general public.

Another constraint to SFM is confusion over ownership. SFM is unlikely to succeed without the security provided by credible, negotiated arrangements on tenure. In many countries, resolving disputes over land

tenure is no easy task but it must be tackled—preferably through a transparent and equitable process—if resource management is to become sustainable.

Civil society on SFM

Some NGOs have criticized SFM as an excuse for a 'business as usual' approach to forest management, placing timber values first and offering little consideration to the protective, social or ecological values from forests. For example, in their critique of the World Bank's Forest Investment Programme, Greenpeace and Rainforest Foundation (2009) stated that SFM has, in practice, often been misused to legitimize destructive activities. On the other hand, other NGOs have helped to advance SFM through forest certification (Box 4).

BOX 4: Forest certification

Forest certification has been promoted by many NGOs since the mid 1990s. A voluntary, market-based instrument, forest certification has helped to increase awareness of the need for defining standards for good forest management. It has helped to initiate an important capacity-building and awareness-raising process, and has provided an incentive for many tropical-timber-producing companies, especially those exporting their products to Europe and North America, to improve the standards of their forest management. Although certification has been most successful in temperate and boreal forests, it has also had important effects on SFM in natural tropical forests.

Issues on the implementation of SFM in natural tropical forests

SFM in closed natural tropical forests

In closed natural tropical forests[4] subject to their first timber harvest, the way in which operations are implemented (including the opening-up of areas with access roads) is of major importance in determining the success of SFM. Influencing the way this first cut is carried out, therefore, is an important task of proponents of SFM.

Closed natural forests generally stock more carbon and are biologically more diverse than modified forest ecosystems on the same sites. The entry of forest operations to previously intact primary forests could therefore lead to increased carbon emissions and biodiversity loss (CBD 2009), mainly because the provision of access roads is associated with deforestation and the loss of forest fauna through overhunting (Nasi et al. 2008). For example, the likelihood of deforestation in logged forests in the Brazilian Amazon was found to be up to four times greater than for non-logged forests because logging was often a precursor of land-clearing for agriculture (Asner et al. 2006). In Southeast Asia, roads built by loggers to access high densities of valuable *Dipterocarpus* trees in lowland forests led to deforestation in sparsely populated protected areas (Curran et al. 2004). Nasi et al. (2008) concluded that improved access to forests considerably increases the risk of unsustainable hunting of bushmeat.

[4] 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 2005); the term 'primary forest' is also often 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. 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" (ibid.). ITTO proposes a set of definitions in a continuum of forest use, including, as main categories, primary forests, modified natural forests and planted forests.

Deforestation and overhunting are incompatible with SFM. Therefore, 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 is the most effective determinant of deforestation, as improving access to a forest area often creates strong pressures to deforest it (The World Bank 2007). This should be taken into account at all stages of SFM at the landscape and national levels when natural forests are involved.

Forest degradation and restoration

Forest degradation is often considered to be a precursor to 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 forest for agriculture or ranching, the expansion of urban areas, and infrastructure development, some of which is 'governed' (sanctioned by government authorities) and some of which is ungoverned (Blaser and Thompson 2010). On the other hand, most degradation is the result of unsustainable extraction of forest products and values by local people as part of their livelihood strategies (ibid.). The area affected as such is estimated to be between 850 million hectares (ITTO 2002) and 1.1 billion hectares (WRI 2009). An additional cause of forest degradation is commercial logging, but this affects a relatively small area (about 130 million hectares, ITTO 2006).

Since the actors and processes are different, it follows that strategies to deal with deforestation may differ from those aiming to reduce forest degradation. Moreover, while a reduction in deforestation will reduce greenhouse-gas emissions, curbing degradation will both reduce emissions and (usually) increase carbon capture. This is because reducing degradation pressures and instigating SFM—including forest restoration programs—will usually lead to forest growth. Box 5 explores some of the aspects of the relationship between SFM and REDD+.

SFM and biodiversity

There is a close relationship between ecosystem resilience and forest biodiversity (Thompson et al. 2009). Resilience is an emergent property of ecosystems that is conferred at multiple scales by genes, species, functional groups of species, and the processes within an ecosystem. From an ecological perspective, SFM attempts to manage and maintain ecosystem resilience. To accomplish this, biodiversity must be maintained 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 moral reasons). Thompson et al. (2009) suggested that the relationship 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.

Biodiversity conservation should be considered at the landscape scale (among others). 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 habitat should be provided for in forest zoning and harvesting patterns. Methods are available to help achieve a balance between different components of a landscape mosaic that will provide optimal conditions for a broad range of species and populations.

BOX 5: 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, however, their stored carbon is released into the atmosphere as carbon dioxide and other greenhouse gases. Tropical deforestation is estimated to have released 1–2 billion tonnes of carbon per year for the past 20 years. There are no estimates of counteracting tropical-forest-based sequestration. The largest source of greenhouse-gas emissions in most tropical countries is deforestation and forest degradation. In Africa, for example, deforestation accounts for nearly 70% of total greenhouse-gas emissions of all sectors.
- REDD+ focuses on the capacity of forests in developing countries to capture and store carbon. Carbon may accumulate rapidly in young planted forests or in recently harvested forest stands but is lost when forests are converted to other land uses and also on harvesting. Mature natural tropical forests usually have very large carbon stocks in their biomass but tend to sequester little new carbon. Theoretically, a sustainably managed production forest will be carbon-neutral—that is, it will produce no net carbon emissions over the long term.
- The aim of REDD+ is to provide financial incentives to tropical countries to compensate them for forest-based climate change mitigation efforts by reducing greenhouse-gas emissions from forests and by increasing carbon sequestration. By carrying out REDD+ activities, countries could simultaneously increase the resilience of ecosystems and social systems to face climate change, conserve biodiversity, protect other ecosystem goods and 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.

How to use these guidelines

The basis of these guidelines is a set of eight framework principles and ten management principles. These core principles are applicable to SFM in natural tropical forests worldwide, with an emphasis on production forests in the PFE. They can also serve as a framework for the preparation of specific national or subnational guidelines. For each principle, practical *guidelines* are proposed, together with possible *recommended actions* addressed to particular target groups.

An important 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 extent possible. Thus, the documents makes full use of the wealth of scientific literature that explicitly or implicitly provides evidence for recommended actions (i.e. practical approaches or measures for context-specific SFM implementation). Nevertheless, anecdotal evidence and field experience from experts and practitioners have also been taken into consideration.

The document comprises three parts. Part 1 introduces the guidelines and provides background information on important concepts, including definitional aspects of SFM, multi-purpose management, landscape-based approaches, and adaptive management. Part 2 gives an overview of the framework and management principles and their associated guidelines. For each guideline, the main relevant stakeholder group is identified. Part 3 sets out recommended actions for each guideline at the national and FMU scales.

An addendum provides a set of two principles and eight guidelines specifically on the role of SFM in climate change adaptation and mitigation. A glossary of terms used in this document is presented in annex.

PART 2 OVERVIEW OF PRINCIPLES AND GUIDELINES

FRAMEWORK PRINCIPLES FOR THE SUSTAINABLE MANAGEMENT OF NATURAL TROPICAL FORESTS

The following eight principles are applicable at the national and sub-national levels or related to landscape-level issues. They are of a strategic nature, implicitly identifying the enabling conditions for SFM.

Principle 1: Forest governance **Adequate national policies, laws and regulations are implemented and enforced with the support of appropriate institutions and by a strong and continued commitment to SFM by all stakeholders.**			**Indicative stakeholder group[5]**					
			Government	**Forest manager**	**Private sector**	**Civil society**	**Research/education**	**Other**
1.1	Political commitment and supportive policies for SFM	There should be a strong and continued political commitment and an enabling policy environment to formulate, reform and implement policies within and outside the forest sector for the effective implementation of SFM.	x					
1.2	Coherent and coordinated policy and laws	An agreed, up-to-date forest policy should be supported by appropriate legislation, which should, in turn, be in harmony with laws concerning related sectors, and, where applicable, customary laws and rights.	x					
1.3	Effective regulations and administrative procedures	SFM should be encouraged by a lean bureaucracy, by fiscal and economic incentives, and by the elimination of excessive administrative requirements that often drive forest users into illegality.	x					
1.4	Forest law compliance and enforcement	Law compliance in the forest sector requires effective enforcement, control systems and institutions, as well as the effective dissemination of relevant information to actors and their capacity building. Policies on law enforcement should address the underlying	x	x	x	x	x	x

[5] Governments (generally forest departments under a specialized ministry; forest managers (public, private or community-based); private sector (e.g. downstream industries, investors); civil society (including NGOs); research and education organizations; and other stakeholders (including national-level extra-sectoral institutions and international organizations).

		causes of illegality and the need for remedial actions, assess the economic feasibility and social acceptability of reforms, and ensure stakeholder participation.						
1.5	Appropriate and capable institutions	There should be appropriate institutions with adequate personnel and other resources at all levels to promote SFM in a transparent manner.	x			x	x	x
1.6	Decentralized forest management	Appropriate political support and adequate planning, financial resources, capacity building and follow-up should be in place to create the enabling conditions for decentralized forest management.	x			x		x
1.7	Monitoring of SFM and the cross-sectoral forces that influence SFM	At the national level, there should be monitoring of progress towards SFM as well as of the external forces that affect forest management—including economic issues and market fluctuations, societal pressures, national development policies, and climate change. Forest monitoring systems should measure the impacts and progress of cross-sectoral forces.	x	x	x	x	x	x

Principle 2: Land-use planning and permanent forest estate **Managing tropical forests sustainably requires that land allocation to different uses and spatial planning within and outside forests ensure that the social, environmental and economic values of forests are maintained or enhanced. This, in turn, requires collaboration between sectoral institutions at the national or subnational level and negotiation among all stakeholders.**			**Indicative stakeholder group**					
			Government	Forest manager	Private sector	Civil Society	Research/education	Other
2.1	National and subnational land-use planning	A land-use policy aimed at the conservation and sustainable use of natural resources, including the establishment of a permanent forest estate, should be developed in collaboration with all stakeholders.	x	x	x	x	x	x
2.2	Permanent forest estate	Based on the land-use policy, suitable land, whether public or private, should be kept under permanent forest cover and so categorized in order to secure the multiple functions of forests and their optimal contributions to national development and ecological sustainability.	x	x		x	x	x

Principle 3: Security of tenure, access and use rights **Secure forest tenure and clearly defined access and use rights, including customary and traditional rights, are necessary conditions for SFM.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil Society	Research/education	Other
3.1	Security of forest tenure	Security of tenure is a necessary condition for SFM, based on legislation and recognized customary and traditional rights.	x					x
3.2	Clear and equitable rights to forest access and use	Rights to access and use forests and their goods and services must be clearly defined, documented and recognized (e.g. by demarcation, titling or customary practice).	x			x	x	x
3.3	Clear and respected traditional use rights	Recognized tenure, access and use rights of communities and indigenous peoples over publicly owned forests should be respected.	x			x	x	x

Principle 4: Multi-purpose forest management **The role of 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 the forest to yield the full range of benefits to society.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil Society	Research/education	Other
4.1	Forest resource assessment	National and/or subnational forest resource assessments and inventories, such as on timber and NTFPs, forest carbon, other ecosystem services and social aspects, should regularly be carried out.	x				x	x
4.2	Enabling environment for multi-purpose forest management	Policies and institutions should be reviewed to ensure they are effective in their support for multi-purpose forest management.	x	x	x	x		
4.3	Public participation in forest management	All stakeholders should have access to information on forest management and the opportunity to participate in decision-making processes.	x	x	x	x	x	x
4.4	Integrating emerging issues	Emerging issues such as climate change adaptation and mitigation should be identified and integrated into SFM, capturing synergies and addressing tradeoffs with existing	x	x	x	x	x	x

		objectives of forest management.						

Principle 5: Forest resilience **Resilience is a key tenet of SFM in natural tropical forests. Measures to conserve and enhance forest resilience should be incorporated in strategic and operational planning and implemented at the applicable scales.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
5.1	Forest health and resilience	Forests are vulnerable to abiotic and biotic effects, such as climate change, extreme events, fire, pests and diseases. Policies and programs to support preventative and remedial actions should be in place.	x				x	x
5.2	Conservation and use of biodiversity	Biodiversity should be used and conserved in ways that maintain forest resilience and to enable adaptation to future change. High-conservation-value forests should be identified and managed accordingly.	x			x	x	x
5.3	Maintaining functional forest ecosystems	Forests should be managed in ways that maintain their regenerative capacity and ecosystem resilience.	x	x			x	
5.4	Soil and water conservation	The conservation of soil and water is essential for maintaining the productivity and health of forests and their related aquatic ecosystems, supporting downstream water quality and flow, and reducing flooding and sedimentation.	x	x			x	
5.5	Restoring degraded forest ecosystems	To the greatest extent possible, degraded forest ecosystems should be restored to their original species composition, structure, biodiversity, productivity and ecosystem functions.	x	x			x	

Principle 6: Social values of forests and inclusive decision-making **Policies on forest management should recognize and aim to meet the social needs from forests. Decisions about SFM should be participatory and inclusive and the costs and benefits of forest management should be shared equitably among stakeholders.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
6.1	Livelihood benefits from SFM	The livelihood needs of people, including indigenous peoples and other vulnerable	x	x		x		

		forest-dependent peoples and communities, need to be addressed by national and subnational forest policies and programs related to SFM.						
6.2	Gender in SFM	Gender aspects should be integrated into national and subnational forest policies and programs related to SFM.	x	x				
6.3	Stakeholder participation and involvement	The participation of stakeholders, especially affected local communities, is an essential element of SFM. SFM policies and practice should be transparent and accountable, and effective conflict-resolution mechanisms should be in place.	x	x		x		
6.4	Observance of and respect for cultural and spiritual values	Cultural and spiritual values should be recognized and respected. Archaeological, cultural and spiritual sites should be identified and protected at the landscape level.	x	x		x		x

Principle 7: Economic viability **Capturing the full value of forests and ensuring the equitable distribution of costs and benefits are essential for SFM.**			**Indicative stakeholder group**					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
7.1	Financial viability	In order to manage the PFE sustainably, instruments should be developed to support acceptable financial returns for forest use and adequate financial compensation should be provided for otherwise unpaid ecosystem services and social benefits.	x					x
7.2	Equitable distribution of costs and benefits	The distribution among the principal stakeholders of the costs and benefits of forest management should be monitored to promote SFM.	x	x				
7.3	Economic instruments	Economic instruments, such as fees, taxes, incentives and bonds, should encourage SFM and discourage unsustainable and destructive use. They should also support the establishment of an efficient downstream industry and markets for forest products and the creation of payment mechanisms for	x					

		ecosystem services, such as those associated with water, carbon and biodiversity.						
7.4	Access to well-functioning markets	Efficient markets should be promoted as a way of encouraging SFM and preferential access should be provided for products from sustainably managed natural tropical forests.	**x**	**x**				**x**

Principle 8: Regional and international commitments **Legally and non-legally binding intergovernmental agreements at the regional and global levels to which countries have committed have implications for SFM.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
8.1	International commitments and the legal and regulatory framework	The national legal and regulatory frameworks for SFM should be adjusted, as appropriate, to incorporate the provisions of international commitments.	x			x	x	
8.2	International reporting requirements on SFM	Information systems should be developed or improved to provide data to meet international reporting requirements, including those of the International Tropical Timber Agreement, the United Nations Forum on Forests and the Convention on Biological Diversity.	x			x	x	
8.3	Institutional networking and collaboration	Networking and collaboration among national and international forest institutions, NGOs, the private sector and individual experts, using modern information and communication technologies, should be improved to provide more access to and the better dissemination of existing knowledge and experiences on SFM.	x	x	x	x	x	

MANAGEMENT PRINCIPLES IN NATURAL TROPICAL FORESTS

Principles 9–18 are designed to guide SFM at the FMU level.

Principle 9: Well-defined and established forest management units **SFM should be applied to clearly defined forest areas that are managed to achieve explicit objectives and according to long-term management plans.**			**Indicative stakeholder group**					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
9.1	Define and secure the FMU	As part of the PFE, FMUs should be clearly defined and have secure tenure or use rights and boundaries that are demarcated and respected.	x	x	x	x		
9.2	Forest management objectives	Management objectives should be established for an FMU, taking into account the tradeoffs needed to achieve the desired mix of forest goods and services and ensuring the long-term maintenance of the environmental, social and economic values of the forest.	x	x				
9.3	Zoning of the FMU	Wherever there is more than one management objective for an FMU, the process of forest management planning should include zoning by forest function.	x	x			x	

Principle 10: Management planning **Good planning, at the FMU and operational levels, reduces economic and environmental costs and is therefore essential for SFM.**			**Indicative stakeholder group**					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
10.1	Forest resource assessment	There should be a clear and reliable definition of all the resources in an FMU, irrespective of ownership or control.	x	x		x		
10.2	Forest management plan	An FMU should have an approved management plan with clearly stated management objectives and measures for achieving them; the plan should be periodically revised in the light of accumulated experience, new information and	x	x				

		changing circumstances.						
10.3	Non-timber forest resources	Forests may be managed primarily for the sustainable production of non-timber forest products.	x	x			x	
10.4	Ecosystem services	Forest management should take into account the potential for generating income from the ecosystem services provided by an FMU, such as those related to carbon, water and biodiversity.	x	x			x	
10.5	Adaptive management	An FMU should be managed using an adaptive learning approach that effectively supports decision-making in the planning, implementation, evaluation and modification of forest activities.	x	x		x	x	

Principle 11: Yield regulation and control **A reliable method for regulating and controlling yield is needed to ensure the sustainable production of timber and other forest products and services from each FMU.**			**Indicative stakeholder group**					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
11.1	Continuous forest resource assessment	Forest resource assessments should be carried out periodically to ensure the sustainable production of forest goods and services. They provide essential information not only on the quantities that may be harvested but also on the type and quality of forest produce that may be extracted.	x	x			x	
11.2	Sustainable levels of product harvesting	To ensure the sustainable production of wood and other forest products and services from an FMU, a reliable method for determining the annual allowable cut and controlling the harvest intensity should be adopted.	x	x			x	
11.3	Yield control	Forest managers should conduct regular checks to ensure that the annual allowable cut and other harvesting prescriptions are followed by logging crews.	x					

Principle 12: Harvesting operations **Reduced impact harvesting is a key element of SFM.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/educati on	Other
12.1	Harvest planning for optimal efficiency and to minimize impacts	Harvesting should be planned to enable good technical control, minimize harvesting costs and reduce environmental impacts.		x				
12.2	Efficient and safe harvesting operations	Harvesting practices and standards should be employed to ensure safe and efficient operations, minimize damage and waste and reduce environmental impacts, including from road construction and logging tracks.		x				x
12.3	Post-harvesting measures	Post-harvest measures should be undertaken as required, such as the deactivation of harvested areas, erosion mitigation, and the rehabilitation of high-impact areas.		x			x	
12.4	Harvest-quality assessment	The quality of harvesting operations should be assessed and the need for corrective actions or measures determined.	x	x			x	

Principle 13: Silviculture **Silvicultural interventions should be implemented in accordance with the management objectives defined in the management plan of an FMU.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/educati on	Other
13.1	Silvicultural assessment and planning	The need for and nature of silvicultural interventions in an FMU should be assessed.		x			x	
13.2	Silvicultural interventions	Silvicultural interventions should be implemented in accordance with specific prescriptions set out in the FMU's management plan.	x	x			x	

Principle 14: Forest protection **The forest needs to be protected from destructive and illegal activities.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
14.1	Illegal activities	The FMU should be protected from illegal activities, especially those that are incompatible with SFM.	x	x		x		x
14.2	Fire prevention and suppression	A fire management plan for the FMU and adjacent lands should be formulated and implemented.		x		x	x	
14.3	Management of pests and diseases	The management of pests and diseases should be an integral part of an FMU's forest management plan.		x			x	
14.4	Management of wastes and chemicals	All waste derived from, and chemical used in, forest management activities should be stored and disposed of properly.	x	x				

Principle 15: Biodiversity conservation at the FMU level **Management measures in production forests can make an important contribution to the conservation of biodiversity.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
15.1	Measures to conserve biodiversity	Biodiversity should be given a prominent place at all stages of the preparation and implementation of the management plan of an FMU.	x	x			x	
15.2	Monitoring biodiversity	Biodiversity monitoring should be in place to ensure that forest management does not impact negatively on biodiversity features identified as having special value.		x			x	

Principle 16: Community involvement in SFM **Community involvement is essential for SFM to succeed.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
16.1	Consultation with local communities	Free, prior and informed consent in forest management decisions should be obtained in an appropriate, consultative manner.		x		x		
16.2	Rights and responsibilities of local communities	Local communities should be fully informed of their responsibilities in forest management, which in turn should be commensurate with their rights to use and benefit from the forest.	x	x		x		
16.3	Equitable benefit-sharing	Benefits should be shared equitably among stakeholders according to their rights, roles and responsibilities.		x		x		
16.4	Community-based forest management	Local communities should have opportunities to actively and sustainably manage forests to increase income and improve living conditions.	x	x		x		

Principle 17: Working conditions and capacity development at the FMU level **The provision of safe and adequate working conditions and capacity building are essential elements for SFM.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
17.1	Rights and responsibilities of forest workers and local stakeholders	The rights and responsibilities of forest workers and local stakeholders in an FMU should be clearly defined, acknowledged and respected.		x				x
17.2	Occupational safety and health	Measures should be taken to ensure the safety and health of workers.						
17.3	Capacity building	Capacity building, including attention to workers' rights, skill development, and working conditions, is essential for SFM.	x	x			x	x

Principle 18: Monitoring, evaluation, research and communication **Monitoring, evaluation, research and communication are essential elements of SFM, providing a sound and transparent basis for guidance and feedback to improve the planning and implementation of operational activities.**			Indicative stakeholder group					
			Government	Forest manager	Private sector	Civil society	Research/education	Other
18.1	Monitoring progress in the implementation of forest management	A program should be put in place to monitor the implementation of an FMU's forest management plan and the impacts of interventions and to use the findings to improve forest management practices and revise forest management plans.	x	x		x		
18.2	Reporting	The information generated by a monitoring program should be reported regularly to the responsible people or organizational structures within the company, forest agency or other entity.		x				
18.3	Research	Ongoing research into the effects of forest management at the landscape, national and international levels should be complemented by research at the FMU level.		x			x	
18.4	Communication, transparency and public awareness	The public should be kept informed about the management of an FMU through clear and open communication and the provision of regular information, thereby helping to ensure market access and public acceptance of forest management.	x	x				

Part III –Principles, Guidelines and Recommended actions for The Sustainable Management of Natural Tropical Forests

FRAMEWORK PRINCIPLES FOR THE SUSTAINABLE MANAGEMENT OF NATURAL TROPICAL FORESTS

Principle 1: Forest Governance

Adequate national policies, laws and regulations are implemented and enforced with the support of appropriate institutions and by a strong and continued commitment to sustainable forest management by all stakeholders.

Governance is the process of governing, 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 government is accountable to its citizens and how society obliges its members to observe its rules and laws (FAO 2009).

Governance and REDD+.
Governance for REDD+ requires that mutually supportive arrangements be established among international obligations and opportunities and that these be balanced by national development priorities on the part of sovereign governments and by local conditions. It requires a framework which can effectively and reliably maintain multiple forest values and sustainably deliver appropriate benefits, incentives, payments and revenue (Hoosgafvel 2008).

Policies and laws provide incentives and disincentives which affect the behavior 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. Political will and good governance are, in turn, fuelled by adequate stakeholder participation and awareness in all sectors of the importance of sustainable management and use of natural tropical forests. Today, an effective forest policy is widely understood as a negotiated agreement among government and other stakeholders on a shared vision on forests and their use (FAO 2010a).

GUIDELINES

Guideline 1.1 Political commitment and supportive policies for SFM

There should be a strong and continued political commitment and an enabling policy environment to formulate, reform and implement policies within and outside the forest sector for the effective implementation of SFM.

A national forest policy is understood as a negotiated agreement between governments and stakeholders on the orientations and principles of actions they adopt, in harmony with other national socio-economic and environmental policies, to guide decisions on the sustainable management of forests for the benefit of society. It guides present and future decisions relating to forests, determines appropriate actions and

provides directions over a period of time. Forest policy goals should be clearly linked to national development strategies that determine wider societal developments. For example, new challenges relating to food security, energy security and climate security open up possibilities for a wide array of new forms of forest management. Forest policies no longer address only the traditional aspects of forestry, but 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 (FAO 2010a). Considerations in deciding on a forest policy include inter alia the present proportion of land under forest cover, the needs and aspirations in regard to forests of present and future generations of the population, the place of forestry in national economic planning, and the needs of protection and conservation of biological diversity.

Recommended actions:

- Develop, jointly with all interested stakeholders, a formal forest policy statement that implies the formulation of a shared vision and goals on forests and lays out the strategies for their achievement. Consider in the further formulation of the forest policy to be embedded within a broader national policy context.
- Specific topics of forest policy should be developed with one or several other sectors. This comprise e.g. a national land use policy aiming at the sustainable use of all natural resources, including the establishment of a permanent forest estate (PFE).
- Conceive and implement forest policies in concert with improvements in tenure rights and other issues of resource access. These policies should also be developed in close dialogue with forest-dependent groups and those who work with them.
- When revising an existing forest policy or developing a new forest policy, allow flexibility for the methods to be used. A mechanism should be established for regular revision of policy in the light of new circumstances and/or availability of new information or opportunity to manage forests.
- Consider maintaining a permanent platform for dialog among stakeholders to allow continuous adaptation and fine-tuning of forest policy and its implementation.

Guideline 1.2: Coherent and coordinated policy and laws

An agreed, up-to-date forest policy should be supported by appropriate legislation, which should, in turn, be in harmony with laws concerning related sectors, and, where applicable, customary laws and rights.

A forest policy sets out a broad vision or goal and a long-term direction about forests and their use but does not specify in detail the instruments or practices to implement it. One key instrument for implementing a forest policy is the forest legislation. While government policy needs to be consistent with the Constitution and other overarching legislation of a country, all laws, including those pertaining to forests, need to be based on policies. Thus, a policy needs to be developed before any aspect of it can be made legally binding. The primary purpose of forest legislation is the distribution and enforcement of rights and responsibilities that support the sustainable management of forests. A forest legislation that is generally accepted and implementable can only be drafted in a meaningful way after the policy decisions have been made.

Recommended actions:

- Based on an updated forest policy, ensure compatibility between laws, regulations and the institutional frameworks at different levels of decision making — federal/central, state and municipal — and also with related sectors (notably agriculture, energy, tourism, and mining).
- In revising legislation that regulate sustainable forest management, observe principles for drafting better forestry laws as defined by Lindsay (2002): (i) avoid legislative overreaching; (ii) avoid unnecessary or superfluous licensing and approval requirements; (iii) enhance provisions for transparency and accountability; (iv) enhance role of stakeholders; (v) ensure that the drafting of laws is participative; and (vi) ensure that the law includes direct enforcement mechanisms.
- As defined in the forest policy, incorporate in the legislation the regularization of property rights, land tenure and the usufruct of forest goods and services.

Guideline 1.3: Effective regulations and administrative procedures

Sustainable forest management should be encouraged by a lean bureaucracy, by fiscal and economic incentives, and by the elimination of excessive administrative requirements that often drive forest users into illegality.

Legislation is setting out rights and obligations and institutionalizing the rules through primary legislation (as prescribed in Guideline 1.2) and secondary legislation, defined by e.g. regulations, decrees, ordinances and by-laws. Many implementation aspects of SFM policies, e.g. encouraging certain type of behavior, prohibiting certain conduct, providing for sanctions or offering foundations for actions are defined at such secondary legislative level. Often, that level is much influenced by bureaucracy and has the potential to comprise some undesired consequences, e.g. excessive administrative requirements or incentives and disincentive measures that do not correspond to the needs of adaptive management. Addressing effective regulations and defining clear and implementable administrative procedures is key for sustainable forest management.

Recommended actions:

- Ensure consistency of the regulatory framework to make certain that rules and regulations do not contradict others within the forest legal framework or other sectors.
- Minimize bureaucracy, streamline legal procedures and adopt simple regulations, for instance through decentralization, avoiding regulator proliferation and promote transparent and simple forest regulations concerning forest management planning.
- Foster and practice a transparent governance culture in administrative processes. Keep and promote a transparent process to allow the public to be informed of government decisions that affect them. This requires constant explanation and discussion.

Guideline 1.4: Forest law compliance and enforcement

Law compliance in the forest sector requires effective enforcement, control systems and institutions as well as the effective dissemination of relevant information to actors and their capacity building. Policies on law enforcement should address the underlying causes of illegality and the need for remedial actions, assess the economic feasibility and social acceptability of reforms, and ensure stakeholder participation.

The lack of forest law compliance and good governance has far-reaching environmental, social and economic consequences in-side and outside forests. Although the extent of illegal forest activities is

notoriously difficult to quantify, their economic cost is likely to be high. Five factors give rise to a lack of forest law compliance: (i) failings in the policy and legal frameworks, (ii) insufficient enforcement, (iii) a lack of information, (iv) corruption, and (v) market distortions. Problems relating to inconsistent forest policy and legal frameworks arise when laws are incoherent, unrealistic and unenforceable and fail to address forest land tenure and use rights. Excessive regulations can mean that the transaction costs of legal operations are prohibitively high and push forest users to illegal practices. Insufficient enforcement capacity is often due to institutional weaknesses coupled with 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, government institutions and among local decision-makers is linked to a lack of transparency in policy implementation, the marginalization of rural people, and a lack of public scrutiny. Market distortions for wood products can occur in domestic and export markets where there are ready outlets for low-priced illegally harvested products.

Recommended actions:

- Build institutional capacity for forest law enforcement. This may include *inter alia*: (i) increasing the operational capacity of the forest administration to detect and suppress forest crimes; (ii) promoting better interagency linkages at national and local levels; establishing partnerships with appropriate NGOs, civil society or private sector actors to support enforcement and/or monitoring; (iii) encouraging the development and use of independent forest certification and voluntary corporate codes of conduct; (iv) enabling citizens, supported where necessary by NGOs and government agents, to assist in monitoring and detecting forest crime; (v) monitor the informal sector and small-scale producers in the use of resources
- Make the legal option more financially attractive (e.g. by reducing the costs of accessing legality), create rules that can be implemented and sanctioned, define standards according to objectives and scales, incentive dialogue and agreement among legitimate actors, and eliminate obstacles to use of technology in order to increase transparency and control.
- Assure that accurate and up-to-date information for forest crime prevention, detection, monitoring, reporting, investigation and eventually suppression is made available.
- Strategies for control of illegal activities should focus on preventive actions coupled with incentives to promote attractiveness of forest-based legal activities. This includes measures such as: training, deregulation, financial incentives (*e.g.*, devolution of stumpage, tax reductions for investments in integrated productive chains), better technical assistance services, greater access to information and technology, and better service of government staff
- Ensure that regulatory frameworks are enabling as well as enforcing. They should enable key stakeholders to improve their own livelihoods and the condition of forests by removing any constraints that inhibit them from doing so.

Avoiding unsustainable use and degradation of forests – Some basic policy measures (FAO 2005)

a) assess underlying social, economic, cultural and political causes of noncompliance to rules and regulations;
b) analyze the impact of the forest policy and legal framework on the livelihoods of local people;
c) increase clarity, transparency and consistency of forest and forest-related legislation
d) promote transparency, reduce the potential for corruption
e) secure forest land ownership rights in order to ensure accountability;
f) ensure that in-country industrial capacity does not exceed sustainable supplies;
g) increase the competitiveness of legal operations;
h) promote the independence of the judiciary and transparency of judicial processes.

Guideline 1.5: Appropriate and capable institutions

There should be appropriate institutions with adequate personnel and other resources at all levels to promote SFM in a transparent manner.

As part of an effective governance arrangement, there must be adequate institutions and personnel at all levels to undertake sustainable forest management. These include effective government agencies that guide and supervise forest management, forest managers and other implementing agencies, research institutions and appropriately trained personnel to ensure that management is in accordance with scientific and technical knowledge. Nonetheless, forest institutions also need to be able to appropriately deal with non-technical issues as balancing conflicting interests in SFM is often rather a political and societal than a technical matter. The diversity of public and private stakeholders involved in policy implementation calls for the need to be explicit about the division of responsibilities among different government institutions and stakeholder bodies.

Hurdles towards effective decentralization

- ✓ Unwillingness on the part of those in power to cede significant authority and resources
- ✓ Uneven local capacities and will
- ✓ Elite capture
- ✓ Unclear guidance and division of labor among governmental levels
- ✓ Inadequate resources to accomplish the goals of decentralization

Recommended actions

- Establish an organizational structure responsible for the direct or delegated management of all forests that has adequate, well-trained, competent and efficient human resources for carrying out its mission.
- Maintain an appropriate structure and provide sufficient funding to enable implementing agencies for forests and forestry dispose of an adequate number of professionals and technical personnel at all levels to perform and support SFM.
- Develop clear terms of reference for implementing agencies for forests and forestry. Assure that they include provisions for assistance to customary rights holders and private forest owners to manage the forests sustainably.
- Strengthen forest education and forestry research in technical areas as well as in non-technical issues, knowledge and skills to determine and understand what society wants and needs from forests.

Guideline 1.6: Decentralized forest management

Appropriate political support and adequate planning, financial resources, capacity building and follow up should be in place to create the enabling conditions for decentralized forest management.

Decentralization is based on the ideals of greater accountability in local governments for sustainable forest management, increased voice for local communities and more appropriate use of forest resources. Decentralization is implemented through the delegation of authority and responsibilities for the development of the forest sector at local levels to municipalities, communities and other local players. It requires considerable efforts by government officials to coordinate and collaborate not only across sectors but also across different levels of government as more levels of government share responsibility for implementation of SFM. Thus, public agencies at all levels need to have goals, structures and capacities to discharge their mandate in respect to SFM.

In order to have an effective decentralization process, it is critically important to establish a dynamic balance between authority, accountability mechanisms, responsibilities and revenue sharing across different levels of government. Experiences from diverse countries indicate that the relationship and balance among these elements determine, to a large extent, the effectiveness and efficiency of decentralized systems of forest governance (Colfer and Capistrano 2005). Equally important are effective linkages with other sectors that affect or are affected by the forest sector. In general terms, successful decentralization is linked to secure tenure and access to forest resources, financial means and authority at lower levels, commercials rights and market access, and sensitivity to cultural traditions and local knowledge.

What kind of deforestation should be monitored and avoided?

- ✓ When it is not efficient from an economic perspective in the longer term and the widest sense;
- ✓ When it is a threat to broader environmental stability at the landscape level;
- ✓ When it leads to social inequities and conflicts;
- ✓ When it leads to levels of biodiversity loss which unduly limit options for present and future generations.

Recommended actions

- In support of decentralization processes, central governments should gradually increase local government's awareness, coordination and ownership for sustainable forest management. Such processes should both benefit from as well as enhance social capital, increasing coordination and trust among different levels and sectors.
- Facilitate delegation of administrative power from national governmental institutions to local public institutions and civil society groups. In order to create an environment that promotes successful implementation of SFM in a decentralized institutional setting, local institutional capacity needs to be strengthened through extensive training, technical assistance, financial resources and empowerment of the different social actors.
- Strengthen further the capacities of local constituencies *(e.g.*, municipalities, communities) in terms of organization and managerial skills to develop and implement norms that are more adequate and adapted to the local realities and conditions managing forests sustainably.
- Decentralization of managing forests should take into account livelihoods, ways for life and improving the economic well-being of local peoples, as well as address inequities such as those relating to gender.

Guideline 1.7: Monitor of SFM and the cross-sectoral forces that influence SFM

At the national level, there should be monitoring of progress towards SFM as well as of external forces that affect forest management – including economic issues and market fluctuations, societal pressures, national development policies, and climate change. Forest monitoring systems should measure the impacts and progress of cross-sectoral forces.

Forest managers need to content to various forces that affect the way how forests are managed (see Figure 1). The upmost and most crucial threat to SFM is deforestation. Social and economic pressures make it almost certain that substantial areas of what is still natural tropical forest today will be converted to agricultural production. The decision on where and what to convert, and for whose benefit, is one of the most crucial in land-use planning. Such a decision is usually taken at a national or sub-national level; nonetheless, the decision to convert forest to another land-use is often made on an ad hoc basis, without effective and transparent participatory mechanisms. Thus, monitoring of cross-sectoral forces is of upmost importance for implementing SFM. Forest monitoring systems need to be adjusted to measure impacts and

progress of cross-sectoral forces. Climate change in particular (including changes in forest carbon stocks as well as factors related to adaptation) often exacerbate other factors facing forests, but may also create new opportunities.

Recommended actions

- Monitor cross-sectoral human-induced forces that influence the sustainable management of natural tropical forests. Determine extent and nature of forest encroachment, degradation and disturbance and the control procedures applied.
- Assess in particular drivers of deforestation and forest degradation at national and landscape level. Consider the results of such analytical work in an adaptive forest management planning process.

Forests at landscape level: Four fundamental questions

- ✓ How much forest do we need or want?
- ✓ What kinds of forest should there be?
- ✓ Where should it be situated?
- ✓ How should it be preserved and managed?

Principle 2: Land use planning and Permanent Forest Estate

Managing tropical forests sustainably requires that land allocation to different esess and spatial planning within and outside forests ensure that the social, environmental and economic values of those forests are maintained or enhanced. This, in turn, requires collaboration between sectoral institutions at the national or sub-national level and negotiation among all stakeholders.

RATIONALE

Sustainable forestry requires good planning that strategically begins with an integrated land-use plan. This plan serves as the backdrop for the allocation and wise use of the resources in a particular area of forest, and for the conservation of the area's ecological integrity (Canadian Council of Forest Ministers)6.

Comprehensive land-use planning and land management is important for creating functional landscapes where agriculture, sustainably managed forests, conservation areas and other land uses are integrated in a sustainable manner. To achieve this, integrated, cross-sectoral, landscape-scale planning and development approaches, which simultaneously focus on different economic activities and social and environmental values over broad areas, are needed (IUFRO/WFSE 2010).

To sustain biological diversity and ecosystem services, efforts must be made to conserve trees and a large spectrum of forest types across the landscape through a combination of protected areas and the application of sustainable management practices. The reduction of landscape fragmentation is also necessary for conservation of biodiversity and related ecosystem services. More attention must be directed to restoration of landscape integrity through biological corridors and landscape connectivity, which facilitate species migration and the long-term viability of populations (IUFRO/WFSE 2010).

Land use planning - both at the micro and macro scale - should be made using a participatory and equitable approach involving all relevant sectors in order to prevent unplanned and uncoordinated changes in land use driven by factors outside of the forest sector (such as cattle farming, biofuels, soy and palm-oil plantations, etc.) (Holopainen and Wit 2008).

Classifying a Permanent Forest Estate (PFE) is a central requirement for SFM. ITTO defined the PFE as "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 fulfill a combination of these functions.

GUIDELINES

Guideline 2.1: National and sub-national land use planning

[6] "An 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).

A land use policy aimed at the conservation and sustainable use of natural resources, including the establishment of a Permanent Forest Estate, should be developed in collaboration with all stakeholders.

Land use planning at landscape level should balance the developmental needs of a country as a whole, or for specific states or provinces within a country, with those of natural resources conservation, including SFM. A fundamental component of national land use planning is identification of a Permanent Forest Estate (PFE), comprising forests of all ownership types.

Traditionally the objective of producing wood was overwhelmingly important. The awareness that forest management decisions and developments in other sectors are closely interconnected recently led to approaches to SFM that require a broader perspective that more closely integrates the management of forests with economic, ecological and social realities. Planning thus tends to gravitate to the landscape level, an area large enough that will be able to be resilient and to keep its ecological integrity. Landscape management is an essential approach for the sustainable management of natural resources, one that requires coordinated inter-institutional action and the effective participation and involvement of diverse stakeholders. The failure to use this approach and the lack of land-use planning has contributed in many countries to processes of landscape degradation and fragmentation.

Recommended actions

- Assure that a national forest policy is forming an integral part of a national land use policy taking into account the multiple-use nature of forests. The designation and allocation of land should be based on as much relevant environmental, social and economic information as possible. These facts may best be supplied by environmental resource surveys, sensitive analysis of the needs and desires of people who will be affected and a careful assessment of demand and markets.
- Efforts should be made to empower and build the capacity of local people, NGOs, extension agencies, governments, and other local institutions for planning and implementing sustainable land uses.
- Planning at landscape level must be flexible to allow for changing circumstances. However, basic decisions on land-uses should be taken to guarantee sustainability of natural resources, including forests.
- Provide quality assistance on land-use planning for smallholders (surveying, demarcation, titling, etc.) in order to encourage them to invest in forestry.

Guideline 2.2: Permanent Forest Estate

Based on the land-use policy, suitable land, whether public or private, should be kept under permanent forest cover and so categorized, in order to secure the multiple functions of forests and their optimal contributions to national development and ecological sustainability.

A key policy feature of SFM is a commitment by government, endorsed by all stakeholders, to define, and defend a Permanent Forest Estate (PFE) based on secure, long-term land tenure for communities, concession holders and other forest users. The different categories of land to be kept under PFE are: land to be

A key issue in Forest Tenure (FAO 2011a)

Communities living adjacent to forests, particularly those that depend on forests for livelihood support, have frequently developed customary institutional arrangements that define locally relevant access and use rights. These arrangements often overlap and conflict with State-defined legal tenure

protected (e.g. forests on fragile land), forests set aside for plant and animal and ecosystem conservation, land for production of timber and other forest products, and land intended to fulfill combinations of these objectives. Forest set aside for promoting productive and other functions need a balanced management combining productive, environmental and social 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 (Johnson and Cabarle 1993).

Recommended actions

- At landscape level, plan and map the permanent forest estate. Forests that are to be managed for different long-term purposes should be clearly defined as such. *Geographic information systems* (GIS) and satellite remote sensing are valuable tools for forest mapping and zoning, serving for modeling alternative technical options as an aid in decision-making.
- When establishing the area that should be kept under permanent forest estate, emphasize on the integrity of the forest's ecological functions, the continuity of the forest's productivity, and the continuity of the forest's socio-cultural functions
- Based on initial plans of zoning the PFE at landscape level, consult with surrounding populations, taking into account their present and future needs for agricultural land and their customary use of the forest.
- Land destined for conversion to other uses (agriculture, mines, etc.), and any land for which the final use is uncertain, should be kept under managed forest until the need for clearing arises.

Principle 3: Security of tenure, access and use rights

Secure forest tenure and clearly defined access and use rights, including customary and traditional rights, are necessary conditions for sustainable forest management.

RATIONALE

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 on the land (Romano and Muller 2009).

Secure forest tenure is a fundamental element in achieving improved livelihoods and sustainable forest management. It is a strong incentive for investing in forest resources and their management.

Conflicting issues in tenure and legislation need to be resolved. Incompatibility between traditional tenure rights (land, trees and other resources) and formal land allocation have often led to contradictory (and free access) situations, resulting in the mismanagement of forest resources. These conflicting issues need to be harmonized and streamlined, whereby customary laws are incorporated into formal land allocation laws. In this respect, multi-stakeholder participation as well as appropriate rules and regulations to enforce

legislation at the local level are key issues necessary. The status of women, landless, tenants and immigrants, in particular, needs to be reviewed as they play an important role in the management of this resource.

Forest tenure reform should be implemented as part of a holistic and integrated reform agenda. The reform of forest tenure is a learning process and requires an adaptive, deliberative, reflective and multi-stakeholder approach.

Guideline 3.1: Security of forest tenure

Security of tenure is a necessary condition for sustainable forest management, based on legislation and recognized customary and traditional rights.

Forest tenure reform should be embedded within the overall development agenda of the country or region. 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 and to titling, but some kind of formal recognition is necessary.

When undertaking a forest tenure reform a careful review of current policies and laws is necessary to ensure that they are supportive to the reform and do not present inconsistencies or contradictions to the objectives of the reform. A land-use planning process, as outlined in Guideline 2.1, should take as a starting point the identification of forest user rights and traditional ownership and control of land.

Recommended actions

- Provide secure and long-term access or ownership rights to forest resources. Forest tenure reform should not be limited to recognizing or granting title and/or usufruct rights, but implemented as part of a holistic and integrated reform agenda supported by related forest policy, legislation and institutional arrangements.
- When conducting a tenure reform, carefully verify current land ownership. Updating of the cadastral system and the development of a data management system that allow them to keep track of who owns and manages forests might be needed.
- Carefully define the rights for access and use and appropriate duration for use, including specific rights on e.g. products and services, such as NTFP, water rights and rights to and trade of forest carbon.
- Harmonize and streamline conflicting issues, inter alia through incorporating customary laws into formal land allocation laws.

Guideline 3.2: Clear and equitable rights to forest access and use

Rights to access and use of forests and their goods and services must be clearly defined, documented and recognized (e.g. by demarcation, titling or customary practice).

Any new tenure system involving local stakeholders should provide adequate incentives for the new owners/managers to invest human and financial resources in SFM. Incentives can be economic, but should encompass also an increased sense of ownership, equity and empowerment in decision making. Long term arrangements are preferable over short or medium term arrangements because they provide a stronger sense of security.

Forest concessions are a form of forest tenure. They involve a contract between the forest owner and another party giving rights to harvest specified resources from a given forest area (forest utilization contracts) and/or a contract to manage given resources within the specified forest area (forest management services contracts).

Recommended actions

- Relevant customary tenure systems should be identified, recognized and incorporated into regulatory frameworks.
- Where appropriate, policies and laws should allow for the recognition of customary tenure systems and be attentive to the needs of the poorer and marginalized sections of the population.
- Administrative procedures must be simple, easy to understand and affordable for local stakeholders.
- Strengthen knowledge and information about forest tenure with accurate, detailed, and publicly available information on the ownership and control of forest resources.

Guideline 3.3: Clear and respected traditional use rights

Recognized tenure, access and use rights of communities and indigenous peoples over publicly owned forests should be respected.

Formal recognition may also "legitimize" customary tenure systems, which otherwise are often in danger of being ignored or undermined, especially when different interest groups compete for the same resources. It may thus contribute to reducing conflict potential in forest areas.

Recommended actions

- When pre-existing customary rights are recognized or new rights are formally granted supportive measures should be in place to ensure that smallholders and local and indigenous communities know their rights and responsibilities and have the capacities to obtain the benefits provided by access to forest resources.
- Administrative procedures must be simple, easy to understand and affordable for local stakeholders. The requirements for forest management plans that have usually been developed for the management of large forest areas might need to be simplified and adapted to the management objectives and capacities of local forest owners and managers.

Principle 4: Multi-purpose forest management

The role of 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 the forest to yield the full range of benefits to society.

RATIONALE

Forests can be managed for multiple, most times complementary objectives: production of goods, protection of soil and water and other environmental services, conservation of biodiversity, provision of socio-cultural services, livelihoods support and poverty alleviation (FAO 2010).

Multiple-purpose forest management (also called multiple-use management) has been envisioned as a promising and balanced alternative to single timber-dominated strategies of forest use. It can be found in existing livelihoods of forest dependent peoples, the operations of some forest industries and is even supported by some regional forest legislation. However, in practice, multiple-purpose management is not a dominant strategy and is often a marginal activity in forest sectors. Incipient efforts are emerging ranging from community forestry projects to national programs to develop comprehensive REDD+ strategies, but much more could be done to diversify and enhance multiple-purpose management (Guariguata *et al.* 2008).

Under the right conditions, multiple-purpose forest management could diversify forest use, broaden forest productivity and provide incentives to maintain forests. It could also allow a greater number of stakeholders to participate in forest benefit streams. In addition, multi-purpose management could provide a venue for reducing social conflict and exclusion related to remaining forest resources. It could also provide useful alternatives for reducing forest degradation.

The multi-purpose approach applies to the management of primary as well as secondary and degraded forests. In secondary forests, in particular, the multiple-use (edible fruits, firewood, wood for rural construction and handcrafts, medicinal compounds, etc.) of many species growing in those stands is one of the most important features to take into account for management purposes.

GUIDELINES

Guideline 4.1: Forest resources assessment

National and/or sub-national forest resources assessments and inventories, such as on timber and NTFPs, forest carbon, other ecosystem services and social aspect, should regularly be carried out.

Multi-resource inventory (MRI) refers to "data collection efforts designed specifically to meet all or parts of the information requirements for two or more functions, e.g. forest products, wildlife carbon etc. The objective is to collect the needed information at least cost and present it in such a way so it is available and useful to the maximum number of decision-makers" (Lund and Wigton 1996).

A first consideration in planning for multi-resource forest inventories is to decide what forest resources or production capabilities to look for, i.e. the assessment of the production possibilities. As a second consideration is the assessment of relative economic values of, and of the level of demand for the various resource services of the forest (Bowles and Krutilla 1989). The generally little knowledge available about the resource possibilities and the economic value of mostly non marketed commodities pose difficulties that may be overcome by a incremental, and even experimental approach.

Recommended actions

- Multi-resource inventories should be carried out at national level including information on timber and on the existence, abundance and distribution of *all* currently and potentially useful plants, threatened and endangered and wildlife. Combine remote-sensing and field assessment methods.

- If forest carbon is considered as a management option, integrate into the national multi-resource inventory the specific assessment methods that are proposed at international or national level; decide if the assessment is done for all five carbon pool or focused on the main pool(s).

Guideline 4.2: Enabling environment for multi-purpose forest management

Policies and institutions should be reviewed to ensure they are effective in their support for multi-purpose forest management.

Conflicts over use can be minimized by legally protecting those tree species whose economic and social value as NTFP equals or exceeds its timber value. For example, such a protection currently exists for Brazil nut (*Bertholletia excelsa*, Lecythidaceae) trees in Brazil, Peru and Bolivia due to their importance in contributing to supporting extractive communities throughout the Amazon Basin (Ortiz 2002, Peres et al. 2003).

However, in other cases the degree of conflict between concurrent uses may be culturally and geographically specific which complicates the necessary steps for legal protection at wider spatial scales.

Recommended actions

- Adequately access different user rights in forest areas prior to new management options
- During the execution of forest inventories mark tree species individuals that produce valuable NTFP.

Guideline 4.3: Public participation in forest management

All stakeholders should have access to information on forest management and the opportunity to participate in decision-making processes.

Public participation is needed to ensure that forest management planning and implementation incorporates a wide range of values, priorities and knowledge, and to provide oversight of a key public resource. The Joint FAO/ECE/ILO Committee on Forestry Technology, Management and Training (2000)[7] defined *public participation in forestry* as "various forms of direct public involvement where people, individually or through organized groups, can exchange information, express opinions, and articulate interests, and have the potential to influence decisions or the outcome of specific forestry issues."

One of the core principles of SFM is that it reflects a diverse range of societal values in reference to forest conservation and use. For this reason, the active and informed participation of stakeholders affected by forest management decisions is critical to the credibility and sustainability of management processes. Public awareness raising and communication activities play a critical role in informing and educating the public, thereby allowing them to more effectively participate in SFM decision-making (CBD 2009).

[7] Joint FAO/ECE/ILO Committee on Forest Technology, Management, and Training. 2000. Public participation in forestry in Europe and North America. Report of the Team of Specialists on Participation in Forestry. International Labour Office, Sectoral Activities Department, Geneva, Switzerland. Reference cited by Parkins et al. (2006).

Raising awareness[8] can contribute to public involvement in that it helps people formulate their interests, knowledge and understanding as being a precondition for real participation. However public participation processes are also an important means of raising awareness: the involvement of the public in forest management decision-making is an important way of transmitting knowledge and values. They provide opportunities for dialogue, mutual learning, and trust (FAO/ECE/ILO 2003).

[8] ***Awareness raising*** is «a multi-way communication and interaction process which empowers people. This provides the basis for long-term relations and partnerships between the forest sector and the public, and enables better informed decision making ». In this sense awareness raising can be considered as an integral part of the social dimension of sustainable forest management (FAO/ECE/ILO 2003).

Recommended actions

- Allow for public multi-sectoral participation in the decision-making process for managing natural forests, for instance, making forest management plans available for inspection by the public
- Develop pathways for more transparent information and communication that are locally accepted and that are adaptable for community and other stakeholders.
- Whenever possible, make use of modern information and communication technologies for timely, improved access and outreach targeted to different audiences.

Achieving Public Participation

i) open discussions such as workshops;

ii) policy memos or policy briefs – developed with local stakeholders and widely distributed;

iii) publishing local policies in printed and electronic media;

iv) public hearings in local parliament or similar governance entity; and

v) distributing draft regulations to various stakeholders, asking for and using feedback to formulate final regulations.

Guideline 4.4: Integrating emerging issues

Emerging issues such as climate change adaptation and mitigation should be identified and integrated into sustainable forest management, capturing synergies and addressing tradeoffs with existing objectives of forest management.

Sustainable forest management provides a flexible, robust, credible and well-tested framework for addressing emerging issues concerning forests. Some issues, that are classified as emerging in these days have been internalized in forest management since many years: the regulatory function of forests on freshwater is well known; also the renewed regard on the role of forests to deliver bioenergy is well known (fuelwood) even that today new demands and technologies are at stake. The role of forests to simultaneously reducing carbon emissions, sequestering carbon, and enhancing adaptation to climate change is however a new challenge for SFM. At the same time, forests can help supply environmentally friendly forest products, protect biodiversity, secure freshwater supplies and other essential ecosystem services, providing an effective framework for forest-based climate change mitigation and adaptation.

Recommended actions

- Include particular societal demands in the resource assessment, planning and implementation strategies for SFM at national and/or sub-national level. New and emerging issues are often considered from a non-technical angle and need to be embedded into the overall forest management approach.
- Assure accurate forest monitoring and assessment of such new and emerging issues in SFM; such assessment - requiring greater coordination at all levels - is needed for informed decision-making.
- In respect to the role of forests in climate change, incorporate adaptation and mitigation, including REDD+ and other climate change initiatives, into national forest management planning and in the broader national development strategies through multi-stakeholder consultations.

Principle 5: Forest Resilience

Resilience is a key tenet of sustainable management in natural tropical forests. Measures to conserve and enhance forest resilience should be incorporated in strategic and operational planning and implemented at the applicable scales (national, sub-national, local).

RATIONALE

Forest management should be adaptive according to the specific circumstances where it is applied. It should be based on monitoring and evaluating the outcomes of actions, learning lessons, and applying them. Management needs to be site and circumstance specific, which is *per se* superior to generic defined prescriptions at a national level. One main objective of forest management at all levels is to maintain the functions of the ecosystems in the long term. Addressing forest resilience, including biodiversity contributes to the functions of the ecosystems increasing its stability and durability for the production of timber and other products.

Biodiversity plays an important role in ecosystem functioning and is essential to ecosystem resilience. A good understanding of forest successions and the dynamics of climax (primary) forests is essential to maintain or increase resilience of forests to adverse effects. Of particular interest are the habitat requirements of the different species of interest for production and conservation. Efforts to implement SFM need to consider numerous ecological interactions such as the pollination, seed dispersal and symbiotic relationships on which the productive forest depends.

To sustain biological diversity and ecosystem services, efforts must be made to conserve trees and a large spectrum of forest types across the landscape through a combination of protected areas and the application of sustainable management practices. The reduction of landscape fragmentation is also necessary for conservation of biodiversity and related ecosystem services (IUFRO/WFSE 2010). All significant management interventions in natural forests have impacts on forest resilience, and in particular on biodiversity; thus, due consideration to strategies and specific measures in forest management planning and implementation in respect to forest resilience are primordial.

Some ways to mitigate biodiversity impacts of forest management in tropical regions *(Source: ITTO/IUCN 2008)*

Measures to reduce the damage done to the forest by harvesting, road-building and other forest practices are likely to be beneficial to increase forest resilience. Many such measures are already incorporated in SFM under the umbrella of reduced impact logging, but more can often be done. It should be possible, for example, to protect important habitat structures – such as large trees, hollow trees, dead stems and fruiting species. Special habitats such as pools, wallows, salt-licks, edible clays, caves, and leaking and nesting sites could also be protected. Reducing timber extraction rates and lengthening recovery periods will also reduce the impact of logging on the forest and its biodiversity.

GUIDELINES

Guideline 5.1: Forest health and resilience

Forests are vulnerable to abiotic and biotic effects, such as climate change, extreme events, fires, pests and diseases. Policies and programs to support preventative and remedial actions should be in place.

Recommended actions

- Strengthen forest authorities, both technically and financially, to perform their normative and supportive duties related to increase forest resilience in managed natural forests.
- Secure technical support to private and community forest owners to ensure that their activities contribute to increase the resilience of forests to negative abiotic and biotic effets.
- Maximize the effective use of scarce resources available through efforts to: (1) improve the availability of basic reference materials, (2) improve access to current information, (3) establish technological information systems, and (4) supply adequate equipment and the means for its use and maintenance
- Assess the impacts and risks of climate change on the forests (including *inter alia* yield prediction, harvesting, livelihood impacts)
- Monitor forest responses to climate change (e.g. at the level of species responses, ecosystem processes such as hydrology, nutrient cycles, carbon balance and economic factors)

Guideline 5.2: Conservation and use of biodiversity

Biodiversity should be used and conserved in ways that maintain forest resilience and to enable adaptation to future change. High conservation-value-forests should be identified and managed accordingly.

An important argument for why forest managers should conserve biodiversity is that it will help ensure the healthy functioning of their forests. In the long run, forests will produce more valuable products and will be more resistant to external changes, including climate change, if they retain as much of their natural biodiversity as possible.

Recommended actions

- Ecological knowledge should be improved and applied to ensure that forest management enhances or maintains biodiversity and thus ensures forest functions such as pollination, seed dispersal and nutrient cycling. The ecology and habitat requirements of species of both commercial and conservation concern need to be understood and addressed in forest management planning.
- Special management consideration should be given to species that are strongly interactive or play a key role in the ecology of other species or have important influences on the overall ecology of a forest and the survival of other species.

Guideline 5.3: Maintaining functional forest ecosystems

Forests should be managed in ways that maintain their regenerative capacities and ecosystem resilience.

The conservation of ecosystem diversity can best be accomplished by the establishment and management of a system 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 fulfill many of the objectives of protected areas and effectively fulfill the role of stepping stones. Management measures in production forests can make an important contribution to the conservation of biodiversity by contributing to forest quality and making conservation in neighboring protected areas more effective. Effectiveness and efficiency of conserving functional forest ecosystems can be best ensured by effective land-use policies that are developed with and through the involvement of local communities.

Recommended actions

- Develop a functional forest ecosystem at landscape level that include protected areas and stepping stones with well defined roles for natural production forests.
- Develop procedures for the protection and monitoring that include: (a) retaining a considerable portion of undisturbed forest areas; (b) protecting rare, threatened and endangered forest species of faua and flora; (c) protecting features of special biological interest (e.g. nesting sites, seed trees, niches, keystone species, etc); and (d) assessing recent changes in (a), (b) and (c) above through inventories, monitoring/assessment programs and comparison with control areas.
- Integrate measures to increase resilience and conserving biodiversity in harvesting and silvicultural practices in natural production forests

Guideline 5.4: Soil and water conservation

The conservation of soil and water is essential for maintaining the productivity and health of forests and their related aquatic ecosystems, supporting downstream water quality and flow, and reducing flooding and sedimentation.

First, the conservation of soil and water in forests has a bearing on maintaining the productivity, health and condition of the forests themselves. Secondly, it plays a crucial role outside the forest in maintaining downstream water quality and flow and in reducing flooding and sedimentation. Quantitative indicators of the effects of forest management on soil and water include such measures as soil productivity within the forest and data on water quality and average and peak water flows for streams emerging from the forest.

Recommended actions

- At landscape level (national, subnational levels), develop and maintain an adequate area of the permanent forest estate that is primarily managed for the protection of soil and water. Monitor its extent and effectiveness over time.
- Develop specific guidelines for the protection of soil and water for different situations that are based on experience and research. Valid national indicators often can only be derived from the aggregation

of data from indicators at the FMU level. Thus, considering soil and water conservation in forest management planning and implementation at FMU level is key.

- Ensure that adequate procedures to protect soil productivity and water retention capacity within production forests have been developed at national level to be applied in FMUs.

Guideline 5.5: Restoring degraded forest ecosystems

To the greatest extent possible, degraded forest ecosystems should be restored to their original species composition, structure, biodiversity, productivity and ecosystem function.

Reducing degradation of natural tropical forests implies reversing the trend in many tropical countries of gradual loss of forest productivity and carbon stocks through systematic and planned ecological restoration activities. This becomes particularly important in the development of REDD+. REDD+ makes a clear distinction between deforestation and degradation ("the second D"). Ddegradation tends in practice to focus on improved management options, such as ecological restoration that does not simply reduce degradation, but result in enhancement of productivity (and forest carbon stock). The aim of restoring forest ecosystems is to regain the dynamic forest processes, species composition, structure, biodiversity and productivity that are normally associated with the natural forest type expected in the given site.

In many other places, and in other types of forest, degradation is not caused by commercial logging but by extraction of various forest products, often for subsistence or local marketing (timber, firewood, charcoal, fodder) or by patchy clearance and re-growth associated with shifting agriculture, by forest dwellers and indigenous communities. In such areas degradation very rarely leads to deforestation – but to a gradual loss of carbon stocks (degradation). To deal effectively with many types of degradation, it is important to see them not as the beginning of a deforestation processes but as a form of poor forest management, which needs to be improved.

Recommended actions

- Assess and classify, at landscape level (national, subnational levels) the various forms of forest use that degrade existing natural forests without necessarily leading to deforestation.
- Refer to ITTO guidelines for the restoration, management and rehabilitation of degraded and secondary tropical forests.

Principle 6: Social services of forests and inclusive decision making

Policies on forest management should recognize and aim to meet the social needs of the forests. Decisions about SFM should be participatory and inclusive and the costs and benefits of forest management should be shared equitably among stakeholders.

RATIONALE

SFM is dependent upon social needs from forest being met. An appropriate understanding of SFM encompasses a wide range of social, economic and environmental processes and interrelationships,

including gender aspects that affect decision making. Decision-making processes should embrace the different phases of the forest management cycle (from strategic and operational planning to implementation to monitoring and evaluation) taking into account the dynamic context in which it operates.

Adaptive and collaborative approaches for managing forests have received considerable attention over the past years. Participatory approaches that link forest stakeholders, empower local communities and their subgroups, and strengthen adaptive capacities of communities as well as of local governments are of particular importance.

GUIDELINES

Guideline 6.1: Livelihood benefits from sustainable forest management

The livelihood needs of people, including indigenous peoples and other vulnerable forest-dependent peoples and communities, need to be addressed by national and sub-national forest policies and programs related to SFM

The active and informed participation of communities and stakeholders affected by forest management decisions is critical to the credibility and sustainability of management processes. Public awareness raising and communication activities play a critical role in informing and educating the public, thereby allowing them to more effectively participate in SFM decision-making (CBD 2010). An informed, free, and independent development of opinions among indigenous peoples in particular is one of the essential elements for successfully managing natural tropical forests. Thus multistakeholder processes are an important approach for supporting people's direct participation in decisions, building collaboration and managing conflicts among competing interest groups (Wollenberg et al. 2005).

In planning management frameworks for the sustainable management of natural tropical forests, include provisions to respect the knowledge and rights of local communities and indigenous peoples by also taking into account relevant international obligations, national circumstances and laws, and noting that the United Nations General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples. Also, provisions should be made that forest managers should work with forest communities in assessing, planning and monitoring the management of natural tropical forests, according to locally defined concerns, needs and goals, in order to better address rural communities' needs. Effective mechanisms should be formulated that will enable the achievement of effective and enduring two-way communication between forest managers and forest communities.

Recommended actions

- Prescribe in the management provisions for SFM the use participatory approaches and tools to facilitate the involvement of local communities in sustainable forest management, such as Participatory

Rural Appraisal, farming systems analysis and Participatory Assessment Monitoring and Evaluation (see methods described by FAO 1998).

- Promote collaboration amongst people and institutions who are involved in the various aspects of forest management, integrating professional skills and training with traditional knowledge and resources of local populations in order to more effectively support the needs of rural communities and to minimize or avoid conflicts in the management of natural tropical forests.
- Ensure that there is a clear recognition and respect for the rights of indigenous peoples who live in or have a traditional dependence on tropical forests.

Guideline 6.2: Gender in SFM

Gender aspects should be integrated into national and sub-national forest policies and programs related to SFM

There are often very different concerns between men and women in respect to the use and conservation of forest resources. These differences also affect the way how forests are managed. The variety of activities and knowledge systems of one group are complementary to those of the other, meaning one group usually depends on the other to be able to develop strategies to efficiently use and manage the forest, in order to produce the livelihood outcomes they long for. This therefore indicates how important men and women are to the management process and that they should therefore be considered equal partners in this management process. In order to improve on SFM, it is necessary to include both, the local/indigenous men and women 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. This can influence the decision-making capacity of professional women in forestry. 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 in forestry and forest resource management are fully valued and acknowledged for the diversity and distinctive perspective they currently bring to the field. This shift must occur in both policy and practice, within organizations and field level activities.

Recommended actions

- Prescribe in the management provisions for SFM particular measures the need to reflect on the role that local and indigenous women will have in managing natural tropical forests.
- Promote gender at the level of forest education, research and in the implementation of SFM.

Guideline 6.3: Stakeholder participation and involvement

The participation of stakeholders, especially affected local communities, is an essential element of SFM. SFM policies and practice should be transparent and accountable, and effective conflict-resolution mechanisms should be in place.

Participation allows the public to be involved, creating a more informed public, gaining insight into the decision-making process of the government. Participation also can lead to a better informed government in that it allows new ideas to be presented to the government, creating a more comprehensive understanding of an issue. It further serves to reduce the likelihood of conflicts in implementing a decision because issues from which conflicts may arise are aired earlier with greater potential of being resolved during the decision making process. Lastly, it serves as a form of accountability, allowing the public to examine.

Recommended actions

- Establish participation processes and design multi-stakeholder dialogues to formulate the normative framework for the management of natural tropical forests.
- Conflicting issues in tenure and legislation need to be resolved at a broader level. E.g. incompatibility between traditional tenure rights (land, trees and other resources) and formal land allocation have often led to conflicting (and free access) situations, resulting in the mismanagement of forest resources.
- Develop forest management plans that link traditional forest-related knowledge and practices; recognize and value the knowledge and skills of experienced local people about forest resources (ecology, assessment, management and utilization).

Guideline 6.4: Observance of and respect for cultural and spiritual values

Cultural and spiritual values should be recognized and respected. Archaeological, cultural and spiritual sites should be identified and protected at the landscape level.

Recommended actions

- Prescribe in the norms for forest management planning the need for consultation with local people on archaeological, cultural and spiritual sites in a natural production forest area
- Fully respect local decisions on the protection and conservation of such sites and prescribe relevant actions to be fulfilled by forest managers, if required.

Principle 7: Economic Viability

Capturing the full value of forests and ensuring the equitable distribution of costs and benefits are essential for sustainable forest management.

RATIONALE

Natural tropical production forests need to be managed for more than just timber production, but also for objectives such as supporting local livelihoods, biodiversity conservation, and environmental services, including carbon capture and storage. A key aspect to capture the full value of forests and ensuring the equitable distribution of costs and benefits involves the concept and application of adaptive management. Important for all processes is the availability of financial resources, mechanisms that guarantee that costs and benefits are distributed in fair way amongst all stakeholders that contribute to SFM and that markets are accessible to all types of products and services that are delivered by the forests. The full value of forests include direct use values from timber, fuelwood, NTFP etc; indirect use values from services, such as water, biodiversity and carbon, option values relating to the willingness to pay to conserve the option of use the

forests even that there even though that no current use of it made out of it[9]. The full value of forests does not include only the financial return for the stakeholders that are involved directly and presently, but also to those that take benefit indirectly and in a forseeable future. Clear incentive structures need to be defined in order to respect not only the financial return to the immediate stakeholders, but also the economic return to society.

GUIDELINES

Guideline 7.1: Financial viability

In order to manage the permanent forest estate sustainably, instruments should be developed to support acceptable financial returns for forest use and adequate financial compensation should be provided for otherwise unpaid ecosystem services and social benefits.

One of the most important requirements for sustainable forest management to succeed is the availability of financial resources, as well as the provision of incentives and appropriate economic instruments that promote and support sustainable forest management.

Recommended actions

- Help forest managers and stakeholders understand the value of the adaptive management process (for instance, engaging in broader processes to valorize forests goods and services) and implement adaptive management approaches to improve financial viability of managing natural tropical forests.
- A share of the financial benefits accruing from timber harvesting in particular should be considered and used as funds for maintaining the productive capacity of the forest resource
- Full economic viability must take account of the reinvestment required for maintenance of the system and the additional costs (or income forgone) due to protection of the forest ecosystem and equitable distribution of social costs and benefits of forest management.
- National and international marketing efforts should be intensified in order to realize highest possible value of forest products and improve utilization of the resources from sustainably managed forests.

Guideline 7.2: Equitable distribution of costs and benefits

The distribution among the principal stakeholders of the costs and benefits of forest management should be monitored to promote SFM.

Reliable data and information are important for monitoring and decision-making. Monitoring systems should be designed to be flexible and able to respond to a dynamic context, which can change the scope and objective of monitoring. The monitoring system design must consider the end user and sustainability of the system. Engagement of end users in the design and implementation of the system increases their confidence in the system and ensures its utility (World Bank 2008).

[9] Pierce, D.W. (1991). The Economic Value of Forest Ecosystems. Economic Health 7(4): 284-295

Participatory monitoring[10] can create spaces and opportunities for more inclusive, better-informed decision making in forest management, facilitating community-based decision making and management action. For participatory forest monitoring programs to be sustainable, they must be simple to conduct, inexpensive and locally relevant. Furthermore, participatory monitoring activities should build on existing management institutions (village leaders, forest user group councils), and in turn be institutionalized at the local level (Evans and Guariguata 2008).

Recommended actions

- List any mechanisms for the distribution of incentives among all parties involved in forest management
- Explore the opportunity of interested parties to be employed under comparable conditions to those in other sectors
- Check the existence of effective mechanisms for the resolution of conflicts between interested parties
- Check the ability of forest land or right-holders to receive a fair return for the use of their forest land

Guideline 7.3: Economic instruments

Economic instruments, such as fees, taxes, incentives and bonds should encourage SFM discourage unsustainable and destructive use. They should also support the establishment of an efficient downstream industry and markets for forest products and the creation of payment mechanisms for ecosystem services, such as those associated with water, carbon and biodiversity.

Policies and laws provide incentives and disincentives which affect the behavior and choices of forest managers, users and other stakeholders, including investors.

Forest fees and taxes should be considered as incentives to encourage more rational and less wasteful forest utilization and the establishment of an efficient processing industry, and to discourage high-grading and logging of natural tropical forests which are marginal for timber production. They should be and remain directly related to the real cost of forest management.

Forest fees and taxes may need to be revised at relatively short notice, due to circumstances outside the control of forest managers and the forest agency (e.g. fluctuations in international timber market and currency). The national forest agency should be granted the authority to carry out such revisions.

Recommended actions

- Governments should ensure that there are effective measures in place to encourage forest owners and managers to operate legally and sustainably manage the forest resources. This includes facilitating the participation of economic operators in the promotion of forest products. In this regard, develop less complex and more equitable taxation in respect to the management of natural tropical forests.
- Governments should make use of international payment or similar financial mechanisms to support and encourage the sustainable management of tropical production forests.
- Encourage smallholders and communities to invest in SFM by providing long-term tenure and user rights, assisting in effective land-use planning (surveying, demarcation, titling, etc.) and facilitating access to appropriate credit and support.

[10] After Evans and Guariguata 2008.

- Secure and clearly defined property rights and land tenure are necessary to secure effective financing for SFM (Holopainen and Wit 2008).
- Create incentives for those that operate responsibly.

Guideline 7.4: Access to well functioning markets

Efficient markets should be promoted as a way of encouraging SFM and preferential access should be provided for products from sustainably managed natural tropical forests.

Recommended actions

- Support, through adequate policies and, if needed, economic instruments, access to markets of sustainably produced products and services from natural tropical forests.
- Recognize independent voluntary forest certification as a way of encouraging the sustainable management of production forests and as a means to access well functioning markets for forest products

Principle 8: Regional and international commitments

Legally and non-legally binding intergovernmental agreements at regional and global levels to which countries have committed have implications for sustainable forest management.

RATIONALE

Most of the countries have signed and ratified international agreements that influence the management of their forest estate. They include, inter alia, agreements on human rights, health, welfare and safety, biodiversity conservation, climate change, wetland protection etc. In respect to forest management, particular attention has to be given to agreements that directly relate to the use and protection of natural forests, including *inter alia* agreements in respect to the rights of forest workers and to the emerging role of forests in the international climate change regime.

GUIDELINES

Guideline 8.1: International commitments and the legal and regulatory framework

The national legal and regulatory frameworks for sustainable forest management should be adjusted, as appropriate, to incorporate the provisions of international commitments.

Forest management needs to comply with the national policies and legislation in force in the country where it is implemented, and also with all the international treaties the country has ratified. This include in particular new commitments taken by countries at the level of climate change, e.g. through the REDD+ mechanisms. REDD+ requires new forms of consultation and participation in forest management, the preparation of a REDD+ strategy, the establishment of reference levels for repeated carbon assessments and monitoring, reporting and independent verification of the implementation of REDD+.

Recommended actions:

- Monitor and report on the compliance of international agreements in respect to forest management and eventually admit national legislations and regulations in the management of natural tropical forests in order to respect international commitments.
- Allow independent monitoring of compliance mechanisms to be applied for the management of natural tropical forests

Guideline 8.2: International reporting requirements on SFM

Information systems should be developed or improved to produce data to meet international reporting requirements, including those of the International Tropical Timber Agreement, the United Nations Forum on Forests, the Convention on Biological Diversity and others.

Recommended actions:

- Coordinate efforts at national level to guarantee institutional coordination for the preparation of international reports
- Validate international reporting at national level through participatory processes on the management of natural tropical forests.

Guideline 8.3: Institutional networking and collaboration

Networking and collaboration among national and international forest institutions, NGO's, the private sector and individual experts, using modern information and communication technologies, should be improved to provide more access to and dissemination of existing knowledge and experiences on SFM.

Recommended actions:

- Foster collaboration, strategic alliances and partnerships among relevant stakeholders (government agencies/forest services, forest users, universities, research agencies and other organizations) on the development and application of systems for the collection, storage and processing of, and improved access to, existing and new data/information for forest management planning and implementation.
- Promote collaboration among relevant stakeholders to produce manuals, guides and other material for communicating the underlying concepts, objectives and values of SFM to forest managers and field personnel, key stakeholders and the media in language that is understandable, relevant and useful for all stakeholder groups. [Ref. Bio, P 7, GL 16]
- Facilitate a greater and better use of research for SFM by providing institutional incentives and taking up the results in the formulation of policies and forest management promotional strategies.

MANAGEMENT PRINCIPLES IN NATURAL TROPICAL FORESTS

Sustainable forest management is fundamentally about managing defined forest areas (Forest Management Units, FMUs) and the essential element of it is that the ecological potential of each FMU should not be reduced by management. There may have to be some trade-offs between various objectives of management but the ecological potential should be preserved.

The concept of SFM has been extended to cover management at national and other levels. At the national level, the notion of the permanent forest estate is absolutely crucial. It should be sufficiently large, well chosen and well protected to give the needed security and flexibility at the national level to maintain the ecological potential of the various FMUs within the PFE. National SFM is the sum of the SFMs in all the FMU of a country. Principles 10 to 21 are essentially meant as management principles for applying SFM at the forest management unit level.

Principle 9: Well defined and established forest management units

Sustainable forest management should be applied to clearly defined forest areas that are managed to achieve explicit objectives and according to long-term management plans.

The Forest Management Unit (FMU) is an integrative part of the Permanent Forest Estate. It is an area of forest under a single or common system of management, which is described in the management plan. The FMU might be a large continuous forest concession or community forest or a group of small forestry operations, possibly with different ownership. The important element is the common system of management (Higman et al. 1999).

Guideline 9.1: Define and secure the Forest Management Unit (FMU)

As part of the PFE, FMUs should be clearly defined and have secure tenure or use rights and boundaries that are demarcated and respected.

Recommended actions

- Clarify the ownership and other tenure rights (e.g. customary or traditional) over the designated forest management area.
- External boundaries of FMUs, respectively of compartments within FMUs - irrespective of land ownership and tenure - should be clearly and permanently defined, demarcated and properly maintained.

Principle 10: Management planning

Good planning, at the FMU and operational levels, reduces economic and environmental costs and is therefore essential for SFM.

RATIONALE

Planning is an integral component of forest management. It is about determining and expressing the goals and objectives which government, rural communities or companies have, and for deciding the targets and steps that should be taken in order to achieve those objectives (FAO 1998). Decisions in forest

management have long-term effects, requiring a good planning of actions both at the FMU as well as its surrounding environment.

Under real-world conditions, management will always involve dealing with conflicting priorities, local insights or innovations (Meijaard et al. 2005). In that regard, management often follows an intuitive process of consultation and compromise between various stakeholders (Kleine 1997).

Adaptive management is a dynamic approach to forest management in which the effects of decisions and management practices are continually monitored and utilized, along with research results, to modify activities, thereby ensuring progress toward management objectives. Adaptive management encourages active participation by all stakeholders to improve the effectiveness of management interventions providing a flexible and responsive way to deal with uncertainty and change (IUFRO/WFSE 2010).

A ***planning inventory*** should serve to refine the stratification of forest types obtained from remote sensing; to locate and quantify stand types in order to design appropriate patterns of silvicultural treatment, to schedule the advance of harvesting cycles over space and time and to calculate work volumes; and to provide an accurate quantitative and qualitative estimate of first-rotation harvests per species *(Source: FAO 2004).*

Planning at the FMU level needs to consider a range of scales and interactions between scales. This certainly involves observance of a number of factors related to management objectives, the biophysical setting, the legal and institutional framework, economic as well as social and cultural aspects.

The production of timber and non-timber forest products (NTFP) requires careful planning and good management. Also, harvesting of NTFP and provision of environmental services are often compatible.
Detailed management planning at the FMU may produce three documents of differing duration and strategic importance (FAO 2004): the *strategic or long term management plan*, covering 20-40 years and reviewable every 5-10 years; the *tactical management plan*, which expresses the strategic management plan at the medium-term level, covering successive 5-7 year periods; and the *annual plan of operation* through which the management plan is programmed, implemented and monitored annually.

GUIDELINES

Guideline 10.1: Forest resource assessment

There should be a clear and reliable definition of all the resources in an FMU, irrespective of ownership or control.

An assessment of the forest resource and its potential for production of timber and NTFPs as well as environmental services should be carried out for the basis of zoning of the FMU and the Forest Management Plan (FMP).

Two levels of forest resources assessment or forest inventory can be distinguished at the FMU: a *planning* or general *inventory* for the whole or a substantial part of a FMU - for example, an inventory of wood or of specific non-wood resources; and an *operational inventory* at the level of the compartment - for example, pre-harvest inventories and diagnostic sampling (as part of the planning of silvicultural interventions). Planning inventories are the basis for preparing the strategic or tactical management plans, while operational inventories provide the detailed information needed for the annual operational plans (FAO 1998, 2004).

Forest resource assessments for SFM in natural production forests have traditionally considered just one specific product (commercial timber). When managing for multiple uses or purposes at FMU level,

however, a range of products and services - depending upon objectives, existing forest uses, forest composition and resource distribution, or existing or prospective forest values (economic, environmental, cultural) - need to be considered.

Recommended actions

- Assemble all relevant databases and updated maps available, e.g. on vegetation/forest types, topography, soil, hydrological network, infrastructure, flora and fauna (composition and distribution) and existing forest uses.
- Consider the status of locally important species in the forest inventory, with special attention to the distribution of and threats to species that are protected by national law, threatened species, and species much used by, or significant to, local communities. Such data shall be presented in a GIS format.[11]
- Measures favoring compatibility of managing timber and non-timber forest species may include: i) forest inventories that include timber and non-timber forest species; ii) tree marking of timber species and tree non-timber forest species to minimize damage during selective felling; and iii) hunting control in forest concessions to secure availability of animals for local populations that depend on this resource.[12]
- Mark tree species individuals that produce valuable NTFP during the execution of forest inventories.
- If carbon management is a primary objective or one of the objectives for the FMU, integrate it into forest management planning, defining its level of prioritization (e.g., at the compartment level). One first step should be to clarify "C-rights" (carbon rights). Options for improved carbon management should also be identified, assessing the carbon reference levels and evaluating the associated costs and benefits (in comparison with the other forest management objectives). Update forest inventory procedures (e.g. include a more detailed inventory on timber and living biomass, deadwood, soil samples etc).

Guideline 10.2: Forest management objectives

Management objectives should be established for an FMU, taking into account the tradeoffs needed to achieve the desired mix of forest goods and services and ensuring the long-term maintenance of the environmental, social and economic values of the forest.

The FMU is managed with well-defined and clearly established objectives compatible with SFM. Formulation of objectives should allow the forest manager to respond flexibly to present and future variations in physical, biological and socio-economic circumstances, keeping in mind the overall objectives of sustainability.

Recommended actions

- Forest management objectives and the means of achieving them should be defined in a FMP or equivalent document.
- The definition of management objectives should, as far as possible, involve all stakeholders through a participatory process.

[11] Source: Meijaard et al. (2005).
[12] Source: Guariguata et al. (2009).

- Defining management objectives is a process. Start defining preliminary objectives, adjusting them as new information becomes available from the planning process.
- Management objectives should be realistic, clearly articulated, acceptable, well informed and clearly prioritized.
- In selecting management objectives consider all potential range of goods and services from the FMU.
- Analyze market opportunities when deciding on management objectives. Products with an established market should normally be included among the management objectives, subject to an analysis of the resource availability and suitability and compared to the characteristics of alternative, potential products.

Guideline 10.3: Zoning of the FMU

Wherever there is more than one management objective for an FMU, the process of forest management planning should include zoning by forest function.

As a mapping technique, *forest zoning* is applied where multiple-uses or functions (e.g. production, conservation, protection or recreation forests) occur and involves identification of the predominant values for specific areas of forest land that are to be managed in respect of management objectives that are related to those values.

Recommended actions

- Understand and analyze the conditions for implementation of forest management. Start reviewing existing information on land use planning and zoning, and the contextual biophysical, social, economic and institutional aspects in the corresponding region.
- Conduct multi-stakeholder dialogue to understand their views and perceptions, as well as interests and motivations regarding the various functions for forest lands and the associated opportunities and risks. Depending on the local conditions, if appropriate, carry out a consensus-building process on the range of possible forest management options.
- Forests that are to be managed for different long-term purposes should be clearly defined as FMU, and, to the extent possible, each specific area should be placed in clearly defined *compartments*[13] (or sub-compartments).
- Set up, plan and map *exclusion zones* excluded from production, e.g.: cultural areas, watercourses, water bodies and shore-lines, landslip areas, conservation and protection zones, community forest and local community zones, biological diversity conservation zones, wildlife conservation zones, scientific research zones and buffer zones.[14]
- Consult with local people about the existence of archaeological, cultural and spiritual sites. Map out such places and mark them in the field, and ensure their protection during forest management implementation.

Guideline 10.4: Forest Management Plan

[13] A permanent, geographically recognizable unit of forest land forming the basis for planning, prescription, implementation, monitoring and recording of forest operations (FAO 1998).
[14] Source: Elias et al. (2001) in Meijaard et al. (2005).

An FMU should have an approved management plan with clearly stated management objectives and measures for achieving them; the plan should be periodically revised in the light of accumulated experience, new information and changing circumstances.

The main objective of Forest Management Plans (FMPs) is to guarantee that management practices promote sustained yield and environmental conservation. The management plan is a tool for steering and controlling forest management operations. It tells the forest manager which activities to carry out, where, how and when in order to fulfill the management objectives.

To be effective, a FMP for the FMU should comprise basic information having direct relevance to the management of a forest, a long-term management goal and specific prescriptions to achieve each of the objectives. The FMP should regulate protection, inventory, yield determination, harvesting, silviculture, monitoring and other forest operations.

The planning of the precise activities to be carried out over one year is expressed in the *operational plan* or *annual plan of operation*. Although this plan mainly refers to operations to be carried out on the area authorized for harvesting in one year (*annual harvesting area* or *block*), it also covers activities related to silviculture, post-harvesting assessments, protection, monitoring, training, etc.

Up to 96% of the value of forests is derived from non-timber forest products (NTFPs) and services (MEA 2005). In Central Africa, for example, the use of wildlife from forests (bushmeat) accounts for up to 80% of protein intake in rural households.

(Source: Nasi et al. 2008, CBD 2009).

Recommended actions

- The duration of a management plan should not be less than five year and consistent with the production cycle.
- A management plan should be revised periodically taking account of changing situations, new information and technology. Each revision is an opportunity for the forest manager to revise objectives and methods.
- Develop management plans that link traditional ecological knowledge and sustainable harvest methods, such as those already developed for non-timber forest products [15]. Whenever possible, existing NTFP harvesting by local communities should be accommodated in the management plan.
- Whenever possible, simplify or adapt the requirements for FMPs that have usually been developed for the management of large forest areas by forestry administrations or private companies to the management objectives and capacities of local forest owners and managers.[16]
- Forest management plans should include information on the presence and conservation status of plants, animals and habitats of special conservation concern.
- Annual plans of operations (*operational plans*) are written for a one-year period and should be derived from a five-year (or longer) management plan. A plan of operation should express specific activities in tabular form for one year only and for a specific locality, such as a felling area.
- Effective implementation of forest management plans depends to a large extent on a good level of understanding and acceptance of the plan as well as a firm commitment to allocate funds, staff and other resources for the duration of the plan.

[15] See for instance, Peters (1994) and Cunningham (2001).
[16] Source: Romano and Muller (2009).

Guideline 10.5: Managing for non-timber forest resources

Forests may be managed primarily for the sustainable production of non-timber forest products.

Non timber plant resources can be as or even more important for local livelihoods and sources of income, thus contributing to add value to forest use and SFM.

Recommended actions

- Where it is realistic and practicable, a diversity of NTFP should be extracted. This approach can lead to seasonally complementary harvests and to less vulnerability to fluctuations in market demand for a particular NTFP.[17]
- Whenever possible, forest management should include species used by local communities. In this regard, gather information on traditional uses of plants and plant products through consultation with local communities and literature searches (e.g. ethno-botanical references). In addition, prepare a list of NTFPs commonly harvested by local communities, differentiating those species harvested solely to meet subsistence needs and those harvested for all types of commercial purpose and the associated type of production.
- Local level collectors and users often have long-established and detailed knowledge of the resources they make use of (e.g. on life history, distributions and abundance, variation of productivity in time and space, harvesting practices). This information, together with sketch maps drawn by experienced collectors during a preliminary participatory appraisal, can be very valuable.

A basic strategy for managing NTFP on a sustained-yield basis might entail the following process:

1) Species/product selection
2) Market research
3) Resource inventory
4) Growth and yield forecasting
5) Determination of sustainable harvest rates
6) Management planning
7) Monitoring

Sources: Wong et al. in FAO (2001), and Roy et al. (2002).

- Conduct *multi-resource inventories* in order to get estimates of the actual abundance, distribution, size-class structure, volumes, and regeneration status of NTFPs. This information may be used to assist the development of marketing and marketing strategies for particular non-timber forest resources[18]. Such inventories combined with growth and yield monitoring and specific studies also provide the baseline data necessary to monitor the impact of harvesting.
- Where limited experience in the management and production of NTFPs exist, a maximum of five or six commercial NTFPs should be chosen based on a set of criteria - e.g., resource availability over space and time, market demand, legal access, financial viability, compatibility with timber production, availability of labour, local traditions, etc.). Preference should be given to those products with an established local and regional demand (less likely to be affected by sudden changes compared to demands for products on the international market). Emphasis should be placed on ecologically suitable resources yielding a variety of benefits, so that sudden changes in demand and prices for a single product do not have catastrophic consequences. Seasonality of harvesting and availability of man-power should also be taken into account, and products with a potential for local livelihood improvement - in particular for disadvantaged groups – should, all else being equal, be given priority.
- The ecological sustainability of NTFPs should be assessed, as far as practicable, based on the plant part that is of interest, the forest composition, the type and intensity of harvesting and the particular species or type of NTFP that is being harvested.[19]

[17] Source: FAO (1998).
[18] See for instance, Tieguhong and Ndoye (2008).
[19] FAO (1998).

- Provide training to managers and field staff in incorporating non-timber forest resources in regular inventories and for managing forests for the multiple-use of products.[20]

Wildlife

- Where no information on animal resources exists, an initial *survey of forest animal resources* may comprise several species followed by more intensive surveys of individual species at a later date. An assessment of plants that are important food sources or habitats for (targeted?) animals may be included for the management of the forest animal resources.
- Whenever appropriate, include wildlife in routine forest inventories of the forest under management. The results can provide important recommendations for managers and help limit the negative impacts of logging activities on wildlife.[21]
- Incorporate wildlife concerns into FMPs, particularly in timber concessions. Integrated timber and wildlife management plans should include: i) wildlife regulations in company policy; ii) conservation education for logging company employees and local communities; iii) an agreed system of law enforcement to be carried out by locally recruited staff; iv) development of alternative protein supplies (e.g. fish farms); and v) an intensive program of socio-economic and ecological monitoring.[22]

Guideline 10.6: Managing for ecosystem services

Forest management should take into account the potential for generating income from the ecosystem services provided by an FMU, such as those related to carbon, water and biodiversity.

Ecosystem services (also referred as environmental services) are functions provided by ecosystems from which some services or benefits (economic, ecological or social) can be derived for the forest manager, the local community, the region or even at the national or international level. Forests can provide diverse ecosystem services, which may be remunerated and generate extra income to support SFM. Common forest services - such as for carbon stocking, biodiversity conservation, water conservation, soil conservation, landscaping, etc. - should be considering when planning the multipurpose use and conservation of the forests.

Recommended actions

- Identify and describe the ecosystem service(s) of interest that could be part of the management objectives for the FMU. Gather the necessary information during the planning activities - forest zoning and the resource assessments. Take also into account consultations with the local population and relevant stakeholders about their views, concerns and perceptions regarding the ES of interest.
- Analyze the economic opportunities for providing environmental services at the FMU, and include them in the FMP if suitable.
- Whenever appropriate, provide details in the FMP on activities to maintain and/or restore the ES of interest, including specifications for compliance, monitoring and evaluation.

BOX x

Categories of forest ecosystem goods and services (*Source: CBD 2009*)

→ *Provisioning services* - e.g., food, fiber and fuel; genetic resources, fresh water

→ *Regulating services* - e.g., pollination, seed dispersal, climate regulation, pest regulation, erosion regulation

→ *Cultural services* - e.g., spiritual and religious values, recreation and aesthetic value

→ *Supporting services* - e.g., provision of habitat, soil formation and retention, water cycling

[20] Guariguata et al. (2006).
[21] Van Viet and Nasi (2008).
[22] Nasi (2008).

- A number of tools prepared under the CBD (2008) can provide useful support to defining and valuing forest ES. The CBD also maintains a database on incentive measures that includes information on innovative ways to finance forest ecosystem services.

Guideline 10.7: Adaptive management

An FMU should be managed using an adaptive learning approach that effectively supports decision-making in the planning, implementation, evaluation and modification of forest activities.

A key aspect of SFM involves the concept and application of *adaptive management*, or learning by doing (Holling 1977). Adaptive management involves the use of science (research results) to support best practices, planning, monitoring results against expected outcomes and then adapting the practices to improve outcomes based on the original expectations (Blaser and Thompson 2010).

Management should be responsive and adaptable to changing knowledge and needs (FAO 1998). Even the most carefully planned arrangements should be modified as new information becomes available and good management requires early recognition of the need for modification. Adequate and timely information has thus a significant impact on decision-making.

Effective forest management planning and monitoring requires multiple forms of knowledge. In this regard, it is important to consider and link both the scientific as well as the traditional knowledge for practical forest management implementation. Existing local knowledge, experiences and capacities (for instance, to stratify and classify local forest types, on the uses of tree species or in relation to tending practices) can enrich and improve forest management, broadening the benefits obtained (CIFOR 2007).

Recommended actions

- Institutionalize the adaptive management process so that it is used routinely and systematically in the forest management cycle.
- Have a mechanism in place for the periodic collection and use of information in the amount, type and quality needed for the forest management decision making process.
- The knowledge and skills of experienced local people about forest resources (ecology, assessment, management and utilization) should be recognized and valued. Where appropriate, link traditional forest-related knowledge and practices in forest management planning and implementation.
- Support (applied) research to guide and inform adaptive management.

Principle 11: Yield regulation and control

A reliable method for regulating and controlling yield is needed to ensure the sustainable production of timber and other forest products and services from each FMU.

RATIONALE

A prerequisite for SFM is that removal of forest products does not exceed levels of re-growth. In commercial forests where the major product is timber, this means calculating and implementing sustained

yields for timber harvests. This requires information which shows stocking levels, and replacement rates (for example, inventory data and growth and yield data) and which can be used as a basis for calculating sustainable harvest levels. In areas where NTFP are harvested, similar inventory data and calculations will be needed, to ensure that harvesting levels remain within the capacity of the forest for replacement (Higman et al. 1999).

Yield regulation (or yield allocation) is the practice of calculating and controlling the quantities of forest products removed from the forest each year to ensure that the rate of removal does not exceed the rate of replacement (Higman et al. 1999). The "yield" could be the volume of wood of specific trees, or the wood volume of the whole forest, or it might be non-wood products, or it may be a mix of wood and non-wood products (FAO 1998).

The knowledge of forest growth provides a confident basis for the measurement of increment which can be used to derive yields of wood or non-wood forest production and construct *yield tables* and *growth models* (FAO 1998).

Growth rates of non-timber forest resources *(Source: Ticktin 2004).*

Vital rates of non-timber forest resources may be significantly affected by differences in harvest techniques. These include seasonal timing of harvest, timing of harvest in the plant life cycle, frequency of harvest, size of individuals harvested and intensity of harvest. Furthermore, different sequences of annual variations in harvest intensity can have significant impacts on population growth rates, and the way in which the plant is cut to obtain the desired product can also result in differences in population growth rates, and the variation in spatial patterns of harvest may also have lead to significant differences in rates of growth and reproduction.

GUIDELINES

Guideline 11.1: Continuous forest resource assessments

Forest resource assessments should be carried out periodically to ensure the sustainable production of forest goods and services. They provide essential information not only on the quantities that may be harvested but also on the type and quality of forest produce that may be extracted.

Continuous forest inventory means the measurement of forest growth and development through making repeated measurements of trees in permanently defined areas of forest or *permanent sample plots* (PSPs) to provide the most reliable data for estimation of (FAO 1998):

i. changes in the characteristics of forest stands over time;
ii. variations in forest composition and productivity with site and silvicultural treatment;
iii. the relationships between tree variables, stand variables and increments which may be used for yield forecasting; and
iv. long-term changes in the site and its continuous productive capacity.

Recommended actions

- It is important to have good estimates of forest dynamics (growth, recruitment and mortality) for the different forest types of interest to forest management. For this, carefully design a network of PSPs to adequately cover the main forest types, and also considering differences in management intensity (e.g., harvesting intensities).
- Whenever possible, establish and regularly measure PSPs throughout the forest over a long period of time to monitor the effect of site variation on forest growth and development (phenology, regeneration, etc.), and the real effects of log harvesting operations (e.g. to be measured and analyzed within a yield model). Consider PSPs of intact and harvested forests.

- Include procedures for monitoring and evaluating the impact of harvesting NTFPs. If needed, adapt existing protocols for NTFPs by including phenological observations (i.e. of seed and fruit yields), focusing on early establishment rather than long-term growth, and using shorter time periods and seasonal observations to observe fruiting.[23]

Guideline 11.2: Sustainable levels of product harvesting

To ensure the sustainable production of wood and other forest products and services from an FMU, a reliable method for determining the annual allowable cut and controlling the harvest intensity should be adopted.

A commonly used calculation of the rate of harvest, particularly for timber harvests in natural forest, is the *annual allowable cut* (AAC), defined as the volume of timber which may be cut in one year in a given area. Calculation of the AAC is based on the volume of timber in the area which can be harvested, whilst leaving enough stems to provide the next crop. It depends on the standing stock, the growth rate and the size of the forest operation.

As a practical measure of the sustained yield for a period, the AAC can be used to monitor forest production and set limits for forest use. Although it is usually quoted as an aggregate figure, for all commercial species, in forest management planning it is often broken down by species/species group and stands or harvesting compartments.

The calculation of a sustainable 'harvest' for many NTFPs remains problematic, as very little information is currently available on how to estimate the maximum annual harvesting level from the yield for particular non-timber forest plant resources. Thorough understanding of their productivity must be interpreted from ecological and harvesting studies, which involve determining the rates and patterns of variation in recruitment, growth, mortality, and reproduction, and how these patterns relate to environmental and management changes (FAO 2001).

Recommended actions

- Where there is little or no information of forest increment and where forest management is being introduced for the first time, the AAC should be derived using one of the classical empirical procedures (see, for instance, FAO 1998, Annex 4 - pages 257-259).
- In small forest management areas, where determining the AAC may not be possible, it may be preferred to harvest the entire area at one time and then leave the area to regenerate for a given time. However, adequate provision must be made for the protection of the forest during the intervening period. Areas of forest which have been logged, and appear to be abandoned, are often encroached upon and damaged by "salvage" loggers and small farmers.
- Compile growth and yield predictions and information from existing ecological studies using other relevant material developed in the region. Collaborative research may be the most cost effective means of obtaining data.[24]
- In defining *minimum diameters for harvesting* (MDH) consider the grouping of timber species according to their ecological behavior and their structural and dynamical parameters including maximum diameter limit.[25]

[23] FAO (2001).
[24] Higman et al. (1999).
[25] Sist (2010).

Non timber plant and animal resources

- Set harvest levels of non-timber forest resources based upon observation and experience, supplemented by information gained from monitoring the impact of harvesting over time - the so-called 'adaptive management' approach[26]. This adaptive management approach is based on years of field observation and experimentation.
- To ensure sufficient regeneration and avoid negative impacts of harvesting forest fruits and seeds from populations that have never been exploited before, a good first approximation is to extract no more than 80 percent of the total harvestable yield during the first collection cycle.[27] In the case of leaves, recommended maximum annual harvesting limits vary from 20 to 25 percent for certain palms (less for understory species) to 50 percent for ferns and up to 75 percent for herbs.[28]
- Regulations and prescriptions for the sustainable use of specific animal resources should regulate the hunting season and the minimum size and maximum number of specific species which may be caught, including restrictions on techniques and equipment which may be employed (e.g., certain traps may be prohibited or the use of poisoned bait to kill animals in order to obtain their fur should never be allowed as these methods damage non-targeted species and ecosystems).[29]

[26] Peters (1996), Shanley et al. (2005).
[27] Peters (1994).
[28] Ticktin (2004).
[29] FAO (unpublished).

Guideline 11.3: Yield control

Harvested volumes should be recorded, controlled and analyzed to ensure that the AAC and other cutting prescriptions are followed by field personnel.

A programme of continuous log measurement, or scaling, provides an annual and a compartment-by-compartment basis for yield control (FAO 1998).

Permanent sample plots (PSPs) are permanently defined areas of forest that are periodically but regularly remeasured to provide data on stocking, tree dimensions and volume. Information on changes in the composition, structure and growth of a forest over time can be derived from PSP's. Permanent sample plots are used for the measurement of wood growth and also to measure the growth of non-wood products. The design of a PSP system will be determined by the definition of the yield and should also consider the most effective way of measuring the yield (FAO 1998).

A pilot survey for deriving PSP numbers for a continuous forest inventory is presented in FAO (1998, Annex 3 - pages 255-256).

For further information on establishing PSPs in tropical forests see Alder and Synnott (1991).

Recommended actions

- Division of the FMU into blocks or compartments and definition of annual cutting areas and volumes are essential for the practical control of the harvest level.
- Re-entry of harvested blocks or compartments may be allowed under defined conditions or criteria, as specified in the national or sub-national regulations. However, once the AAC has been achieved from a particular area, the block or compartment must be closed off and no more harvesting carried out until the next felling cycle. Premature re-entry of harvested blocks should not be permitted.
- Records of production levels of wood and non-wood forest products must be maintained for each block or compartment harvested. Records should be reconciled against predicted yields in order to ensure that the AAC is not being exceeded. This information is also essential for the prediction of future growth and yield and the accurate revision of yield levels.[30]

Principle 12: Harvesting operations

Reduced impact harvesting is a key element for sustainable forest management.

RATIONALE

Efficiency and sustainability of forest management depend to a large extent on the quality of harvesting operations. Inadequately executed harvesting operations can have far-reaching negative impacts on the environment (such as erosion, pollution, habitat disruption and reduction of biological diversity), may jeopardize the implementation of the silvicultural concept, and increase health risks for field personnel.

Improved logging procedures and techniques are collectively referred as *Reduced Impact Logging* (RIL). The application of RIL pursues two goals: to harvest marketable trees as economically and safely as possible, and to achieve desirable characteristics of the residual forest as they derive from ecological and, to a

[30] Higman et al. (1999).

certain extent, social requirements (TFF 2007). RIL can be defined as timber harvest technologies and practices with the following main objectives (TFF 2007):

- minimize impact on the environment (including wildlife) and related social aspects;
- minimize damage to potential future crop trees (including regeneration);
- provide safe working conditions, and
- improve timber utilization and recovery of the forest.

RIL comprises the entire spectrum of harvesting operations from pre-harvest inventory, selection of merchantable trees and design of infrastructure to felling, extraction and hauling of logs, and finally post-harvest operations and assessments (see details in FAO 1996 and Applegate et al. 2004).

GUIDELINES

Guideline 12.1: Harvest planning for optimal efficiency and to minimize impacts

Harvesting should be planned to enable good technical control, minimize harvesting costs and reduce environmental impacts.

Preliminary planning is paramount to facilitate harvest operations also in order to make operations safer and more efficient. Being an essential component of RIL, harvest planning involves annual harvest estimates based on stand potential in designated harvest areas. It follows the harvest cycle and can cover one or more harvesting blocks or compartments. The planning is normally one to two years before harvesting and generally produces a document on scheduled operations, actions to be taken, means to be employed and a detailed map (1:5 000 or 1:10 000) of the areas to be harvested (FAO 2004).

What are non-harvest areas *(Source: FAO 2004)*

- Unharvestable areas: swamps, very steep slopes (normally above 45 percent for tractor skidding), rock outcrops
- Sites of cultural or religious value: sacred trees and forests
- Areas of ecological, scientific or touristic importance: areas with extensive diversity of wildlife, habitat of endemic species, unique and fragile habitats, etc.
- Environmentally sensitive areas, i.e. adjacent to permanent watercourses and backwaters or around swamps.

Harvest plans are of two types, *strategic* and *tactical*, and both are an integral part of the forest management planning process. A map and a written plan are the basic components for both strategic and tactical harvest planning[31].

Recommended actions

- A pre-harvesting inventory is conducted in areas about to be harvested to provide information that facilitates the planning and control of an efficient harvesting operation.
- Develop and implement documented procedures to ensure that harvesting operations are carried out to the highest standards. These may be based on or adapted from the *FAO Model Code of Forest Harvesting Practice* (FAO 1996). Whenever possible or desirable, incorporate also appropriate local standards.
- Make and implement arrangements for effective training of all personnel involved in harvesting operations (managers, supervisors, operators, workers). The aim is to increase and maintain the

[31] For detailed information on the content of these harvesting maps, see FAO (1996) and FAO (1998).

professional skills, work performance, and work quality of workers, and to develop and maintain an awareness of social and environmental issues.[32]

- Provide safe and healthy working conditions for all personnel according to international occupational health and safety standards.
- Locate and demarcate *non-harvest areas* that have to be excluded and protected from harvesting in order to reduce negative impact on local populations, resources and the ecosystem. These areas need to be clearly marked on the survey map and should be distinguished from areas that are already eliminated on regulatory grounds (e.g. roadside areas restricted to community use) or because of stratification in the management plan.[33]
- Use machinery and equipment that are appropriate for RIL.
- Properly design and construct forest roads and layout skid trails according to environmentally sound practices[34].
- Design and implement forest harvesting operations in ways that accommodate and, if possible, enhance the multi-resource character of the forest. Consider the possible complementarity of harvesting non-timber forest products.
- In planning and implementing forest harvesting practices, aim to conserve as wide a range of species as possible. In particular, endangered plant and animal species need to be protected.[35]

Simple measures with substantial impact - Lessons learnt in implementing RIL *(Source: Hinrichs et al. 2002)*

- *A long-term commitment by senior management* to change from a functioning and legally acceptable harvesting system to a more complex system that requires detailed instructions to field managers.
- *Willingness to invest* in human resources development (training, study tours) and, if required, in new technologies (database management, GIS)
- Freedom for the field staff to apply a *learning-by-doing approach*
- *Time to adjust* planning and production measures (a minimum of 2-3 yr)
- Intensive and reliable *internal control systems*
- *A culture of openness and regular communication* and feedback

The *FAO Model Code of Forest Harvesting Practice* (FAO 1996) provides recommendations for developing strategic and tactical harvest plans, as well as guiding principles and recommended practices for implementing harvesting operations, including detailed explanations on forest road engineering, cutting, extraction, landing and transport operations, harvesting assessment, and the forest harvesting workforce.

Recommendations include practices for harvest inventories, road planning and construction; and planning and layout of secondary road network, skid trails and landings.

Guideline 12.2: Efficient and safe harvesting operations

Harvesting practices and standards should be employed to ensure safe and efficient operations, minimize damage and waste and reduce environmental impacts, including from road construction and logging tracks.

Harvest operations basically comprise cutting, extraction, landing, log measurement and transport.

[32] FAO (1998).
[33] FAO (2004).
[34] See recommendations on reduced-impact practices in road construction and skid trail layout in FAO (2004).
[35] See *FAO Model Code of Forest Harvesting Practice* (FAO 1996) in regard to principles and some aspects of forest harvesting practice, and the "Guidelines for implementing harvesting operations" in FAO (1998).

Recommended actions

- Safety, trained personnel, adequate supervision and, when appropriate, performance-based incentives are key elements for efficient, safe and careful implementation of harvest operations.
- Directional felling can reduce damage to both vegetation and soils, keep trees away from streams and increase the utilizable volume of the tree stem by reducing breakage. It can also help the frequency and severity of accidents associated with felling operations. Recommended practices for *cutting operations*[36] are described in FAO (1996, pages 25-27) and FAO (1998).
- Regardless of the *extraction*[37] system used, extraction is a difficult, often hazardous operation that can inflict substantial damage on forest ecosystems. Considerable skill is required, on the part of both supervisors and workers, to carry out extraction operations that are efficient and safe, as well as environmentally sound. Recommended guidelines and practices for extraction with ground-skidding equipment (the most common system) and other extraction systems (forwarders, cable systems, aerial systems, helicopter, drawing animals, among others) are described in FAO (1996) and FAO (1998).
- *Landings*[38] are places of potentially high risk and must be regarded as such; they are also potential sources of water pollutants and soil sediments. Proper planning, layout and due respect of sound practices can help reduce the risks and ensure that operations proceed efficiently and safety. Recommended practices for the design, construction and efficient operation of landings are given in FAO (1996) and FAO (1998).
- The measurement of log production in relation to a production target prescribed in a forest management plan is based upon consistently accurate log length and diameter measurements for deriving log volumes. Whatever scaling system is used it must be fair to the buyer and to the seller of wood. Recommended practices and standards for *scaling operations* in tropical forests involving large logs are described in FAO (1998).
- *Transport operations* should deliver logs safely to a point of destination without significant loss of volume and without adverse impacts on the forest environment. Recommended practices and standards are given in FAO (1996, pages 53-56) and FAO (1998)
- Efficient harvesting minimizes *waste* and reduces costs - see Higman et al. (1999) for ways to reduce harvest waste).
- Minimize harvesting waste through efficient harvesting practices by, e.g.: reducing splitting and damage to timber and surrounding trees applying directional felling, establishing guidelines for the optimal length to cut logs, effective control of felling to ensure that no marketable component of the felled tree is left behind in the forest.[39]
- Where appropriate (e.g. applicable to concession holders and contractors), consider establishing a system of incentives and penalties to encourage practices to reduce waste.
- Whenever feasible, extract forest residues as an additional income source, especially for forest dependent communities.

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[36] *Cutting* includes all activities undertaken to fell and prepare trees for extraction, including felling a standing tree, measurement to determine best log lengths, limb removal and cross-cutting to form logs (FAO 1998).

[37] *Extraction* is the process of moving trees or logs from the cutting site to a landing or roadside where they will be processed into logs or consolidated into larger loads for transport to the processing facility or other final destination (FAO 1996).

[38] *Landings* are collection areas to which logs are delivered during the extraction process. At the landings, these logs may be sorted, possibly stored temporarily in log docks, and then assembled for transport to the processing facility or other final destination (FAO 1996).

[39] Higman et al. (1999).

- Penalties should be imposed on harvesting crews for careless working practices that lead to unnecessary or avoidable damage or negative environmental impacts. Penalty arrangements should be included in management contracts that are specific to the local situation. Frequent operational monitoring is necessary in order to detect damages or impacts and to identify who caused it.
- Define and implement measures aiming to minimize damage from roads and infrastructure, to protect non-harvest zones (reserved or exclusion areas), and to minimize damage in production areas during harvesting operations.

Guideline 12.3: Post-harvest measures

Post-harvest measures should be undertaken as required, such as the deactivation of harvested areas, erosion mitigation, and the rehabilitation of high-impact areas.

Deactivation of harvested areas as well as rehabilitation of harvested areas can serve as measures aiming to reduce erosion and sedimentation, to maintain/increase vegetation diversity for wildlife conservation purposes, and to safeguard against unauthorized activities.

Recommended actions

- Enforce the minimum time period before re-entry.
- All debris from harvesting operations should be removed from buffer zones and banks.
- All obstacles blocking water-flow under bridges e.g. culverts or box drains should be removed.
- Clean landings of all debris, off-cuts, bucking waste and bark after harvesting. Level or drain adequately all areas prone to water pounding. Loosen the soil on the landing site by ripper to facilitate regeneration. Ripping should be crossways to slope gradient.[40]
- Develop and implement instructions for deactivating landings, skid trails and roads no longer required for forest management after finishing an annual compartment or felling coupe.[41]
- After harvesting, all roads not to be used until the next rotation should be closed to all traffic to prevent the incursion of unauthorized vehicles, especially poachers. Road closure can be done by placing a large log across the roadway, or digging a ditch across the roadway by excavator.
- Reforest landings and roads, where these will not be used in future harvest cycles.
- Rehabilitation with replanting after soil loosening, if needed, should be done continuously as harvesting based on each landing is completed, rather than waiting until the whole compartment has been worked over.[42]

Guideline 12.4: Harvesting assessment

The quality of harvesting operations should be assessed and the need for corrective actions or measures determined.

A *harvesting assessment* is a systematic check made in the field during or following harvesting to determine the degree to which the operation is or has followed a harvesting plan and has complied with its objectives. It provides information about the quality of operations, including the volumes cut and the condition of a

[40] FAO (2004).
[41] TFF (2007).
[42] DFID (1999) in Meijaard et al. (2005).

forest following harvesting. Harvesting assessments may be undertaken while the operation is still under way (*in-process assessment*) or after its completion (*post-harvest assessment*) (FAO 1996, 1998).

Recommended actions

- Harvesting assessments should be completed not more than two years after the end of the operation so that any corrective action needed can be initiated in a timely fashion.
- Harvesting assessments should be carried out by qualified planning and supervisory staff in the presence of operational personnel who are directly responsible for harvesting activities.
- Harvesting assessments should look at items such as:
  - Location, condition of roads, landings and skid trails
  - Extent (in percentage) of the operating area disturbed by roads, landings, skid trails and cable corridors
  - Condition of buffer strips and water courses
  - Stump heights and any usable logs left in the forest
  - Trees marked for felling but not felled
  - Trees marked for retention but were felled or otherwise destroyed or damaged
  - Areas in need of rehabilitation
  - Type and condition of equipment, and qualification of operators
  - Availability, suitability and actual use of protective equipment
- Communicate the results of the harvesting assessment to the relevant authorities and to management, as well as to the harvesting crews. Financial incentives for good work and penalties for work that does not meet standards, will reinforce the organization's commitment to sustainable harvesting practices.

Principle 13: Silviculture

Silvicultural interventions should be implemented in accordance with the management objectives and as defined in the FMUs management plan.

RATIONALE

Silviculture is essentially about decision-making on how to treat or manipulate forest stands in order to achieve stand management objectives (Kleine 1997). Silviculture includes all operations that are done between one harvest and the next, such as planting, thinning, pruning, weeding or poison girdling. Harvesting operations themselves are a major silvicultural treatment (Higman et al. 1999).

The choice of a silvicultural system is determined by the ecological characteristics of a forest for which sustainable management is being planned (e.g. forest type, site conditions, current species composition, regeneration status of desirable species etc.) and by the management goal and objectives for a specific forest management unit (FAO 1998). But silviculture also requires moving towards a more comprehensive ecosystem management with adequate consideration of the socio-economic (such as labour and inputs available for management, the end-products and services required, including current and foreseeable demands) and institutional/ regulatory environment.

In forest managed for timber production, silvicultural interventions are generally necessary to overcome the relative depletion of commercial tree species, to compensate for the slow growth rate, and to ensure a future commercial timber value of the forest. Options that can be applied, depending on the condition of the forest stand and the objectives (what major products are expected), include improvement treatments, treatments to stimulate natural regeneration, enrichment planting, and direct planting (Sabogal and Nasi 2005).

GUIDELINES

Guideline 13.1: Silvicultural assessment and planning

Needs for silvicultural interventions should be assessed based on forest management prescriptions considering inventory results and harvesting and other operational records, according to which respective plans should be prepared to ensure regeneration and improve productivity.

To guide decisions on silvicultural intervention a simple assessment method called *diagnostic sampling* can be used. This is a rapid and inexpensive field sampling method intended to estimate the potential productivity of a forest stand and decide whether treatment is necessary or not, and if necessary, whether it can be delayed or not, and what type of treatment should be given.

Silvicultural decisions on the type of interventions needed may also be based upon the conclusions of studies that have been made to gain a better understanding of forest ecology problems which are considered to be barriers to the effective practice of silviculture (FAO 1998).

Silvicultural systems, treatment regimes and operations *(Source: adapted after Kleine (1997)*

The silvicultural decisions can occur at three levels: silvicultural systems, silvicultural treatment regimes, and silvicultural operations.

A *silvicultural system* may be defined as the process by which the crops constituting a forest are tended, removed and replaced by new crops resulting in the production of stands of distinctive form" (Matthews 1994).

A *silvicultural treatment* may be defined as a planned programme of silvicultural operations that can be implemented during the entire or partial rotation of a stand. Within the context of silvicultural stand treatment, each stand is assigned a specific silvicultural objective and separately assessed for its size (e.g., locality, slope, soil type) and stocking conditions (e.g., composition, age, diameter distribution, regeneration). Based on this information, a *treatment regime* is formulated.

Silvicultural operations are procedures that aim to achieve the stand-specific objectives by using specific *silvicultural techniques*. Such techniques may refer to canopy alterations to induce natural regeneration, harvesting of mature trees, planting, or thinning etc to improve timber quality and stand growth. Decisions at this level are related to operational aspects such as methods, work organization, machinery and equipment, manpower and skills as well as operational costs and investment requirements.

Recommended actions

- A diagnostic sampling can be used as a tool for determining stocking and regeneration targets. Its results are used for making decisions on the priorities for silvicultural interventions in different forest types or conditions. Steps and field procedures for using this method can be found in Hutchinson (1991) and FAO (1998).
- Acquire a good understanding of the ecology of the forest for which management is being planned. The light requirements of the desired regeneration and the structure of the existing stand are particularly important in choosing a silvicultural practice.
- Determine the number of *potential* (or future) *crop trees* (PCTs). These are trees of marketable species with well-formed stems which have the potential to form the final crop. A stand with more than 100 PC trees/ha can be considered well stocked.
- In choosing a silvicultural system or treatment regime consider the likely impact it might have on the sustainable production of NTFPs. It should not change the ecological structure to the extent that significant NTFP species are endangered or lost.[43]
- Document and justify the silvicultural system in the forest management plan. The process of justifying the choice of the silvicultural approach and techniques helps to ensure that all levels of management understand what they are doing and why. The description of the silvicultural system should also refer to the harvesting procedures to be used.[44]
- When developing and implementing a silvicultural system or regime consider how the interventions might have an effect on[45]:
    - growth rates of harvestable species (timber and non-timber);
    - forest services such as watershed protection, recreation or aesthetic value;
    - biodiversity and wildlife;
    - ecological sustainability (processes such as nutrient and water cycles);
    - seed production;
    - regeneration (e.g. the effects of minimum harvesting diameters on regeneration);
    - applicability to forest ecology (e.g. periodic small to large scale disturbances)
    - social acceptability (particularly to surrounding communities)

[43] FAO (1998).
[44] Higman et al. (1999).
[45] Higman et al. (1999).

Guideline 13.2: Silvicultural interventions

Silvicultural interventions should be implemented in accordance with specific prescriptions set out in the FMU's management plan.

Recommended actions

- Wherever possible, use simple silvicultural practices. The use of simple and clear silvicultural techniques will produce faster results and also tends to reduce costs and labour requirements and facilitates the participatory process.
- Combine silviculture with the main harvesting operation. This reduces the cost of silvicultural treatments while simultaneously reinforcing the idea that logging itself can be silviculturally useful[46].
- Given our currently limited knowledge on the ecology and biology of the different forest types and their species and the effects of the interventions (for instance on biodiversity), any silvicultural treatment should be cautiously applied. Every effort should be made to avoid unnecessary silvicultural treatments. Silvicultural interventions should be used to address specific objectives, sometimes in relation to particular species or products or considering certain ecological or social functions. The selectivity of species in the treatment increases significantly the economic yield.
- Silvicultural treatments should be applied within one or two years of harvesting, before regrowth makes movement difficult.
- The advanced regeneration of current and potential commercial or useful tree species should be the first target for silvicultural interventions.
- In intensive silvicultural systems, where biodiversity is reduced, protection of exclusion areas for conservation of biodiversity should be considered.
- Soil disturbance by skidders could be used as an inexpensive silvicultural tool to improve conditions for germination or resprouting of commercial tree species in logging gaps and increase the subsequent growth of seedlings established due to control of competing vegetation. This soil scarification could be carried out just prior to extraction of the log during harvesting operations. (Fredericksen and Pariona 2002).
- Prefer the use of indigenous species with proven commercial value for enrichment planting in harvested natural forests.

Principle 14: Forest protection

The forest needs to be protected from destructive and illegal activities.

RATIONALE

Sustainable forest management cannot be achieved in the absence of a firm commitment and action to effectively protect a forest management unit. Protection measures against unauthorized access or illegal activities, from conversion to other land uses, from fire and other potential threats are amongst the most

[46] Putz et al. (2000).

critical to be implemented, irrespective of the objectives. Also, in particular in intensively managed logging concession, waste management is an important protection function. Effective planning, implementation and enforcement of protection measures and related security arrangements should actively seek collaboration and cooperation with local forest communities.

GUIDELINES

Guideline 14.1: Control of illegal activities

The FMU should be protected from illegal activities, especially those that are incompatible with SFM.

Recommended actions

- Place forest guards to patrol forest boundaries, roads and tracks and the interior of the FMU to observe and monitor whether unauthorized operations may be taking place. They should be trained for their duties, including in public relations and, where practicable, have earlier security experience.
- Organize regular patrolling in the area, especially where harvesting has already taken place. Where there are risks of invasion demarcate and signal the FMU boundaries.
- Put up signs on access roads and other critical places explaining under what conditions access is permitted and also signs prohibiting unauthorized activities such as hunting and fishing.
- Develop collaboration with local authorities, alert them in case of transgressions to the FMU and facilitate access by enforcement personnel.
- Develop and enforce internal rules with regards to subsistence hunting and actively inform workers about its observance.
- Close unused roads, where legally permitted, through means such as removal of bridges and culverts.

Guideline 14.2: Fire prevention and control

A fire management plan for the FMU and adjacent lands should be formulated and implemented.

Fire is a serious threat to future productivity and environmental quality of the forest. Increased fire risk in areas being harvested, and even more so in areas which have been harvested, demands stringent safety measures.

Recommended actions

- When wildfire is perceived as a possible problem, a fire plan for the prevention and control of fires should be prepared for a FMU, or specific parts of it, as a requirement of a forest management plan. Following approval, the fire suppression plan should be annexed to, and form a part of the general management plan. Action to be taken by staff and workers if an accidental fire occurs should be clearly outlined in the fire plan, including the use of available equipment, the necessary manning strength in anticipation of a fire outbreak and the efficient clean-up and patrol of a fire area to prevent recurrence. See FAO (1998, pages 216-217) for specifications about this plan.
- Integrate fire management considerations into forest management planning. For example, when making forest inventories, it is important to include information on the quantities of fuel (dead tree, branches, litter) with a view to assessing the danger of fire, and sources of water for fire fighting.

- Identify relevant information and training needs to support the fire management plan. Where necessary, disseminate appropriate materials and conduct seminars, workshops**,** short courses, and field training sessions dealing with the principles and application of forest fire management, including fire prevention and suppression.
- Organize and maintain an effective capability in a condition of operational readiness in order that a rapid and effective response to forest fire emergencies can always be made.[47]
- Establish a brigade for fire prevention and control, and train their members on fire fighting techniques and tactics. Ensure that fire fighting tools and basic equipment are available to them, including fuel for vehicles and signing posts. Regular tests of fire readiness should be carried out to ensure fire protection capability is adequate.
- Develop and enforce operational procedures for fire prevention and control to promptly handle fire outbreaks during harvesting operations. Foresee specific measures during periods of extreme dry weather or high fire risk (for instance, total or partial restrictions on logging and the transport of logs to processing plants).
- Undertake patrols in areas frequented by people to ensure compliance with rules and regulations in force. Such patrols should be more intensive during periods of high fire risks or during holiday seasons.
- Encourage the involvement and participation of local communities in the planning and/or implementation of *fire management*[48] (see also *Community Based Fire Management*[49]). As some forest based activities of local communities involve the use of fire. Encourage regular dialogues to regulate such activities through measures which reduce the risk of wildfire starts from these activities.
- Identify and recruit suitable members of the community to be trained in fire prevention measures and in the use of techniques and equipment (including traditional tools), to suppress and manage fires. Include women as active participants in these activities (to capitalize on their knowledge and experience in the use of fire in agriculture, livestock production, and forest management).
- Whenever possible and appropriate, stimulate community cooperation in fire prevention through various incentive measures such as provision of funding popular initiatives for villages which have succeeded in preventing the spread of wildfires into adjoining forest lands. Also, prepare and conduct basic education programs, and provide extension materials for communities near the forest to increase their awareness on the importance of the forest environment and the role of fire.
- Monitor the effects of both fires and control activities in order to achieve a balance between stopping the fire and protecting the resource. Monitoring the effectiveness of the fire organization will help managers determine if the plan is working.[50]
- Establish and maintain a register and supporting maps recording the location, dates, reasons, areas and vegetation types lost or damaged by wildfires.[51]
- Whenever appropriate, a Fire Danger Rating System for the FMU and surrounding areas should be established and publicly displayed, preferably with daily updates on the internet.

[47] FAO (1998).
[48] All activities required for the protection of burnable forest values from fire; and the use of fire to meet land management goals and objectives (ITTO 1997).
[49] *Community Based Fire Management* (CBFiM is an approach to fire management in which local communities are actively enga8ged in the development and in some instances implementation of fire management strategies designed to prevent, control or utilize fires in ways that will improve their environment, livelihood, health and security (Van Lierop 2011).
[50] FAO (2006).
[51] FAO (1998).

Guideline 14.3: Management of pest and diseases

The management of pests and diseases should be an integral part of an FMU's forest management plan.

Keeping forests healthy requires careful planning throughout all of the resource management phases from regeneration to harvest. In some cases, specific management practices can be selected to promote natural regeneration and minimize the impacts on the ecosystem (FAO 2011).

The deliberate introduction in forestry operations of plants, animals, fungi and other microorganisms that might be invasive should be avoided and prompt action taken to eliminate established populations of invasive species. In areas where invasive alien species are a particular threat, special measures should be taken to avoid the transfer of seeds and propagules via, for instance, shoes, equipment and vehicles (ITTO/IUCN 2009).

Some procedures for waste disposal in the FMU *(Source: Higman et al. 1999)*

- Litter should be collected in each operational area and removed to be disposed as appropriate.
- Large items, such as tires, broken vehicle parts and oil drums, must be collected from the forest and removed before operations are considered complete.
- Oil, hydraulic fluid, fuel and other oil-based waste should not be allowed to leak on to the ground. They should be collected, removed from the forest and disposed of appropriately.
- Used oil, chemicals and their containers should not be stored near water bodies.

Recommended actions

- Incidence of pest and diseases should be regularly monitored and contingency plans prepared for controlling serious outbreaks.
- Whenever possible, carry out *pest surveys* to determine that healthy advanced regeneration has established and whether or not it is sufficiently free from weeds or competition from understory plants.[52]
- During silvicultural activities it is imperative to ensure that these activities and the associated equipment and tools do not move pests or intensify their impacts.[53]
- In enrichment planting activities use weed-free seed and sterilized potting soil to prevent the accidental introduction of invasive species.
- Forestry operations can encourage the introduction and spread of invasive alien species. Take measures to eradicate invasive alien species that become established.
- Good practices for natural regenerated forests that minimize pest presence are provided in FAO (2011).

Guideline 14.4: Management of wastes and chemicals

All waste derived from, and chemical used in forest management activities should be stored and disposed of properly.

All waste (organic and inorganic residues)[54] derived from forest management activities should be adequately handled, stored and disposed of properly with due attention to the local legislation and according to practices and procedures that avoid or minimize the risk to affect human health and environment conservation (Sabogal et al. 2009).

[52] FAO (2011).
[53] FAO (2011).
[54] Inorganic waste includes items such as litter, used oil, chemical containers, old tires and broken-down vehicles. Organic waste items are mainly kitchen rests, food rests, wood and parts of plants.

Recommended actions

- Incorporate in the forest management plan the considerations and measures for waste management, including the final destination of the waste generated.
- Adopt procedures and practices that minimize the quantity of waste and, whenever appropriate, recycle the residues.
- Provide adequate training for staff on procedures and practices defined in the waste management strategy.
- Make sure that procedures for the disposal of all types of waste are understood and followed by all employees.
- Adopt a risk management approach for those activities that use, produce, transport or storage significant quantities of materials which, in case were freed, may cause serious damage to human health and the environment (soil, water, wildlife).
- Organize awareness campaigns, e.g., using written communication and conferences.
- Use appropriate collectors to store dangerous inorganic waste such as oil residues, fuel, containers, filters etc.
- Where registered or recognized waste disposal sites exist within the region, these should be used.

Use of chemicals[55]

- Instructions for handling and storage of chemicals should be provided and enforced. Special restrictions are to apply near watercourses and other sensitive areas.
- Provide training to those operating chemicals and ensure appropriate and well-maintained equipment is always being used.
- Develop and enforce the application of documented procedures on chemical management to ensure that all personnel in contact with chemicals are aware of the correct methods for their use.[56]

Principle 15: Biodiversity conservation at the FMU level

Management measures in production forests can make an important contribution to the conservation of biodiversity.

The ITTO/IUCN *Guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests* (ITTO/IUCN 2009) have been specially designed to assist policymakers and forest managers by bringing together in one place the specific actions that are needed to improve biodiversity conservation in tropical production forests, and should serve as a prime reference, in particular Principle 9: *Biodiversity considerations at the forest management unit level* (Guidelines 24 to 37).

Guideline 15.1: Measures to conserve biodiversity

[55] Chemicals include fertilizers, insecticides, herbicides, fungicides and hormones which are used in forest management (Higman et al. 1999).
[56] Higman et al. (1999).

Biodiversity should be given a prominent place at all stages of the preparation and implementation of the management plan of an FMU.

Effective forest management, in which economic, social and environmental objectives are balanced in accordance with societal needs and priorities, is essential for setting and achieving biodiversity conservation and sustainable use goals.

Recommended actions

- Focus conservation efforts on those species or habitats that are of greatest conservation value. In this regard, pay particular attention to the management of species or habitats that are internationally recognized as rare, threatened or endangered.[57]
- Measures and safeguards to protect biodiversity should be included in all FMPs. Biodiversity should be given a prominent place at all stages of the preparation and implementation of the FMP.
- Set aside a portion of the FMU for complete protection. Optimally, these reserves should be large, shaped so as to minimize edge effects, cover representative areas of all the ecosystem types present, and include features of special concern for biodiversity maintenance such as water courses, rock outcrops, and salt licks.[58]
- Forest management plans should include information on the presence and conservation status of plants, animals and habitats of special conservation concern. In the preparation of the plan, consult with local people/communities and ensure that their traditional knowledge of biodiversity is taken into account. Whenever possible, encourage collaboration with museums, herbaria, environmental agencies and conservation NGOs to assemble baseline information on biodiversity resources (GL 26).[59]
- Significant gains in conserving biodiversity can be made by improving harvesting and silvicultural practices. For instance, by ensuring that land allocation and the planning of harvesting cycles and other silvicultural treatments result in patterns of forest cover that provide conditions suitable for biodiversity conservation[60]
- The preparation of harvesting plans, including stock maps at the compartment level, should take into consideration the local occurrence of species or habitats of special conservation concern. The information collected during the pre-harvesting inventories can be used to develop precise maps of the distribution of species and assemblages of species of conservation concern, such as nesting and fruit-bearing trees, and of other important biodiversity features such as wetlands, dry-season water supplies, patches of unusual habitats, saline earths and migratory routes.[61]
- Forest management should ensure that changes do not impact negatively on biodiversity features identified as having special conservation value.
- Assess the need for special measures to encourage the retention of viable populations of seed trees and maintain the genetic diversity of commercially important species, and ensure that the silvicultural requirements of target tree species are known and applied.[62]

[57] Reference to guideline 4 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, pages 30-31).
[58] Putz et al. (2000).
[59] Reference to guideline 26 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, page 47).
[60] ITTO/IUCN (2009).
[61] Reference to guideline 29 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, page 50).
[62] Reference to guideline 31 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, pages 52-53).

- Hollow trees, although generally of low commercial value, should be retained in harvest operations, as they provide important habitats for a wide range of animal species.[63]
- Disruption of canopy cover might be important in allowing the regeneration of light-demanding species but this should be balanced by the need to retain canopy connectivity for canopy-dwelling animals and to reduce fire risk and the exposure of open ground to rain and sun. Make use of the best available knowledge in decisions on the extent of canopy disturbance permissible during logging operations.[64]
- Avoid the use of arboricides or other means of suppressing certain tree species (particularly keystone species).
- Ensure that forest managers are trained and motivated to seek locally appropriate approaches to biodiversity conservation and sustainable use.

Biodiversity conservation measures during harvesting
(Source: Meijaard et al. 2005)

To maintain habitat complexity and diversity

- Retain *hollow trees* as much as possible as these provide cavities of importance to vertebrates that use them for breeding, nesting and food storage.
- Retain *rotting tree stumps* as much as possible. They are used by a number of animal species such as seed dispersers.
- Do not disturb *'salt springs', 'salt earths' and sites with clays eaten by animals*. These should be located and incorporated in area planning.
- *Wallows and pool*s over 1 m wide, and sites of permanent or near-permanent water, should be protected from skid trails.
- *Liana cutting* should be considered on a tree-to-tree basis. The advantages (reduced damage) should be weighed against the disadvantages (reduced vegetation diversity and fruit).

To keep keystone resources

- Retain as many *large fruiting trees* as possible, particularly those that fruit throughout the year and may be critically important for canopy frugivores during lean periods.
- Conserve as many figs (*Ficus* spp.) as possible, regardless of age. Figs are especially important for wildlife as they provide fruit throughout the year, and fulfill vital nutritional needs.
- *Local/Indigenous knowledge* regarding tree species and important for maintaining wildlife populations should be evaluated and as much as possible incorporated in forest management.

- Encourage collaboration between conservation NGOs and timber companies to adapt management practices to suit local conditions.

Non timber plant resources and wildlife

- Measures should be taken to avoid unsustainable levels of hunting and the gathering of NTFPs. Awareness-raising through education, publicity and consultation with forest-dependent communities, hunters and collectors, and the broader public (such as consumers of commercially harvested bushmeat), can play an important role in changing the consumption habits by local people of species of conservation concern. Forest managers should support measures, including collaboration with local communities, for controlling the harvesting and transport of bushmeat and NTFPs. To reduce the demand for bushmeat, large-scale operators should provide forest employees with meat and fish obtained from sustainable sources.[65]
- Wherever is relevant to do so, harvest planning for timber production should be dispersed so that adjacent or nearby compartments are at different stages of recovery following harvesting and mature

[63] Reference to guideline 32 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, page 53).
[64] Reference to guideline 34 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, page 54).
[65] Reference to guideline 36 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, pages 55-56).

and near mature compartments are located close to each other. By minimizing forest fragmentation greater species diversity is likely to be maintained and the risk of loss of NTFP species is minimized.[66]

- The method and scale of timber harvesting should accommodate any existing NTFP harvesting and trade patterns of local communities if well developed and where disruption that might be caused by logging would become a source of conflict.[67]
- An optimal planning of the road network limits the direct negative impacts on wildlife while a better control of access limits commercial hunting and fishing activities.
- Measures benefiting wildlife species include leaving dead snags and large fruiting trees (these should be marked for retention in timber harvesting operations); and having wide riparian corridors for animal access to water, and to provide migration pathways for the larger wide-ranging predators that are essential keystone species and which help maintain ecosystem health and functioning. As certain animal species are known not to cross open spaces over a certain width, any clear-cutting should give regard to patch size and shape so that the cutting is not a barrier.
- Forest managers should consider, in forest management plans, potential human-wildlife conflicts that could arise from logging activities and take appropriate measures to prevent their occurrence.[68]

Guideline 15.2: Monitoring biodiversity

Biodiversity monitoring should be in place to ensure that forest management does not impact negatively on biodiversity features identified as having special value.

Biodiversity monitoring is needed to ensure that the practices and specific measures defined in the FMP do indeed translate into minimum levels of performance on the ground, and to evaluate the extent to which these management standards are adequate and how they can be further refined to ensure continued progress towards the long-term management goals.

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 that make information on achievements and failures widely available (ITTO/IUCN 2009).

Recommended actions

- Ensure that FMPs provide for biodiversity monitoring and that management will be responsive to the results of that monitoring.
- The first option for biodiversity conservation in FMUs is to protect and control within a framework of precaution. For this strategy firstly consider simple, widely recognized and widely applicable measures for protection, control and impact reduction that can be taken with respect to each human impact. As a general approach, concentrate on measures to reduce or eliminate the major threats identified, monitoring whether the management actions are effective in achieving that[69].

[66] FAO (1998).
[67] FAO (1998).
[68] Reference to guideline 37 of the ITTO/IUCN Biodiversity Guidelines (ITTO/IUCN 2009, pages 57-58).
[69] An exception could be hunting, where biological monitoring might be a better way to evaluate the true impact of hunting on forest biodiversity than trying to monitor the incidence and control of the activity itself (CATIE 2004).

- Involve local people in setting up a system for biodiversity monitoring. This will facilitate the process of implementing any management recommendations, providing a cost-effective and sustainable means of data collection and a potentially rich source of local knowledge to help interpret results.[70]
- Forge partnerships for long-term biodiversity monitoring between forest operators and universities and specialized institutions.[71]

Principle 16: Community involvement in Sustainable Forest Management

Community involvement is essential for SFM to succeed.

RATIONALE

Community forest management (CFM) – embracing various degrees of community involvement, including arrangements such as participatory forest management, joint forest management, co- management and community-based forest management – can significantly contribute to improve the livelihoods of rural people, reduce forest emissions and increase forest carbon stocks, while maintaining other environmental and social services. CFM can also be an important vehicle providing employment and income, strengthening community rights on land and resource use, as well as organizational capacities for achieving sustainable development. Community forest management is defined here according to the UNFF (2011)[72] as "the management of forest lands and forest resources by or with local people, whether for commercial or non-commercial purposes". Local people encompass a diversity of actors including native groups, other traditional communities (like river dwellers), settlers and migrants. The associated concept of *smallholder forest management* is also considered, though in this case land and resource use rights are not collective and most management activities are not necessarily shared among.

GUIDELINES

Guideline 16.1: Consultation with local communities

Free, prior and informed consent in forest management decisions should be obtained in an appropriate, consultative manner.

The practice of *free, prior, and informed consent* (FPIC) consists of giving local people a formal role —and some form of veto power—in the consultations and ultimate decisions about local development projects. It is intended to secure the rights of indigenous peoples and local communities: their rights to self-determination, to control access to their land and natural resources, and to share in the benefits when these are utilized by others (WRI 2005). FPIC is a tool for greater equity and a natural pathway to a co-management role for local communities in large development projects.

Recommended actions

- The consultation process should include participatory methodologies to ensure participation and voice of marginalized social groups within affected communities, to build community consensus, to enhance transparency, and to ensure local ownership of the process. Use of traditional decision-making

[70] Zagt et al. (2010).
[71] Zagt et al. (2010).
[72] UNFF. 2011. Ninth session, New York, 24 January-4 February 2011. Item 5 (a) of the provisional agenda Forests for people, livelihoods and poverty eradication. Community-based forest management. Report of the Secretary General.

processes that are familiar to local communities, along with skilled facilitation and capacity building activities, will usually enhance the process and outcome.[73]

Guideline 16.2: Rights and responsibilities of local communities

Local communities should be fully informed of their responsibilities in forest management, which in turn should be commensurate with their rights to use and benefit from the forest.

It is important that the rights and responsibilities of those concerned about and making use of the forest be adequately considered in forest management. This approach requires taking into account the rights attained by practice as well as rights attributed by formal laws with regards to use and benefit from the forest.

The active participation from and support to local stakeholders provides useful knowledge about local forest use and management strategies. It contributes to efforts to control access to and regulate the use of forest resources and a means for conflict resolution and empowerment.

Recommended actions

- Communities can participate in all aspects of implementing SFM.
- Whenever possible, involve neighbor communities in management decisions that may affect or benefit them. Effective mechanisms should be formulated to enable the achievement of effective and enduring two-way communication between forest managers and forest communities.
- Promote collaboration amongst people and institutions who are involved in the various aspects of forest management, including wood production, integrating professional skills and training with traditional knowledge and resources of local populations in order to more effectively support the needs of rural communities and to minimize or avoid conflicts in forest management.[74]

Guideline 16.3: Equitable benefit sharing

Benefits should be shared equitably among stakeholders according to their rights, roles and responsibilities.

Equitable benefit sharing and decision making processes are fundamental factors in the sustained development of community forestry. The income generated from selling timber and non-timber forest products can be used for common community interests and as a direct form of compensation or income for communities (Huy 2007).

Experiences to date highlight that equity is not an automatic outcome of community-based forest management, so that promoting more equitable sharing of benefits is a shared concern (Mahanty 2008). In particular, if communities are able to secure the benefits that community-managed forests generate, and whether these actually reach the poorest at the community level.

Recommended actions

- Benefit sharing must be both equitable and transparent.

[73] World Bank (2008).
[74] FAO (1998).

- From the very start of the process, the community should prepare to manage the (financial and non-financial) benefits from their forests and seek assistance from other actors, including civil society, private sector, and forest administration.[75]
- In assessing the costs and benefits of community forestry, it is important to take into account who bears the costs and who receives the benefits.
- The identification, valuation and analysis of costs and benefits can help community decision makers to define options for distributing costs and benefits on an equitable, efficient and sustainable basis.[76]
- As a basis for benefit sharing, there is a need for local governance bodies to operate transparently and have accountability, with appropriate legal and procedural supports.[77]
- As women, poor and disadvantaged users of community forestry need special assistance, there should be particular focus on these groups while introducing cost and benefit distribution systems. This can help to increase the participation of women, poor and disadvantaged in CFM.[78]

Guideline 16.4: Community-based forest management

Local communities should have opportunities to actively and sustainably manage forests to increase income and improve living conditions.

Community-based forest management can be an effective tool for improving rural livelihoods and ensuring sustainable management of forest resources.

Recommended actions

- In planning CFM take particular attention to the community needs, the potential of the forest resources, the organizational and technical capacities and the availability of workforce in the community.
- The integration of CFM into the economic/productive, social and cultural context and situation of the involved communities is important. This calls for considerations regarding production calendars, setting community objectives and expectations in relation to CFM, defining the communities' knowledge and practices, and acknowledging their strengths and weaknesses for forest management.

CBFM practices are most effective when they (Mazur and Stakhanov 2008):
- utilise truly participatory processes from project initiation to completion;
- transfer ownership to communities under clear, negotiated, consensus-based agreements;
- create the legal environment and build community capacity to implement planned activities;
- provide training and secure access to new skills and technologies; and
- improve horizontal linkages and spread benefits to nearby communities.

- Well organized communities can develop sustainable approaches for forest management. The community's organizational capacity (existing skills and behaviour patterns within an organization) and 'capability' (what an organization can do) are key to face the challenges posed by CFM, and need to be developed and/or strengthened.

[75] The potential benefits from CBFM may be go well beyond financial revenues from commercial use of forest products to include non-financial benefits of CBFM, in terms of human assets, resource security, development of social capital and political empowerment that make the greatest difference to the poverty agenda (Mahanty and Guernier 2008).
[76] Maharjan (1998).
[77] Mahanty and Guernier (2008).
[78] Maharjan (1998).

- Clearly define roles and responsibilities of community members in the forest management process, including processing and marketing of any products and/or services derived from the FMU.
- Encourage diversified and value-added forest production integrating timber and non-timber forest products in CFM plans.
- Improve profitability and competitiveness of forest management, e.g., through the development of forest product value chains to help community managers gain market access for lesser known species, non-wood products, and to use wood and forest waste more efficiently.
- Involved communities should be able to qualify and measure the products and/or services in the forest management area, as well as to monitor and assess the impacts of the management interventions. This will improve their negotiating position to deal with external agents, increase their own capacity for reflection and comply with the necessary market and/or legal requirements.
- Keep track of hours worked by individuals, expenses, income, distribution of goods and monetary income, individual responsibility of the community members, etc.
- *Participatory monitoring*[79] can create spaces and opportunities for more inclusive, better-informed decision making in forest management, facilitating community-based decision making and management action. For participatory forest monitoring programs to be sustainable, they must be simple to conduct, inexpensive and locally relevant. Furthermore, participatory monitoring activities should build on existing management institutions (village leaders, forest user group councils), and in turn be institutionalized at the local level.[80]
- Mechanisms for improving communities' bargaining position with outside actors are necessary. This includes timber price information, connections to different timber buyers, for example at forest events and written contracts between buyer and community[81]. Communities may consider the support from related community organizations or other external actors such as NGOs or service providers.
- Public-private and community/smallholder-corporate partnerships can provide means to overcome common challenges, e.g., those related to access to capital and technology, as well commercial opportunities and favorable integration of small and medium forest enterprises into supply and value chains to generate income.[82]
- External technical and/or financial support is especially important in the process of implementing CFM. This support or assistance must occur in a timely manner and must be coordinated between the institutions involved.

Principle 17: Working conditions and capacity development at the FMU level

The provision of safe and adequate working conditions and capacity building are essential elements for SFM.

RATIONALE

[79] The term "participatory monitoring" applies to monitoring activities within an ongoing process where local forest users systematically record information about their forest, reflect on it and take management action in response to what they learn (Evans and Guariguata 2008).
[80] Evans and Guariguata (2008).
[81] Bojesen (1997).
[82] Katila et al. (2010).

Human beings are the most precious asset in any forest management operation and as such every effort should be made to ensure adequate working conditions and capacity building.

Forestry in general and logging in particular continue to be among the most dangerous occupations. Accidents are normally caused by poor organization and supervision, inadequate tools and equipment, poor planning, and lack of skills and competence among workers, supervisors and managers (ILO 2011). In this regard, policies should be developed to: i) eliminate risks, ii) control risks at the source, iii) minimize risks by focusing on safety of work methods and organizations, and iv) provide personal protective gear, equip all machinery with safety devices and make sure these are used.

Although training of forest workers has made great strides in some countries over the last decades, it is rudimentary or non-existent in most tropical countries. Often training is limited to high level positions of management and to supervisors and does not address the productivity and safety of unskilled and semi-skilled workers (ILO 2011).

GUIDELINES

Guideline 17.1: Rights and responsibilities of forest workers and local stakeholders

The rights and responsibilities of forest workers and local stakeholders in an FMU should be clearly defined, acknowledged and respected.

Recommended actions

- According to the importance and intensity of forest operations, the FMU manager contributes to the improvement of the economic and social well-being of workers in the FMU and of local populations.
- Ensure that relations between workers and management are based on regular consultation and fairness on both sides.[83]
- In situations of equal qualification and experience, priority should be given to workers from nearby communities or localities.[84]

Guideline 17.2: Occupational safety and health

Measures should be taken to ensure the safety and health of workers.

Forest managers must consider safety management as a top priority, actively promoting health and safety at the work place.

Recommended actions

- Provide safe and healthy working conditions for all personnel according to international occupational health and safety standards. The code of practice on "Safety and Health in Forestry Work" published in 1998 by the International Labour Office (ILO) contains practical guidelines to protect workers from occupational safety and health hazards in forestry work and to prevent or reduce the incidence of illness or injury. The code is accessible at www.ilo.org/wcmsp5/groups/public/---ed.../wcms_107793.pdf.
- Whenever possible, establish a training program for qualification and awareness-raising of staff on forest management activities, specifying risks and preventive measures for each operation, and listing the important aspects for quality maintenance during health and safety plan implementation.[85]
- All FMU personnel should be aware and able to identify risk situations and assess the probability of accidents in their work environment. The responsibilities of each crew member in the different management operations should be clearly defined.
- Workers should only be assigned to jobs that correspond with their age, physical capacity, state of health and vocational qualifications.[86]
- workers should dispose of and wear appropriate safety equipment. Assess protective equipment requirements according to job and circumstances and keep sufficient stocks for the workforce. Clothing should be in bright or fluorescent colors that stand out in forest surroundings.
- Ground workers operating heavy machinery (crawler of wheeled equipment) should be specifically trained in personal safety and safety in team work.[87]

[83] ILO (2011).
[84] FAO (2004).
[85] Safety rules for harvesting operations are provided in FAO (2004, pages 99 onward). See also Nogueira et al. (2010).
[86] FAO (2004).

- Remuneration should no longer be based solely on productivity. Financial incentives (e.g. bonus system) should be introduced to encourage workers to observe safety regulations, to reduce negative impacts and to maximize timber recovery.[88]
- Make sure that all equipment, tools and materials needed to work under conditions of safety are provided and kept in good state of repair; and provide safe and appropriate forms of transport for personnel and equipment to and from the worksite.[89]
- Foster stability of workforce as a way to reduce the occurrence of hazardous situations and thus risks of accident.
- All work accidents or professional diseases should be communicated in written and adequately registered in an information system and database. This would allow, among others, to indicate the main areas of attention for training and recycling.[90]
- Forest workers should ideally be given first-aid training as they are generally dispersed in crews operating over wide areas.
- Clearly marked and serviceable first-aid kits should be available in all worksites.
- Arrangements should be made for the rapid evacuation of workers in emergency situations.
- Crews working in remote areas (e.g. for inventory) should be connected to base by radio and should have permanent access to radio contact with an emergency vehicle operator.
- Whenever possible, forest managers should arrange regular medical check-ups for all personnel, especially those exposed to occupational disorders.
- Logging camps need to be carefully planned, built and maintained. They should be supplied with clean water that should be duly tested on a regular basis; any necessary filtering and treatment should be provided at the source. Camps should also have a basic sewerage system of septic tanks and/or drainage sumps located at least 100 m from the nearest source of clean water. Wastewaters should not discharge into a watercourse but be buried.[91]

Guideline 17.3: Capacity development

Capacity development at all levels of workforce, including attention to working conditions, is essential for SFM and should be integrated in forest management plans**.**

One of the major constraints for SFM is the lack of skilled personnel (technicians, operators, workers) to plan, execute and supervise management operations. Supervisory and managerial capacity is also inadequate. Forest managers should therefore consider the critical importance of staff training at all level in order to: i) minimize damage to the forest and the environment by implementing RIL in an effective and efficient manner; ii) make staff fully aware of the social and environmental impacts of harvesting; iii) increase work productivity, quality and safety; and iv) reduce harvesting losses as well as direct costs and production costs (FAO 2004).

Recommended actions

[87] FAO (2004).
[88] FAO (2004).
[89] FAO (2004).
[90] Nogueira et al. (2010).
[91] FAO (2004).

- Ensure forest workers receive adequate training and supervision to ensure proper implementation of the forest management plan.[92]
- Practical on-site training modules should be designed and applied as a matter of priority for inventory, felling and skidding crews.
- Continuous training (e.g. through regular on-site training modules) and recycling of technical and operational staff is important.
- Increase and maintain the professional skills, work performance and work quality of workers, and develop and maintain an awareness of social and environmental issues.[93]
- Recognize and value the knowledge and skills of experienced local people about forest resources (ecology, assessment, management and utilization).
- Whenever possible, develop and implement a sustained training program for all levels, from office (e.g., planners) to forest managers and workers with focus on SFM best practices, safety and efficiency.
- Consider establishing or supporting a formal program to prepare practical instructors (e.g. para-taxonomists) to provide regular training activities at the FMU level.

Principle 18: Monitoring, Evaluation, Research and Communication

Monitoring, evaluation, research and communication are essential elements for SFM, providing a sound and transparent basis for guidance and feedback to improve the planning and implementation of operational activities.

RATIONALE

Monitoring is a key component for the success of the forest management plan. A main goal of a monitoring system is to inform the forest manager about the performance and the effects of management within the FMU and surrounding area, as related to the management objectives. The results of monitoring should feed back into the planning process as forest management cannot be improved without data on its impacts (Higman et al. 1999).

The aims of monitoring, analysis and reporting on progress towards the achievement of management objectives are to (FAO 1998):

- control forest operations, including the performance of contractors or concession companies or other agencies working under contract or license in the forest;
- identify under- or over-achievement, to determine the causes and to take action to rectify the situation and to adjust the annual plan of operations if necessary;
- detect inefficiency or fraud;
- provide information for the future revision of the plan;
- provide information for the evaluation of the management plan or its prescriptions.

[92] The simplest and least expensive way to develop skills is through on-the-job training by FMU's supervisors and managers, supplemented by regular (generally annual) RIL technical courses run by vocational trainers (FAO 2004).
[93] Possible alternatives to decrease employees´ turnover rate could be to keep the staff during the non-harvest season (e.g., pre-harvest activities, post-harvest silviculture); or offer opportunities to professional progression of the employees.

GUIDELINES

Guideline 18.1: Monitoring progress in the implementation of forest management

A program should be put in place to monitor the implementation of an FMU's forest management plan and the impacts of interventions and to use the findings to improve forest management planning and practices.

Monitoring the implementation of activities set out in an approved forest management plan is fundamental to SFM and forms the basis for transparent accountability of operational activities. Monitoring at the FMU should be addressed at two levels: operational and strategic. *Operational monitoring* should provide information on whether appropriate procedures are being followed and management objectives are being met. *Strategic monitoring* should provide data about the long-term effects of the forestry operation, so that potential problems can be rapidly identified and resolved (Higman et al. 1999).

One possible approach to monitoring involves making comparisons between physical achievements and targets as set in the forest management plan and between financial expenditure and budgets at the end of specified time periods (for example, at three- or six-monthly intervals) – this is the so-called *periodic monitoring*. Another approach is to monitor specified key indicators continuously (*continuous monitoring*), which enables information on the progress of plan implementation to be collected more frequently, such as at weekly intervals, thus allowing a close control over forest operations (FAO 1998).

Recommended actions

- Reliable data and information are important for monitoring, evaluation and decision-making.
- Design a monitoring system that is flexible and able to respond to a dynamic context. Monitoring procedures should be developed which are consistent and replicable.
- Although all operations being carried out under an approved management plan should be capable of being monitored, some are more meaningful than others. Although the exact monitoring needs of each FMU will be specific to that forest there are "key" topics which can often be applied as indicators of operational performance at the forest level. A summary of key topics and monitoring guidelines can be seen in FAO (1998, pages 228 to 235).
- Internalize at the proper decision-making levels in the FMU the results of monitoring and new scientific findings or technical data, so that these are adequately taken into account to improve forest management.
- Engagement of end users in the design and implementation of the system increases their confidence in the system and ensures its utility[94]. Whenever appropriate, actively involve forest users groups in monitoring the quantities produced and the environmental effects of harvesting, hunting, fishing and recreational use of the forest and in identifying ways and means to reduce potential negative impacts.
- Local participation in resource monitoring can be an important strategy in gaining support for management prescriptions amongst harvesters. It is important for the local people who are using non-timber forest resources to understand the basis for quotas and other management prescriptions in order to make management credible to them. Local people can also adapt and improve methods through their knowledge of the resource[95]. Using indicators of resource condition chosen by local

[94] World Bank (2008).
[95] For instance, the case of rattan harvest in Indonesia described in Shanley et al. (2005).

people can increase their commitment to both the monitoring, and to consequent management adjustments[96].

- Consider collaborative relationships or arrangements with research institutions for participating in forest monitoring and related activities (e.g. research and capacity development).

Guideline 18.2: Reporting

The information generated by a monitoring program should be reported regularly to the responsible people or organizational structures within the company, forest agency or other entity.

The preparation and maintenance of permanent records of forest operations is an essential feature of forest management. Permanent records and costs of what activities took place, when and where, provide valuable information for forest management planning in the future (FAO 1998).

Recommended actions

- Prepare and maintain permanent records of forest operations. Continuously register all expenditures related to labor, material and equipment involved in forest operations. Daily records provide the management with an increasingly clear idea of production quantity and quality, and of productivity trends of workers and equipment throughout harvesting.[97]
- Ensure that reporting is made both written and oral in order that specific problems, unexpectedly good achievements or any other aspects of management are able to be discussed and any necessary action that is required can be taken quickly.[98]
- The frequency of reporting should be related to the nature of the topic being reported on. Reporting should be at least monthly, weekly or even daily in the case of log harvesting where close control of output, location of logging and trees being cut should be followed closely. Other topics can be reported upon less often, at monthly, three-monthly, six-monthly or at annual intervals, depending upon the sensitivity of the "key" topic in the management pattern of the agency or concession company.[99]

Guideline 18.3: Research

Ongoing research into the effects of forest management at the landscape, national and international levels should be complemented by research at the FMU level.

The complexity of tropical forest ecosystems and the ever increasing demands or expectations on SFM pose serious challenges for forest managers in terms of sound information needed for decision-making on the managerial, economic, environmental and social aspects. In that regard, research plays a key role by continuously informing managers on how to improve planning and actions in the forest to maintain a flow of goods and services (Blaser and Thompson 2010).

Research on SFM can be divided into two categories: 1) Research with a practical orientation which aids a field activity and which is intended to provide an answer to a concrete question or a concrete problem; and (2) research with a strategic orientation which aims to benefit the forestry sector as a whole (Bodegom 2000).

[96] FAO (2001).
[97] Sabogal et al. (2009), FAO (2004).
[98] FAO (1998).
[99] FAO (1998).

Recommended actions

- The forest management plan should foresee applied research in support to management operations. The larger the management scale, intensity and impact, the greater may be the need to undertake research efforts to improve management performance and minimize damage and waste.
- Whenever possible and appropriate, forest managers should seek collaboration or partnerships with research institutions and/or other service providers to conduct relevant applied experiments, in order to find solutions for the technical or operational problems in the field.
- Forest managers should be willing to test technological innovations derived from basic and applied forestry research in the FMU.
- Promote applied and participatory research to extend and communicate knowledge and experiences on all aspects of implementing SFM.
- A good forest management requires efforts of research and development appropriate to the local circumstances to solve problems, respond questions and increase our understanding on how the forest functions, how it reacts to management activities, and how these can be more efficient.[100]

Guideline 18.4: Communication, transparency and public awareness

The public should be kept informed about the management of an FMU through clear and open communication and the provision of regular information, thereby helping to ensure market access and public acceptance of forest management.

One of the core principles of SFM is that it reflects a diverse range of societal values in reference to forest conservation and use. For this reason, the active and informed participation of communities and stakeholders affected by forest management decisions is critical to the credibility and sustainability of management processes. Public awareness raising and communication activities play a critical role in informing and educating the public, thereby allowing them to more effectively participate in SFM decision-making (CBD 2009).

Successful awareness-raising activities must conform to the principles of professional communication, such as honesty and reliability, openness and transparency, fairness and continuity, but also the capacity of listening to the public and taking its concerns seriously. Professional communication and public relations offer a whole array of instruments and methods that can equally be used in awareness raising. The choice of the appropriate instruments depends very much on the context, objectives and characteristics of the awareness-raising process (FAO/ECE/ILO 2003).

Recommended actions

- To work with the different stakeholders, communication, education and public awareness (CEPA) are crucial instruments to build trust, understanding and shared agreements for action and to reduce conflict.[101]
- Prepare and regularly update an informative summary of the forest management plan and the progress with implementation, and disseminate it in regular meetings or consultations with local stakeholders as well as through official channels, schools, traders, etc. A minimal factsheet (showing information such

[100] Wood (1992).
[101] A didactic toolkit on CEPA, prepared by the CBD (Hesselink et al. 2007) is available at www. Toolkit n www.cbd.int/cepa/toolkit/2008/doc/CBD-Toolkit-Complete.pdf

as: logging licence number, map of operating area, size of concession, AAC and production records) should be posted on the FMU website and updated quarterly.

ADDENDUM

CLIMATE CHANGE MITIGATION AND ADAPTATION AT THE FMU LEVEL

Principle 1: Forest carbon management

Climate change mitigation actions in natural tropical forests must not compromise the ecological principles of SFM. It can be complementary to other objectives of forest management but may also involve tradeoffs. Synergies between forest-based climate change mitigation and climate change adaptation should be sought.

Managing forests for one or several of the five REDD+ options—reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks—can contribute to global climate change mitigation goals and can potentially yield economic benefits for a country's forest sector in general and for FMUs in particular. This requires that a country has the appropriate institutional and incentive structures for REDD+ and that rules and regulations for REDD+ governance and management are operationalized.

Guideline 1: Assessment of carbon management options for climate change mitigation in FMUs

Existing REDD+ country strategies and regulations, including on carbon rights, incentives and the responsibilities of forest managers, should be analyzed, an action plan for forest carbon management developed, and safeguards established to avoid negative social and environmental impacts.

Recommended actions

- Analyze national REDD+ strategies, financial and other incentives, and national laws regarding rights to own and trade forest carbon.
- Consult with local interested parties on the appropriate REDD+ options for a given FMU.
- Identify primary stakeholders, including indigenous people and local communities, and clarify rights to carbon in the FMU.
- Identify options for improved carbon management and evaluate the risks, costs and benefits of carbon management options and their implications for other forest management objectives.
- Assess and identify means for addressing leakage, permanence and safeguard requirements.
- Integrate carbon management into the forest management plan.

Guideline 2: Defining the reference emission level and reference level for carbon management

The reference emission level (REL) is the benchmark established for assessing progress in reducing emissions from deforestation and forest degradation. The reference level (RL) is used for assessing the

mitigation effects achieved through the conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks.

Recommended actions

- Calculate the REL and/or RL for the FMU using existing approved methodologies under UNFCCC REDD+ instrument or the voluntary carbon market framework.
- Harmonize the identified REL/RL with the national/sub-national REL/RL.

Guideline 3: Monitoring and reporting on forest carbon and safeguards

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. It requires that safeguard measures are in place to avoid negative impacts on biodiversity, indigenous peoples and local communities.

Recommended actions

- Update forest inventory procedures to meet REDD+ requirements related to forest carbon measurement, reporting and verification.
- Carry out forest carbon assessments using the guidelines of the Intergovernmental Panel on Climate Change, as specified by the UNFCCC.
- Develop and implement monitoring of social and environmental safeguards for REDD+, consistent with national guidelines on REDD+ safeguards.
- Undertake leakage monitoring and assessment, as per national guidance on REDD+ or voluntary carbon markets.
- Develop a reporting system to meet the national requirements for reporting on REDD+, including on REDD+ actions taken, forest carbon monitoring, and social and environmental safeguards.

Guideline 4: Research into and development of best-practice forest carbon management

Research is needed to develop effective forest carbon management options at the FMU level and will entail collaboration between research institutions and forest managers.

Recommended actions

- Collaborate, where possible, with research institutions and access and use relevant research findings to identify and implement best-practice forest management for climate change mitigation under varying conditions consistent with ecological principles and social responsibilities.
- Review and promote suitable forest management options and the sharing of lessons learned with a view to strengthening forest-based climate change mitigation activities.
- Take up REDD+ demonstration activities and spread awareness about their climate change mitigation and income-enhancing potential.

Principle 2: Climate change adaptation related to tropical forests

Climate change is likely to affect tropical forests as well as people who depend on those forests. Predicted changes in climate will place pressure on the capacity of forests to maintain biodiversity, productivity and ecosystem services. Managers of tropical forests should take measures to reduce the vulnerability of forests to climate change and facilitate their adaptation to changing conditions.

Guideline 1: Impact assessment on forests

An assessment of the impacts of climate change and climate variability on the physical characteristics of the forest and its productivity, ecological dynamics and ecosystem functions will help forest managers to respond quickly to changing conditions.

Forests may be affected biophysically by climate change in several ways: plant physiology and metabolism; pathology; insect and animal herbivory; the incidence and severity of fire, floods and drought; ecosystem functioning; and spatial extent. Climate-related change could have significant impacts on the availability and quality of forest goods and ecosystem services, including the capacity of forests to sequester and store carbon.

Recommended actions

- Obtain information on recent trends and projected changes in climatic variables (e.g. temperature and precipitation) and impact assessments relevant to a given area.
- Monitor trends in the frequency and severity of climate change-related impacts (e.g. the incidence of pest and disease outbreaks, fire, floods and drought).
- Assess the current and likely future impacts of climate change on forest characteristics, productivity and ecosystem services.

Guideline 2: Assessment of social and economic impacts of climate change

Climate change may have significant impacts on forest-related social and economic factors. Forest managers should be aware of such impacts and should seek to limit them when they are negative and maximize them when they are positive.

Climate change could lead to, for example, the movement and resettlement of human populations, increased pressure on forests for agricultural use (e.g. if the productivity of agricultural lands decreases), and changes in markets for forest products driven by increased demand for renewable energy. Climate change may also affect the livelihoods of rural people, who could benefit from forest-based employment, including in small-scale forest enterprises. The management of forests for the delivery of forest ecosystem services, such as the protection of soil and water resources, could become more important under climate change.

Recommended actions

- Referring to climate change impact assessments and other relevant sources of social and economic data, identify emerging and likely future socioeconomic impacts of climate change on forests.
- Monitor changes in markets for forest products due to changes in demand for forest-based energy and for product substitution.

Guideline 3: Costs of adaptation

Estimates of the costs and benefits of climate change adaptation are needed to support decisions on forest management and related investments.

Implementing climate change adaptation measures should enhance forest resilience and provide co-benefits including biodiversity conservation and the protection of forest soils and hydrological cycles. Nevertheless, the implementation of such adaptation measures may be costly. 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 to leverage financial support for adaptation.

Recommended actions

- Promote and support research into the analysis of forest adaptation costs and benefits in different forest types and under various management options, and share the results of such research.
- Monitor key variables (indicators) of adaptation effectiveness.

Guideline 4: Management for adaptation

Well-planned and implemented adaptation actions will maximize benefits and minimize costs.

Forest managers should modify forest management plans and practices to include adaptation measures, taking into account the biophysical, social and economic impacts of climate change, the costs and benefits of action, and the long-term costs of inaction.

Recommended actions

- At the level of forest stands within an FMU, identify the short-term and long-term risks, costs and benefits of adaptation measures.
- Modify forest management plans and practices to include relevant adaptation measures.

***

GLOSSARY

Adaptive management. Also known as adaptive resource management (ARM), is a structured, iternative process of optimal decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring

Biomass stock. Organic material both above-ground and below-ground, and both living and dead, e.g., trees, crops, grasses, tree litter, roots etc. Biomass includes the pool definition for above - and below - ground biomass

Civil society. Groups affecting voluntarily in their capacity as citizens to advance common goals and agendas.

Deforestation. The conversion of a forest into another land-use.

Ecosystem Services. The multitude of resources and processes that are supplied by natural ecosystems.

Externality. A consequence of an action affecting others for which the actor is neither rewarded nor penalized through the market.

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. Land spanning more than 0.5 hectares with trees higher than five meters and a canopy cover of more than 10%, or trees able to reach those thresholds in situ. It does not include land that is predominantly under agricultural or urban use.

Forest degradation. Reduction of the capacity of a forest to provide goods and services. 'Capacity' includes the maintenance of the elasticity of ecosystem structures and functions.

Forest management unit. A clearly defined forest area, managed to a set of explicit objectives according to a long-term management plan.

Forestry. Forestry is the art and science of managing forests and trees, embracing a broad range of concerns which include providing timber, fuelwood and non-wood forest products, biodiversity management, wildlife habitat management, watershed management and water quality management, recreation, landscape protection and erosion control, employment, and sinks for atmospheric carbon dioxide.

(Forest) Governance. A policy and political approach related to defining the elements needed to conserve and sustainably managing forests.

Growing stock. Volume over bark of all living trees more than X (generally 10) cm in diameter at breast height (DBH). Includes the stem from ground level or stump height up to a top diameter of Y cm (generally end of the bole), and may also include branches up to a minimum diameter of W cm

Landscape. A cluster of interacting ecosystem types, pristine or modified by man.

Non-wood forest products (NWFP). Non-wood forest products consist of goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests

Private sector. Encompasses for-profit entities that are not owned or operated by the government.

REDD+. Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries

(Forest) Stakeholders. Any individuals or groups who are directly or indirectly affected by, or interested in, a given resource and have 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 and/or usage of a particular land unit or the associated resources (such as individual trees, plant species, water or minerals) therein.

User 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

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