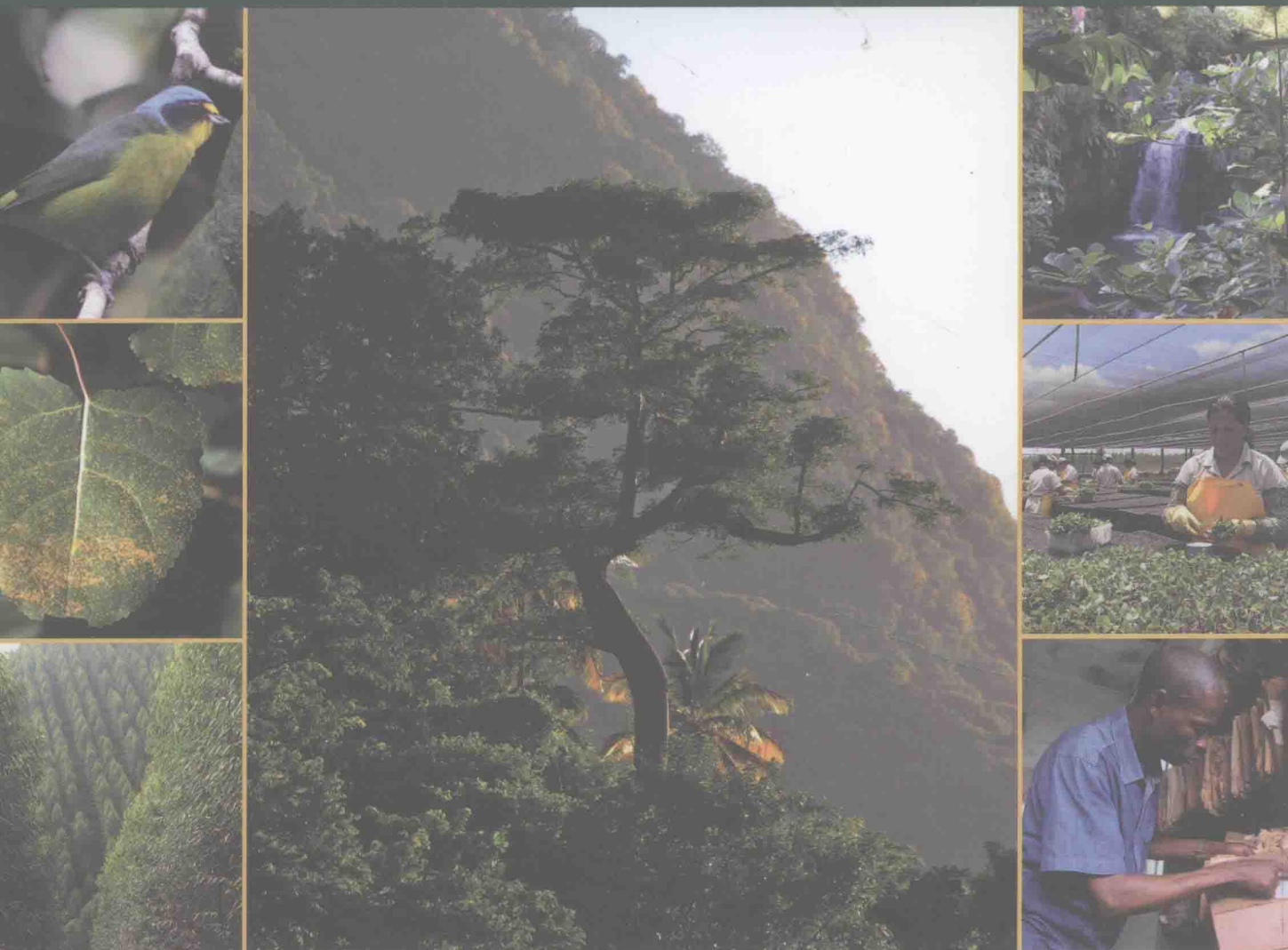


# Global Forest Resources Assessment 2010

Main report

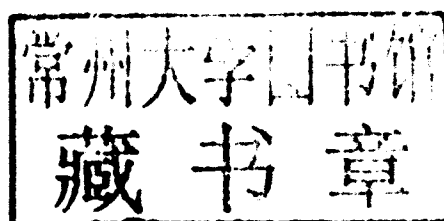


# Global Forest Resources Assessment 2010

FAO  
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PAPER

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Main report



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# Acknowledgements

The FRA 2010 main report represents a major effort of FAO's Forestry Department, FAO member countries, donors, partners and individual experts. More than 900 people have been directly involved in this mammoth task. National correspondents and their teams provided detailed country reports containing the basic data for the assessment. More than 70 FAO staff members at headquarters and at our regional and subregional offices, as well as consultants and volunteers, contributed to the review of reports, preparation of desk studies for countries and areas that did not have a national correspondent, and analysis and presentation of the results. Several countries and organizations contributed extra budgetary financial resources or secondments to the country reporting process for FRA 2010, including Denmark, Finland, the International Tropical Timber Organization, Japan and the United States of America. The UNECE/FAO Forestry and Timber Section in Geneva assisted with the assessment process for several European and Central Asian countries. Participants in the expert consultation held in Kotka, Finland, in 2006 provided initial guidance on FRA 2010, while the FRA advisory group provided continuous support and advice throughout the process.

FAO is grateful for the support of all countries, organizations and experts inside and outside the organization that have made FRA 2010 possible.

Individual contributors to the country reporting process of FRA 2010 are listed in Annex 1. Green Ink ([www.greenink.co.uk](http://www.greenink.co.uk)) conducted the language editing, translation and layout of the report.

# Foreword

Interest in the world's forests has grown to unprecedented heights, especially with growing awareness of their role in the global carbon cycle. The possibility of mitigating climate change by reducing carbon emissions caused by deforestation and forest degradation, and by increasing carbon uptake through afforestation and sustainable forest management, highlights the essential role of forests in supporting life on Earth.

But forests are more than just carbon. In 2010 we celebrate the International Year of Biodiversity, and we are reminded that forests represent some of the most diverse ecosystems on Earth. In a time of economic crisis, we are also reminded that forests provide employment and livelihoods for a large proportion of the population – especially in developing countries – and often act as an economic safety net in times of need.

FAO's Global Forest Resources Assessment (FRA), carried out at five-year intervals, provides the data and information needed to support policies, decisions and negotiations in all matters where forests and forestry play a part.

Each successive assessment is more comprehensive than the last. Organized according to the seven thematic elements of sustainable forest management, FRA 2010 contains information to monitor progress towards international goals and targets – among others the Millennium Development Goals, the 2010 Biodiversity Target of the Convention on Biological Diversity and the four Global Objectives on Forests of the Non-Legally Binding Instrument on All Types of Forests adopted by the United Nations General Assembly in January 2008. In addition, the statistics on trends in forest carbon stocks will support predictions of climate change and development of appropriate mitigation and adaptation measures.

FRA 2010 also includes information on variables such as forest health, the contribution of forests to national economies and the legal and institutional framework governing the management and use of the world's forests.

Behind the data in this report lies a well-established process of data collection, processing, validation, compilation and analysis. The participation of national experts from virtually all countries and all key international forest-related organizations ensures that the best and most recent knowledge is shared and applied, and that feedback reaches national policy processes. FAO thanks all participants for their vital collaboration.

Documentation for FRA 2010 includes 233 country reports, available online ([www.fao.org/forestry/fra](http://www.fao.org/forestry/fra)). Complementing the main report will be a series of special studies on topical issues as well as a global remote sensing survey of changes on forest biomes between 1990 and 2005, scheduled for completion in 2011.

The results of the present assessment are encouraging in some respects. They show that the rate of deforestation, while still alarming in many countries, is slowing down at the global level, and that afforestation and natural expansion in some countries and regions have further reduced the net loss of forests. However, most of the losses of forest happen in countries in the tropical region, while most of the gains take place in temperate and boreal zones. Furthermore, many emerging economies have moved from net loss to net gain of forest area. These results highlight the key role of economic development in reversing global deforestation.

FAO hopes that the information in this report will help broaden discussions on forests and stimulate action at all levels in the International Year of Forests (2011) and beyond.



Eduardo Rojas-Briales

Assistant Director-General, Forestry Department, FAO

# Acronyms and abbreviations

<b>CBD</b>	Convention on Biological Diversity
<b>COFO</b>	Committee on Forestry (FAO)
<b>CPF</b>	Collaborative Partnership on Forests
<b>FORIS</b>	Forestry Information System (FAO)
<b>FRA</b>	Global Forest Resources Assessment
<b>FTE</b>	full time equivalent
<b>IFF</b>	Intergovernmental Forum on Forests
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IPF</b>	Ad Hoc Intergovernmental Panel on Forests
<b>IPPC</b>	International Plant Protection Convention
<b>ISPM</b>	International Standards for Phytosanitary Measures
<b>ITTO</b>	International Tropical Timber Organization
<b>IUCN</b>	International Union for Conservation of Nature
<b>LFCC</b>	low forest cover countries
<b>MCPFE</b>	Ministerial Conference on the Protection of Forests in Europe (now known as Forest Europe)
<b>NFP</b>	national forest programme
<b>n.s.</b>	not significant, indicating a very small value
<b>NWFP</b>	non-wood forest product
<b>REDD</b>	reduction in emissions from deforestation and forest degradation
<b>SIDS</b>	small island developing states
<b>UNCED</b>	United Nations Conference on Environment and Development
<b>UNECE</b>	United Nations Economic Commission for Europe
<b>UNEP</b>	United Nations Environment Programme
<b>UNEP-WCMC</b>	UNEP World Conservation Monitoring Centre
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UNFF</b>	United Nations Forum on Forests
<b>UNSD</b>	United Nations Statistics Division
<b>WRI</b>	World Resources Institute

# Executive Summary

FAO, in cooperation with its member countries, has monitored the world's forests at five to ten year intervals since 1946. These global assessments provide valuable information to policy-makers, to international negotiations, arrangements and organizations related to forests and to the general public.

The Global Forest Resources Assessment 2010 (FRA 2010) is the most comprehensive assessment to date. It examines the current status and recent trends for more than 90 variables and all types of forests in 233 countries and areas for four points in time: 1990, 2000, 2005 and 2010.

FAO worked closely with countries and forest assessment specialists in the design and implementation of FRA 2010. More than 900 contributors were involved, including 178 officially nominated national correspondents and their teams.

In the main section of this report, results are presented according to the seven thematic elements of sustainable forest management:

- extent of forest resources;
- forest biological diversity;
- forest health and vitality;
- productive functions of forest resources;
- protective functions of forest resources;
- socio-economic functions of forests;
- legal, policy and institutional framework.

A summary of key findings is presented below, followed by a section that attempts to answer the question: What does FRA 2010 tell us about progress towards sustainable forest management since 1990 at global and regional scales?

## KEY FINDINGS

### **Forests cover 31 percent of total land area**

The world's total forest area is just over 4 billion hectares, which corresponds to an average of 0.6 ha per capita (Figure 1). The five most forest-rich countries (the Russian Federation, Brazil, Canada, the United States of America and China) account for more than half of the total forest area. Ten countries or areas have no forest at all and an additional 54 have forest on less than 10 percent of their total land area (Figure 2).

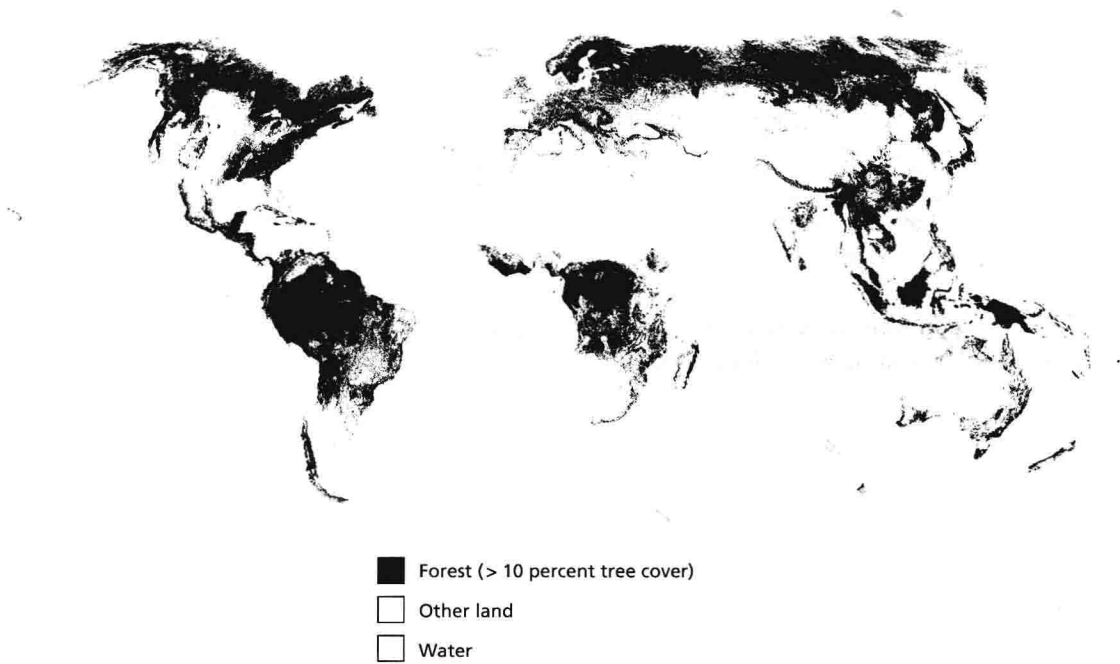
### **The rate of deforestation shows signs of decreasing, but is still alarmingly high**

Deforestation – mainly the conversion of tropical forest to agricultural land – shows signs of decreasing in several countries but continues at a high rate in others (Boxes 1–3). Around 13 million hectares of forest were converted to other uses or lost through natural causes each year in the last decade compared with 16 million hectares per year in the 1990s. Both Brazil and Indonesia, which had the highest net loss of forest in the 1990s, have significantly reduced their rate of loss, while in Australia, severe drought and forest fires have exacerbated the loss of forest since 2000.

### **Large-scale planting of trees is significantly reducing the net loss of forest area globally**

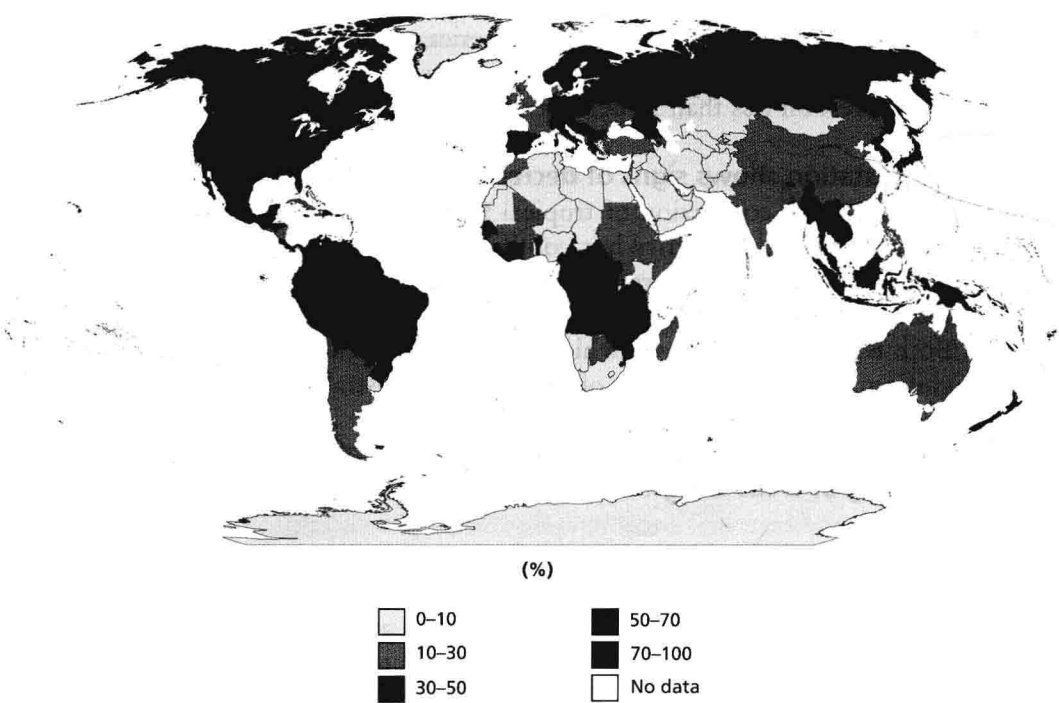
Afforestation and natural expansion of forests in some countries and regions have reduced the net loss of forest area significantly at the global level (Figure 4). The net change in forest area in the period 2000–2010 is estimated at -5.2 million hectares per year (an area about the size of Costa Rica), down from -8.3 million hectares per year in the period 1990–2000.

FIGURE 1  
The world's forests



Note: Tree cover derived from MODIS VCF\* 250 meter pixels for year 2005.  
\* Moderate-resolution Imaging Spectroradiometer Vegetation Continuous Fields (Hansen *et al.* 2010).

FIGURE 2  
Forest area as a percentage of total land area by country, 2010





## BOX 1

**Deforestation and net change in forest area**

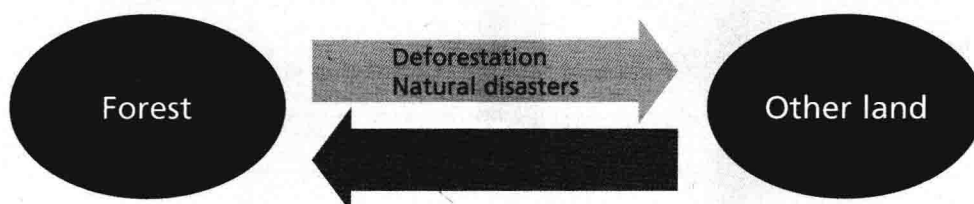
Figure 3 is a simplified model illustrating forest change dynamics. It has only two classes: forests and all other land. A reduction in forest area can happen through either of two processes: deforestation and natural disasters. Deforestation, which is by far the most important, implies that forests are cleared by people and the land converted to another use, such as agriculture or infrastructure. Natural disasters may also destroy forests, and when the area is incapable of regenerating naturally and no efforts are made to replant, it too converts to other land.

An increase in forest area can also happen in two ways: either through afforestation (i.e. planting of trees on land that was not previously forested) or through natural expansion of forests (e.g. on abandoned agricultural land, a process which is quite common in some European countries).

Where part of a forest is cut down but replanted (reforestation) or grows back on its own within a relatively short period (natural regeneration), there is no change in forest area.

For FRA 2010, countries were asked to provide information on their forest area for four points in time. This enables the calculation of the net change in forest area over time. This net change is the sum of all negative changes due to deforestation and natural disasters and all positive changes due to afforestation and natural expansion of forests.

FIGURE 3  
Forest change dynamics



## BOX 2

**Previous figures underestimated the global deforestation rate for the 1990s**

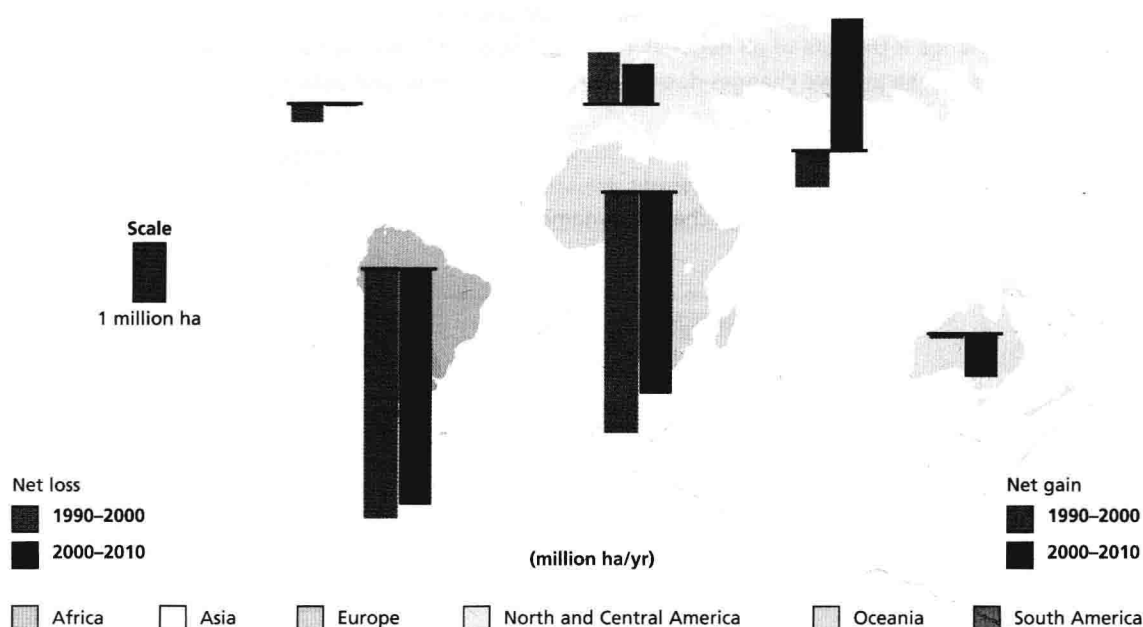
FRA 2010, like FRA 2005, did not directly compile data on deforestation rates because few countries have this information. In FRA 2005 the global deforestation rate was estimated from net changes in forest area. Additional information on afforestation and on natural expansion of forest for the past 20 years has now made it possible to also take into account deforestation within those countries that have had an overall net gain in forest area. As a result, the revised estimate of the global rate of deforestation and loss from natural causes for 1990–2000 (close to 16 million hectares per year) is higher, but more accurate, than was estimated in FRA 2005 (13 million hectares per year).

## BOX 3

### A global remote sensing survey of forests will yield improved information on changes in the area of major forest types over time

Countries use differing frequencies, classification systems and assessment methods when monitoring their forests, making it difficult to obtain consistent data on major forest types that span national borders. FAO, in collaboration with countries and key partner organizations, is currently undertaking a global remote sensing survey – based on a systematic sampling of some 13 500 sites around the globe – to provide additional and more consistent information on deforestation, afforestation and natural expansion of forests at regional and biome levels for the period 1990–2005. Results are expected at the end of 2011.

FIGURE 4  
Annual change in forest area by region, 1990–2010



### South America and Africa continue to have the largest net loss of forest

At a regional level, South America suffered the largest net loss of forests between 2000 and 2010 – about 4.0 million hectares per year – followed by Africa, which lost 3.4 million hectares annually (Figure 5). Oceania also reported a net loss of forest (about 700 000 ha per year over the period 2000–2010), mainly due to large losses of forests in Australia, where severe drought and forest fires have exacerbated the loss of forest since 2000. The area of forest in North and Central America was estimated as almost the same in 2010 as in 2000. The forest area in Europe continued to expand, although at a slower rate (700 000 ha per year) than in the 1990s (900 000 ha per year). Asia, which had a net loss of forest of some 600 000 ha annually in the 1990s, reported a net gain of forest of more than 2.2 million hectares per year in the period 2000–2010, primarily due to the large-scale afforestation reported by China and despite continued high rates of net loss in many countries in South and Southeast Asia.

FIGURE 5  
Annual change in forest area by country, 2005–2010

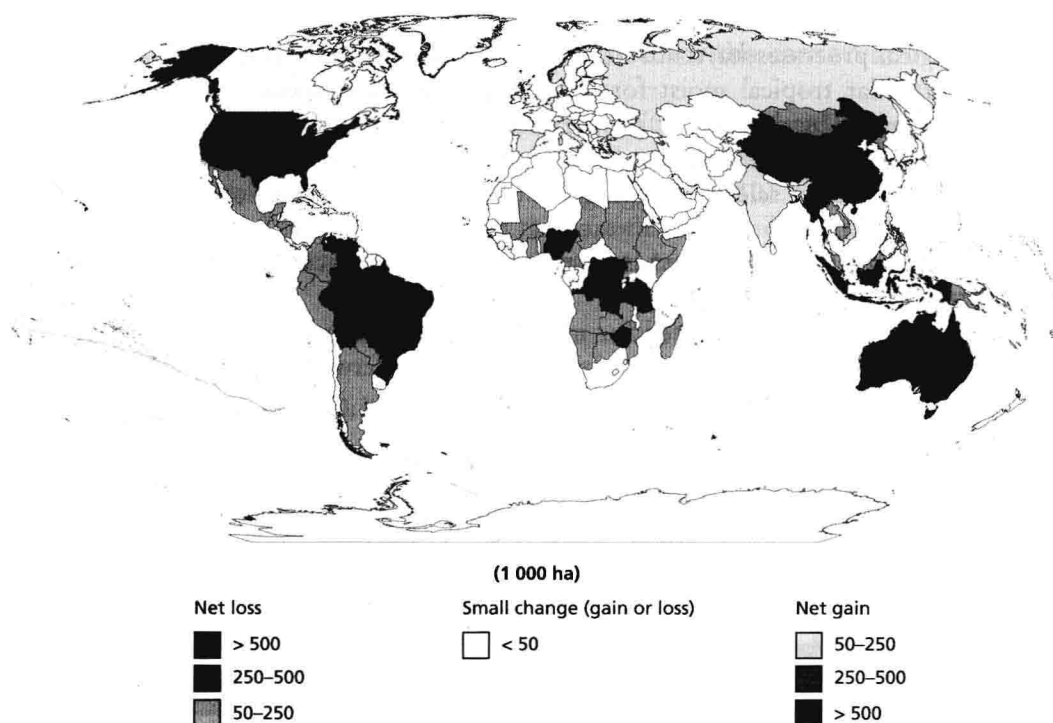
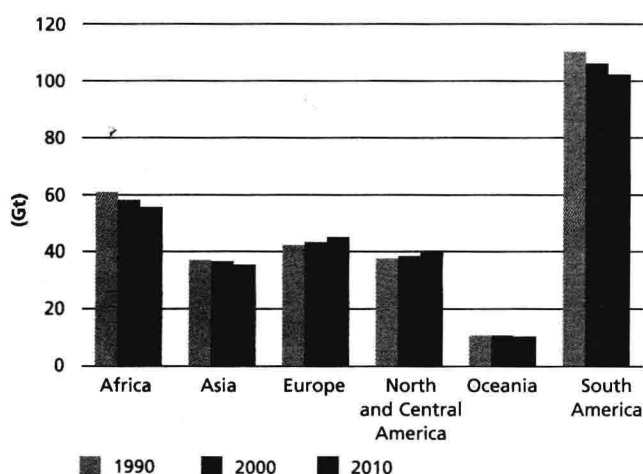


FIGURE 6  
Trends in carbon stocks in forest biomass, 1990–2010



### Forests store a vast amount of carbon

Estimates made for FRA 2010 show that the world's forests store 289 gigatonnes (Gt) of carbon in their biomass alone. While sustainable management, planting and rehabilitation of forests can conserve or increase forest carbon stocks, deforestation, degradation and poor forest management reduce them. For the world as a whole, carbon stocks in forest biomass decreased by an estimated 0.5 Gt annually during the period 2005–2010, mainly because of a reduction in the global forest area (Figure 6).

**Primary forests account for 36 percent of forest area – but have decreased by more than 40 million hectares since 2000**

On a global average, more than one-third of all forest is primary forest, i.e. forest of native species where there are no clearly visible indications of human activities and the ecological processes have not been significantly disturbed (Figure 7). Primary forests, in particular tropical moist forests, include the most species-rich, diverse terrestrial ecosystems. The decrease of primary forest area, 0.4 percent annually over a ten-year period, is largely due to reclassification of primary forest to ‘other naturally regenerated forest’ because of selective logging and other human interventions.

**The area of planted forest is increasing and now accounts for 7 percent of total forest area**

Forests and trees are planted for many purposes and make up an estimated 7 percent of the total forest area, or 264 million hectares. Between 2000 and 2010, the area of planted forest increased by about 5 million hectares per year (Figure 8). Most of this

FIGURE 7  
Characteristics of the world's forests, 2010

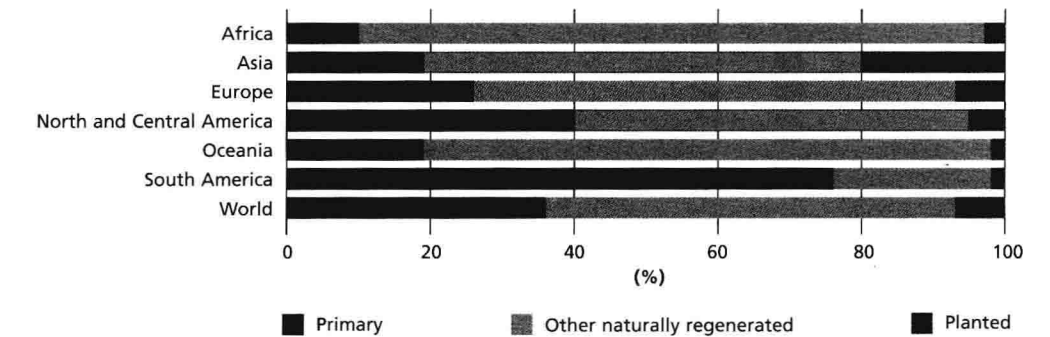
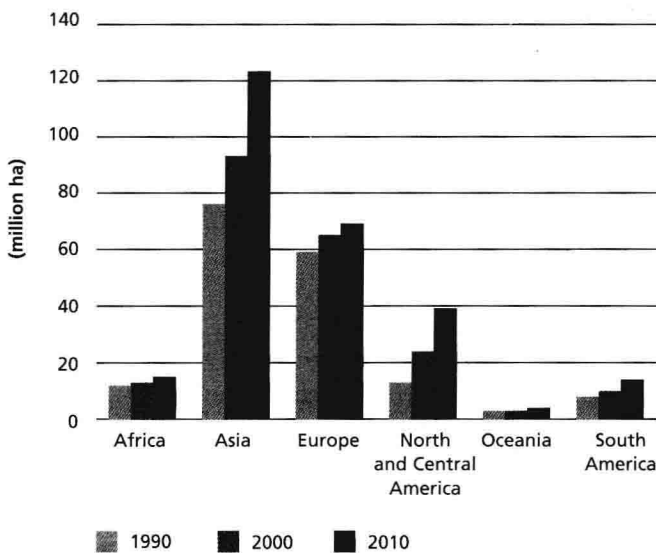


FIGURE 8  
Trends in area of planted forests, 1990–2010



was established through afforestation (i.e. planting of areas not forested in recent times) particularly in China. Three-quarters of all planted forests consist of native species while one-quarter comprises introduced species (Figure 9).

**Twelve percent of the world’s forests are designated for the conservation of biological diversity**

The area of forest where conservation of biological diversity is designated as the primary function has increased by more than 95 million hectares since 1990, of which the largest part (46 percent) was designated between 2000 and 2005 (Figure 10). These forests now account for 12 percent of the total forest area or more than 460 million hectares. Most but not all of them are located inside protected areas.

FIGURE 9  
Proportion of planted forests consisting of introduced species, 2010

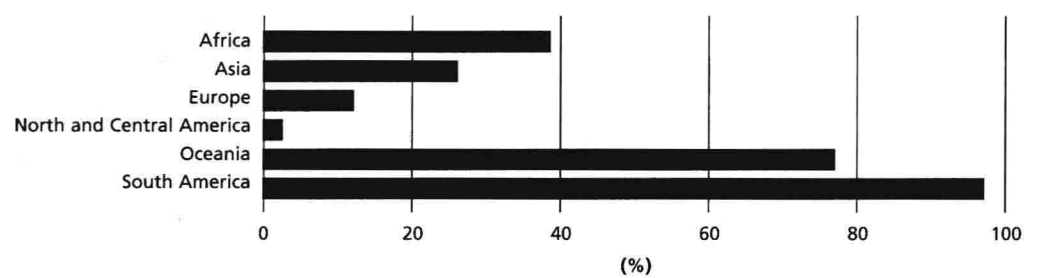
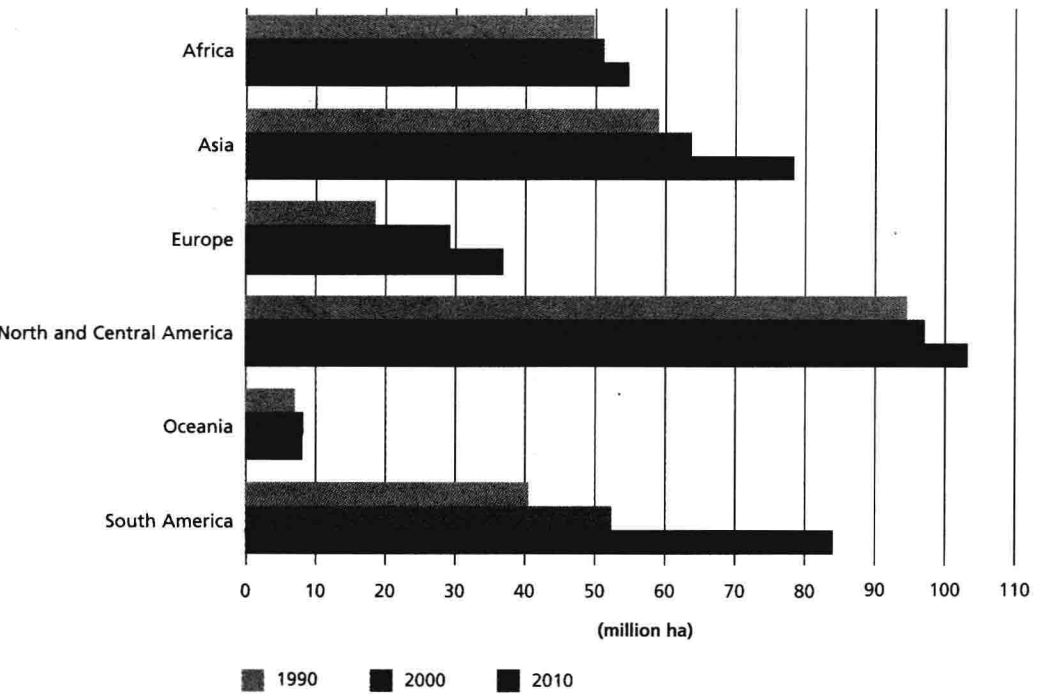


FIGURE 10  
Trends in area of forest designated for conservation of biodiversity by region, 1990–2010



**Legally established protected areas cover an estimated 13 percent of the world’s forests**

National parks, game reserves, wilderness areas and other legally established protected areas cover more than 10 percent of the total forest area in most countries and regions (Figure 11). The primary function of these forests may be the conservation of biological diversity, the protection of soil and water resources, or the conservation of cultural heritage. The area of forest within a protected area system has increased by 94 million hectares since 1990. Two-thirds of this increase has been since 2000.

**Forest fires are severely underreported at the global level**

While some forest ecosystems depend on fire for their regeneration, in others forest fires can be devastating and also frequently cause loss of property and human life. On average, 1 percent of all forests were reported to be significantly affected each year by forest fires. However, the area of forest affected by fires was severely underreported, with information missing from many countries, especially in Africa. Less than 10 percent of all forest fires are prescribed burning; the rest are classified as wildfires.

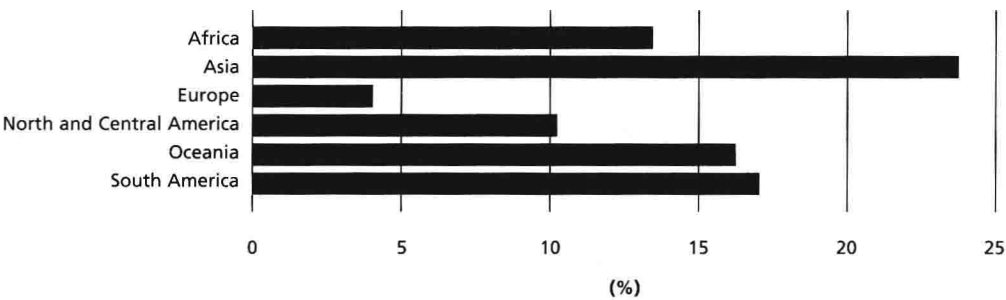
**Insect pests and diseases, natural disasters and invasive species are causing severe damage in some countries**

Outbreaks of forest insect pests damage some 35 million hectares of forest annually, primarily in the temperate and boreal zone. The mountain pine beetle has devastated more than 11 million hectares of forest in Canada and the western United States of America since the late 1990s – an unprecedented outbreak exacerbated by higher winter temperatures. Severe storms, blizzards and earthquakes have also damaged large areas of forest since 2000. Woody invasive species are of particular concern in small island developing states, where they threaten the habitat of endemic species. Information availability and quality continues to be poor for most of these disturbances.

**Thirty percent of the world’s forests are primarily used for production of wood and non-wood forest products**

Close to 1.2 billion hectares of forest are managed primarily for the production of wood and non-wood forest products. An additional 949 million hectares (24 percent) are designated for multiple use – in most cases including the production of wood and non-wood forest products. The area designated primarily for productive purposes has decreased by more than 50 million hectares since 1990 as forests have been designated for other purposes. The area designated for multiple use has increased by 10 million hectares in the same period.

FIGURE 11  
Percentage of forest area in protected areas by region, 2010



### Wood removals increased between 2000 and 2005, following a fall in the 1990s

At the global level, reported wood removals amounted to 3.4 billion cubic metres annually in the period 2003–2007, similar to the volume recorded for 1990 and equivalent to 0.7 percent of the total growing stock (Figure 12). Considering that informally and illegally removed wood, especially woodfuel, is not usually recorded, the actual amount of wood removals is undoubtedly higher. At the global level, woodfuel accounted for about half of the removed wood.

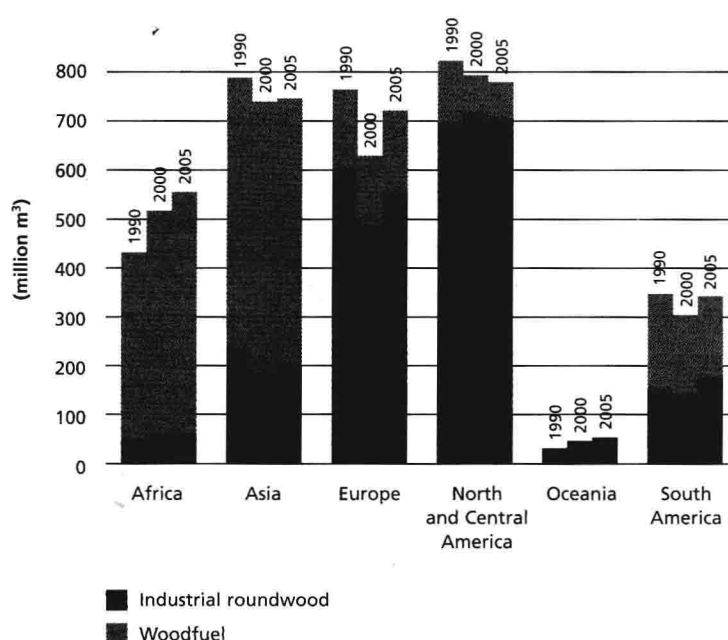
### Eight percent of the world's forests have protection of soil and water resources as their primary objective

Around 330 million hectares of forest are designated for soil and water conservation, avalanche control, sand dune stabilization, desertification control or coastal protection. The area of forest designated for protective functions increased by 59 million hectares between 1990 and 2010, primarily because of large-scale planting in China aimed at desertification control, conservation of soil and water resources and other protective purposes.

### The management of forests for social and cultural functions is increasing, but the area is difficult to quantify

The only subregions and regions with fairly good data on the designation of forests for recreation, tourism, education or conservation of cultural and spiritual heritage are East Asia and Europe, where provision of such social services was reported as the primary management objective for 3 and 2 percent of the total forest area, respectively. Brazil has designated more than one-fifth of its forest area for the protection of the culture and way of life of forest-dependent people. Globally, 4 percent of the world's forests are designated for the provision of social services.

FIGURE 12  
Trends in wood removals, 1990–2005



### The value of wood removals is high, but fluctuating

Wood removals valued just over US\$100 billion annually in the period 2003–2007, mainly accounted for by industrial roundwood. At the global level the reported values show no change between 1990 and 2000, but an increase of about 5 percent annually over the period 2000–2005, suggesting that roundwood prices recovered somewhat since their decline (in real terms) in the decade 1990–2000 (Figure 13). However, they have since fallen sharply.

### The value of non-wood forest products remains underestimated

The reported value of non-wood forest product removals amounted to about US\$18.5 billion in 2005. Food products accounted for the greatest share. However, information is still missing from many countries in which non-wood forest products are highly important, and the true value of subsistence use is rarely captured. As a result, the reported statistics probably cover only a fraction of the true total value of harvested non-wood forest products.

### Around 10 million people are employed in forest management and conservation – but many more are directly dependent on forests for their livelihoods

Reported employment in forest establishment, management and use declined by about 10 percent between 1990 and 2005, probably because of gains in labour productivity. Europe, East Asia and North America saw steep declines (15 to 40 percent between 1990 and 2005), while in other regions, employment increased somewhat – probably because roundwood production has increased faster than gains in labour productivity. Most countries reported increased employment in management of protected areas. Given that much forestry employment is outside the formal sector, forest work is surely much more important for rural livelihoods and national economies than the reported figures suggest.

### Governments generally spend more on forestry than they collect in revenue

On average, total forest revenue collection was about US\$4.5 per hectare, ranging from under US\$1 per hectare in Africa to just over US\$6 per hectare in Europe (Figure 14).

FIGURE 13  
Trends in value of wood removals, 1990–2005

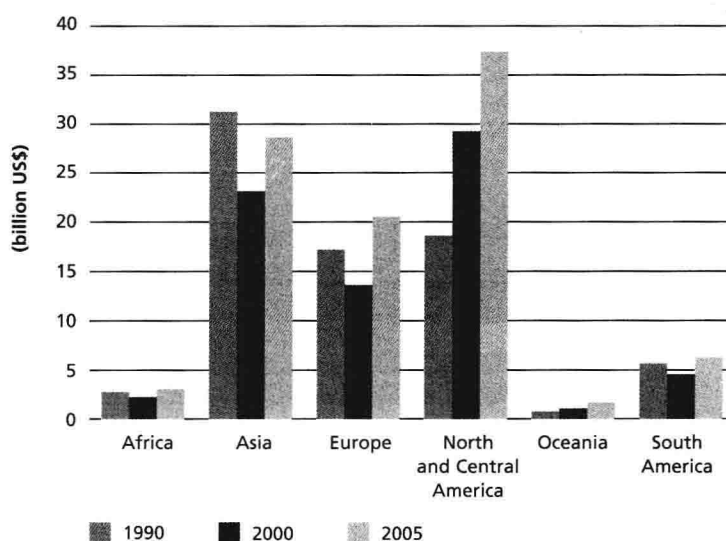
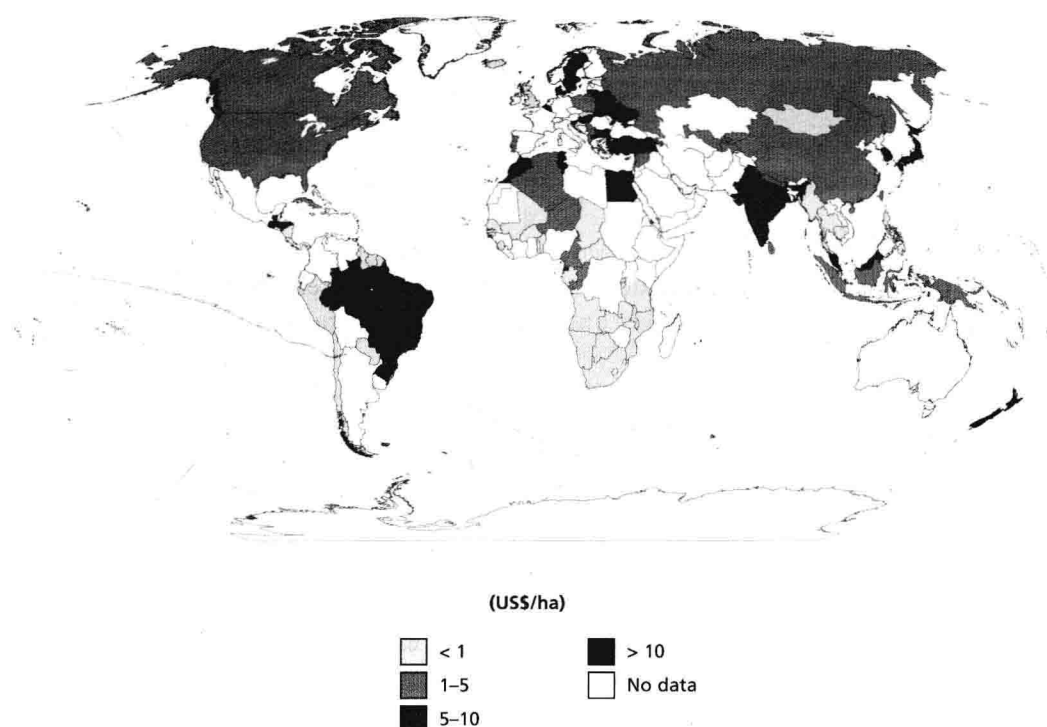




FIGURE 14  
Forest revenue collection by country, 2005



Public expenditure on forestry was about US\$7.5 per hectare on average. Average expenditure was highest in Asia (over US\$20 per hectare). In contrast, the average expenditure per hectare was less than US\$1 in South America and Oceania (Figure 15).

### Significant progress has been made in developing forest policies, laws and national forest programmes

Of the 143 countries that have a forest policy statement, 76 countries have issued or updated their statements since 2000. Of the 156 countries that have a specific forest law, 69 countries – primarily in Europe and Africa – reported that their current forest law has been enacted or amended since 2005. Close to 75 percent of the world's forests are covered by a national forest programme, i.e. a participatory process for the development and implementation of forest-related policies and international commitments at the national level (Figure 16).

### Staff numbers in public forest institutions are decreasing

Around 1.3 million people were reported to work in public forest institutions in 2008, 22 percent of whom were female. At the global level, the number of staff has declined by 1.2 percent annually since 2000. More than 20 000 professionals work in public forest research institutions.

### The number of university students graduating in forestry is increasing

More than 60 000 university students graduate in forestry annually. This equates to about 1 per 86 000 inhabitants, or around 200 per 10 million hectares of forests. One-third of graduating students are female, and this proportion is increasing.