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 conclusions presented here.

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 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 (in some cases close to total land areas), 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 ITTO (2011) does not use the estimates of overall forest cover provided by UNEP-WCMC (2010), it did make use of data from that source in several ways. 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 were used to indicate areas with significant forest cover, although overall those 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

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.*

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

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 ITTO (2011).*

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.

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 here and in the full 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 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).

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 ITTO (2011).*

Log landing in the buffer zone of the Pulong Tau National Park, Sarawak, Malaysia, with Batu Lawi in the background. *Photo: J. Blaser*

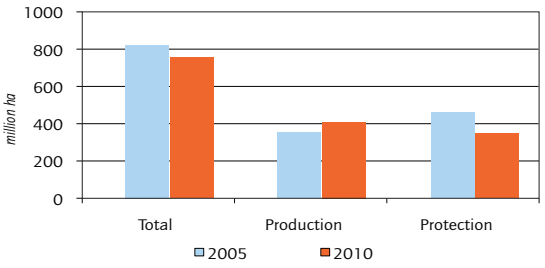
Permanent forest estate

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 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

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



Source: Country profiles in ITTO (2011).

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 ITTO (2011).

resolved and complicate efforts to prescribe a PFE or ensure its security on the ground. A trend towards greater community 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

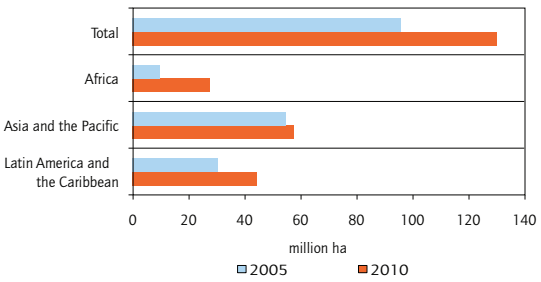
The total area of natural-forest production PFE in ITTO producer countries reported here is 403 million hectares (53% of the total PFE), compared with 353 million hectares in 2005 (Table 6). The estimate for Brazil in 2010 was considerably larger than in 2005 (135 million hectares compared with 98.1 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.

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



Source: Country profiles in ITTO (2011).

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 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

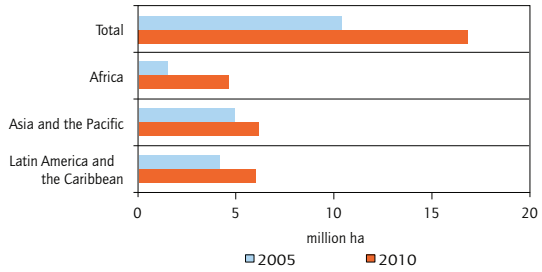
The area of production PFE considered to be under SFM increased between the 2005 and 2010 surveys, from 25.2

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**

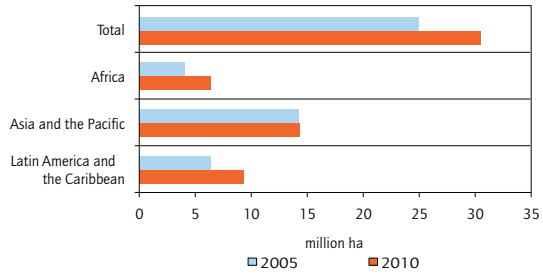
Note: Totals might not tally due to rounding. A/P = Asia and the Pacific; LAC = Latin America and the Caribbean.
Source: ITTO (2006) for 2005 estimates, country profiles in ITTO (2011) for 2010 estimates.

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



Source: Country profiles in ITTO (2011).

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



Source: Country profiles in ITTO (2011).

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).

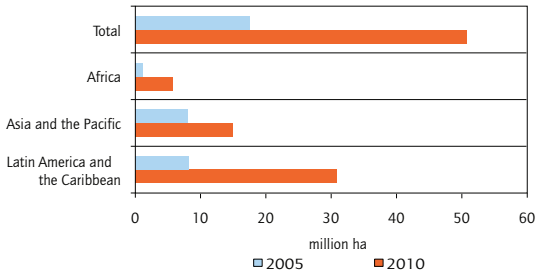
Protection PFE

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.

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).

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



Source: Country profiles in ITTO (2011).

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 ITTO (2011).

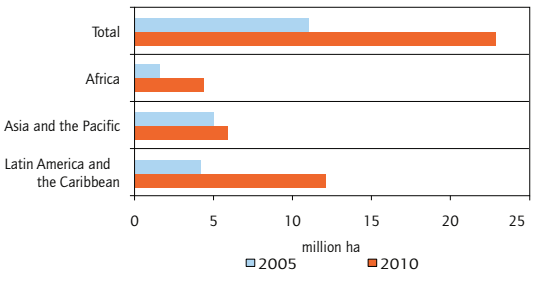
Ceiba pentandra logs await processing in an Ivoirian plywood mill. *Photo: J. Blaser*

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).

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



Source: Country profiles in ITTO (2011).

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 ecoregions and a classification of forest types is necessary. Many classifications have been devised for this purpose. The World Wide Fund for Nature'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

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).*

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.

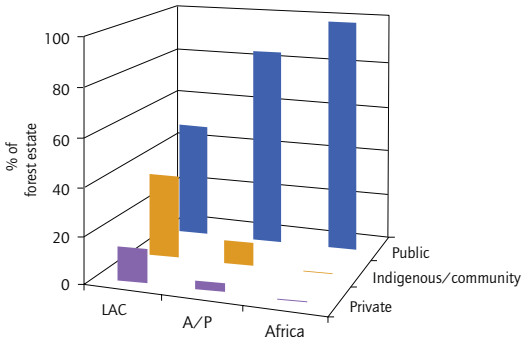
Mworeover, as noted earlier, the concept of big conservation—the setting aside of large areas of forest, where human disturbance is discouraged—can be counterproductive where Indigenous people and local communities have customary land-rights claims over those forests. In many countries, further work 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

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 ITTO (2011).*

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

Continued on page 19

... continued from page 15

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

Region	Industrial roundwood production (2009) (million m³/year)	Total area of production PFE (million ha)	Average annual production per ha of production PFE (m³/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.*
Sources: *Country profiles in ITTO (2011); ITTO (2010).*

Philippines and Thailand. In the Pacific Island states of Fiji, Papua New 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.

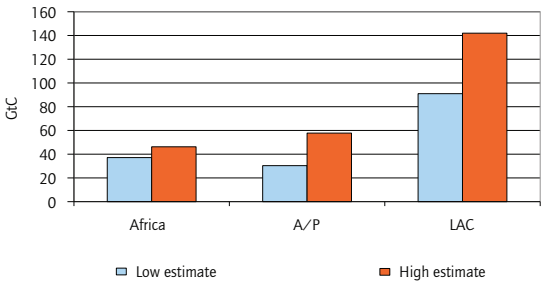
It is generally accepted that the mean annual increment of well-managed tropical forest is about 1 m³ per hectare. As Table 9 shows, average production is well below this in all three regions, and a country-by-country analysis (see full report) shows that this is true for the great majority of ITTO producer countries. For 24 countries the average annual industrial roundwood harvest is under 0.5 m³ per hectare. Harvest levels exceed 1 m³ per hectare per year in the following five countries: Ghana (1.39 m³ per hectare per year), Nigeria (2.29 m³ per hectare per year), Togo (8.2 m³ per hectare per year), Malaysia (1.64 m³ per hectare per year) and Thailand (2.37 m³ 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 forests, for example). Moreover, the sustainable mean annual increment may be higher than 1 m³ 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 Intergovernmental Panel on Climate Change (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+.

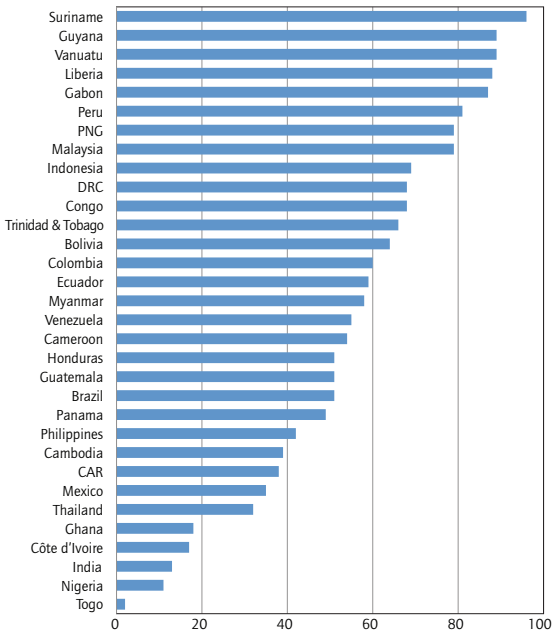
ITTO (2011) provides estimates of the total above-ground forest carbon stock on the basis of Gibbs et al. (2007) and

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 ITTO (2011), based on data in Gibbs et al. (2007).*

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



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

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 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, 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+.

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 ITTO (2011) 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.