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Sustainable Development in Amazonia

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Sustainable development has become a phrase that often loses much or all of its meaning because everybody is in favour of it in Brazilian Amazonia. Everything that is proposed is described as sustainable development, and, although the discourses can be very similar, what is actually meant can be very different. So we must be very clear about what sustainable development is — what is sustainable and what is development. In Amazonia (Figure 1), decisions about how land is to be used are now supposed to be made through the Ecological Zoning Project as required in Brazil's 1988 Constitution. These very important decisions have had to deal with various zoning proposals. EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária), the agricultural research organization of the Brazilian Ministry of Agriculture, for example, proposes that virtually all of the State of Acre be zoned for agriculture (Régis 1989). Yet Acre happens to be the best place for other sorts of activities such as extractive processes and forest products (Fearnside 1989a).

Most proposals for the forest, after it undergoes different forms of development, wind up with the question of forest

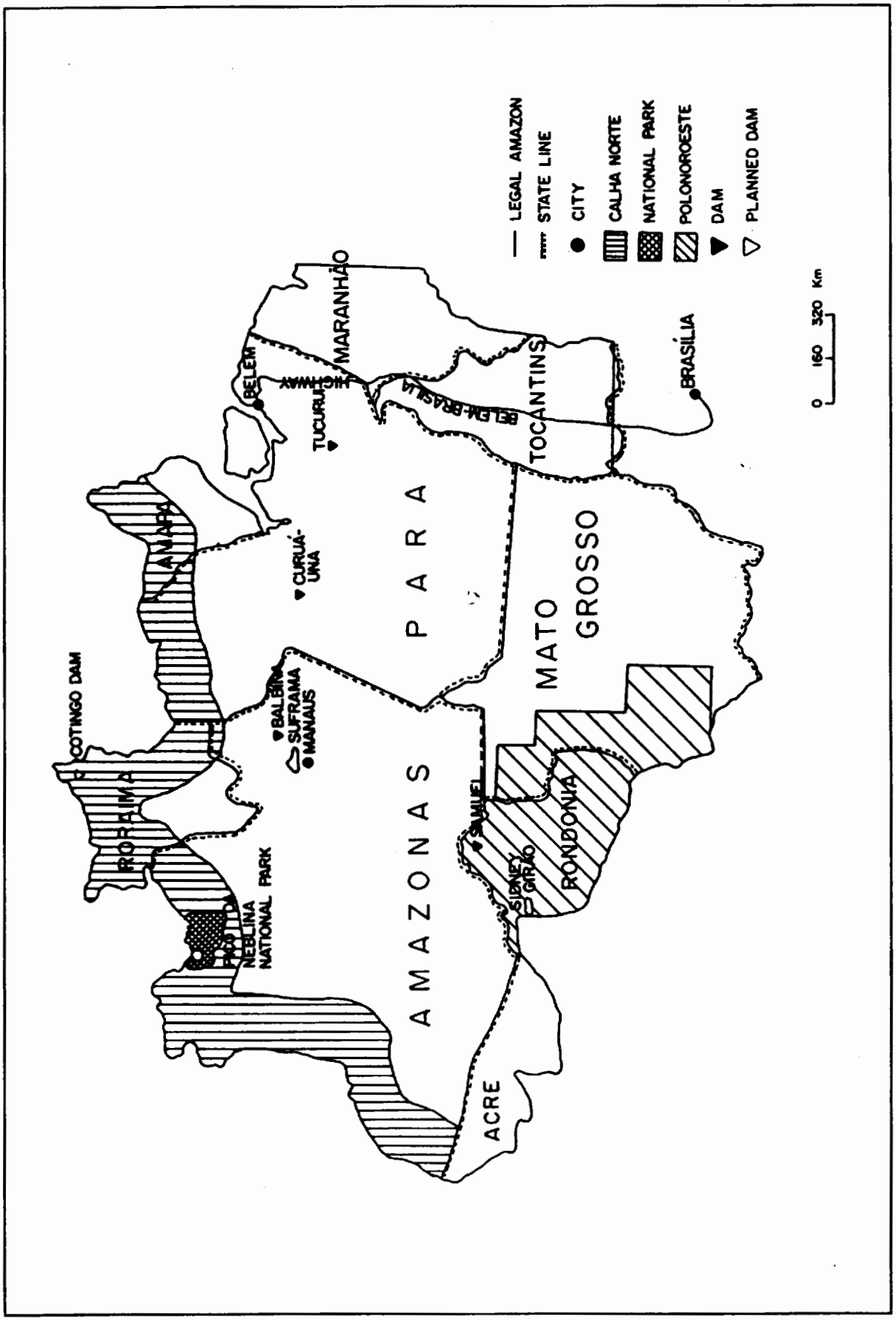

Figure 1: Brazil's Amazon Legal Region.

management to produce timber. It is very important to examine this if there is to be sustainable development. Logging activity has been growing explosively in Amazonia, although there is less than in some other places of the world, such as Southeast Asia. Amazonian logging has been limited by the fact that it concentrates on only a few species. Although there are many species in the forest, very few are used commercially, and a much smaller fraction is exported. Just one species, mahogany in Rondônia, makes up most of the value of Brazilian exports. Utilizing that one species has a significant impact, particularly on indigenous reserves in Amazonia. For example, there is a contract to sell logs from an indigenous reserve in Rondônia, drawn up by FUNAI (Fundação Nacional do Índio), which resulted in a scandal that led to the downfall of the president of FUNAI, who then was appointed Governor of Roraima. The sale of logs from Indian reserves, both with and without official intermediaries, continues.

Sale of logs is just one of the effects logging has on indigenous reserves. Another is the tremendous effort to build roads into the forest to get to the logs. In 1992 I was with some of the settlers along the shores of the Tucuruí reservoir. They are looking for a place to be relocated and want to be on a logging road which now connects Tucumã in southern Pará with the Transamazon Highway. In this case logging roads from the South and the North were joined. Approximately 400 kilometres of road are inside the forest, yet there are no roads on the map. Also, the number of sawmills has exploded to the point that you can see them everywhere. Most of them are small operations — many of them illegal — which makes it very difficult to gather reliable information.

Thus going after just one species of timber has a significant impact leading to these other forces that lead to deforestation. Now, that is really just a tiny fraction of the potential impact. For

example, Brazil only permits the export of sawn timber, but in 1987 an exception was made for raw logs coming from areas that would be flooded for hydroelectric dams. So, logs were brought from the Samuel reservoir in Rondônia, down the Madeira River, and then put on ships. There were plenty of accusations that logs supposedly coming from that one hydroelectric dam were in fact coming from all over the Western Amazon. At the port of Itacoatiara, a ship was loaded with timber approximately once every two weeks over a period eighteen months. Those logs are going to China, a country which has cut down virtually all of its forests. In China it is very clear why they want those logs. At a sawmill in Southern China the logs being sawn are all crooked and full of knots, and would never be touched in Amazonia. In Szechwan, a province in central China, logs going to a sawmill are even smaller. So, obviously it is a situation where a tremendous demand for timber circumvents a bureaucratic impediment.

There are very serious doubts about exporting of logs or even increased exporting of sawn timber as a form of sustainable development, but the Rondônia state government has for years been trying to open up the export of logs. This was done in Nigeria until they essentially cut down all the forest. This, of course, is something that has happened in many countries. Nigeria did not become a developed country because of this. Nigeria is still a poor country. That is very different from the political discourse in Manaus, which is that the United States cut down its forest and became a rich country, so the forest in Amazonia should be cut down. That is not what happens. When the forest is sold, the country does not necessarily become developed. If the forest is cut down in a place that has fertile soil, the benefits of development may be abundant. That has happened in some places in North America and Europe; it also happened in Paraná, in

southern Brazil. However, if the forest in Amazonia is cut down that is not what happens at all. It also did not happen in many parts of the United States that were deforested through logging. For example, northern Wisconsin had a legendary forest in the last century and now it is a permanent pocket of poverty and social problems. In 1930 people were actually paid to leave the area. Other places in the U.S., such as the Ozark Mountains and Appalachia, also are permanent areas for poverty, because they do not have good soil for agriculture and the logging is now finished.

The proposals that are often made for sustainable development based on logging have serious problems. The assumption is that by increasing the financial value of the forest, it will then become attractive to manage the forest sustainably. Governments will receive tax revenues from using the forest sustainably so they will enact regulations to force people not to cut too many trees, and the forest exploiters themselves, out of self interest, will want to have a continued income stream and thus will restrain their cutting activities. This theory is the basis of the programme of the International Tropical Timber Organization (ITTO) headquartered in Yokohama, as well as all the Tropical Forest Action Plans, and the policies of Brazilian government forestry agencies. Some basic problems with this are obvious in the contrast between Southeast Asia and Brazil. A forest on the island of Sumatra, Indonesia, looks very much like the Amazonian forest, except there is the very great difference that almost all the species in the Sumatran forest have commercial value. They are almost all of the same plant family which makes it much easier to group them into a few categories for sawmill and marketing purposes.

In Brazil there has been an effort to do something similar, but nothing very significant has come of it because the species

are distributed among dozens of plant families. (Technologies for using all of the species are continually being improved. For example, there was chipping for power production during construction of the Balbina hydroelectric dam, but this is more advanced in Asia. Japanese firms in Papua New Guinea, do what is called "total harvest", where they cut down an entire forest and take it away by ship. That sort of thing is not done in Amazonia yet but is certainly entirely possible.) Technically the wood characteristics are very different, so it is much more difficult to exploit the forest and it requires more investment to extract the same amount of timber and to manage. In the understorey of the forest in Indonesia, for example, almost all of the seedlings are viable timber trees. So, if an adult tree is removed, one of those seedlings will grow up and fill the hole in the canopy without human intervention. If a mahogany tree is taken out of Amazonia, almost certainly the seedling that will fill the hole will not be a commercially valuable tree. So good management requires the ability to recognize dozens of species when they are only seedlings, to remove the ones that are not valuable, and to plant seedlings. Thus it takes much more knowledge and investment to manage the Brazilian forest. One might expect then that Southeast Asia would be a paradise for sustainable forestry management, especially since the forest there is already much more valuable per hectare than the Brazilian forest is ever likely to be, even with all the research that is being done. In fact, logging practices in Southeast Asia are just as destructive as those in Brazil, and logging is one of the leading causes of forest loss in Asia, precisely because the forest is more valuable.

So there is something basically wrong with the logic that is underpinning all this sustainable development discourse on timber management. In Brazil that is apparent with rubber which can

easily be managed sustainably. People have been tapping rubber for a century or so, taking the latex in a system that can be maintained forever. Yet it is quite common to see a rubber tree cut for the timber, even though in Brazil it is not considered a high-quality wood. In Asia it is prized. A short-term profit from cutting the wood is much more interesting than a continuous stream of rubber production that is guaranteed. There is something wrong with that. What is wrong is not hard to figure out if you calculate, as for any financial analysis of an investment project, the value of a future return using the discount rate. That rate devalues future returns from a forest management scheme, so people do not manage the forest in Asia or Brazil.

With destructive exploitation, that is, cutting all the trees in the first year, one can calculate in this example $80 constant units independent of whether the discount rate is 0%, 3% or 10%. (Most financial calculations are based on 10% after inflation.) If there is a much more modest, but extended offtake (in this case over a hundred years), and if there is no discounting, the return is much more attractive, $ 300 as opposed to $ 80. If the discount is 3%, still the return is better than cutting all the trees at once. If the discount is 10% ($ 33 in this example), the sort of rate which is based on comparison with opportunities for investing elsewhere in the economy, then the decision would be that it is best to take all the money now by cutting down the trees, selling them, and investing in the stock market or something else, instead of waiting for the trees to grow and cutting them slowly (Fearnside 1989b). That is, of course, exactly what is happening because there is no connection between discount rates and the growth of the forest. Trees can only grow so fast. They are dependent on such things as how fast they can perform photosynthesis and how many nutrients there are in the soil. They cannot be expected to

compete with money market accounts or factories or other sorts of investment. In fact, they do not. They grow at their own rate and that happens to be somewhere in the vicinity of 3% at the most, and thus will always appear to be unattractive in financial terms. Now that assumes constant prices. It is completely unrealistic to expect prices to increase at a competitive rate, which is around 15 to 17 years for each doubling of the real value of the timber.

Table 1
Example of Net Present Value (NPV) Calculations
Favoring Resource Destruction (DR = Discount Rate)

	FUTURE VALUE (DR = 0%/year)			PRESENT VALUE (DR = 3%/year			PRESENT VALUE (DR = 10%/year)		
Year	Cost	Benefit	Gain	Cost	Benefit	Gain	Cost	Benefit	Gain
DESTRUCTIVE EXPLOITATION									
1	50.00	130.00	80.00	50.00	130.00	80.00	50.00	130.00	80.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total = 80.00				Total (NPV) = 80.00			Total (NPV) = 80.00	
SUSTAINABLE MANAGEMENT									
1	10.00	13.00	3.00	10.00	13.00	3.00	10.00	13.00	3.00
2	10.00	13.00	3.00	9.71	12.62	2.91	9.09	11.82	2.73
3	10.00	13.00	3.00	9.43	12.25	2. 83	8.26	10.74	2.48
100	10.00	13.00	3.00	0.54	0.70	0.16	0.00	0.00	0.00
	Tota l = 300.00				Total (NPV) = 97.64			Total (NPV) = 33.03	

To outline a strategy for sustainable development in Amazonia, then, what must be done is to turn this logic around completely. What has been happening so far is that people look at what the world wants to buy. For example, if the world wants to buy aluminum, pig iron, timber or jaguar skins, people rush to figure out how to produce those things. That is not the way to achieve sustainable development in Amazonia. What is needed is to start out looking at what Amazonia can produce sustainably, and then see how that can be turned into a way of supporting the population there. What Amazonia has that is obviously sustainable is the forest, and it happens to be something which produces very valuable products. However, those products are not commodities that are sold on international exchanges. Instead, they are mainly environmental services, and that is what most of the debate about global change focusses on.

Because Amazonia is such a large area, it has a major role in various climate processes and biodiversity, among other things. Mechanisms need to be worked out to transform that role into a means of supporting the population. One example is the question of global warming through the greenhouse effect (Fearnside 1992; Fearnside et al. 1993). Deforestation in Amazonia today contributes significantly to that. Even with a reduced rate, compared to a decade ago, it is still a significant contributor to global warming. Because close to 90% of the forest is still standing, the potential for contributions of gases from Amazonia is much, much greater than in other parts of the tropics where the forests are nearly down to the last tree. After the last tree is gone, of course, more emissions can not be produced in the same way from deforestation, but in Brazil much more can be expected. It is not only a question of how much is contributed now, but the potential, which is very large. This is something we

have been working on for some time. We need to know such things as what the biomass of the forest is and how it burns before we cut and weigh the remains of the forest.

There are very serious reasons for putting a high value on the amount of carbon that is involved. There are various ways to calculate the equivalence of the different gases that are emitted, but by my calculations, deforestation at the 1990 rate — 13,800 square kilometres per year — released approximately 300 million metric tonnes of carbon dioxide carbon per year, which is 3-4% of the global greenhouse effect. That may sound small, and most of the greenhouse effect is indeed from other places, but it is still very significant in comparison to the benefits that are derived from deforestation. So, clearly, it is interesting to put a value on keeping these gases from being emitted. For example, results from the Intergovernmental Panel for Climate Change (IPCC) analysis show global average temperatures over the last thousand years and what is projected for the next century, which is higher than it has been before. Going further back, there are the ice ages of 10-20,000 years ago, when temperatures were around four degrees cooler than the average now. That is the range for projections in just the next century.

It is important to remember that although most of the debate about global warming is based on either doubling the global warming impact of carbon dioxide and other greenhouse gases, which is expected to happen by 2025, or on what would happen by 2100. However, the clock does not stop at 2100 or at the doubling of carbon dioxide, it keeps on going and would not level off until around ten degrees above present temperatures. Even these levels — the medium around 2.5 degrees and a high estimate around 4.5 degrees (Houghton et al. 1992), which is probably the more accurate one because of a number of optimistic

assumptions — are the same amount that the climate has changed since the ice age. So the amount of change that has taken place is unprecedented in the lives of those now alive. Various proposals have been made. I would suggest that the obvious top of the list proposal should be maintaining forest by avoiding deforestation, which is much cheaper than any other option for combatting global warming. One of the major proposals is to fund huge plantation areas — 20 million hectares — in Brazil, most of it outside Amazonia (Universidade de São Paulo 1990). The first part, however, is actually in Amazonia, along the Carajás Railway. There, in 1991, President Collor announced 1 million hectares of Eucalyptus were to be planted specifically to absorb carbon dioxide and avoid global warming. It just so happens that is also the place where the wood could be used for making charcoal to process pig iron and where a paper pulp industry is being started (Fearnside 1989c). Where investments are placed, in terms of these different response options to global warming, is a major question in Amazonia, and is a major reason for both plantation proposals and avoiding deforestation .

It is very important to clarify one global warming issue which most people have probably seen in cartoon form (Figure2). A rich, probably North American, tourist is shown speaking to a poor farmer from a developing country: "Yo amigo! We need that tree to protect us from the greenhouse effect." Since there is a grain of truth in that image, it is very important that we both come to terms with it and realize that there is some distortion in it. First, there is the implication that deforestation is being done by the poor. In Brazil, deforestation is being done mostly by the rich. Second, the developed countries have a very big stake in avoiding the greenhouse effect, and they should therefore both provide the money to combat this and reduce their emissions. There is no

question about this. At the same time, it is important to realize that much of the impact is not in the developed countries. In places like Bangladesh or Africa, which are on the edge of being able to support their populations, these climate changes translate into millions of human lives. People there are likely to die because of these changes, and that is usually overlooked in the discourse about global warming.

There is another major area where Amazonia is providing environmental services for which no one is paying and for which mechanisms need to be developed. The greenhouse effect influences the entire world, including the rich countries which can afford to pay more for the services they receive. Another major impact is on the water cycle in Brazil. A series of experiments in parts of Rondônia, around Manaus, on the Transamazon Highway in Pará, and in Roraima have all yielded the same results (Fearnside 1989d). These studies of soil erosion in pastures and forests measured the runoff — water that falls on the plot, goes into a trough and out through a pipe, and is collected in barrels. It takes four 200 litre barrels just to hold the water that falls on a 1 x 10 metre plot of cattle pasture. In the forest, one barrel is easily sufficient. The contrast in water runoff is obvious, and when the water runs off the land and into the streams and rivers, it does not penetrate the soil where the roots of trees can suck it up and put it back into the atmosphere so it can fall again as rain. Several independent analyses show that about 50% of the rainfall in Brazil is recycled water (Salati et al. 1979).

In the dry season, when the rain is needed most, the contrast in runoff is even greater. In cattle pastures in the dry season either the grass has been eaten by the cattle or the leaves have died and are not transpiring. In contrast, the forest remains green all year and continues to pump water back into the atmosphere. That

Figure 2: Cartoon image of international relations regarding tropical deforestation and greenhouse gas emissions (Source: *San José Mercury News*).

amount of water is equal to what is in the Amazon River, by far the world's largest river. The Amazon River has seventeen times more water than the largest river in North America, the Mississippi-Missouri system, and 50% of that is being put back into the atmosphere through tree leaves. That water vapour is transported by wind and clouds. The prevailing winds in Brazil make a semi-circle, because of the rotation of the Earth, and thus the water vapour goes from Amazonia back towards the central part of Brazil, which is mostly agricultural (Eagleson 1986; Salati and Vose 1984).

This water process starts in Amazonia and does not affect the whole world, as the greenhouse effect does, but it does affect all of Brazil, including the major agricultural areas. That is important because Brazil has a tremendous agricultural output. In 1992, according to the Minister of Agriculture, agricultural output in Brazil was worth $65 billion, which is equivalent to winning all the prizes in Brazil's national lottery for the next 900 years. Virtually all of that is from southern Brazil, but it depends on water that comes from Amazonia. Almost none of that agricultural output is from Amazonia, where the soils are very poor. Nobody knows the exact figure, but if only 20% of that agricultural production depends on water from Amazonia, that would translate into $30 per hectare for every hectare of forest in Brazilian Amazonia. If it were 10%, that would still be $15. This environmental service can compete favorably with lots of other uses for newly cleared land.

Some evidence of the potentially catastrophic effects of continuing deforestation is in a study of reserves near Manaus done by the Smithsonian Institution in collaboration with INPA (Instituto Nacional de Pesquisas da Amazônia). Reserves are 1 hectare patches of forest left in pastures, where all trees are tagged

and collected to see when each one dies. The trees along the edges of these reserves die first, probably because of the dry conditions there caused by the dry wind blowing in from the pasture (Rankin-de-Merona, Hutchings and Lovejoy 1990). Exactly the same conditions would occur more broadly if the climate were to change in Amazonia because of reduced transpiration. So there has to be a way of calculating what the services of the continuous forest are worth. In addition, there must be research to determine, from a scientific and technical point of view, what this is worth. International negotiations may arrive at agreed values for these things, but obviously that may not be the same as what scientists say they are worth. Then some sort of institutional mechanism must be designed to collect money and apply it to achieve two objectives: maintaining the population in Amazonia at a reasonable level of sustenance and maintaining the forest. That is very difficult for there are no such mechanisms, or even viable proposals for them, and there are all sorts of impediments. However this is something that needs to be done.

Imagine, for example, if the wealthy countries were to write cheques for billions of dollars to the Brazilian government for environmental services from Amazonia, how much of that money would wind up supporting people in Amazonia. Virtually none would because there is no mechanism. Should free bags of food be handed out as politicians do in Manaus? Should the Legion for Brazilian Assistance distribute money to the poor, even though it was the subject of a major scandal under the previous president? There is no mechanism for translating money flow into sustenance for people. Also, a top-down mechanism has all sorts of built-in impediments which makes it inherently unlikely to achieve the objective, unless there is some sort of innovation in the way that such money is applied. There is also very little in the

way of guarantees that the forest would actually be maintained. After all there are many examples of international agreements which accomplish little or nothing. For example, in 1993 Brazil signed its sixth letter of intent with the International Monetary Fund. In these agreements the country agrees that it will maintain inflation and interest rates at a set percentage. When those rates go off the top of the charts a new agreement is drawn up and so it continues. It is easy to imagine the same sort of thing happening with any environmental agreement in which a country agrees to maintain a given amount of forest in a specified way. When the deadline approaches, however, either the forest has been destroyed or protective mechanisms are not in place, so another deadline is set. Some way has to be found to translate agreements into actual maintenance of the forest, which would involve understanding the causes of the deforestation that takes place.

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