PART 1 OVERVIEW

An iguana lies on a forest log, Trinidad and Tobago.

INTRODUCTION

In 1987 the International Tropical Timber Organization (ITTO) commissioned a survey of tropical forests in its member countries, specifically directed at the management of forests for timber production. The scope of that survey was later extended by the publication *No Timber without Trees* (Poore et al. 1989), which set it in the wider context of the management of tropical forests for all purposes. It concluded that an insignificant proportion of the world's tropical forests was managed sustainably, although some – but not all – of the conditions for sustainable management were present in a much larger area.

At its 30th session in 2001, the International Tropical Timber Council decided to prepare a new and more comprehensive survey of sustainable forest management (SFM) in the tropics and, in its Decision 9(XXX), authorized the Executive Director "to prepare and publish [a] Status of Forest Management Report, based on available evidence". The main report of that survey, which used 2005 as its nominal reporting year, was published in 2006 (ITTO 2006).

In its 2008–09 Biennial Work Programme, the International Tropical Timber Council made provision for a further report on the status of tropical forest management, and it made funds available to member countries to assist in the preparation of national reports that were to be used as one of the sources of information. This document is an outcome of that process, presenting, in effect, a third survey of the status of tropical forest management in the tropics.

Survey coverage

The present survey covers the same 33 ITTO producer member countries (referred to as ITTO producers in the figures and tables below) as were covered in the 2005 survey. It is divided into two main parts: this overview, and detailed profiles of all ITTO producer member countries, arranged according to region as follows:

- **Africa** – Cameroon, Central African Republic (CAR), Democratic Republic of the Congo (DRC), Republic of the Congo (abbreviated to Congo), Côte d'Ivoire, Gabon, Ghana, Liberia, Nigeria and Togo.
- **Asia and the Pacific** – Cambodia, Fiji, India, Indonesia, Malaysia, Myanmar, Philippines, Papua New Guinea (PNG), Thailand and Vanuatu.
- **Latin America and the Caribbean** – Bolivia (Plurinational State of, abbreviated to Bolivia), Brazil, Colombia, Ecuador, Guatemala, Guyana, Honduras, Mexico, Panama, Peru, Suriname, Trinidad and Tobago, and Venezuela.

The year of reporting for all data is nominally 2010 – that is, five years after the nominal reporting year, 2005, used in ITTO (2006) – but the actual year to which data refer varies according to availability. Appendices to this report contain data on tropical forest area (Appendix I), summary tables on a range of parameters for ITTO producer member countries (Appendix II), notes on methodology (Appendix III), a list of tropical timber species and their common names by country (Appendix IV), and a tabulation of industrial roundwood production versus area of production forest for ITTO producer member countries (Appendix V).

ITTO forests in a global setting

Almost all of the world's closed tropical forests are found in 65 tropical countries, of which 33 are members of ITTO. The forests of these 65 countries cover about 1.66 billion hectares, and ITTO member countries account for 1.42 billion hectares (85%) of this (Table 1; Figure 1). Of the 65 countries, the top seven in terms of total forest area are ITTO producer member countries – Brazil (520 million hectares), DRC (154 million hectares), Indonesia (94 million hectares), India and Peru (68 million hectares), Mexico (65 million hectares) and Colombia (60 million hectares). The reported area of forest categorized by the Food and Agriculture Organization of the United Nations (FAO 2010) as 'primary forest' amounts to about 887 million hectares, of which ITTO producer member countries contain 96%. Brazil has an estimated primary forest area of 477 million hectares, which is more than 50% of primary tropical forests worldwide. Data for all 65 countries are presented in Appendix I.

Definitions

In a survey of this scope, which relies on such a wide range of sources (see below), clear definitions are essential. The following are definitions of the most important terms used in this survey.

Figure 1 Tropical forested countries and ITTO members

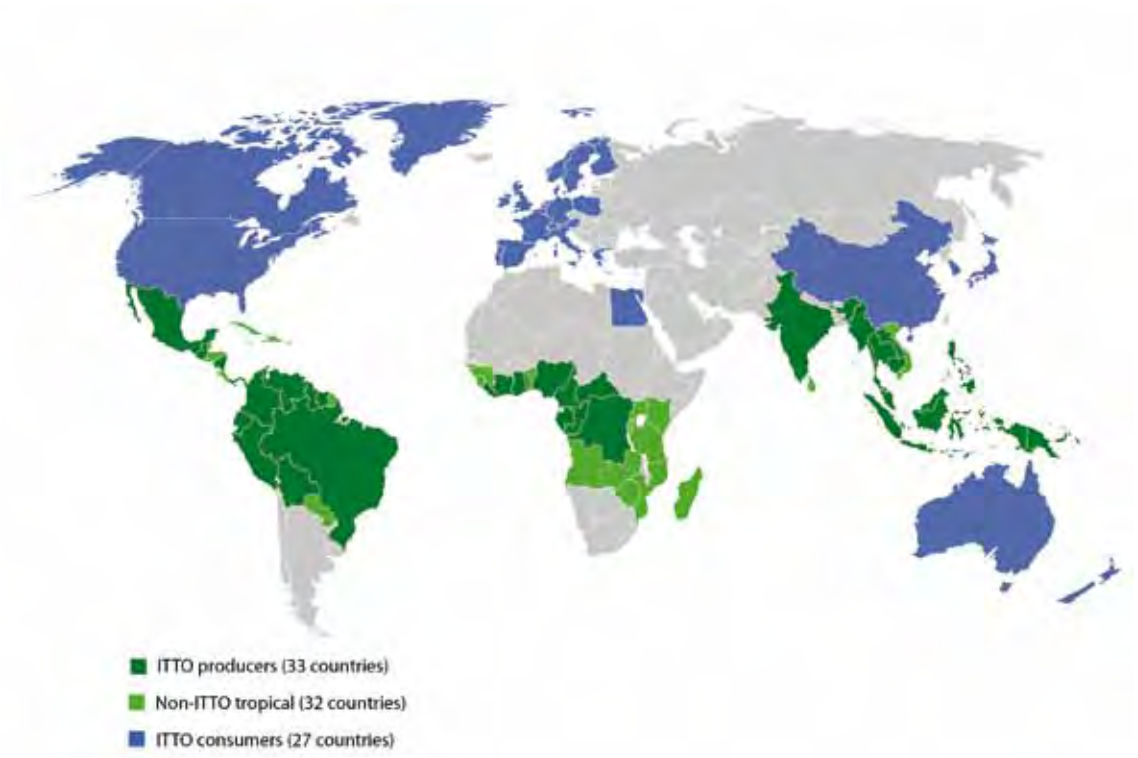


Table 1 Global tropical forest area, by region

Region (number of countries)	Total forest area (million ha)	% of forests in ITTO producer countries	Primary forest (million ha)	% of primary forests in ITTO producer countries
Tropical Africa (26)	**440**	**61**	**102**	**98**
ITTO (10)	270		100	
Other (16)	170		2	
Tropical Asia and the Pacific (16)	**317**	**89**	**108**	**97**
ITTO (10)	282		104	
Other (6)	35		3	
Tropical Latin America and the Caribbean (23)	**907**	**96**	**678**	**96**
ITTO (13)	868		647	
Other (10)	38		30	
Global total (65)	**1664**	**85**	**887**	**96**
Total ITTO producers (33)	1421		851	
Total non-ITTO (32)	243		35	

Note: Totals might not tally due to rounding. 'Other' refers to non-ITTO member countries with significant closed forests in the tropics. A few countries in Africa with at least part of their territories in the tropics – i.e. Sudan, Ethiopia, Namibia and the countries of the Sahel belt – are not counted here. While the open savannas of these countries are of significant value for many ecological, economic and social reasons, their low productivity means that they are not major contributors to the tropical forest products and services that are ITTO's main interest (see also definition of permanent forest estate below).

Source: FAO (2010). Note, however, that FAO (2010) does not provide estimates of primary forests for several countries, including the large forest area of DRC, in which cases ITTO estimates are used.

Forest

The definition of forest used by FAO is applied here. The definition is:

> Land spanning more than 0.5 hectares with trees higher than five metres and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use (FAO 2010).

Tropical forest

Consistent with the International Tropical Timber Agreement, 1994, this report defines tropical forest as forest lying between the tropics of Cancer and Capricorn (so forests at higher altitudes within the tropics that effectively are temperate forest types are still 'tropical'). Several producer countries – Brazil, India, Mexico and Myanmar – have significant areas of forest outside the tropics. In ITTO (2006) at attempt was made to distinguish tropical from non-tropical forests but it was not possible to do so from the available data for India. In this report, however, an attempt has been made to do so. This posed certain difficulties in comparing the results of the two surveys for India because in many cases the parameters being measured were different.

Primary forest

The term primary forest is used in some country profiles and also in this overview. Much of the data on primary forest has been obtained from FAO (2010), which defines it as:

> naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.

Closed forest

The definition of closed forest used in this survey is forest whose tree canopy covers 60% or more of the ground surface, when viewed from above. In the case of India the percentage cover used was 40%, since only this measure of canopy cover was available for India's tropical forests.

Sustainable forest management

ITTO (2005) defined SFM as:

> the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction in its inherent values and future productivity and without undue undesirable effects on the physical and social environment.

To elaborate the definition and assist the monitoring, assessment and reporting of SFM, ITTO has developed a set of key criteria and indicators (C&I) for the sustainable management of tropical forests. These comprise the essential elements of SFM and are consistent with the seven thematic elements of SFM specified in the Non-Legally Binding Instrument on All Types of Forest (United Nations General Assembly 2007). Along with the definition of SFM given above, they constitute the basis for the assessment of SFM presented in this report.

The definition of SFM given here was not formulated for application in forests in totally protected areas, where forest goods are usually not extracted. Nevertheless, it can still be applied in such forests with the understanding that the extraction of 'desired goods' (both timber and non-timber forest products – NTFPs) should be zero, or close to zero, for SFM to be achieved.

Permanent forest estate

ITTO policies stress the need for countries to establish a PFE, which is defined in ITTO (2005) 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 fulfil a combination of these functions.

In this report, two types of PFE are distinguished: production and protection. The production PFE includes both natural forest and planted forest, quantified separately. Figures given for production PFE are usually relatively dense forest and therefore large areas of savanna (even though they are counted as forest under FAO's definition of forest if canopy cover is 10% or greater) are often not included in the production PFE. In general, then, production PFE in this report comprises those tropical forests and planted forests (except those established solely for protective purposes) deemed to be accorded 'permanent' status. In general, protection PFE is considered to be the area of forest inside designated protected areas, where timber

production and other forms of resource exploitation such as mining and commercial hunting are not legal land uses.

Planted forest

The term 'planted forest' is preferred to 'plantations', but the two are used interchangeably in this report. ITTO (2005) defined planted forest as:

> A forest stand that has been established by planting or seeding.

FAO (2010) used the following definition:

> Forest predominantly composed of trees established through planting and/or deliberate seeding.

These two definitions are essentially complementary and constitute the definition of planted forests used in this report.

In some countries the distinction between planted forest and natural forest is blurred, especially where indigenous species have been planted. In some cases, such forests are regarded as 'semi-natural' forests. In this report, some 'semi-natural' forests are treated as natural forests, as indicated in individual country profiles.

Sources of data

The country profiles presented in this report were compiled from many sources. The most important sources, however, were reports of the ITTO producer member countries as requested by the International Tropical Timber Council in the format devised for the ITTO C&I. The ITTO C&I have been revised periodically in the light of experience and developments in international forest policy. The previous survey (ITTO 2006) used as a source of information questionnaires submitted by ITTO producer member governments based on a set of C&I published in 1998. ITTO (2005) presented a revision of the C&I, reducing the number of indicators and simplifying the reporting format. ITTO producer member countries were requested to use this revised set of C&I as a basis for submitting information to ITTO for the present survey.

Other datasets were also used. These included FAO's Global Forest Resources Assessment 2010, country reports submitted to the World Bank's Forest Carbon Partnership Facility, and others such as web-based datasets maintained by the International Union for Conservation of Nature (IUCN), the United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC) and ITTO member countries. Other useful sources included diagnostic missions conducted by ITTO at the request of members, ITTO field projects, national-level training workshops on the application of the ITTO C&I, field visits, investigative reports published by non-governmental organizations (NGOs), and personal communications with organizations and individuals with specialist knowledge. Sources varied by country, and are identified in each country profile. Some countries provided maps of ecological zones, forest types or other relevant parameters. Where they were of sufficient resolution, these maps are presented in the country profiles in their original languages.

The data obtained from such diverse sources are necessarily highly variable, which often posed considerable difficulties in interpretation. These are discussed later.

Estimating the area under SFM

In order to assess progress in the achievement of SFM, this report estimates the area of natural forest in each ITTO producer member country that can reasonably be thought to be under management that is largely consistent with SFM. These estimates have been derived for the natural-forest production PFE by adding the forest management units (FMUs) that have been independently certified or in which progress towards certification is being made; have fully developed, long-term (ten years or more) forest management plans with firm information that these plans are being implemented effectively; are considered as model forest units and information is available on the quality of management; and/or are community-based units with secure tenure for which the quality of management is known to be of a high standard.

Since trends are more useful than one-off measurements in determining progress towards sustainability, the assessment of SFM requires the long-term monitoring of forest values, but there are very few tropical production forests in which this is carried out. For some forests, therefore, information on changes in the quality of management is anecdotal or unpublished.

Many people living in Amazon have a high dependency on forests for their livelihoods. © *J. McAlpine*

In most cases the estimates should be considered conservative, since they include only those forest areas where information about the quality of forest management was available. It is possible that other forest areas are also being managed well, but information was not available to identify these. The resulting estimates of SFM in this report give the area of forests being managed in a way that is unlikely to cause long-term, undue harm to the biological, physical and social environments (as consistent with the definition of SFM).

Where data allowed, estimates were also made of the extent of protection PFE under management considered consistent with SFM. These estimates were derived from information provided by countries and from other (mostly unpublished) sources. Areas included are those with secure boundaries and a management plan (usually fully in place, but in some instances still being developed), that are generally considered in the country and by other observers to be well managed, and that are not under significant threat from destructive agents.

Other methodological matters are described in Appendix II.

Recent developments

There has been considerable change in the global policy environment in the five years since the preparation of ITTO's report on the status of tropical forest management in 2005 (ITTO 2006). Some of these changes have had, or are likely to have, a significant effect on efforts to promote SFM in the tropics. Many of them also feature in the country profiles in the second part of this report, and they are therefore described briefly below.

REDD+

A concept that was only nascent in debates on tropical forests in 2005 is that of REDD (reduced emissions from deforestation and forest degradation) and its more evolved form, REDD+. REDD+ is part of a broader development agenda that particularly addresses the role of tropical forests in climate-change mitigation and adaptation. The term has been defined in the framework of the climate-change negotiations of the United Nations Framework Convention on Climate Change (UNFCCC) as "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" (UNFCCC 2007). REDD+ has developed since 2008 as a major new policy tool in tropical forests and has the potential to provide substantial new and additional funding for the sustainable management of tropical forests.

REDD+ focuses on the capacity of forests, especially in the tropics, to capture and store

carbon. Forest carbon occurs in living and dead above-ground biomass, litter, below-ground biomass (roots) and the organic soil (collectively, 'carbon pools'). In most closed tropical forests, living biomass is by far the most important component of the carbon stock (although there are exceptions, such as heath forests on poor podsolic soils and, in particular, peat swamp forests). Carbon may accumulate rapidly in young planted forests or in recently harvested forest stands but is mostly lost on harvesting, unless retained in the form of wood products. Primary forests often have the largest accumulation of carbon in their biomass but they tend to sequester little new carbon. A sustainably managed production forest is carbon-neutral in the long term – that is, there is no long-term net emission or sequestration of carbon.

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 (CO_2) and other greenhouse gases (GHGs; such as methane). Tropical deforestation is estimated to have released in the order of 1–2 billion tonnes of carbon per year over the past 20 years, with estimates of the contribution to global GHG emissions ranging up to 20% (e.g. Houghton 2005). There are no estimates of counteracting sequestration. The largest source of GHG emissions in most tropical countries is deforestation and forest degradation. In Africa, for example, deforestation accounts for nearly 70% of total emissions (FAO 2005). Moreover, clearing tropical forests further destroys globally important carbon sinks that are currently sequestering CO_2 from the atmosphere and are critical to future climate stabilization.

The aim of REDD+ is to provide financial incentives to help tropical countries voluntarily reduce national deforestation, conserve and sustainably manage their permanent forest estates, and increase forest cover through reforestation and afforestation. Thus, REDD+ could simultaneously mitigate climate change (through carbon capture and storage), conserve biodiversity, protect other ecosystem goods and services, increase income for forest owners and managers, and help address issues of forest governance.

The operationalization of REDD+ will require accurate monitoring and reporting; forest management activities included in REDD+ schemes are likely to be subject to high levels of scrutiny and accountability at the international level. Concepts such as PFE and SFM are likely to be adapted for use in REDD+ schemes. In this report, each country profile includes information on forest vulnerability to climate change and the country's potential to address the challenges and opportunities for tropical forests stemming from an international climate-change regime.

Vulnerability of forests to climate change

Climate change and climate variability[1] could be among the most serious threats to sustainable development, with potential adverse impacts on natural resources, physical infrastructure, human health, food security and economic activity. Forests and rural landscapes in the tropics may be particularly vulnerable to the effects of climate variability, for example extreme weather events such as droughts (and associated wildfires), flooding and storms. At the same time, forests have the capability to reduce both environmental and social vulnerability.

In many tropical countries the climate appears to be changing. Recent data (as reported in Part 2) provide evidence of, for example, increasing temperatures and prolonged dry periods in some regions, and increased rainfall and more frequent tropical storms in others. In Mexico, there has been an increase in mean annual temperature of 0.6 °C in the past four decades. In Peru, average annual temperature has increased by 0.3 °C in the last 50 years. In Ghana, average annual temperature has increased by 1.0 °C since 1960, thus damaging the integrity of forest ecosystems. Adaptive approaches to forest management will become increasingly important in the face of climate change. Regardless of the pace of such change, healthy forests maintained under SFM will be better able to cope than those weakened and/or degraded by over-exploitation.

Rise of local stakeholders

In many countries, not only in the tropics, forest management has often taken a 'top-down' approach, whereby a central forest administration has supervised the harvesting and management of

1 Climate change refers to long-term changes of climatic parameters, such as temperature, while climate variability refers to short-term changes and extreme weather conditions, such as droughts and increased frequency or intensity of storms.

large areas of forest. In recent years, however, people living closer to the forest, including Indigenous communities, have begun to express, at the national and international levels, their strong desire for more control over local resources. This trend has been strengthened in the United Nations with the adoption, in 2007, of the Declaration on Rights of Indigenous Peoples. Among other things, this declaration:

- States that Indigenous peoples have the right "to the recognition, observance and enforcement of treaties" concluded with states or their successors.
- Prohibits discrimination against Indigenous peoples.
- Promotes the full and effective participation of Indigenous peoples in all matters that concern them.
- Declares that states should consult and cooperate in good faith with Indigenous peoples in order to obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them.

The effects of this rise of local stakeholders vary. At the international level, the increased influence of Indigenous peoples is having an effect in shaping policies, especially in climate-change related bodies such as the UNFCCC, the Forest Carbon Partnership Facility and the REDD+ Partnership. In Latin America, there has been a significant transfer of forest ownership from the state to Indigenous and local communities. In Asia a similar if less significant trend has been observed, but there has been less change in Africa (ITTO & RRI 2009). In some instances there has been increased tension at the local and national levels over rights to land and resources.

The rise of local stakeholders has highlighted the limitations of what has been termed the 'big-conservation' model, whereby biodiversity conservation is achieved through the creation of large protected areas, often without accommodating the traditional ownership attached to, or the use made of, those areas by Indigenous and local people. In recent years there has been a strengthening of the view that a big-conservation approach to forest protection can be counterproductive where Indigenous people and local communities have customary land-rights claims over those forests. At the international level and in many countries, including some in the tropics, efforts are being made to strengthen the participation of Indigenous and local people in policy debates and decisions and to reform land tenure, including forest tenure.

Ecosystem services

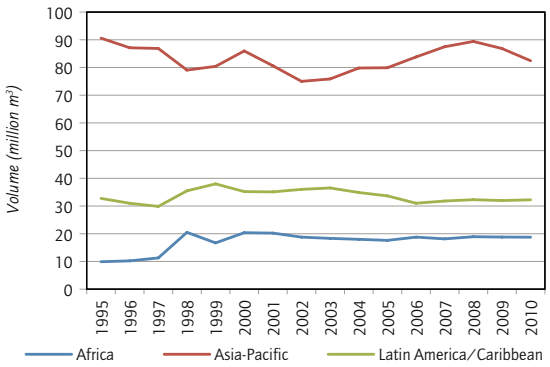
The role of tropical forests in the provision of ecosystem services, such as catchment protection, biodiversity conservation and carbon sequestration, is increasingly being recognized. Markets to facilitate payments for such services have been created in a number of countries and also internationally. At the international level, the volume and value of payments is still low, but, as discussed above in the context of REDD+, there is substantial potential for an increase, especially for carbon sequestration.

Tropical timber trade

The tropical timber trade faces increasing competition from non-tropical timber and a range of substitute products such as aluminium, plastics and steel. Moreover, some export markets are increasingly requiring evidence that imported timber is legal and, in some cases, that it has been produced in well-managed forests or is certified as sustainably produced. In some countries, especially in Africa, these demands appear to be having an effect on forest management.

Figure 2 shows that official timber (industrial roundwood or log) production was more-or-less stable in the 16 years from 1995 to 2010 in each of the three tropical regions, with declines in production in natural forests in some countries offset by increases in production from planted forests. Figure 3 shows charts of regional price indices derived by combining data for species tracked in ITTO's *Annual Review and Assessment of the World Timber Situation* (ITTO 2010). The charts show that despite the cyclical nature of tropical timber commodity markets, most products have experienced modest price increases over the past decade. African and Asian logs (both up by over 60% in real terms since January 2000, an average increase of about 5% per year) were the best performers, due to continuing demand from countries such as China and India and supply restrictions (including export bans) in several

Figure 2 Tropical timber production, by region, 1995–2010



Note: *Data reflect official production statistics from most countries.*
Source: *ITTO (2010).*

exporting countries. African and Latin American sawnwood prices have risen by over 40% during the period (averaging about 3.5% per year), while Asian prices remained at 2000 levels at the end of 2010. Asian plywood prices were up by around 20% from 2000 levels at the end of 2010 (an annual increase of less than 2%), while Latin American plywood prices rose by around 15%. Even the average annual increase in log prices identified above barely kept pace with inflation in most exporting countries. The global financial crisis led to significantly lower prices for most tropical timber products in the second half of 2008 (although it had little apparent impact on overall timber production), and pre-crisis prices had generally not been attained by December 2010.

Tropical plywood exports, once a mainstay of the sector in several countries, have declined dramatically since the 1990s (Figure 4). Overall, many tropical countries are concerned that their natural-forest-based timber sectors are in decline, with key export markets turning away from natural tropical timber, supply dwindling, and prices stagnant or rising only slowly.

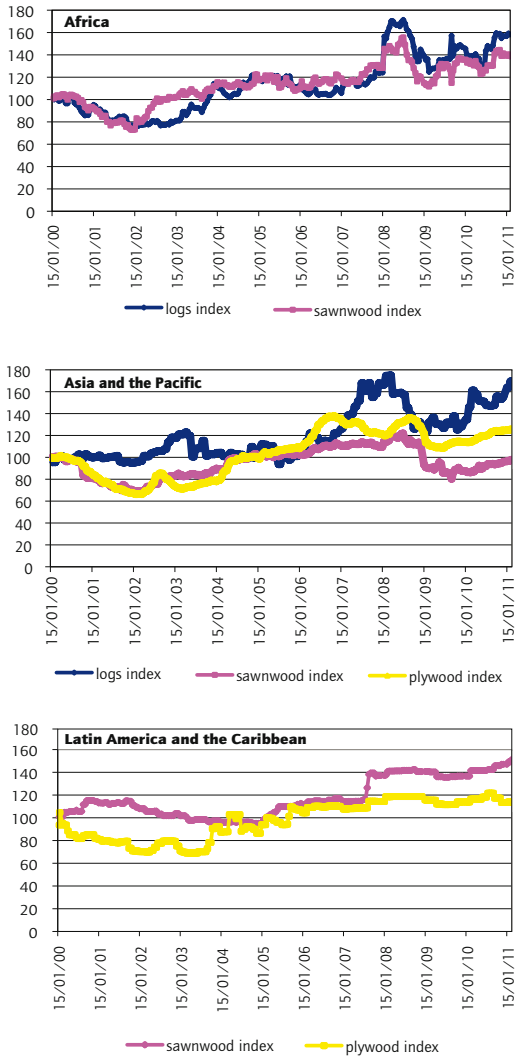
Nevertheless, the tropical timber sector also has opportunities to consolidate its position by moving towards SFM and by improving marketing and the use of innovative wood technologies. Some governments and industry segments believe that a move towards the production of certified, higher-value products would capitalize on an emerging 'green economy' and help to secure a viable future for the natural-forest-based tropical timber sector.

Measures to combat illegal timber trade

A number of consumer markets are becoming increasingly sensitive about the environmental credentials of timber products. New trade legislation, procurement policies and buyer preferences for legality-verified wood (as a minimum) are being developed and enforced. In 2008, the United States passed legislation (the Lacey Act) that makes it a criminal offence to import or trade in timber products that have been harvested illegally. The Government of Japan has adopted a public purchasing policy whereby only legally produced timber products may be procured for government projects. The European Union has passed legislation that requires all entities placing timber products on the European Union market to implement management systems that provide assurance that such products have been produced legally. In addition, several European Union member states have adopted public procurement policies that demand legally or sustainably produced timber, and the European Commission has issued guidelines for green public procurement that recommend legally produced timber as a minimum requirement.

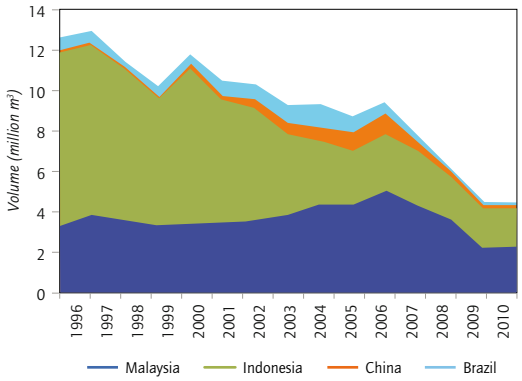
Such measures could have a dramatic impact on the tropical timber trade, and many export-oriented companies and countries are moving to adapt their management systems to meet these market demands. To assist such moves, the European Union is providing, through its Forest Law Enforcement, Governance and Trade Action Plan, technical assistance to governments, industry and NGOs to improve forest governance and the production and trade of legal timber products. In some cases this assistance is being provided on the basis of 'voluntary partnership agreements' (VPAs) between the European Union and timber-exporting countries, which, once entered into, become legally binding on both parties, committing them to trading only legal timber. Under VPAs, exporting countries develop systems to verify the legality of their timber exports to the European Union. The European Union and its member states provide support to help implement those systems. Other organizations are also helping tropical countries to address forest governance and timber legality through a range of measures. ITTO, for example, is assisting its member countries through several national-level projects and through its Tropical Forest Law Enforcement and Trade thematic program.

Figure 3 Tropical timber price indices, 2000–2010 (Jan 2000 = 100)



Source: ITTO (2010).

Figure 4 Aggregate tropical plywood exports, major countries, 1996-2010



Source: ITTO (2010).

STATUS OF TROPICAL FOREST MANAGEMENT

Assessment of data reliability

The capacity of countries to provide data for the present survey varied considerably, and no country was able to provide data for all indicators. In some cases there were differences in the ability to provide data depending on the legal status of the forests: for example, good-quality data might have been available for production forests, but few or no data were available for forests in protected areas.

Federations have an additional challenge in supplying national-level information because they must collate sometimes inconsistent data from their states or provinces. This is also an issue in countries undergoing decentralization.

Nevertheless, there has been a significant improvement in the information submitted by ITTO producer member countries. This can be seen in the overall response: in the 2005 survey, 21 of 33 countries submitted reports as requested, compared with 32 of 33 in the present survey (Vanuatu was the only country that did not submit a report). Moreover, Table 2 shows that, overall, the usefulness of country responses also increased.

Notwithstanding improvements in the information provided by countries, however, overall the data available for the present survey must be viewed, in many cases, as still unreliable or, at best, inconsistent. Ten countries[2] did not submit their reports in the ITTO C&I reporting format and there was a lack of recent quantitative data on a range of parameters. Estimates for the same parameter often differed according to source. Where the sources were credible, such contradictory estimates are included here, partly to illustrate the uncertainty associated with the data and partly to provide readers with realistic bounds for estimates. Overall, there remain serious deficiencies in the data, which should be borne in mind when assessing the report's conclusions.

For example, there were often very large differences in the estimates of total forest cover made by FAO (2010) and UNEP-WCMC (2010). These differences can be explained, at least in part, by the different methods employed in producing the

2 CAR, Gabon, Indonesia, India, Liberia, Mexico, Myanmar, Papua New Guinea, Thailand and Trinidad and Tobago.

Table 2 Assessment of ITTO producer responses, ITTO C&I reporting format , by region

Criterion*	Average score**							
	Africa		A/P		LAC		Overall average	
	2005	2010	2005	2010	2005	2010	2005	2010
1. Enabling conditions for SFM	1.6	2.3	2.1	2.0	2.3	2.3	2.0	2.2
2. Extent and condition of forests	1.1	2.0	1.8	2.0	2.1	2.2	1.7	2.1
3. Forest ecosystem health	1.0	1.5	1.9	1.8	1.8	2.1	1.6	1.8
4. Forest production	1.1	2.1	1.6	1.7	1.6	2.4	1.4	2.1
5. Biological diversity	1.2	1.6	1.6	1.6	1.8	2.1	1.5	1.8
6. Soil and water protection	0.9	1.2	1.4	1.7	0.9	1.9	1.1	1.6
7. Economic, social and cultural aspects	1.2	1.9	1.8	1.8	1.7	2.1	1.5	1.9
Average, all criteria	**1.2**	**1.8**	**1.7**	**1.8**	**1.7**	**2.2**	**1.5**	**1.9**

Note: A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.

* *The wording of criteria 2, 3, 4 and 6 has changed slightly. The criteria used in ITTO (2006) were: 2) Forest resource security; 3) Forest ecosystem health and condition; 4) Flow of forest produce; 6) Soil and water. Nevertheless, the scoring is comparable between reports.*

** *0 = no information submitted; 1 = information given was not useful for reporting; 2 = information was partly useful for reporting; 3 = information was useful for reporting.*

two datasets, but they nevertheless complicate any attempt at interpretation. For FAO (2010), the countries themselves provided estimates of their forest cover reached in various ways. UNEP-WCMC (2010), on the other hand, generated estimates of forest cover (in three crown-cover classes – 10–30%, 30–60% and >60%) on the basis of MODIS satellite imagery, which is unable to resolve at less than a 25-hectare scale. Under the approach taken by UNEP-WCMC (2010), any imagery pixel containing at least 10% canopy cover was counted as completely covered by forest, resulting in forest-cover estimates that are likely to be considerable over-estimates, as shown in Table 3.

This discrepancy in forest-cover data according to different sources and methods of data collection illustrates the difficulty of preparing consistent estimates of the many forest parameters that should be measured for the assessment of the status of forest management. While the estimates of overall forest cover provided by UNEP-WCMC (2010) are not used in this report, data from that source were used in several ways, as detailed in Appendix II. Moreover, the forest-cover maps generated by UNEP-WCMC for each ITTO producer member country (and each tropical region) on the basis of that organization's forest-cover estimates are included here to indicate areas with significant forest cover, although overall these maps almost certainly over-estimate forest cover.

Inconsistency in the data makes comparisons between the 2005 and 2010 surveys difficult. The sources of data, or the methodology by which they were obtained, often differ: for example, the Government of Brazil did not submit a C&I report for the 2005 survey, but provided a great deal of useful information for the 2010 survey. There may also be differences in the parameters measured. To again use Brazil as an example, its tropical forest estate is taken to comprise forests in Amazonia, on the Atlantic coast, and in the *cerrado* and *caatinga*, although parts of some of these occur outside the tropics.

Table 3 Comparison of forest area estimates

Country	FAO (2010) and other sources*	UNEP-WCMC (2010)
	'000 ha	
DRC	112 000–154 000	224 000
Ghana	4680	19 000
Guatemala	2850–4290	10 600
Honduras	5190–6660	11 000
Indonesia	94 400–98 500	182 000
Nigeria	9040	52 300

* *Other sources are specified in country profiles in Part 2.*

Log landing in the buffer zone of the Pulong Tau National Park, Sarawak, Malaysia, with Batu Lawi in the background.

There is often uncertainty about what constitutes a PFE. In many countries a PFE could not be identified, data were ambiguous, forest designated as PFE had not been allocated to a particular function (e.g. production or protection), or it was unclear how much of a legally designated PFE was actually forested. As far as possible, anomalies in the PFE, and in the interpretation adopted here, are identified, by country, in the country profiles. In the case of the protection PFE, information was often deficient because the management of protected areas comes under a different jurisdiction to that of the institution providing the report to ITTO and internal communications between such institutions are often less than optimal.

Given their inconsistency, the data presented in this report should in many cases be treated with caution. Nevertheless, some broad legitimate conclusions can be drawn on the status of tropical forest management, and on the changes that have occurred since 2005, based on the following results.

Forest area and deforestation

Table 4 shows the estimated total forest area, total area of closed forest, and area of planted forest in ITTO producer member countries. By far the largest share of both total forest and closed forest is in Latin America and the Caribbean, due mainly to Brazil, which has an estimated 520 million hectares of forest (including non-tropical forest), an estimated 265 million hectares of which is closed forest.

The total estimated area of productive planted forest in ITTO producer member countries is 22.4 million hectares, more than half of which is in the Asia/Pacific region. Compared with other sources, such as FAO (2010) and ITTO (2009a), this is a low estimate, and indicates a halving in the area of planted forests since the 2005 survey (when a total planted forest area of 44.8 million hectares was reported). However, the entire apparent decline is accounted for by India, where the 32.6 million hectares reported in ITTO (2006) is now regarded as a significant over-estimate and has been reduced

Table 4 Total forest, closed forest and planted forest, ITTO producers by region, 2010

	Africa	A/P	LAC	Total
	million ha			
Total forest area*	270	282	868	1421
Total closed**	153	162	497	811
Total planted**	0.95	12.0	9.4	22.4

Note: *Totals might not tally due to rounding. A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.*

* *Source: FAO (2010); estimates include non-tropical forest in Brazil, India, Mexico and Myanmar. Total forest area includes natural and planted forest.*

** *Source: Country profiles in Part 2.*

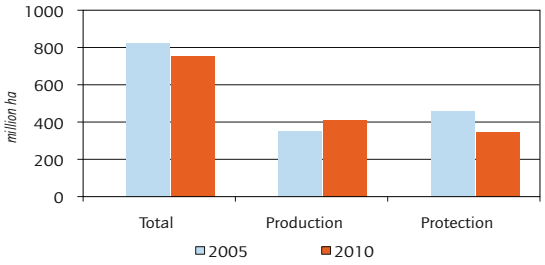
to 5.60 million hectares in this report. The apparent decline in area of 27 million hectares in India is due partly to the consideration in the report of India's tropical forest area only, partly to differing definitions of 'planted forest' (the higher estimate included 'natural' forests that had been subject to enrichment planting of local species, especially teak), and partly to the reportedly very low survival rates of newly established planted forests in India. The decline in India's reported planted forest area is partly offset in the regional and global totals shown in Table 4 by gains in a number of countries, the largest increases (in gross area) being in Brazil, Colombia, Malaysia, Myanmar and Peru.

In most ITTO producer member countries, deforestation rates in the period 2005–10 were generally well below 1%. Countries which exceeded this were Togo (5.75%), Nigeria (4.0%), Ghana (2.19%), Honduras (2.16%), Ecuador (1.89%), Guatemala (1.47%), Cambodia (1.22%) and Cameroon (1.07%) (FAO 2010).

Permanent forest estate

Overall, the global natural-forest tropical PFE in ITTO producer member countries reported here (761 million hectares) is lower than that reported for 2005 (814 million hectares; Table 5; Figure 5). This is not likely to be due to an actual reduction in the PFE, however. As noted above, the Government of Brazil did not submit data for the 2005 survey; the overall decrease in the estimated total PFE in Brazil (and differences in estimates for the production and protection PFE) between the 2005 and 2010 surveys is most likely due to differences in the definition of what constitutes PFE rather than to a significant change in legal status or forest area. In India, estimates of PFE for 2005 and 2010 refer to different kinds of forest; in 2010 only the PFE situated in the tropical part of India has been counted, whereas the 2005 estimate also included

Figure 5 Total, production and protection natural-forest PFE, ITTO producers, 2005 and 2010



Source: Country profiles in Part 2.

PFE in the temperate forest zone. If Brazil and India are ignored, the area of PFE in the tropics increased somewhat between surveys.

Sixty-three percent (482 million hectares) of the total natural-forest tropical PFE is in Latin America and the Caribbean, 22% (167 million hectares) is in Asia-Pacific and 15% (112 million hectares) is in Africa. Brazil accounts for 40% (310 million hectares) of the entire PFE of all ITTO producers, and about one-third of the total tropical natural-forest production PFE. Other countries with large natural-forest PFEs include Indonesia (65.9 million hectares), DRC (48.3 million hectares), Bolivia (38.2 million hectares) and Peru (38.1 million hectares).

The concept of PFE was first conceived for forests under state ownership and centralized control. It remains important for SFM and is likely to be crucial in REDD+, but, in many countries, its status under the law, its identification, and its demarcation on the ground remain problematic. This is not always for want of trying. Many conflicts over land tenure, discussed in greater detail below, are yet to be resolved and complicate efforts to prescribe a PFE or ensure its security on the ground. A trend towards greater community

Table 5 Total, production and protection natural-forest PFE, ITTO producers, by region

Region	Total PFE		Natural-forest PFE		Of which				Planted-forest PFE	
					Production PFE		Protection PFE			
	million ha									
	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
Africa	111	113	110	112	70.5	68.2	39.3	43.7	0.82	0.95
A/P	206	179	168	167	97.4	108	71.0	58.4	38.3	12.0
LAC	542	491	536	482	185	227	351	256	5.60	9.4
Total	**859**	**783**	**814**	**761**	**353**	**403**	**461**	**358**	**44.8**	**22.4**

Note: Totals might not tally due to rounding. A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.
Source: Country profiles in Part 2.

Table 6 Natural-forest production PFE, ITTO producers by region, 2005 and 2010

Region	Total		Total available for harvesting		With management plans		Certified		Sustainably managed	
	million ha									
	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
Africa	70.5	68.2	44.0	45.7	10.0	28.0	1.48	4.63	4.30	6.56
A/P	97.4	108	72.5	62.8	55.1	58.0	4.91	6.37	14.4	14.5
LAC	185	227	34.7	56.9	31.2	44.7	4.15	6.02	6.47	9.51
Total	**353**	**403**	**151**	**165**	**96.2**	**131**	**10.5**	**17.0**	**25.2**	**30.6**

Note: *Totals might not tally due to rounding. A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.*
Source: *ITTO (2006) for 2005 estimates, country profiles in Part 2 for 2010 estimates.*

ownership need not render the PFE concept obsolete, although it could mean that it will need to be approached in new ways.

Many countries still have large areas of forest outside the PFE. These are sometimes set aside deliberately for later planned conversion or reservation for other uses – as agricultural land, for example. Sometimes, however, land-use plans – if formulated – are not followed and forest – including in parts of the PFE – is parceled up and converted to other uses in an ad hoc fashion, jeopardizing efforts to achieve SFM.

Natural-forest production PFE

The total area of natural-forest production PFE in ITTO producer countries reported here is 403 million hectares (53% of the total PFE), compared with 353 million hectares in 2005 (Table 6). The estimate for Brazil in 2010 was considerably larger than in 2005 (135 million hectares compared with 98.1 million hectares), and it was larger in most other countries in Latin America and the Caribbean and in India and Myanmar. The estimated area of natural-forest production PFE decreased in Indonesia, from 46.0 million to 38.6 million hectares.

The extent of the production PFE in African ITTO member countries was relatively stable between the two surveys, although there was an increase in CAR and a decrease in Cameroon and Congo. Of the 403 million hectares of natural-forest production PFE, 165 million hectares are available for harvesting (e.g. they have been allocated as concessions, are under harvesting licences, or communities have harvesting rights), an increase of 14 million hectares compared with 2005.

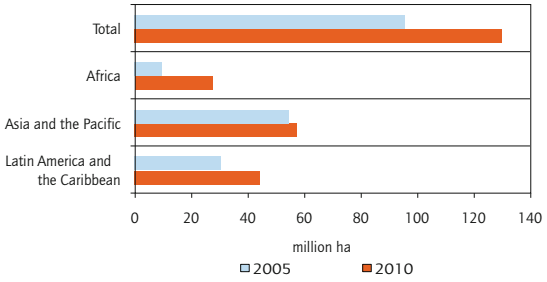
Management plans

The area of natural-forest production PFE under management plans increased in each region between the 2005 and 2010 surveys (Figure 6). Overall, an estimated 131 million hectares of the natural-forest production PFE is subject to management plans, an increase of about 35 million hectares since 2005. There were significant increases in the area subject to management plans in Bolivia, Brazil, Cameroon, Congo, DRC, Gabon, Myanmar, Peru and Venezuela, and there was a decrease in Indonesia. In Latin America in particular, a large area of PFE is neither harvested nor subject to management plans and may be under no threat due to its remoteness. A part of the estimated change in area can be attributed to improved information.

Certified forest

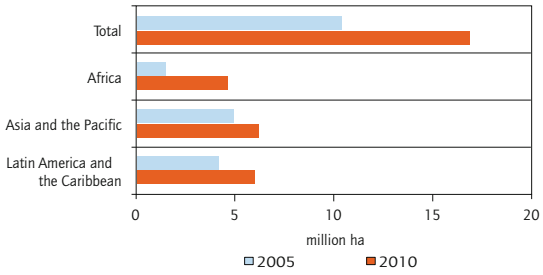
The area of certified natural-forest production PFE increased in each region between 2005 and 2010 (Figure 7). In all three regions combined, the certified forest area grew from 10.5 million hectares to 17.0 million hectares, an increase of 63% (1.3 million hectares per year). In percentage terms the

Figure 6 Area of natural-forest production PFE with management plans, ITTO producers by region, 2005 and 2010



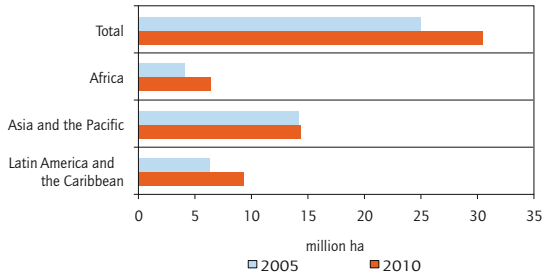
Source: *Country profiles in Part 2.*

Figure 7 Area of certified natural-forest production PFE, ITTO producers by region, 2005 and 2010



Source: Country profiles in Part 2.

Figure 8 Area of sustainably managed natural-forest production PFE, ITTO producers by region, 2005 and 2010



Source: Country profiles in Part 2.

biggest growth was in Africa, where the certified forest area more than tripled, from 1.48 million hectares to 4.63 million hectares.

The general upward trend in the area of certified forest masks declines in some countries. In Bolivia, for example, there was a decline of about 500 000 hectares between the two surveys, and in Mexico there was a drop of about 150 000 hectares.

Under SFM

The area of production PFE considered to be under SFM increased between the 2005 and 2010 surveys, from 25.2 million hectares to 30.6 million hectares, an increase of about 20% (1.1 million hectares per year). This was despite a significant decline in the area under SFM in PNG (where the estimate made in the 2005 survey was likely a significant over-estimate) and lesser decreases in several other countries, such as CAR, Côte d'Ivoire and Ghana. Figure 8 shows that the area was steady in Asia and the Pacific and increased in Africa and Latin America and the Caribbean.

Even though the estimated total area of natural-forest production PFE is somewhat larger than the area estimated in 2005, the area under SFM as a percentage of the natural-forest production PFE increased slightly, from 7.1% in 2005 to 7.6% in 2010.

Planted-forest production PFE

ITTO producer countries have an estimated 22.4 million hectares of timber-producing planted forests, of which 54% is in the Asia-Pacific region, 42% is in Latin America and the Caribbean, and only about 4% is in Africa (Table 5).

Protection PFE

The area of natural-forest protection PFE reported here is 358 million hectares (47% of the total PFE), compared with 461 million hectares in 2005 (Table 7). The estimated protection PFE for Brazil was considerably lower in 2010 (175 million hectares) than in 2005 (271 million hectares), which, combined with a decrease in protection PFE in India (from 25.6 million hectares to 4.54 million hectares), accounts for most of the decline. The protection PFE increased or was relatively stable in most other countries. Exceptions to this included Suriname, Mexico and DRC. All the apparent declines were due to the supply of better information, which allowed a more accurate estimation, rather than to changes in legal status.

Table 7 Protection PFE, ITTO producers by region, 2005 and 2010

Region	Total		With management plans		Sustainably managed	
	million ha					
	2005	2010	2005	2010	2005	2010
Africa	39.3	43.7	1.22	6.0	1.73	4.38
A/P	71.0	58.4	8.25	15.0	5.15	6.06
LAC	351	256	8.37	30.8	4.34	12.3
Total	**461**	**358**	**17.8**	**51.9**	**11.2**	**22.7**

Note: A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.
Source: Country profiles in Part 2.

Management plans

The estimated area of protection PFE with forest management plans in 2010 (51.9 million hectares) is significantly higher than the estimate made for 2005 (17.8 million hectares). The largest regional increase in percentage terms was in Africa, and the largest in terms of gross area was in Latin America and the Caribbean (Figure 9).

Part of the overall increase in 2010 may be due to better information. For example, no data were available in 2005 on the extent of protection PFE covered by management plans in Myanmar, but an estimate of 5.33 million hectares was provided for 2010. Nevertheless, there has also been a real expansion in the use of management plans for protected areas. For example, considerable progress in the development of management plans has occurred in Cameroon (2.23 million hectares of protection PFE now covered by management plans, compared with none in 2005), provisional management plans are now in place for about 1.23 million hectares of protection PFE in Gabon, and about 11.6 million hectares of protection PFE in Peru are now subject to some sort of management planning.

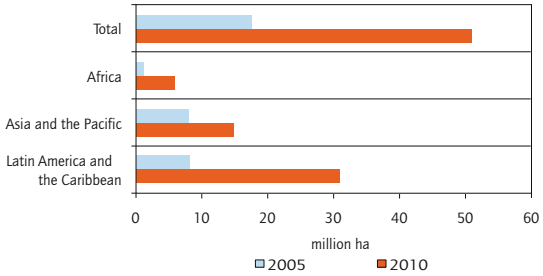
Under SFM

The estimated area of sustainably managed protection PFE more than doubled over the period, from 11.2 million hectares in 2005 to 22.7 million hectares in 2010. This increase was due mostly to a near tripling of the area in Africa and Latin America and the Caribbean (Figure 10).

To a very large extent the apparent increase is due to the better availability of information on the management of protected areas. In 2005, no estimates were made of the area of protection PFE under SFM in 19 of the 33 ITTO producer member countries; in 2010, estimates have been made in all but seven countries. Nevertheless, payments for ecosystem services, and international donors, including NGOs, are playing an increasing role in the financing of protected-area management in tropical countries and thereby helping to ensure the sustainable management of the protection PFE.

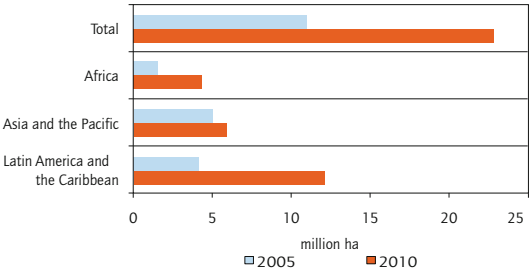
If protected areas are to be effective in the conservation of biodiversity it is essential that, among other measures, large samples of each forest type should be conserved in all the ecoregions in which they occur. For this, a division into

Figure 9 Area of protection PFE with management plans, ITTO producers by region, 2005 and 2010



Source: Country profiles in Part 2.

Figure 10 Area of protection PFE under SFM, ITTO producers by region, 2005 and 2010



Source: Country profiles in Part 2.

ecoregions and a classification of forest types is necessary. Many classifications have been devised for this purpose. The World Wide Fund for Nature (WWF)'s 'ecoregions framework' was used recently by Coad et al. (2009) in a review of progress towards the Convention on Biological Diversity (CBD)'s targets on protected-area coverage. This framework distinguishes five tropical ecoregions – Neotropic, Afrotropic, Indo-Malay, Australasia and Oceania – and identifies twelve tropical forest types (plus some areas of 'unresolved tree cover'). For each of these forest types, Coad et al. (2009) estimated the area of forest in IUCN protected-area categories I–IV globally, as shown in Table 8.

One of the CBD's targets with respect to protected-area coverage is "at least 10% of each of the world's ecological regions effectively conserved". Table 8 shows that, at the global scale, this target has been achieved or exceeded in six of the twelve tropical forest types, is relatively close to being achieved in four tropical forest types, and is some way from being achieved in tropical freshwater

swamp forest and tropical mixed needleleaf/broadleaf forest. There is immense ecological variation within these broad categories which should be considered in the design of protected-area networks at the subregional and national levels.

In some ITTO producer member countries there are moves towards an expansion of the protected-area network, as illustrated by a growing trend towards the establishment of transboundary conservation areas (that is, complexes of protected areas and sustainable-use areas involving cross-border cooperation, many of which have been supported by ITTO). More data on the representativeness of protected-area networks are required, however.

Moreover, as noted earlier, the concept of big conservation – the setting aside of large areas of forest, where human disturbance is discouraged – can be counterproductive where Indigenous people and local communities have customary land-rights claims over those forests. In many countries, further work is required to ensure that the establishment and management of representative protected-area networks are compatible with the rights and needs of Indigenous and local people.

Forest ownership

There have been many recent developments in forest tenure and ownership in response to a general movement to involve local communities more closely in decisions about the future of the forests and the realization that clear tenure is a prerequisite for SFM.

Data on forest ownership were not tabulated in the 2005 survey and the discussion below relates to the present situation and qualitative changes that have occurred in recent years. Figure 11 shows that the trend towards greater ownership by Indigenous and other local communities is most pronounced, by far, in Latin America and the Caribbean. Generally, however, data on forest tenure are patchy, and few countries were able to provide data on tenure specific to the PFE. In some countries, confusion about the status of land tenure may partly be the cause of the generally poor data available on forest ownership.

In most countries in West and Central Africa the state has claimed legal title since the colonial period, although the customary ownership of the same areas dates back centuries. In Ghana, forests are owned by tribal chiefs but held in trust by the state. The disconnection between the legal and customary systems in Africa is a hindrance to SFM, exacerbating problems of governance, inequity and conflict and restricting the capacity of local communities to pursue development opportunities (ITTO 2009b). Nevertheless, in some African countries, such as Cameroon and Liberia, there are signs that governments have recognized the problem and are moving to address it.

In Asia, too, the overwhelming majority of forest is owned by the state, with greater than 80% public ownership in Cambodia, India, Indonesia, Malaysia, Myanmar, the Philippines and Thailand. In the Pacific Island states of Fiji, Papua New

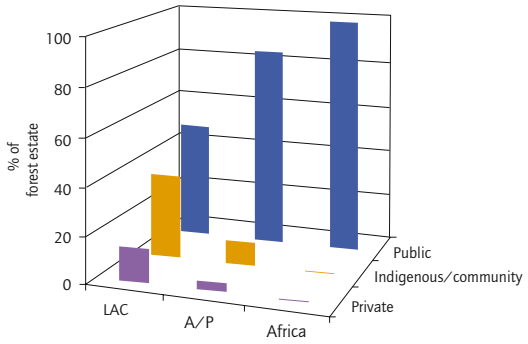
Table 8 Tropical forest types, and their representation in IUCN protected-area categories I–IV

Tropical forest type	Total area	Area in IUCN I–IV	% of total
	million ha		in IUCN I–IV
Upper montane forest	47.6	8.65	18
Semi-evergreen moist broadleaf forest	84.3	14.9	18
Sclerophyllous dry forest	24.1	3.87	16
Mangrove	11.9	1.69	14
Lower montane forest	44.8	5.69	13
Lowland evergreen broadleaf rainforest	649	66.7	10
Thorn forest	1.01	0.10	9.5
Deciduous/semi-deciduous broadleaf forest	173	15.4	8.9
Needleleaf forest	3.20	0.28	8.8
Sparse trees/parkland	101	8.02	8.0
Freshwater swamp forest	44.0	3.01	6.9
Mixed needleleaf/broadleaf forest	0.89	0.04	4.3
Total forest cover	**1180**	**128**	**11.3**

Note: This table gives a lower estimate of total tropical forest cover than that shown in Table 1. In part this is due to differing assessment methodologies, including in the definition of tropical forest.

Source: Coad et al. (2009).

Figure 11 Tropical forest ownership, ITTO producers by region, 2010



Note: *A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.*
Source: *Country profiles in Part 2.*

Guinea and Vanuatu, in contrast, almost all forest is under Indigenous or community ownership, although compared with the Asian countries the area of forest involved is small. Conflicts over land ownership are reported to be widespread in Cambodia, and there is an ongoing dispute over land ownership between the state and the Penan in Sarawak, Malaysia. In India, the legal transfer of ownership to Indigenous communities may increase under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, although the implementation of that Act has so far proved problematic.

In Latin America and the Caribbean, large areas of forest are owned by Indigenous people and other local communities. In Brazil, for example, 106 million hectares of the Amazon Basin have been allocated to Indigenous communities, and the majority of those lands have been regularized (meaning that full rights have been secured). More than 50% of Ecuador's forest is under Indigenous or community ownership, and there are also significant areas under such ownership in Bolivia, Colombia, Guatemala and Mexico. In contrast, almost all forest is owned by the state in Suriname and Venezuela, and 80% or more is owned by the state in Guyana, Panama and Trinidad and Tobago. In Brazil, where about 20% of the forest is already owned privately, a law approved in 2009 will facilitate the further privatization of federally owned forest in the Legal Amazon. As elsewhere in the tropics, disputes over land tenure are common in Latin America and the Caribbean, and recent tensions have been observed in Bolivia, Colombia, Mexico and Peru.

Timber production

Table 9 shows the total official industrial roundwood production and the area of production PFE, by region. The ratio of these two parameters gives an approximation of the average harvest per hectare per year, an (albeit rough) indicator of the sustainability (or otherwise) of timber production.

It is generally accepted that the mean annual increment of well-managed tropical forest is about 1 m^3 per hectare. As Table 9 shows, average production is well below this in all three regions, and a country-by-country analysis (Appendix IV) shows that this is true for the great majority of ITTO producer countries. For 24 countries the average annual industrial roundwood harvest is under 0.5 m^3 per hectare. Harvest levels exceed 1 m^3 per hectare per year in the following five countries: Ghana (1.39 m^3 per hectare per year), Nigeria (2.29 m^3 per hectare per year), Togo (8.2 m^3 per hectare per year), Malaysia (1.64 m^3 per hectare per year) and Thailand (2.37 m^3 per hectare per year). Note, however, that even in these countries the harvest in the PFE may not exceed the sustainable yield, since some of the recorded harvest was obtained from planted forests (with a much higher annual yield per hectare than natural forests) and/or from outside the PFE (in conversion

Table 9 Industrial roundwood production versus area of production PFE, ITTO producers by region

Region	Industrial roundwood production (2009) (million m^3/year)	Total area of production PFE (million ha)	Average annual production per ha of production PFE (m^3/ha)
Africa	18.8	69.2	0.27
A/P	85.5	120	0.71
LAC	31.7	236*	0.13
Total	**136**	**425**	**0.32**

Note: *A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.*
* *Includes planted forest in Brazil, some of which is non-tropical.*
Source: *Country profiles in Part 2, and ITTO (2011).*

forests, for example). Moreover, the sustainable mean annual increment may be higher than 1 m^3 per hectare in some forest types. On the other hand, official data for timber harvests often do not take into account illegal and other informal extraction (often including fuelwood harvesting) and therefore may underestimate the actual off-take. In addition, some of the PFE (e.g. some planted forest in Brazil) is outside the tropics.

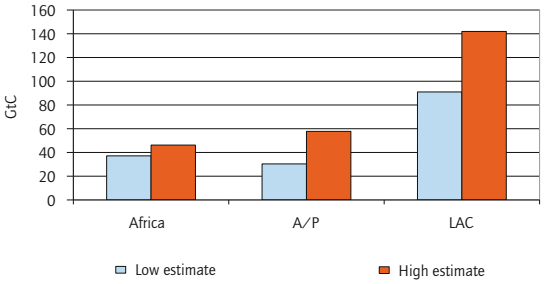
Forest carbon

The IPCC (2007) estimated the total global carbon stock in above-ground living forest biomass in the range 352–536 gigatonnes of carbon (GtC). There is considerable uncertainty about forest carbon estimates, however, because there is no methodology for measuring it directly. Some authors have proposed lower estimates for above-ground living forest biomass than those of the IPCC because of forest degradation and the effects of management interventions on carbon stock; for example, Kauppi (2003) estimated it at 300 GtC. Outside the tropics, the stock of carbon in above-ground living forest biomass is reasonably well known on the basis of ongoing forest inventories (Houghton 2005), but data on the carbon stock in tropical forests is much more uncertain because only a few tropical countries have reliable forest inventory data. Thus, the range of estimates of carbon emissions arising from tropical deforestation and forest degradation is broad. This uncertainty over the size of tropical-forest carbon pools and emissions, and their potential as sinks, is one of the main challenges for the readiness phase of REDD+.

This report provides estimates of the total above-ground forest carbon stock on the basis of Gibbs et al. (2007) and other sources for the 33 ITTO producer member countries. In total, the estimates by Gibbs et al. (2007) are in the range 157–247 GtC, which is more than 80% of the total estimated above-ground forest carbon stock in the tropics. Figure 12 summarizes these estimates by region. For both the high and low estimates, Latin America and the Caribbean accounts for about 57% of the total, due mainly to the vast stocks in the Amazon.

The vegetation density of a country is a good indicator of its potential for both the conservation of existing forest carbon stock and the creation of additional carbon sinks. Figure 13 shows, for each

Figure 12 High and low estimates, forest carbon (above-ground living biomass), ITTO producers



Note: *A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.*
Source: *Country profiles in Part 2, based on data in Gibbs et al. (2007).*

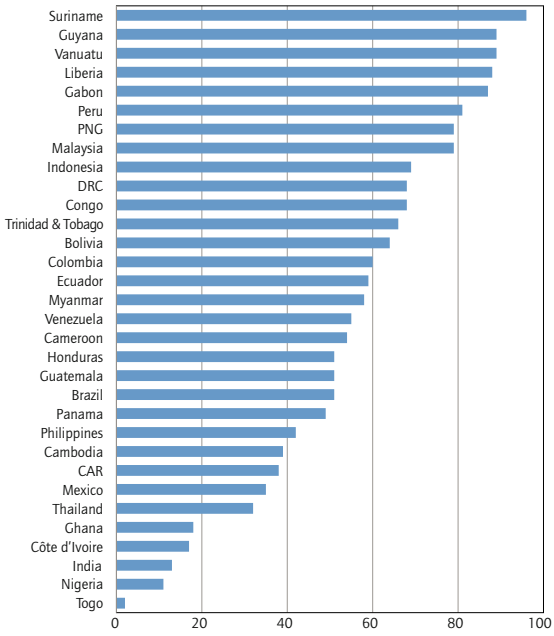
ITTO producer member country, the area of forest with canopy cover greater than 60%, based on data provided by UNEP-WCMC (2010).

Adaptation to climate change

Few data are available on the adaptive capacity of ITTO producer member countries to address the issue of vulnerability in the forest sector. More research and action-oriented planning is needed to assess more exactly the possible nature of climatic changes in each instance, the vulnerability of the forest to these anticipated changes, and the most suitable adaptive measures in each case. Many management options are available to increase the resilience of forest ecosystems, including adaptive silviculture and, in planted forests, judicious species selection. At the landscape scale, the protection of large areas of forest with internal variations in climate, altitude and soils and the development of linking networks of forest would likely enable the internal migration of species and decrease vulnerability to climate change.

ITTO producer member countries have addressed the vulnerability of their forest sectors to climate change in various ways. Those classified as Least Developed Countries – Cambodia, CAR, DRC, Liberia, Togo and Vanuatu – are eligible for funding to develop national adaptation programs of action (NAPAs), which include references to the importance of ecosystems, including forests, in climate-change adaptation. Other countries (e.g. Indonesia, Ghana and Peru) have included forests in their national adaptation strategies and linked their forest-based adaptation agenda to REDD+.

Figure 13 Percentage of forest with canopy cover >60%, ITTO producers



Note: *Data unavailable for Fiji.*
Source: *UNEP-WCMC (2010).*

Involvement in REDD+

As of March 2011, only seven of the 33 ITTO producer members (Côte d'Ivoire, Fiji, Malaysia, Myanmar, Togo, Vanuatu and Venezuela) were not participating in one or more of the major global initiatives on REDD+ readiness (i.e. the Forest Carbon Partnership Facility, UN-REDD, the Forest Investment Program, the Global Environment Facility and major bilateral programs on REDD+). Some ITTO producers (e.g. Brazil, DRC, Indonesia and others) are involved in several such initiatives.

Each country profile presented in this report contains a qualitative assessment (on the basis of a methodology proposed by Herold 2009) of the country's potential for forest carbon capture and storage and (where available) information on the challenges facing the country in exploiting that potential.

CONCLUSIONS AND RECOMMENDATIONS

Key parameters

Overall, there appears to have been continuing progress towards SFM in tropical forests in the period 2005 to 2010. Some of the developments that were identified as indicating progress towards SFM in the 2005 survey have continued since, including the move towards the enactment of new forest laws and regulations and the reorganization of departments responsible for forests. Increasing interest in certification is also apparent within both government and the private sector. There have been developments in forest law compliance, stimulated particularly by demands from importing countries for legality-verified products.

The REDD+ concept has been embraced in many countries, stimulated in part by the growing availability of funds to support such measures. Overall there have been increases in the areas of production and protection PFE subject to management plans and the area of production PFE that is certified, and there has been a significant increase in the total area of production and protection PFE under management considered consistent with sustainability, from 36.4 million hectares in 2005 to 53.6 million hectares in 2010, an increase of nearly 50%, or about 3.4 million hectares per year. Part of this increase may be due to improvements in information, especially for the protection PFE.

The improvement in the quality of information submitted by countries for the survey is noteworthy. This is no doubt due in part to the revision of the ITTO C&I reporting format (and associated national training workshops), which reduced the number of indicators and provided clearer guidance. Moreover, there have been improvements in many countries in data collection and management. For the present survey, eight countries[3] submitted reports without financial assistance from ITTO, suggesting a growing capacity to generate and supply data as part of routine work. However, many countries are still unable to provide reliable data on a range of parameters, and there is a continuing need to improve data collection and management. For example, few countries provided estimates of

3 Brazil, Fiji, Guyana, Honduras, Malaysia, Myanmar, Trinidad and Tobago and Suriname.

sustainable timber yields or data on actual off-takes in their PFEs.

There has been a continued devolution of responsibility to lower echelons of government and to communities. In the long run this may have a beneficial effect on SFM but, in the short term, local governments and communities often lack the human and financial resources to pursue SFM. In many countries, the capacity of Indigenous organizations requires strengthening to ensure that SFM is feasible on lands under their control and that Indigenous rights are upheld. In some cases, community enterprises have struggled to sustain certification programs because of their relatively high cost and uncertain benefits. While some countries have enacted laws designed to clarify land (including forest) tenure and to recognize customary ownership, the pace of such reforms is often slow. Conflicts over resource ownership and use continue and appear to be particularly prevalent in countries that are not moving to address tenure.

Countries that appear to have made significant progress towards SFM in the past five years include Brazil, Gabon, Guyana, Malaysia and Peru. These countries were all able to supply useful information in the C&I reporting format (with the exception of Gabon, whose report was not in the C&I format), they have generally progressive forest-related policies, laws and regulations, relatively clear tenure regimes and strong institutions, and law enforcement is improving on the ground. There has been a general improvement in countries of the Congo Basin, including rapid growth (albeit from a low base) in the area of certified natural forest.

While almost all countries have seen improvements in forest management in the past decade, some countries appear to be making less progress towards SFM than others. A number of ITTO producer countries – for example, Cambodia, Côte d'Ivoire, DRC, Guatemala, Liberia and Suriname – have endured major conflicts in recent decades, greatly hindering the development of the institutions required to put SFM into effect and restricting the development of local expertise. In countries such as Nigeria and PNG, the forest administration lacks the resources to adequately supervise the forest management regime. A lack of forest law enforcement remains a major problem in many countries, and there has been less progress in identifying, demarcating and securing PFEs than ITTO and other observers hoped for. While Vanuatu has not been subject to conflict, its inability to provide information on the management of its forest resources may be indicative of a lack of capacity to implement SFM. ITTO and others will continue working with all countries to try to accelerate progress towards SFM.

Natural-forest production PFE

Significant progress has been made since the 2005 survey towards the sustainable management of the production PFE. There has been an increase in the overall area of the PFE (403 million hectares, compared with 353 million hectares in 2005), in the area covered by management plans (131 million hectares, compared with 96.3 million hectares in 2005), in the area certified (17.0 million hectares, compared with 10.5 million hectares in 2005), and in the area considered to be under SFM (30.6 million hectares, compared with 25.2 million hectares in 2005). Table 10 summarizes these trends for the natural-forest production PFE in each of the three regions.

As noted in the 2005 survey, the area of production PFE under management plans is much greater than the area considered to be under SFM. Part of the discrepancy may be because more information is available on the area covered by management plans than on the extent to which such management plans are being implemented. The process of developing management plans is important in itself because it requires the collection and collation of data on the forests in question and a clear statement of management objectives and requirements. If SFM is to be achieved, however, at any scale, management plans must be implemented, their implementation must be supervised, and their impacts must be monitored and reported. Ultimately, new knowledge must be gained through monitoring and experience to feed into the future planning of adaptive forest management.

In many ITTO producer member countries, such a process is lacking or only nascent; it is hampered by a general lack of capacity in the agencies and community organizations that have responsibility for overseeing forest management. Increased international support, including that envisaged through REDD+, would help to address this problem, as would increased domestic support for forest administration.

Table 10 Regional trends, production PFE, ITTO producers

Region	Area of forest in:			
	Production PFE	Production PFE under management plans	Certified forest	Production PFE under SFM
Africa	→	↑	↑	↑
A/P	↑	↑	↑	→
LAC	↑	↑	↑	↑
All	↑	↑	↑	↑

Note: Trend assumed to be steady if less than 5% change. Trends in individual countries may differ from regional trends. A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.

Planted-forest production PFE

Planted forests are playing an increasingly significant role in the supply of tropical timber. Although the quality of data on the area of productive planted forests is highly variable, it is clear that the area of planted tropical forest has expanded considerably in the last 15–20 years. Some areas where trees were planted but subsequently died or were otherwise removed are still recorded as plantations in forest area statistics of a number of countries. The estimated 22.4 million hectares of productive planted forests in ITTO producer countries is about 5% of the total production PFE. This percentage varies by country and region. In the Asia-Pacific region, for example, planted forests comprise about 10% of the total production resource.

Often, countries with scarce natural-forest resources have particularly focused on their planted-forest estates, but an exception is Brazil, which not only has the single-largest natural-forest resource among ITTO producer member countries but also a large area of planted forests. In some countries, the absence of well-defined property rights has been an obstacle to attracting investment in planted forests. Additional constraints are competition for land; low technical or organizational ability in the management of planted forests; little dialogue between the public and private sectors; insufficient research and development; and a lack of financing mechanisms.

In some countries, the expansion of planted forests will ease pressure on natural forests as they meet an increasing proportion of those countries' timber needs. On the other hand, this easing of pressure may be at least partly offset by the superior financial performance of well-managed plantations, which increases their attractiveness as a land-use, possibly at the expense of natural forests. Many industrial forms of agriculture have a similar superior financial performance, and this is a major cause of deforestation.

Non-timber forest products

Although NTFPs are important for local livelihoods in all ITTO producer member countries, and many are traded in significant quantities at the local, regional and global levels, data on their use and economic value remain scarce. Moreover, in many countries the management of NTFPs is ad hoc, and little is known about its sustainability. There is little doubt that some NTFPs, such as some forms of bush meat, are being harvested unsustainably, and more effort is needed to regulate their management, harvesting and trade.

Protection PFE

Significant progress has been made since the 2005 survey towards the sustainable management of the protection PFE. The apparent decrease in the overall area (358 million hectares, compared with 461 million hectares in 2005) is due mainly to greater clarity in the data rather than to any change in legal status of such areas. There have been large increases in the area covered by management plans (51.9 million hectares, compared with 17.8 million hectares in 2005) and the area considered to be under SFM (22.7 million hectares, compared with 11.2 million hectares in 2005). Table 11 summarizes these trends for the protection PFE in each of the three regions.

Data are still sparse on the extent to which the protection PFE represents the full diversity of forest ecosystems found in tropical countries. Until recently, the designation of protected areas

Table 11 Regional trends, protection PFE, ITTO producers

Region	Area of forest in:		
	Protection PFE	Protection PFE under management plans	Protection PFE under SFM
Africa	↑	↑	↑
A/P	↓	↑	↑
LAC	↓	↑	↑
All	↓	↑	↑

Note: Trend assumed to be steady if less than 5% change. Trends in individual countries may differ from regional trends. A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.

has often been relegated – not just in the tropics – to those areas of land left over when all other economic land-uses have been satisfied or that are too difficult to harvest. But it is now recognized that protected areas should be selected according to their intrinsic value for biodiversity conservation, which usually means the inclusion of representative samples of all forest ecosystems; any areas of exceptional biological richness or where there are concentrations of endemic species; and the breeding, feeding and staging grounds of migratory species. It is desirable that protected areas are large and contain internal variation and, ideally, they should constitute a network of connected habitats if they are to accommodate large animals and be buffered against environmental change. They also depend crucially on the cooperation and support of local communities. Data were generally insufficient to assess the extent to which the present allocation of protected areas takes account of such factors.

Forest carbon

Most ITTO producer member countries have considerable potential for forest-based carbon capture and storage, and most have taken steps to prepare for REDD+. Given the high expectations in many countries that REDD+ could generate significant funds for tropical forest management, clear signals from international climate-change negotiators, including the eventual establishment of a market in forest carbon credits, are to be welcomed.

Summary of change

The following points summarize the present status of SFM in ITTO producer countries.

- In many countries, more progress is needed to clarify the concept of PFE according to national circumstances and to identify, inventory, demarcate and protect the PFE.
- Forest-related laws and regulations continue to evolve, for the most part in a direction compatible with SFM.
- A general trend towards decentralization and greater recognition of Indigenous and local people is not yet matched by a flow of resources to support efforts to achieve SFM at the decentralized level.
- Forest law enforcement is often weak, exacerbated by a lack of enforcement capacity, confusing and sometimes conflicting laws, especially those related to tenure, and uncertainty generated by decentralization processes, including disputes over jurisdiction between government agencies. In some countries, the demand for legality-verified timber is having an effect on timber exports.
- The resources allocated by governments and development assistance agencies to forest management remain seriously inadequate, reflected in a lack of capacity in government agencies.
- Information about SFM continues to improve but is still far from adequate for the comprehensive monitoring, assessment and reporting of SFM and any large-scale fund-transfer mechanism arising out of REDD+ or other schemes designed to improve the management of tropical forests.

Constraints to SFM

Putting aside the difficulties caused by wars and armed conflicts, which are profound, several constraints frequently recur in the country profiles. Probably the most important, and the

Ghanaian scientists assess plant biodiversity in a forest plot in Ghana. © *L. Amissah*

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 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, tropical timber prices remain relatively low. It is possible that they will increase in the future to better reflect the true cost 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 a valuable 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 important 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 – are likely to play a large part in determining the fate of the remaining tropical forests. In order for such payments to achieve their potential to impact 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. Without the security provided by credible, negotiated arrangements on tenure, SFM is unlikely to succeed. 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 ever to become sustainable. If the trend towards greater community and Indigenous ownership, and less state ownership, continues, the concept of PFE may need to be re-thought, but it should not be discarded.

Future directions

The global setting for the management of tropical forests is changing. Populations and aspirations are growing and the ability of people living in remote areas to communicate with others is escalating at phenomenal speed. The agricultural frontier is continuing to advance at the expense of forests. For timber, the demand for certified and/or legality-verified wood is starting to influence the management of export-oriented suppliers, but

this effect may be very small for the majority of the tropical forest estate. Conversely, the ready availability of relatively cheap commodity timbers from non-tropical forests, tropical planted forests and illegal operations, as well as other substitute materials, will restrict the price increases that are possible for timber from sustainably managed natural tropical forests for as long as it remains a commodity product.

The global market for tropical timber is also changing. Demand in the traditional export markets of Europe, Japan and North America has declined, and ITTO producer countries are exporting increasing quantities of timber to China and India and intra-regionally. Domestic markets are growing. Some of these markets place little emphasis on certification or legality-verification. The continued growth of these markets may reduce the incentive to pursue SFM, but certification and legality-verification will likely emerge as drivers in some of them.

Standards of forest management tend to improve as countries become richer and better able to allocate resources to enforce forest laws and implement SFM. It is likely, therefore, that SFM will become more widespread in the tropics as economies grow, although such growth might also increase deforestation, at least temporarily. In some instances there may be migration from the forest to cities, which may reduce pressure on the forest. Eventually, countries that continue to develop economically will attain the capacity necessary to safeguard their PFEs and to manage them sustainably. Conversely, continued poverty poses a significant threat to tropical forests.

A review of the information used to assemble this report indicates that a number of developments in tropical forests are possible in coming years, including the following.

- A continued expansion of planted forests and the use of agricultural tree crops for timber may reduce timber-demand pressure on the natural forest by supplying an increasing proportion of wood production, although it may also cause more deforestation, as might an increased demand for biofuels.
- Declining timber prices, increased prices for agricultural products and/or a larger shift to emerging markets could undermine efforts towards SFM.
- A flow of funds for REDD+ and other forest services could stimulate increases in the capacity to manage, monitor and police forests; it could also induce efforts in reforestation and forest restoration.
- A greater focus on the management of high-value timber species, an expanded range of species, and/or increased value-added production could help increase the profitability of natural forest management.
- Changes in climate or weather patterns could affect the growth, yield and vitality of forests. Extreme weather conditions, such as prolonged droughts, torrential rain and tropical storms could reduce the stability of forest structure and lead to increased erosion, forest fire and wind damage, and changes in the incidence of pests and diseases. Adaptive management, and a diverse forest resource, will increase resilience.
- Tenure issues could be resolved more often on the basis of transparent and equitable negotiation between claimants. As their rights become more recognized, Indigenous peoples could play an increasing role in the management of natural forests.
- The wider responsibilities of communities and Indigenous people living in constant contact with the forest may lead to a diversification of forest use, with more emphasis on ecosystem services.

Overall, it seems likely that the global area of natural tropical forests will continue to decline in the medium term as land is diverted to more profitable uses. On the other hand, the management of the PFE is likely to continue to improve, although the pace of such improvement is less easy to predict. Those countries with clear and undisputed forest tenure, a well-defined PFE and adequate resources for administering the resource are best placed to make rapid progress. ITTO and others seeking to promote SFM in the tropics must be vigilant for change, remain flexible in approach, but continue to press for the sustainable management and conservation of tropical forests.

Recommendations

The usefulness of this survey will be enhanced if it continues to be repeated at reasonably regular (and frequent) intervals, because the identification

of trends is essential in assessing progress towards SFM. It is therefore recommended that regular reporting on the status of tropical forest management be continued at the international level. Given that FAO has also started to provide data on SFM in its five-yearly forest resources assessment, there will be benefits in continuing to align the two processes more closely.

Many countries still lack the capacity to collect, analyze and make available comprehensive data on the status of forest management. Assisting countries to improve the quality of data on forest management should be a priority for the international community.

A crucial element of improving forest management is an accurate picture of the PFE. Many countries still lack such an accurate picture, and assistance should be provided as a matter of urgency to enable them to establish their PFEs if they have not already done so and to undertake detailed inventories of these areas. This will be even more crucial should significant funds become available through REDD+.

A general progression towards SFM in the tropics will be faster and more robust if SFM is seen as a financially competitive land-use. Another priority for the international community should be to increase payments for the global ecosystem services provided by natural tropical forests, including those related to carbon capture and storage.

Member countries should be encouraged to build on the advances identified in this report. ITTO will continue working with its many partners to help them to do so.

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