

College of Saint Benedict and Saint John's University

DigitalCommons@CSB/SJU

Honors Theses, 1963-2015

Honors Program

1993

Development of the Brazilian Rainforest

Antony Dispanet

College of Saint Benedict/Saint John's University

Follow this and additional works at: https://digitalcommons.csbsju.edu/honors_theses



Part of the [Political Science Commons](#), and the [State and Local Government Law Commons](#)

Recommended Citation

Dispanet, Antony, "Development of the Brazilian Rainforest" (1993). *Honors Theses, 1963-2015*. 338.
https://digitalcommons.csbsju.edu/honors_theses/338

Available by permission of the author. Reproduction or retransmission of this material in any form is prohibited without expressed written permission of the author.

Development of the Brazilian Rainforest

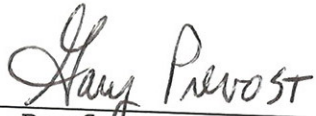
A Thesis
The Honors Program
College of St. Benedict/St. John's University

In Partial Fulfillment of the Requirements
for the Distinction "All College Honors"
and the Degree Bachelor of Arts
In the Department of Government


by
Anthony C. Dispanet II
May, 1993

Project Title: Development of the Brazilian Rainforest

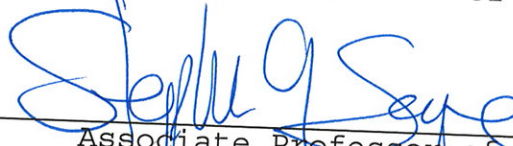
Approved by:



Professor of Government



Associate Professor of Economics



Associate Professor of Biology



Chair, Department of Government



Director, Honors Thesis Program

There are many environmental problems facing our world today. Streams are polluted, resources are wasted through lack of recycling programs; simply breathing in Mexico City is supposedly equivalent to smoking two packs of cigarettes a day. Most problems don't attract enough attention, or would disrupt the free market system too much to fix, or both. However, the destruction of the Brazilian rainforest is a problem outside these boundaries. There has recently been a large amount of attention focused on the rainforest, and it appears that the deforestation has been fueled by improper economic and development practices. This leads me to believe that this is one environmental problem that could be solved, so this paper will have an optimistic tone. I will discuss what has been destroyed so far, what policies led to destruction of the rainforest, the forces on different sides, what is being lost through continued deforestation, and what alternatives should be pursued to halt deforestation and eliminate some of the economic conflicts in Brazil, for we cannot accomplish the former without accomplishing the latter.

Details and Dangers of Deforestation

How much rainforest has been destroyed already, and how fast is the rest going? As far as how much is gone, the average of the figures given by different sources comes out to a little more than ten percent of the 4.6 million square kilometer total area of Legal Amazonia (Anderson 5a, Fate 45, Bonalume 368). According to

satellite imagery recorded by Brazil's Institute of Space Research (INPE), twelve percent of Legal Amazonia, almost 600,000 square kilometers, were deforested by the end of 1987, an area larger than France (Anderson 5a). However, INPE recently suggests that that data may be incorrect, as new and more advanced methods of data processing reduce the margin of error (Bonalume 368). The rate of deforestation increased rapidly through the decade of the 1980's. The average annual rate from 1976 to 1978 was 0.3 percent of Legal Amazonia, which increased to 0.5 percent from 1979 to 1980, and jumped to nearly 1.2 percent between 1981 and 1988 (Anderson 8a). However, there are data that show this rate is falling. INPE declared in 1989 that 17,871 square kilometers were deforested, while in 1990, only 13,818 square kilometers of rainforest disappeared, which is a reduction of 27 percent (Bonalume 368).

There is a severe ecological and economical problem with deforestation, especially in the rainforest. "Desertification" is a term used to explain the process of decline in the productivity of an ecosystem, which well describes the dramatic change from rich, abundant rainforest to useless, sterile plots of land that resemble parking lots. Rainforest ecosystems simply cannot withstand deforestation above the smallest of scales and remain productive. To understand why, we must examine rainforest ecology. The fertility of the soil in the tropical forests is very low (Anderson 3a, Fate 34). Even when the soil has nutrients applied, either in the form of fertilizers or ash, it is unable to retain them to any useful degree (Fate 34). 90 percent of the nutrients

in the rainforest are stored in the tissues of living organisms, rather than in the soils (Weinberg 22; Fate 35), as we are accustomed here in the temperate zone. While other forests absorb nutrients from the soil, the organisms of the rainforest live off their own debris, often before the nutritive material reaches the forest floor (Weinberg 22). With the poor soils, any nutrients that are allowed to escape the cycle are leached away.

The rainforest has other adaptations as well. Most of the roots of rainforest vegetation are found within the first foot of soil, which allows rapid capture of the nutrients deposited by rainfall or leaf debris (Fate 35). Other adaptations include those that prolong the lives of leaves, allow leaves to be replaced using fewer nutrients, and that deter predation by animals or insects (Fate 36). The last adaptation makes leaves tough, unpleasant, or poisonous to eat, which is also why so many pharmaceutical products can be found in the plants of the rainforest (Fate 36).

Other problems that are created by deforestation are erosion and flooding. One definition of "rainforest" I found was tropical forests that receive at least 4,000 millimeters of rainfall every year, four times as much as New York City (Myers 39,41). Where the forest cover is eliminated, the ground is unprotected from tropical storms, which causes erosion and flooding. In War on the Land, Bill Weinberg quotes from ecologists James D. Nations and H. Jeffrey Leonard:

Undisturbed, a tropical forest acts like a

giant sponge, breaking the force of torrential rains and allowing water to percolate slowly into the thin tropical soils. Gradually, the forest releases the captured water to the benefit of downstream agriculture. When tropical forests are cleared, however, precipitation rushes off sloped land and causes downstream flooding and soil erosion. (22)

A rainforest on undulating terrain allows erosion of no more than one ton of soil per hectare per year, but it will lose 60 to 200 tons if replaced with human-made pasture, and possibly 1000 tons or more with field crops (Myers 79).

Another effect deforestation may have on rainfall is through the process called evapo-transpiration, which is the transpiration (loss) of water through the leaves of plants, plus the evaporation of water off other surfaces. Another passage from Nations and Leonard well explains it.

...almost half the rain that falls on a lowland tropical forest is water recycled by the forest itself through evapo-transpiration. Forest vegetation breathes out water vapor equivalent to thousands of gallons per hectare per day. When forest is

cleared, this vast recycling system is destroyed...markedly altering regional climate. (Myers 23)

Transpiration is proportional to leaf area, so the broad leaves of rainforest plants recycle much more than do pasture or field crops (Fearnside 238b). This is especially relevant during the dry season, when pasture and crops are dry and the rainforest is still green (ibid). The results of decreasing amounts of water being recycled through evapo-transpiration could be very severe droughts every 20 to 50 years, which would kill many drought-intolerant trees (Fearnside 239b). Eventually, this could lead to the replacement of rainforest with more drought-tolerant forms of scrubby, open vegetation (ibid).

The question of the greenhouse effect is another factor we must consider under the topic of deforestation. The greenhouse effect is the gradual increase in global temperature, thought to be caused by increased levels of carbon dioxide in our atmosphere, mostly due to the burning of fossil fuels. Simply put, the sun's energy that would normally escape the earth's atmosphere is reflected back to earth by the increasing carbon dioxide. About 35 percent of the world's carbon pool is contained in moist tropical forests (Anderson 4a), 50 billion metric tons of which are in Brazilian Amazonia (Fearnside 237b). During the burning period of July to September in 1987, researchers at the Goddard Space Flight Center monitored the numbers of fires in the flank of Amazonia most

hard hit by felling and burning. They counted more than 8000 fires a day, which, when factoring in the average duration of fires, comes to a total of 240,000 fires over the season (Fate 44). An average fire spews out 4500 metric tons of carbon dioxide (ibid). This works out to about 36,000,000 metric tons of carbon dioxide being dumped into the atmosphere through natural and human-caused fires in just part of Amazonia. Scientists are beginning to complain that they cannot get decent dry-season pictures of Amazonia anymore, because of the clouds of smoke that hang over the area (ibid). We used to think that the rainforest was the "lungs of the planet", and it was inferred that through the process of plant respiration, the fauna of the Amazon could filter out the excess carbon dioxide. Instead, because of our insistance on burning it down, it may end up choking us instead.

The Wonders of Nature

To fully understand the necessity of maintaining the integrity of the Brazilian rainforest, an explanation of the various aspects and components found therein is needed. The magnificence of the rainforest as detailed by facts and figures is staggering, yet, it is a very crude way to try and demonstrate the importance of sustaining what is very simply one of the most amazing natural constructions on this planet. A research paper does not provide stimuli for all the senses in the way the actual rainforest does. However, the facts and figures of the rainforest do explain why it

is worth much more standing than slashed and burned.

Biological Diversity

The actual number of different species of organisms on our planet is unknown. There are estimates as to the total ranging between five and ninety million (Fate 24, Ramakrishnan 151). Scientists have identified about 1.6 million species so far, but information on all but a few is meager (Ramakrishnan 150). The question of how many species there are and what we can learn about them is, for all practical purposes, unanswerable, because of the number of species that die off without us realizing that they ever existed, not just in the rainforest, but worldwide.

How diverse is the rainforest itself? Whatever the accepted estimate of the total number of species, safely half of that number can be found (or expected to be found) in the Amazon (Fate 24, Plotkin 9). The region gives home to one in five of all bird species on Earth (Myers 58). A hectare of forest in the northeast United States contains about twenty species of trees, while a similar plot in western Amazonia may contain more than 300 (Plotkin 10). The estimated total number of fish species to be found in the Amazon is about 3000, which is twelve times the number of species in the Mississippi River system, and fifteen times the number found in the whole of Europe (Myers 58). Entomologist Terry Erwin, while working with his team in the forest canopy, identified more than 3000 species of beetle within only five plots of twelve square

meters each (Fate 24). A single species of tree can give residence to many species peculiar to it alone, and each region of the Amazon shares few species with other regions (ibid). For example, in Ecuador, only ten percent of the insects of one plot were found in the next (ibid). Also, near Manaus, Brazil, forests only fifty miles apart shared only one percent of their species (ibid). Unfortunately, because of deforestation in the Amazon and other tropical rainforests, we are losing this valuable resource faster than we can learn what we are losing. Harvard biologist Edward O. Wilson estimates that, at a minimum, 50,000 invertebrate species per year, about 140 each day, are lost to extinction by the destruction of the tropical rainforests (Ryan 9). At least five plant and animal species become extinct each day in the Amazon (Hayden 52). Extinction of species is a natural occurrence, but Wilson estimates that the present rate of extinction is 400 times that of the recent geological past (Plotkin 10).

There are a few different theories of how this extraordinary multiplicity of species came to be. The theory believed in by a particular conservation group or "expert" in some part determines what they feel would be the best course of action to save and/or use the rainforest. If we can determine the most probable reason why the organisms of the Amazon became so diverse, we will also gain some understanding into how we may sustainably use the resources found there, instead of the just reaping the short-term gains of deforestation.

New species can evolve in two ways. The first is polyploidy,

the multiplication of the number of chromosomes (Fate 24). This can happen in already existing species, or in two species, which is hybridization (ibid). This type of chromosome multiplication is basic to the human domestication of plants (ibid). The second process, allopatric speciation, involves geographic isolation and the divergence of species from similar stock as they adapt to different environments (ibid). Darwin stressed geographic isolation and competition in his theory on the origin of species, based on his studies of the Galapagos.

As for the Amazon, one body of theory has espoused what are called "equilibrium models" for explaining rainforest diversity (Fate 25). This view proposes that high diversity is the result of stability in geography (there were no glaciers in the Amazon, as opposed to the northern hemisphere) and in the ecological communities (ibid). Basically, since the rainforests didn't suffer the traumatic changes of glaciers or similar events, they had time to quietly evolve millions of species in the benevolent environment of warm temperatures and abundant rainfall.

However, there is evidence that the tropics, while not experiencing the direct tumult of glaciers, still would have felt considerable climatic agitation, expressed in changes in sea level, rainfall, and temperature (ibid). These disturbances would have forced changes in the distribution of species inconsistent with the "equilibrium model" (ibid). This brings us to the "non-equilibrium models", which view the Amazon as an environment of constant and rapid transformation; forces great and small, from geological

upheaval to a tree falling across a stream act to incessantly alter the landscape and its inhabitants (ibid). The Amazon is not primeval forest; rather, it is quite the opposite. Falling trees can open up areas to light that were under canopies for decades, giving the light-tolerant species a chance to develop (ibid). There is still further dispute. Jürgen Haffer and Ghilleen Prance formulated a theory concerning "refugias" to explain ways in which allopatric speciation may have occurred (ibid). They believe that climatic changes turned large areas of the Amazon into drier savannah, while other parts, in the Andean foothills and other places where the contours of the land drew rainfall, remained well-watered (Fate 26). The ranges of savannah separated these "islands" of rainforest, in which distinct species evolved; in moister times, the forest reclaimed the drier areas (ibid). The "refugia" theory was the first to explain some of the curious features of the Amazon forests: how one genus might have several species growing adjacent to one another, instead of one species being dominant, and the discontinuities of the distribution of species in the Amazon (ibid).

Biologist Paul Colinvaux contests the "refugia" theories on the basis of pollen deposits in lake sediments and other data, and concentrates on local disturbances, such as tree falls, flooding, and other local events (ibid). Flooding is important in explaining the diversity of the rainforest at both the level of major historical catastrophes and in annual flood cycles (ibid). During the glacial periods, the sea level rose, and the major river

courses may have become so large as to create actual islands in the Amazon, which isolated different plant and animal populations (ibid). At an intermediate level, large floods every one or two hundred years would obliterate mature vegetation and reduce it bare ground (ibid), thereby "wiping the slate" clean for a new period of evolution. Also, Colinvaux holds that at least once during the last two hundred years, increased rainfall in the Andes caused extensive floods in the western drainage systems (ibid). Even today, over a quarter of the land surface in the western Amazon is being reworked by changing river courses (ibid). Colinvaux states:

possibly a quarter of the forests of the whole region has been destroyed by flowing rivers within no longer than a few tree generations and that probably more than a tenth of the entire western forest is disturbed so frequently as to be kept in early successional stages. (Fate 27)

As stated before, the theory believed in by different groups is often intertwined with their proposed "solution". Those who believe that the rainforest evolved so dramatically because it was left alone, stable until the intervention of man, tend to surmise that the only way to save the forest is to set it aside and exclude human beings (ibid); basically, they believe we should lock it up. This is also often true of the believers of the "refugia" theories;

the areas of especially high diversity would be protected and, for all practical purposes, become museums of evolution (ibid). These conservationists suggest that about twenty parks, located in the most biologically diverse areas, would be capable of safeguarding twenty percent of the species of the Amazon (ibid). Besides the fact that this type of plan fails to account for the remaining eighty percent (ibid), these kind of reserves do not allow the local populations the chance to sustainably use the resources of the most biologically resourceful parts of the planet, except possibly from the small income generated when Western tourists come. Until recently, most of the movements to save the rainforests have espoused this kind of emphasis.

What is left out of virtually all of the theories on the diversity and distribution of the species in the Amazon is humanity (Fate 28). One rapidly growing area of research is how indigenous and local populations manipulate their natural resources and sustain them (ibid). This knowledge gives an understanding of the forest as the outcome of both human and biological history, and leads us to believe that humans can continue to live in the forest and sustain themselves, as well as the forest (ibid). As John Ryan writes, "Although indigenous peoples have proved fully capable of abusing land and hunting wildlife to extinction, it is clear that the world's healthy ecosystems are found predominantly in areas under their control" (Ryan 16). This is a topic that will be examined in more detail later in this paper.

Pharmaceutical Products

One area that offers vast potential for use of the tropical forests (and, in light of this potential, has been virtually overlooked, or at least unexplored) is the search for and production of pharmaceutical compounds. As researcher and writer Norman Myers puts it, "Tropical forests represent nature's main storehouse of raw materials for modern medicine" (Myers 210). However, it is wrong to infer that pharmaceutical companies have not yet gained from researching the organisms of the rainforests. There is a one in four chance that any pharmaceutical product we buy, prescription or non-prescription, comes from the plants and animals of tropical forests in some way or another (ibid). Analgesics, antibiotics, heart drugs, enzymes, hormones, diuretics, anti-parasite compounds, ulcer treatments, dentifrices, laxatives, dysentery treatments, and anti-coagulants, as well as many others come from plant origins (Fate 49, Myers 61). But, because incentives of short-term profits are often necessary for investment, the private sector has been slow in utilizing the Amazon as a source for future medicines. The fact that the extensive testing process necessary before new drugs can be marketed is often longer than the job longevity of most corporate executives also inhibits much development and growth of this industry (Fearnside 392a).

There are several examples of medicines that have been derived from tropical forests. An important one is curare, which is obtained from Chondrodendron tomentosum, a vine found in the

western Amazon (Myers 222, Plotkin 12). Curare induces paralysis in skeletal muscles, and is used during abdominal surgery, tetanus convulsions, shock therapy, and also by sufferers of spastic cerebral palsy (ibid). It was "discovered" by modern science after indigenous peoples were viewed using it to paralyze prey by putting it on the tips of arrows (ibid). Another example is the alkaloid derived from the rosy periwinkle, which is found in the tropical forests of Madagascar (Myers 212). Alkaloids are complex biocompounds, and are among the most important materials with which pharmacologists manufacture drugs (Myers 210). Of all the biomes, tropical forests contain the highest proportion of alkaloid-bearing plants, and the alkaloid yield is also higher in the plants of the tropics (ibid). The particular alkaloid produced by the rosy periwinkle is used to combat childhood leukemia (Myers 212). A child that faced a one in five chance of remission before the discovery of the alkaloid now has a four out of five chance (ibid). Also, seventy percent of the plants known to have some kind of anti-cancer compound are indigenous to the lowland tropics (Fate 49).

Mark Plotkin has outlined four ways in which tropical forest species can serve modern medicine. First, plants from the tropics can be used as sources of direct therapeutic agents (Plotkin 12). Scientists have been unable to synthesize curare in a form that has all the attributes of the natural product, so pharmacologists must continue to rely on the collection of the plant from the wild (ibid). Also, harvesting wild plants is often cheaper than

synthesizing them (ibid). Reserpine, an important treatment for hypertension, is extracted from Rauwolfia serpentina. It can be synthesized for about two dollars a gram, while it costs about half that to extract it from the wild (Myers 216, Plotkin 12). Second, the natural product can be the starting point for the development of more complex semi-synthetic compounds (Plotkin 12). Saponin extracts are chemically altered to make sapogenins, which are necessary for manufacturing steroidal drugs (ibid). Third, the species from the wild can be the sources of substances used as models for new synthetic compounds (ibid). Cocaine, which comes from the coca plant, served as the model for many synthetic local anesthetics, such as procaine (ibid). Finally, the natural products can act as taxonomic markers for the discovery of new compounds (ibid). From a plant chemistry standpoint, the plant kingdom has been investigated haphazardly; some families have been relatively well studied, while others have been almost completely passed over (ibid). Noted Brazilian plant chemist Otto Gottlieb wrote in 1981, "Nothing at all is known about the chemical composition of 99.6 percent of our flora" (ibid). Obviously, there is much the field of pharmaceuticals can learn and use from the rainforests; the question is, will its secrets be told before they are lost forever?

Again, our efforts can be enhanced by the knowledge of the indigenous peoples. For centuries, botanists have been guided in their searches by Amazonian shamans; the search for drug plants was the first impetus for the occupation of the Amazon (Fate 49).

Indeed, ethnobotany, the study of tribal peoples and their utilization of the plants of tropics, is a much more cost-effective method for searching out medicinally useful plant materials than random screening (Plotkin 12). Native medicines of the Amazon include cures against animal toxins, anti-worm medicines, natural insect repellants (a common feature of the pigments used in body painting), contraceptives, anti-convulsives, muscle relaxants, emetics (for example, ipecac), anti-malarial and anti-fever drugs (such as quinine), and also psychotropic drugs (Fate 49). Professor Richard E. Schultes, Director of the Botanical Museum at Harvard, has found that the indigenous peoples of northwestern Amazonia use over 1300 plant species for medicinal and related purposes (Myers 209). About three quarters of the drug plants commercialized by pharmaceutical companies have the same or related uses as first devised by the folk doctors and shamans who originally collected them (Fate 50).

The information that we can receive from further research of ethnobotany, in addition to the medicinal plants themselves, is another loss we will have to accept with the continued destruction of the rainforest. The people and the cultures that nurtured and developed these plants are becoming extinct as fast as the plants themselves. We must accept, as tough as it is to swallow, this bitter pill that we have forced upon ourselves: among the species that we are exterminating in the rainforest are human beings.

Users and Uses

There are many groups that could be found guilty of deforestation in the Amazon. That, however, is only part of the story. As we look deeper, we begin to find the reasons behind the actions, and it doesn't always appear that the person holding the chainsaw is necessarily the one to blame. Brazil is not different from the rest of Latin America in the sense that there are a but a few real actors who influence the majority that are acted upon. It is often easy to take the mainstream First World view, to simply blame the government and be done with it; it is better to examine what policies the government were trying to follow, and who or what influenced those policies. With extinction occurring on a daily basis in the Amazon already, we can not afford to make many mistakes twice.

Slash-and-Burn Farmers

This diverse group has received much of the blame for the destruction of the rainforest. They are certainly one of the easiest groups to spot; the fires they start to clear off the forest are distinctly recorded by satellites. Slash-and-burn farmers, according to Anthony Hall, are the second most important cause of deforestation in the Amazon (Hall 150), and their practices should most likely be discontinued, or at least greatly modified. However, the primary cause of their interaction with the rainforest is hard to pin on the settlers themselves. Would they have left their urban homes and ventured out into the jungle if the

government had not proffered land for the taking and the World Bank did not finance the bulding of the roads that brought the settlers to their "promised land"? The answers to these two questions seem obvious, but they are not often asked.

The practices followed by these small farmers are inappropriate to the ecology of the rainforest setting. The farmers clear small areas of forest, burn the vegetation, grow two or three harvests of food crops, and then abandon the degraded soil to repeat the same process on another plot (Fearnside 240b, Hall 150). As was stated before, the nutrients of the rainforest are contained in the biomass; when the biomass is removed, so are the nutrients. After three plantings, the soil is useless for farming, and is usually planted with grass, which leads to cattle grazing and further degradation of the soil (Fate 151, Fearnside 240b). Limited deforestation and sustainable slash-and-burn farming is undertaken by indigenous groups and other forest-dwelling cultivators, but only at the smallest scale (Hall 150). With the large influx of new land-hungry farmers, crop rotations shorten and the land is not allowed enough time to recover; the result is that the sustainable system breaks down (ibid). The settlers often do not bring with them the skills necessary for sustainable farming in the Amazon (Hall 151). Also, what skills they might have are usually unsuited for rainforest conditions. They do not cultivate the wide variety of crops planted by indigenous cultures, and their short-cycle crops rapidly exhaust the already poor soil (ibid). Rather than adapt (which is often too expensive an option for all

but the most affluent of the settlers), the farmers move on to another plot and start over.

One myth that focuses much of the blame on the rural poor is that deforestation is caused in large part by overpopulation. In other areas of tropical deforestation, overpopulation may contribute somewhat, but not to the extent that many believe it does, which is especially true in Brazil's case. In Brazil, as in most areas, it ultimately boils down to the unequal distribution of resources, specifically, fertile farmland. Brazil has an estimated ten million landless families (Fearnside 240b). If all potential farmland outside Amazonia were equally distributed, each citizen of Brazil could have four hectares (Alternatives 9). The real figures dictate that 4.5 percent of Brazil's landowners hold 81 percent of the farmland, and 70 percent of rural households do not own any land (ibid). 43 percent of the land area in Brazil is occupied by 0.7 percent of the farms ("Ecologists" 26). Landless peasants are destroying the rainforest because they are increasingly excluded from the large landowner-based agrarian development policies of the Brazilian government (Hall 152). There always was and still is enough to go around, but, as history has shown, this does not mean that everyone will get what they need.

In addition to the inequities of land distribution, the settling of the Amazon was prompted by other problems as well. Poverty, drought, and land eviction in the North East (which has been historically a source of migration within Brazil) and eviction elsewhere in the face of development policies formulated by the

government during the mid-1960's (Hurrell 208). In the 1970's the population of the Amazon expanded at a rate of 6.3 percent, while Brazil as a whole grew by only 2.8 percent (ibid). The population of Rondonia, one of the Amazon states in Brazil grew by an amazing 34.2 percent (ibid), from 10,000 people (mostly indigenous) in 1965 to more than a million by 1985 ("Ecologists" 26). However, the majority of the settling in the Amazon did not occur as a spontaneous movement; it was formalized and became national policy when the government realized the dangers of the inequities of their development programs, and so initiated the colonization of the Amazon (Fate 108).

The government's program of development had so far only included the elites of Brazilian society. It was obvious that something must be done to appease the masses, before the fires of rebellion spread to their country. The answer was simple: the Amazon. With an area as large as Amazonia in their possession, it would be inconceivable for the government to redistribute the land owned by the large landowners and industrialists, the groups most closely tied to the generals, when they could easily afford to give away a few acres of rainforest to satisfy the people's hunger for land (Fate 108). Medici announced his intent to open up the Amazon in a dramatic and emotional speech while visiting the drought-stricken North East (Fate 108, Hall 10). He offered "a land without men for men without land" (Fate 108). The government had a perfect safety valve for anticipated social conflicts, and therefore business could continue as usual.

And so, the Plan for National Integration (PIN) was started in 1970 (Hall 10). The main project included in this plan was the financing of the 5000 kilometer Trans-Amazon highway (BR 230), as well as other complementary roads (Fearnside 240b, Hall 10). This not only opened up the Amazon to settlers, but also provided the manufacturing centers in the south access to both the raw materials from the rainforest and to the new markets created by colonization (Hall 11). In summary, the PIN had three main consequences. First, it formalized the military government's first venture into colonization, by providing credit for small farmers and, through the National Institute for Colonization and Agrarian Reform (INCRA), by setting up an agency to mediate land disputes and award land titles (Fate 109). Second, it nationalized the unclaimed lands along the federal highways, taking the control of these lands away from the individual states, and thereby greatly increasing the power of the federal government and the military (*ibid*). Finally, in 1971, PIN was complemented by the Land Redistribution Program (PROTERRA), which provided a large line of credit for investment in Amazonia (Fate 109, Hall 11). This credit was initially designed for small farmers, but its funds were often appropriated by large landowners (Fate 109).

INCRA provided the colonists with transportation to the Amazon, a sure title to a 240-acre plot, and guaranteed credit for planting rice, corn, and beans (Fate 110). They were also given a six-month household subsidy to get them through the initial struggle, and promises of housing, schools, medicine,

transportation, and technical assistance (ibid). Even with all the inducements, the actual number of subscribers to the program was much lower than expected. The generals initially anticipated 100,000 would migrate, but in the end less than 8000 participated (ibid). Then, after they got there, many went back to the city after failing at farming or moved on to new plots further west (ibid).

Susanna Hecht and Alexander Cockburn make strong arguments that the agricultural ability of the colonists and their land was not the determining factor in their failure. The settlers had few ways to market their produce, and because of that, the middlemen and truckers charged monopolistic prices for their services (Fate 110, Millikan 56). Delays in land titling sometimes left settlers without the collateral needed to get credit (Fate 110). In addition, the government set price ceilings on the farmers' produce (ibid). The returns on an excellent yield could barely cover their costs (ibid), and without additional income from another source (wage labor or petty extraction), three quarters of the settlers could not make ends meet (Fate 112, Millikan 60). When the jobs and the extractive resources were gone, the colonists had no choice but to start over somewhere else.

Not only did the infrastructure and the market system work against the settlers, but it appears the government was conspiring against them as well. Just a year after the Trans-Amazon settlement began, the Minister for the Interior, Reis Velloso, stated "...the necessity of both avoiding predatory occupation

with consequent deforestation and of promoting ecological equilibrium leads us to invite large enterprises to assume the tasks of developing the region" (Fate 110). Velloso's logic was simple; if the settlement project was abandoned, then the lands allocated to the settlers could be given to ranchers and large landowners (Fate 112). After the address given above, Velloso allocated six million acres that had been previously designated for colonization to large ranchers, and delivered with the land an additional warning: the peasants "carry out the sole, dangerous activity available to them: deforestation and the exhaustion of soil for subsistence agriculture" (ibid). Meanwhile, the highest levels of deforestation and soil degradation were obviously occurring on the large ranches on either side of the Trans-Amazon (ibid), but the government's direction was clear. With the reality of the land reform program left in name only, the government's development program became business as usual once again. The wealthy continued to be favored, and the poor were only to be monitored for social conflicts, not really to be helped.

Two years after the Trans-Amazon was begun, the generals decided that their social development plans were costing too much, so they went back to promoting large-scale development projects, which meant continued poverty for those not included in those projects (Fate 113). However, by 1985, the government again needed to open up the Amazon as a safety valve to quiet cries for land reform. Included in the "Third National Development Plan" was the national agrarian reform plan, which aimed to distribute more than

a hundred million acres to a million and a half families across Brazil, and specifically about a hundred thousand acres for 140,000 people in Amazonia (Fate 117). The agrarian reform plan emphasized expropriation of unused land, which instigated a large degree of rapid deforestation, since it was harder to expropriate lands that were in some form of use (Fate 118). In the end, this reform program was as unable to deliver to the peasants as the first program; less than five thousand families were resettled in the Amazon, and the main outcome was increased deforestation (ibid).

The peasant farmer in Brazil is not significantly different than the peasant farmer in other Latin American countries. The essential characteristics are the same: they are impoverished, farm at the subsistence level, use wages earned outside their farming activities to continue their basic existence, and are powerless (for the most part) to change any of these characteristics. What is specific to the farmers in Brazil is that their (potential) farmland is probably the most publicized area of environmental dispute on a global basis. Their activities are not what distinguishes them; they just happen to live in the wrong place. It is generally agreed that their destructive practices should be discontinued, but accusations and tongue lashings do not relieve their oppressed conditions. We are putting the cart before the horse when we tell the peasants to terminate their livelihoods before offering any viable alternatives. It is easy to preach from a soapbox, especially if we happen to be living in the most gluttonous nation on the earth. If we truly value the rainforest,

we must be prepared to pay the price, because it will truly cost us to save it.

Cattle Ranchers

Again, it must be noted that care should be taken when placing the blame for deforestation in Amazonia, lest false accusations be flung about, which has often been the case. However, the formation of pasture for cattle ranching is definitely one of the more serious causes of destruction of the rainforest. In fact, there is a general consensus among environmentalists that ranching is the leading cause of deforestation in the Amazon (Hall 145). According to a 1986 World Bank land-use survey of central Rondonia, a Brazilian state in Amazon, 46 percent of the deforested land (thirty percent of the total surface area) was used as cattle pasture (Millikan 55). But, as in the case of the peasant farmers, there is more to the picture than just what appears to be one of the proximate causes of deforestation. For example, how can the formation of pasture be the foremost cause of deforestation while Brazil and Amazonia in specific are net importers of beef (Fate 98, Sawyer 268)? In fact, the notorious "hamburger connection", in which First World fast food restaurants were increasing profits by using cheap beef raised on plots of former rainforest in Central America, does not apply to Brazil; Amazonian beef is prohibited from sale on international markets due to the presence of aftosa, more commonly known as foot-and-mouth disease, in Brazilian cattle

(Fate 98, Hall 147). Once we add this information to our perspective of livestock production in the Amazon, it is almost obvious there is something behind the levels of deforestation attributed to pasture formation besides the raising of cattle.

At first glance, livestock production in the Amazon does not seem more profitable than farming. At the start of pasture use, there are very low levels of productivity; only one animal per hectare (2.4 acres) can be sustained initially, and this decreases to one head per five hectares after five years (Hall 146, Myers 138). The normal pattern is for cattle ranchers to follow in the path of deforestation of the peasant farmers, either through legal or extra-legal means (Hall 145). After the soil is no longer fertile enough for food crops, grass is usually planted, which extends the usefulness of the plot for a few years, until it becomes choked with weeds (many of which are poisonous to the cattle) or so degraded that the land is of no use to anyone for agricultural means (Fate 151, Fearnside 237b, Hall 147). Soil erosion, the leaching of nutrients, and the compaction of the soil by the hooves of the cattle also work to exhaust the land (Fearnside 236b, Hall 147). In essence, cattle are often used as a final means to eke some worth out of the land, rather than allow it to follow the natural (but not profitable) succession back to secondary rainforest.

After we learn of the inefficiencies and contradictions of livestock production in the Amazon, a question arises: how can raising cattle in the Amazon be made profitable? The answer,

almost apparent, is through government aid. Government subsidies and tax incentives for livestock production, as part of the larger plan of development in the Amazon, are directly related to the amount of rainforest destroyed to make way for cattle pasture. Several studies have shown that livestock in the Amazon is not profitable without subsidies (Fate 150). According to Hans Binswanger of the World Bank, the tax credits given by the Superintendency for the Development of the Amazon (SUDAM) for corporate livestock ranches in the Amazon has the largest effect on deforestation (Binswanger 824). By 1983, the total investment in the SUDAM-approved ranches had reached had already reached almost one billion dollars (in 1982 U.S. dollars) (Binswanger 825). By September 1985, SUDAM had approved 527 livestock projects (*ibid*). The average size of these ranches is 23,600 hectares, which clearly shows that the incentives program favored large enterprises (*ibid*). In total, as of 1991, SUDAM-approved ranches occupy 8.4 million hectares, of which half was to cleared for pasture, according to Brazilian land use policy (Binswanger 825, Hall 148). According to figures published by the Brazilian Institute of Forestry Development (IBDF), livestock production was responsible for 38 percent of the deforestation in the Amazon, ninety percent of which was financed by SUDAM (Hall 145).

In addition to the tax incentives, very favorable credit policies have been available to ranchers. Until recently, real interest rates on official credit was negative (Binswanger 826). To get these loans, land titles or some form of occupancy is

required, which means that all SUDAM-approved ranches are eligible for loans (ibid). This further establishes the dominance of large livestock operations in the Amazon (since the poor are less likely to have land titles), and subsequently deforestation rates accelerate.

Despite the staggering amount of money poured into the subsidizing of ranches, the program failed to create viable ranching operations in the Amazon. Realized livestock production is less than sixteen percent of anticipated production (Binswanger 825). While disbursement of the tax incentives has been close to 100 percent, actual implementation of livestock projects has been less than forty percent (ibid). About thirty percent of the large projects were abandoned, and forty percent sold nothing (Fate 150). Even with government backing through money and supportive policies, the actual production of livestock in the Amazon could not take hold.

Land speculation is the main factor that has furthered pasture formation, ergo deforestation, in spite of the seemingly apparent impossibilities of raising cattle in the Amazon. Due to all the benefits of starting an agricultural project (tax breaks, low-interest loans, etc.), land itself became a prize possession; if you owned the land (and had title to it), you could reap the harvest of subsidies. Investment in livestock, especially, was one of the least risky opportunities, and often the cheapest (Fate 107, Fearnside 234b).

Brazil's lavish fiscal and monetary policies also led to high

and unstable levels of inflation; in 1988, prices rose 933 percent ("How" 69). The combination of the benefits of livestock enterprises and the disadvantages of not investing in anything prompted a furious land boom. Land values rose as much as 100 percent in real terms (Fate 107). SUDAM's programs had transformed land from a means to enter the agricultural market into a speculative commodity and an object of exchange in and of itself (ibid). Businesspeople soon realized the usefulness of agriculture and land as tax shelters, and began to buy farmland, mainly to misdeclare business income as farm income to escape taxes ("How" 69). The returns on raising cattle may be negative, but if enough tax credits are granted, investment in ranching may still be attractive to businesspeople (ibid). Additional factors, like the formulas that stated that land near roads was worth from four to ten times more than more distant plots, and land cleared as pasture was usually thirty percent more valuable than forested land added more fuel to the fire, literally (Fate 122).

Legislation has been passed to limit eligibility for SUDAM approval, but the regulations are not always enforced (Binswanger 825-6). As long as there are still profits to be had from land speculation and ranching through subsidization, the rainforests will still be cut down. Before we expect projects promoting sustainable development to succeed, these distorting policies must be removed. Of course, land speculation will not be discontinued just because we wish it so; comprehensive land use planning must also come into being. We must prove through extensive practice of

non-destructive agricultural techniques what has only been theorized: the destruction of the rainforest for activities such as ranching is not only a tragedy, it is truly an economic waste. It must become clear through strict land-use policies that livestock production in the rainforest for purposes other than domestic consumption are not sustainable, and therefore are not possible.

Extractors

Petty extraction is the least destructive of all major economic exploits in the Amazon, and the most marginalized. While peasant farmers have been pushed aside to allow for the development of ranching and industrial projects, lands devoted to extractive activities have been, until recently, expropriated for nearly everything else, colonists included. Even most writers, while detailing the abuses of ranchers and peasant farmers and suggesting changes in Brazilian policies, somehow forget or ignore the whole system of extractors, transporters, and processors involved in extracting. The life of the petty extractor should not be glorified as a panacea for the deforestation of the Amazon, but had the millions of dollars of research and development funds that have been given to the more destructive programs ended up developing extractivism, there would most assuredly be much more of the Amazon left standing today.

Extraction in the formal sense implies destruction, of taking away. In the definition applicable to extraction in Amazonia,

supplied by Hecht and Cockburn, "it involves removal of some part of an ecosystem's material for commercial or domestic consumption in a manner that does not threaten the long-term productivity of the resource" (Fate 154). Indeed, forest collectors have been supplying international markets for five hundred years (*ibid*). Extracting is probably the longest existing form of rainforest use. If extraction meant deforestation, the effects would be felt and reported along with those of slash-and-burn farming and ranching.

Extraction constitutes the removal of non-timber forest products, of which approximately thirty are collected for commercial use (Fearnside 387a). The main commercial products are rubber and Brazil nuts (Allegretti 256, Fearnside 389a). In addition to these, many more products are collected for food, medicine, or other personal uses (Allegretti 256, Fate 154, Fearnside 387a). Some riverside dwellers and indigenous groups are also included in the category of extractors (Allegretti 253). They are a diverse group, but they share a common bond; they all depend on the rainforest for survival.

The largest group of extractors is the rubber tappers, and they are also the most visible politically. There were 68,000 rubber tapper families counted in the 1980 census of Brazil, although rubber tapper organizations claim the actual number is much higher (Allegretti 255, Fearnside 387a). They occupy an estimated four to seven percent of the Amazon, with the majority living in the states of Amazonas and Acre (Allegretti 255, Fearnside 387a). Contemporary rubber tappers are descendants of

migrants from the Brazilian Northeast, who came in the wake of the rubber boom of the late nineteenth century, when the Amazon was the world's exclusive supplier of rubber (Allegretti 254, Fate 61). However, this monopoly did not last long, for by 1910, Hevea brasiliensis, the Brazilian rubber tree, had been transferred by the British to Southeast Asia, where rubber plantations were established (Allegretti 254, Fate 77). Another smaller wave of migration occurred during WWII as a result of agreements between the United States and Brazil to guarantee the supply of strategic goods to the U.S. (Allegretti 254, Fate 87).

There are two major systems of rubber production in use today in Amazonia. The more traditional system is similar to the latifundista system of agriculture used throughout history in much of Central and South America. To obtain rights to tap rubber trees, rubber tappers are required to pay rent to the landowner, referred to as a seringalista (Allegretti 255, Fate 88, Fearnside 388a). The rubber tapper is a seringueiro, and the estate in which the natural rubber tree groves are located is a seringal (Fate 88). The landowner provides industrialized goods to the rubber tapper, which are paid for in kind at the end of the rubber harvest (Allegretti 255, Fate 62). Money does not actually change hands in this type of economic relation, and in most cases, the value of the rubber production is inefficient to pay off the debts, leaving the rubber tapper in permanent indebtedness (Allegretti 255, Fate 62). The prices for the manufactured and consumer products purchased from the landowner and the prices paid for the extracted forest

products are all determined by the landowner, which further establishes the rubber tappers' slavery to debt (Allegretti 256). This system is concentrated in areas relatively distant from commercial centers (Allegretti 255).

The second production system is referred to in the Amazon as "autonomous" or "free", because the rubber tapper is not subordinated to the landowner, and therefore is open to freely commercialize their production; "free" tappers refer to their indebted counterparts as "captive" (Allegretti 255-6). The autonomous mode is gradually undermining the traditional production system, and is found in areas closer to commercial centers, where debt peonage has been unable to take a firm hold (Allegretti 255). The transformation from "captive" to "freed" occurred intensively in the 1970's, and was associated with the consolidation of a more diversified local economy (Allegretti 256). Autonomous rubber tappers assure a better quality of life, because the diverse activities of the autonomous rubber tapper are aimed at meeting the needs of the family, not at solely producing rubber (ibid). The activities of a rubber tapper family or group of families include extraction of one or two regionally commercialized products; extraction of other forest products; shifting cultivation of traditional crops, and crops that can be substituted for industrialized goods like sugarcane and tobacco; the raising of livestock for transport, milk, and the storage of savings; as well as fishing and hunting (Allegretti 256, Fate 154, Hecht and Cockburn 18).

Autonomous extractors rely mostly on family labor, variants of sharecropping, or upon what anthropologists call "fictive relationships: rubber tappers appeal to each for help on the basis of some sort of familial relationship (Fate 154). Some wage labor may be hired in as well, and labor exchange is also common (ibid). The autonomous rubber tapper family may also be engaged in wage labor, commerce, and other small-scale enterprises (ibid). The pattern of commercial and subsistence production is quite different for "captive" rubber tappers. The overriding objective is clearly rubber production, and other activities are subordinate (Allegretti 256). Agriculture is only permitted when it does not interfere with rubber tapping, and can only occur when enough family labor is available to carry out both activities at once (ibid). The "captive" tapper truly is trapped; they are not paid money for their products, nor are they given the slightest chance to earn money from other sources, lest they find a more reasonable price for needed consumer goods.

In the 1970's, rubber tappers throughout the Amazon began formulating development plans to meet the needs of themselves and other forest workers (Hecht and Cockburn 18). Brazilian land policy failed to grant land titles to extractors in the same fashion as homesteaders; rubber stands were defined as areas in which landowners are absent (Allegretti 257). Violent conflicts over the use and deforestation of traditional rubber tapping areas broke out (Allegretti 257, Fate 169). In most cases, the lands containing rubber stands were bought out from under them by

business groups planning on converting the land to cattle pasture, which meant expulsion of the rubber tapping families (Allegretti 257). In response to these expulsions, Chico Mendes, a rubber tapper who was to gain world-wide notoriety in the mid-1980's, organized a group of seventy men, women, and children in Brasileia in 1976 and held the first empate, or "stand-off", a peculiar form of non-violent protest (Allegretti 257, Fate 169). Mendes and the others joined hands to stop the clearing, and if the gunmen who came with the deforestation crew wanted to fire, they have to shoot women and children (Fate 169). The tactic worked, and quickly spread to other Amazonian states (ibid).

Initially, there was little organized legal resistance to the expulsions, until through the National Confederation of Agriculture (CONTAG) and community organizations of the Catholic Church the rubber tappers began to learn of their rights under Brazilian law (ibid). Resolution of land conflicts began to take another direction, which varied from compensation for property improvements to appropriation of contested lands and redistribution of individual lots to rubber tappers (ibid). The tappers finally began to get titles for their lands.

However, the situation was far from rectified. As the lands were divided into individual lots, the traditional forms of subsistence were eliminated (Allegretti 257). The holding of an individual autonomous rubber tapper is traditionally 300 to 500 hectares, and the lands were doled out by the government in lots of sixty to one hundred hectares (Allegretti 258). Also, the rubber

trees along a traditional holding may lie within a area legally defined to another person's lot (Allegretti 259). Because of the uselessness of the individual plots for rubber tapping, many lots were sold or abandoned (Allegretti 257). Although they now had clear titles to land, most of the former rubber tappers had only two options to choose from: either clear the land and become a peasant farmer, or migrate and join the growing number of impoverished people in the cities.

However, it became clear to the rubber tappers that the empates, even though mostly successful, simply were not enough; the empates were only temporary solutions, and every rubber and Brazil-nut tree was still vulnerable to the chainsaw (Fate 180). As a result of the search for lasting solutions, or at least an alternative to deforestation that would be palatable to the land use planners in the government, the first rubber tapper congress was held in Brasilia in August of 1985, and thus, the National Council of Rubber Tappers was established (Allegretti 258, Fate 181). The central points agreed upon by the approximately 130 rubber tappers present emphasized the importance of the inclusion of rubber tappers and other extractors in the drafting and execution of all regional development plans that would affect them (ibid). All forests used by extractors should be preserved, and any colonization projects designated for areas of rubber and Brazil-nut trees should be stopped immediately (Fate 181). In order to legally preserve the forests used by extractors and to guarantee extractors' rights to be there, the meeting called for

the creation of extractive reserves (Allegretti 258, Fate 181).

Extractive reserves are a distinct departure from the types of regional development plans carried out so far in Amazonia. Instead of uninhabited areas being flooded by unknowledgable colonists, extractive reserves already contain people who are familiar with the conditions of the rainforest and how to maintain a livelihood under those exacting conditions (Allegretti 258). It should be clarified that there are no "uninhabited" expanses of Brazil; indigenous groups flourish wherever the Brazilian government has not yet implemented development projects. These "unused" sections of the Amazon, if left to the indigenous peoples, could be considered extractive reserves of a sort immediately, because they support a population. Unfortunately, this idea has not received much serious thought until recently, when the homeland of the Yanomami group was declared a reserve.

The structure of the extractive reserves is also quite different than other development projects. The government retains ownership of the land, while use rights and specific holdings are recognized for each rubber tapping and/or extracting family (Allegretti 261, Fate 181, Fearnside 387a). The extractors cannot sell or deforest the land, except for small clearings for subsistence crops (Fearnside 387a). These rules became law when the Minister for Agrarian Reform signed the legislation concerning extractive reserves in July of 1987 (Fate 182). The legislation read that extractive reserves could be implemented in areas that were expropriated under the agrarian reform laws (ibid). At the

time of the legislation, more than 84 percent of the state of Acre was covered by latifundias, and ripe for expropriation (ibid).

And so, three years after the rubber tappers' meeting, the first extractive reserve was created in February of 1988 at Sao Luis de Remanso in Acre (Fate 183, Fearnside 387a,). It covers about 100,000 acres and provides a home for about ninety rubber tappers and their families (Hecht and Cockburn 18). In May of 1988, the governor of Acre expropriated the seringal Cachoeira and created another extractive reserve, mainly because of empates organized by Chico Mendes, but also because lending bodies such as the World Bank and the Inter-America Development Bank were becoming interested in environmental controls (Fate 184,191). Five million acres of extractive reserves have been proposed for the states of Rondonia, Amazonas, Amapa, as well as Acre (Fearnside 387a, Hecht and Cockburn 18). Provisions for extractive reserves have even been included in Brazil's new constitution, which took effect on October 5, 1988 (Fearnside 387a).

As was said before, extractive reserves should not be viewed as a miracle cure for the deforestation of the Amazon. While the reserves will allow many rubber tappers to continue their livelihood and save portions of the rainforest from destruction, it is unlikely that sufficient land will be set aside to employ all the rubber tappers that have been already expelled from their stands. Displaced tappers fill the ranks of the urban slums, or else live as refugees to continue tapping in the forests of neighboring countries, such as Bolivia (Fearnside 387a). It would

also be poor planning to try and accomodate all the displaced tappers; extractive reserves of any type are not a means to support a dense population. Even for those expert in extractivism, only a sparse population can be supported (ibid). Despite the best efforts of the Brazilian government, the Amazon cannot be used as a safety valve against real economic and land reform. The state government of Amazonas has launched an "extractivist project" that will increase the number of tapping families from 500 to 5000 (ibid). The word "extractivist" in this sense is only a not-so-subtle way of undertaking yet another over-settlement project.

After being tied down for so long by the constraints of debt, economic self-sufficiency is an important goal for extractors. This would require maximizing the variety and value of the products collected, limiting the amount of money that is lost to intermediaries, and minimizing the cost of establishing and maintaining extractive reserves (Fearnside 388a). These guidelines are also imperative if extractive reserves are to become a lasting institution in the Amazon. Brazil actually only produces less than one percent of the world's natural rubber, and it imports approximately two-thirds of the natural rubber it uses (Fearnside 390a, Fearnside 242b). In addition, rubber prices in Brazil are about three times higher than the international price, due to the South American leaf blight fungus, which does not afflict rubber trees in Asia (Fate 84, Fearnside 242b). Prices on products made of rubber are propped up by subsidies in Brazil because plantation rubber is inherently cheaper to produce; rubber trees in natural

settings suffer only light levels of fungal attack (hence the necessity of large sized holdings), but the long distances that must be walked between trees makes labor requirements high per ton of rubber collected (Fearnside 390b). Brazil's unstable economy is unlikely to be able to maintain the subsidies for a long period of time (Fearnside 391). This is further reason not to attempt to over-settle extractive reserves and to diversify the products they collect and sell.

Brazilian extractive reserves face the same problems as other development programs in Latin America, in that it is hard to create a windfall in a depressed economy. But they do have advantages that other projects in Brazil do not. The idea for extractive reserves originated with the people most affected by the plan, at the grass-roots level, which is unlike almost all other Amazonian development plans. The system of extraction stands a much better chance of being maintained intact because of that, which has been a problem with other projects (i.e. ranching and land speculation). Also, the rubber tappers union is not only a trade union, but it is becoming a strong political force in Brazil as well, which is often (conveniently) forgotten by most mainstream environmental groups, who would try to fix the problem of deforestation without addressing the deeper issues of social justice. And for those that only read balance sheets to find the worth in something, extractive reserves can prove there is economic value in stopping deforestation. Reserves will continue to evolve, and new products will continue to be found.

Indigenous Peoples

Of all the human groups that have felt the destruction of the rainforest, none compare to the loss of culture and push to extinction the indigenous people have suffered. The Amazon has been subject to interactions with humans since indigenous populations arrived about 12,000 years ago (Alternatives 4). By, or more importantly, before 1492, there were six to twelve million inhabitants of the Amazon (Fate 2). Today, only about 200,000 indigenous people remain there today (ibid 3). One tribe has gone extinct virtually every year since the turn of the century ("Ecologists" 28). More than a third of the tribes extant in 1900 are extinct now (Fate 3). The indigenous peoples have been enslaved, robbed, raped, subjected to diseases, forcibly moved--completely dominated since Columbus first "discovered" North America. It has been a five hundred year era of despair for the indigenous people who could not run deeper into the forest, ultimately to found out anyway. A Txukarramaes tribal leader summed up the demoralized spirit of many indigenous groups: "I think the whites should kill us all right away and take our lands and be done with it" (Sweeney and Olson 11).

While it is clear that certain parts of Brazilian society benefited from the government's various development programs and others lost out at the former's expense, the suffering that these programs and development in general brought upon the indigenous peoples of the Amazon is beyond compare. Brazilian tribes have

been fighting ranchers for almost five hundred years, but since the 1960's they have been under intense pressure from ranches, not only through the direct occupation of their lands, but through the dramatic rise in road construction as well (Fate 140). Federal and state highways in the Amazon have increased at more than thirteen percent a year, from 7,376 miles in 1960 to 15,365 miles in 1984 (ibid). This does not include the vast network of private roads that link farms, ranches, and other private enterprises to the main roads. The roads constructed under PIN alone affected 96 tribes, more than half the tribes in Brazilian Amazonia (ibid). When the Trans-Amazon was built, one of the tribes affected, the Parakana lost 45 percent of their population within a year of its construction (ibid). When something as seemingly harmless as a reporter establishing contact can emaciate the tribe, because the reporter is unknowingly carrying the influenza virus, the construction of roads in indigenous territory can mean genocide.

Brazilian agencies set up to protect the rights of the indigenous peoples have also incurred deaths among the indigenous themselves, because of corruption in the agencies. The Indian Protection Service (SPI) was investigated in 1967 by the Brazilian Attorney-General; the inquiry was commissioned by the Minister of the Interior, General Albuquerque Lima (Fate 138). The result was a 21 volume report which documented massacres of entire tribes by dynamite, machine guns, poisoned sugar, and the introduction of disease microbes, all under the acknowledgement of the SPI (ibid).

The SPI had joined with land speculators and ranchers to murder

indigenous people and steal their lands. Interior Minister Lima abolished the SPI and set up a new agency, the National Indian Foundation (FUNAI) (ibid). The next year, Lima was out of politics, and the Trans-Amazon highway was announced (ibid).

FUNAI soon proved to be as open to corruption as its predecessor. Its officials quickly developed profitable arrangements with large-scale ranchers, mining groups, loggers, and government road builders (ibid). In 1970 the head of FUNAI, Bandeira de Mello, issued several certificates to large-scale ranchers stating that no indigenous people lived in the area to be converted to pasture; actually, the area was home to the Nambiquara (ibid). FUNAI has also negotiated inequitable contracts with a logging company for the mahogany trees found on Kayapo lands (Fate 140). The logging company provided the Kayapo with a road to the trees, a potable water system, and paid them \$50 per tree in return for 10,000 trees, each of which was worth between \$350 and \$500 (ibid). This is an example of one of the extortionate but legal logging practices on indigenous land; the prized mahogany trees are also taken illegally (ibid).

In 1973 the Brazilian Congress passed the Indian Statute, which provided for the protection of native rights to land, resources, and to their own communities and culture (Fate 139). Unfortunately, it also declared that indigenous groups could be removed from their lands by presidential decree, and that indigenous lands were subject to existing Brazilian law, in that all sub-surface minerals belonged to the federal union (ibid).

This paved the way for state-run mining on tribal lands.

Indigenous lands have become used for individual placer mining for gold as well. As of the summer of 1989, more than 560 applications for documents that permit prospecting and imply claims had been approved on 88 indigenous reserves, with an additional 1,685 pending (Fate 141). The largest of the gold mines is the Cumaru mine in the Gorotire Kayapo reserve (Fate 143). 10,000 garimpeiros, or placer miners, invaded the reserve in 1980 (ibid). The Kayapo requested government intervention, and negotiated a ten percent royalty on the mine's production (ibid). The Kayapo have used this money to demarcate their lands (ibid), but at what cost? The placer mining process uses mercury to separate the gold, and the poisonous properties of mercury are well-known. A study carried out in 1988 by the Department of Mines and Energy showed that Kayapo children, far away from the actual mine, now have mercury levels in their blood only slightly less than the miners themselves (ibid). Mercury is absorbed by the water in the rivers, by the fish in the water, and by the people who eat the fish.

Not much has been written about what we can learn from the indigenous people. They are seen mostly as an impediment to development, much like the rainforest itself. We, as members of Western culture, tend to look at any other culture that is not as "civilized" as us as inferior, and unable to function properly in our "modern" world, which appears to be the only option available. The Brazilian government until recently considered the indigenous people as wards of the state, and they were unable to participate

in the political environment that determined the factors of their existence. When their stature in society is considered equal to that of a deer, it is easy to forget their contributions to modern society. For example, the economic value of all the plants, domesticated and medicinal, contributed by Amazon natives to modern society is staggering, yet is almost completely disregarded (Fate 30). The pattern of simultaneously subjugating and ignoring indigenous cultures is unfortunately basic to Western thought, and it is a struggle to break free of that mindset. The rights of the indigenous forest peoples are continually subordinated to those involved in ranching, mining, logging, plantation agriculture, and any other profit-making venture. Global market forces take indigenous peoples' autonomy and sovereignty and give them no rights in return. If we are to more fully understand the changes that must be undertaken to successfully develop the rainforest, while successfully limiting deforestation, we must break free.

In previous times, the areas that were most heavily concentrated with native populations were the fertile floodplains, which contained fertile sediments, new oxbow lakes filled with fish and other game, and water-saturated land which was able to support the annuals and tree crops the natives planted (Fate 28). Their planting techniques, well-adapted for the conditions of the rainforest, were seen as deficient agricultural practices by the Europeans (*ibid*). The Europeans also missed the numerous trails and portages of the natives, along with their extensive river trading networks (*ibid*). With the extinction and enslavement of

the indigenous people, Westerners lost the knowledge of the rainforest crucial to native agricultural practices, and have been forced to settle for much less productive methods that limit us to continual deforestation as the only means to achieve at least one decent crop.

Mainstream society still views the native agricultural procedures as little more than strolling through the forest and picking bananas off a tree. While some groups subsist purely on hunting and collecting naturally occurring vegetative foodstuffs, North American anthropologist Darrell Posey has documented substantial accounts of rainforest manipulation by the Kayapo, an indigenous tribe. The Kayapo have shifted valuable medicinal, ritual, and other useful plant species to locations easier for them to reach (Fate 29). They collected germ plasm (clippings and samples of different species) over a region roughly the size of Western Europe, and planted it in areas of interest, such as by trails, in forest gaps, at camping sites, and in favored hunting areas; they created "resource islands" (Fate 29, Saving 124). The resource islands are not necessarily closer to the village, but important to the human community and the ecology of the region (Fate 29).

The traditional lands of the Kayapo were about the size of France, so in order to understand their methods, we must replace our limited view of agriculture as occurring only in an isolated field with a more spacious one (ibid). There is evidence to suggest that prior to European contact, population densities along

the major rivers in Amazonia may have been higher than they are today (Anderson 4a). This is further proof that we must adapt our views of agriculture to fit the rainforest, instead of destroying the forest to fit our restricted methods. Indigenous people were able to sustain more people than we are in "modern" times, and they were able to do it without cutting down the rainforest.

Janis B. Alcorn, a biologist from Tulane, has determined that indigenous agroforestry strategies have seven common attributes: 1) incorporation of native species into their systems; 2) reliance on succession (the process a forest undergoes as it rebuilds and redevelops after any level of deforestation) to produce resources; 3) use of natural environmental variation; 4) development of numerous crops and native species; 5) flexibility; 6) diversification as a means of self-insurance; and 7) use of all available resources to ensure that needs will be met (Alcorn 142-3). These strategies are complex management systems that use biological processes as tools (Alcorn 148). The indigenous people have developed a way to use the resources of the forest to sustain themselves given the restrictions of limited labor, limited land, low capital, and limited availability of artificial inputs such as fertilizer and improved hybrids of seeds that face peasant farmers all over the world (ibid). Using what is available to them, the native farmers have accomplished what Western science and technology have been unable to do; they have made agriculture in the Amazon without deforestation possible, and perhaps economically profitable. What is ironic is that it has taken Western society

500 years of abusing the indigenous peoples to begin to understand this, and realization is still slow in coming.

The Brazilian Government and International Organizations

For most of its history, the Brazilian government has had what could be described as an adversarial relationship with the Amazon. The rainforest has long been seen by many in Brazil (especially the military) as a barrier to what they think Brazil could be, a truly developed world power. How can they be considered developed when such a large part of Brazilian territory is merely forest, and unexplored forest at that? The emotions aroused by this question are similar to the Manifest Destiny felt here in the United States. Also, the potential for Communist guerilla forces to muster in the Brazilian hinterlands and follow the pattern set by Castro in Cuba has always made the military governments feel more than a little nervous. For the most part, it has been money-hungry Brazilian elites (with the help of some foreign capital), eager to maintain the unequal distribution of assets, that have caused the majority of the deforestation of the Amazon. This distribution inequity has not changed much, but it is finally beginning to be understood in Brazil and elsewhere that the key to increasing Brazilian development, bettering living conditions for all Brazilians, and raising Brazil's stature in the world is probably tied to using the Amazon sustainably. One thought recurs: a resource destroyed is worse than having no resource at all.

Development of the Amazon was first formulated into a distinct doctrine in the mid-1960's. After the Brazilian military (and U.S. assisted) coup of 1964, General Golbery do Couto e Silva was named chief of state security (Fate 102). Golbery outlined a plan for the development of Brazil, which was based philosophically on German geopolitical theorists and practically on United States hemispheric doctrines, prompted by the victory of the Cuban revolution (Fate 103). Golbery's plan was constructed in three phases: first, the Northeast and the South (the most developed areas of Brazil) must be further integrated, and possible corridors for guerilla insurgency must be closed off; second, the colonization of the South must be redirected to the Northwest, into what are now the states of Rondonia and Acre, the heart of the Amazon; and third, development must be coordinated in an east-west progression along the Amazon itself, "to protect certain frontier points and inundate the Amazon forest with civilization" (ibid). These principles were incorporated in the training manuals for officers entering the Brazilian war college, and formed the basis for both Brazilian development and security (ibid). This mindset must still be kept in mind when discussing changes in Brazilian policy towards the rainforest, since the military only relinquished power less than ten years ago, and they remain a powerful force in the Brazilian government.

More recently, the Calha Norte project was announced in the fall of 1986, after a year of secret elaboration, under the guise of national security. (Fate 118). It was originally conceived as

a military project, and its area of control was vast: the project covered roughly 14 percent of the national territory and 24 percent of legal Amazonia (Fate 118, Hall 36). The objectives are to establish a permanent military presence in the area (eight new military bases are to be constructed); to improve bilateral relations with neighboring countries, primarily to combat drug trafficking; to define new indigenous policies for the region, by giving them plots of land and turning them into Brazilian peasants; and to set up development poles with adequate infrastructure (Fate 119, Hall 36). The size and objectives of this project prove that geopolitical considerations were still major influences on official policy for Amazonia in the mid-1980's, and today.

The government of Brazil cannot be called conservative when it comes to development programs. The Greater Carajas Program (PGC) is the largest development scheme ever undertaken in an area of tropical rainforest (Hall 41). Since it is the most ambitious project of the Brazilian government, it gives us a fairly good litmus reading of both what Brazil is trying to carve out of the rainforest, and what we can, in reality, expect to gain from industrialization in that ecosystem.

The PGC was formally inaugurated in 1980 (Hall 45). The project covers almost 900,000 square kilometers (almost eleven percent of Brazil), the size of England and France combined (*ibid*). As originally planned, approximately US \$62 billion in global investments were called for (Anderson 1192b). The main project of the PGC is an iron ore mine, and other industrial projects include

two aluminum plants and the Tucuruí hydroelectric dam on the River Tocantins, but agricultural, livestock, and forestry enterprises are also involved (Hall 42-43).

In 1967, by accident, it was realized that the Carajas Mountains, located in the northeast part of Brazil, had the largest high-grade iron ore deposits in the world (estimated at eighteen billion tons with an average grade of 67 percent pure iron) (Anderson 1192b, Fate 133, Hall 43). Other significant mineral deposits include manganese, copper, bauxite, nickel and tin (Anderson 1192b). After a few years of negotiations, a joint mining corporation was formed (AMZA), with 51 percent of the company in the hands of the largest state-owned company, the Rio Doce Valley Company (CVRD), and 49 percent controlled by US Steel (Hall 43). In 1974, AMZA was granted exploration rights to the whole Carajas area (ibid). In 1977, US Steel sold its stake in AMAZ to CVRD for \$50 million, citing negative repercussions from the rise in oil prices for the reason (Hall 44). Although somewhat skeptical, CVRD went ahead with the project, and more importantly, the Brazilian government went ahead with the financing of the project. Other sources of financing were loans from the World Bank (\$304.5 million), the EEC (\$600 million), and Japan (\$450 million) (Anderson 1192b, Hall 51). Repayment terms were generous, but European and Japanese lenders had the interests of their own steel industries on their minds when they issued the loans; the loans were tied to contracts for delivery of large amounts of iron ore every year to Europe and Japan, at steadily dropping world iron

prices (Hall 53).

The strategy of the PGC was to establish "integrated" industrial development along the new Carajas railway, which was financed by Brazil, the United States, and Japan (Fate 133, Hall 53). This meant the setting up of over thirty pig-iron smelters and industrial plants to produce goods like ferro-alloys, aluminum, cement, alumina, and some steel (Anderson 1192b, Hall 53). This industrial strategy holds potentially devastating ecological and social consequences (Hall 53). The Iron Ore project, when separated from the rest of the PGC, has been a model of environmentally sound development, in which natural resources have been either conserved or are actively being restored (Anderson 1192b). In fact, only one hundred square kilometers (0.5 percent of the CVRD's area) will be deforested as a direct result of mining (Hall 166). However, outside of the specifics of the Iron Ore project, deforestation is fueled by uncontrolled settlement, gold mining, logging, unsustainable agricultural practices, pasture conversion, and the supply of charcoal for the smelting and industrial plants (ibid). It is safe to assume that deforestation for the PGC carries with it the attributes of deforestation in other parts of the Amazon, namely erosion, flooding, land degradation, and the extinction of plants, animals, and indigenous cultures.

Dr. Anthony Hall calls the Tucuruí dam the "lynchpin" of the whole PGC, because of the dependence of the mineral processing sector on abundant supplies of inexpensive electricity (Hall 58).

The Tucuruí dam is the largest ever built in a tropical rainforest area, and the fourth largest in the world (ibid). The aluminum complexes, when fully completed, will consume over half of the power the dam produces. The dam cost 4.6 billion U.S. dollars, two-thirds of which came from foreign loans (ibid). Virtually all considerations of social and environmental repercussions of constructing the dam were cast aside, due to the urgency of cheap power to service the industrial components of the PGC (Hall 59). Up to 35,000 people were displaced with inadequate or no compensation, and almost 2,500 square kilometers of rainforest were flooded without much thought towards the consequences (ibid). All warnings about problems of flooding uncleared rainforest, such as anaerobic decomposition, siltation, and clogging of the turbines were ignored (ibid). A manager of the North Brazil Electricity Board (ELETRONORTE) admitted, "the environmental question was totally secondary", "the energy of the Tucuruí is vital to the other great projects which are going to solve our foreign debt problem" (ibid). And this is apparently not enough; the Tucuruí is merely the first in a series of 27 dams along the Araguaia-Tocantins system (Hall 58).

The agricultural and silvicultural aspects of the PGC are questionable as well. The CVRD, working with Japanese consultants, planned spending US\$11 billion on agricultural plans covering ten million hectares of eastern Amazonia by 1990, which would produce incomes totaling US\$7 billion a year (Hall 63). One-third of the area would be divided into 300 cattle ranches of 10,000 hectares

each, four million hectares would be used for rice cultivation, and sugar and manioc plantations would comprise another 2.4 million hectares (ibid). These fantastic goals were based on yields far exceeding national averages, and definitely beyond those attainable because of the agricultural qualities of the Amazon (Hall 64). After further studies, cheaper and more realistic agricultural development plans were created. The most comprehensive plan is the Grand Carajas Agricultural Plan (PGCA), prepared by the Brazilian Ministry of Agriculture (Hall 66). This plan is budgeted at US\$1.18 billion, and emphasizes large-scale, commercial, export-oriented production using capital-intensive "modern" technology (ibid). Although the plan hoped to create a class of small-medium family farmers, the plan is essentially a modern, capitalistic form of the latifundios (Hall 67). Only 17 percent of the land is actually allocated to small farmers, which leaves 83 percent for larger producers (ibid).

Virtually of the agricultural plans for the PGC have a heavy bias towards mechanization and technology, and ignore both the detriments of those types of systems and the benefits of traditional indigenous and locally-adapted cultivation schemes (Hall 67-68). However, the PGCA never got further than the planning stage (Hall 68). The cost of the PGCA, though lower than previous plans, was still considered too high by the Brazilian government (ibid). In fact, it has been suggested that the preliminary study for the PGCA was nothing more than an image builder, conceived only to portray the PGC as a well-integrated

development plan to foreign investors (Hall 69). Small provisions for the development of agriculture and livestock are included in the PGC, and by mid-1987, over twenty agriculture, livestock, and associated projects have been approved by the PGC Interministerial Council (ibid). These projects absorb only about one percent of total PGC funding, but function to further the agrarian inequalities discussed previously in this paper (ibid).

The silvicultural plans of the PGC are integral to the pig-iron smelting and other industrial operations, and yet may be the most ludicrous in terms of expected production, and gravest in terms of rainforest destruction. As of 1990, 34 industrial operations were either approved or under analysis; if all are approved, they would require over three million tons of charcoal for fuel a year, which represents over fourteen tons of wood (Anderson 1194b). Pig-iron production would use 86 percent of this amount (ibid). Due to consistently falling iron ore prices, charcoal represents fifty to seventy percent of the final price for the pig-iron (Anderson 1194b, Hall 169).

Until recently, the principal sources of charcoal used by the PGC industries were either scraps and sawdust from regional sawmills, or fuelwood harvested from sites cleared for pasture or other agricultural uses (Anderson 1199b). The growth of the PGC forces this arrangement to change. Brazil's former Institute for Forest Development (IBDF), which has since been renamed, requires charcoal-consuming industries to present a forest management plan, and, by 1995, to obtain all forest biomass from either plantations

or through the sustained management of natural forest (ibid). However, as IBDF staff admit, their analysis of these plans is limited to whether the projected yields will be met, not whether the plans will be sustainable (ibid). The CVRD itself has done the only research on forest management for charcoal production in Amazonia, and formulated some general recommendations and predictions, one of which was that a minimum period of 25 to 30 years between fuelwood harvest would be necessary (Anderson 1198-9b). There is not much reason to believe that these recommendations will be followed. In one example of a pig-smelter operating in the PGC, the company failed to abide by two of four basic recommendations, and their cycle of exploitation was 8.5 years, well below their estimate of 12 years, which is still less than half of the prediction made by the CVRD (Anderson 1199b). There is no reason for us to assume that any other company would do any better, which casts serious doubts on the possibility of sustained forest management for charcoal production, ergo deforestation will undoubtedly increase.

The Grand Carajas Program, from virtually any viewpoint, threatens to be a spectacle of disaster. Pollution in the water, air, and soil could shorten or corrupt the lives of those who have no choice but to live within the realm of the PGC. The Tucurui and the other proposed dams will force many to migrate to the slums of the cities and live a life of poverty. Who can estimate how much of the rainforest will be decimated before the project is admitted unsustainable and uneconomic? As with most of the development

projects introduced by the government of Brazil, the core of Brazilian society, the majority poor, are the ones who sacrifice the most and benefit the least.

By 1988, the Brazilian government was under heavy fire from both inside and outside Brazil about the destruction of the Amazon. Normally conservative bodies like the World Bank and the Inter-American Development Bank were beginning to freeze or suspend loans based on environmental concerns, due to the pressure they were feeling themselves for their earlier financing of the deforestation (Fate 119). Politicians in the United States had begun to call for the internationalization of the Amazon, which did not sit well with the strongly nationalist Brazilian government. As a countermeasure, on April 1, 1989, the Nossa Natureza plan, Our Nature in English, was announced, the first time any Brazilian development plan had an environmental perspective (Fate 119-20).

The plan recognized the pollution involved with gold mining, elaborated the need for environmental protection and research, and examined the effects of environmental degradation on areas occupied by indigenous people, extractors, and river dwellers (Fate 120). A possible government strategy that emerged was the creation of a number of reserves across the Amazon for goldminers, indigenous peoples, and extractors, which made clear for the first time that the Brazilian government must consider these groups' social and political wishes, and was probably the most groundbreaking development of the plan (*ibid*). Two other provisions, the temporary suspension of SUDAM's incentives for ranching and the

prohibition of the exporting of uncut logs sounded more innovative than they actually were; SUDAM's incentive programs were already coming to a close, and the export of round logs had been prohibited for years (ibid).

What was not covered by Nossa Natureza is also important. Migrants were not even mentioned in the plan, an unevitable position formerly held by extractors (Fate 121). Neither did the plan address the environmental implications of further infrastructure development, specifically roads and dams (ibid). Hecht and Cockburn hold that despite the seeming concern for the environment, what the plan made clear is that Brazil's real Amazon policy would remain covert, or at least out of the arena of public discussion. (ibid).

Other developments show that international opinion about the environment cannot be ignored by Brazil, nor are they. On July 2, 1991, Brazil accepted a \$100 million reduction of its debt in exchange for environmental concerns (Goethals 3). This is what is commonly referred to as a debt-for-nature swap. This is a definite change in policy, as Brazil had formerly been opposed to such deals, claiming that they infringed on the sovereignty of Brazil, which is always forefront with the Brazilian government. The money was deposited in a Patrimonial Fund, which accumulates 6 percent interest annually (ibid). The interest will then be used to finance one or several specific environmental and ecological programs (ibid). While this can only be viewed as a victory for environmentalists and a much needed reduction in Brazil's debt, the

\$100 million represents only a miniscule part of Brazil's total debt, which at over \$100 billion, is the largest in Latin America.

Also in 1991, the World Bank, the European Commission, and the Group of Seven leading industrialized nations (G7) granted \$250 million to Brazil for conservation of the Amazon (Pearce 7). The money is to fund scientific research establish national parks and extractive reserves (ibid). The donations are put into a Rainforest Trust by the World Bank, and all proposed projects must be approved by the Bank (ibid). This grant is also innovative, because it is the first international project developed to save any country's rainforests (ibid). Again, the World Bank, which now employs renowned bioeconomist Herman Daly, is trying to save face for its former funding of the destruction of Amazonia, but it is another step in what many consider the right direction.

There are still many uncertainties about what the future holds for the Amazon. The recent coup in Costa Rica reminds us that political actions must unfortunately still be considered somewhat of a gamble in Latin America, and the military holds on to its prominent position in Brazilian politics. However, it appears that the World Bank and other similar institutions are beginning to notice the implications of their funding. If they continue to put environmental restrictions on their operations, and if Brazil remains open to debt-for-nature swaps, extractive and indigenous reserves and similar endeavors, then deforestation in the Amazon can at least be slowed, which, in hindsight, is a remarkable achievement.

Conclusions

The tone of this paper has been optimistic, maybe a little too much. The reason I am hesitant to say that deforestation in the Amazon will slow down to acceptable levels in the near future (a good question itself; what are acceptable levels of deforestation?), despite all the economic, ethical, and scientific reasons to stop the practice, is because the environmental problems in Brazil reflect what are, at the heart of the matter, social problems. Brazil assets are more unequally distributed than anywhere else in the world; this fact does not change over night, nor over just a couple years. In order for deforestation to be brought under complete control, this inequity must be redressed. Advancements in scientific knowledge and enforcement of protective measures are important and cannot hurt, but these achievements may be in vain if the easiest and surest way to guarantee that your family has enough food is to cut down the rainforest and plant crops or raise cattle.

Fortunately, the majority of the latest advancements and news concerning the rainforest has been positive. Brazil has finally opened itself up to debt-for-nature swaps, which is obviously good for the environment, but also may help to cure the social imbalances of Brazil. The World Bank and similar institutions are realizing that they, under the seemingly beneficial auspices of development, have been funding much of the deforestation. So, they are beginning to put environmental restrictions on loans to

developing nations and are organizing outright environmental trust funds. I am somewhat fearful that some of these programs are merely window dressing, and that Brazil may end up doing what it wants to anyway, considering the history of the Brazilian-World Bank relationship, but a little skepticism is a healthy thing. Another point in Brazil's favor is that more and more extractive reserves, indigenous reserves, and national parks are being demarcated. Also, they are increasing the budgets of scientific and environmental research departments; this knowledge, together with more markets for Brazilian extracted products will help to establish the fact that the rainforest is worth more standing than cut down, even in the most narrow-sighted accountant.

To finish up, I ask a final question: what is to be done? I think in order for an ultimate solution to the problem of deforestation in Amazonia to come about, we must see more interdisciplinary work between social and physical scientists. The social scientists realize the assets in Brazil need to be redistributed, but to do this, the world's largest natural resource, the Amazon, must be utilized. To fully utilize the rainforest, we need the scientific community to give us answers to such questions as what can be produced, how much, and for how long? Without both inputs, I believe failure is unavoidable. Finally, after possible solutions have emerged, we need to rethink them in the context of Brazil and the Amazon. The Brazilian government has shown in the past that they guard their sovereignty above most other things. What I think will be the lynchpin in this regard are

social movements, primarily within Brazil. The life and death of Chico Mendes stirred many a conscience, both in and outside of Brazil. Along with Mendes and the empates of the rubber tappers, the political aspirations of people like Lula da Silva of the Workers' Party give hope that the necessary social movements will coincide with environmental ones. In the past, social conflict in the Amazon usually resulted in increased deforestation; in the future, it just may be the other way around.

Bibliography

- Allegretti, Mary Helena. "Extractive Reserves: An Alternative." Alternatives to Deforestation. Ed. Anthony B. Anderson. New York: Columbia UP, 1990. 252-264.
- Anderson, Anthony B. (a) "Deforestation in Amazonia: Dynamics, Causes, and Alternatives." Alternatives to Deforestation. Ed. Anthony B. Anderson. New York: Columbia UP, 1990. 3-23.
- . (b) "Smokestacks in the Rainforest: Industrial Development and Deforestation in the Amazon Basin." World Development. 18 (1990): 1191-205.
- Binswanger, Hans P. "Brazilian Policies that Encourage Deforestation in the Amazon." World Development. 19 (1990): 821-9.
- Bonalume, Ricardo. "Deforestation Rate is Falling." Nature. 350 (1991) 368.
- Colchester, Marcus. "The World Listens to the Indios." The Geographical Magazine. June 1989: 16-20.
- "Ecologists Make Friends with Economists." The Economist. 15 Oct. 1988: 25-6+.
- Fearnside, Philip M. (a) "Extractive Reserves in Brazilian Amazonia." Bioscience. 39 (1989): 387-93.
- . (b) "Land Uses in Brazilian Amazonia." Alternatives to Deforestation. Ed. Anthony B. Anderson. New York: Columbia UP, 1990. 233-51.
- Goethals, Henry. "Brazil Accepts a Debt for Nature Swap." Americas. May-June 1991: 3-4.
- Gradwohl, Judith, and Russell Greenberg. Saving the Tropical Forest. Washington: Island, 1988.
- Hecht, Susanna, and Alexander Cockburn. The Fate of the Forest. New York: Verso, 1989.
- Hecht, Susanna, and Alexander Cockburn. "Defenders of the Amazon." New Statesman and Society. 23 June 1989: 16-21.
- "How Brazil Subsidizes the Destruction of the Amazon." The Economist. 18 March 1989: 38-9.
- Hurrell, Andrew. "The Politics of Amazonian Deforestation." Journal of Latin American Studies. 23 (1991): 197-215.
- McCleary, Rachel M. "The International Community's Claim to Rights in Brazilian Amazonia." Political Studies. 39 (1991): 691-707.
- Millikan, Brent H. "Tropical Deforestation, Land Degradation, and Society: Lessons from Rondonia, Brazil." Latin American Perspectives. 19 (1992): 45-72.
- Myers, Norman. The Primary Source. New York: Norton, 1984.
- Patterson, Alan. "Debt for Nature Swaps and the Need for Alternatives." Environment. Dec. 1990: 4-13.
- Pearce, Fred. "International Trust Fund for the Amazon." New Scientist. 21 Dec. 1991: 7.

- Plotkin, Mark J. "The Healing Forest: the Search for New Jungle Medicines." The Futurist. Jan.-Feb. 1990: 9-14.
- Ramakrishnan, P.S. "Tropical Forests: Exploitation, Conservation and Management." Impact of Science on Society. 166 (1992): 149-62.
- Ryan, John C. "Conserving Biological Diversity." State of the World 1992. Norton: New York, 1992.
- Rudel, Thomas K. "Population, development, and Tropical Deforestation: a Cross-national Study." Rural Sociology. 54 (1989): 327-38.
- Sawyer, Donald. "The Future of Deforestation in Amazonia: A Socioeconomic and Political Analysis." Alternatives to Deforestation. Ed. Anthony B. Anderson. New York: Columbia UP, 1990. 265-74.
- Swaney, James A., and Paulette I. Olson. "The Economics of Biodiversity: Lives and Lifestyles." Journal of Economic Issues. 26 (March 1992) 1-25.
- Tyler, Charles. "The Sense of Sustainability." The Geographical Magazine. Feb. 1990: 8-13.
- Weinberg, Bill. War on the Land: Ecology and Politics in Central America. New Jersey: Zed, 1991