Chapter 6

Protective functions of forest resources

OVERVIEW

Early assessments of forest resources were focused on the productive functions of forests, particularly wood supply, as this was the main issue identified by policy-makers. In response to increased awareness in many countries of the important role of forests in providing environmental services including protection – and consistent with the overall concept of sustainable forest management – FRA 2005 also evaluates trends in those forest resources with a protective function.

Each succeeding FRA has given more attention to environmental services. While demand for wood has remained static or increased only slightly and demand for non-wood forest products (NWFPs) has increased steadily but slowly, the demand for environmental services of forests – largely unmonetized – has burgeoned (Leslie, 2005). Many of these services have to do with the protective role of forests.

The world's forests have many protective functions, some local and some global.

Influence on climate. Forests affect climate globally by reflecting less heat back into the atmosphere than other types of land use that have more bare soil and less green cover. They also play a very significant role in the global carbon cycle that affects global climate change (see Chapter 2). Locally, in both cities and rural areas, trees provide shade and absorb heat energy, producing a cooling effect. During the cold season, they obstruct, filter and deflect wind, reducing wind chill. Windbreaks of trees can reduce evaporative losses from small water bodies. These functions of reducing wind velocity, moderating soil temperature and increasing relative humidity are also beneficial in agroforestry systems (Vergara and Briones, 1987).

Protection from wind erosion. Wind-rows and shelterbelts reduce the loss of nutrient-rich topsoil and protect young plants from wind within their zone of influence. They also help stabilize dunes.

Coastal protection. Coastal forests, particularly mangroves, reduce shoreline erosion and siltation and the impacts of storm surges and tsunamis. Mangroves also filter and remove some of the nutrients and heavy metals coming from upstream land uses and industry, immobilizing them in the mud – as long as they prove non-toxic to the mangroves themselves (Wharton *et al.*, 1976). Salt-spray barriers of salt-tolerant trees have been planted along windward coasts to protect crops.

Protection from avalanches. The Alpine countries in Europe have had much experience with protection from snow avalanches by forests and have many forests designated for this purpose. As more tourism and infrastructure enter the mountain areas of other countries, this function of forests should be increasingly recognized.

Air-pollution filters. Trees perform a valuable role in intercepting and trapping windborne particulate matter – again, as long as the pollution does not damage or kill them. This is one of the benefits of urban forests and greenbelts. Dust, ash, pollen and smoke that adversely affect human health and visibility can be 'raked' from the atmosphere, then washed to the ground by rainfall or snow.

Protecting water resources. Forests protect water by reducing surface erosion and sedimentation, filtering water pollutants, regulating water yield and flow, moderating floods, enhancing precipitation (e.g. 'cloud forests') and mitigating salinity. Additional information on forests and water is presented in a separate thematic study (Box 6.1).

BOX 6.1

FRA 2005 thematic study on forests and water

Since quantitative information on the role of forests in protecting water supply is rare, with few statistics available, a qualitative thematic study on forests and water was carried out as part of FRA 2005. The report of the study is being completed for release during 2006. It highlights the following main points:

Reduction of soil erosion as it affects water

One of the most effective protective functions of forests is reducing soil erosion by water, which degrades water quality. Soil erosion on sloping land is generally of two major types: surface erosion and 'mass wasting'. Forests have a beneficial role in both types.

Surface erosion includes sheet, rill and small gully erosion, and is at a minimum in forests, with their understorey trees, shrubs and ground cover, and their forest floor debris. In fact, the small trees, understorey and litter protect soil from the impact of falling raindrops (soil dislodgement and splash erosion), overland flow of rainwater as a sheet, or channelling into rills and gullies (Hamilton and King, 1983; Wiersum, 1984). It is the removal of this ground protection, rather than removal of the tree canopy over 10 m high, that results in accelerated erosion. These uncompacted forest soils also have the highest infiltration rates and storage capacities, which reduce the frequency and degree of overland flow. Any activity that bares or compacts the soil reduces the protective role of forests to varying degrees, e.g. tree extraction, litter collection, grazing in forestland and fires. The more intensively forest is used, the greater the potential for erosion. If forest harvesting is contemplated, good management can minimize this impact.

Mass wasting consists of landslips, slumps and debris flows (landslides) and, again, forests are the most effective vegetative cover for minimizing these soil movements, particularly shallow landslips and slumps. The mechanisms are the root shear strength and the lowering of pore pressure (O'Loughlin, 1974). Slip-prone areas can be identified in land-use planning, and forest retention is warranted on these sites.

Sediment. The product of erosion is sediment, which has adverse impacts during transport in flowing water and as a deposit in stream channels or standing water bodies (such as ponds, lakes and reservoirs). Sediment can harm or kill valuable aquatic life; impair water quality for drinking, domestic use or industry; reduce reservoir capacity for flood control, hydropower, irrigation or low flow augmentation; interfere with navigation; shorten the useful life of hydro-turbines or pumps; and build up river channel beds, aggravating flooding (Hamilton and Pearce, 1991). Thus the protective role of forests in reducing erosion on-site has a far-reaching, off-site effect through reduced sedimentation.

Influence on water regulation

The influence of forests and forest alteration on water yield and timing is complex. Where forests were the original land cover, the protective effect consists in maintaining as far as possible the 'natural' flow regime, which inevitably consisted of both flooding and low flows to which stream channels and associated biota were adjusted. With human intervention and occupancy, there is a need for better understanding of the forest/water interaction. With regard to floods, it is now quite clear that forests reduce stormflow peaks and delay them better than other land cover, but that this effect occurs close to a forest and diminishes further downstream in the watershed (Hamilton and King, 1983). On major rivers, headwater forests have little or no effect in reducing flood intensity in the downstream reaches (Hewlett, 1982; FAO, 2005f). But close to the protective forest, the frequent, lower intensity storms are ameliorated more than with other land covers or land uses, to the benefit of local people.

Forests absorb larger amounts of soil moisture than other vegetation, owing to greater canopy evaporation and deeper roots. In most cases, tree removal results in greater low flows during the dry season, but the other protective values are lost if trees are removed "to make more water" (Hamilton and King, 1983). Forest removal has at times been advocated to increase water availability. Indeed, where reforestation has occurred in grasslands or semi-arid areas, the water demand by these forests has in some cases been a harmful and unintended consequence. This has led to oversimplified and exaggerated popular articles against the use of trees for water regulation.

Precipitation-enhancing cloud forests

Montane cloud forests have a special protective role with regard to water resources; they capture horizontally moving fog moisture in areas of persistent wind-blown clouds. This water capture and the low evapotranspiration of cloud forests add water to the watershed above normal vertical precipitation. These forests occur in the tropics and subtropics in bands or zones of frequent cloudiness and wind, at elevations of from 2 000–3 000 m on continental mountains to as low as 500 m on oceanic islands and in coastal situations. The additional water capture ranges from 15–20 percent of ordinary rainfall in humid areas (2 000–3 000 millimetres per year) up to 50–60 percent for exposed ridge tops and areas of lower precipitation (Bruijnzeel and Hamilton, 2000). Where fog/cloud situations exist in dry seasons or locations, 100 percent and higher additions have been recorded.

Riparian forests

Protecting stream and river banks from undue horizontal erosion is only one function of a buffer zone of trees along both sides of a watercourse. The buffer area also acts as a filter and depository for sediment, pesticides and fertilizers from upslope land use. It may also reduce water temperatures through shading, thereby improving conditions for many forms of aquatic life. Several countries find this protective function so compelling that they have established 'green stream corridors' or they protect such corridors through zoning regulations, including mandatory practices in logging. This trend merits being continued and accelerated.

Forests mitigating salinity

Secondary salinity, as opposed to natural (or primary) salinity, can be caused by the removal of forests. Reduction of the evapotranspiration of deep-rooted trees causes a rise in the water table. In areas in which salts are present in the lower layers of the soil, this higher water table can bring salts into the root zone and adversely affect plant growth, even proving toxic. This is especially critical where clearing and establishment of crops is attempted. It is estimated that perhaps 7 percent of the agricultural area of western Australia is suffering from such secondary salinization in lands formerly forested (Ghassemi, Jakeman and Nix, 1995). Moreover, saline water draining from such areas can adversely impact downstream or downslope usefulness of water. Reforestation in these areas has made salinized land useful once again. Forests are thus playing a protective role in areas prone to soil salinization. Wood harvesting, followed by regeneration, should not result in salinity as long as clear-felled areas are not extensive.

Conclusions

In view of the critical importance of water in adequate quantity and quality to meet human needs, and the direct and indirect roles of forests in protecting these attributes, managers and policy-makers need to consider carefully the impacts of forest removal or alteration and forestation on water resources. To this end, the FRA 2005 thematic study on forests and water sets forth guidelines for each of a number of major situations in which the forest/water interaction is strong.

Many countries have identified forest areas that serve a protective function and have given them special status, e.g. avalanche protection, watershed reserve, natural catchment area or multiple-use management area. Maintenance of these environmental services, including protective functions, looms large among the management objectives of the IUCN Category System for Protected Areas (1994). This is the system of nomenclature most widely accepted and adopted throughout the world (Table 6.1), and efforts are underway to determine how it can be appropriately applied to the protective functions of the forest estate.

Forests in all categories, whether they be in national parks or marine/coastal reserves, perform some of the protective functions discussed above. For example, a watershed reserve might fall within Category I (Strict Protection) or Category VI (Managed Resource Protection Area). Yet not all protected areas have protection of soil and water as their main objective. Many are primarily established for the conservation of biological diversity or natural/cultural features. Conversely, some forests that have protection as their primary management objective may not form part of a protected area network, e.g. plantations established to combat desertification. The area of forest in protected areas is thus not necessarily a good measure of the protective functions of forests.

Data for two variables in FRA 2005 provide some indication of the role of protective forests and are reviewed in this chapter:

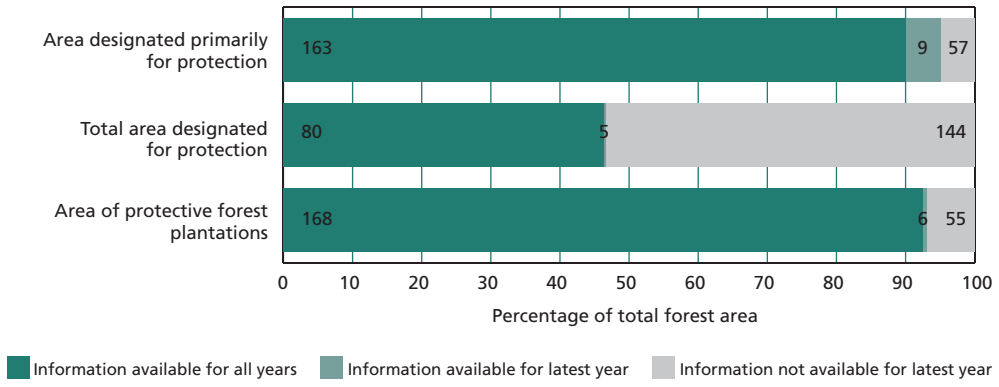
- area of forest designated for protective purposes (as the primary function or as one of several functions);
- area of protective forest plantations.

Limited quantitative information for these variables is available (Figure 6.1), but an initial evaluation has been made of the importance of the protective functions of forests.

TABLE 6.1
Protected area categories and management objectives

IUCN World Commission on Protected Areas Categories (IUCN, 1994)
I. Strict protection
(a) (Strict Nature Reserve)
(b) (Wilderness Area)
II. Ecosystem conservation and recreation (National Park)
III. Conservation of natural features (Natural Monument)
IV. Conservation through active management (Habitat/Species Management Area)
V. Landscape/seascape conservation and recreation (Protected Landscape/Seascape)
VI. Sustainable use of natural ecosystems (Managed Resource Protected Area)

FIGURE 6.1
Information availability – protective functions of forest resources



Note: Figures present number of countries in each category.

KEY FINDINGS

In 2005 the extent of forests with protection as their designated primary function was 348 million hectares – or 9 percent of the global forest area. At the same time, 1 190 million hectares of forest were identified as having a protective function as one of the designated functions (not necessarily the primary function).

The findings of FRA 2005 suggest that there is a trend towards increasing identification and designation of areas for forest protection. For the world as a whole, the percentage of forest with protection as the primary function increased from 8 percent in 1990 to 9 percent in 2005 – equivalent to an increase of more than 50 million hectares since 1990. Similarly, the proportion of the world's forests having a protective function as one of the designated functions increased from 61 percent in 1990 to 65 percent in 2005 – or an increase of close to 60 million hectares.

It would seem likely that the trend for a greater proportion of the world's forests to be classified as having "a primary function of protection" will continue, and that FRA 2010 will show more than 9 percent in this category.

On a global basis, the protective forest plantation area increased by 405 000 ha per year during 1990–2000 and by 330 000 ha per year during 2000–2005. The proportion of protective forest plantations increased from 0.63 percent of total forest area in 1990, through 0.75 percent in 2000, to 0.82 percent in 2005. However, regions and subregions reported changes that varied markedly.

In view of the many protective functions of forests and their growing importance, it is becoming increasingly necessary for countries to gather, analyse and present information on the extent and condition of 'protective forests'. All forests and woodlands, even 'productive' forests, have varying degrees of protective roles, and the protective values could often be enhanced by some alteration of the management regime. While this might result in giving up or expending some direct monetary value (for example, foregoing harvesting on critical sites or upgrading harvesting practices), the value of these environmental services to human welfare, health and economies is being increasingly recognized. Environmental or ecological economics is providing new tools for monetizing these services (see, for example, Landell-Mills and Porras, 2002).

FRA 2005 is a first attempt at evaluating the importance of the protective functions of forests at the global level and is based on a limited number of quantitative variables. Nevertheless, these variables all show a positive trend, indicating an increased recognition of the importance of the protective functions provided by forests.

FOREST AREA DESIGNATED FOR PROTECTIVE PURPOSES

This variable indicates to what extent forest areas have been set aside for protective purposes, either by legal prescription or by decision of the landowner or manager.

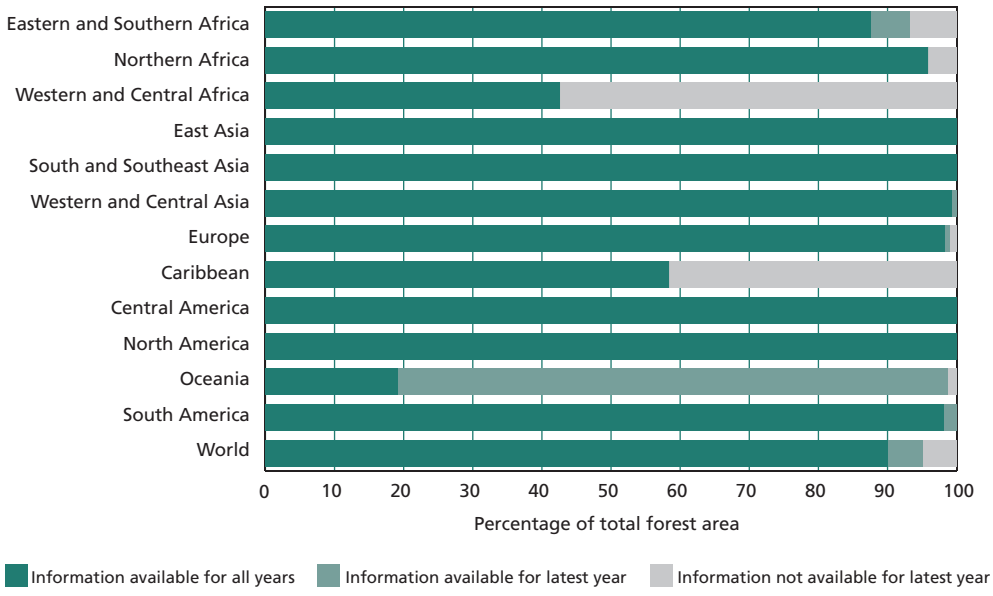
Forest designation is reported in two ways: 'primary function' and 'total area with function'. Forest areas with a specific, designated function considered to be significantly more important than other functions are reported as 'primary function'. All forest areas with a designated function (not necessarily primary) are reported under 'total area with function'.

As mentioned previously, it is important to stress that the concept of 'protective function' goes beyond the protected area definition, because forests and other wooded land can have a protective function although outside protected areas.

Information availability

Of 229 country reports, 172 contained information on designated primary functions of forests, together accounting for 95 percent of the world's forest area (Figure 6.2). Of these, only 134 reported that they had areas specifically designated for protective purposes, while several countries reported that they had insufficient information on this specific category or they included such areas as part of the category 'multiple purpose'.

FIGURE 6.2
Information availability – area of forest designated primarily for protection



In 2005 a total of 85 countries, representing 46.6 percent of the world's forest area, reported data on total area of forests with a function of protection (not necessarily primary) (Figure 6.3). Some countries, for example Japan, stated that all forests are expected to perform multiple functions. Such countries may not have designated any land as having a primary function of protection: the entire forest area is expected to have protective, productive and possibly other functions.

Results show an improvement in the overall reporting of countries over the past 15 years. There is a clear prevalence of Asian countries among those reporting data for all three years, followed by European countries.

Status

The total extent of forests with protection as their primary function (Table 6.2) was estimated in 2005 at 348 million hectares, equivalent to 9 percent of total forest area. Asia has the highest proportion of forests with a primary function of protection (24 percent), followed by South America (11 percent) and Europe (9 percent). The figures for Western and Central Africa are quite low. This may be due to the fact that only a few countries in this subregion have reported on the protective function of forests.

The relatively small proportion of forests with protection as the primary function reported in North and Central America (0.5 percent) is due to lack of information on protection as a primary function from Canada and the United States, which have included those areas in the multiple purpose category, identifying that as the primary function. This affects the overall analysis, given the large forest area in these two countries. A similar explanation is provided for the very low figure for Oceania: Australia does not have a classification system that can directly report on the designated function classes used by FRA, and so has included areas with protective functions in the multiple purpose category.

It is also useful to consider the reporting of data on the total area of forest for which a specific function of protection has been designated, regardless of whether it is primary or not. Globally, a total forest area of 1 190 million hectares was identified as having a

FIGURE 6.3
Information availability – total area of forest designated for protection

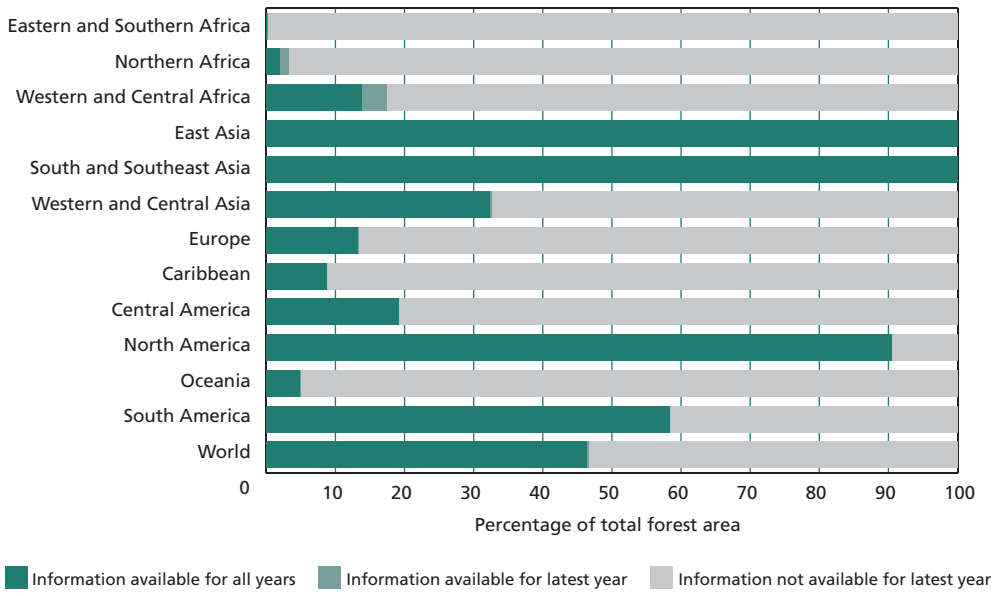


TABLE 6.2
Area of forest designated primarily for protection 2005

Region/subregion	Information availability			Area of forest designated primarily for protection	
	Countries reporting	Forest area *(1 000 ha)*	% of total forest area	1 000 ha	% of forest area
Eastern and Southern Africa	16	211 181	93.2	6 018	2.8
Northern Africa	13	125 667	95.9	12 567	10.0
Western and Central Africa	15	118 280	42.6	2 206	1.9
Total Africa	**44**	**455 129**	**71.6**	**20 791**	**4.6**
East Asia	5	244 862	100.0	66 992	27.4
South and Southeast Asia	17	283 126	100.0	59 097	20.9
Western and Central Asia	23	43 579	100.0	13 069	30.0
Total Asia	**45**	**571 567**	**100.0**	**139 158**	**24.3**
Total Europe	**36**	**991 192**	**99.0**	**90 488**	**9.1**
Caribbean	9	3 489	58.4	1 291	37.0
Central America	7	22 411	100.0	1 068	4.8
North America	4	677 464	100.0	986	0.1
Total North and Central America	**20**	**703 364**	**99.6**	**3 345**	**0.5**
Total Oceania	**14**	**203 467**	**98.6**	**502**	**0.2**
Total South America	**13**	**831 540**	**100.0**	**93 559**	**11.3**
World	**172**	**3 756 260**	**95.0**	**347 842**	**9.3**

protective function in 2005 (Table 6.3). North America has the highest proportion of forests with a protective function, followed by Oceania and Asia.

Twenty-five countries reported that all their forests had protection as one of the designated functions. These countries are Afghanistan, American Samoa, Austria, Bahrain, Belarus, Canada, the Democratic People's Republic of Korea, Egypt, Georgia, Guadeloupe, India, Japan, Kuwait, Kyrgyzstan, Libyan Arab Jamahiriya, New Zealand, Quatar, Singapore, Tunisia, Ukraine, United Arab Emirates, United States of America, Uzbekistan, Viet Nam and Wallis and Futuna Islands.

TABLE 6.3
Total area of forest designated for protection 2005

Region/subregion	Information availability			Total area of forest designated for protection	
	Countries reporting	Forest area *(1 000 ha)*	% of total forest area	1 000 ha	% of forest area
Eastern and Southern Africa	2	77	n.s.	30	39.0
Northern Africa	5	4 160	3.2	2 490	59.9
Western and Central Africa	5	48 595	17.5	1 516	3.1
Total Africa	**12**	**52 831**	**8.3**	**4 036**	**7.6**
East Asia	5	244 862	100.0	227 343	92.8
South and Southeast Asia	17	283 126	100.0	183 714	64.9
Western and Central Asia	13	14 176	32.6	13 600	95.9
Total Asia	**35**	**542 164**	**94.9**	**424 656**	**78.3**
Total Europe	**22**	**133 854**	**13.4**	**50 371**	**37.6**
Caribbean	3	524	8.8	200	38.2
Central America	1	4 294	19.2	3 133	73.0
North America	3	613 226	90.5	613 225	100.0
Total North and Central America	**7**	**618 044**	**87.6**	**616 558**	**99.8**
Total Oceania	**7**	**10 235**	**5.0**	**8 907**	**87.0**
Total South America	**2**	**485 761**	**58.4**	**85 204**	**17.5**
World	**85**	**1 842 890**	**46.6**	**1 189 732**	**64.6**

TABLE 6.4
Trends in area of forest designated primarily for protection 1990–2005

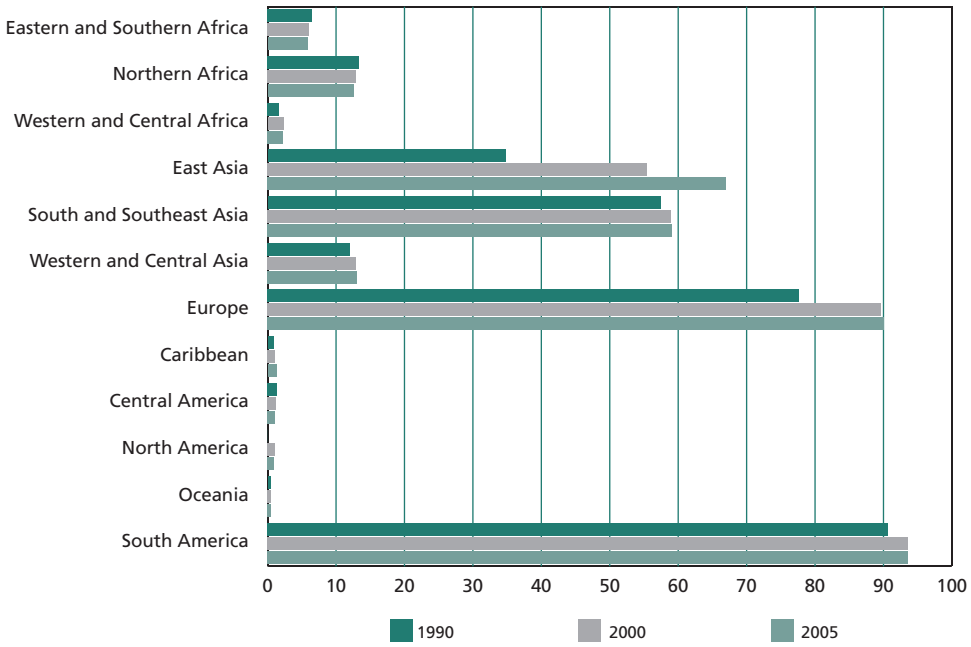
Region/subregion	Information availability (all 3 years)			Area of forest designated primarily for protection *(1 000 ha)*		
	Countries reporting	Forest area *(1 000)*	% of total forest area	1990	2000	2005
Eastern and Southern Africa	15	198 343	87.6	6 440	6 102	5 840
Northern Africa	13	125 667	95.9	13 323	12 866	12 567
Western and Central Africa	15	118 280	42.6	1 630	2 320	2 206
Total Africa	**43**	**442 291**	**69.6**	**21 392**	**21 287**	**20 613**
East Asia	5	244 862	100.0	34 763	55 424	66 992
South and Southeast Asia	17	283 126	100.0	57 422	58 907	59 097
Western and Central Asia	21	43 272	99.3	12 079	12 933	13 047
Total Asia	**43**	**571 259**	**99.9**	**104 264**	**127 263**	**139 136**
Total Europe	**34**	**984 468**	**98.3**	**77 705**	**89 599**	**90 098**
Caribbean	9	3 489	58.4	850	1 085	1 291
Central America	7	22 411	100.0	1 344	1 178	1 068
North America	4	677 464	100.0	0	1 047	986
Total North and Central America	**20**	**703 364**	**99.6**	**2 194**	**3 310**	**3 345**
Total Oceania	**11**	**39 593**	**19.2**	**413**	**450**	**467**
Total South America	**12**	**816 436**	**98.2**	**90 631**	**93 632**	**93 559**
World	**163**	**3 557 412**	**90.0**	**296 598**	**335 541**	**347 217**

Note: As some countries did not report a complete series, figures for 2005 are slightly different from those presented in Table 6.2.

Trends

The results of the trend analysis, based on those countries that provided information for all three reporting years (1990, 2000 and 2005), show an overall increase in the area of forests with protection as their primary function, from 8 percent in 1990 to 9 percent in 2005 (Table 6.4 and Figure 6.4). Similarly, there has been an increase in the proportion of the world's forests with protection as one of the designated functions (not necessarily the primary one) from 61 percent in 1990 to 65 percent in 2005 – or an increase of 58 million hectares in the 80 reporting countries providing information for all years.

FIGURE 6.4
Area of forest designated primarily for protection 1990–2005
(million ha)



PROTECTIVE FOREST PLANTATIONS

Recognizing the important protective role of forests, many countries have planted substantial areas of forests and trees for this purpose. These range from large-scale forest plantations to stabilize sand dunes and combat desertification to windbreaks and individual trees planted to provide shade.

For FRA 2005, countries were asked to characterize their forests in five classes: primary, modified natural, semi-natural, protective plantation and productive plantation. While the previous section focused on the total area of forests with a protective function, including both naturally regenerated and planted forests, this section focuses on forest plantations having a primary objective of protection – i.e. the fourth class.

Protective forest plantations are defined as those with introduced species and in some cases native species, established through planting or seeding, with few species, even spacing and/or even-aged stands, predominantly for the provision of services such as protection of soil and water, rehabilitation of degraded lands, combating desertification, etc.

Some countries had difficulty in differentiating whether the purpose of a forest plantation was predominantly productive or protective because of forest plantation management policies for multipurpose or multiple functionality. Protective forest plantations do not totally preclude some harvesting of wood, fibre and other products.

It should be noted that this category only captures a subset of all the forests and trees planted for protective purposes. It does not include, for instance, the planted component of semi-natural forests (sown or planted native species), windbreaks with a width of less than 20 m or an area of less than 0.5 ha or individual trees or groups of trees. A thematic study on planted forests, to be released during 2006, complements FRA 2005 with more detailed data and analysis (see Chapter 2, Box 2.1).

Information availability

Of the 174 countries that provided information on the characteristics of their forests, 93 reported protective plantation data for 1990, 103 for 2000 and 101 for 2005. The

remaining countries reported that they had no protective forest plantations or were unable to distinguish between productive and protective plantations.

As can be seen in Figure 6.5, data availability is generally good, with all subregions except Western and Central Africa and the Caribbean providing information for more than 85 percent of the total forest area in the respective subregions.

Status

The global area of protective forest plantations reported in 2005 was 30.1 million hectares (Table 6.5). A few countries dominated their respective regions, including the Russian

FIGURE 6.5
Information availability – area of protective forest plantations

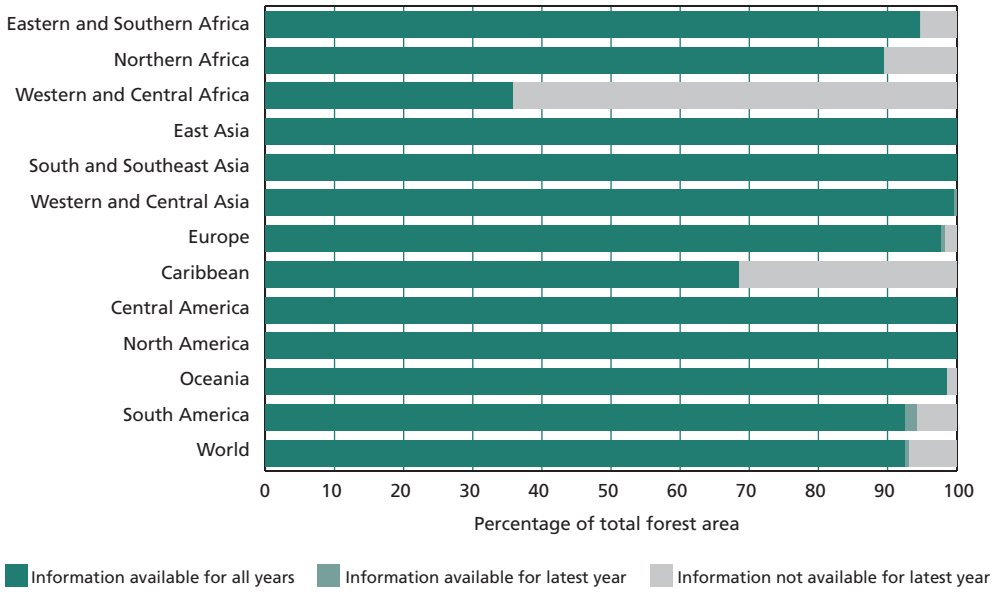


TABLE 6.5
Area of protective forest plantations 2005

Region/subregion	Information availability			Area of protective forest plantations	
	Countries reporting	Forest area *(1 000 ha)*	% of total forest area	1 000 ha	% of forest area
Eastern and Southern Africa	18	214 589	94.7	66	0.03
Northern Africa	12	117 193	89.4	2 192	1.87
Western and Central Africa	17	99 566	35.8	112	0.11
Total Africa	**47**	**431 347**	**67.9**	**2 370**	**0.55**
East Asia	5	244 862	100.0	13 160	5.37
South and Southeast Asia	17	283 126	100.0	4 809	1.70
Western and Central Asia	23	43 579	100.0	2 505	5.74
Total Asia	**45**	**571 567**	**100.0**	**20 474**	**3.58**
Total Europe	**36**	**983 907**	**98.3**	**6 027**	**0.61**
Caribbean	12	4 090	68.5	170	4.16
Central America	7	22 411	100.0	34	0.15
North America	4	677 464	100.0	986	0.15
Total North and Central America	**23**	**703 965**	**99.7**	**1 190**	**0.17**
Total Oceania	**11**	**203 455**	**98.6**	**32**	**0.02**
Total South America	**12**	**783 827**	**94.3**	**31**	**n.s.**
World	**174**	**3 678 069**	**93.1**	**30 125**	**0.82**

Federation, which accounted for 84 percent of all protective forest plantations in Europe; Japan, with 50 percent in Asia; Mexico, with 83 percent in North and Central America; and Algeria and the Sudan, accounting respectively for 31 and 29 percent in Africa. The ten countries with the largest area of protective forest plantations (Figure 6.6) accounted for 25.7 million hectares or 85 percent of the global protective forest plantation area.

Trends

Trends were reported for those countries that provided data sets for all three reporting years.

On a global basis, the protective forest plantation area increased by 405 000 ha per year during 1990–2000 and 330 000 ha per year during 2000–2005. The proportion of protective forest plantations increased from 0.63 percent of total forest area in 1990, through 0.75 percent in 2000, to 0.82 percent in 2005. However, regions and subregions reported changes that differed significantly (Table 6.6).

FIGURE 6.6
Ten countries with largest area of protective forest plantations 2005
(%)

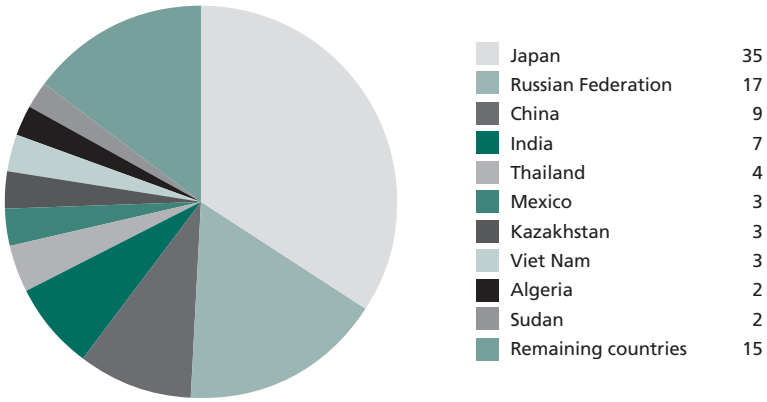


TABLE 6.6
Trends in area of protective forest plantations 1990–2005

Region/subregion	Information availability (all 3 years)			Area of protective forest plantations *(1 000 ha)*		
	Countries reporting	Forest area *(1 000)*	% of total forest area	1990	2000	2005
Eastern and Southern Africa	18	214 589	94.7	66	66	66
Northern Africa	12	117 193	89.4	1 840	2 021	2 192
Western and Central Africa	16	99 414	35.8	70	87	112
Total Africa	**46**	**431 195**	**67.9**	**1 975**	**2 173**	**2 370**
East Asia	5	244 862	100.0	11 622	12 490	13 160
South and Southeast Asia	17	283 126	100.0	3 869	4 451	4 809
Western and Central Asia	22	43 443	99.7	2 175	2 518	2 505
Total Asia	**44**	**571 430**	**100.0**	**17 666**	**19 459**	**20 474**
Total Europe	**34**	**978 682**	**97.7**	**4 569**	**5 574**	**6 027**
Caribbean	12	4 090	68.5	155	151	170
Central America	7	22 411	100.0	32	29	34
North America	4	677 464	100.0	-	1 047	986
Total North and Central America	**23**	**703 965**	**99.7**	**187**	**1 227**	**1 190**
Total Oceania	**10**	**203 284**	**98.6**	**1**	**3**	**21**
Total South America	**11**	**768 723**	**92.4**	**10**	**27**	**31**
World	**168**	**3 657 281**	**92.5**	**24 408**	**28 464**	**30 114**

Note: As some countries did not report a complete series, figures for 2005 are slightly different from those presented in Table 6.5.

TABLE 6.7
Ten countries with largest area of protective forest plantations 1990–2005

Country/area	Area of protective forest plantations *(1 000 ha)*			Annual change *(1 000 ha)*		Annual change rate *(%)*	
	1990	2000	2005	1990–2000	2000–2005	1990–2000	2000–2005
Japan	10 287	10 331	10 321	4.4	-2.0	n.s.	n.s.
Russian Federation	3 407	4 648	5 075	124.1	85.4	3.2	1.8
China	1 335	2 159	2 839	82.4	136.0	4.9	5.6
India	1 317	1 890	2 173	57.3	56.6	3.7	2.8
Thailand	661	1 081	1 102	42.0	4.2	5.0	0.4
Mexico		1 047	986		-12.2		-1.2
Kazakhstan	1 034	1 056	909	2.2	-29.4	0.2	-3.0
Viet Nam	303	666	903	36.3	47.4	8.2	6.3
Algeria	614	644	742	3.0	19.6	0.5	2.9
Sudan	764	705	675	-5.9	-5.9	-0.8	-0.8
Total Top 10[1]	**19 722**	**24 227**	**25 725**	**345.8**	**299.7**	**2.1**	**1.2**

[1] Does not include Mexico under area for 1990 and under annual change and annual change rate for the period 1990–2000.

The top ten countries reported markedly varied trends in protective forest plantation area for 1990–2000 and 2000–2005 (Table 6.7). Overall, the protective forest plantation area in these countries increased by 346 000 ha per year[1] for 1990 and by 300 000 ha per year during 2000–2005. However, it did not increase to the same extent for all countries.

Some countries also had difficulty in reporting the proportion of protective forest plantations as a percentage of total forest plantation area, so trends can also reflect reclassification of existing areas (e.g. Japan), rather than an increase in new protective forest plantations.

[1] Excluding Mexico, which did not report for 1990.