

Forests and humans throughout history

A brief history of the complex relationship between forests and modern man is traced. Emphasis is given to both the evolution of forests from the interglacial period prior to the last (Würm) glaciation to recent times and to the gradual increasing usage of wood and timber (for heating, cooking, housing, building, naval fleets, etc.) and the consequent exploitation of forests after the Neolithic revolution. The effect of agricultural practices and the occupation of space for farming is also described. Thus, the effects of fluctuating climatic and ecological changes and of anthropogenic causes are taken into consideration with attention to interacting ecological, economic, social, technological, and anthropological aspects. The history of forests and of humans is synthetically reconstructed for prehistoric times, ancient civilizations, the Middle Age, and modern times (underlining the effects of the manmade intercontinental transfer of species). Finally, the consequent current state of forests is schematically described together with possible future trends

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Introduction

Several definitions of *forest* have been proposed. The simplest one is: a dense growth of trees, plants, and underbrush covering a large area (American Heritage Dictionary of the English Language). More precisely: an ecosystem or assemblage of ecosystems dominated by trees and other woody vegetation¹.

Other terms are used instead of *forest*: *wood* or *woods*, and less often and more archaically *wold* (or *weald*), *holt*, *frith* (or *firth*), all indicating an area with a high density of trees. *Foresta* is a Medieval Latin word of obscure origin, while *wood* derives from the Old English *widu* (possibly from the Indo-European *weidh* mean-

ing *separate* in the sense of *remote*): *forest* was also used to indicate hunting grounds or land where to gather mushrooms and other non-wood products. The Latin world for *forest* was *silva* (the same root of *silvaticus*, that is, *savage*). *Silva* was used by Romans as distinct from *saltus*, an area of pasture obtained by cutting down trees. The derivatives of *selva* (later also *sylva*) are still used now, together with *forest*, in Romance languages. In modern Italian, *selva* is somehow archaic:

*Nel mezzo del cammin di nostra vita
mi ritrovai per una selva oscura*

(Dante Alighieri, *Divina Commedia, Inferno*, 1308-1321)

whereas *foresta* is commonly used, and *bosco* is the equivalent of *woods*, often as referring to a smaller entity in respect to cognate with English *bush*), and in French *bois*, are more commonly used than *foresta* or

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one of its derivatives; in Spanish *selva* and *floresta* are rarer. In Portuguese, both *bosques* and *floresta* are used. There is no antonym of *forest*: but *prairie* or *pasture* are sometime used as the Latin *saltus* (modern Italian: *pascolo*).

The Prehistory

The relation of humans with forests is very ancient. The image of prehistoric man coming down from the forest trees was a sort of neo-positivist legend of the 19th century. However, recent comparative research on the form and function of the wrist bone of primate species suggests that man bipedalism did not evolve from knuckle-walking ancestors (as in the case of gorilla). Rather, it is a likely evidence of arboreality. In simpler words, the ancestors of *Homo*, some 7 million years ago, were living on trees, then moved to the ground, and began walking upright, taking advantage of mutations to adapt to a new environment.

Of course, the relation between the ancestors of *Homo sapiens* and forests went on, whilst the extent of the vegetation fluctuated through the last four glaciations and three interglacial periods. Woody areas became useful for man as a source of heat and light: archeological evidence of controlled use of fire dates from 400,000 to 300,000 years BP (“before present”).

Archaic *Homo sapiens* is believed to have evolved to anatomically modern man, *Homo sapiens sapiens*, in Africa between 200,000 and 150,000 years BP, and to have migrated out of Africa between 70,000 and 60,000 years ago. The last glaciation (Würm) began approximately 115,000 years BP, and entered its coldest phase 65,000 years BP. 73,500 years ago, the Toba volcano in Sumatra underwent a super-eruption and exploded (8th degree of the VEI, the volcanic explosivity index) scale, leaving a crater of 100 km diameter, releasing up to 6,000 km³ of dust and tephra (fragmented material), and possibly 5 billion tons sulfuric acid aerosol; it is estimated that it caused six years of “volcanic win-

ter”. The possible role of this catastrophe in triggering the main phase of the Würm glaciation is under discussion. Apparently, *Homo sapiens sapiens* came out of Africa after that catastrophe, after surviving some kind of “genetic bottleneck. In Europe, 18-14,000 years ago, there was still a full glacial condition: a massive ice shield covered almost all of Britain, central-northern France and Germany, Scandinavia, and Russia; vast glaciers extended southward from mountains such as Alps, Pyrenees, the Caucasus, even parts of the Apennines and the North African Atlas. A similar situation existed in North America (Wisconsinan glaciation) and Siberia, but not in the southern hemisphere (due to the astronomic position of Earth and to geographic differences in land distribution).

The causes of glaciations, of their triggering and termination, are not completely clear and several (overlapping) mechanisms have been invoked: the Croll-Milankovic cycles based on long-term variations of Earth’s orbit and rotation, the axis precession cycle, astronomic forcing, etc.; and their intensity and duration may be affected by the surface albedo, volcanic activity, solar cycles, oceanic current streams, even meteoric collision events, etc. In this Würm phase, the climate was characterized by water being locked in ice, consequent high aridity, and very cold conditions: forests were at a minimum, especially at the tropics, and deserts very extended (the Sahara-Arabic and the central-eastern Asian desert belts were thicker than they are today).

FIGURE 1

An Alaska glacier giving an image similar to a view towards the end of the last glaciation



By 13,000 years BP, the glaciacion could be considered ended. By 12,000 years BP, there was a rapid warming of the environment and thawing of frozen water, but in 12,000-11,700 BP the Older Dryas and in 11,000-10,000 BP the Younger Dryas cold waves (possibly due to the flow into the ocean of the cold water from the post-glacial Agassiz lake in central Canada and the central Siberian lake and/or to minor collision events) for a time arrested the process. The sea level started to rise around 10,000 years BP. The climate was entering the so-called Holocene Climatic Optimum (7,000-3,000 BC). In the early-Holocene around 8,000 BC, the interglacial period was firmly in, exhibiting a climate warmer and moister than today. The tropical forest expanded in Africa and Asia as well, the desert decreased, the ice regressed, the trees were able to re-colonize the North with the temperate and boreal forests. Humans started to exploit forests not only for wood and food, but also for space: with the beginning of the Neolithic Revolution (6,500 BC), agriculture was born in the Fertile Crescent (with the domestication of wheat, other grains, legumes), and around 6,000 BC the domestication of animals (goat, *Capra hircus*, and then sheep, *Ovis aries*) was achieved, with consequent increase in overgrazing and tree-grazing due to pastoralist mismanagement. In the East, herd pig (*Sus scrofa*) was managed, millet was introduced, wild rice harvested, chicken domesticated, but, for instance in the Yunnan, human presence was already affecting the permanent vegetation cover (deciduous forests and marshes giving way to loess plateau).

The ancient human civilizations

In mid-Holocene, around 5,000 years BP, the climate remained practically the same even if with a reduction in monsoon rain. The Near East was fully forested from Anatolia to Syria and Lebanon, to Mesopotamia, to Persia, to the Indus and Ganges valleys, and also in the large islands of the Mediterranean: beech, oak, maple, cork, accompanied by maquis and garrigue

(bush and brush). Human exploitation of forests increased in this region: in addition to agriculture, urbanization and the construction of states were under way, with increasing need of wood and timber for the building of public structures and housing. Stone axes were being fabricated from about 3,000 BC. The epic of Gilgamesh (around 2,500 BC) narrates clearly about anthropogenic deforestation to obtain building material. The human expansion was favored by a humid warm period (5,500-3,500 BC).

In late-Holocene, 4,000-3,000 years BP, a minor climate change favored the re-expansion of the desert, while the full impact of agriculture started, and deforestation in Greece and the Aegean region increased for the needs of agriculture and the beginning of the constructions of fleets and navies. The first thalassocracy, the Minoan civilization on Crete, Cyprus, and the Aegean islands, started in 2,600 BC, collapsed around 1,450-1,425 BC (or 1628-1626 BC according to another dating), possibly following the explosive eruption of the Thira (Santorini) island volcano with consequent tsunami, but also linked to an ecological crisis caused by deforestation, aggravated by over-grazing. Evidence of deforestation has been found in the environs of the Palace of Knossos in Crete. Other instances of possibly deforestation-related civilization collapses have been reported, from Greece and Syria during the last centuries BC, especially as effect of alluvial silt deposits, to the Easter Island in the 17th-18th century AD.

In 2,500-1,200 BC, there was a cold period, but the agriculture (cereals, legumes, millet) continued to expand. In 1,200 BC, a large eruption of Iceland's Hekla-3 volcano possibly elicited climatic effects. The climate was again warmish at the time of the foundation of Rome (753 BC): irrigation systems were developed, particularly in Mesopotamia, Italy, and China. By 400 BC, a cold period was again in (the Tiber river was reported frozen by Livius in 401 BC), at least in the North Hemisphere.

The second half of the 2nd millennium and the 1st millennium BC were characterized by the growth of commercial and military naval power in the Mediterranean, with very high consumption of forest timber by the various peoples trading and expanding through the sea: Sea Peoples (2,600-1,175 BC), Mycenaean Greeks (1,600-1,500 BC), Dorian Greeks (1,200-338 BC), Phoenicians (969-322 BC) and Carthaginians (814-202), Etruscans (600-464 BC), Macedonians and Diadochi states (322-30 BC), Romans (348 BC to 476 AD), ancient Mediterranean pirates (Liburnians, Cilicians, Balearics, pirates of Sextus Pompeius, approximately from the 2nd century to 30 BC), Vandals (429-534 AD). The naval technology underwent enormous progresses, until the launching of the Roman *quinqueremes* warship and transport *oneraria*, but the cost for the Mediterranean forests was high: Lebanon, Syria, and Asia Minor were devastated, and, to the East, Persia, Afghanistan, Baluchistan, and the Indus valley. The temple of Solomon (963-923 BC) was built from cedarwood. After 168 BC, the Romans, having conquered Macedonia, were compelled to introduce the prohibition of tree-cutting in that province. In Italy, oak and beech forests (*Quercus*, *Robur*, *Fagus*, etc.), arriving in some cases to the marine waterline, started to disappear; in the hills, the traditional Mediterranean landscape of olive groves, grape, almond, and fig, was established next to the pastures of transhumance's sheeps: the traditional money was called *pecunia* from *pecus*, another term for sheep, and *salarium* (salary) from *sal* (salt). Plantations

of willow were created for the production of wicker baskets. In the late Republic and the Empire, the food provision of the populace and of Rome itself caused an expansion abroad of the land dedicated to wheat cultivation (from Italy to Sicily, to Egypt, to North Africa), with further, in certain cases, full deforestation. Chestnut was the predominant cultivated arboreal species. In the first half of the 1st millennium AD, imperial Rome exploited for wood and timber the still almost intact German forests (e.g. Teutoburg Wald).

Difficulties and reactions in the Middle Age

It seems that the Sahara was inhabited in permanent villages surrounded by woody areas in the period 320-680 AD and even before (see Herodotus and Pliny), undergoing a desertification process in later historical times, and moving southward 1 m/year in the last 500 years along a front of 3,000 km (e.g., diminishing of Lake Chad), probably due to both natural and anthropogenic causes. During the last 3,000 years, gradual deforestation and desertification has affected Northern Sudan, Libya, Egypt, the Arabian Peninsula, the Somali coast.

In the late 1st and early 2nd millennia of our era, the naval expansion continued: Austronesians (from Borneo to Madagascar, as early as the 1st century), Arabs (since 711), Vikings (790-1300, opening also the route Norway-Iceland-Greenland-Labrador) and Normans (1000-1194), the Italian maritime republics (Venice, Amalfi, Naples, Sorrento, Gaeta, Pisa, Genoa, Ancona, Bari, Ragusa/Dubrovnik, etc., since 726) and Byzantine territories, Portuguese and Biscayne fishermen in the Atlantic (approximately since the 9th century).

The naval progress went on, with the construction of larger and technologically more advanced ships (e.g., *caravels*, *galleons*, etc.), capable of high-sea transoceanic journeys: Polynesian migration in the Pacific (1,300 BC to 800 AD), the Dravidian Chola Empire in the Indian Ocean (900-1100), Arabs in the Indian Ocean (since

FIGURE 2

A roman ship



at least the 12th century), the Hansa in the northern seas (since 1150), China (1274-1433), Turks and Barbaresques (since 1413), Portugal (since 1415, opening the route of Cape of Good Hope), Aragon (since 1096) and Castile (since 1312) becoming Spain (1492), Netherlands (since 1580), England (since 1584), France (since 1603). The amount of forest timber consumed was staggering: for instance, Venice, after consuming practically all the woods of the Terraferma (alpine and subalpine forests), resolved to import the material to be used in its yards from North Europe.

In the 1580s, the building of galleons and barrels for the Spanish Armada (130 ships against 150 of the British fleet, of which 36 only participated to the confrontation in the British Channel) was a problem. The material could not be found in the residual Spanish forests, and king Philip II had to buy trees in Poland and to confiscate all enemy ships he could find: after a disastrous campaign, only 16 ships went back to Spain, the other being lost at sea. This tragic waste of forest wood was not unusual: in the battle of Lepanto (1571), the Christian fleet was composed of 212 ships (115 of which from Venice), against an Ottoman Turk fleet of more than 278 ship, 67 of which were sunk or lost at sea; in the Nine Years War (1594-1603) and in the War of the Spanish Succession (1701-1714), the British lost 4,000 and 3,250 ships, respectively, a number lower than that of the Spanish ships lost to privateers in the 16th-17th century. Finally, in the 19th century, there was the exploit of the river steamboats, using the wood cut every day from the riverbanks (Mississippi, Ohio, African and South American rivers).

The Middle Age was characterized by a Climatic Maximum (600-1300), following an episode of possible “volcanic winter” (535-536, reported by Procopius, perhaps due to a Krakatoa eruption), and by a population decrease (linked to the end of the Roman Empire, malaria outbreaks, invasions and raids, famines, plagues): the consequences were a de-structuration of the agricultural landscape and a return of the forests

(for instance, in England), favored by castle feudalization, but also erosion due to the lack of proper land management. Some remedies were offered by the diffusion of monastic orders (since 529, the Benedictines), institutionally committed to countryside work. The Arabs introduced new irrigation systems and the cultivation of cotton, carob, pistachio, citruses; the Chinese developed the irrigated terraced rice paddies. The forests became royal properties (see also the legend of Robin Hood in the Sherwood Forest):

Omnia nemora et pasqua sunt curiae

(“all forests and pastures are of throne’s property”)

(Frederick II, 1220-1250)

The hilly slopes were colonized by fir, beech, oak, alder, elm. There were episodes of weather-related famines (e.g. 1314-1317, the dry, harvest-less years “of the comets”).

Buscar el Levante por el Ponente: the coming of the modern age

In 1492, Columbus landed in America. The so-called “Columbus exchange” implied the introduction from the Americas of corn, potato, squash, beans, tomato, pepper, cocoa, and peanuts, while some crops went the opposite route: wheat, coffee, etc. The new expansion of agriculture caused further deforestation, even in the mountains. The climate changed again: the so-called Small Ice Age (1550-1850), very cold, dry in the beginning (1572-1620 in Europe, 1580-1640 in the monsoon regions). The end of the 16th century was characterized by economic, agricultural, and alimentary crisis, with population decrease, favored by the Black Death (peak in 1630).

After 1250 (the Europeans) became so skilled at deforestation that by 1500 they were running short of wood for heating and cooking,

(Norman F. Cantor)

In the 17th century, the climate remained cold, but changed to moist and wet, as shown by the frequent disastrous floods. There was an expansion of cereal

FIGURE 3

The practice of slash-and-burning in Latin America



farming in the coastal plains of temperate countries, and of plantations of tea, coffee, sugarcane, and fruits in the tropics and islands; and the first experiences of re-forestation (like the pine forests in Italy, starting in 1700, the eucalyptus in Europe, starting in 1850, and the sycamores on the road margins planted by the Napoleonic administration). There were several eruption-related episodes of “volcanic winters” from Iceland and South-east Asia’s volcanoes (1601-1603, 1783-1784, 1815-1816, 1883-1888). In 1825, modern agriculture, animal breeding and rearing, and ranching started: mechanization, drainage and reclamation, irrigation, use of natural phosphates and production of chemical fertilizers (superphosphate of lime), tractors, implements, scientific genetic selection, all factors progressing toward the Green Revolution. Forests were again pushed back to gain space for agriculture. Furthermore, the use of charcoal made from wood led to an increase of forest exploitation with, in addition, the danger of wildfire and of landslide from erosion (1600-1900). However, from the 18th century, peat and coke produced from fossil coal became available and were essential for carrying out the Industrial Revolution.

The imaginary of the forest was very much used in the Romanticism and neo-Gothic literature:

The path strangled onward into the mystery of the primeval forest.

(Nathaniel Hawthorn, *The Scarlet Letter*, 1850)

Further needs of wood were due to the modern production of paper and, even more, with the rapid in-

crease of population, to the use of such material to build wooden houses (traditionally in Scandinavia, Germany, Russia and Slavic countries, Alps, North America, British dominions) and even temples and public buildings (Japan). In the meanwhile, in developing countries, wood continued to be used for heat and cooking, the practice of slash-and-burning was employed to prepare new agricultural terrains, erroneous pastoralist practices induced vegetal cover degradation. Space was increasingly needed for urbanization, agriculture, other anthropic uses, under the pressure of population growth (particularly in India and China). Finally, in recent times, the demand of quality tropical wood (e.g., teak, mahogany, sandalwood, etc.) for household furniture and floors elicited some tropical countries (and also boreal countries) to massive export of forest produce.

A very recent problem for forests concerns criminal fires, in general to clear-up ground for illegal housing and resorts (Italy and other Mediterranean countries). But at the same times, the expectation is increasing for forest conservation, recreational uses, even spiritual needs (by indigenous peoples and local communities), for afforestation and re-forestation. The first national park, Yellowstone, was established in the US in 1872; in Italy, Gran Paradiso in 1922; in Africa, the Virunga Mountains in the Congo in 1925; there are now about 7,000 national parks worldwide (2% to 25% of the national area in selected countries; specific European policies are in force from 1992).

Re-forestation turned out to be particularly useful during the anti-malarial campaigns. Malaria was diffuse in the Mediterranean region by the 5th century BC. In Republican Rome the problem was aggravated by the arrival of the *Plasmodium falciparum*, responsible of the most severe form of the disease, probably from Africa, and furthermore by the abandonment of agricultural land and water control works in the Middle Age, with the consequent diffusion of the efficient vector *Anopheles labrachiae*. Towards the end of the 19th century, more than one-third of the Italian population was affected by malaria. The mosquito was eradicated by a

long-term integral reclamation (1920-1940) of swampy areas with re-forestation (*Pinus pinaster* on the sea line, *Pinus pinea* on the dunes, and herbaceous species as protection of the seedlings) and finally eradicated with DDT (1950s). Re-forestation is important in the combat against other environment-related infectious diseases, in the production of natural therapeutic agents, in the sedentarization of hunter-gatherers, etc.

The current situation

To summarize the complex history of forests during the time of human presence on the planet is not simple. The main aspect appears to be the fluctuation as a function of time of the space of land occupied by forests. It is estimated that, currently, forests cover 30-33% of the surface of Earth's land mass, but that, in the past, the cover has reached, more than once, at least 50%. Three main factors appear to govern these fluctuations:

- climate changes;
- occupation, exploitation, and destruction of forests by humans;
- pollution (mainly caused by anthropogenic activities).

The mechanism of the first factor is relatively simple, even if the origin of the changes is complex. The different types of ecosystems, and forest ecosystems in particular, depend to a large extent on the temperature and level of rainfall. They are, therefore, found in broad bands between the poles and the equator which change location, for considerable distances over a period of several thousand years, according to climate change, with their position sometime affected by geographical factors (orography, presence of an inner sea, position of the continental land masses in respect to the ocean). Thus, as a sequence from the pole, the following types of forest can be found:

- tundra (poorly drained acid soils covered in low scrub), affected by low rainfall, low temperature, and presence of permafrost;

- great coniferous boreal forests known as taiga (not in the south hemisphere due to the lack of emerged land in the right position);
- temperate forests, with rich secondary flora and better soils (the Mediterranean forest is a secondary type characterized by semi-aridity conditions and the presence of bush and brush);
- grasslands, with less rain and poorer soils, interspaced with large desert belts affected by large masses of very dry air, and sometimes followed by savannas with scattered thorny trees;
- tropical rainforest with both high rainfall and temperature but relatively poor soil (producing up to 40% of all terrestrial primary plant production and containing half of the plant and animal species).

Until recently, the climate changes affecting the position on the globe of the vegetation bands were due to completely natural, although complex causes. Anthropogenic deforestation, as indicated above, depends from a variety of activities: harvest of wood for heating and cooking, slash-and-burning to obtain cultivable land for subsistence agriculture, space for urbanization and other human necessities. Recently, new factors have come into the picture. Modern agriculture is a main factor, especially for its main crops:

- wheat and other cereals; main exporters: USA (the south-north belt from Texas to the Dakotas), Canada (the provinces north of the US belt), France, Argentina, Russia (South Russia and Siberia); for internal consumption: China (mainly Manchuria), India;
- corn (USA, with the Minnesota-Wisconsin-Michigan belt, as the main producer and exporter, not least Brazil) and rice (China, India, Indonesia, etc.);
- fruits and Mediterranean produce: Mediterranean countries (Spain, Italy, France), California, Chile, South Africa (Cape), Australia, Argentina.

Many of these territories, before farming, were originally prairies, but others, especially in tropical and subtropical areas, were forests. To these crops, the agriculture based on a monoculture or a main commodity must be added (often in plantations of colonial

origin): coffee (Brazil, Viet Nam, Colombia), tea (China, India, Sri Lanka, Kenya), cocoa (Ivory Coast, Ghana, Indonesia).

More recently, the subtraction of space from forests has been accompanied by the demand of timber for the developed countries market: not only timber from sustainably managed forests (e.g. USA, Canada) but also from developing countries at risk of deforestation (India, Brazil, Indonesia, Ethiopia, Congo-Kinshasa, Nigeria, etc.). Wood pulp for paper production comes from boreal forests harvested sustainably (USA, Canada, Finland, Sweden, etc.).

Of course, pollution affecting forests (physical, chemical, photochemical smog, biological pollution) is of human origin as well as the possible human interference with climate. It is estimated that tropical deforestation releases 1.5 billion tons of carbon each year into the atmosphere. Other hydrological, on soils, and ecological effects are recognized. The issue of carbon dioxide and the carbon cycle will be treated elsewhere.

It is estimated by the FAO that, in the period 1950-1980, Central America underwent a 40% loss of its forest area, and Africa a 23% loss. At present, the edges of the rainforest undergoing the most rapid deforestation are: the southern margin and the Colombian bor-

der of the Amazon basin, the north-western margin of the Brazilian coastal forest, parts of the Meso-America forests, the Sahel margin of the African rainforest, areas of Congo, Angola, Malawi, Mozambique, Madagascar, Tanzania, and Kenya, the residual Indian forests, areas of Indochina and Indonesia.

According to the UN Framework Convention on Climate Change (FCCC), the main direct cause of deforestation is agriculture: subsistence farming is responsible for 48% of deforestation, commercial agriculture for 32%, logging for 14%, and fuel wood removals for up to 5%. However, previously, in modern times, deforestation was due not only to extensive agriculture, but also to extractive industries, other industrial factors, and large-scale cattle ranching (especially in the Americas). Furthermore, an additional ecological injury is represented by forest fragmentation, affecting, especially in Europe, even marginal lands, abandoned by agriculture, that could be open to trees re-colonization.

Currently, the first ranking countries in terms of percentage of forest areas higher than 45% of the national territory are (data between 2007 and now):

Rank	Country	Area (km ²)	Percent national territory	Trend
* 1.	Russia	8,086,000	49	increasing
* 2.	Brazil	7,415,000	62	increasing
* 7.	Congo DR (Kinshasa)	1,330,000	56	
* 8.	Indonesia	940,000	52	
* 9.	Peru	686,000	53	stable
* 13.	Colombia	606,000	55	increasing

and with less than 45%:

* 3.	Canada	3,101,000	31	increasing
* 4.	United States	3,034,000	33	increasing
* 5.	China	2,054,000	22	stable
* 6.	Australia	1,233,000	19	decreasing

notable cases:

* 23	Japan	249,000	69	increasing
*	Finland & Sweden		65-70	increasing
* 52	Italy	102,000	34	increasing
* 58	South Africa	92,000	8	decreasing
* 83	Kenya	35,000	6	decreasing
* 98	Algeria	23,000	1	decreasing

Over the last five years, the world suffered a net loss of about 37 million hectares (7.3 million hectares per

FIGURE 4

The effect of the modern agricultural methods on landscape



year) of forest. This number comprehends the felling of 64 million hectares of trees and the planting or regeneration of 28 million hectares of new forest. The overall decrease of forested surface interests some continents (Africa, South America), while other continents are stationary (Asia, North and Central America, Oceania), and Europe shows an increase. The currently most endangered forests are in Indochina and Myanmar, New Caledonia, Borneo and Sumatra, the Philippines, Eastern Africa and Indian Ocean islands, all in the tropics; and the temperate forests in South America and South-west China. The problem is still open.

FIGURE 5

An intact part of the great Amazon Forest



Notes

- 1 Other scientific or specialized definitions are possible. In particular, specific definitions are used by the Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol to quantitatively estimate the carbon sink function carried out by forests and to evaluate the vegetal carbon stock accumulated in arboreal organic matter: in this case, to distinguish forests from bushland, glades, heaths, and similar formations, parameters such as the average tree height and the minimal tree density (number of trees per hectare or square kilometer) are taken into account.

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