



FORESTRY ISSUES

Deforestation: Tropical Forests in Decline

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Originally published January 1999, revised January 2006

This FORESTRY ISSUES paper examines the extent of tropical deforestation in developing countries, its causes and consequences, and the prospects for more sustainable land use alternatives. The paper has been prepared as a contribution to the general public's better understanding of the complex social, economic, and environmental issues that surround tropical deforestation. It represents the analysis and opinion of the authors and no official Canadian Government policy is implied.

SUMMARY

There are approximately 2,047 million hectares of tropical and subtropical forests in the 133 developing countries examined. They represent an enormously valuable resource in terms of the diverse economic products and environmental services they provide.

Since 1990, 12.3 million hectares of natural tropical and subtropical forests are being converted each year to other land uses, mostly agricultural (FAO 2005C). The principal agents of deforestation -- those individuals who are cutting down the forests -- include slash-and-burn farmers, commercial farmers, ranchers, loggers, firewood collectors, infrastructure developers and others.

The predisposing conditions that favour deforestation include poverty, greed, quest for power, population growth, and illiteracy. The indirect causes of deforestation include inappropriate government policies, land hunger, national and global market forces, the undervaluation of natural forests, weak government institutions, and social factors. The more visible direct causes of deforestation include the land uses that compete with the natural forests (e.g. agriculture, ranching, infrastructure development, and mining and petroleum exploration). Logging, fuelwood collection, and tree plantations also have a role in the deforestation phenomena. The economic and environmental consequences of deforestation are profound, making it one of the most critical issues facing our global society.

While it is impossible to stop deforestation in the foreseeable future, there are many opportunities for bringing it under control and minimizing its negative impacts. Alternatives include the protection and management of remaining forests, socioeconomic development in rural areas, and policy and institutional reforms.

ACKNOWLEDGMENTS

The authors would like to express their appreciation to all of the persons who offered their comments and suggests on the earlier drafts of this paper, in particular: Frederic Achard of the TREES Project, Javed Ahmed of IUCN, Arild Angelsen of the Centre for International Forestry Research (CIFOR), Jean Arnold of the Falls Brook Centre, Richard Baerg of the International Model Forest Network Secretariat, Jay Blakeney, Brian Brunton of Greenpeace (Papua New Guinea), Francois Catzeflis of the Institut des Sciences de l'Evolution, Jim Cook, Rudi Drigo of FAO, Paul Earl of the Universidad Nacional Autonoma de Mexico, Frank Endean, Svend Korsgaard of the International Tropical Timber Organization (ITTO), Roger Leakey of the Institute of Terrestrial Ecology, H.S.Leng of the Malaysian Timber Council, Dag Lindgren, Paul Martins, Patricia Negreros-Castillo of Iowa State University, Barry Pittock of the Climate Impact Group CSIRO, Rosario Ortiz Quijano of the Latin American Regional Focal Point of the Joint Initiative Underlying Causes of Deforestation and Forest Degradation, John Revington of the Rainforest Information Centre, Jeffrey Sayer of the Centre for International Forestry Research (CIFOR), Erich Schaitza of EMBRAPA-Florestas, Ashbindu Singh of the UNEP Environmental Information & Assessment Programme, James Thomas, Jacques Trencia of the Canadian Forest Service, and Eric Walker. A special thanks goes out to Elizabeth Ruiz for reviewing the paper and doing the HTML layout and to Lois Richardson for editing it

1. BACKGROUND

In 2005, there were approximately 4 billion hectares of forests in the world, representing 30 per cent of land use (FAO 2005C). Of this total forest area, 1,819 million hectares of tropical and sub-tropical forests are found in the 133 developing countries studied in this paper¹. Although the original forest area is not known precisely, it is estimated that the world has lost approximately 40 per cent of the original forest area of 6,000 million hectares over the last 8,000 years (Bryant, 1997; Laarman and Sedjo, 1992). Most of the loss in forest area is a direct consequence of human intervention in the 20th century.

There are many different types of tropical forests, ranging from the rain forests of the Amazon to the dry woodlands of Southern Africa, from the coastal mangroves of Southeast Asia to the alpine forests in the Andean highlands of South America.

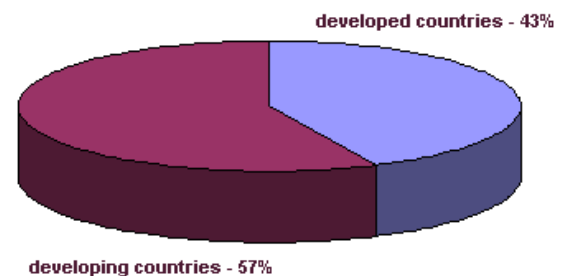
Deforestation is the conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold (FAO, 2005). Silvicultural practices like clear-cutting if followed by reforestation are not deforestation, rather it is considered to be the permanent loss of forests to other land uses such as agriculture, grazing, new settlements, infrastructure, and dam reservoirs. Tropical deforestation is now widely recognized as one of the most critical environmental problems facing the world today, with serious long-term economic and social consequences. Largely overlooked by the developed countries and the urban dwellers of

the developing countries until the 1980s, deforestation has received much attention in recent years. Vivid images of burning trees in the Amazon have been seen by people around the world, and the effect of deforestation on biodiversity and climate change has been the subject of many newspaper articles and television documentaries.

The economic and environmental problems facing the developing world are staggering in their magnitude and their complexity. They are fueled by the vicious cycle of population growth and persistent poverty. Most countries face serious problems in the urban environment: overcrowding, unemployment, growing crime, lack of potable water, inadequate sewage disposal, increasing air pollution, and the inappropriate disposal of toxic wastes. In rural areas, the deterioration of natural resources not only destroys the environment, but also undermines the very foundation on which economic growth and long term prosperity depend. The catastrophic impact is seen in accelerating soil erosion which results in permanent loss in agricultural productivity, in advancing desertification accompanied by drought and famine, in declining coastal and inland fisheries with the associated threats to food security, in the misuse of agrochemicals that poison both people and the environment, in the alarming sedimentation of fragile coral reefs; and in the destruction of biodiversity-rich wetlands. None of these natural resource problems is more threatening, none more in need of immediate action, than the destruction of the tropical forests.

It is not within the scope of this paper to undertake a thorough examination of tropical forest degradation. Forest degradation is defined as those “changes within the forest which negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services” (FAO, 2005D). Unlike deforestation, degradation does not involve a change in land use, but it is a serious problem in the tropics. Probably more than 10 million hectares are degraded each year by the action of loggers, firewood collectors, and livestock herders. Although the land remains under forest use, its composition and biological functions are compromised by human intervention. The chief cause of forest degradation is exploitative logging, with its selective removal of tree species, felling damage to the residual forest, soil damage from road construction and log skidding, and the displacement of bird and mammal species. Logging roads provide new access for farmers and ranchers who come to clear and burn the logged-over forests once the skidders and chainsaws have left. Forest degradation also occurs as a consequence of intensive fuelwood collection and overgrazing by livestock and wildlife. More research is required on the scale and impact of degradation on all types of forests.

Global Forest Area



¹ Excluding OECD countries and members of the former Soviet Union, territories held by developed countries, and countries not possessing tropical or sub-tropical forests.

2. IMPORTANCE OF TROPICAL FORESTS

2.1 Environmental Importance

Tropical forests have a special role in the conservation of biodiversity. They are the home to approximately 75 percent of the world's plants and animals -- more than 13 million distinct species (Anon., 1996). The tropical forests contain 70 per cent of the world's vascular plants, 30 per cent of all bird species, and 90 per cent of invertebrates. Many of the mammals are among the most famous icons of natural history -- the great cats, the primates, and the ungulates of the East African woodlands. In tree species alone, tropical rain forests are extremely diverse, often



having more than 200 species per hectare. Boreal forests, on the other hand, are biologically much simpler, with as few as one species per hectare for fire-regenerated stands like lodgepole pine in North America.

Forests influence the local and global climates. They moderate the diurnal range of air temperatures and maintain atmospheric humidity levels. Forests absorb atmospheric carbon and replenish the oxygen in the air we breathe. The conservation of forest resources in the watersheds that supply water for irrigation, sanitation, and human consumption is an important component of water supply strategies. When tropical watersheds have balanced land use, their forests absorb excessive rainfall that is gradually released later. Forests regulate stream flows by intercepting rainfall, absorbing the water into the underlying soil, and gradually releasing it into the streams and rivers of its watershed. This minimizes both downstream flooding and drought conditions. Tree cover conserves moisture in the soil by providing shade that reduces the evaporative loss from radiant energy exchange with the atmosphere. Tree roots enhance soil porosity, reduce compaction, and facilitate infiltration. Trees act as windbreaks, reducing the force of desiccating, eroding winds at ground level.

2.2 Socioeconomic Importance

Some 400 million people live in or at the edge of the tropical forests (UNFF 2005). They are some of the least privileged groups in our global society. They depend on the forests for many important products and environmental services. Included in this population of forest-dependent peoples are the world's 60 million native or indigenous peoples who rely on the forests for their way of life. They not only meet their economic needs for food and shelter but also form an integral part of their culture and spiritual traditions. It is estimated that there are 1.2 billion people in farming communities that rely on trees and forests as integral components of their farming systems.

Forests provide us with a wide range of industrial wood products that we use in daily life -- lumber, panels, posts, poles, pulp, and paper. The manufacturing of forest products represents about one percent of world gross domestic product and accounts for three percent of the international trade in goods (FAO, 2005F). The global export of industrial forest products is valued at over \$US 200 billion. In 2004 (FAO, 2006), the total world production of wood for all end uses is reported to have been 3,402 million cubic metres, of which 2,019 million cubic metres were produced in developing countries. World production is divided almost equally between industrial uses and fuelwood. The economic value of non-wood forest products like foods or fibres is difficult to estimate, however, they are important to the livelihoods of 600 million people in developing countries.



Manufacture of Forest Products in Developing Countries (2004)

Product	Developing Countries Production	Percentage of World Production
Total Wood Production	2,019 million cubic metres	59%
Sawnwood	99 million cubic metres	24%
wood-based panels	80 million cubic metres	36%
pulp for paper	46 million tonnes	24%
paper & paperboard	86 million tonnes	26%
wood fuel	1,599 million cubic metres	90%

(source: FAO, 2006; FAOSTAT: FAO Statistical Databases: Forestry, <http://faostat.fao.org/>)

Whereas the developed countries produce most of the world's industrial wood products, developing countries account for the majority of fuelwood consumed. Fuelwood and charcoal makes up 52 per cent of global wood production and developing countries account for 90 per cent of it. Wood is by far the most important source of energy for developing countries and the only source of energy for much of the world's rural areas.

In addition to wood products, tropical forests give us a wide range of non-wood forest products, the so-called "minor" forest products which in many cases are "major" forest products for the local people. These include fibres, resins, latexes, fruits, and traditional medicines. Forests are often important sources of foodstuffs, particularly in times of drought and famine when conventional agricultural crops have failed. For example, in the state of Madhya Pradesh in India, tribal peoples rely on their forests for up to 25 per cent of their basic food requirements. Most of these "minor" or non timber forest products are produced, traded, and consumed outside the cash economy and therefore are not quoted in the national economic statistics.

Tropical forests are also very important economically for plant-improvement breeding. For example, a species of wild maize has been found in Mexican woodlands that is resistant to five of the world's seven most important corn viruses; it is now an important genetic resource for corn-improvement programs. Forests are also important sources of new pharmaceuticals used to fight cancer, AIDS, and other serious human diseases. The periwinkle plant from the Madagascar forests provides a drug that has proven very successful in treating lymphocytic leukemia. The bark of *Prunus africanum* is now an important commodity in world trade as a pharmaceutical for the treatment of prostate disorders (Leakey 1998). At present, our knowledge about tropical forest plants is limited, but it is improving with ongoing research.

Obviously, the great variety of forest products is important by any economic standard.

3. DEFORESTATION - PAST AND PRESENT

3.1 Historical Deforestation

Eight thousand years ago at the advent of sedentary agriculture, forests covered approximately 40 per cent of the world's land area or about 6,000 million hectares. For the next 7,500 years, farm and pasture lands gradually crept into the forests, covering the most fertile, most accessible soils. The areas most greatly affected were the Middle East, the Mediterranean watershed, South Asia, and the Far East. Forest removal in Mesopotamia and the Mediterranean Basin was well advanced in pre-Christian times. Those forests that do remain are in many cases badly degraded. For example, in Turkey, the forests of *Pinus brutia* have been selectively harvested for only the tallest, the straightest trees for centuries. The present trees are now reported to be genetically inferior in form and

stature, a consequence of harvesting only the best trees. In centuries past, countries like China and India had considerably more forest cover than they do today. Their forests were decimated to supply their growing populations with wood for building materials, to provide firewood to cook their food and heat their houses, and to open up new lands to grow crops on.

After the first European contact with the New World over 500 years ago, the forests of the Western Hemisphere also began to disappear. The more accessible forests of coastal Brazil and those of the Caribbean were converted into sugar plantations. In North America, settlers arrived from Europe and slaves were brought in from Africa to convert what was once a vast expanse of temperate forest into farms and ranches. Forests were cleared to accommodate the settlers' growing needs for new land on which to grow their food crops. Favourable temperate soils made sustainable agriculture possible and a viable alternative to forestry as the best use of the land. Forests were also cleared for firewood for cooking and heating, and for construction wood for houses and furniture. Meanwhile, back in Europe, the arrival of the Industrial Revolution put tremendous pressure on the remaining forests to supply fuel for the smelters and foundries of the new industries. Before the end of the 19th century, most of the Europe's ancient forests were only distant memories.

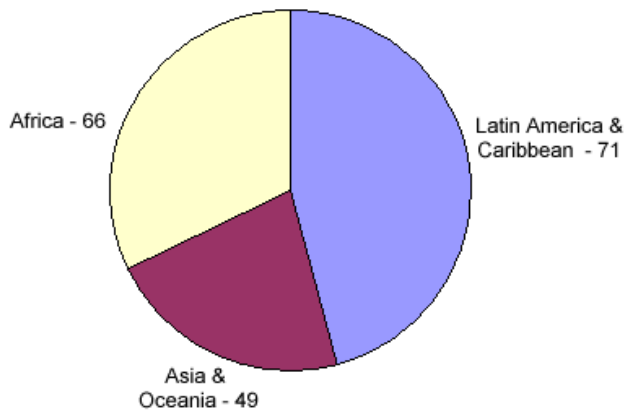
Between 1850 and 1980, 15 per cent of the world's forests and woodlands were cleared (Rowe et. al, 1992). The world forest area has now shrunk to 3,952 million hectares as a consequence of human exploitation, most of which occurred in the latter half of the 20th century (FAO, 2005C).

3.2 Contemporary Deforestation

Although the world's forest area has been declining for centuries, it is since the middle of the 20th century that the process has accelerated to alarming proportions, especially in the rate at which tropical forests are being cleared. Since 1990, 12.3 million hectares of natural forests have been cleared annually in tropical and subtropical countries (see [Annex 1](#)). This has resulted in approximately 185 million hectares of forests being converted to other land uses, primarily agriculture. This has been partially compensated by the concurrent establishment of nearly eight million hectares of forest plantations. In the Forest Resource Assessment 2005 report (FAO 2005C), FAO presents an annex with statistics on the annual average changes in forest areas by country. For the 133 countries considered in this paper and not accounting for the inclusion of forest plantations in these figures, FAO estimates that there were 12.3 million hectares of tropical forests lost each year in the 1990s and 12.2 million hectares lost annually between 2000 and 2005. This suggests that there has been no progress in containing deforestation or in reducing its serious socioeconomic and environmental effects for the countries in question.

Tropical Deforestation 1990-2005

millions of hectares



To put these figures in perspective, the 185 million hectares deforested from 1990 to 2005 is roughly the equivalent of the combined land area of Western European countries of France, Finland, Sweden, and Spain!

In contrast, the area of forests in temperate and boreal countries has been growing. For example, the forests of Europe grew by 805,000 hectares, the fruits of natural regeneration and forest plantation programs (FAO 2005C). Similarly, Canada witnessed a net increase in its area of forestland from 416.2 million hectares in the late 1980s to 417.6 million hectares in 2002 -- an increase of 1.4 million hectares (Lowe et. al, 1994; Canadian Forest Service, 2002).

FAO (Drigo, 1997) reports that the change in forest cover between 1980 and 1990 in Africa is largely the result of the forests being cleared for small farmer agriculture and permanent agriculture/pastures, with slow, progressive degradation occurring from firewood collection. Rural population pressures were attributed to be the main driving force behind these changes. In contrast, Latin America has seen a shift towards permanent agriculture and cattle ranching, often in association with settlement and infrastructure projects. In Asia, the situation is more complex with large resettlement schemes, intensive timber harvesting, the expansion of commercial agriculture, and the

continued spread of shifting cultivation into the remaining forests. Converting forests to plantations, both forest plantations and agriculture plantations (e.g. rubber, oil palm,) was carried out on a large scale in Asia.

The tragedy lies in the fact that most of these deforested lands are not suited for long-term farming or grazing and they quickly degrade once the forest has been cut and burnt. In fact, throughout the tropics, very few of the forested lands that are left have any potential for sustainable agriculture.

Desertification, particularly in Africa and Asia, has also contributed to deforestation through land degradation in drier climates. It affects about 3,000 to 3,500 million hectares, about one-quarter of the world's land area as a consequence of unsustainable over-cultivation, over-grazing, over-cutting of trees and shrubs, and poor water management on irrigated lands.

**"Top 20" Tropical Countries in Terms
of Area of Natural Forest Lost (1990 - 2005)**
(total area in 1000's hectares)

Ranking	Country / Region	natural forest area 1990	natural forest area 2005	loss of natural forest 1990-2005
1	Brazil	514,957	472,314	-42,643
2	Indonesia	114,358	85,096	-29,262
3	Sudan	70,270	62,142	-8,128
4	Myanmar	38,825	31,373	-7,452
5	D.R. of the Congo	140,531	133,610	-6,921
6	Zambia	49,064	42,377	-6,687
7	Nigeria	16,983	10,740	-6,243
8	Tanzania	41,291	35,107	-6,184
9	Mexico	69,016	63,180	-5,836
10	Central America	27,556	22,137	-5,419
11	Zimbabwe	22,080	17,386	-4,694
12	Venezuela	52,026	47,713	-4,313
13	Bolivia	62,775	58,720	-4,055
14	Cameroon	24,545	21,245	-3,300
15	Ecuador	13,817	10,689	-3,128
16	Paraguay	21,134	18,432	-2,702
17	Cambodia	12,879	10,388	-2,491
18	Philippines	8,794	6,542	-2,252
19	Papua New Guinea	31,460	29,345	-2,115
20	Ethiopia	14,623	12,509	-2,114

Notes: assumes natural forest area = total forest area - area of forest plantations
Source: adapted from FAO 2005

Most of the deforestation is concentrated in relatively few countries. The "top 20" deforesting countries accounted for 156 million hectares or approximately 80 per cent of all of the natural tropical forest lost from 1990 to 2005. This is the equivalent of 10.4 million hectares annually. If fundamental changes in land use can be made in those countries, it will have a major impact on reducing future forest loss.

Brazil is the country with the largest area of tropical forests and, at the same time, suffers from the greatest deforestation. Until the late 1970s, deforestation in Brazil was considered a minor problem with a limited local impact. However, the situation changed dramatically. During the next 20 years, 50 million hectares of forest were cleared in the states of Rondônia, Pará, Amazonas, Mato Grosso, and Acre, accounting for nearly 14 per cent of the Brazilian Amazon. This was deforestation at an unprecedented scale.

Many factors contributed to Brazil's runaway deforestation. The most notorious agents of deforestation were the ranchers who took advantage of existing government subsidies that encouraged expansion of the cattle industry. Incentives and improved access from new highway construction fueled a land speculation frenzy. Ranchers were joined by tens of thousands of small farmers from southern Brazil who were looking for new farming land after having had been displaced by commercial farming estates. On another front, thousands of hectares of forest were cleared to feed the charcoal burners supplying the government-controlled Carajás mine in the State of Pará before eucalyptus plantations were established to supply the mine's energy needs. More recently, pressure has been placed on the "cerrado" woodlands of northern Brazil by commercial farmers who are clearing the land to plant soybeans (Schaitza, 1998). Gold mining, flooding from hydroelectric dams, and commercial logging were other important factors.

In addition to the "Top 20" countries, there are other countries that have experienced very high annual rates of deforestation. In these cases, the total area of forests being lost each year might not be that great but the impact on remaining forests, their biodiversity, and their continued ability to perform their environmental functions and provide their economic goods is being seriously threatened.

Important Deforesting Countries in Terms of Annual Rate of Loss (1990 - 2005)

Country	% annual loss		Country	% annual loss
Niger	-2.70		Uganda	-1.77
Nigeria	-2.45		Philippines	-1.71
Pakistan	-2.06		Indonesia	-1.71
Benin	-2.04		Nepal	-1.66
Ghana	-1.84		Ecuador	-1.51

Source: adapted from FAO 2005

Some countries have witnessed the virtual disappearance of their forests in the last half century. In *The Last Frontier Forests* (Bryant et. al. 1997), the World Resources Institute describes the extent and location of the remaining undisturbed, biologically-intact tracts of forests. Thirty developing countries are identified as having lost all of their frontier forests. This is not to say that these countries do not have any forests, however the ones that have survived, have been impacted upon so severely that they have lost the capacity to provide the environmental functions (e.g. conservation of biodiversity, hydrologic cycles, moderation of climate) that they once did. Most of this decline has come as a consequence of deforestation. If current trends continue, other countries will join the ranks of nations that have allowed their forests to degrade and disappear.

Developing Countries With No Remaining Large Tracts of Undisturbed, Biologically Intact Forests

<< Africa >>			<< Latin America and Caribbean >>
Angola	Guinea	Senegal	El Salvador
Benin	Guinea-Bissau	Sierra Leone	Haiti
Botswana	Kenya	South Africa	Paraguay
Burundi	Liberia	Tanzania	
Equatorial Guinea	Madagascar	Togo	<< Asia >>
Eritrea	Mozambique	Uganda	Pakistan
Ethiopia	Namibia	Zambia	Philippines
The Gambia	Rwanda	Zimbabwe	
Ghana	Sao Tome & Principe		

(source: adapted from Bryant et. al. 1997)

In the last decade, there were serious losses in forest cover from the forest fires in Southeast Asia, particularly in the Sumatra and Kalimantan regions of Indonesia. The widespread fires were related to new commercial agricultural projects, land clearing for tree and agricultural plantations, dry residues left in the forest after logging,

and slash-and-burn agriculture. The situation was complicated by the very dry climatic conditions caused by the El Niño phenomenon. Despite the concerns of the Ministry of Forests and the advice of numerous missions from international development agencies, the fires could not be contained. The area of forest lost to the fires has not been accurately documented; estimates vary from 170,000 hectares to over 2 million hectares (Byron and Shepherd, 1998; Lewis, 1998). A devastating fire in 1982 destroyed over 3 million hectares, according to estimates. These fires were associated with clearing brush fallow and forest to establish plantations of oil palm, pulpwood, and rice. In the last decade, Mexico, Central America, and the Caribbean also suffered serious forest fires after unusually long dry seasons. The fires were associated with land clearing for new cattle pastures and for slash-and-burn agriculture.

3.3 How Reliable are the Deforestation Estimates?

How reliable is the FAO information on deforestation? Despite the apparent precision of the quoted figures for the rates of deforestation, the exact area of forest lost each year is not known. The accuracy of estimates is hampered by the lack of reliable time-sequence land use maps, varying standards for forest and non-forest classification, inadequate ground truthing of satellite imagery, and the institutional weakness of government forest departments around the world. This is further complicated by FAO's changing standards / definitions of what constitutes a forest, making comparisons of different years difficult or impossible.

Comparison of 1990 Forest Areas as Reported in the 1990, 2000, and 2005 Forest Resource Assessment Reports of FAO

Country / Region	FRA 1990		FRA 2000		FRA 2005
	Forest Area 1900	variation from FRA 2005	Forest Area 1900	variation from FRA 2005	Forest Area 1900
	(1000's has.)	(%)	(1000's has.)	(%)	(1000's has.)
Brazil	566,007	8.84	566,998	9.03	520,027
Indonesia	115,674	-0.77	118,110	1.32	116,567
Sudan	43,179	-43.47	71,216	-6.76	76,381
Myanmar	29,091	-25.82	39,588	0.94	39,219
D.R. of the Congo	113,317	-19.37	140,531	0.00	140,531
Zambia	32,349	-34.15	39,755	-19.07	49,124
Nigeria	15,785	-8.41	17,501	1.55	17,234
Tanzania	33,709	-18.66	39,724	-4.14	41,441
Mexico	48,695	-29.44	61,511	-10.87	69,016
Central America	21,592	-21.88	21,227	-23.20	27,639
Zimbabwe	8,981	-59.61	22,239	0.02	22,234
Venezuela	45,943	-11.69	51,681	-0.66	52,026
Bolivia	49,345	-21.42	54,679	-12.92	62,795
Cameroon	20,366	-17.03	26,076	6.24	24,545
Ecuador	12,007	-13.10	11,929	-13.66	13,817
Paraguay	12,868	-39.18	24,602	16.28	21,157
Cambodia	12,170	-5.99	9,896	-23.56	12,946
Philippines	8,034	-24.02	6,676	-36.86	10,574
Papua New Guinea	36,030	14.30	31,730	0.66	31,523
Ethiopia	14,354	-5.03	4,996	-66.94	15,114

If the reference area, in this case total forest cover in 1990, keeps changing; how can there be any assurance of the accuracy of the estimates for deforestation. Will the FRA 2010 provide different figures for 1990 or 2005?

Figures on the amount of deforestation of natural forests are not clearly presented in FAO's Forest Resource Assessment reports. Instead, the area of forest plantations is combined with the area of natural forests to produce total forest area figures. This approach masks the true area of natural forest being lost to deforestation and deforestation's direct impact on the conservation of biodiversity and sequestered carbon stored in primary forests.

The monitoring of deforestation has improved in recent years, but it is still far from acceptable. Mexico is a good example of the monitoring and reporting problem. According to FAO (FAO 1997), Mexican deforestation in the period 1990-1995 averaged 510,000 hectares annually. However, for the 1980s it is difficult to find a reliable estimate. In a recent government-planning document, 13 different estimates are quoted for the annual deforestation rate ranging from 370,000 to 1,500,000 hectares annually with most estimates about 670,000 hectares per annum (Anon, 1995). Most forest loss occurred in southern Mexico in the states of Chiapas, Quintana Roo, Campeche, and Yucatan, as a consequence of the expansion of farming and ranching combined with illegal timber cutting and forest fires.

Deforestation estimates are probably conservative and underestimate the rate of forest cover loss. FAO, the UN body responsible for collecting and publishing the statistics, is largely dependent on the information provided to it by the forest departments of each reporting country. The information is often inaccurate, based on old forest inventory and land use data, and at times tempered by political and national security considerations. Unfortunately, considerable caution must be used when drawing conclusions about the extent of deforestation at the national and regional levels from the data currently available.

This problem could be overcome by having an independent organization undertake periodic forest cover assessments using modern, remote sensing technologies. When combined with an analysis of the impacts of development programs (infrastructure construction or settlement projects), this assessment could help political decision-makers understand the implications of their actions on the country's forest resource base.

4. AGENTS OF DEFORESTATION

It is important to distinguish between the agents of deforestation and its causes. The "agents" are those individuals, corporations, government agencies, or development projects that clear the forests as opposed to the forces that motivate them. Much of what has been written about deforestation fails to distinguish between "agents" and "causes". At times, this deficiency mistakenly assigns blame to groups who are only acting in an economically rational manner given the socioeconomic and political framework in which they find themselves.

Who is doing the deforestation? There is considerable debate about who is doing the deforestation and why they are doing it. Small farmers? Commercial farmers? Loggers? Cattle ranchers? The answer is all of them and more. In all geographic areas, slash-and-burn farmers rank high as the most important agents of deforestation. They occupy forest land to clear the trees to plant food crops. Other major agents of deforestation in the agriculture sector are ranchers who remove the forest to seed new pasture to graze their livestock and the commercial farmers who establish estate crops like rubber and oil palm. Secondary agents of deforestation include loggers, commercial tree planters, firewood collectors, mining and petroleum industrialists, and infrastructure developers.

IMPORTANT AGENTS OF DEFORESTATION

Agents	Links to Deforestation
slash-and-burn farmers	- clear forest to grow subsistence and cash crops
commercial farmers	- clear the forest to plant commercial cash crops, sometimes displace slash-and-burn farmers who then move to the forest
cattle ranchers	- clear the forest to plant pasture, sometimes displace slash-and-burn farmers who then move to the forest
livestock herders	- intensification of herding activities can lead to deforestation
loggers	- remove commercial timber, logging roads provide access to other land users
commercial tree planters	- clear mostly forest fallow or previously logged forests to establish plantations to supply fibre to the pulp and paper industry
firewood collectors	- intensification of firewood collection can lead to deforestation
mining and petroleum industrialists	- roads and seismic lines provide access to other land users, localized deforestation related to their operations
land settlement planners	- relocation of people into forested areas as well as settlement projects displacing local people who then move to the forest
infrastructure developers	- new access for other land users from road and highway construction through forested areas, flooding by hydroelectric dams

There is considerable variation region to region and country to country as to which groups are the most important agents of deforestation. In Latin America, slash-and-burn farmers and cattle ranchers are at the front line of deforestation. In contrast, in Southeast Asia, commercial farming, logging, and oil palm plantations play a more significant role. The situation in Africa is a complex mixture of overgrazing in the dry forest zones, with slash-and-burn farming and high-grade logging in the moist forests of West and Central Africa.

There is no definitive, quantified list of the main agents of deforestation by geographic region. It is therefore impossible to say with certainty how much deforestation occurs as a consequence of the actions of the various agents involved. This is a reflection of the current poor state of monitoring and inadequate resource assessment in the forest sector. The following table pulls together information from a variety of sources and attempts to rank by geographic region the important agents of deforestation. Care must be taken in attempting to apply such generalizations to any specific country or geographic area.

Principal Agents of Deforestation by Region

Region	Main Agents of Deforestation
Africa	<ol style="list-style-type: none"> 1. slash-and-burn farmers 2. commercial farmers 3. loggers 4. livestock herders 5. refugees from civil disturbances
Asia - Oceania	<ol style="list-style-type: none"> 1. commercial farmers 2. slash-and-burn farmers 3. loggers 4. commercial tree planters 5. infrastructure developers
Latin America and Caribbean	<ol style="list-style-type: none"> 1. slash-and-burn farmers 2. cattle ranchers 3. commercial farmers 4. loggers 5. infrastructure developers

(source: * adapted from: FAO 1997; World Commission on Forests and Sustainable Development 1998; ** adapted from FAO 1997)

Who is doing the deforestation is much less important than the reasons why they are doing it. The following section of this issues paper describes the main causes of deforestation and the forces driving this process.

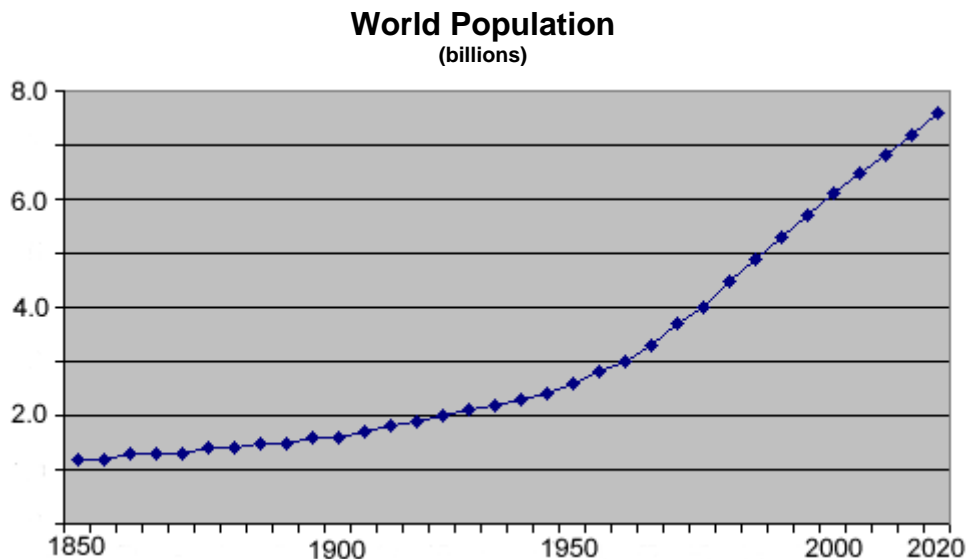
5. CAUSES OF DEFORESTATION

Deforestation is the product of the interaction of the many environmental, social, economic, cultural, and political forces at work in any given region. The mix of these forces varies from decade to decade, and from country to country. As a consequence, generalizations are dangerous. In most cases, deforestation is a process that involves a competition amongst different land users for scarce resources, a process exacerbated by counter-productive policies and weak institutions. It creates wealth for some, causes hardships for others, and almost always brings serious consequences for the environment.

This section discusses four aspects of the causes of deforestation - the predisposing conditions, the direct causes, the indirect causes, and the role of forest exploitation and plantation development in the loss of natural forests. The predisposing conditions create an environment where deforestation can occur. The direct causes are the most visible, the most easily identified and are readily associated with the agents of deforestation. They are driven by the other less visible, socioeconomic forces -- the indirect causes.

5.1 Predisposing Conditions

Predisposing conditions are those factors that combine to create an environment where deforestation can occur. They are conditions created by society, at times intentionally and at times the consequence of human nature, that pervade all aspects of society and are not just related to land use. They are some of the most systemic, most difficult issues that frustrate human progress and sustainable development.



Without a doubt, one of the most important predisposing conditions that underlies tropical deforestation and many of the world's other problems related to achieving sustainable development is our growing population. Our numbers are currently growing at the rate of one billion new individuals every decade. In the last half of the 20th century, we will have more than doubled our numbers from 2.5 to 6.1 billion people (United Nations Population Division, 2003). Most of the population increase is occurring in developing countries, those nations least equipped to absorb them. Nearly all of the expected 3.2 billion increase in our global population by the year 2050 will come from the developing countries -- 3.2 billion more people requiring food, energy, shelter, water, wood, paper, and all the other goods and services that come from the forests. Approximately 4.9 billion people, or 80 per cent of the world's population, live in the developing countries and a 1.2 billion of them live in abject poverty (IFAD, 2001). Most of those countries are in the tropics where deforestation is a serious problem. Furthermore, an estimated 2.5 billion people in developing countries are employed in agriculture to meet their basic needs. This is an increase of one billion since 1960 (AAAS, 2001). Many of these people cultivate cleared forestland once arable land becomes scarce. The exact number of people who live by clearing the forest to plant subsistence crops is not known, but the accepted figure is at least 400 million people or about 1 in every 6 persons in developing countries who are employed in agriculture.

Another predisposing condition of deforestation is poverty, particularly poverty in rural areas. Although poverty is not a "cause" of deforestation, it is a condition of life that the majority of people in this world must endure. While greed and power can be the motivations of some groups in society that deforest, survival and the desire to escape from poverty is what drives most people. Poverty is the socioeconomic environment that limits peoples' economic options, damages health, limits the formation of rural capital, reduces income generating opportunities, and limits institutional and infrastructure development. It is an underlying condition that facilitates deforestation. There is some evidence from the industrialized countries of the North that suggests as societies become more economically secure they reach a point where the economic development pressures that drive deforestation are replaced by a growing environmental concern and a greater appreciation of environmental values. However, for most developing countries that point is off in the far distant future.

The rural poor have very few options. There are few prospects of off-farm employment in either the urban centers or the rural areas. For those opportunities that do exist, there is intense competition for the few jobs available. Illiteracy further limits the options of many because they do not have the basic tools needed to pursue other economic alternatives to subsistence farming. In some cases, people migrate from the overpopulated, depressed regions to the forest frontier in search of a more prosperous, more secure life. Hand-in-hand with poverty comes food insecurity and chronic under nourishment. With few alternatives available to them, the rural poor look to the forests as a short-term solution to their economic problems.

Studies have been carried out on the relationships between rural poverty and deforestation and population growth and deforestation. At times the correlations have been inconclusive because the dynamics of rural land use are very complex, and deforestation is rarely the consequence of one single cause, rather it is the product of the interaction of many forces. For example, on the island of Java in Indonesia, high population densities have not resulted in the elimination of forest cover. On the other hand, high population densities in the Andean highlands led to settlement projects in the Amazonian lowlands, resulting in deforestation. The effect of population pressures as a predisposing condition for deforestation is dependent on the influences of the carrying capacity of the land, the prevailing land use practices, the importance of forest-derived products and services to the local people, and the strength or weakness of the institutional framework in place. In most cases, a rising population pressure and a prevailing climate of rural poverty are important conditions that facilitate deforestation.

Greed and the quest for economic and political power are important underlying forces. Individual and corporate greed that seeks excessive profits at the expense of human suffering and environmental degradation can be witnessed in the actions of many of the agents of deforestation. Unregulated land uses and monopolistic national markets favour the politically influential at the expense of the majority. This can be manifested in competing land uses that favour export oriented agricultural crops or exploitative logging practices. Slash-and-burn farmers are some of the poorest, least-privileged people in the world. They live in the more remote areas of their countries, areas that receive little or no attention from the political and economic decision-makers. They do not have access to more modern technologies that could increase their productivity and economic security.

5.2 Indirect Causes

5.2.1 Fiscal and Development Policies - Government policies outside the forest sector have profound impacts on the forest resource, as do international policies on debt repayment, structural adjustment, and trade. Structural adjustment programs have encouraged the expansion of foreign exchange-earning export crops, which have in turn encouraged the liquidation of forest capital either by accelerating timber harvesting or by converting forests to agricultural uses. The expansion of agricultural cash crops means that either forests are cleared directly for these crops or subsistence farmers are displaced for them, forcing the farmers to relocate to the forest where they practice slash-and-burn agriculture. Incentives (e.g., low interest rates or tax exemptions) to industries that would otherwise be less economical, or even uneconomical, have permitted them to prosper at the expense of forests when they couldn't otherwise. Government policies that have been adopted to facilitate economic development in other sectors that have resulted in deforestation include:



- subsidized credit for agricultural and livestock expansion, e.g. lower than commercial interest rates on loans for agricultural development,

- reduced rates of income and corporate taxes for competing land uses,
- tax "holidays" for the importation of equipment for new industries that negatively impact on forests,
- high taxes on imported petroleum products that discourage the use of alternative fuels to firewood,
- infrastructure and energy development projects that do not account for the value of forest capital lost,
- reliance on cash export crops by commercial farmers that force displaced small farmers to cultivate marginal forest soils.

Government-sponsored colonization schemes, such as the transmigration program in Indonesia or the Amazon colonization schemes in Peru, have been used as "development" projects by many governments. Sometimes they have been officially sanctioned by governments and sometimes they have occurred more spontaneously. They have been attractive to governments because they allowed them to avoid the politically sensitive issues of population control and land reform, relieve the pressure of overcrowded and underserved urban areas, defer otherwise needed investments in urban infrastructure, and avoid investments in agricultural research and extension to increase agricultural productivity on existing arable lands. Many countries have used colonization schemes as a way of asserting national sovereignty on their frontiers. Peasant farmers were encouraged to relocate to the forests of border areas to establish a physical presence there. The watershed of the Rio Putumayo is at the convergence of the borders of Ecuador, Peru, and Colombia. All three governments have sponsored settlement programs over the last two decades for the specific purpose of exercising sovereignty. Forests have been cleared to be replaced by marginally productive subsistence farming.

Economic structural adjustment and macroeconomic reform programs being implemented in many countries have the potential to be a serious threat to tropical forests. Economic reforms have aggravated unemployment in some sectors, causing greater poverty which has, in turn, motivated people to migrate to forested lands to practice slash-and-burn farming. The greater emphasis on exports has, at times, resulted in unsustainable timber exploitation and the encroachment of commercial agriculture upon forested lands. The World Bank and some of the bilateral donor agencies have been advocating the privatization of public resources in the structural adjustment programs and have made it conditional for loan approval. The privatization of state forest resources favours those management alternatives that can produce a short-term economic gain for the new owners whether they be local governments, communities, or the private sector. Protection forests or forests that are "rich" in non-monetary values like soil conservation are held in very low esteem in such a market-driven environment.

In 2003, the total external debt in developing countries was US\$ 2.6 trillion and still growing (World Bank, 2005). Brazil and Mexico, two of the principal deforesting countries, have the largest external debts of all developing countries. Debt affects all countries. It drains the available financial resources that could otherwise be used for routine operations of government, including conservation and the wise management of the country's forest resources. Funds are not available to pay staff, to pay for operational costs, to develop infrastructure, or to pay for education and training. The average debt/GNP percentage for the most important deforesting countries rose from 26 per cent in 1975 to 60 per cent in 1996 (World Bank, 1998). Forest-rich countries can be tempted to service their debt in part by liquidating the standing capital in their natural forests through an accelerated exploitation program.

The policies and institutional weakness of governments have significantly contributed to deforestation. Why have government policies failed so often in the past? Sometimes the policies were devised without a complete understanding of all of the issues involved and all of the potential impacts. This is often the case when decisions are made that result in deforestation because political decision-makers do not appreciate the real value of forests' goods and services compared to other land uses. Problems can also reflect the general weakness of the national forest institution and its inability to formulate and execute sound policies. In other cases, deliberate decisions are made to favour a small group of politically and economically powerful individuals at the expense of society at large. In general, government policies reflect the political will, the power structures, the democratic processes, and the level of public awareness present in the country. Even when policies are adopted with the best of intentions, they can have unforeseen negative impacts -- a consequence of the complexity of the issues being dealt with and the multiple impacts they can have. Institutions can find that rescinding a policy is a daunting task. Many countries, however, have made substantial progress in reforming their policies and legislation that contributed to deforestation in years past. Brazil, for example, has repealed its subsidies to promote cattle ranching in the Amazon, and Costa Rica is starting to account for the destruction of forest capital when doing its national economic accounts.

5.2.2 Land Access and Land Tenure - In most developing countries, the arable land base cannot support the growing population. First, the amount of land suitable for farming is limited. The real arable land that can sustain long-term cropping is, for the most part, currently under cultivation. Increases in agricultural production can come

from increased productivity through the use of improved technology, but they cannot come from extending the land under cultivation into forested areas because there are no large "reserves" of unused forested land suitable for farming. Second, as the farming population grows and the land passes on from generation to generation through inheritance, the individual farm plots become too small to be economical. Third, much of the truly arable land is held by large landowners or by corporations and, therefore, is not accessible to the majority of the farming population who really need it. In many countries, particularly in Latin America; large landowners -- latifundistas -- have traditionally controlled most of the farming land, a bad situation made worse in the second half of the 20th century when many small farms were bought out to become more economically viable. The introduction of new agricultural pesticides and fertilizers and the greater mechanization of farm labour shifted the profitability in farming to those landowners who had the available capital to invest. The small farmers were displaced and often went to the forest frontier to start over again.

Under these circumstances, the only solution for most families is to either move to the towns and cities to look for work or to relocate to the forest frontier to clear the trees to make a new farm. Forested lands, both fertile and infertile, have been a social safety valve for land pressure. For governments, it has been politically less painful to look the other way and ignore deforestation than to deal with the difficult issues of land reform, job creation, and population control. Obviously, the issue of lack of access to arable land is one of the most compelling for the rural poor who have very few alternatives available to them.

Land tenure has an important influence on people's attitude towards land use. The vast majority of the world's slash-and-burn farmers do not have formal land title -- at best they have customary rights, at worst no rights at all. Without some guarantee that the land will remain theirs, farmers have no incentive to invest in making it more productive. Under these circumstances, clearing the forest and planting annual crops for a few seasons before moving on to clear more land is a logical farming strategy. Governments are either unwilling to title state lands to small farmers or their land titling procedures are so complicated and so costly that small farmers find it impossible to obtain legal title. The lack of ownership excludes them from obtaining credit for much needed farm inputs and discourages any long term investment that could lead to increased productivity, prosperity, and enhanced well-being. The short term alternative is to slash-and-burn the forest.

In many countries, settlers must clear the land to exercise their tenure rights. In this case, deforestation is considered an "improvement" to the land and an expression of the occupant's good faith in developing the property.

Tree tenure systems can also discourage the planting and tending of tree crops as an economic alternative to agriculture. Some countries like the Dominican Republic and Guinea have had laws that extend state ownership to all trees and forests whether they be on private property or state land. When tree ownership rests with the state, there is no incentive for the rural population to invest their labours in forest management because the benefits derived are only enjoyed by the government. In fact, this situation has encouraged deforestation because many farmers illegally removed the trees on their property so there would be no government interference in the way they used their land.

5.2.3 Market Pressures - Often mentioned as causes of deforestation are the demand for forest products and the demand for other goods (mostly food) that are produced on deforested lands. Clearly, without any demand there would be no economic reason for cutting down the trees. As human population continues to grow, so does the demand for forest-derived goods. Similarly, as we become more prosperous, our per capita consumption rises. This is evident in the great discrepancy between per capita consumption of almost all goods by North Americans in comparison to the less affluent peoples in developing countries. For example, paper consumption per capita rises as individuals become more prosperous. Paper and paperboard product consumption in North America averaged 339 metric tons per 1000 people in 1995 compared to 3 metric tons per 1000 people in Africa and 31 metric tons per 1000 people in Latin America.

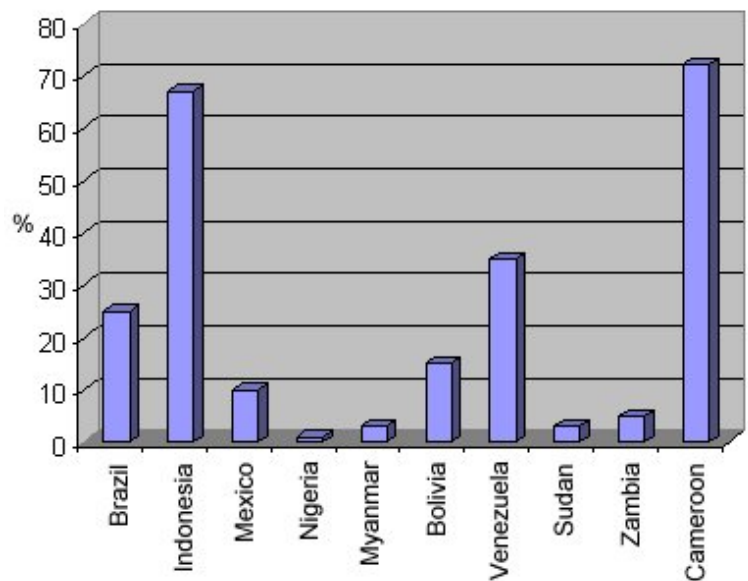
The importance of our consumption patterns to the exploitation of forest lands cannot be denied. What is debatable is the importance of the export market in deforestation. As mentioned in section 2.2 of this issues paper, developing countries produce about 25 per cent of the world's industrial wood products -- sawnwood, panels, wood pulp, paper -- and almost 90 per cent of its fuelwood. In the case of industrial forest products, it is difficult to generalize the importance of international market demand. Sawnwood and plywood are good indicators of natural forest disturbance (and susceptibility to subsequent deforestation) and exports clearly show the relative importance of the international markets. In the case of Indonesia and Cameroon; exports accounted for over 50 per cent of the total production and are obviously a major force behind timber exploitation in those countries and its contribution to

deforestation. In contrast, exports in Brazil and Venezuela account for a modest 25 and 35 percent respectively of total production. Nigeria, Myanmar, Mexico, Bolivia, Zambia, and Sudan register negligible exports.

Pulp and paper are important commodities in world trade, accounting for over US\$ 91.6 billion in global exports in 2003 (FAO, 2006). The industry has witnessed dramatic growth in many countries where deforestation is a problem, particularly in Asia. Since 1980, paper and paperboard production has increased over ten-fold in Thailand, fourteen-fold in Malaysia, and a breathtaking thirty-one fold in Indonesia. The majority of production comes from plantations of fast-growing species that were established on non-forest lands, forest fallow lands, or logged over forests that were not being managed sustainably. In some cases the natural forest was cleared to establish the plantations. To a very limited degree, natural forests have been harvested to supply mixed tropical hardwoods as the raw material for pulp and paper production.

Most new pulp and paper production in developing countries has gone to meet the demands of growing local populations, populations that are, in many cases, increasingly more affluent. In terms of paper and paperboard products, only a few countries have had significant exports (FAO, 2006). In 2004, Indonesian exported of 1.9 million metric tons of paper and paperboard products, which accounted for 26 per cent of the total production of 7.2 million metric tons. In the same year, Thailand's exports of 0.8 million metric tons represented 24 per cent of its total production of 3.4 million metric tons. In contrast, the many other paper and paperboard producers were primarily satisfying their local demand with less than 10 per cent of total production being exported. Brazil produced 8.2 million metric tons paper and paperboard products in 2004 but only exported 0.5 million metric tons or just 6 per cent. The situation in the wood pulp market is very similar with most of the increased production being consumed in the country of origin.

Sawnwood and Panel Exports as a Percentage of Total Production (2004)



In summary, the demand for forest products continues to rise as population and affluence grow. The national demand for forest products within the countries where deforestation is occurring is a much more important cause of deforestation than the demand for these same products on the international markets. This generalization varies from region-to-region and from country-to-country within each region. It should be noted that this conclusion is contrary to the opinion held by many Northern NGOs that it is the industrialized countries' insatiable demands for tropical timber that is driving deforestation.

In the agriculture sector, the importance of export crops as a driving force behind deforestation is, again, difficult to generalize. Rice is the staple food crop in Asia, but it is not an export commodity in most Asian countries that are losing their tropical forests. For example, Indonesia and Malaysia are net importers of rice, and of the important deforesting countries only Thailand is a significant exporter of about 37 per cent of its 2004 production (FAO, 2006). In Central America, the single most important crop of the slash-and-burn farmers is maize. All countries in the region are net importers of maize, which indicates that all of the forestland converted into maize production is for internal consumption only, not for export. In 2004, Central America's production of 22.9 million metric tons had to be supplemented by net imports of 7.6 million metric tons of maize and maize products to feed its population. Obviously clearing forested land was not done to take advantage of the export market, rather it was done to meet the domestic demand. In Indonesia, exports of palm oil have risen sharply in the last three decades that correspond to rapid deforestation in that country. Since 1970, exports of palm oil have increased over fifty times and are now valued at \$US 3.4 billion annually.

The situation in the livestock sector is very similar. Over the last two decades, beef production in Brazil has risen sharply from 2.85 million metric tons in 1980 to 7.77 million metric tons in 2004 (FAO, 2006). This rise in production corresponds with dramatic increases in deforestation as ranchers, farmers, and land speculators occupied the forested regions of the Amazon watershed. Beef exports, in terms of total volume exported and as a percentage of total production, peaked in the 1990 at approximately 3,300 metric tons or about 0.1 per cent of total production of more than 4 million metric tons. Clearly, the boom in beef production and its devastating impact on Brazil's forests is being driven by the domestic beef market not by the demand from Europe, North America, or Japan. Similarly, beef exports relative to total beef production in Central America account for a small percentage of total production. Despite the early importance of the American market as a driving force in the growth of the Central American cattle industry, most of the production went to satisfy the local demand, not for export sales. Exports as a percentage of total production peaked in the early 1970s but then fell in the following two decades (FAO, 1998; Leonard, 1987). It is a popular myth that the Central American forests were sacrificed to satisfy the Americans' love of cheap, fast-food hamburgers but, in fact, that is only a partial explanation.

Like the growth in forest products, the growth in agricultural production and its consequent impact on deforestation has been more a response to the growing national markets than an attempt to satisfy the international demand. While international market pressures are important factors in understanding the causes of deforestation, their importance should never be overemphasized. The causes of deforestation, like the solutions for controlling it, are to be found within the borders of each of the countries affected. International trade offers some leverage to halt or reverse deforestation in some countries, but it is far from a panacea.

5.2.4 Undervaluation of Natural Forests - In economic terms, there is little understanding of the value of the goods and services provided by tropical forests or of the real costs of forest management being borne by resource users. As a consequence, forests are undervalued and play a less significant role than they should in the decisions affecting resource allocations, development priorities, and land use. They are, therefore, more susceptible to being converted to other land uses which are perceived to be more beneficial. Tropical forests are undervalued because:

- they produce many different products that are consumed in many unrelated markets often outside the cash economy, thereby creating the perception that they are less important;
- they produce many non-market goods (e.g. forest food, game, resins, fibres) and environmental services (e.g. climate control, water regulation, soil conservation) that do not enter into the national economic accounts;
- "downstream" benefits of "upstream" conservation are enjoyed but not paid for by beneficiaries;
- the harvest cycle (rotation) of natural forests in the tropics is very long compared to agricultural crops, even outside the realm of conventional commerce;
- the establishment of natural forests incurs no direct costs for the exploiter hence; they are viewed as "free" commodities;
- there is still much unknown about the potential value of the forests, a consequence of the lack of systematic research,
- market knowledge is imprecise, except for the traditional timber products,
- prices are often set by monopolies (government or private sector) and do not necessarily reflect society's value of forest products and services,
- forests are important to the rural poor, a social group that has little political influence and therefore little economic influence.

Forests that are perceived to have low value will be cleared and replaced by other more attractive land uses. It is important that people's perceptions be based on as complete an understanding as possible of the true value of all the goods and services that forests provide.

In recent years, much has been said and much written about the potential of both ecotourism and pharmaceutical research as saviours of the tropical forests. While these can be important alternatives to slash-and-burn farming at a very local level, they have a limited potential to impact global land use. The magnitude of the challenge and the need for meaningful benefit-sharing with the hundreds of millions of persons involved dwarfs their limited potential to generate grassroots benefits. On the other hand, the economic potential of the forests' carbon sequestration and storage capacity could be enormous under the joint implementation agreements that are coming out of the climate change convention.

5.2.5 Weak Government Institutions - Many institutional failures have been identified as contributing factors to deforestation. In most countries, forestry departments have a low status within governments relative to competing land uses, reflecting the economic power base in the countries. Typically, forestry departments are handicapped by poorly paid staff, inadequate budgets, lack of staff, and lack of staff training. As a consequence, the departments have been ineffective in successfully putting forth pro-forestry arguments to the political decision-makers and to the public at large. Even when there are adequate policies and legislation in place, the weakness of the departments in enforcing the law, resisting political pressures, and maintaining a field presence has bred contempt and indifference for the law.

Corruption in government has had a disastrous impact on forest conservation. It has been evident at all levels of government and includes such actions as influencing the granting of timber concessions and timber-cutting permits, giving approval to clear the forest for ranching or agriculture, undergrading the value of timber exports, condoning illegal logging, even allowing the cutting of endangered tree species. Government officials have looked the other way in return for under the table cash payments or for political support. The end result has been that government decisions have been taken with an eye to the personal benefits for the bureaucrats taking the bribes rather than to sustainable forest management, a loss in government revenues that could otherwise be used to fund sustainable forestry, and a lack of incentives for the private investors to practice sustainable forest management. Corruption also undermines the respect for forestry departments at large as administrators of the law. This has had a direct impact on people's attitudes towards the forestry departments' efforts to stop deforestation.

Although universally recognized as a problem, the lack of coordination of the policies of the various government agencies continues to frustrate sustainable development efforts. Narrow sectoral analysis and planning processes have led agencies to adopt conflicting objectives, having produced them without due consultation and consideration of their impacts on neighbouring sectors. Government leadership in land use planning has been universally very weak, due in part to a planning process that has been non-participatory in nature. If interest groups do not buy into the land use plan for their own perceived benefits, the plan becomes non-functional. Realizing this, international donor agencies are choosing to work more and more with non governmental partners that have strong links to the local populations.

Many government agencies, not only the forestry departments, have prepared ambitious plans that are far beyond their capacity to implement. The resulting failures contribute to the growing distrust and lack of respect for government and to the current disillusionment with government and its role in society.

Internationally, forestry has suffered from the lack of strong leadership. This has manifested itself countless times in international fora where forestry and forest-related concerns have received lower priority than other sectors by decision-makers when allocating resources.

5.2.6 Social Factors - Faced with political decisions about urban migration, food production, agrarian reform, employment generation, national security, economic structural adjustment, and all the other issues that demand their attention; many governments have opted to ignore deforestation. Deforestation has been a safety valve that has helped to take the socioeconomic pressure off other areas, thereby avoiding political turmoil that would inevitably come. While politically expedient, this has been a very short-sighted approach that is not in the long term interest of anyone.

In many cultures, "common" resources like publicly owned forests are not looked upon as opportunities for collective management of valuable resources. They are perceived as "free" commodities to be used by anyone, free from government regulation. Rather than being managed for the common good, they are abused and neglected. Without a sense of ownership, there is no incentive to manage the resource.

Special Interest Groups - Different Perspectives on Tropical Forests

Special interest group	Forestry perspective
environmentalists	- concerned about preservation of forests, conservation of biodiversity, and possible negative impacts of development (e.g. flooding, climate change)
small farmers	- interested in clearing the forests provides land to grow crops and provides family with economic security
ranchers	- interested in clearing the forests to sow pasture for cattle
foresters	- interested in managing forests for the sustainable flow of their goods and services and the maintenance of the biological functioning of their ecosystems
loggers	- interested in cutting commercial timbers to produce wood products
communities & indigenous peoples	- want more economic benefits from forests, guaranteed access for hunting and harvesting forest products, continued water supply
politicians	- developing the forests for agriculture or logging creates immediate jobs, prosperity and tax revenues for government; also temporarily relieves the pressures of need for farm land, jobs, and poverty alleviation
international community	- concerned about sustainable economic growth, the future of a world heritage, preservation of forests and their biodiversity

source: adapted from WCFSD;

In most countries, forestry development has been characterized by centralized planning and management of the resource. Government departments have been created to act as the public's custodian of the trees and the land upon which they grow. Forestry department activities like tax collection and cutting control have usually been more important than extension and cooperation with rural communities. As populations have grown and their demands on the resource increased, governments have begun to look for new, more democratic approaches to managing forests.

Many countries lack a "forest culture", an appreciation by the population of the value of forests to their society and a tradition of managing the resource for the collective benefit of all. Forests are often looked upon as impediments to development. In other societies, communities have traditionally managed their forests but recent changes in their political systems have destroyed the custom. For example, the forests of the Western Province of Zambia were managed by the Paramount Chief through the "induna" system where the harvest was regulated, taxes collected, fines levied, and a rudimentary system of forest management employed. This system, which functioned well for generations, was dissolved at independence. Rural people now have less respect for the forests because they do not perceive them to be theirs, rather they are seen as being the property of the State. Other land uses, like the cattle ranching industry in Latin America, have been a traditional part of the local culture since colonial times. The image of the cattle rancher is a role model much respected in Latin American societies.

In terms of forestry development, the types of interest groups can be very diverse - indigenous peoples, forest communities, small farmers, livestock herders, forest industrialists, forestry department staff, charcoal burners, basically any group that uses the forest resources.

One of the lessons of the last 30 years of trying to contain deforestation is that the people who are meant to benefit from the forests must be full partners in the process of identifying and implementing solutions. The word participation means many things to many people, and it is often described in forest conservation programs from the wrong perspective. References are constantly made to "involving the communities", "insuring people's participation", or getting a "consensus of stakeholders". The implication in these phrases is that the objective is to get the people to buy into some notion of development conceived by planners from outside the locality. It is mistakenly believed that the community's involvement through consultation will fine tune the planned activities of a project so it will be more successful. Those intentions, although well meant, approach participation from the wrong perspective. True participation is the process by which people identify their own problems and agree on a course of action to solve them. Governments can assist with the material and human resources that people do not have at their disposal. In this sense, participation really means government and development agencies helping people to solve their problems, not people becoming involved in projects conceived by government. The distinction between these two approaches is significant, with profound implications for conserving the tropical forests.

Participation can be both active and passive. *Passive participation* was the typical involvement witnessed in past decades when people were consulted after the conceptualization and planning of a project, when merely employing people was a measure of participation, or when people were the involuntary, and at times unknowing, "beneficiaries" of development projects. Essentially, development proceeded on people's behalf and in spite of them. Most efforts to curb deforestation met with resistance. *Active participation* is the current approach taken by many NGOs and too few government departments. In this case, people lead the development process to solve their problems according to their priorities. Their local knowledge of their forest and other natural resources and their traditional skills in managing them are the basis for development and for protection of the forest.

Participation means the self-empowerment of the resource users through their own efforts and their acceptance of both benefits and obligations. It means sharing power in the making of decisions, it means sharing the benefits that come from resource management, and it means acquiring tenure to the forest resource.

5.3 Direct Causes

5.3.1 Slash-and-Burn Farming - By far the most important agents of deforestation globally are the slash-and-burn farmers who live in or on the margins of all of the world's tropical forests. It is estimated that small farming families account for nearly 2/3 of all deforestation (Rowe et al, 1992).

long fallow shifting cultivation	short fallow shifting cultivation	forest pioneer farming
<ul style="list-style-type: none"> - long fallow rotation - traditional - mainly subsistence crops - mainly self-generated capital - far from urban areas - minimal to moderate cause of deforestation 	<ul style="list-style-type: none"> - short fallow rotation - semi-traditional - mixed subsistence & cash crops - mixed capital sources - intermediate distance to urban areas - moderate to serious cause of deforestation 	<ul style="list-style-type: none"> - no rotation - modern - mainly cash crops - mainly outside capital - close to urban areas - serious cause of deforestation

(source: adapted from Brown and Schreckenberg, 1998)

"Slash-and-burn" farming includes a diverse collection of farming systems from long fallow shifting cultivation to short fallow shifting cultivation to forest pioneer farming. Unlike traditional farming methods that were used in harmony with the forests' recuperative capacity, current slash-and-burn farming depletes the very soil resource upon which all agriculture and forestry depend. One of the strong commonalities of all slash-and-burn farmers is that they are among the poorest, most marginalized groups of their societies and have little or no influence on the important land use policy decisions made in their countries.

In his landmark book, *The Primary Source* (Meyers, 1992); Norman Meyers coined the phrase "shifted cultivator" to describe the peasant farmer who has left his traditional farm lands in search of new opportunities on the forest frontier. With a growing local population, restricted access to arable land, and few economic alternatives; the shifted cultivator has been forced to migrate to forested state lands to establish a new farm and homestead. The shifted cultivator is the typical slash-and-burn farmer of Mexico and Central America, the Amazon, parts of West Africa, the Philippines, and the settlement schemes in Indonesia -- the typical slash-and-burn farmers of the second half of the 20th century. They are unlike the traditional farmers who have practiced sustainable shifting cultivation for centuries. At times, the shifted cultivators have moved to ecosystems unfamiliar to them where many of their traditional practices are not applicable, as was the case of the Peruvian farmers who colonized much of the east slopes of the Andes.

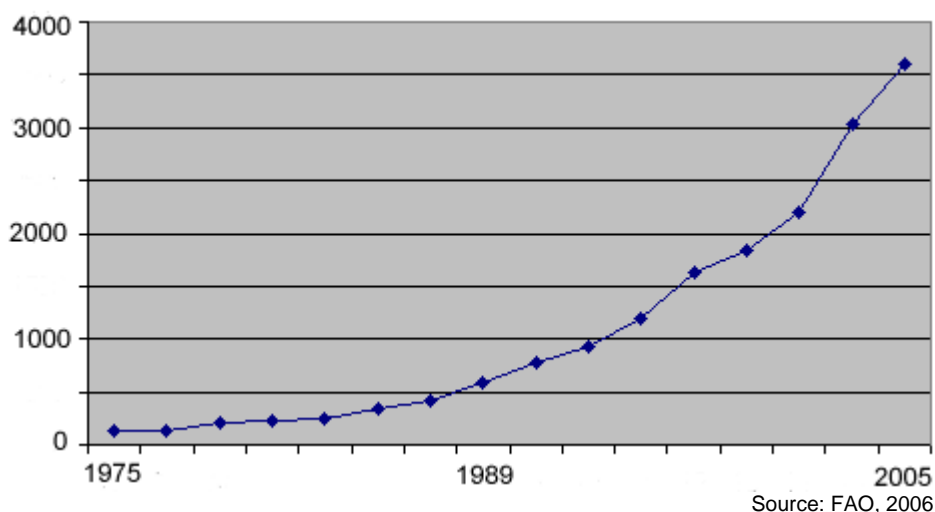
Rather than the villains of the deforestation cycle, small farmers are its victims. Prisoners of illiteracy and endemic poverty, and driven by the lack of access to arable lands and the lack of alternative employment opportunities, subsistence farming families must survive by clearing the forests to plant their crops.

Typically, they cultivate less than two hectares in a year and their important crops are corn, beans, cassava, plantains, and upland rice, depending on the region. Secondary crops include coffee, cacao, citrus and other fruits, vegetables, and a few head of livestock. In times of low population density and land abundance, slash-and-burn farming has been an environmentally sustainable and economically sound alternative for growing food crops on fragile tropical soils. However, as populations have grown and land has become scarce, farming has become more intensive, making it unsustainable with diminishing economic returns. Their farms are on soils not suited to

sustainable farming and, as a consequence, they must abandon their fields after two or three years of cropping and move on to new forests to clear. For most, it is a day-to-day fight for survival with their family's future dependent on the fortunes of the next uncertain crop. Their labours are rewarded by only meager cash incomes that keep them well below the poverty line.

5.3.2 Commercial Agriculture - In contrast to subsistence farming, commercial or plantation agriculture is often agribusiness practiced by corporations. Important plantation crops in the tropics include sugar, palm oil, natural rubber, coffee, cacao, and tropical fruits (bananas, citrus, etc.). Commercial agriculture's role in deforestation is two-fold. First, agribusiness can indirectly result in deforestation. Commercial farms occupy the best, most fertile agricultural soils located in the valleys. As a consequence, this land is not available to the growing rural population that depends on agriculture for their subsistence. Without access to farmland in their immediate area, farming families have had to relocate to less fertile, less productive forested land. In Honduras in the 1970s, thousands of small farmers and ranchers were displaced from the north coast valleys to make way for the establishment of oil palm cooperatives. They were pushed onto the steep forested slopes and benchlands and proceeded to clear them for farms and pasture.

Area of Oil Palm Plantations in Production in Indonesia
(thousands of hectares)



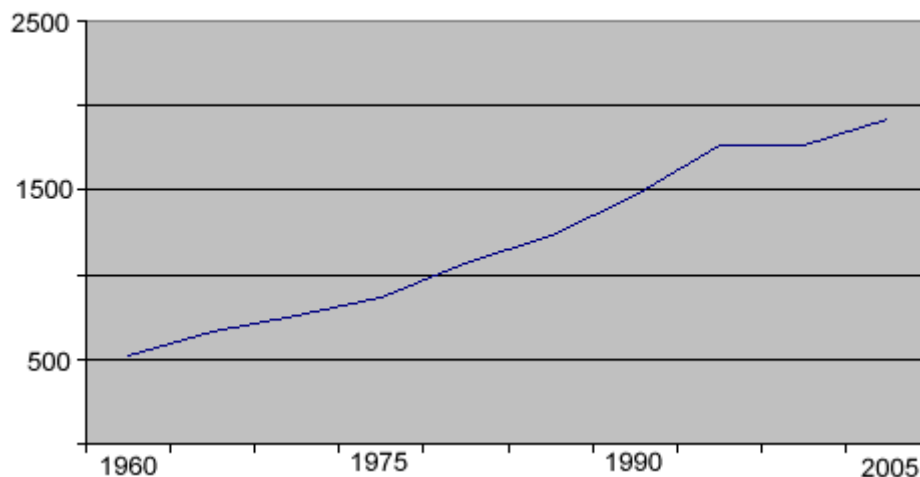
Second, agribusiness can be a direct cause of deforestation. Through a concession agreement, land purchase, or an informal land occupation; companies take possession of forested land with the intention of converting it to another use. As illustrated in the preceding graph, the area of oil palm plantations in Indonesia has skyrocketed in the last 30 years. This has been at the expense of the natural forests and of the fallow brush that comes in after slash-and-burn farming. The Indonesian experience with oil palm has been replicated in many other tropical countries in recent years. Examples of other important agricultural tree crops that are cultivated on forest lands include coffee, cacao, citrus, and rubber.

In addition to the negative environmental impacts that are common to all forms of deforestation, commercial agriculture often brings with it a series of problems related to the use of agrochemicals including deterioration of workers' health and the contamination of crops, soils, and ground water.

5.3.3 Cattle Ranching and Livestock Grazing - Cattle ranching, particularly in Latin America, is a major cause of deforestation. Ranchers either occupy large tracts of forests and clear the land themselves or they buy the "improvements" made by small farmers. Traditionally, ranchers favoured the more easily managed range and pasture lands of the dry forest zones, but for the last four decades there has been intensive clearing of the moist tropical forests in both South America and Central America. Open-range grazing as is practiced in the dry woodlands and savannas of Africa can be a major contributor to deforestation when herd populations exceed the carrying capacity of the range. It can also seriously degrade the composition and quality of the forest when practiced too intensively.

One of the more well-known regions where the expansion of cattle ranching has caused serious deforestation is Central America. Ranching has been part of the culture of rural Central America since colonial times. Dominated by large landowners, it was concentrated on the fertile valley soils of the central highlands of the isthmus and along the dry Pacific coast. With the opening of American markets for cheap beef and improved local infrastructure in the second half of this century, ranchers expanded their operations by moving into the humid forests of the Atlantic watershed. Cattle pasture was originally established in the flat valley bottoms on soils best suited for permanent agriculture, but eventually spread to the forests in the surrounding mountains. Many ranchers took possession of large tracts of forested land and contracted labourers to clear it with chainsaws and fire. A more common method of acquiring new pasture land was to purchase the "improvements" to the untitled land held by slash-and-burn farmers. These so-called "improvements" were little more than a few opening in the forest made by the farmers to plant their crops. After obtaining the squatter's rights, the rancher would then finish the land clearing, sow the grass, and fence in the property. Once the land was transferred to the rancher, the farmer would vacate the property and move deeper into the forest to repeat the same cycle of deforestation.

Central American Beef Production
(thousands of metric tons)



Source: FAO, 2006

Although reliable land use data is not available, it is estimated that the area of land under permanent pasture in Central America increased from 3.9 million hectares in 1955 to 13.4 million hectares in 1995 (Sunderlin and Rodriguez, 1996; FAO, 1998). The more than tripling of the pasture area was at the expense of the region's tropical forests. Ranching was a very attractive alternative to other land uses in that it was reasonably profitable in the short term, carried only moderate levels of risk and uncertainty, required little labour, and had well established markets with less volatile price fluctuations than other cash crops.

In conclusion, cattle ranching has been an important direct cause of deforestation in the latter half of this century, particularly in Latin America. The expansion of cattle pasture is closely linked to slash-and-burn agriculture through land speculation in forest land.

5.3.4 Mining and Petroleum Exploration - Mining and oil exploration are locally important to deforestation. Large mines like those of Carajás in Brazil and the Copperbelt of Zambia consumed vast quantities of indigenous woodlands to supply fuel to their smelting operations before plantations of fast-growing species were established. The impact of gold mining has been widely publicized, particularly placer mining in the Amazon, but its negative impacts have affected the indigenous peoples and the quality of the water more than the adjacent forests. Oil exploration activities, such as the clearing of the seismic lines in the forests of eastern Ecuador, not only destroy the forests but also open them up to colonization by subsistence farmers who follow the exploration crews.

5.3.5 Infrastructure Development - The construction of new roads has a profound impact on the forest. The Trans-Amazonian highway opened up millions of square kilometres of previously inaccessible forest to colonization and expansion of the cattle industry. Main arteries were soon followed by secondary roads that penetrate deeper into the forest, eventually producing a wide swath of deforested land on either side of the road. All roads that are constructed with the purpose of providing better access to less developed regions within a country tend to push up real estate values for non-forest uses and encourage land speculation and deforestation.

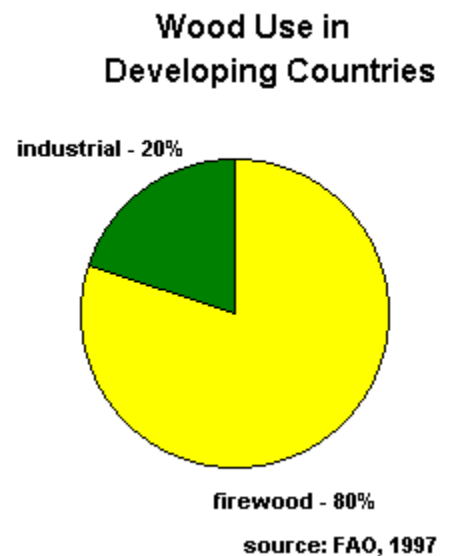
Logging roads are among the most important types of access roads that facilitate deforestation. Hydroelectric development is another important factor in deforestation. Reservoirs flood forest lands and transmission line right-of-ways are cut out of the forest to carry the energy to consumers, causing permanent losses of forest cover. Forests are also encroached upon by industrial and residential development as populations grow and cities extend outward.

5.4 Role of Forest Exploitation and Plantation Development

For the most part, firewood collection and logging are not direct causes of deforestation, however, they do produce a change in the composition of the natural forest and can increase the risk of a subsequent transition in favour of other land uses. In some circumstances, deforestation can result when harvesting occurs under very sensitive environmental conditions or when it is very intense over a long period of time. In the case of tree plantations, replacing the natural forest with plantations results in a loss of natural forest area but it does not cause deforestation because there has been no permanent change in land use.

5.4.1 Fuelwood Collection and Charcoal Making - Fuelwood is the most important wood product in developing countries where it accounts for 80 per cent of all wood used. Even with predicted fuel substitution from electricity, kerosine, and propane, it is not expected that this dependence on fuelwood will change significantly before the end of the 21st century. Worldwide, over 2.0 billion people use fuelwood as their principal source of energy, particularly in rural areas and particularly among the least privileged groups in society.

In many places, fuelwood collection, while not completely destroying the forests and woodlands, significantly impoverishes them and alters the habitat by the selective removal of preferred species. However, around urban areas there is often a ring of denuded land that has been stripped of all its combustible material by people trying to meet their basic energy needs. With very intensive collection over a long period of time, the original trees and shrubs lose their ability to coppice and die out, giving way to a different mix of plant species. Niamey in Niger and Lusaka in Zambia are two well known African examples of this process. Fuelwood is collected mostly from unregulated commons and, as a consequence, is very sensitive to overexploitation as the population increases.



5.4.2 Logging - FAO (1993) reports that there are almost six million hectares logged annually in the tropics and that the rate of logging has doubled in the last 30 years. Like most forest sector statistics, these estimates are not precise due to the poor record keeping and lack of field supervision of logging operations. The greatest increase in activity can be found in Asia and Latin America while the annual area logged in Africa has remained somewhat constant.

Very few natural forests in the tropics are managed professionally. Poore, in his well-known and much quoted ITTO study, estimated that the less than 1 per cent of the total productive forest area in the tropics was under some system of sustained yield management (Poore et.al.1989). Logging in the tropics does not in any way resemble scientific forestry and is often characterized by a "cut-and-get-out" mentality in logging companies. Forestry uses science and management skills to manipulate the natural vegetation to favor the long term production of a selected number of goods and services. In contrast, most tropical logging involves the short term exploitation of only industrial wood products with no eye to the future of the forests. This approach has led many observers to the conclusion that sustainable forest management is not possible in tropical forests.

Although the intensity of logging is low in most tropical forests with most of the original timber being left standing, there is high felling damage and residual waste, no long-term regulation of the harvest, and poor natural regeneration of commercially useful species. The intensity of logging in South East Asia's diptocarp forests is much higher than in the tropical forests found in Latin America or Africa. The removal of high volumes per hectare has led to serious degradation of the diptocarp forests, even causing their destruction in extreme cases where clear-cutting has been used. Poorly designed logging roads damage watercourses and cause severe soil erosion. The intrusion of men and logging machinery with the resulting changes in the forest ecosystem, displaces many forms of animal

life, particularly birds and larger mammals. Environmentally appropriate silviculture systems have failed in the tropics, not for ecological reasons, but because they lack the appropriate policy and strong institutional frameworks in which to operate. Without question, logging continues to be the principal cause of forest degradation in the tropics but not one of the principal causes of deforestation. However, there are examples of logging being the direct cause of deforestation. Intensive logging in South East Asia has resulted in the invasion of *Imperata* grass -- a noxious weed that excludes most other vegetation -- on thousands of hectares of once forested land. In this example, deforestation has occurred without the intervention of one of the competing land uses like farming or grazing.

In terms of its contribution to deforestation, the single most important failing of governments and forest products companies has been their inability to maintain a permanent forest estate. Sustainable forest management assumes that once the forest has been logged, it will remain a forest until the end of the rotation or to the end of the next cutting cycle and beyond. In most cases, this does not happen. When the logging is finished, the farmers, agribusiness agents, ranchers, and fuelwood collectors move in to clear the land for other economic uses. Previously inaccessible tracts of frontier forest are opened up by logging companies when they build new haul roads, open new skid trails, and remove a portion of the forest biomass, making it easy for the other land users to clear the remaining trees. In short, logging provides them access to the forests. Throughout the tropics, production forests are inadequately protected from this type of encroachment, despite the fact that management plans and concession agreements oblige both government and industry to do so.



Although usually well meant, many government policies in the forest sector are counter-productive in that they produce undesirable, unforeseen impacts that are detrimental to the sustainable development of tropical forests. For example, logging concession agreements are meant to be a tool to regulate the commercial exploitation of forests but they can have negative impacts on the resource and increase the susceptibility to deforestation. Concessions are given out for timber extraction without consideration to the other goods and services produced by the forest nor the impact exploitation can have on local people. Concessions are usually short term, often less than 10 years in duration and always less than the rotation of the timber crop. Without a long term commitment, the concessionaire has no incentive to protect the forest from encroachment or invest in forest management.

Stumpage, the tax the government charges loggers for buying public timber, is almost always lower than the real cost of forest management. This type of depressed pricing undervalues the resource and makes it appear less economically attractive to other land uses; i.e. it is an incentive to deforest. Low pricing encourages waste which in turn results in degradation of the forest and subsequent deforestation.

5.4.3 Tree Plantations - It is estimated that in 2005 there were more than 39 million hectares of tree plantations in 133 countries studied in this paper and the annual rate of plantation establishment during the last 15 years was approximately 527,000 hectares (FAO, 2005C). Globally, industrial plantations make up 48 per cent of the area planted and the remaining 52 per cent were community woodlots, agroforestry, environmental plantings, or the end use was unspecified. The objectives of the plantations varies substantially from region to region – from 6 per cent for industrial plantations in Oceania to 90 per cent in South America.

For the most part they are even-aged, single-species plantations. There has been a growing interest in Indonesia and Brazil in establishing plantations to produce fast-growing fibre of *Eucalyptus* and *Acacia* for the global pulp and paper industry. There are many issues concerning tree plantations that are not related to deforestation that will not be touched on here - e.g. sustainability, genetic impoverishment, soil depletion, danger of insect and disease. Large tracts of heterogenous natural forests have been cut down in the past to plant more uniform, more easily managed monocultures. The Jari project in Brazil is a well-known example of this practice, as are some of the recently established plantations in South East Asia. Large areas of forest fallow and "logged-out" forests in Indonesia are being converted to *Acacia* plantations to grow pulpwood. The current area of tree plantations of the "Top 20" deforesting countries is estimated as follows:

**Tree Plantation Area of the "Top 20" Deforesting Countries
(hectares)**

Country	Total Area Planted 2005	Annual Area Planted 2000 - 2005
Brazil	5,384,000	21,000
Indonesia	3,399,000	79,400
Sudan	5,404,000	-47,123
Myanmar	849,000	30,600
D.R. of the Congo		
Zambia	75,000	0
Nigeria	349,000	6,600
Tanzania	150,000	0
Mexico	1,058,000	0
Central America	274,000	12,600
Zimbabwe	154,000	0
Venezuela	766,000	19,400
Bolivia	20,000	0
Cameroon		
Ecuador	164,000	560
Paraguay	43,000	1,400
Cambodia	59,000	-2,600
Philippines	620,000	-46,400
Papua New Guinea	92,000	1,980
Ethiopia	491,000	0

Source: FAO 2005

The net annual area of new plantations established in the "Top 20" deforesting countries is approximately 77,000 hectares or less than one per cent of the 10.4 million hectares deforested in those same countries each year. Tree plantations have the potential to produce substantial benefits in terms of supplying wood and fibre and sequestering atmospheric carbon that could potentially outweigh the costs of losing natural forest. Carbon sequestration and storage is still an emerging issue and the values that will be assigned to carbon-sink plantations are still not known. In theory, the sequestration and storage values could substantially exceed those of the values of the wood and non-wood forest products. Universal standards will have to be developed to guide plantation establishment to ensure that natural forests are not destroyed in the name of ameliorating global warming. The vast areas of unproductive forest fallow found throughout the tropics could be made available for new plantations, making it unnecessary to disturb the remaining natural forests.

Are tree plantations a cause of deforestation? No, they are not. Along with the natural forests, plantations form part of a country's forest estate. True, they are different from natural forests in their species composition and complexity, in their contribution to biological diversity, in their management regimes, and in the benefits and values they bring to society but they are still forests -- a different type of forests. Analog forest plantations can also be the first step in a long-term strategy to restore degraded lands with forests of similar species composition and structure to the original forests. What constitutes a "forest" is an issue of public debate in some countries with many environmental groups proposing that plantations are not true "forests" and equating them to agricultural crops like corn or wheat. This is a debate that goes beyond mere semantics to our perceptions and expectations of forests' roles in the environment and their potential contribution to the welfare of Humankind.

It should be noted that the term "tree plantations" is understood in this issues paper to include only those plantations that produce wood and non-wood forest products. In South-East Asia, the term "tree plantations" is also used to refer to agricultural plantations like oil palms, rubber, coconuts, fruit trees, and the like. They are treated in Section 5.10 Commercial Agriculture.

6. CONSEQUENCES OF DEFORESTATION

In some cases, deforestation can be beneficial. Given the right mix of social needs, economic opportunities, and environmental conditions, it can be a rational conversion from one type of land use to a more productive one. The tragedy lies in the fact that most lands that have been deforested in recent decades are not suited for long-term farming or ranching and they quickly degrade once the forest has been cut and burnt. Unlike the fertile soils of temperate latitudes, most tropical forest soils cannot sustain annual cropping. The carrying capacity of the soil will not support intensive annual cropping without rapid, irreversible degradation. Similarly, intensive cattle grazing cannot be supported because grasses grown on forest soils do not have the same productivity levels as those on arable soils. In fact, there are very few forested soils in developing countries today that are available for future agricultural expansion, underscoring the urgent need to increase agricultural production on existing farmlands rather than converting more forests to farms.

In many cases, political decision-makers knowingly permit deforestation to continue because it acts as a social and economic safety valve. By giving people free access to forested lands, the pressure is taken off politicians to resolve the more politically sensitive problems that face developing countries, such as land reform, rural development, power-sharing, and so on. Nonetheless, the problems do not go away. They persist as do the injustices associated with them.

The social consequences of deforestation are many, often with devastating long-term impacts. For indigenous communities, the arrival of "civilization" usually means the destruction of their traditional life-style and the breakdown of their social institutions. Individual and collective rights to the forest resource have been frequently ignored and indigenous peoples and local communities have typically been excluded from the decisions that directly impact upon their lives. Many of the indigenous peoples of the Brazilian states of Amazonas and Rondônia have been encroached upon by slash-and-burn farmers, ranchers, and goldminers, often resulting in violent confrontations. The intrusion of outsiders destroys traditional life styles, customs, and religious beliefs.

Watersheds that once supplied communities with their drinking water and farms with irrigation water have become subject to extreme fluctuations in water flow. The loss of safe, potable water puts communities' health at risk for a variety of communicable diseases.

In economic terms, the tropical forests destroyed each year represent a loss in forest capital valued at \$US 45 billion (Hansen, 1997). By destroying the forests, all potential future revenues and future employment that could be derived from their sustainable management for timber and non-timber products disappear.

Probably the most serious and most shortsighted consequence of deforestation is the loss of biodiversity. The antiseptic phrase "loss of biodiversity" masks the fact that the annual destruction of millions of hectares of tropical forests means the extinction of thousands of species and varieties of plants and animals, many of which have never been catalogued scientifically. How many species are lost each year? The exact figure is not known, a consequence of our limited knowledge of tropical forest ecosystems and our inadequate monitoring systems. Some estimates put the annual loss at 50,000 separate species but this is an educated guess at best. Fragmented stands of trees left during deforestation are usually not large enough to be self-perpetuating in terms of maintaining even an altered balance of biodiversity. Deforestation is eroding this precious resource of biodiversity.

Although there is some debate about the rate at which the atmosphere is warming, there is general agreement that it is warming. The current average global surface temperature of 15C is nearly 0.6C higher than it was 100 years ago - most of the increase has been the consequence of human activity. Even though the 1990's were the warmest decade on record, the recent higher temperatures are very modest in comparison with the predictions for the coming years. Scientists now estimate that the average global surface temperature will rise another 1.4C to 5.8C by the end of the 21st century. This is due to the increase in the amount of carbon dioxide present in the atmosphere,



which has risen by about 25 per cent in the last 150 years. Although it is less than 1/20 of one per cent of the earth's atmosphere, carbon dioxide has a high capacity to absorb radiant heat (Woodall, 1992).

The negative consequences of global warming are catastrophic -- increasing drought and desertification, crop failures, melting of the polar ice caps, coastal flooding, and displacement of major vegetation regimes. The amount of carbon currently in the atmosphere is estimated to be about 800 billion tons and is increasing at the rate of about 1 percent annually. Deforestation is an important contributor to global warming, however, its contribution relative to the other factors is not precisely known. The principal cause of global warming is the excessive discharges in industrialized countries of greenhouse gases, mostly from the burning of fossil fuels. Annual discharges from burning fossil fuels are estimated to be about 6.3 billion tons of carbon, mostly in the form of carbon dioxide. It is thought that an additional 1.6 billion tons or about 25 percent of the total carbon dioxide emissions are a consequence of deforestation and forest fires (WCFSD, 1997). At the regional level, deforestation disrupts normal weather patterns, creating hotter and drier weather. Unfortunately, efforts to find solutions to the deforestation crisis has not been as success in capturing investment money as have improvements to automotive exhaust emissions.

The long term impact of deforestation on the soil resource can be severe. Clearing the vegetative cover for slash and burn farming exposes the soil to the intensity of the tropical sun and torrential rains. This can negatively affect the soil by increasing its compaction, reducing its organic material, leeching out its few nutrients available, increasing its aluminum toxicity of soils, making it marginal for farming. Subsequent cropping, frequent tillage, and overgrazing by livestock accelerate the degradation of the soil.

In the dry forest zones, land degradation has become an increasingly serious problem, resulting in extreme cases in desertification. It affects about 3,000 to 3,500 million hectares, about one-quarter of the world's land area, and threatens the livelihoods of 900 million people in 100 countries of the developing world. Desertification is the consequence of extremes in climatic variation and unsustainable land use practices including overcutting of the forest cover. Growing populations are making ever-increasing demands on the land to produce more, leading to an intensification of use beyond the carrying capacity of the land.

By 2050, two billion people, or 20 per cent of the world's population, will suffer from water shortages (WRI, 1994). Most of these people will be living in developing countries. Once denuded, the same watersheds lose their capacity to regulate stream flows and experience rapid fluctuations in stream and river levels, often resulting in disastrous downstream flooding. Water shortage is a major health risk in terms of inadequate sewage disposal, poor personal hygiene, and insufficient potable water. Food security is threatened as irrigation water becomes scarcer. Without the protection of the tree cover, soils are exposed to the rigors of severe tropical climates and are rapidly eroded. Freshwater and coastal fisheries are devastated by the high sedimentation loads carried by the rivers, as are wildlife-rich wetlands. Sedimentation from degraded watersheds is also one of the principal causes of the decline of coastal coral reefs. The economic and environmental costs are staggering.

7. ALTERNATIVES FOR SUSTAINABLE DEVELOPMENT

This section presents a series of alternatives to the status quo that could minimize the negative impacts of tropical deforestation. The alternatives are focussed on the forest sector, the land uses that compete with forests, and the government policies that guide development. They are grouped into three broad categories: the protection and management of remaining forests, socioeconomic development, and policy and institutional reforms. Some of the alternatives cover more than one of these general categories.

7.1 Protection and Management of Remaining Forests

7.1.1 Support for protected area networks - One of the most direct actions to arrest deforestation is to create networks of protected areas where the forests are protected from encroachment. The United Nations Conference on the Environment and Development (UNCED) endorsed the goal that nations protect 12 per cent of their area to conserve the natural flora and fauna. Although agreed to in principle, this good intention still falls far short of being a reality.

Greater support is needed to establish new protected areas and maintain existing national and regional networks of protected areas and biological corridors, strategically chosen as representative of the world's ecosystems and their biodiversity. Protected areas must be sufficiently large to be representative of the ecosystems in question and the stages of its natural succession. The support needed includes innovative funding schemes to provide the responsible agencies with guaranteed long-term funding for their field operations, institutional strengthening of government and non-governmental bodies, and enhancement of research, education, and training opportunities.

Protection measures should not be developed in isolation from the needs and expectations of the neighbouring population and other resource users. These measures must be acceptable tools to the societies in which they are applied. No one approach will work in all circumstances. Field staff must be adequately trained, reasonably paid, and sensitive to the perceptions of the local population. In order for the protected areas to have a chance at meeting their goals, human activities surrounding protected areas must be more sustainable. Environmentally sensitive development activities, such as sustainable agriculture, appropriate forest management, or ecotourism, should be encouraged in the buffer zones and even within some protected areas. Greater support is needed for the international conventions related to protected areas and their biodiversity -- Ramsar, CITES, and the biodiversity and climate change conventions signed at UNCED.

7.1.2 Adopt joint forest management and/or model forest approaches - In acknowledgment of the need to involve local people in the planning and implementation of programs to manage tropical forests, countries like India, Zimbabwe, and Honduras have developed new approaches to resource-sharing and co-management. They are characterized by agreements between government and the local communities that create true partnerships for the management and benefit-sharing of the forest resource. Given the appropriate policy framework, these successful experiences can be replicated elsewhere.

In 1991, Canada embarked on a program designed to establish a network of working models of sustainable forest development. The program was expanded internationally in the following year as part of Canada's commitment to UNCED. Model forests strive to bring resource users together to develop new forest resource management solutions. The network fosters international cooperation and information exchanges. Model forests supports the involvement of all interest groups in resource management decisions and the application of appropriate forest science and social science technologies.

7.1.3 Improve the quality of resource information base - Despite numerous forest resource assessments in decades past, our knowledge of the extent and composition of the tropical forest resource base is still woefully inadequate, particularly with respect to non-timber and as yet non-commercial values. Comprehensive resource inventories are needed, not only of the timber but other plant forms, fauna, soils, and water resources. Periodic monitoring systems are needed that measure changes in forest cover and relate them to changes in public policy and development programs in other sectors.

New technologies offer considerable promise in improving resource assessment. Remote sensing using radar imagery, geographic positioning systems, and geographic information systems can assist in assessing forest cover and identifying problem areas. Satellite-based systems have the advantage of being available to independent assessors who are not inhibited by national concerns of security or political sensitivities.

7.1.4 Adopt sustainable timber harvesting - For forests to continue to perform their vital environmental functions and to realize their enormous economic potential, they must be managed. Those forest management technologies that have been found to be successful should be used more widely as the first steps in moving from exploitative logging to wise forest use. Although there are many unanswered questions about truly sustainable silvicultural systems for tropical forests, there are many well-known practices that can be employed more extensively which will improve forest management and reduce the degradation of forests by logging and their susceptibility to deforestation. Measures could include operating under a management plan that reflects national standards for forest management, restricting logging to "production" forests, and improving access road and skid trail construction and maintenance, preserving forested buffer zones along watercourses, minimizing felling damage, and taking steps to ensure adequate regeneration of logged-over stands.



A permanent forest estate, using adequate and socially-appropriate protection measures must be in place for this to happen. Improvements in forest management require sincere commitments on the part of both government and industry to make real changes. Considerable awareness building directed at key decision-makers is needed for this to happen.

In the last five years, over 100 countries comprising about 90 per cent of the earth's forest area and trade in forest products have become involved in developing criteria and indicators for sustainable forest management. A number of independent initiatives have been started including the Montreal and Helsinki Processes which deal with boreal and temperate forests, the Tarapoto Proposal for Amazonian forests, and the Lepaterique Process for Central America. These criteria and indicators can be tools for assessing trends in the state of forests and in promoting sustainable forest management. The widespread interest has been stimulated by a desire amongst foresters to advance a common understanding of what sustainable forest management means and a common basis for monitoring and reporting progress on it. Criteria and indicators are not just concerned with the timber trade, rather they are a more comprehensive measure of forest management and go to the heart of the sector's regulatory environment. However, criteria and indicators will be useless unless governments are committed to using them to make policy adjustments inside and outside the forest sector.

There has also been a growing interest in timber certification as a means of encouraging producers to meet established environmental standards for timber harvesting. The Forest Stewardship Council (FSC) is an independent, non-profit, non-governmental organization that was founded in 1993 as an international accrediting organization for timber certification. Forest products bearing the FSC "green label" have to meet the organization's standards of forest stewardship as defined in the "Principles and Criteria for Forest Management." Certification holds much promise for raising the level of forest management, although there are critical issues that must be resolved before it can be really operational. One of the most difficult issues is the issue of chain of custody and the logistics of separating certified wood products from non-certified as they travel from the woods, to the mill, and eventually to the retailer. Certification can assist in reducing degradation by curtailing illegal wood cutting, normalizing forest operations through the use of management plans which include protection measures and controls to limit the indiscriminate conversion of natural forests to plantations. Measures that improve forest management and forest-derived benefits will reduce the risk of deforestation.



7.2 Socioeconomic Development

7.2.1 Improve productivity of subsistence agriculture and extensive ranching - Of particular concern to the forest sector is the low productivity of subsistence agriculture and extensive livestock ranching. There has been very little investment in the agricultural sector to improve these activities, given their relative importance to the large numbers of people involved. Investments in the agricultural sector have favoured commercial farming, state-supported agricultural co-operatives, and corporate ranching ventures that are typically located in the arable valley bottoms. For the marginal hillside lands; viable alternatives to traditional methods do exist -- techniques such as minimum tillage, contour plantings, composting, ground covers, fodder trees, and deferred grazing. Additional investments in extension services to promote these alternatives are urgently needed, as are innovative credit schemes that will give farmers access to the financial resources they require to improve their farming methods. Greater productivity from the existing farm and range lands will reduce the pressure to convert more forests to these uses. Support is also needed for collaborative research programs in farming systems and animal husbandry that work closely with farmers and ranchers to find new, improved ways to increase the sector's productivity.

7.2.2 Promote the use of agroforestry - Agroforestry is the practice of growing trees with agricultural crops or livestock on the same parcel of land. Well-known examples of agroforestry are windbreaks, hedgerows, and mixed home gardens where trees form an integral part of the property. It has proven itself to be an effective tool for improving land use and for increasing overall agricultural productivity. It is particularly appropriate for resource-poor farmers who cannot afford the escalating cost of fertilizers, pesticides, improved seeds, and other modern farm inputs. As population pressures rise and tree cover disappears, farmers become more willing to plant agroforestry trees on their property to meet their requirements for wood products, firewood, poles and posts, tree fruits, and animal fodder.

Many agroforestry extension projects have successfully increased crop production by 25 to 100 percent by using multipurpose trees to arrest soil erosion, enhance soil fertility, and provide a favourable micro-climate for crops and livestock. At times farmers have been reluctant to adopt new agroforestry technologies, a problem usually related to the types of extension programs used, the degree to which farmers were true participants in the development of extension packages, the type of socioeconomic research done prior to project start-up, farmers' perceived risks and uncertainties, and the other economic opportunities present. Extension projects have found their greatest success when implemented by non-governmental organizations (NGOs) as part of more general development programs.

7.2.3 Expand the area of tree plantations - Industrial plantations of fast-growing trees have a great potential for satisfying much of the demand for forest products and, at the same time, reducing the need to exploit the natural forest. However, caution must be exercised to ensure that the opposite effect does not occur. If plantations diminish the perceived value of the neighbouring natural forests by replacing them as suppliers of forest products, then the natural forests could come under greater pressure to be converted to other land uses thought to be more beneficial to the local population. When deforestation is being driven by demand to open new forest lands for farming, plantations will not help to reduce the pressure. However, in those cases where the exploitation of natural forests for wood products is an important factor in driving deforestation, then tree plantations could have a potential to reduce the pressure.

The successes of countries like Brazil and Zimbabwe show how industrial plantations can be managed in an environmentally sustainable manner and profitably grow the raw material for a thriving local forest products industry. If they are established on degraded forest land or non-forest land, plantations can significantly improve land use productivity. Tree plantations should be expanded only if:

- they are integral part of a broader, participatory land use plan;
- they do not involve the clearing of natural forests;
- they are accepted as an appropriate land use by the local population; and
- their ecological and social impacts are positive, to the degree possible (WCFSD, 1997).

It has been estimated that all of the world's demand for pulpwood could be met by plantations that would occupy only 3 per cent of the world's forest area, allowing much of the remaining natural forests to be managed for environmental objectives (WCFSD, 1997). While the economics of producing high-value tropical hardwoods like teak from plantations is questionable, fast-growing plantations of eucalyptus, acacia, and pine have proven very successful in producing fibre, lumber, poles, and firewood. With growth rates that can reach 40 cubic metres per hectare per year or much more for clonal stock, plantations can produce many times more wood volume than the natural forests can in the same time period.



To reverse the trends in global warming, it will be necessary for the nations of the world to dramatically reduce their dependence on fossil fuels and to reduce the current rate of deforestation. Sequestering atmospheric carbon by planting trees is one means of combating carbon buildup. It has been estimated that 100 to 200 million hectares of new forest would be needed for each 1,000 million tons of annually sequestered carbon (Woodwell, 1992). Five million hectares (FAO, 1997) are currently being planted every year. Therefore, an intensified effort to double the number of plantations established for the next 30 years would provide a carbon sink capable of sequestering one-eighth of the present global level of carbon emissions.

7.2.4 Restore degraded lands - It is estimated that there are nearly 200 million hectares of degraded land in upland watersheds of tropical countries (Anon. 1985). There is an additional area of degraded lowlands that have not been suitable for sustainable agriculture or livestock raising. Much of this degradation is the result of past deforestation. For all those lands that now lie abandoned or under-utilized, every effort should be made to bring them into more productive use. Tree planting and the protection of existing vegetation from fire, grazing, and land clearing should be encouraged and the appropriate incentives offered. Afforestation with multiple-use species will have the benefits of renewing the watersheds' ability to regulate groundwaters, reducing soil erosion, producing useful commercial crop, as well as sequestering carbon from the atmosphere. These are real environmental and economic benefits.

For some time now, there has been a growing interest in the use of indigenous shrub and tree species to reforest and restore previously deforested land. This is done with an eye to enhancing the other values of the forests beside wood production - e.g. restoring the biological diversity or producing non-wood forest products. Analog forestry shows much promise in re-establishing forest ecosystems that are analogous in structure and ecological function to the original vegetation.

7.3 Policy and Institutional Reform

7.3.1 Enhance participation in decision-making and benefit sharing - In the past, many worthwhile, technically-sound initiatives failed to arrest deforestation because they were conceived without the true participation of all interest groups (communities, companies, local government, and other land users) in their planning and execution. Controlling deforestation must take into account the special interest groups from within the forest sector and the other sectors that share, and at times compete for, the same land base. The need for this type of cooperation is particularly true of the agriculture, forestry and conservation, energy, and water sectors. Win-win situations are possible when agroforestry is used as a tool for soil conservation, when the health sector uses the management of micro-catchments for potable water supplies, when watershed management is used to improve water flows to irrigation systems and when improved firewood supply satisfies energy needs. Supporting the formation and functioning of natural resources user groups would be a positive step to enhancing participation. Natural resources must be managed more holistically, recognizing the interdependence of all sectors. Of particular importance is deciding on a just formula for sharing in the benefits and responsibilities that derive from using forest resources sustainably as an alternative to deforestation. Furthermore, the formal involvement of natural resource user groups in government decisions on the allocation and use of forests would contribute to reducing corruption in government.

7.3.2 Invest in more research - More support is needed for national and international research into forestry and other land uses for combating deforestation. Research priorities include:

- documenting the underlying causes of deforestation and the measures to address them;
- assessing and monitoring the changes in forest land use;
- developing appropriate agroforestry systems for marginal lands;
- implementing appropriate forest management practices for tropical forests including protection measures that are acceptable to local people;
- undertaking tree breeding for fuelwood and industrial plantations;
- enhancing the participation by local people and more effective roles for local institutions;
- developing mechanisms for conflict resolution between resource users;
- studying the valuation of goods and services of forest resources, both timber and non-timber products;
- cataloging the richness of biodiversity, its distribution and potential economic value;
- assessing the impact of public policy on deforestation; and
- and documenting the traditional knowledge of forest products.

This should include support for the strategic and applied research being undertaken by the Centre for International Forest Research (CIFOR), the International Centre for Agroforestry Research (ICRAF), and national research centres.

7.3.3 Reform government policies and institutions - Reforms to natural resource policies and other policies affecting forest lands should be given the highest priority. Before project-level or community-level interventions can have a meaningful effect, national policies must encourage sustainable management of forests. Forest policies should reflect the environmental importance of the forests as well as their economic value and the appropriate roles of the public and private sectors in implementing the policies. The adoption of national-level criteria and indicators would provide a policy framework for sustainable forest management. In addition to the other policy-related issues mentioned in this section, the following policies should be reviewed where appropriate:

- remove fiscal incentives that subsidize competing land uses, particularly agribusinesses and cattle ranching,
- establish effective natural resource accounting within national economic planning which recognizes the true value of forest products and services as well as the costs of liquidating existing natural resource capital,
- extend agricultural extension services to slash-and-burn farmers,

- introduce a property tax formula that encourages landowners to develop their properties to their potential and conserve natural forests,
- require all government-sponsored projects and private developments to pass an independent environment impact assessment,
- adopt ecologically-based land use planning with full participation of resource users,
- insure that the national economic accounts reflect the depletion of natural resource stocks when calculating economic growth and progress,
- give priority to establishing the scientific infrastructure and human resource capacity to conduct forest-related research,
- ensure that settlement programs are located well away from forested areas, or at least do not impact negatively on ecologically sensitive areas,
- grant of clear land title, or at a minimum user rights, to the slash-and-burn farmers who live on the forest margins,

Incentives that encourage deforestation and other destructive land use practices should be reformed and replaced by policies that encourage the sustainable use of natural resources. The true costs and benefits of incentives must be determined prior to implementation. Land-use policy reforms are needed to secure long-term commitments to sustainable forest management. Adequate resource tenure systems must be adopted that provide security of supply for producers while protecting long-term public interests and ensuring a stable environment. In the agricultural sector, small farmers require secure tenure to invest in farm productivity. This will help relieve some of the pressure to deforest. Caution must be exercised when implementing a land titling program to avoid land speculation.

World leadership in forestry is weak. This is one of the underlying reasons why forestry institutions have not been able to command the attention of political decision-makers and capture the support needed to address deforestation. The current problems and trends include weak monitoring of the status/trends of forests and related resources; lack of strategic studies; shortage of policy guidelines and focussed research; increasing confusion among proliferating international programs; and increasing conflict between countries and regions regarding forest sector development and trade ([Roberts and Nagle, 1997](#)). A critical objective of institutional reform will be to enhance the effective representation of ministers responsible for forests (and not surrogates from agriculture, trade or environment ministries), the commercial private sector and representative citizen groups.

The World Commission on Forests and Sustainable Development (WCFSD, 1998) has recommended the creation of a citizens' forum, "ForesTrust International" for the monitoring of forest policies and the condition of the world's forests. ForesTrust International would have counterpart organizations at the national level that would act as watchdogs. There would be forest ombudsmen to provide independent opinions on disputes that arise between the various special interest groups. Such measures will be important in the transition phase of creating a new forest governance structure such as the proposed Global Alliance for Forests and Sustainable Development (GLOBALFOR) ([Roberts and Nagle, 1997](#)). Reform of international forest institutions is urgent if deforestation is to be arrested. These reforms could result in fewer institutions at lower total cost and with increased resources for more effective global forest-related activity.

7.3.4 Determine the social and economic value of forests - The long-term future of the tropical forests and their environmental health depend largely on how the forests are perceived by people. If they are considered worthless, mere impediments to the economic growth and prosperity of other sectors; tropical forests will surely be lost in a matter of a few generations. If the forests are to survive, they must be of value to the people who might otherwise destroy them and the benefits derived from them must be distributed fairly.

Traditionally, forests have been undervalued. By not collecting forest-user taxes that reflect the true value of the resource and the cost of managing it, governments have discouraged sustainable management and the long-term investments needed to make forests more productive. Stumpage, user fees, and other forms of revenue should, at a minimum, provide the state with sufficient revenues to manage the forests and, if possible, generate surplus revenues for the public treasury. Forest-derived benefits can be enhanced by:

- adopting tenure systems that recognize co-management of the resource by the government and local communities;
- by practicing more intensive silviculture; by making more efficient use of the resource (more species and greater recovery per species);

- by recognizing the important role that forests play in water supply;
- by more effectively marketing non-wood forest products;
- by capitalizing on the ecotourism potential of the tropical forests;
- by adopting policies that provide society a fair return from the exploitation of its natural resources; and
- by ensuring long-term management of the forests.

Each country should find an institutional mechanism appropriate to local conditions that will permit the acknowledgment of indigenous peoples rights and recognition of their cultural and spiritual values related to the forest.

7.3.5 Support education and awareness-building about forest sector issues - More support must be given to public education and awareness-building campaigns. Using both environmental and socioeconomic messages, campaigns must target the general public and the political/economic decision makers. Awareness-building must reach audiences living in the cities and in the country, adults and children, rich and poor. Decision-makers in developing countries must understand the causes and consequences of mismanagement of the tropical forests, the potential benefits of sustainable use, and the appropriate, alternative actions they can take. Campaigns must move beyond the "beauty-of-nature" focus or the "for-the-good-of-your- grandchildren" appeal. Sound, quantifiable arguments must be made about the economic and social benefits of wise use of the forest resources and the high costs of deforestation. It is only through an informed public and informed leadership that the political will can be found to make the tough policy decisions required. On another front, much can be done to educate the public on the consequences of their consumption patterns on tropical deforestation so they might make informed choices in the marketplace.

7.3.6 Participate in National Forest Programmes (NFP) - In the wake of decades of less than successful attempts to arrest deforestation, it is now understood that more holistic solutions are needed that involve other sectors in the process. While this approach is quite correct, it should not exclude the possibility of the forest sector putting its own house in order. To achieve the goal of environmental sustainability, new approaches to development cooperation must be found. Greater coordination of actions between the various sectors at the national level is needed as well as greater cooperation among donors. NFP is an internationally coordinated effort by national governments, NGOs, and donor agencies for forest sector development. An NFP brings together the various stakeholders in a country's forest sector to work together on a national development plan that truly reflects society's constraints and opportunities. Many forested countries in the developing world and many donor agencies are involved in the NFP process.

National planning for the development of natural resources should be based on land-use planning that takes into account not only the short-term economics of alternative land uses but also the long-term capability of the environment to sustain the proposed use. To be "do-able", they must be technically sound and have the active participation of a broad spectrum of forest resource interest groups. They must also be realistic and account for the inevitable forest area losses that will occur in the next century. Many of the remaining tropical forests will disappear in the coming decades, so it will be important to prioritize the forests that should be managed as production forests and protection forests. This will require a rationalization of scarce resources -- forest to forest, country to country, and region to region.

8. INTERNATIONAL DEVELOPMENT ASSISTANCE

The Tropical Forestry Action Program (TFAP) was the most ambitious, internationally coordinated effort to address deforestation to date. TFAP initiated national forestry action planning on an unprecedented scale, raised public awareness of the impacts of deforestation, and captured substantial new resources for forestry development. Yet, TFAP is considered to have been a failure. Why? It did not stop deforestation.

Criticisms of TFAP were that weak leadership was provided by FAO, it was donor-driven and lacked adequate grassroots participation, there was a basic misunderstanding of the causes and potential solutions to deforestation, planning was not multisectoral, the absorptive capacity of national governments was not reflected in the sectoral action plans prepared, and it was too industry-focussed and did not take into account the conservation aspects of forestry. Some criticisms were more valid than others, but the result has been a loss of momentum in international

support to control deforestation. Development assistance funding to forestry and conservation has plummeted in recent years.

The 1992 United Nations Conference on Environment and Development in Rio de Janeiro brought forestry issues, in particular deforestation, to the world stage. The proposed Forest Convention did not materialize but the Conference spawned a series of international initiatives related to promoting sustainable forest management -- the Intergovernmental Panel on Forests, the Intergovernmental Forum on Forests, the World Commission on Forests and Sustainable Development, and initiatives related to criteria and indicators and timber certification.

The need for a coordinated approach to international assistance efforts remains as important today as it did when TFAP started over a decade ago. The international community can assist developing countries in their struggle to control deforestation by renewing their long-term commitment to addressing deforestation and by giving their active financial and technical support to:

- helping establish global priorities (geographic priorities and intervention priorities) for the use of limited resources available,
- supporting national initiatives to better conserve and manage the remaining forest areas,
- coordinating external assistance in order to maximize the benefits to recipient countries,
- investing in long-term capacity building of national institutions,
- requiring independent environmental impact assessments for all bilateral investments,
- partially or completely forgiving of public debt,
- supporting global initiatives to provide stronger leadership within the world community like the creation of ForesTrust International or the Global Alliance for Forests and Sustainable Development,
- creating the office of an independent "auditor" to monitor the performance of governments and multilateral organizations in arresting deforestation.

Until a better mechanism is agreed upon, international development assistance can be best coordinated through a national-level forest planning office that has the full support of the highest levels of government, the non-governmental organizations, the forest dependent communities, the private sector, and other interest groups.

The United Nations Forum on Forests (UNFF) recognizes of the important role of forests in achieving the Millennium Development Goals, in eradicating poverty, and in maintaining environmental stability. Deforestation has been one of the critical issues being discussed at the UNFF Sessions that are attended by the United Nations member states and specialized United Nations agencies. In the February 2006 resolution of its Sixth Session, the UNFF established four global development objectives for forests that included the reversal of forest loss and the increase in ODA and other funding sources for sustainable forest management (Anon. 2006). As noted in this paper, the principal cause of forest loss is tropical deforestation and to reverse it will require substantial new investments.

9. CONCLUSIONS

Is it possible to stop deforestation? It is unlikely in the foreseeable future, but the rate of deforestation can be slowed down considerably and its negative socioeconomic and environmental impacts can be minimized. Based on the most recent estimates of the rates of deforestation, and assuming that 75 per cent of forest losses are attributable to agricultural expansion, it is estimated that over the next 25 years the agriculture sector will require an additional 250 to 300 million hectares of new land to accommodate the demands of commercial farming, subsistence cropping, pasture and range development. Most of this increase in land area will come at the expense of tropical forests. The agriculture sector must be challenged to find appropriate solutions.

Any effort to combat deforestation must be based on a complete understanding of who the agents of deforestation are and what its direct and underlying causes are. The circumstances vary from country to county and from region to region. Through improved protection and management of the remaining forests, through well-targeted socioeconomic development programs, and through policy and institutional reforms; deforestation can be brought under control. While forests will continue to be lost for decades to come, it is critically important that the fight

against deforestation be done in the most rational way possible. Only then will the long-term benefits to humankind be favourable and the costs to the environment minimal.

No other forest-related issue approaches tropical deforestation in its importance to the long-term well-being of our planet. The technologies for making a difference are known, so are the approaches needed to implement them. It is time for all peoples to renew their commitment to live in harmony with the tropical forests before they are lost forever.

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