PART I
THE SITUATION AND DEVELOPMENTS IN THE FOREST SECTOR

Forest resources

In 2001, FAO published the Global Forest Resources Assessment 2000 (FRA 2000), the most comprehensive such survey ever undertaken. Largely based on information provided by the countries themselves and a remote sensing survey of tropical countries, it was supplemented by special studies undertaken by FAO. Among the outputs were two new global forest cover maps, estimates of forest cover, deforestation rates and forest biomass for each country, and several specialized studies on such topics as forest management and forest fires. After the release of FRA 2000 (FAO, 2001), an international meeting of experts was convened to review results and plan future steps. The present chapter highlights some of the recommendations arising from these discussions, notes trends pointing to continued deforestation as a result of pressure to increase agricultural production, and reports on the conversion and conservation of mangroves.

GLOBAL FOREST RESOURCES ASSESSMENT

FAO's Global Forest Resources Assessment is designed to serve countries, international processes and the public by providing information that can be used in policy-making, planning and evaluation of progress in achieving sustainable forest management. Forests and trees not only provide wood and non-wood products, but also provide numerous environmental goods and services such as conservation of biological diversity and mitigation of climate change, and they have a key role in alleviating poverty and improving food security. These multiple uses, especially local and gender-specific ones, have in the past been under-represented in forest assessments, and their inclusion will help determine the usefulness of future efforts. Key characteristics of the global assessment are:

- agreed common sets of definitions for the most important parameters;
- close collaboration among international forest-related processes such as those related to criteria and indicators for sustainable forest management;
- the involvement of countries;
- the neutral role of FAO and its partners in implementation of the assessment.

Several initiatives along these lines have recently been taken: a global and interorganizational process to harmonize forest definitions met twice in 2002; the Collaborative Partnership on Forests (CPF) established a task force on monitoring, assessment and reporting; and steps have been taken to establish an advisory group on the Global Forest Resources Assessment.

More than changes in forest area

Assessments have shown for many years that the area of the world's forests is shrinking. Estimates have become more reliable over repeated assessments, particularly with the recent agreement that FRA 2000 use one definition for forest. According to current estimates (FAO, 2001), 0.38 percent of the world's forests were converted to other land uses (i.e. deforested) every year in the 1990s. At the same time, large areas reverted to forest, leaving a net annual loss of 0.22 percent. While these findings clearly show a substantial loss, particularly in the tropics, it is equally obvious that change in forest area is not the only indicator of the state of the world's forest resources or their capacity to supply goods and services.

Another way to describe declining forest resources is the extent to which they have been degraded (FAO, 2001). For example, poor silvicultural practices may have lowered wood production, unwisely managed harvesting may have led to reduced biological diversity, or overharvesting of fuelwood – in combination with grazing – may have negatively affected soil fertility. However, it is hard to obtain an accurate

Gaps in the forest estate

Much of the agricultural expansion on to forest lands, particularly in the tropics, is temporary, inasmuch as fields are abandoned three or four years after clearing because of a significant loss of nutrients and hence of agricultural productivity. Some of this land remains abandoned forest, while some, in the case of true shifting cultivation, becomes managed forest fallows. The official figures indicating the balance between the removal of forest and reforestation or afforestation miss these additions to the forest estate, as well as the millions of trees outside forests that are planted and tended by rural inhabitants. Many forest fallows in Africa and other tropical regions that appear to be unproductive are in fact well managed to meet a variety of basic local needs.

overall picture of forest degradation without also taking into account improvements that result in increased benefits. In this regard, future assessments will have to delve into aspects related to function, impact and potential, providing much more information than in the past. Weighing different benefits to determine whether the total is increasing or decreasing in a given forest stand therefore becomes an important element in the forest assessment equation. Similarly, there is a need to review the complementarity of products and services from different forest stands at the landscape and national levels. While it is generally agreed that forest degradation is more common than forest improvement in many countries, the lack of systematic data prevents a balanced calculation of positive and negative trends.

Although evaluating trends in local forest stands is a fairly straightforward matter, the challenge is to make such samples representative for a country or the world. It would therefore appear that the solution to complex national or global accounting of forest resources lies in systematic local observation and assessment.

Planning future direction

In July 2002, FAO and several partners convened a global expert consultation on forest assessments in Finland (entitled Global Forest Resources Assessments – Linking National and International Efforts, referred to in short as Kotka IV) to review the results of FRA 2000 and to plan the future direction of FAO global assessments. Among its many recommendations, Kotka IV agreed on the importance of capacity building, especially in developing countries, to increase the quality, timeliness and usefulness of forest inventories and assessments. Kotka IV also concluded that national forest inventories and assessments should be driven by the needs of national policy processes.

In addition, the meeting noted that global forest assessments should continue to be broad, including information on all aspects of forest resources. This means that the wide range of forest goods and services must be assessed and the quantitative and qualitative values of the benefits studied, so far as possible. The provision of industrial wood and conditions for biological diversity, for example, should therefore be reported.

Precedents for assessing all benefits from forests have already been set with the Millennium Ecosystem Assessment, a four-year initiative designed to provide decision-makers and the public with relevant scientific information on the condition of ecosystems, expected consequences of ecosystem change and options for response; and the United Nations Environment Programme (UNEP) Global Environmental Outlook studies which, while focusing on environmental issues, also place trends in the context of forest benefits.

As many countries lack the capacity to conduct systematic assessments and generate the information required to meet policy and planning needs, FAO has a programme to support national forest assessments and build country capacity. The programme focuses on support for systematic field measurements and observations of forests and their use in order to obtain national-level statistics. A balanced use of remote sensing and field sampling is essential, as

is close collaboration among national institutions and the newly established National Forest Programme Facility (see p. 55).

AGRICULTURAL EXPANSION AND DEFORESTATION

Over the years, researchers have identified agricultural expansion as a common factor in almost all studies on deforestation. Indeed, much of the increase in food production has been at the expense of hundreds of millions of hectares of forest. Although there are no solid estimates of how much farm and grazing land was originally under forest, the point remains that a large portion was cleared for agriculture, and that additional land will be cleared in the future. Efforts are therefore under way to gain a better understanding of the relationship between the two sectors.

Added pressure from population increases and growing consumption

Large population increases and growing per capita consumption will place unprecedented strains on resources and present new challenges to the sustainable management of forests, including other wooded land.

- About 50 percent of the world's inhabitants, mostly in developing countries, are likely to suffer malnutrition and poverty in the next 50 years unless technologies to increase current levels of agricultural productivity are developed in time (IIASA and FAO, 2002).
- Capital formation per agricultural worker has remained stagnant or declined in countries where more than 20 percent of the population is undernourished and where agriculture is essential to alleviate poverty and improve food security (FAO, IFAD and WFP, 2002).
- By 2050, the global population is expected to increase by about 3 billion to a total of about 9 billion, with growth occurring primarily in developing countries where the potential to increase arable land is minimal (IIASA and FAO, 2002).
- The net impact of climate change on agriculture in developing countries is expected to be negative and more significant than in industrialized countries (IIASA and FAO, 2002).

Such extreme conditions over the next 50 years are likely to result in significant incentives to expand agriculture, mostly but not entirely on new land cleared through deforestation. In many industrialized countries, however, the area under agriculture is shrinking, and land thus abandoned is being converted to forest.

Relationship between forested and agricultural areas

To shed light on whether there is a clear relationship in the dynamics between forested and agricultural areas, FAO analysed qualitative temporal change trends on the basis of global statistics. However, this analysis excluded the identification of factors that drive agricultural expansion or contraction and the processes that facilitate such changes.

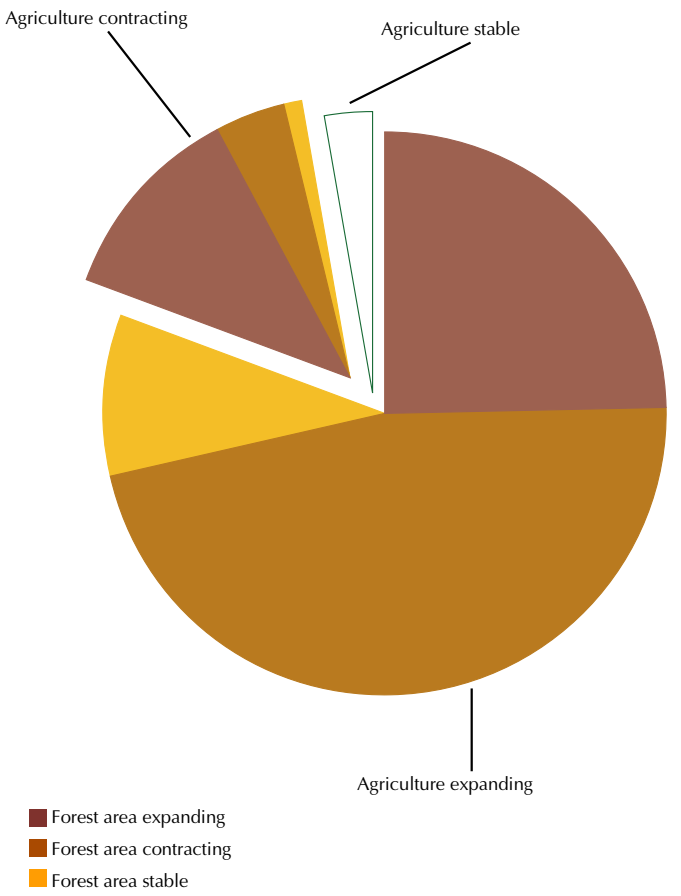
Preliminary findings indicate that agricultural land is expanding in about 70 percent of countries, declining in 25 percent and roughly static in 5 percent (Figure 1).

- In two-thirds of the countries where agricultural land is expanding, forest area is decreasing, but in the other one-third, forests are expanding.
- In 60 percent of the countries where agricultural land is decreasing, forests are expanding. In most of the rest (36 percent), forests are decreasing.

Other wooded lands (shrub and forest fallows) have roughly maintained their share of the land. However, given the dynamic nature of land use, some land might revert to secondary forests over time.

Because other wooded lands may be a buffer for changes in land use, it is important to understand changes in these areas. Integrated assessment and monitoring of trees outside forests is necessary to draw meaningful inferences for wider cross-sectoral policy interventions in the forest, agriculture and environment sectors (IIASA and FAO, 2002). As agricultural expansion into forests seems inevitable (FAO, 2001), a key question for future

FIGURE 1
Expansion and contraction of agriculture and forests: percentage of global area



Forestry and agriculture are inseparable

"It is rightly said that the solution to problems of deforestation and forest land degradation lies outside the forests. ... FAO is fully convinced, based on its many years of experience, that it is essential for forestry and agriculture to work hand in hand."

Dr Jacques Diouf, FAO Director-General
Ministerial Meeting on Forestry,
Rome, 8 to 9 March 1999

sustainable livelihoods, food security and sustainable forest management is the extent to which this buffer can absorb or cushion the expected increase in the demand for agricultural production.

Improved agricultural technology and its impact on forests

It is equally important to recognize that many technological innovations to intensify agricultural production since the green revolution have had a positive impact on forest area. Without them, much more land would be needed to produce today's amounts of wheat, maize, rice and other major food crops.

Indeed, the more agriculture is intensified on a sustainable basis, the less pressure there will be to deforest in order to provide new areas for agriculture. This point has significant implications in terms of forging links among environmental interests, agricultural research and intensification efforts. The following are particularly needed:

- direct policy linkages between forest and agricultural uses of land, perhaps through national or regional land-use policy initiatives;
- new initiatives to support agricultural research, technological development and activities that help bring about sustainable increases in yields per hectare of farmland;
- increased support for forestry research, the development of planted forests and land-use policies that can help to reduce pressure on ancient and fragile forests – areas that are also linked to economic aspects of forest production, industry development and trade.

MANGROVE CONVERSION AND CONSERVATION

Mangroves are found along sheltered coastlines in the tropics and subtropics, where they fulfil important functions in conserving biological diversity and providing wood and non-wood forest products (NWFPs); coastal protection; and habitat, spawning grounds and nutrients for a variety of fish and shellfish, including many commercial species. High population pressure in

Forestry and agriculture face similar challenges

Today, agriculture and the forest sector are more inextricably linked than ever before as they face similar challenges in coping with poverty and food insecurity. While these problems contribute to forest destruction and degradation, the solution for alleviating them and for minimizing the negative impacts of agriculture on the environment involves a complex set of factors, using the best of old and new technologies, innovative ideas and modern institutional arrangements. The sustainable management of forests and trees, including the use of agroforestry and watershed management, is an integral part of the effort to reduce food insecurity, alleviate poverty and improve environmental quality for the rural poor. Technological innovations and new management methods that increase agricultural and forest yields per hectare can also have a significant positive impact on the world's forests.

coastal areas has led to the conversion of many mangrove areas to other uses, including infrastructure, aquaculture, rice growing and salt production. Numerous case studies have described mangrove losses over time. However, information on global-level status and trends is scarce. The first attempt to estimate the total mangrove area in the world was undertaken as part of the FAO/UNEP Tropical Forest Resources Assessment in 1980, when the world total was estimated as 15.6 million hectares. More recent estimates range from 12 to 20 million hectares (Table 1). In many of these studies, countries with small areas of mangroves were excluded because of a lack of information and because their combined area of mangroves would not significantly affect the world total.

A recent initiative by FAO aims at facilitating access to comprehensive information on the past and present extent of mangroves in all the countries and areas in which they exist. This builds on the earlier FAO/UNEP assessment and on the recent FRA 2000, for which all countries were asked to provide information on current forest area according to forest type, using their own classification systems. Because mangroves are a distinct and relatively easily defined forest type, most countries that have mangroves were able to provide information about them.

TABLE 1
Previous estimates of global mangrove area

Reference	Reference year[a]	Number of countries included	Estimated world total *(ha)*
FAO & UNEP, 1981a, b, c	1980	51	15 642 673
Saenger, Hegerl & Davie, 1983	1983	65	16 221 000
FAO, 1994	1980–1985	56	16 500 000
Groombridge, 1992	1992	87	19 847 861
ITTO/ISME, 1993[b]	1993	54	12 429 115
Fisher & Spalding, 1993	1993	91	19 881 800
Spalding, Blasco & Field, 1997	1997	112	18 100 077
Aizpuru, Achard & Blasco, 2000	2000	112[c]	17 075 600

[a] For FAO & UNEP, 1981a, b, c and Aizpuru, Achard & Blasco, 2000, the reference year is the average for all the estimates included, weighted by the area of each estimate. For all other sources, the reference year is the date of the publication(s).
[b] Combined figure from three publications: Clough, 1993; Diop, 1993; and Lacerda, 1993.
[c] New data were provided for 21 countries. For the remaining countries the estimate is based on Spalding, Blasco & Field, 1997.

An extensive literature search yielded additional information. More than 2 800 national and subnational data sets have been collected so far, covering 121 countries and areas where mangroves are known to exist, with the earliest estimates dating back to 1918. The information

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Red mangroves
(Rhizophora mangle)
in the Caribbean

has been analysed with the assistance of mangrove experts throughout the world. One of the results is an updated list of the most reliable, recent estimates for each country, based mainly on inventories or the analysis of remote sensing imagery. Regression analyses based on earlier data provided estimates for 1990 and 1980 and an extrapolated estimate for 2000 to each country. The regional and world totals are shown in Table 2, while Table 3 shows results for individual countries. Three examples of the trend analysis generated from the data are given in Figure 2.

As can be seen from the results, mangrove deforestation is continuing, albeit at a slightly lower rate than in the 1980s. The relatively high mangrove deforestation rates in Asia, the Caribbean and Latin America in the 1980s reflect the large-scale conversion of mangroves for aquaculture and tourism infrastructures. Most countries have now banned the conversion of mangroves for aquaculture purposes and require environmental impact assessments prior to any large-scale conversion of mangroves to other

TABLE 2
Status and trends in mangrove area by region

Region	Most reliable recent estimate		1980 *('000 ha)*	1990 *('000 ha)*	Annual change 1980–1990 *(%)*	2000 *('000 ha)*	Annual change 1990–2000 *(%)*
	('000 ha)	Ref. year[a]					
Africa	3 390	1993	3 659	3 470	-0.5	3 351	-0.3
Asia	6 662	1991	7 857	6 689	-1.5	5 833	-1.2
North and Central America	2 103	1994	2 641	2 296	-1.3	1 968	-1.4
Oceania	1 578	1995	1 850	1 704	-0.8	1 527	-1.0
South America	2 030	1992	3 802	2 202	-4.2	1 974	-1.0
World	**15 763**	**1992**	**19 809**	**16 361**	**-1.7**	**14 653**	**-1.0**

[a] Weighted average of all the countries in the region.

TABLE 3
Status and trends in mangrove area

Country/area	Most reliable recent estimate		1980 *(ha)*	1990 *(ha)*	Annual change 1980–1990 *(%)*	2000 *(ha)*	Annual change 1990–2000 *(%)*
	(ha)	Ref. year					
Africa	**3 390 107**	**1993**	**3 659 322**	**3 469 844**	**-0.5**	**3 350 813**	**-0.3**
Angola	60 700	1992	125 000	71 400	-4.3	59 700	-1.6
Benin	1 700	1989	4 400	1 400	-6.8	1 080	-2.3
Cameroon	227 500	2000	267 000	248 000	-0.7	229 000	-0.8
Comoros	2 600	1976	2 600	2 600	n.s.	2 600	n.s.
Congo	12 000	1995	30 000	20 000	-3.3	11 900	-4.1
Côte d'Ivoire	15 000	1995	89 000	40 000	-5.5	12 700	-6.8
Dem. Rep. of the Congo	22 600	1995	60 600	35 300	-4.2	22 100	-3.7
Djibouti	1 000	1985	1 000	1 000	n.s.	1 000	n.s.
Egypt	482	1998	500	500	n.a.	480	n.a
Equatorial Guinea	25 700	1995	26 700	26 000	-0.3	25 300	-0.3
Eritrea	6 400	1997	6 700	6 500	-0.3	6 300	-0.3
Gabon	115 000	2000	140 000	127 500	-0.9	115 000	-1.0
Gambia	59 600	1993	64 300	61 700	-0.4	59 100	-0.4
Ghana	10 000	1995	12 000	11 000	-0.8	9 000	-1.8
Guinea	296 300	1995	285 000	292 500	0.3	290 000	n.s.
Guinea-Bissau	248 400	1990	245 000	245 000	n.s.	245 000	n.s.
Kenya	52 980	1995	54 400	53 100	-0.2	51 600	-0.3
Liberia	19 000	1995	19 000	19 000	n.s.	19 000	n.s.
Madagascar	325 560	1987	327 000	320 000	-0.2	314 000	-0.2
Mauritania	104	1993	140	112	-2.0	84	-2.5
Mauritius	7	1991	7	7	n.s.	7	n.s.
Mayotte	668	1989	670	670	n.s.	670	n.s.
Mozambique	392 749	1997	402 800	396 600	-0.2	390 500	-0.2
Nigeria	997 700	1995	999 000	998 000	n.s.	997 000	n.s.
Sao Tome and Principe	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Senegal	182 400	1985	175 000	175 800	n.s.	176 700	0.1
Seychelles	2 000	1995	2 400	2 100	-1.3	1 900	-1.0
Sierra Leone	156 500	1986	165 600	150 500	-0.9	135 300	-1.0
Somalia	10 000	1975	9 500	8 500	-1.1	7 500	-1.2
South Africa	673	1991	1 200	720	-4.0	667	-0.7
Sudan	500	1995	605	535	-1.2	465	-1.3
United Rep. of Tanzania	143 284	1987	140 700	152 500	0.8	164 200	0.8
Togo	1 000	1999	1 500	1 300	-1.3	960	-2.6
Asia	**6 661 717**	**1991**	**7 856 500**	**6 689 280**	**-1.5**	**5 832 737**	**-1.3**
Bahrain	100	1992	100	100	n.s.	100	n.s.
Bangladesh	622 482	1992	596 300	609 500	0.2	622 600	0.2

n.a. = not available.
n.s. = not significant.
Notes: The 1980, 1990 and 2000 estimates are based on regression analysis of existing estimates over time for each country extrapolated to 2000. Where insufficient information was available, i.e. only one estimate within the last 30 years (less than 1 percent of the total mangrove area), the area was assumed to have remained constant unless qualitative information indicated otherwise. Where recent information was unavailable (about 5 percent of the total mangrove area), the extrapolation to 2000 was based on the overall forest change rate as reported in FRA 2000 (FAO, 2001) applied to the latest reliable estimate.
For detailed information on methodology, see FAO, 2002a; and FAO, 2002b.
The reference year given for the regional totals of the most reliable recent estimates is the weighted average of all the countries reported.
All primary data sets are available on the Internet at www.fao.org/forestry/mangroves.

Country/area	Most reliable recent estimate		1980 (ha)	1990 (ha)	Annual change 1980–1990 (%)	2000 (ha)	Annual change 1990–2000 (%)
	(ha)	Ref. year					
Brunei Darussalam	17 100	1992	18 300	17 300	-0.5	16 300	-0.6
Cambodia	72 835	1997	83 000	74 600	-1.0	63 700	-1.5
China	36 882	1994	65 900	44 800	-3.2	23 700	-4.7
India	487 100	1997	506 000	492 600	-0.3	479 000	-0.3
Indonesia	3 493 110	1988	4 254 000	3 530 700	-1.7	2 930 000	-1.7
Islam. Rep. of Iran	20 700	1994	25 000	21 000	-1.6	20 000	-0.5
Japan	400	1980	400	400	n.s.	400	n.s
Kuwait	2	2000	n.a.	n.a.	n.a.	2	n.a.
Malaysia	587 269	1995	669 000	620 500	-0.7	572 100	-0.8
Maldives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Myanmar	452 492	1996	531 000	480 000	-1.0	432 300	-1.0
Oman	2 000	1992	2 000	2 000	n.s.	2 000	n.s.
Pakistan	207 000	1990	345 000	207 000	-4.0	176 000	-1.5
Philippines	127 610	1990	206 500	123 400	-4.0	109 700	-1.1
Qatar	500	1992	500	500	n.s.	500	n.s
Saudi Arabia	20 400	1985	20 400	20 400	n.s.	20 400	n.s
Singapore	500	1990	2 700	500	-8.1	500	n.s.
Sri Lanka	8 688	1992	9 400	8 800	-0.6	7 600	-1.4
Thailand	244 085	2000	285 500	262 000	-0.8	244 000	-0.7
Timor-Leste	3 035	2000	4 100	3 600	-1.2	3 035	-1.6
United Arab Emirates	4 000	1999	3 300	3 600	0.9	4 000	1.1
Viet Nam	252 500	1983	227 000	165 000	-2.7	104 000	-3.7
Yemen	927	1993	1 100	980	-1.1	800	-1.8
North and Central America	**2 102 886**	**1994**	**2 641 289**	**2 296 400**	**-1.3**	**1 968 397**	**-1.4**
Anguilla	90	1991	90	90	n.s.	90	n.s.
Antigua and Barbuda	1 175	1991	1 570	1 200	-2.4	900	-2.5
Aruba	420	1986	420	420	n.s.	420	n.s.
Bahamas	141 957	1991	170 000	145 000	-1.5	140 000	-0.3
Barbados	14	1991	30	16	-4.7	10	-3.8
Belize	65 767	1995	75 000	68 800	-0.8	62 700	-0.9
Bermuda	16	1992	17	16	-0.6	15	-0.6
British Virgin Islands	587	2001	660	630	-0.5	590	-0.6
Cayman Islands	7 268	1991	7 300	7 300	n.s.	7 200	n.s.
Costa Rica	41 330	1992	41 000	41 000	n.s.	41 000	n.s.
Cuba	529 700	1992	530 500	529 800	n.s.	529 000	n.s.
Dominica	10	1991	40	13	-6.8	9	-3.1
Dominican Republic	21 215	1998	33 800	26 300	-2.2	18 700	-2.9
El Salvador	26 800	1994	47 200	35 600	-2.5	24 000	-3.3
Grenada	255	1992	295	262	-1.1	230	-1.2
Guadeloupe	2 325	1997	3 900	2 500	-3.5	2 300	-0.8
Guatemala	17 727	1998	19 800	17 800	-1.0	15 800	-1.1
Haiti	15 000	1990	17 800	15 000	-1.6	10 000	-3.3
Honduras	54 300	1995	156 400	103 300	-3.4	50 000	-5.2
Jamaica	9 731	1997	23 000	10 800	-5.3	9 300	-1.4
Martinique	1 840	1998	1 900	1 900	n.s.	1 800	n.s.
Mexico	488 000	1994	640 000	543 000	-1.5	440 000	-1.9
Montserrat	5	1991	5	5	n.s.	5	n.s.
Netherlands Antilles	1 138	1980	1 140	1 138	n.s.	1 130	n.s.
Nicaragua	282 000	1992	336 000	280 000	-1.7	214 300	-2.3

Country/area	Most reliable recent estimate		1980 (ha)	1990 (ha)	Annual change 1980–1990 (%)	2000 (ha)	Annual change 1990–2000 (%)
	(ha)	Ref. year					
Panama	158 100	2000	230 000	166 000	-2.8	158 000	-0.5
Puerto Rico	6 410	2001	6 500	6 400	-0.2	6 400	n.s.
Saint Kitts and Nevis	79	1991	84	80	-0.5	75	-0.6
Saint Lucia	200	2002	200	200	n.s.	200	n.s.
Saint Vincent and Grenadines	51	1991	60	52	-1.3	45	-1.3
Trinidad and Tobago	7 150	1991	9 000	7 200	-2.0	6 600	-0.8
Turks and Caicos Islands	23 600	1991	23 600	23 600	n.s.	23 600	n.s.
United States	197 648	2001	263 000	260 000	-0.1	203 000	-2.2
United States Virgin Islands	978	1991	978	978	n.s.	978	n.s.
Oceania	**1 577 967**	**1995**	**1 850 068**	**1 703 949**	**-0.8**	**1 526 924**	**-1.0**
American Samoa	52	1976	51	50	-0.2	50	n.s.
Australia	955 277	1997	1 150 000	1 050 000	-0.9	955 000	-0.9
Fiji	42 464	1991	47 000	43 000	-0.9	37 000	-1.4
Guam	70	1993	88	74	-1.6	60	-1.9
Kiribati	258	1995	260	260	n.s.	250	n.s.
Marshall Islands	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Micronesia	8 564	1983	8 500	8 500	n.s.	8 500	n.s.
Nauru	1	1993	2	1	-5.0	1	n.s.
New Caledonia	20 250	1987	20 500	20 100	-0.2	20 000	n.s.
New Zealand	22 200	1996	24 000	22 000	-0.8	19 900	-1.0
Niue	3 000	1981	3 000	3 000	n.s.	3 000	n.s.
Northern Mariana Islands	7	1984	7	5	n.s.	5	n.s.
Palau	4 708	1985	4 700	4 700	n.s.	4 700	n.s.
Papua New Guinea	464 000	1993	525 000	492 000	-0.6	425 000	-1.4
Samoa	752	1993	1 000	809	-1.9	618	-2.4
Solomon Islands	52 500	1995	61 200	55 400	-0.9	49 500	-1.1
Tokelau	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Tonga	1 305	1990	1 300	1 300	n.s.	1 300	n.s.
Tuvalu	40	1993	60	50	-1.7	40	-2.0
Vanuatu	2 519	1993	3 400	2 700	-2.1	2 000	-2.6
Wallis and Futuna Islands	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
South America	**2 030 330**	**1992**	**3 801 600**	**2 202 000**	**-4.2**	**1 974 300**	**-1.0**
Brazil	1 012 376	1991	2 640 000	1 150 000	-5.6	1 010 000	-1.2
Colombia	379 954	1996	440 000	396 600	-1.0	354 500	-1.1
Ecuador	149 688	1999	193 000	166 400	-1.4	147 800	-1.1
French Guiana	55 000	1980	55 000	55 000	n.s.	55 000	n.s.
Guyana	80 400	1994	91 000	83 400	-0.8	76 000	-0.9
Peru	4 791	1992	7 600	5 000	-3.4	4 700	-0.6
Suriname	98 121	1998	115 000	105 600	-0.8	96 300	-0.9
Venezuela	250 000	1986	260 000	240 000	-0.8	230 000	-0.4

n.a. = not available.
n.s. = not significant.
Notes: The 1980, 1990 and 2000 estimates are based on regression analysis of existing estimates over time for each country extrapolated to 2000. Where insufficient information was available, i.e. only one estimate within the last 30 years (less than 1 percent of the total mangrove area), the area was assumed to have remained constant unless qualitative information indicated otherwise. Where recent information was unavailable (about 5 percent of the total mangrove area), the extrapolation to 2000 was based on the overall forest change rate as reported in FRA 2000 (FAO, 2001) applied to the latest reliable estimate.
For detailed information on methodology, see FAO, 2002a; and FAO, 2002b.
The reference year given for the regional totals of the most reliable recent estimates is the weighted average of all the countries reported.
All primary data sets are available on the Internet at www.fao.org/forestry/mangroves.

FIGURE 2
Mangrove area changes over time – three examples

uses. The study did not provide information on the rate of mangrove degradation.

Another valuable source of information on mangroves is the Global Mangrove Database and Information System created by the International Society for Mangrove Ecosystems with support from the International Tropical Timber Organization (ITTO). It contains information on institutions, projects and people working with mangroves, as well as an extensive database on mangrove-related documents. See www.glomis.com for details.

Other developments include:

- ITTO's Mangrove Workplan 2002–2006, which was presented to the International Tropical Timber Council (ITTC) in May 2002 to support the sustainable management and conservation of mangrove forest ecosystems over the next five years;
- a workshop organized by the South Pacific Regional Environment Programme, held in Fiji in 2001, which identified key threats to mangrove wetlands in the Pacific islands and actions to address these;
- a meeting in Guatemala in August 2002 to consider how to incorporate the evaluation of the goods and services provided by mangroves into national and regional mangrove management strategies, along with mechanisms to pay for environmental services and provide for broader public participation in mangrove management. ◆

REFERENCES

Aizpuru, M., Achard, F. & Blasco, F. 2000. *Global assessment of cover change of the mangrove forests using satellite imagery at medium to high resolution.* EEC Research Project No. 15017–1999-05 FIED ISP FR. Ispra, Italy, Joint Research Centre.

Clough, B.F. 1993. *The economic and environmental values of mangrove forests and their present state of conservation in the South-East Asia/Pacific Region.* Mangrove Ecosystems Technical Reports, Vol. 1. ITTO/ISME/JIAM Project PD71/89 Rev.1 (F). Okinawa, Japan, International Society for Mangrove Ecosystems (ISME).

Diop, E.S. 1993 *Conservation and sustainable utilization of mangrove forests in Latin America and Africa regions, Part II – Africa.* Mangrove Ecosystems Technical Reports, Vol. 3. ITTO/ISME Project PD114/90 (F). Okinawa, Japan, International Society for Mangrove Ecosystems (ISME).

FAO. 1994. *Mangrove forest management guidelines*. FAO Forestry Paper No. 117. Rome.

FAO. 2001. *Global Forest Resources Assessment 2000: main report*. FAO Forestry Paper No. 140. Rome (also available at www.fao.org/forestry/fo/fra/main/index.jsp).

FAO. 2002a. *FAO's database on mangrove area estimates*, by M.L. Wilkie, S. Fortuna & O. Souksavat. Forest Resources Assessment Working Paper No. 62. Rome.

FAO. 2002b. *Status and trends in mangrove area extent worldwide*, by M.L. Wilkie & S. Fortuna. Forest Resources Assessment Working Paper No. 63. Rome, FAO.

FAO, IFAD & WFP. 2002. *Reducing poverty and hunger: the critical role of financing for food, agriculture and rural development*. Paper for the International Conference on Financing for Development, Monterrey, Mexico, 18 March (also available at www.ifad.org/media/press/2002/20-20.htm).

FAO & UNEP. 1981a. *Los recursos forestales de la America tropical: proyecto de evaluación de los recursos forestales tropicales*. Rome, FAO.

FAO & UNEP. 1981b. *Tropical forest resources assessment project: forest resources of tropical Africa. Part II: country briefs*. Rome, FAO.

FAO & UNEP. 1981c. *Tropical forest resources assessment project: forest resources of tropical Asia*. Rome, FAO.

Fisher, P. & Spalding, M.D. 1993. *Protected areas with mangrove habitat.* Draft report. Cambridge, UK, World Conservation Monitoring Centre.

Groombridge, B., ed. 1992. *Global biodiversity: status of the earth's living resources*. London, Chapman & Hall.

IIASA & FAO. 2002. *Global agro-ecological assessment for agriculture in the 21st century*, by G. Fischer, M. Shah, H. van Velthuizen & F.O. Nachtergaele. Laxenburg, Austria & Rome.

Lacerda, L.D. 1993. *Conservation and sustainable utilization of mangrove forests in Latin America and Africa regions, Part I – Latin America.* Mangrove Ecosystems Technical Reports, Vol. 2. ITTO/ISME Project PD114/90. Okinawa, Japan, International Society for Mangrove Ecosystems (ISME).

Saenger, P., Hegerl, E.J. & Davie, J.D.S., eds. 1983. *Global status of mangrove ecosystems*. Commission on Ecology Paper No. 3. Gland, Switzerland, World Conservation Union (IUCN).

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997. *World mangrove atlas*. Okinawa, Japan, International Society for Mangrove Ecosystems (ISME). ◆