

Forests

Eighty per cent of the forests that originally covered the Earth have been cleared, fragmented or otherwise degraded (WRI 1997). Most of the remaining

forest is located in just a few places, mostly in the Amazon Basin, Canada, Central Africa, South-east Asia and the Russian Federation. These large blocks of ecologically-intact natural forest are valuable because they house indigenous cultures, shelter global biodiversity, provide ecosystem services, store carbon, contribute to local and national economic growth, and meet diverse recreational and spiritual needs. Yet logging, mining and other large-scale development projects threaten 39 per cent of the remaining natural forests, with those in South and Central America, western North America, and the boreal regions of the Russian Federation most at risk.

Natural forest covers 47 per cent of the Caribbean and Latin America region's total land area (according to the latest available estimates for 1995). Al-

most all (95 per cent) is tropical forest (852 million hectares), located in Central America, the Caribbean and the South American tropics (FAO 1997b). The remaining resources, covering approximately 43 million hectares, are located in temperate South America, mainly in Argentina, Chile and Uruguay (FAO 1997b). The largest untouched forest area is located in the northern Amazon Basin and Guyana (WRI 1997). The Amazon Basin is also important in terms of global metabolism since it generates approximately 10 per cent of the net terrestrial primary production (LBA 1996). Of the eight countries of the world that still have more than 70 per cent of original forest cover, six are located in South America (Brazil, Colombia, French Guiana, Guyana, Suriname and Venezuela).

However, during 1980–90 alone, the region lost 61 million hectares (6 per cent) of its forest cover, the largest loss in the world during those years (although existing calculations may underestimate total deforestation by 50 per cent) (Monastersky 1999).

Natural forest cover continues to decrease in all countries. A total of 5.8 million hectares a year was lost during 1990–95, resulting in a 3 per cent total loss for the period (FAO 1997b). The highest average annual rate of deforestation was in Central America (2.1 per cent), while Bolivia, Ecuador, Paraguay and Venezuela all had annual deforestation rates greater than 1 per cent for the same period (FAO 1997b).

In Paraguay, for example, forest cover in the eastern region decreased from 8.8 million hectares (55 per cent cover) in 1945 to 2.9 million hectares (18 per cent cover) in 1991. The decrease in the western region was from 16.8 million hectares (70 per cent cover) to 0.8 million hectares (45 per cent cover). Estimates indicate that the forest loss for 1992 was 200 000 hectares (Stöhr 1994).

Brazil lost approximately 15 million hectares of forest in the period 1988–97. Though deforestation in the Brazilian Amazon nearly doubled in 1994 and 1995, with 2.9 million hectares of forest cleared in 1995 (the greatest extent in recorded history) there have since been substantial declines – to about 1.8 million hectares in 1996 and an estimated 1.3 million hectares in 1997 (INPE/IBAMA 1998). Due to

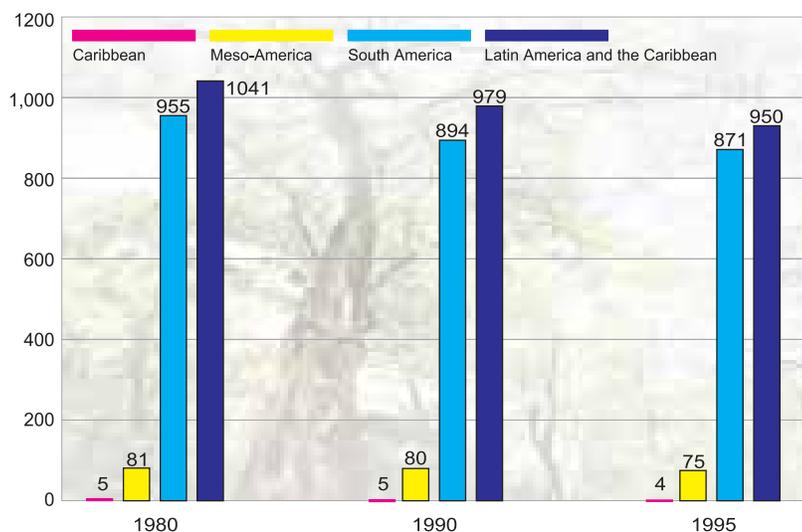
forest depletion in other areas, in the last two decades, the forest products industry in Amazonia has increased from 14 per cent to 85 per cent of the national production, and the percentage could be even higher. Government sources estimate that 80 per cent of Brazilian Amazon production is illegal (Câmara 2000). Only 15 per cent of production is exported, mainly to the United States of America, the European Union, Japan, the Philippines, the Caribbean and Argentina (Câmara 2000). The Asian crisis and the 80 per cent devaluation of the Brazilian real against the United States dollar have increased the competitiveness of Brazilian production and the number of foreign production companies in the country. In 1999, these foreign companies led the country's export production: eight multinational companies own approximately 2.4 million hectares in Amazonia (Câmara 2000).

Natural forest cover continues to decrease due to clearance for cropland and stock farming; construction of roads, dams and other infrastructure; and mining. Forest fires are particularly crucial factors in this process (FAO 1997b; see also 'Forest fires' section).

The expansion of the agricultural frontier has been one of the main causes of deforestation. High population densities generate greater demands for agricultural land: if the forest is considered a territorial

The extent of natural forest cover continues to decrease in all sub-regions. More than 90 million ha were lost during 1980-95, resulting in an 8.7 per cent total loss for the period.

Forest extent 1980, 1990 and 1995 (million hectares)



Source: Compiled by UNEP GRID, Geneva, from WRI, UNEP, UNDP and WB 1988 and FAO 1997a and 1997b.

reserve, it is often occupied by invaders. Uncertainty of land tenure in turn provokes poor land management practices, thus increasing forest clearings. Traditional slash-and-burn practices have been the principal means of advancing the agricultural frontier in many countries. However, modern agriculture, mining and the need for new roads and settlements are responsible for the largest forest clearances. In the case of agriculture, banana expansion in Meso-America, Colombia, Ecuador and some Caribbean countries, and coffee and sugar production in Brazil, have been major pressure factors.

Other factors that are becoming important threats include logging for the forest products industry, the pressures exerted by exotic species on native species and their habitats, and fires caused by drought and human carelessness. In Bolivia, Guyana and Suriname, a drive to exploit natural resources, mainly brought about by an economic crisis, has accelerated the fragmentation of pristine forests over the past decade. Selective logging has changed the structure and composition of many of the remaining forested areas, particularly in south-eastern Amazonia and along river courses, leading to irreversible losses in biodiversity (WRI 1997). Even modest deforestation and the increase of exotic species plantations can produce significant species and habitat loss (UNEP 1999b). In Chile, for example, substitution of native species by exotic species has

been one of the main causes of native forest destruction and deterioration, estimated to represent a yearly average proportion of 19–30 per cent of the total affected area during 1991–94. Other causes are stock farming (10–15 per cent) and forest fires (3 per cent). Estimates indicate that native forest reduction in Chile varies from 7 per cent to 43 per cent (Lara *et al.* 1995; Emanuelli 1996).

Another important related problem is that an increasing number of countries are considering granting extensive forest concessions to forestry companies. In Guyana, one company has been granted nearly 6 million hectares, and countries such as Suriname, Bolivia and Venezuela are following suit by opening up large areas of primary forest to forest harvesting (Bryant *et al.* 1997). Increasing pressures for forest concessions in South America are likely to exacerbate deforestation and forest degradation throughout the region.

In the Caribbean, large tracts of forest have been lost because of direct forest exploitation, as well as through the conversion of forested areas to cropland and permanent pasture. Historically, forest clearance for sugar and banana plantations affected nearly all Caribbean countries. Fragmentation has also affected many of the natural forests.

Production and trade of forest products vary widely across the region. Fuelwood accounts for 78 per cent of the region's production, and industrial roundwood for 16 per cent. However, the trade in products from natural forests may be affected as major importing countries insist on timber certification. The focus on endangered species can also affect trade: Brazil, for example, has placed a ban on mahogany harvesting (IBAMA 1998). Non-timber forest products, and non-timber gathering, still constitute the main source of cash income for many poor farmers throughout tropical South America.

The need for forest conservation has been placed high on the political agenda in many countries. Another positive development is the use of incentives for promoting the establishment of forest plantations. Recent policy reforms in Costa Rica, Guatemala, Paraguay and Uruguay are expected to stimulate the reforestation of thousands of hectares.

Latest figures on deforestation in the Brazilian Amazon show a substantial decline from the all-time high of 1994-95.

Annual deforestation rates in the Brazilian Amazon (million hectares per year)



Note: Data for 1993 and 1994 are estimates based on the mean rate of deforestation during 1992-94. The 1997 rate is estimated from an analysis of 47 Landsat images.

Source: INPE/IBAMA 1998

Despite all these efforts, the region's forest resources remain under extreme and competing pressures. Even where large population groups are heavily dependent on forests for food, especially in tropical South America (FAO 1997b), there has been heavy encroachment into forests by the rural poor in their search for land for agricultural use, and now also by large agro-exporters and logging consortiums. At the same time, strong external and internal pressures are being put on countries with extensive tropical forests in an attempt to ensure the conservation and protection of these unique ecosystems.

Forest fires

During 1995–98, fire swept through forests in Australia, Brazil, Canada, China, France, Greece, Indonesia, Italy, Mexico and several other countries in Latin America, the Russian Federation, Turkey and the United States. More than 3 million hectares of forest in Mongolia were burnt in 1996. Forest fires in South-east Asia in 1997 were the worst in 15 years,

with at least 4.5 million hectares burnt, and smoke and haze affecting some 70 million people (UNEP 1999a).

The forests of South-east Asia and Brazilian Amazonia were especially vulnerable to fire in 1997 and 1998 because of a severe drought, probably related to the strong *El Niño* of the same period and changing global weather patterns. The 1997 and 1998 fires were far more extensive in these regions than fires after the *El Niño* event of 1982, and coincided with an even more severe *El Niño*.

Forest fires can destroy up to 50 per cent of the forest's surface biomass, with severe but still unknown effects on the forest fauna. In addition, since forest fires can liberate significant amounts of carbon into the atmosphere, the potential impact on global atmospheric problems, including climate change, is another important consequence. Finally, the direct impact of forest fires on neighbouring local and regional human groups has also increased: forest fires

Extraction reserves in Brazil

In the 1970s and 1980s, the Brazilian Government encouraged the establishment of agricultural settlements in the Amazon forests for people originally from the south and south-east of the country. Many of these people migrated because of the unemployment generated by automation of agricultural practices, and excessive increases in the price of land, in their areas of origin. The settlements caused large-scale deforestation in sensitive areas, particularly in the state of Rondonia, and subsequent migration to cities in the Amazon region. The consequence of this process was the loss of social structure and marginalization of many human groups – known as *seringueiros* – who made a living from extracting timber and non-timber products from the Amazon forests.

The struggle of the *seringueiros* and the murder of 'Chico' Mendes – their union leader – raised the awareness of the federal government, in the late 1980s and early 1990s, of the need to create a new category of protected area. These so-called 'extraction reserves' would strive to achieve compatibility between the expectations of these social groups and the sustainable exploitation of the forest. The reserves were defined as large extensions of federal property, with joint management by the resident population and the government, by means of a free concession agreement for sustainable land use. Currently, these reserves comprise about 3.2 million hectares, located in new areas under the administrative responsibility of the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA).

Extractive activities to be fostered in these reserves include agriculture, forestry and cattle-raising with appropriate technologies, as well as associated processing and marketing activities. Of a total of ap-

proximately 200 000 families involved, around 15 600 people live within the reserves. Sustainability of the activities within the reserves is sought through joint management by the population and the state, which provides health, transportation, demarcation and oversight services, promoting income generation together with the communities.

The Resex Project was created in order to implement these actions. For a period of four years, almost US\$8 million were invested in four extraction reserves. The project's results include the implementation of programmes in co-management, parcelling, environmental education, community stores, promotion of fertilization techniques, small product processing centres, ecotourism, production and marketing of non-timber forest products, and the provision of drinking water wells. In addition, the project allowed the construction of 48 bridges and 2 000 kilometres of roads.

In the two reserves in which participatory monitoring plans were developed, it was shown that the deforestation index was lower than that of the federal state in which the reserves were located. Given these good results, the Brazilian federal government is planning to increase the number of extraction reserves in the coming years in order to strengthen the rational use of the Amazon forests.

Sources: CNPT-IBAMA-PNUD 1999; Pinzón Rueda 1997, 1998, 1999.

have caused great economic losses to Central American (CCAD and IUCN 1996) and South American (Nepstad *et al.* 1997) countries.

The health impacts of forest fires can be serious and widespread. Estimates for the fall-out from fires in South-east Asia suggest that 20 million people were in danger from respiratory problems. In 1997, smoke and air pollution from fires in Guatemala, Honduras and Mexico drifted across much of the south-eastern United States, prompting Texas officials to issue a health warning to residents. Smoke from fires in Mato Grosso, Brazil, contaminated the air in Paraguay, and the smoke produced by fires in Paraguay polluted the air in Argentina. These problems reveal the transboundary dimension of contamination caused by forest fires and demonstrate the need for a regional action plan on fire control and response in Latin America and the Caribbean.

A combination of logging activities and drought is increasing the flammability of Amazonian forests.

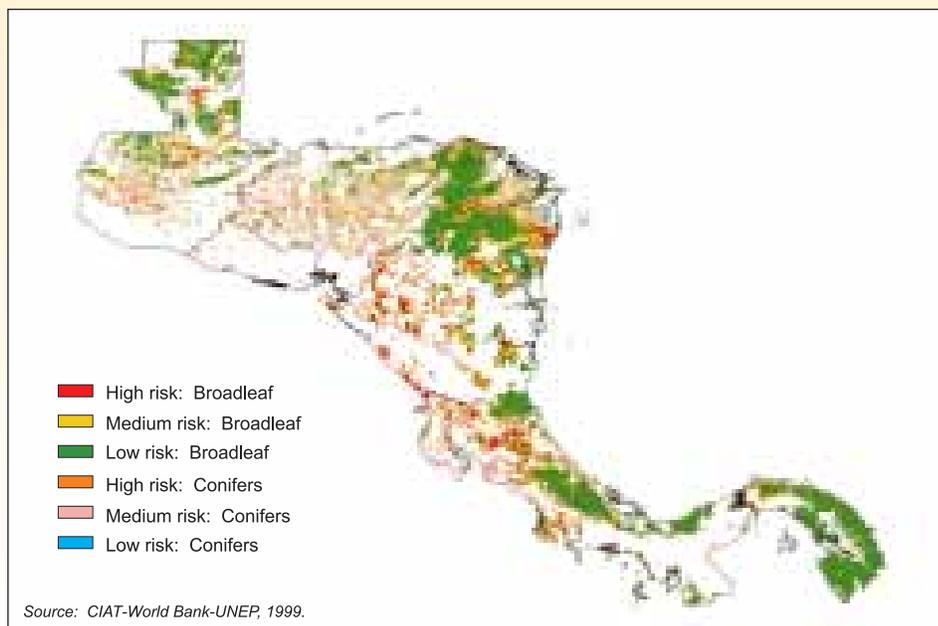
Selective logging increases flammability by opening up the leaf canopy, allowing sunlight to penetrate to the fuel layer on the ground, and by increasing the fuel load through the production of woody debris. Surface fires also increase the forest's flammability, thus producing a very dangerous positive feedback effect by which regional forests – particularly in Amazonia – are becoming progressively more flammable with each new fire season. Fires are generally not included in deforestation monitoring programmes, even though they can increase the forest area affected by human activity by 60 per cent.

Even virgin forests become flammable when drought is severe. More forests in eastern and southern Amazonia (half of the 400 million hectares of closed canopy forest in Brazilian Amazonia) are subject to severe dry seasons each year, more particularly during *El Niño* events. These forests are on the margins of the rainfall regime that is necessary for them to resist fire (Nepstad *et al.* 1997).

A Forest Risk Index for Central America

A Forest Risk Index for Central America has been developed as part of a CIAT–World Bank–UNEP joint project on rural sustainability indicators. Deforestation and forest fragmentation are two of the most important consequences of the development process in the region. This index rates the areas with forest cover on the basis of their proximity to markets, that is to say, their 'accessibility'. Thus, a high-risk (forested) area is one located less than one hour away from a market; areas at intermediate risk are located between one and two hours away; low risk areas are those located more than two hours away. The map also distinguishes between broad-leaf and coniferous forests.

According to this index, 29 per cent of the forest is at a high risk of being lost, 21 per cent is at intermediate risk and 50 per cent is at low risk. Nevertheless, coniferous forests (55 per cent at high risk) are at a greater risk of disappearing than broadleaf forests (23 per cent at high risk). It must be taken into account that in developing indices, certain assumptions must be made. In this case, it is assumed that the risk of exploitation of a forest is greater if it is located closer to a market. Dividing this time/distance variable into periods of one hour was done arbitrarily.



Because of the role forest clearance plays in forest fires, much of the blame for starting fires has fallen on small farmers. However, only 12 per cent of the forest cleared in the Amazon is actually used for arable farming: the remaining 88 per cent is used for pasture (Nepstad *et al.* 1997). Other pressures on natural resources must also be taken into account. These include technological factors, such as slash-and-burn practices, and other more complex factors, related to the expansion and depletion of the agricultural frontier, where small farmers – if they intervene – represent just the first stage in the progressive colonization of virgin territories that later will be intensively exploited by stock farming concerns, agro-industrial companies (banana, pineapple, coffee) or forestry companies (Bryant *et al.* 1997; O'Brien 1998; Pasos *et al.* 1994).



All countries in Latin America and the Caribbean develop forest fire monitoring, control and response actions and policies to support the rational and sustainable use of forests. Actions vary according to available technology, expertise and institutional and human capacities, and the accompanying table shows some of the current institutions and programmes in the region. In general, these institutions promote regulatory, monitoring, control and research activities on forest fires, and actions to promote the controlled use of fires by farmers.

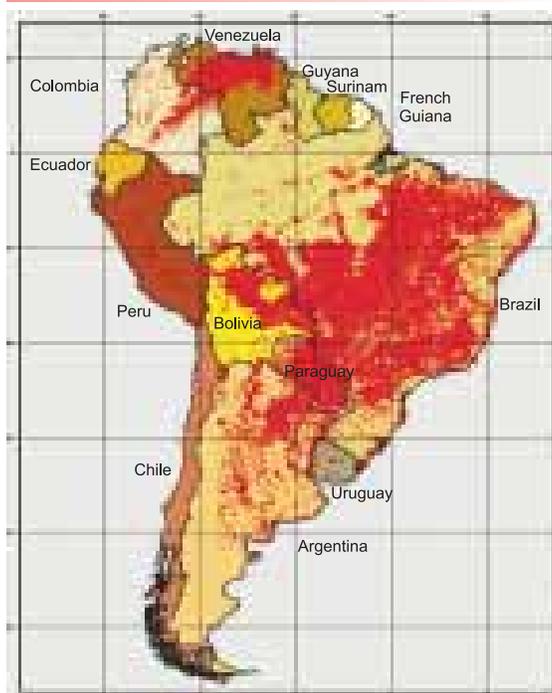
According to several current studies on fire behaviour and potential fire risks in Latin America and the Caribbean, these risks are generally associated with farming and arise from the use of fire for soil preparation, as a means of removing economically useless plant debris.

Seasonal droughts are another important factor. In direct association with *El Niño* events, Mexico, Central America and the northern part of South America suffered prolonged seasonal droughts in 1997, 1998 and 1999. It is most likely that these droughts facilitated the large-scale fires that swept Bolivia, Brazil, Mexico, Paraguay and Venezuela during 1998.

Using satellite images, 219 401 heat sources were identified in 1999. These heat sources represent the incidence of forest fires or the use of fire for soil preparation during that period. The term 'heat source' is used for the interpretation of surface tem-

perature records above 47 degrees Celsius registered by AVHRR sensors on NOAA satellites. According to this information, Brazil – with approximately 48 per cent of the total area of South America – had 66.4 per cent of recorded heat sources in 1999. Three other South American countries registered important numbers of heat sources in that period: Bolivia and Argentina, with almost 11 per cent each, and

Forest fires or use of fires in agriculture in South America, 1999



Source: Night images from NOAA satellites, Nov 01, 98 and Oct 31, 99, <http://www.ibama.gov.br/~hmafra>

Forest fire monitoring, control and combat programmes and institutions in Latin America and the Caribbean (1999)

Country	Programmes and institutions
Argentina	National Fire Management Plan
Brazil	National System for the Prevention and Combat of Forest Fires – PREVFOGO (Brazilian Institute of Environment and Renewable Natural Resources – IBAMA)
Colombia	National Centre for the Prevention and Mitigation of Forest Fires
Cuba	Forestry Research Institute
Chile	National Program for the Prevention of Forest Fires (National Forestry Corporation – CONAF)
Guatemala	Forest Fires Project (National Institute of Forestry)
Honduras	Co-ordination for the Protection of Forest Fires (Honduran Forestry Development Corporation)
Mexico	Project on the Prevention, Combat and Control of Forest Fires (Environment, Natural Resources and Fisheries Secretariat – SMEARNAP)
Dominican Republic	Division for the Prevention and Control of Forest Fires
Uruguay	Fire Department
Paraguay	Fire Department
Venezuela	Department of Prevention and Extinction of Forest Fires (Ministry of Environment and Renewable Natural Resources – MARNR)

Paraguay, with 8.2 per cent. The table below lists the principal subnational regions and local areas affected.

of fire fighting teams, often with volunteers and temporary workers, during critical seasons of forest fire occurrence.

The use of fire in farming and forestry practices is deeply rooted in the culture of the region. Therefore, institutions charged with controlling and monitoring fire for agricultural purposes must concentrate on training rural farmers in fire management techniques, and on appropriate licences and fire-fighting mechanisms – linking these initiatives with the intervention of fire departments and the support

Incidence of forest fires at the sub-national level

Countries	Affected areas
Argentina	Northern region (Provinces of Corrientes, Formosa, Chaco, Santiago del Estero, Santa Fe, Iguazú-Misiones, Entre Ríos, Gran Chaco, Jujuy and Bariloche).
Bolivia	Northern and eastern regions (Departments of Santa Cruz de la Sierra, Trinidad, San Ignacio, San José de Chiquitos, Santa Rosa and San Joaquín).
Brazil	North-eastern, central western and south-eastern regions (with the highest concentrations in coastal areas and in the far northern part of the north-eastern region, and northern part of the southern region, and in the southern part of Amazonia, more severely in the states of Rondonia, Acre and Para, with isolated areas in the state of Amazonas).
Chile	Central region (Provinces of Concepción, Bio-Bio, Temuco).
Colombia	Central and eastern regions (Aruca, Santa Fe de Bogotá, Bucaramanga).
Paraguay	Almost all the country's territory except for the departments in the farther north and north-western regions.
Peru	Provinces in the central and central southern regions (Cerro de Pazco, Machu Picchu, Cuzco, Puerto Maldonado).
Venezuela	Central north region (north of Orinoco River, Porto Cabello, Valencia, Caracas, Cumaná, Guanare, Barquisimeto)