FORESTS OR FIELDS: A RESPONSE TO THE THEORY THAT TROPICAL FOREST CONSERVATION POSES A THREAT TO THE POOR

PHILIP M. FEARNSIDE
Department of Ecology
National Institute for Research
in the Amazon (INPA)
C.P. 478
69.011 Manaus-Amazonas
BRAZIL

Fax: 55-92-236-3822

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ABSTRACT

The theory that tropical forest conservation poses a threat to the poor has been put forward by David Wood in a paper entitled "Forests to Fields: Restoring Tropical Lands to Agriculture," published in Land Use Policy (this issue). Wood proposes to open to deforestation almost all of the tropical forests that are still standing. Conversion to non-forest uses would be promoted through increased flows of international funds with less provisions than such projects presently have regarding sustainability and environmental protection. These proposals are unwise and dangerous.

Wood's justification for unleashing deforestation rests heavily on the history of shifting cultivation practiced by tribal groups in most tropical forest areas at some time prior to European contact. He reveals a profound lack of understanding of the arguments for tropical forest conservation, which do not depend on forests having been forever 'pristine.' Wood also greatly exaggerates the capacity of tropical forests to recover from deforestation, as well as the prospects for agricultural sustainability in deforested land. Sacrificing the remaining forests would do nothing to address the major factors underlying poverty in developing countries. Dividing the resource pie more equitably and recognizing carrying capacity limits would only be postponed for a brief moment by the proposed sacrifice. By destroying tropical forests, Wood's proposal would destroy one of the most valuable potential resources for sustaining local populations in tropical forest areas: the environmental services of the forests.

I.) THE ATTACK ON CONSERVATIONISTS

David Wood (nd) proposes in a paper entitled "Forests to fields: Restoring tropical lands to agriculture" that present and planned protected areas in tropical forest areas be drastically reduced to allow deforestation for expansion of agriculture. He alludes to the "threat" to developing countries posed by the "conservationist lobby" made up of "trans-national conservation bodies" with "multi-million dollar budgets." The World Bank is portrayed as dangerously influenced by "pressure" from conservationists, whose allegedly unreasonable demands are hindering development to feed the masses in the Third World. This does not sound like the same World Bank that I know, where environmental concerns have very little influence and where the vast majority of funding is definitely not going either to feed the poor or to protect the environment. See Rich (1990) for a review of the Bank's recent record in these areas. Wood even argues

that "a substantial part of the funds now spent on tropical forest conservation should be allocated to agricultural development".

"Environmentalist groups and scientists" are accused of advancing "conservationist objectives" based on arguments that tropical forests are pristine in the sense of never having been disturbed by humans, and that deforestation is irreversible on any time scale. Let me make clear at the outset that arguments for maintaining a substantial part of the remaining tropical forests uncleared are both valid and compelling; they are not dependent on forest being "pristine" or on deforestation being forever "irreversible." Ironically, it is the same scientists that Wood attacks who have progressively brought to light information on prehistoric disturbances in tropical forest areas. Wood's implication is unfounded that underestimation of the extent of prehistoric clearing in tropical forests is a deliberate deception perpetrated by "conservationists, who have some interest in establishing that present tropical forest is 'natural'". In fact, I suspect that I myself was the first to show through any sort of systematic soil survey that charcoal is present in soils under Brazil's "virgin" forest over substantial continuous areas (Fearnside, 1978). This pattern has since been found repeatedly, including studies near Manaus (Basseri and Becker, 1990) and in Colombia and Venezuela (Sanford et al., 1985; Saldarriaga et al., 1986). In the Manaus area I have found charcoal throughout the reserve system of the INPA/Smithsonian Institution "Minimum Critical Size of Ecosystems" project (see Lovejoy and Bierregaard, 1990: 62), as well as in other INPA reserves, and have dated samples at 675 and 1080 years before present. Better knowledge of the extent of anthropogenic black soils in Amazonia also points to widespread human occupation (Smith, 1980). It is not true that "the credibility of tropical forest conservation programmes will be in doubt until we have more reliable information on past use of forested lands," as this is not the basis of arguments for avoiding deforestation.

A previous history of clearing does not render deforestation "environmentally benign," as Wood puts it (see Fearnside, 1988a for a review of the environmental impacts of deforestation).

II.) THE SCENARIO FOR UNFETTERED DEFORESTATION

Wood's paper proposes opening virtually all tropical forest to deforestation for agriculture, allowing any forest previously cleared by humans to be converted to agriculture, and shifting the "burden of proof" to "conservationists" for demonstrating lack of any history of previous use. The basic premise is that any previous clearing, even if thousands of years in the past, invalidates the arguments in favor

of establishing reserves. Only a few remnants of different vegetation types (including the majority that have been disturbed at some time in the past) need to be maintained for a future role as sources of wild organisms to recolonize an agricultural landscape that has been temporarily "borrowed" from the forest. According to Wood's scenario, this land would no longer be needed once human population naturally stabilizes and increases the intensity of its use of cleared land, so as to be satisfied with the off-take from a smaller area. In the first place, it should be made clear that Wood's scenario for the future stabilization and retraction of agricultural demand for land is totally unrealistic. Among its unfounded premises is the unmentioned assumption that land is only or mainly used for producing food for subsistence -- a commodity with a limited demand that is constrained by the size of people's stomachs. In fact, most deforestation in the tropics is being done for other reasons.

Brazil, it should be remembered, has by far the largest area of remaining tropical moist forest, and the importance of events here can be expected to increase even more as the forests of other tropical countries continue to succumb to deforestation. In Brazilian Amazonia, most deforestation is for low-productivity cattle pasture, much of which is planted as a means of securing land claims that produce profits through land speculation and other activities not related to beef production (Fearnside, 1987a, 1989a,b; Hecht et al., 1988). Wood's frequent references to "farms," "farmers" and "agriculture" conjure up bucolic images of an agrarian society and landscape that are far from the realities of Amazonia. As of 1985, when Brazil's last agricultural census was carried out, 62% of all private land in the Amazon Region was in ranches over 1000 ha in area, while only 11% was in properties less than 100 ha in area (Brazil, IBGE, 1989). Even in properties less than 100 ha in area most deforested land sooner or later winds up as degraded pasture.

In 1991 approximately 70% of the deforestation activity took place on large (>1000 ha) and medium (100-1000 ha) ranches, while only 30% was in properties less than 100 ha in area (Fearnside, nd-a). In 1991 the rate of deforestation was 11.1 X 10^3 km^2/year (in the portion of the region considered to be originally forested, thereby not including the cerrado or Central-Brazilian scrubland included in a number of estimates made prior to 1989). This rate is half the comparable average rate that prevailed from 1978 to 1988 -- the proportion cleared by large ranchers would be even higher in "normal" times when Brazil's perennial economic recession is less severe. The reduction in clearing rates between 1987 and 1991 can be largely

attributed to the deepening economic recession that left ranchers without money to invest in clearing at the rates that prevailed in the past. Subsistence clearing using family labor is relatively immune to the vagaries of the business cycle; the substantial reduction in deforestation rate reflects the vast majority of Brazil's Amazonian clearing that has nothing to do with feeding the poor.

III.) WOOD'S ARGUMENTS

A.) The need to increase food production

Population growth is seen as completely unimpeded -- an independent variable to which land use will have to adapt. The distribution of income and of access to land are also tacitly assumed to be immutable. Societal changes can make substantial differences in the numbers of people that can be fed: most of the world's hungry cannot feed themselves because they have no money, even though the countries in which they live may have surpluses for export (e.g. George, 1977; Lappé and Collins, 1982; Lappé et al., 1979). However, under any social system, the population must ultimately conform to the land's capacity to support it. No recognition is given to the interaction among these factors. Equilibrium can be reached with or without any forests left, and there are strong reasons for every country to chart a course of development that provides for maintaining substantial areas in forest. I would argue that it should not be taboo to think about either population or income distribution as a factors subject to human planning -- people have to decide the future scenario that they wish to aim for and adopt the policies (including population policies) that will achieve those goals. Feeding the maximum possible number of people should not be, and in fact is not, the goal of any country.

In discussing the equilibrium between population and resources, I hasten to point out that the levels of land intensification and farming technology are not stationary. A longstanding academic debate surrounds the question of whether population increase leads to intensification (Boserup, 1965), or vice versa (Geertz, 1963) -- or, as is more likely the rule, a simultaneous co-evolution of both occurs. Although the role ascribed to carrying capacity in cultural changes has often been unfounded, carrying capacity sets real limits that must be respected in development planning (Fearnside, 1986a). Population and technology change together, but nothing guarantees that the courses these changes take can be sustained for long. The ability of any given area of land to support a human population can go up due to technological change -- and it can also go down due to environmental

degradation and resource exhaustion. The possibility of technological change in no way frees human societies from coming to terms with how the balance is struck between population and resources, including the resulting income distribution and average level of consumption. Wood's emphasis on promising prospects of fertilizer-based agriculture and agroforestry (in addition to unwarranted assumptions to be discussed later) is essentially an expression of faith in future intensification and technological change; paradoxically, he also assumes a disintensification in the case of shifting cultivation -- reversing the unsustainable acceleration of fallowing cycles that has already occurred in much of the tropics.

Wood's view of the role of population in tropical forest destruction is a common one, but is largely unfounded. He states that "in Latin America, the major response to population pressure has been the expansion of agricultural land area, involving widespread deforestation of lowland forest." In fact, the massive migrations of populations into lowland forest areas in Latin America owe most of their impetus to increasing concentration of land tenure in the migrant source areas rather than to population growth. Migration from northeastern Brazil to the Transamazon Highway is one example (Fearnside, 1984a, 1985, 1986a). Migration to Rondônia from Paraná has been mainly from a combination of land tenure concentration and a trend to replacement of labor-intensive crops such as coffee with mechanized cultivation of soybeans and wheat (Fearnside, 1987a,b, 1989c; Zockun, 1980). An excellent example from Central America is the migration from El Salvador to Honduras that led to the "soccer war" in 1969: this conflict, which had been thought to be a classic population war (Ehrlich and Ehrlich, 1970: 311), had its roots primarily in displacement of small farmers in El Salvador by wealthy landowners who plant cotton and other export crops on the country's best land (Durham, 1979).

Despite the fact that the strongest immediate causes of deforestation are usually not absolute numbers of population, it is true that every country as a whole and every region within each country must eventually face the limits of carrying capacity. An implicit choice is being made regarding the form of this equilibrium when new settlements are promoted in tropical forest areas. Many settlement schemes in Latin America are expensive and temporary means of postponing coming to terms with more politically controversial issues such as agrarian reform (Fearnside, 1984a). Population stabilization may occur either before or after facing social questions such as land tenure, just as it may occur either before or after cutting the last

of the tropical forests. When little forest remains, any difference that cutting them would make becomes insignificant. Would India or China's problems be helped by sacrificing their last remnants of tropical forest? Even for countries at the other end of the spectrum of tropical forest endowment, the difference that cutting these forests would make is much less than Wood believes. In the case of Brazil, for example, it is sobering to realize that the Transamazon Highway, which was built and settled with the announced purpose of accommodating excess population from semi-arid northeast Brazil, absorbed the equivalent of only four days of population growth in that region (Fearnside, 1986a: 157). By contrast, a World Bank study of northeast Brazil indicates that the agricultural output of that region could be increased by 80% by redistributing unproductive large landholdings (Berry and Cline, 1976 cited by Eckholm, 1979: 18).

B.) Tropical forested areas as resources for cropland

The paper claims that "limited potential of the rainy tropics for food production" is no longer a problem. The "substantial field work" cited as evidence for this claim is the 1978 paper (Buol and Sánchez, 1978) that gives some of the early results of the work on continuous cultivation begun at Yurimaguas, Peru in 1972. The results cited were highly preliminary, even more so than the more widely-known presentation of the Yurimaguas research four years later (Sánchez, et al., 1982). In fact, the general conclusion of the "Yurimaguas technology" work on a high input system for upland agriculture in the humid tropics was manifestly wrong for a long list of reasons (Fearnside, 1987c, 1988b). The authors of the original study have themselves greatly softened their conclusions from the Yurimaguas work (Sánchez and Benites, 1987), although the group continues to be more optimistic than I find justified (Fearnside, 1988a, 1989c, 1990a). The virtually unrestrained euphoria of the group's earlier publications continues to affect the thinking of people in the development policy field, as reflected in Wood's paper.

Wood affirms that "there are many advantages to crop production in tropical forest zones [in comparison with other zones]." I would recommend a reading of Janzen (1970, 1973) for a review of some of the disadvantages. The present concentration of the world's grain production in mid-latitude and mid-altitude zones has a biological basis. When Wood attacks First World donors for incorporating "their doctrine of 'sustainability'" into guidelines for development funding, he should remember that most concerns over sustainability cannot be dismissed on the grounds of cultural relativism. Most land uses replacing tropical forests today, including most of those likely

to be implanted in any forests liberated for clearing under Wood's proposal, do not endure more than a few years because they are not sustainable for purely technical agronomic reasons.

The paper states that "traditional crop management systems have persisted for thousands of years, and are therefore of proven sustainability" and that "long-fallow shifting cultivation .... can be highly sustainable." Wood fails to mention that this sustainability only applies at very low population densities that permit site quality recovery during a long fallow period (e.g. UNESCO/UNEP/FAO, 1978). The pattern repeated many times in the recent history of areas of traditional shifting cultivation is for population densities to exceed these limits, leading to degradation and collapse (e.g. Penteado, 1967; Vermeer, 1970). Wood draws two false conclusions from his view of shifting cultivation: 1) that countries such as Thailand have become rich from exporting rice and cassava (manioc) produced from this system, and 2) that keeping forest is a "threat to the food security of developing countries." As the paper itself mentions, Thailand is now the world's largest exporter of rice -- could this country possibly be lacking "food security" because of reserves set aside forest conservation? By the same token, Brazil is a major exporter of soybeans, and its 1991 grain harvest (most of which is for export) is estimated to be worth US$65 billion. In both cases, the most productive regions are not those that have recently been converted to agriculture from tropical forest. Certainly the use of good agricultural land for export crops poses a much more serious threat to feeding local populations than does maintaining forests, most of which are on land that is markedly inferior to that already in production (see Fearnside, 1986b for an example from Brazil).

Wood describes deforestation as a "necessary step towards productive agriculture." Perhaps a better way to describe it would be as a loss that eliminates virtually all of the sustainable land use options capable of implantation on the scales needed. The land uses implanted following deforestation are virtually always unsustainable. In the case of Brazilian Amazonia, the area of forest, and even of already-deforested land, greatly exceeds the supplies of physical resources such as phosphates, as well as capital, to maintain it in agricultural systems requiring fertilizers. Brazil's phosphate deposits are virtually all located outside of Amazonia, and are modest in any case -- the United States, for example, has 20 times more phosphates than Brazil (de Lima, 1976). Wood's claim that soil infertility can be overcome by simply adding fertilizer does not apply on the scale of the areas involved.

In addition to long-fallow shifting cultivation and fertilizer-based agriculture, agroforestry is mentioned as one of the means of obtaining sustainable production from the areas to be deforested under Wood's plan. Agroforestry and perennial crop plantations have many advantages over cattle pasture or annual crops, but their potential to occupy the vast areas involved is limited. The same physical resources that limit intensive annual cropping also affect these systems. Markets for many of the commodities produced by agroforestry systems can only absorb the production of a relatively small area. Perennial crops such as cacao and rubber offer good examples of tree species whose expansion is sharply limited by markets (in addition to biological problems). Agroforestry can only be expected to occupy a relatively small part of Amazonia's vast area of already deforested land; it should therefore not be counted on to rescue even more deforested land from the fate of degradation (Fearnside, nd-b).

Wood asserts that Amazonian lands have the potential to "become important components of the global food supply system." I would argue that Amazonia has neither the potential nor any moral obligation to become such a component. The idea that Amazonian forest must be sacrificed in the interests of feeding the populations of Africa, Asia etc. is a recurring one. However, the limited potential for grain production should be used for feeding Amazonia's present population and their descendants rather than trying to postpone the equilibrium between consumption and production elsewhere in the world (Fearnside, 1984a). Among other reasons, many of the products that Amazonian forests can provide (including some of the environmental services performed by the forest) are far less substitutable than are basic foodstuffs, which, in any case, can be produced more efficiently outside of the tropics.

C.) Pressures for conservation of tropical forests

The efforts of conservationists to influence international lending policies are portrayed as inimical to the interests of the poor in tropical countries. Such entities as the World Bank and the governments of the United States, the U.K. and Australia are implied to be highly philanthropic organizations that, except for the misguided influence of conservationists, would be helping the poor in the Third World. Even the budgets of conservation groups are portrayed as enormous, presumably making the World Bank and the governments of major economic powers no match for their nefarious force.

Needless to say, this view "borders on the deceptive", to use one of Wood's epithets for conservationists. The World Bank and the various governments mentioned have long records of promoting development projects in Third World countries that benefit local elites to the detriment of the poor (along with a much more modest selection of projects that do indeed help the poor). The prevalence of socially questionable projects pre-dates any demonstrable environmental concern in lending policies (see Rich, 1985; Wirth, 1986). The World Bank created an Environment Department and launched a new environment policy in 1987, largely in response to the public outcry over the disastrous POLONOROESTE project in Rondônia, Brazil (Holden, 1987). The number of staff allocated to the Bank's environment department has never reached the level initially promised; even if fully staffed the department would account for only 60 of the Bank's 3000 professionals. The limited staff is inadequate to analyze more than a small fraction of the proposals presented to the Bank, which average approximately one per day. More important than the department's size is the fact that most of the staff are economists transferred from other parts of the Bank rather than professionals in environmental sciences. With few exceptions (such as Herman Daly), the Bank's economists do not recognize basic ecological concepts relating to carrying capacity and sustainability (see Holden, 1987). Almost all of the environment department's activities have lacked an independent budget within the Bank, depending instead on requests from the various country desks for funds to travel to verify environmental impacts on site. Even more fundamental than the limitations of the environment department itself is its place within the "project cycle", being consulted only at the last minute after ultimate approval of projects is virtually a fait accompli. In addition, controversial projects can completely bypass environmental review by being funded through "sector loans". An example is the Balbina hydroelectric dam in Brazil: after being refused as a project loan, Brazil obtained a power sector loan that could be spent on any dam in the country without an environmental review of each dam (Fearnside, 1989d). The recently-leaked secret minutes of the World Bank's Board of Executive Directors meeting at which the power sector loan was considered now prove conclusively that the Bank's highest officials knew that the money would be used to fund Balbina (Adams, 1991: 196). Insufficient as the "greening" of the World Bank and the various government aid programs may be, the situation is much better than it would be in the absence of the lending policy reforms that Wood attacks.

Wood decries the idea that "donor-defined system of environmental values has already become a condition of funding for bilateral development". This change is far from complete, and I

would argue that it should be encouraged rather than reversed. It is true that the governments of most developing countries have resisted any form of conditionality on loans received, often claiming that anything but a virtual blank check interferes with their sovereignty. Although illegitimate conditions are indeed sometimes attached to loan agreements, the environmental requirements that are the subject of Wood's attack are not among them.

While sovereign governments have wide latitude to destroy their own environments and impoverish their poor if they so choose, it should be remembered that, when this is done using money from taxpayers in other countries, the rights of those taxpayers and the "sovereignty" of the donor countries are violated if those paying for the projects have no say in how the money is used. Differing viewpoints exist as to where the line lies between legitimate say and illegitimate interference in development projects, and many of these differences can be expected to remain indefinitely.

It is important to recognize and accept that cultural differences exist among the countries involved -- often with historical origins. These differences contribute to the divergence of viewpoints on the amount of say that international donors should have over how their money is spent. As a rule, the tendency for people to feel personally responsible for what their governments do is greater in the countries that are major contributors to the multilateral development banks than in the countries that are the major recipients. In Brazil, for example, the general reaction to a catastrophic project such as the Balbina Dam is that this is simply an example of the stupid things that governments do -- it is lamented and the government is criticized, but people who as taxpayers have paid for the project generally do not feel morally liable or guilty for what has occurred.

The implication that conservationists are somehow against the poor while the World Bank and the aid agencies of First World governments are for them is erroneous. Most conservationists, especially those who work in developing countries, are profoundly concerned with the poverty that has long afflicted most of the people in tropical areas. Most deforestation is doing nothing to alleviate poverty, and is often exacerbating the situation. In the long run, clearing the forest is destroying one of the most important potential resources for maintaining the local populations at a reasonable standard of living. Very few conservationists believe that the bulk of the remaining tropical forests should be fenced off and left completely undisturbed, although total protection should be enforced within a limited suite of parks and reserves. Combatting poverty is

a high priority even from the strictly 'conservationist' standpoint of protecting nature: a scenario of heavily-guarded parks surrounded by starving masses in a devastated landscape is untenable as a strategy for maintaining natural ecosystems.

D.) Reconciling the demands of farming and conservation

1.) Is present tropical forest cover 'natural'?

Wood devotes a substantial amount of space to showing that most tropical forests have been disturbed by human action at some time in the past. This is presented with the avowed aim of "reconciling the demands of food and conservation," by which he means doing away with virtually all forest conservation areas in order to leave agricultural expansion unfettered.

Wood claims that "the concern of conservationists over forests is based on the assumption that present tropical forests are 'wildlands' or 'natural vegetation.'" Not so! The same concerns regarding biodiversity and maintenance of climatic and biogeochemical balances apply regardless of the human uses that have been made of these systems in past centuries and millennia. In Amazonia, for example, the use of tropical forest for shifting cultivation by traditional indigenous peoples is qualitatively different from the large-scale clearings made by ranchers. While nearby seed sources in the surrounding forest allowed recolonization of isolated fields of shifting cultivators, the very slow recovery of forest species in large cattle pastures means that they would not recover in this sense for thousands of years, even if left completely undisturbed. In practice, re-clearing of these areas can be expected to occur long before such a hypothetical recovery of species composition takes place. The qualitative difference between traditional shifting cultivation and modern pastures renders baseless Wood's claim that if sites now forested have a history of clearance for agriculture, future clearance and later reconversion to forest should neither enhance nor diminish biodiversity.

2.) Is tropical forest clearance irreversible?

Wood asserts that "a basic premise of most arguments on the need to conserve tropical forest is that loss of forest is not reversible: clearance of forest will irreparably damage resources that we need for the future." The implication is that an eventual return to a tropical forest of similar composition, even if such a recovery would take centuries or millennia, would invalidate any argument for a

precautionary approach to conversion of tropical forest to agriculture. Three points are relevant: 1.) recovery under the traditional shifting cultivation systems that prevailed in past centuries was slower than Wood believes (as will be discussed later on), 2.) recovery under present conditions is not nearly as rapid as Wood implies, and 3.) the possibility of a theoretical recovery at some future time far beyond human planning horizons in no way invalidates arguments for conservation.

Extinction (a word never mentioned in Wood's text) is one problem if deforested areas become as large as they are likely to under Wood's scenario for the future. Extinction is indeed irreversible, both at the level of species and at the level of genetic varieties below the species level. Extinction implies concrete losses for human welfare (Ehrlich, 1982; McNeely, 1988; Myers, 1985). The highly localized ranges of some species make them vulnerable to extinction even when deforested areas may appear to be modest (Pires and Prance, 1977).

It should also be remembered that small patches of forest in isolated reserves fail to maintain species because small populations of many species are inviable and because isolated reserves degrade from around their edges (Lovejoy and Bierregaard, 1990; Lovejoy et al., 1984). Persistence of trees can be deceptive because the biological relationships that allow many tropical forest trees to reproduce often disappear long before the last individuals of the trees themselves die out (Janzen, 1974; Prance, 1975).

Wood dismisses concerns over tropical deforestation as a source of greenhouse gases as "not part of the conflict between conservation and agriculture: they can be addressed by suitable plantation management or silviculture." Unfortunately, he is gravely mistaken. Tropical deforestation releases a substantial amount of carbon to the atmosphere because the biomass stock per hectare in standing forest is much higher than in any replacement use, including tree crops and silviculture. The greenhouse impact is higher than the difference in carbon stock between the forested and replacement landscapes because of releases of methane and other gases with higher global warming potential than carbon dioxide. In the case of Brazilian Amazonia, gases other than CO_2 increase the impact by about 35% (Fearnside, nd-c). I might add that combatting greenhouse emissions by planting large tracts of silvicultural plantations is very much more expensive than reducing deforestation (Fearnside, 1990b). Because of the difference in biomass stock per hectare, the net release of gases would be substantial even if all areas were miraculously planted to silviculture following clearing.

Wood greatly exaggerates the capacity of tropical forest to recover following deforestation. He claims that "forests in Malaysia more than about 30 years old are said to bear few traces of former cultivation." I would surmise either that whoever "said" this is unobservant or that something has been lost in the passage of information by word of mouth through an unknown number of links before reaching the author of the text Wood cites.

One must never forget that in Brazil, where the largest area of remaining forest is located, cleared areas become cattle pasture rather than shifting cultivation fields that are left fallow after a short period under agricultural use. Barriers to regeneration of forest are formidable in degraded pastures (Nepstad et al., 1990). Above-ground biomass accumulation is slower in abandoned cattle pastures than it is in fallow fields of shifting cultivation. For example, measurements in abandoned pastures near Paragominas in eastern Amazonia (Uhl et al., 1988) indicate accumulation rates of 10 metric tons (MT)/ha/year for abandoned pastures that had been "lightly" used (meaning never maintained though weeding and burning, and abandoned shortly after pasture formation), 5 MT/ha/year for "moderately" used pasture (the most common type: abandoned 6-12 years after formation following use, with weedings and burnings every 1-3 years) and only 0.6 MT/ha/year for "heavily" used pasture (6-10 years of use, weeds bulldozed). In contrast, shifting cultivation fallows accumulate above-ground biomass at up to 6.7 MT/ha/year over a span of 15 years (Brown and Lugo, 1990: 13). Barriers to forest regeneration in Amazonia are compounded by the soil in this region being, in general, poorer than the soils in other tropical regions. The fact that Amazonian forest is being replaced by cattle pasture makes Wood's allusions to biodiversity being increased by disturbance particularly inappropriate.

The speed with which cleared land can return to forest depends on the area of each clearing (e.g. Gómez-Pompa et al., 1972). In Indonesia, clearings exceeding 0.01 ha become diverted to Imperata cylindrica grassland rather than woody secondary forest (Kramer, 1933; see Richards, 1964). This is several orders of magnitude smaller than the areas now being cleared, for example in the Transmigration projects that have received financing from the World Bank and are now largely dominated by the aggressive Imperata grass. In Latin America, the grass species present are less aggressive than Imperata cylindrica, although succession can by diverted to grassy dysclimaxes by other less-aggressive species, including the congeneric Imperata

brasiliensis (Scott, 1978). Fire greatly retards forest recovery in anthropogenic savannas (Budowski, 1956, Fearnside, 1990c). Forest species enter slowly, as movement from seed sources can be only a few meters per generation of trees. In practice, the vast areas of cattle pasture already present in Amazonia cannot be expected to recover forests of the original type on a time scale relevant to human planning.

It is important to realize that the response to the problem of large clearings not regenerating easily should not be to pulverize conservation areas into small time capsules for a hypothetical future colonization of the landscape. Small reserves degrade, losing ecological relationships and breeding populations of species (e.g. Lovejoy and Bierregaard, 1990). They are also difficult to police and often merely represent a temporary step along the way to complete deforestation, as in the case of Brazil's Forestry Code of 1965 requiring that half of each property be left in forest (see Fearnside, 1986c).

Wood claims that "whatever evidence we have points to tropical forest clearance being highly reversible if simple conditions are met." Although he does not specify what these "simple conditions" might be, they are undoubtedly subsumed under his assumption that future conversion will follow patterns that allow forest to recover at the same rate that it did in pre-modern times. As mentioned earlier, this assumption is fatally flawed for present land use patterns in Amazonia.

E.) Evidence for former use of land now forested

Recovery rates less prodigious than Wood implies not only prevail at present and in any likely future scenario, but also characterize the more favorable situation of the former times he emphasizes so strongly. For example, he claims that: "the estimated pre-conquest Amazon population of 1 million people, if clearing forest at the rate of 0.5 ha a year -- a practicable rate for shifting cultivation -- could in theory clear piecemeal the entire Amazon forest of 337 million hectares in 674 years." A clearing rate of 0.5 ha per person, or 3 ha per family of six, is much higher than modern traditional farmers (caboclos) clear: an average of 0.7 ha/year/family in the case of Xingú River caboclos using steel axes (da Silva, 1991: 86). Even colonists in government-sponsored settlement areas, who clear faster than caboclos, cannot maintain a rate of 3 ha/year/family for more than about six years (Fearnside, 1984b). Average clearing rates during the early years of settlement on the Transamazon Highway were 3.49 ha/year/lot, while comparable rates in Rondônia were about 3

ha/year/lot (Fearnside, 1984b). These values are slightly higher than what can be accomplished per family using steel axes, as some of the clearing was performed using power saws and -- particularly in Rondônia -- some lots contained more than one family. The adult male labor requirement for clearing using steel axes on the Transamazon Highway is 11.45 man-days/ha for the underclearing (broca) and 9.34 man-days/ha for felling (derrubada) operations, both done exclusively by adult males and concentrated in a three-month period (Fearnside, 1980: 124). Theoretically, 4.5 ha/year could therefore be cleared per adult male using steel axe technology. In the case of Transamazon Highway colonists, labor requirements for the coivara (piling up unburned material for a second burn) further restrict areas to 3.75 ha/year/adult male (Fearnside, 1980:128), but this step would be less limiting for indigenous peoples preparing land for planting manioc rather than rice. On average, the clearing rates of farmers fall substantially short of the theoretical maximum rate, even though they are integrated into a market economy where most agricultural production is sold rather than consumed directly. Maintenance of activities in already-converted areas absorbs a substantial amount of effort after the first few years of settlement are past. For the Brazilian Amazon region as a whole, clearing rates are therefore much lower than the theoretical maximum: for 1991 the average rate for properties less than 100 ha in area was approximately 0.3 ha/year/property (Fearnside, nd-a). Use of stone axes prior to European arrival in the New World was very much less efficient than steel axes, let alone chainsaws. Clearing rates of contemporary indigenous tribes equipped with steel axes are around 0.3 ha/year/adult male (calculated from Carneiro, 1983).

If one takes 0.1 ha/person/year (approximately 0.6 ha/family/year) as a maximum rate for pre-modern clearing, the turnover time would be 3370 years assuming the population and forest area figures given by Wood. In fact, the originally forested area in Amazonia as a whole is almost twice as large as the 338×10^6 ha area Wood suggests: the most widely used estimate for the area of the drainage basin is 640×10^3 ha, but estimates in current use are as high as 735×10^3 ha (Commission on Development and Environment for Amazonia, nd [1992]: 11). In Brazil alone (where almost all of the non-forest vegetation included in the drainage basin is located), the original forest area is 430×10^3 ha as measured from 1:5,000,000 vegetation maps (Fearnside and Ferraz, nd) or 400×10^3 ha as estimated from 1:250,000 LANDSAT imagery (Brazil, INPE, 1992). A forest area for the whole drainage basin on the order of 600×10^3 ha is likely; assuming that Wood's population estimate is correct, this would mean that the turnover time for forest would be on the order of 6000 years

-- an order of magnitude longer than Wood's calculation of 674 years.

F.) Crop land abandonment and future rotation

Wood admits to the prevailing ignorance of the impact of exploitation (including shifting cultivation) on tropical forest diversity and stability, and calls for "careful husbandry of resources" because regeneration will only be possible "if resources of soil and plant and animal species have been conserved during periods of agricultural use." This caveat does not seem to affect his overall conclusion that the shackles of forest protection policies should be shaken off to allow agricultural expansion into any tropical forest areas where conservationists cannot prove that no previous human clearing has taken place. He proposes the conversion of large tracts of present conservation areas "during the first half of the 21st century."

Wood correctly points out that populations of indigenous peoples were decimated by European contact. This decimation, in fact, still continues in a number of countries, including Brazil, where many indigenous populations are declining in the face of contact. Wood argues that indigenous peoples have a moral right to expand their populations to their pre-contact levels, and implies that "conservationists" are somehow preventing them from doing so. I hasten to correct this impression: the vast majority of conservationists defend indigenous peoples. It is not indigenous peoples who are responsible for most of today's deforestation activity, nor is it they who would expand into the forest areas that Wood proposes to liberate for conversion to agriculture. Preventing further loss of indigenous land to private ranches has the highly beneficial collateral effect of maintaining substantial areas of forest with most of their environmental functions intact. In Amazonia, politicians are urging that land be taken away from indigenous peoples on the grounds that populations (after decimation) are now sparse, and "conservationists" are among those who argue most strongly against these proposals.

G.) Wood's conclusions

Wood's conclusion is a semantic jumble. He poses two possibilities for avoiding dependence on food imports to support tropical populations: land extensification and land intensification. Population growth and income distribution are, of course, being

assumed to be immutable parts of the landscape. He then introduces a "third possibility: the re-allocation to agriculture of land previously cleared." However, this is really the same as land extensification, since virtually all of the world's tropical forests have been cleared at some time in the distant past.

Putting Wood's proposal in more direct language is important: it is to open to deforestation almost all of the tropical forests that are still standing. Furthermore, Wood proposes to promote conversion of these to non-forest uses through increased flows of international funds with less provisions than such projects presently have regarding the sustainability of land uses implanted and the protection of the environments affected. These proposals are unwise and dangerous.

IV.) TURNING CONSERVATION INTO A RESOURCE FOR THE POOR

Any development strategy must begin with a clear definition of its objectives and beneficiaries. Respecting carrying capacity is fundamental to attaining virtually any objective, and examination of this factor often reveals underlying inconsistencies and hypocrisies in plans ostensibly meant to benefit the poor. The usual emphasis on expanding the pie often begs the more important questions of how and for whom the pie is divided. Accepting limits does not mean condemning the poor to poverty; rather, it means condemning the rich to face up to dividing the pie.

Defining carrying capacity inevitably leads to specific decisions on the productive systems used and the limits beyond which they cannot yield sustainably, the distribution of wealth within the population, the average standard of living and the minimum level acceptable, as well as intergenerational allocation of resources. When proposals are made to open additional tropical forest land to clearing for agriculture, many of the wider problems that policy-makers frequently hope to solve through such initiatives are bound to remain unsolved unless limits are recognized and the more difficult but more far-reaching decisions are taken to halt deforestation and bring population into balance with resources.

In the case of Amazonia, the rural population is now supported in ways that can only be temporary. Agriculture and cattle ranching activities are unsustainable as practiced, and unlikely to be converted into sustainable systems over any significant part of this vast region. Timber extraction is predatory, and unlikely to take place as sustainable management under the current economic system (Fearnside, 1989e). Harvest of non-timber extractive products --

although important as a potentially sustainable use of forest in some areas -- has little potential to absorb large human populations (Fearnside, 1989f).

Radically new means of support are needed for Amazonia's population, both in rural and in urban areas. In rural areas, the existing potential must first be used for agriculture in already deforested areas and extractive use of designated areas of standing forests. However, the key to making use of standing forest economically attractive is likely to lie not in fine-tuning the economic system surrounding forest commodities, but rather in developing ways to turn the supply of environmental services into a part of the solution to supporting the local population. Appropriate institutional mechanisms are now totally lacking. The first step is research on valuation of environmental services. These include biodiversity maintenance, carbon storage and water recycling. The per-hectare value of these services far exceeds that of the agricultural production now being obtained from deforested areas in Brazilian Amazonia. None of the forest's services is being paid for at present. What scientists say the services are worth is not necessarily what would be paid: institutional mechanisms for negotiating international agreements on these values are the next step. Separate institutions are then needed to collect funds on the basis of the services agreed upon, and to apply these to programs that will result in achieving the two objectives: supporting the population and maintaining forest with its services intact.

Supporting a dense rural population is not a viable goal for the development of Amazonia or of most other tropical forest regions. Use of standing forest represents the best basis for supporting the modest number of people that can be maintained sustainably. Such uses do not offer a solution for the many migrants who have come to Amazonia and are now engaged in agriculture, ranching, logging and goldmining activities. Support for many of these people will sooner or later have to be found outside of rural Amazonia -- especially in the urban sector.

By clearing the forest, the opportunity to use it sustainably is being thrown away. Halting the current pattern of deforestation for nonsustainable land uses should be the first priority in any strategy for sustainable development in tropical forest areas. This is precisely the opposite of what Wood proposes.

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