ENVIRONMENTAL GORE

A CONSTRUCTIVE RESPONSE TO *EARTH IN THE BALANCE*

Tropical Rain Forests: Myths and Facts

CHAPTER 8

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To build a constructive response to Vice President Al Gore's treatment of the science and ecology of tropical rain forests in his book, *Earth in the Balance,* it is important to outline some of the unique and complex characteristics of tropical rain forests. Tropical rain forests represent some of the world's most diverse, rich, and uncharted ecosystems. In the following pages, I will describe a number of the basic characteristics of rain forests and examine the Brazilian Amazon in depth.

Because of growing public concern over the condition and management of tropical rain forests around the globe, it is imperative that researchers, government officials, environmentalists, indigenous populations, the media, and concerned citizens work together to create the best rain forest management policies possible.

The controversy over rain forest management stems in part from misinformation. The international media has contributed to the general public fervor over the present and future condition of the Brazilian Amazon, and *Earth in the Balance* perpetuates some of the tropical rain forest myths.

I agree with Vice President Gore on a number of basic points, including: (1) human activities have decreased the size and number of tropical rain forests; (2) the threat of species extinction is real, in fact, deforestation causes species extinction; and (3) it is important to protect rain forest biodiversity. But we disagree on some major issues, including: (1) the rate at which deforestation is taking place in the Brazilian Amazon; (2) the fact that humans have induced only negative impacts on the forest ecosystem (studies indicate that humans may have contributed to the level of biodiversity); (3) the kinds and degree of human-ecological interaction that take place in tropical rain forests; and (4) the potential for ecological restoration.

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TROPICAL RAIN FOREST FACTS

Rain forests are among the most complex, sensitive, endangered, and unknown ecosystems on earth. Today, only about half of the earth's original rain forests remain. These remaining forests exist in large blocks throughout 37 countries in Latin America, Africa, Asia, and Australia. Rain forests once covered some 16 million square kilometers (km^2), but human activities, such as farming, logging, cattle ranching, large-scale development projects, and mining, have reduced the world's rain forest area to less than 9 million km^2. About 7 percent of the world's landmass is still covered with this unique ecosystem (Corson, 1990).

Almost all the remaining rain forests are located in the so-called intertropical or tropical zone of the globe, an area generally characterized by its main climatic aspect: high temperatures (Tricart, 1974; Demangeot, 1976). In this zone, daily thermal amplitude is exceptionally high, four or five degrees over the day; whereas, annual thermal amplitude is exceptionally low, two or three degrees over the year. The mean temperature is around 25°C (Lemps, 1970). Some other important characteristics of rain forests are their high humidity levels and their plentiful rainfall - regularly more than 1,500 mm/year (Hallé et al., 1978). In this kind of climate - uniform temperature, water conditions, and light throughout the year - without seasonal fluctuations, the optimum conditions exist for an evergreen, broad-leaved, vegetation to flourish.

Tropical rain forests have three main characteristics. First, lush vegetation. They are dense, closed forests with high canopies that allow little light to reach the ground. Second, they have rich flora and several endemic species. These characteristics are a result of both the climatic conditions, which are favorable mainly to the trees, and the climatic history. The climatic changes over time are never as severe as those in temperate latitudes, thus leading to intense competition and granting various tropical rain forest species the opportunity to adapt themselves to the environment and to diversify. The third main characteristic of tropical rain forests is stratification: ground plants, shrubs, vines, lianas, epiphytes and tress form a complex system of layers ranging from a few centimeters to over 60 meters high. Alexander von Humboldt described the stratification as "a forest above a forest" (Lemps, 1970). Von Humboldt's observation highlights how rain forest ecosystems differ from temperate forests not only in tree arrangement but also in tree architecture. In the rain forests, trees tend to be bigger and taller. Rain forest trees also contain a major part of their biomass as stems and leaves, and they have superficial roots (Demangeot, 1976; Hallé et al., 1978).

Despite the lush vegetation, tropical rain forests often thrive on poor and highly weathered soils. Seventy-five percent of the nutrients found in tropical rain forests is located in the plants, 17 percent is located in the decomposing matter, and only 8 percent is located in the soil itself (Meirelles Filho, 1986). Therefore, these forests have evolved as "closed" nutrient cycles. The anatomical, physiological, biochemical, and ecological mechanisms at work in a tropical rain forest ecosystem guarantee little loss, little uptake from the sources and, thus, conservation of nutrients (Golley, 1983).

These "closed" nutrient cycles scientifically deny the popular characterization of the rain forests as the planet's "lungs." Rain forests are mature forests; they operate at their climax. They have been recycling the same amount of carbon for centuries. The oxygen they produce is totally consumed by the vegetation breathing. The balance between oxygen production and consumption is zero.

Controlled numerical experiments with complex models of the atmosphere have shown that tropical rain forests, as well as their destruction, may play a role in determining local and regional climates (Cutrim, 1990; Shukla et al., 1990). Biosphere-atmosphere interactions are significant within these areas. For instance, the incidence of sunlight is higher in tropical zones than in any other place on earth. The lush vegetation contributes to the sunlight's dissipation, because as water vapor forms it acts as a regulator of temperature and supplier of moisture, working much like an air conditioner.

Tropical rain forests are home to a vast biological array of living organisms. These forests support more plant and animal species per unit area, as well as overall, than any other ecosystem on earth. Current estimates of the total number of living species on the planet range from five to 30 million or more, of which only 1.4 million have been described by scientists (Wilson, 1988; Corson, 1990). More than two-thirds of these species come from tropical rain forests, basically because the forests are home to the most species-rich groups in the world-arthropods and flowering plants (Wilson, 1989).

Peru, for instance, is home to around 30,000 species of plants (Itlis, 1988); Colombia, a country as big as New Mexico and Texas combined, has more than 1,550 bird species (twice the number found in North America) (Schauensee, 1964); a single river in Brazil harbors more species of fish than all the rivers in the United States, and ten one-hectare plots in Borneo, Indonesia contain 700 species of tree (Corson, 1990); the Amazon Forest is home to perhaps 80,000 plant species (including 600 kinds of palm alone) and millions of animal species, most of them insects (Colinvaux, 1989). A world record was established in 1988 by Alwin H. Gentry, who identified about 300 tree species in each of two one-hectare plots in Iquitos, Peru (Wilson, 1989).

Such great richness constitutes a constraint for the commercial exploitation of the forest. In one hectare there are usually no more than two or three trees of the same species (Lemps, 1970). Besides sheltering native populations and providing habitat for millions of plant and animal species-which constitute an important genetic bank-tropical rain forests are also important because they supply a great variety of commercial and noncommercial products: timber (some highly prized woods such as teak, mahogany and rosewood); fuel wood; fruits, vegetables, nuts and spices; medicines (a quarter of all medically active substances come from tropical plants, and according to Caufield (1984) around 70 percent of the 3,000 plants identified by the U.S. National Cancer Institute as having anti-cancer properties are tropical rain forest species); and various industrial products such as oils, waxes, gums, resins, latexes, fibers, rubber, dyes, tanning agents, turpentine, lubricants, rattan and bamboo (Corson, 1990).

This richness and diversity has been threatened by man in three different ways: (1) by destroying species individually; (2) by destroying resources important to survival (such as habitat or food supply); and (3) by introducing exotic species that kill or compete with the native species (Emmons, 1990). In the case of tropical rain forests, the destruction and the fragmentation of habitats due to deforestation are the main causes of losses in biodiversity (Lovejoy et al., 1984). Deforestation reduces the area covered with forest and thus the number of habitats available in this ecosystem. This leads to a reduction in the number of species.

Deforestation is caused by three main factors: (1) agricultural and livestock expansion (human population growth leads to expanded needs for crop and grazing lands); (2) increased demand for commercial forest products (national economic development and international trade stimulate mainly timber harvesting); and (3) increased demand for noncommercial forest products (fuel wood, fodder, and others) (Gregersen et al., 1989). The causes vary from region to region. In Asia, for example, although timber harvesting plays a large role, the major culprits are population growth and extensive agriculture; in America, beyond the above factors, poorly designed governmental policies during recent years plays a significant role; in Africa, the main causes are uncontrolled population growth and nomadic agriculture practices (Siqueira, 1989). The rain forests have been globally destroyed not because of ignorance or stupidity but largely because of poverty and greed (Robinson, 1988).

THE BRAZILIAN TROPICAL RAIN FORESTS - A CASE STUDY

Around 57 percent of the world's tropical rain forests are in Latin America, 30 percent of which are located within Brazilian borders. Brazil has two domains of tropical rain forest; the Atlantic Forest and the Amazon Forest (The World Resources Institute, 1990).

The Atlantic Forest, designated as one of the three top priority areas for conservation in the world, is the most deforested. It originally covered some 450,000 km^2 (5 percent of Brazil's national territory) along the Atlantic coast, from the state of Rio Grande do Norte in the northeast to the prairies of Rio Grande do Sul in the south. But, since the year 1500 when the first Europeans reached these coasts, the forest has been constantly and indiscriminately altered and cleared. The early Portuguese pioneers chopped down the Brazil wood to extract dye; subsequent settlers cleared the forest to open the way for sugarcane and coffee plantations and for settlements; and in the last 50 years, industrial activities, urbanization, and road construction have reduced the forest to just 30,000 km^2, of which only 15,000 km^2 is considered primary forest (Fundação SOS Mata Atlantica, 1988).

Today, 80 million people and a great part of Brazil's heavy industry are crowded in the area originally covered by the Atlantic Forest. Only a few remnants of forest can be found in scattered patches throughout the southeast. In the northeast, practically nothing remains. The current demand for raw materials and space and the current rate of deforestation (around 4,000 km^2 year) could cause the total eradication of this forest by the year 2000 (Vieira & Meirelles Filho, 1989). Despite the deforestation, the Atlantic Forest did keep a great diversity and even now shelters around 200,000 different species, many of them endemic (53 percent of the known trees, 40 percent of mammals, and 80 percent of the nonhuman primates cannot be found anywhere else) (Fundação SOS Mata Atlantica, 1988).

Extinction is, however, a constant threat - 30 percent of the species are in danger of extinction. The primates, golden lion tamarin (*Leontopithecus rosalia*), golden rumped tamarin (*Leontopithecus crysopygus*), and muriqui (*Brachyteles arachnoides*); the trees, jacaranda (*Dalbergia nigra*) and Brazil wood (*Caesalpinia echinata*); the birds, red-tailed parrot (*Amazona brasiliensis*) and tinamou (*Tinamous solitarius*) are just a few examples (Fundacao SOS Mata Atlantica, 1988).

The Amazon Forest, on the other hand, is still almost intact and therefore attracts the attention of conservation groups that fear the threat of an uncontrolled and predatory human occupation. The term "Amazonia" refers to an area that comprises 50 percent of Latin America (nine countries) and contains the largest continuous tropical rain forest in the world - the 6.5 million km^2 Amazon Forest. More than 50 percent of it (3.5 million km^2) is in Brazil alone.

For planning purposes, the Brazilian government created "Legal Amazonia," an area of 4,906,784 km^2 (57 percent of Brazil's total territory). Legal Amazonia includes areas of nine states and is defined and based on geographic, physiographic, social, and political criteria. To understand its size, the entire European continent could fit in Legal Amazonia. Seventy percent of it is tropical rain forest (78 percent of the Brazilian forests), and the remainder is savanna and other vegetal formations (Siqueira, 1989).

The Amazon has been studied for a long time, in fact, as early as colonization in the sixteenth century. But it was not until the 1970s that the first systematic and homogenous study was made - the governmental project RADAM/BRASIL. The whole Amazon, along with the rest of the country, was surveyed by radar, and the final result included 34 reports on natural resources (20 about the Amazon region) and several cartographic products based on radar images (geology, geomorphology, pedology, vegetation, potential land use, agricultural suitability, subsidies for regional planning, hydric resources, and relief evaluation maps). The material collected revealed some of the region's great diversity: different substrata, altitudes, soil types, climates and, consequently, forests. Today, satellite images (from the American satellite LANDSAT or the European SPOT) confirm this diversity (John, 1989).

Formed 50 million years ago between two Pre-Cambrian shields, probably with the arrival of exogenous nutrients through trade winds, Amazonia is a vast sedimentary plain covered by a forest that is not at all homogeneous. From zero to over 3,000 meters altitude, you can find several different kinds of forest. The equatorial climate is permanently hot and humid, but annual precipitation ranges from 1,200 to 3,000 mm, with a brief dry season.

The forest functions in a complex way and plays a significant role in determining local and global environmental conditions (Molion, 1988; Shukla et al., 1990; Setzer and Pereira, 1991). It is a source of biogenic gases and aerosols that, because of the region's intense convective activity, can be rapidly mixed to higher altitudes where they impact global tropospheric chemistry and thus may affect global climate (Harriss et al., 1988). Twenty percent of the world's fresh water cycles through the Amazon basin, which acts as supplier of heat and water vapor to the rest of the country and other parts of the globe. Numerical models have shown that the removal of the forest could cause a reduction in precipitation and evapotranspiration and an increase in surface temperature (Cutrim, 1990). Biomass burning and deforestation in the Amazon generates gases such as CO_2, CH_4, and other pollutants (CO and oxides of nitrogen) that may accelerate the greenhouse effect (Harriss et al., 1988).

The Amazon has great potential for all kinds of exploitation:

- *Vegetal products:* latex from *Hevea brasiliensis* (rubber), wax from *Copernica cerifera* (Portuguese, carnauba), oils from *Orbignya martiana* (Port., babacu) and *Astrocaryum aculeatum* (Port., tucuma), foods from *Euterpes oleifera* (Port., acai), *Bertholletia excelsa* (Brazil nut), *Bactris gasipaes* (Port., pupunha) (Balick, 1985), are only some examples of useful forest products, besides the valuable hardwood trees that may be worth as much as US$ 4,000 each.
- *Animal products:* fishing (more than 2,000 species of fish) and hunting.
- *Minerals:* some of the world's richest ore bodies are found in the Amazon (iron, manganese, cassiterite, bauxite, gold, copper and nickel are some of the commercially exploited) (Berbert, 1989).
- *Hydroelectric resources:* about 45 percent of Brazil's hydroelectric potential is in the Amazon basin (Secretaria de Assessoramento da Defesa Nacional, 1989).
- *Agricultural occupation:* although the soils, as in other tropical rain forests, are poor, shallow, and fragile - except in some wetlands along the Amazon, Solimoes and Madeira rivers - the area is seen as the frontier for expansion of agriculture and cattle ranching (Miranda & Mattos, 1992).

This forest is the world's largest genetic bank and for the last few years has been the target of very controversial discussions about deforestation, biomass burning, global climate changes, and biodiversity loss (Setzer & Pereira, 1991). A lot has been said, but very little attention has been given to the process that has brought us to the present situation. Deforestation has it origin in local social relations and in the country's model for economic development. In the last few decades, the region's population has grown to almost 20 million, large industrial and hydroelectric complexes have been constructed, agricultural projects have been implemented, and nothing indicates that this process will stop or even slow down in the future.

Before we condemn or try to justify human occupation in the Amazon, it is necessary to understand the whole process. Also, it should be remembered that the human presence in the *past, present,* and *future* plays an important role in determining the region's biodiversity. Man has been the cause but could also be the solution to the Amazon's problems. Some aspects of this occupation will be presented next.

BRAZILIAN AMAZONIA: MYTHS AND FACTS

Many myths have been spread by the international media regarding the Brazilian Amazon. Vice President Gore's comments on deforestation in tropical countries seem to incorporate some of these myths. This has led to some damaging misinformation. According to Gore:

- More than 20 percent of the Brazilian Amazon was deforested recently.
- The deforestation is increasing at annual rates of more than 80,000 km²/year.
- Deforestation sterilizes the soil.
- The entire region should be left untouched for humanity's sake.

I will address these issues in the hope that if the myths are separated from the facts, a more accurate understanding will lead to better policy decisions for the rain forest regions of the world.

Extent of Gross Deforestation in the Brazilian Amazon

The extent and the rate of deforestation in Brazilian Amazonia has interested many researchers in the last decade. The National Institute for Space Research (Instituto de Pesquisas Espaciais or INPE) has conducted full surveys of Legal Amazonia, based on LANDSAT satellite images, for the years 1978, 1988, 1989, 1990, and 1991, to map the extent of gross deforestation (that is, not accounting for forest regeneration or plantations), for a total surface area between 3.9 and 4 million km^2 (see Table 1). Each survey uses 230 LANDSAT images at the 1:250.000 scale.

The increment of the extent of gross deforestation in the sequence of LANDSAT satellite surveys was used to estimate the annual rate of gross deforestation in Brazilian Amazonia in the periods between consecutive surveys. Partial surveys of the extent of gross deforestation for parts of Legal

TABLE 1. Extent (km2) of Gross Deforestation in the Brazilian Amazonia.

Year	*Extent Deforestation (km^2)*
1978	152,200
1988	377,600
1989	401,400
1990	415,200
1991	426,400

Source: Instituto de Pesquisas Espaciais (1992).

TABLE 2. Annual Rate of Gross Deforestation (km^2/year) in the Brazilian Amazonia.

Period (years)	Rate of Deforestation *km^2/year*	%/year
1978-1988	21,130	.54
1988-1989	17,860	.48
1989-1990	13,810	.37
1990-1991	11,130	.30

Source: Instituto de Pesquisas Espaciais (1992).

Amazonia during the 1980s indicate that the mean rate of 21,130 km^2 per year was the result of a non-uniform rate in the period 1978-88, which is likely to have reached a peak in the second half of the 1980s and then tapered off. The height and timing of the peak will be better determined after completion of an ongoing survey for the intermediate year of 1985. Nevertheless, these partial data indicate that the peak cannot possibly have reached 80,000 km^2 per year as previously thought. In Table 2, the columns with the annual rates of gross deforestation expressed in terms of square kilometers per year are followed by the values expressed in terms of percentage of the remaining forest removed per year.

The present results are not estimations, nor projections, nor extrapolations. They are exhaustive measurements of the whole Amazon region. These results indicate that the present deforestation of the Brazilian Amazonia (426,400 km^2, including 97,600 km^2 of old deforested areas) corresponds to *less than 10 percent* of the total Amazon (the total Amazon region has 4,906,784 km^2). The deforestation rates have never reached the supposed 80,000 km^2 per year. In Brazil, the rate tendency is clearly decreasing, contrary of what Gore's analysis of tropical deforestation stipulates.

Biodiversity in the Brazilian Amazon

The human presence in the Amazon has simultaneously played a role in increasing, decreasing, and maintaining the region's biological diversity. Biodiversity, or biological diversity, is a global resource made up of the great variety of living forms on earth, both wild and domesticated. It can be understood in many different ways, for instance, genetic diversity (differences in genetic constitution among individual organisms), ecosystem diversity (distinctive assemblages of organisms that occur in different physical settings), and the most common measure, species diversity. It should never be forgotten, though, that man is part of the problem concerning biodiversity. This is a very complex matter, and any generalization is dangerous.

Very distinct situations coexist today in the Brazilian Amazon. In the case of the indigenous populations, several studies have shown how certain tribes have contributed, in a permanent way, to the partition and to the cultivation of vegetal species of their own interest, to the maintenance of a high polymorphism in their plantations, and to the management of several forest ecosystems (Posey, 1985; Taylor, 1988). Other studies indicate that this millenary influence has expanded to vast areas like the savannas, and could be the origin of some vegetation types considered natural until today (Ballée, 1988, 1989; Ballée & Campbell, 1990). Thus, the transformation of the Amazon Forest by man was probably much greater than what was assumed to be the case until recently (Mantovani et al., 1991). This fact raises the first question about the lack of knowledge and research on man-forest interactions in this region and their consequences.

Similar results, in terms of increasing biodiversity, have been observed in riverside populations and in some Caboclo communities (mestizo populations descended from Indians, blacks, and whites). In the state of Maranhao, along the eastern limits of the Amazon Forest, communities have practiced itinerant agriculture in small areas on very poor soils for more than a century. Hunting, fishing, and the exploitation of forest products have also contributed to their success. The inhabitants of Maranhao employ the traditional methods of shifting cultivation: after deforestation the area is cultivated for a brief period (the soil tolerates the maximum of two years of cultivation) followed by a long fallow period. The non-eradication of the vegetation assures its reconstitution, and the agriculturists take 15 years or more to come back to the same place. This agricultural practice generates a mosaic of forests that differ in terms of phytodynamics and vegetal chronosequence, each one with its own characteristics in terms of fauna and floral communities. This spatial heterogeneity can be detected and monitored through satellite images. The diversity indices of these areas are greater than those for original forests. It appears that man - like wild and domesticated animals - can simultaneously exploit the forest and contribute to the growth of its primary productivity, cynegetic and energetic resources (Miranda, 1985).

There are some cases in the Amazon where creation of reserve areas - in an effort to protect rain forest - is leading to a simplification of the ecological systems and to a loss of biological diversity. The consequent expulsion of the agriculturists and the return of relative homogeneity of natural vegetation has not enhanced biodiversity. Several communities of Caboclos in the wetlands of the Amazon River have an extremely elaborate idea of the spatial and temporal partition of the natural resource supply. They practice complex systems of exploitation and production, which guarantee the perpetuity of the ecosystems they use (Frechione et al., 1989). This illustrates one of the complications inherent in creating national parks and reserves, an option many conservationists consider essential to preservation of rain forest ecological systems. It is necessary to apply new instruments and parameters to the research and monitoring of biodiversity in these areas of traditional occupation, many of them places with endemic species that need protection.

As the density of populations living in the forest increases and mobility decreases, the systems of production and exploitation tend to be simplified and seem to have an effect on certain aspects of the rain forest ecological system. The rubber tappers in the western state of Acre are a case in point. The increase in population density and the intensification of land use has been feasible and compatible with maintenance of the vegetal resources of the forest. On the other hand, animal communities, particularly vertebrates, have been subject to systematic, indiscriminate, and quotidian hunting that has lead to local extinction of species, and still does, despite the consequent and dramatic reduction of the remaining populations (Nunes et al., 1990). How is it possible to maintain the biodiversity of these traditional intensified agro-forestry systems in the middle and long term?

The migration of thousands of families of small agriculturists from the South, Southeast and Northeast Brazil to the Amazon has caused changes in the forest ecosystems. The emergence of agro-ecosystems with a great spatial-temporal dynamism has created complex environmental consequences. In the states of Rondonia and Mato Grosso, this colonization process had led, on the one hand, to the loss of biological diversity, stemming mainly from deforestation, eradication of habitats and disruption of traditional Indian, Caboclo, and rubber tapper production systems.

On the other hand, it has caused an expansion of the total number of species, the emergence of interesting cases of sustainable land use for a high density resident population, and the diversification of certain animal communities. Because it is a recent process, diachronic comparisons are only now beginning to emerge, showing a more subtle picture than the one given in several articles that completely disapprove of the agricultural occupation of that region. Even the announced failure of the agriculturists, who after some years of cultivation sell their lands to exploit a new area, has proven to be, in many cases, part of a capitalization strategy (Lena, 1988).

What is one to do with this reality? Even if the immigration of agriculturists into the agricultural frontier is reduced to zero, the thousands who are already there give us reason enough to look for new research alternatives for sustainable agro-forestry systems that could be adapted to the existing settlers' socio-economic conditions.

Finally, in the Amazon there are hundreds of thousands of hectares that are completely deforested, a result of an old agricultural occupation in the region of Belem (Para state). A long highway Belem-Brasilia and in the state of Mato Grosso, extensive cattle ranching in large land holdings has caused extensive deforestation. Very little is said about these areas where deforestation is no longer carried out (since the forest has been eradicated), to which nobody migrates any longer (since all the land is owned and concentrated in the hands of a very few people), and where extensive productive systems have left little space for new industrial projects. The conditions are a result of an old fiscal incentive policy. Agrarian speculation dominates these rural landscapes in Tocantins, Mato Grosso, and Para (Instituto de Desenvolvimento Economico-Social do Para, 1987; Reydon and Herbers, 1989). They represent the largest loss of biodiversity in the Amazon, but it is not yet a permanent loss. Recent research indicates that some areas could have their biodiversity restored (Uhl, 1988; Uhl & Kauffman, 1990).

CONCLUSIONS

In Amazonia it is necessary to acknowledge that some of the remnant areas are more important to preserve than the vast areas of intact forest. The ecological restoration of these regions, especially the degraded pastures and some old mining areas, is essential for the preservation of the rest of the Amazon Forest. Second, and more important, these degraded areas need a new agricultural transformation to recover their biological and production potentials. It represents the possibility of reducing the pressure on the untouched forest, generating a kind of buffer zone in the southern section of the Amazon River. Ecological studies, in this case more than in any other, should be inserted in the region's social and economic contexts. Finally, it is also in this region that some scarce remaining areas of humid forest are still found, making preservation all the more urgent and important.

Within the last few years, the tropical rain forest preservation debate has been thrust into the international environmental policy area. The danger of causing more harm than good is high. It is imperative that decision makers and researchers collaborate to ensure that the best available data are examined and utilized. For the debate to be rational, it is necessary to acknowledge that there are trade-offs involved. It is important that we set priorities and make economically sound decisions.

Cultural and developmental issues must be taken into consideration in creating rain forest conservation policy. We must also realize that the policies for one region may not meet the needs of another. It is crucial that we include a role for the human population of the rain forest by creating policies that guarantee their stake in the forest and make preservation in their best interest.

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