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*Conserving the Tropical Rain Forest: A Critical Analysis
of the Alternative Economic Policies*

by

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Conserving the Tropical Rain Forest: A Critical Analysis of
the Alternative Economic Policies

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1. Introduction

Since the beginning of the eighties the increasing deforestation of tropical rain forests have raised major concerns both in the respective tropical as well as in industrialized countries. The reason is that the destruction of the tropical rain forests does not only impact on the economic and ecological well-being of the respective tropical countries due to ecological damages like increasing desertification and soil erosion. In addition to changes of the microclimate in the tropical countries the shrinking of tropical forests imposes negative externalities on all countries of the world, since the tropical forests play a decisive role for the stabilization of the global climate. It has been estimated that approximately 20 percent of the carbondioxide emissions are due to the burning of the rain forests, thus leading to a deterioration of the greenhouse effect.¹ Moreover, the mere existence of the tropical rain forests has dampened the green house effect, since the tropical rain forests have absorbed carbondioxide thus providing external benefits for both industrialized and tropical countries. It has to be questioned, whether the tropical forests can maintain this absorptive function in light of the current shrinking of rain forests areas.

Moreover, the tropical forest ecosystem is a biosphere for a considerable variety of unknown biological species. This variety has been an important input for research and development in the pharmaceutical industries both in industrialized as well as in developing countries. This biological reserve is endangered because of the current deforestation of tropical rain forests.²

Given these effects on the local and the global climate as well as the conservation of biological species, the conservation of tropical rain forests should be in the interest of both tropical and industrialized countries. However, the tropical countries have recognized the tropical rain forest

areas as a major economic resource that should be exploited to foster economic growth and development. In this respect, there is a divergence of interests between tropical and non-tropical countries. The latter would rather prefer conserving the tropical rain forest areas. The rain forest areas, however, are under the sovereignty of the tropical countries, which are not prepared to transfer any sovereignty rights to an international authority. Hence, the conservation of tropical rain forests can only be achieved through negotiations between tropical and industrialized countries leading to a coordination of national policies.

This paper will focus on various international and multi-lateral policy approaches and instruments that have been developed in order to cope with international environmental problems. In the next section the economic causes of deforestation will be discussed by showing in which way various economic sectors use the tropical rain forest as a resource base. Thereafter, in section 3, current initiatives for the conservation of tropical rain forests such as the Tropical Forest Action Plan and the International Timber Trade Association will be discussed. In section 4 it will be analyzed, whether trade barriers for tropical hardwood, as they have been proposed by various environmentalist organizations in industrialized countries, are effective policy instruments for reducing tropical deforestation. In section 5, we will focus on the concept of debt-for-nature swaps, which has been developed in order to enhance environmental protection by reducing external debt of tropical countries. Finally, in section 6 we will develop a simple model showing the effects of international transfer payments that are meant to compensate for the reduction of deforestation.

2. The Tropical Rain Forest as a Resource for Development

Despite its negative effects on the local climate and ecological stability, most tropical countries have been using the tropical forest areas as a resource for industrial and agricultural development. The resulting deforestation and degradation of tropical rain forests areas is mainly due to four economic sectors. The largest share in the deforestation of tropical forest areas can be attributed to the conversion of tropical forests in agricultural land. Recent estimations suggest that the agricultural sector accounts for 70 percent of deforestation.³ There are different forms of agricultural production in tropical forest areas. On one hand, there are small peasants that burn primary forests areas and establish small agricultural holdings for a limited period of time (shifting cultivations). When the soil loses productivity, the shifting cultivators leave their holdings and establish new ones in other forest areas. Unless the population density does not exceed a certain level, shifting cultivations allow for the regeneration of used forest areas. However, increasing population growth rates, unequal distribution of agricultural land as well as national migration programs such as in Indonesia, Brazil and Malaysia have increased population density in tropical forest areas beyond a level that would facilitate a regeneration of primary forests. The role of shifting cultivations in tropical deforestation varies across countries and regions. Following the estimations of the FAO shifting cultivations were responsible for around 35 percent of total deforestation in tropical America in the 1981-1985 period. In Asia and Africa this rate is considerably higher reaching 49 and 70 percent.⁴

Moreover, tropical rain forest areas are endowed with a number of mineral sources and hydropower potentials. The hydropower projects in developing countries have been criticized for flooding of rain forest areas. Especially the newly industrializing tropical countries face an increasing

electricity demand for industrial production and therefore have to increase their generating capacity by making use of their natural resources eligible for power generation. Yet, only a small share of the hydropower potential has been used by establishing dams and hydropower projects. In Africa only 2 percent of the total hydropower potential of 3100 Twh is used for power generation. In Asia and South America which is endowed with a potential of 5300 and 3800 Twh utilization reaches 5 percent of the potential. By comparison, utilization in Europe (without the USSR) reaches 33 percent.⁵ In the same vein, exploration and exploitation of mineral sources is increasingly undertaken in tropical forest areas. The abundance of energy and mineral sources in tropical forest areas does not only require large-scale infrastructure investments but does also attract related industries, thus adding to the land consumption in tropical forests. It has been estimated that large-scale infrastructure, mining and industrial projects as well as the conversion into large-scale agricultural plantations account for 20 percent of deforestation in tropical forests.⁶

The forest sector is in charge of the smallest share of deforestation. Only approximately 10 percent of forest area degradation can be attributed to logging.⁷ Table 1 shows the annual production of roundwood in 1988, which also includes production of secondary forests and plantations. Brazil, Nigeria and Indonesia rank among the largest producers of the world. As it can be seen from the export shares, only a very small share of the roundwood produced in tropical countries is being exported. The major part of the production serves the domestic demand. There are mainly two reasons for that. On one hand, wood is still one of the leading energy sources in developing countries, while on the other many developing countries have developed wood-based industries which require a large part of the domestically produced roundwood.

Table 1: Production and Export of Roundwood in Selected Tropical Countries, 1988 (in 1000 m³)

Country	Production	Export	Export:Production (%)
<u>Asia</u>			
Malaysia	44431	20853	47
Papua New Guinea	8231	1383	17
Philippines	38218	603	2
Sri Lanka	8882	33	0
Thailand	38214	152	0
Indonesia	173598	1131	1
<u>Africa</u>			
Ivory Coast	12813	550	4
Gabon	3618	913	25
Cameroon	12574	538	4
Nigeria	104881	60	0
Zaire	34239	113	0
<u>Latin America</u>			
Brazil	245751	46	0
Colombia	18163	n.a.	n.a.
Mexico	22302	6	0
Costa Rica	3961	4	0
Guayana	228	22	10

Source: FAO (1989).

Even though the tropical rain forest has a limited regenerative capacity, the present economic use of the forest areas exploits the rain forest as a non-renewable resource in the sense that the degradation of forest reserves is not reversible. Table 2 shows the estimated rate of deforestation for closed primary forests in 26 countries or groups of countries in 1989. Accordingly, tropical forest areas have been diminishing dramatically in some African countries, while in Latin American countries the rate of deforestation has been comparatively low. However, in absolute terms the deforestation in Brazil and India has been the highest of all countries. The Southeast Asian countries range somewhere in between both in relative as well as in absolute terms. Deforestation rates have been especially high in the Philippines and in Thailand, while in absolute terms Indonesia has experienced the highest deforestation among all Southeast Asian nations due to its rich endowment with forest resources.

One explanation for the exploitation of the rain forest as a non-renewable resource is that the negative effects of deforestation become evident in later periods. While economic benefits due to the use of these tropical forest resources accrue to the country and its economic agents in the short run, the ecological costs of deforestation and future benefits of the rain forests are discounted by a high interest rate revealing the time preference of economic agents. A high interest rate shows a preference for present consumption and reduces the present value of conserving the tropical rain forest. Poor countries in terms of per-capita income can be expected to show a higher discount rate, so that future benefits and costs are of less importance because of their low present value. The reason is that in poor countries the income of a high share of the population does not exceed the subsistence level. Hence, more relevance is attached to providing basic needs, whereas future well-being is rather neglected given the high degree of uncertainty with respect to expectations. Depending on the

Table 2: Estimated Annual Rates of Deforestation, 1989

Country	Deforested Area	
	(1000km ²)	(as a percentage of the the remaining forest area)
Bolivia	1.5	2.1
Brazil	50.0	2.3
Birma	8.0	3.3
Ivory Coast	2.5	15.6
Ecuador	3.0	4.0
Gabon	0.6	0.3
Guayana ¹	0.5	0.1
India	4.0	2.4
Indonesia	12.0	1.4
Kamputchea	0.5	0.8
Cameroon	2.0	1.2
Colombia	6.5	2.3
Congo	0.7	0.8
Laos	1.0	1.5
Madagascar	2.0	8.3
Malaysia	4.8	3.1
Mexico	7.0	4.2
Nigeria	4.0	14.3
Papua New Guinea	3.5	1.0
Peru	3.5	0.7
Philippines	2.7	5.4
Thailand	6.0	8.4
Venezuela	1.5	0.4
Vietnam	3.5	5.8
Zaire	4.0	0.4
Central America ²	3.3	3.7

¹ French Guayana, Guayana and Surinam. ² Belize, Costa Rica, El Salvador, Honduras, Nicaragua and Panama.

Source: Deutscher Bundestag 1990, p. 114.

discount rate and their endowment with tropical forests resources deforestation can be expected to differ among tropical countries.

Yet, there is another explanation for the irreversible exploitation of rain forest reserves. In most developing countries forest resources are not subject to enforceable property rights. In most tropical countries the central government is the owner of the forests. Governments, however, tend to perceive the forest reserves as a free good, thus allowing for fostering legal or illegal migration into forest areas, subsidizing agricultural activities in the tropical rain forest, exploiting mineral & energy sources and distributing short-term logging concessions. Moreover, governments in tropical countries are not capable to enforce their property rights because they lack the necessary infrastructure. Hence, a reversal of national policies as for instance the lifting of subsidies for extensive use of rain forest areas could help to reduce the present rate of deforestation. But even when property rights are properly defined, like for example the orderly allocation of long-term logging concessions, economic agents might not favour sustainable forestry production because of uncertainty in expectations. Since sustainable forestry requires long-term investment periods reaching planning horizons up to 50-100 years, private economic agents in the forest sector are very sensitive to changes in the political environment. Given the risk of expropriation in many developing countries, risk averse forest producers will not be inclined to develop methods of sustainable production.

Hence, there are a number of policy measures on the national level that could improve efficiency of the economic use of the environment. Yet, there is an international dimension of the problem. The conservation of rain forests in tropical countries produces external benefits for the non-tropical countries, as the rain forest is a stabilizing factor of the world climate. In economic terms, the tropical countries

export a service in the form of environmental protection, which up to now has not been paid by the beneficiaries or the consumers of these services. For this reason, a co-ordination of national policy measures is needed in order to conserve the tropical rain forests. In the next sections a number of policy measures will be discussed, while the focus is on international policies.

3. Current Multilateral Initiatives and Programmes

The most important multilateral arrangement for the conservation of tropical rain forests is the so-called Tropical Forest Action Plan (TFAP) which was initiated by the Food and Agricultural Organization (FAO) of the UN. The TFAP, as it was worked out by the FAO, the World Bank, the World Resource Institute (WRI) and the United Nations Development Programme (UNDP) in 1985, includes a list of recommended five-year programmes and projects for 53 tropical countries. The programmes developed focus mainly on the following areas:⁸

- fuelwood and agroforestry (fuelwood substitution and improvements in the efficiency of fuelwood production and consumption by introducing energy-saving technologies, supporting education and establish plantations for the production of fuelwood);
- land use on upland watersheds (improving land use by controlling livestock grazing, developing sustainable farming systems, and establishing tree and grass cover to stabilize upland areas);
- forest management for industrial uses (by increasing the area of managed tropical forests as well as industrial plantations, fostering intensive mangement, accelerating research on regeneration and sustained-yield management and increasing the efficiency of harvesting and industrial consumption of tropical timber);

- conservation of tropical forest ecosystems (by intensifying agriculture on nonforest lands, incorporation of trees into farming and pastoral systems, establishing plantations on degraded land, incorporation of primary forests into land use plans, improving forest reserves and wildlife management and developing national conservation strategies in tropical countries);
- strengthening institutions for forest management, research, training and education.

The programmes are financed both by multilateral agencies such as the World Bank, the FAO, UNDP and the Inter American Development Bank and by some donor countries (e.g. Netherlands, West Germany, Finland, Italy, Japan) on a bilateral basis. In this respect, the TFAP serves both as a multilateral programme as well as an instrument of coordination for bilateral aid. Table 3 shows that the bulk of financial support is allocated for fuelwood and agroforestry as well as forest management for industrial purposes, while the conservation of tropical forest ecosystems plays a minor role. In this respect, the TFAP has been challenged. It is questioned, whether the plan will increase deforestation and degradation in developing countries, as the plan stipulates a rapid growth of managed forest and plantation areas, while methods of sustained yield management and sustainable forestry are still being developed. Prior to the implementation of such management systems, however, property rights have to be guaranteed and enforced. Otherwise rising population density in forest areas may hinder efforts in sustainable production. Moreover, the largest share of the TFAP budget has been allocated for projects and programmes in Asia, even though the major part of deforestation and degradation is due to Latin America (see Table 2). Especially in this region of the world it is not the forestry sector which is in charge of the bulk of deforestation. Since the TFAP focuses on the forestry sector and neglects other economic activities, it has to be questioned whether

Table 3: Allocation of Financial Support in the Tropical Forest Action Plan for the Period 1987-1991 (Million US\$)

Area	Region			Total
	Africa	Asia	Latin America	
Land use in upland watershed	139	682	95	916
Forest management for industrial uses	167	565	584	1316
Fuelwood and agro-forestry	439	747	390	1576
Conservation of tropical forest ecosystems	105	148	195	448
Strengthening of institutions	188	557	319	1064
Total	1038	2699	1583	5320

Source: World Resource Institute (1985).

increasing productivity and profitability in forestry production will automatically lead to a decline of deforestation caused by these other activities. Finally, the more basic criticism is that international externalities of rain forest conservation are not likely to be internalized by a once-for-all programme, but requires a persisting international arrangement.

Another international arrangement for the regulation of tropical timber trade is the International Timber Trade Association (ITTO) encompassing 19 producer countries and 25 consumer countries. The ITTO was formed in 1983 in the wake of the UNCTAD initiatives leading to several commodity agreements. The basic idea was to stabilize the prices for tropical timber by establishing buffer stocks.

In the literature, it has been argued that a monopolization of timber trade by a cartel of producer countries would lead to a conservation of tropical rain forests, as the monopoly would restrict output, thereby reducing the degree of deforestation.⁹ However, Rauscher (1990) has shown that the resource-conserving effect of the cartelization is only a short-term phenomenon, while in the long-run the monopolistic case leads to the same degree of deforestation as under perfect competition. Hence, the establishment of a buffer stock and the stabilization of prices at a higher level as it is planned by the ITTO cannot be regarded as a contribution for the conservation of rain forests. Moreover, the ITTO provides financial support for research in sustainable forest management and research & development in the forest sector on the project level. However, these measures can be criticized for the same reasons as it is the case with the TFAP, because all measures focus on the forest sector.

Another multilateral agreement was initiated by the United Nations Organisation for Education, Science and Culture (UNESCO). In its so-called "Man-and-Biosphere" programme the

UNESCO has begun to establish a worldwide system of biosphere reserves, in which applied research for sustainable forest utilization is undertaken. Moreover, the UNESCO has created a so-called World-Heritage-Trust offering financial support to countries that establish protected areas for nature reserves in so-called World-Heritage-Sites. These sites have to be landscapes or ecosystems with outstanding universal value. As it can be obtained from Table 4, a number of biosphere reserves and protected areas (World Heritage-Sites) have been established in tropical rain forest areas. However, the delimitation of sites has been very restrictive, so that the UNESCO's programmes could hardly impact on the conservation of tropical rain forests and on worldwide deforestation.

4. Trade Barriers for Tropical Timber

Apart from these multilateral programmes, trade restrictions for tropical hardwood have been proposed in order to reduce deforestation in tropical countries. There are different forms of trade barriers that have been in discussion or even implemented namely¹⁰

- selective import restrictions: In 1986, the Green Party presented a proposal in the West German parliament. According to this proposal, the import of tropical timber should be restricted, unless it was proven that the wood originated from sites using sustainable production methods. This concept of so-called selective import barriers has been also supported by the World Wildlife Fund (WWF) and other environmental organizations;
- overall import restrictions as stipulated by some smaller environmental organizations such as the Arbeitsgemeinschaft Regenwald und Artenschutz e.V. on the grounds that selective barriers could not be effectively controlled;
- export barriers as they have been implemented in Thailand and West Malaysia;

Table 4: Selected Biosphere Reserves and Protected Areas under the World-Heritage-Trust in Tropical Rain Forests

Country	Region	Size of the Area (km ²)	Status ¹ of the Reserve
Bolivia	Estación Biológica Beni	1350	BR
Cameroon	Réserve forestière de fauna du Dja	5000	BR, WHT
Central African Republic	Basse-Lobaye Forest	182	BR
Congo	Réserve de la biosphère de Dimonika	620	BR
Costa Rica	Cordillera Volcánica Central	1440	BR
Ivory Coast	Parc national de Tai	3330	BR, WHT
Gabon	Réserve naturelle intégrale d'Ipassa-Makokkou	150	BR
Honduras	Rio Plátano Biosphere Reserve	5000	BR, WHT
Indonesia	Gunung Leuser Proposed National Park	9460	BR
Mexico	Reserva de la Biosfera de Sian Ka'an	5280	BR
Peru	Reserva del Manú	18810	BR, WHT
Philippines	Puerto Galera Biosphere Reserve	235	BR
Rwanda	Parc national des Volcans	150	BR
Sri Lanka	Sinharaja Forest Reserve	88,64	BR
Thailand	Skaerat Environmental Research Station	72	BR
Zaire	Reserve Floristique de Yangambi	2500	BR
	Parc national de Salonga	36560	WHT

¹ BR biosphere reserve under the "Man and Biosphere" programme of the UNESCO; WHT protected area under the World-Heritage-Trust

- moral suasion exerted by private environmental organizations on private consumers;
- import duties as proposed by the United Kingdom Timber Trade Association;
- import quotas as proposed by the EC Commission, which is inclined to integrate tropical hardwood into the STABEX.

All of these measures are designed to reduce trade in tropical timber, thereby creating disincentives for logging and exporting in developing countries. However, there are a number of reasons why trade barriers cannot serve as an effective policy instrument. It is widely accepted that trade barriers can only be effective, when a number of countries jointly impose trade restrictions. Table 5 shows the percentage import shares of various countries and regions. Accordingly, the import of roundwood, which accounts for 42 percent of world tropical timber trade, concentrates on Japan, while imports of processed forestry products accounting for the larger part of world trade are distributed across a number of countries with different economic interests. For this reason, a coordination of importing countries with respect to trade barriers is not likely to succeed.

But even if it was possible to implement a worldwide import boycott for tropical timber, this would not necessarily lead to the conservation of the tropical rain forest. As it can be obtained from Table 1, only a small share of the roundwood produced in tropical countries is actually exported. The major share is supplied to domestic wood-processing industries or it is converted into charcoal or fuelwood. Estimations of the FAO have shown, that more than 80 percent of logging in developing countries can be attributed to the energetic use of wood.¹¹ In the same vein, there are a number of middle-income tropical countries that are in a position to replace all exports of roundwood by processed

Table 5: Imports of Tropical Hardwood by Country and Region as a Percentage Share of World Timber Imports, 1986

Country or Region	Roundwood	Processed Products
Japan	54	9
Other Asian Countries	30	23
Europe	12	26
USA	0	13
Other Countries	4	29

Source: FAO (1988).

products. An effective import boycott would have to cover the full range of wood and forestry products in order to avoid the circumventing of import controls.

Even if such an import ban would be effective in the sense that international trade of timber and related products would decline drastically, it cannot be justified on economic grounds. Beside the fact that such protectionist measures against developing countries do not conform to the GATT provisions, all costs of environmental protection are shifted to the tropical countries. As it can be obtained from Table 6, the forestry sector plays an important role as an exporter in many tropical countries. Especially in the Southeast Asian nations a worldwide import ban on tropical forestry products would lead to a substantial loss in foreign exchange earnings. This could cause a decline in the import capacity and the economic growth in the respective countries. By restricting the access to large and absorptive markets in industrialized nations, these tropical countries are not in a position to make use of their natural resources as an input for their economic development, while most developed nations have depleted their primary forest resources in the past in order to foster economic growth.

Moreover, it is to be questioned whether a worldwide import ban on tropical forestry products could impact on the speed of deforestation given the large domestic demand for wood in many tropical countries. There are a number of countries in which the internal market for forestry products is more important than the export market (see Table 6). In these countries a decline of the export demand is not likely to affect the domestic forestry sector. Furthermore, even in countries with a large export share the decline in export demand can be compensated by rising internal demand. As a decline of the export demand may lead to a substantial fall in domestic tropical timber prices, such a substitution is very likely to occur given sufficiently high price elasticities of domestic demand. In the same vein, the domestic

Table 6: Exports of Forestry Products and their Share in Total Exports by Country, 1988

Country	Export Value of Forestry Products (million US\$)	Percentage Share in the Country's Total Exports (%)
<u>Asia</u>		
Indonesia	2873	15
Malaysia	2572	12
Papua New Guinea	109	8
Philippines	279	4
Thailand	130	1
<u>Africa</u>		
Ghana	100	10
Cameroon	113	12
Zaire	23	2
<u>Latin America</u>		
Bolivia	19	3
Brazil	1760	5
Colombia	15	0
Mexico	14	0

Source: World Bank (1990); FAO (1990).

supply of hardwood cannot be expected to decline as a consequence of the fall in prices because price elasticities of supply tend to be very low in the forest sectors in many developing countries.¹² In case of negative supply elasticities an import ban can even cause an increase of supply and logging. This counterintuitive reaction of suppliers occurs, when the economic agents in the forest sector attempt to compensate their income losses because of the price fall by increasing output.

Finally, import bans on tropical forest products are not likely to be effective because this trade policy instrument focuses on the forest sector, thereby neglecting all other economic sectors exploiting the rain forest areas. Rain forest areas, which can be converted into agricultural land or exploited by mineral industries, are not affected by trade restrictions for tropical timber. In Amazonia, for instance, only a small share of deforestation can be attributed to the forestry sector. As a consequence, a decline in timber prices will lead to an increased burning of tropical forests. An effective policy measure has to take into account economic uses of tropical rain forests and should rather change incentives on the supply side than on the demand side.

5. Debt-for-Nature Swaps

Debt-for-nature or debt-for-ecology swaps (DNS) are a typical instrument to affect incentives for deforestation on the supply side. Basically, DNS are an exchange of debts for performance of nature conservation. The presumption underlying this concept is the existence of a causal link between high indebtedness and deforestation. It has been argued that tropical countries are forced to exploit their tropical rain forests in order to produce raw materials for exports. Otherwise the tropical country would lack the foreign exchange for their debt service. A debt default, however, is sanctioned by an exclusion from international capital

markets. The access to these markets is an important determinant for investment and economic growth in developing countries. However, this is not the only possible link between indebtedness and deforestation one might think of. Overindebtedness can also reduce incentives for investment. In the same vein, rising indebtedness is usually accompanied by a loss of credibility and rationing on international capital markets restricting the respective debtor country's financing capacity for further investments. A decline in investment, however, hinders the country to establish the infrastructure for the economic exploitation of the tropical rain forest. Hence, the causality between indebtedness and environmental protection is somehow unclear. As a result, a decline in the external debt of tropical countries must not decrease the rate of deforestation, but can result in the opposite.

Nevertheless, there are a number of DNS that have been implemented. Usually, such DNS are settled as follows.¹³ A private environmental organization based in the creditor country obtains bonds of the tropical country by purchase or grant from the creditor banks which sell these bonds on secondary markets. Thereafter, the private organization as an owner of these bonds engages in negotiations with the central bank or the government of the debtor country. The bond, in agreement with the debtor country's government, will be converted into the debtor country's home currency, thus becoming internal debt. Then, a competent institution, either a NGO or a government organization, will use the debt service from these bonds for purposes of nature conservation and environmental protection.

As Table 7 shows, a number of DNS have been implemented in six tropical countries. The amount of debt swapped in these agreements is reported to total 85 million US\$.¹⁴ Even though this is only a small share of the total official debt of these tropical countries, a number of large rain forest areas became protected reserves. Given the rather limited financing capacity of private environmental organizations,

Table 7: List of Debt-for-Nature Swaps Implemented from 1987-1990

Date	June 1987	October 1987	January 1988	June 1988	April 1989	June 1989
Debtor country/institution	Bolivia/ central government	Ecuador/ Central Bank	Costa Rica/ Central Bank	Philippines/ central government	Madagascar	Zambia
Buyer of the debt	Conser- vation Inter- national (CI)	World Wildlife Fund (WWF)	WWF, CI, Nature Conservancy	WWF	WWF	WWF
Seller of the debt	Citicorp Investment Foundation	n.a.	n.a.	n.a.	Deutsche Bank, Dresdner Bank, National West- minster Bank, Amro Bank, Société-Générale, Banque de l'Union Européenne, Credit Commercial de France	NMB (Netherlands)
Nominal value of debt purchased	US\$ 650 000	US\$ 1 000 000	US\$ 3 500 000	US\$ 2 000 000	US\$ 1 600 000 (only Deutsche Bank)	n.a.
Secondary market value of debt purchased	US\$ 100 000	US\$ 350 000	n.a.	n.a.	n.a.	n.a.
Use of funds (conditionality)	Establishment of the Beni-Biosphere encompassing 1.6 million ha tropical rain forest	Financing of various projects for environmental protection in tropical rain forests	Financing of fund purchases by the Fundación de Parques Nacionales de Costa Rica	Financing of environmental projects	n.a.	n.a.
Other special regulations involved	The amount of the swap in local currency will be used for the management of the park. The swap was given financial support by the Frank Weeden Corp.	Interest rates on the book value have to be invested in to respective projects, while the debt obligation remains.	The amount is invested in bonds at a high interest rate in national currency controlled by the Fundación de Parques Nacionales.	Close co-operation between the WWF, the private local Haribou Foundation and the central government at the project level.	The Deutsche Bank did not sell the debt obligation but donated it to the WWF. In addition, government funding from the US Agency for International Development was involved.	-

Source: Reilly (1990), Schreiber (1989), Amelung (1989), Deutscher Bundestag (1990).

the DNS were quite successful. However, the basic idea underlying the DNS concept, namely a reduction of indebtedness in tropical countries, has not been achieved. Hence, the effectiveness of the DNS has rather resulted from the conditionality associated with the DNS, i.e. the debtor country's obligation to engage in projects for environmental conservation and establish protected reserves, but from a change of incentives due to declining foreign debt. In this respect, the DNS is nothing but a compensation for economic benefits which the tropical country cannot realize when it decides to protect its tropical rain forest.

Nevertheless, the DNS is an insufficient mechanism for compensation payments because it is tied to the reduction of foreign debt. There are a number of tropical countries that are not highly indebted. As a consequence, the secondary market price of their government bonds is comparatively high, so that the realization of a DNS causes high costs. Hence, the DNS concept of compensation neglects or even excludes tropical countries with high credibility and a small foreign debt. In some cases it has to be doubted, whether the external debt of the respective country is high enough to reach the required amount for compensation payments.

Yet, the compensation by DNS has another disadvantage. In order to settle large-scale compensation payments, the arrangement of DNS has to be taken over by the governments in industrialized countries. Government organizations can negotiate DNS arrangements more successfully, since they display a higher degree of bargaining power compared to private environmental organizations. In addition, private organizations lack the financial capacity to settle large-scale compensation agreements leading to a substantial reduction of deforestation. Since the protection of the global climate and the reduction of the greenhouse effect are public goods in its purest form, the supply of these goods through compensation arrangements can be justified.

However, the size of the secondary debt markets does not allow for larger DNS transactions. Given such small and oligopolized markets, the secondary market price would increase drastically, if a government organization reveals its interest to implement a DNS.¹⁵

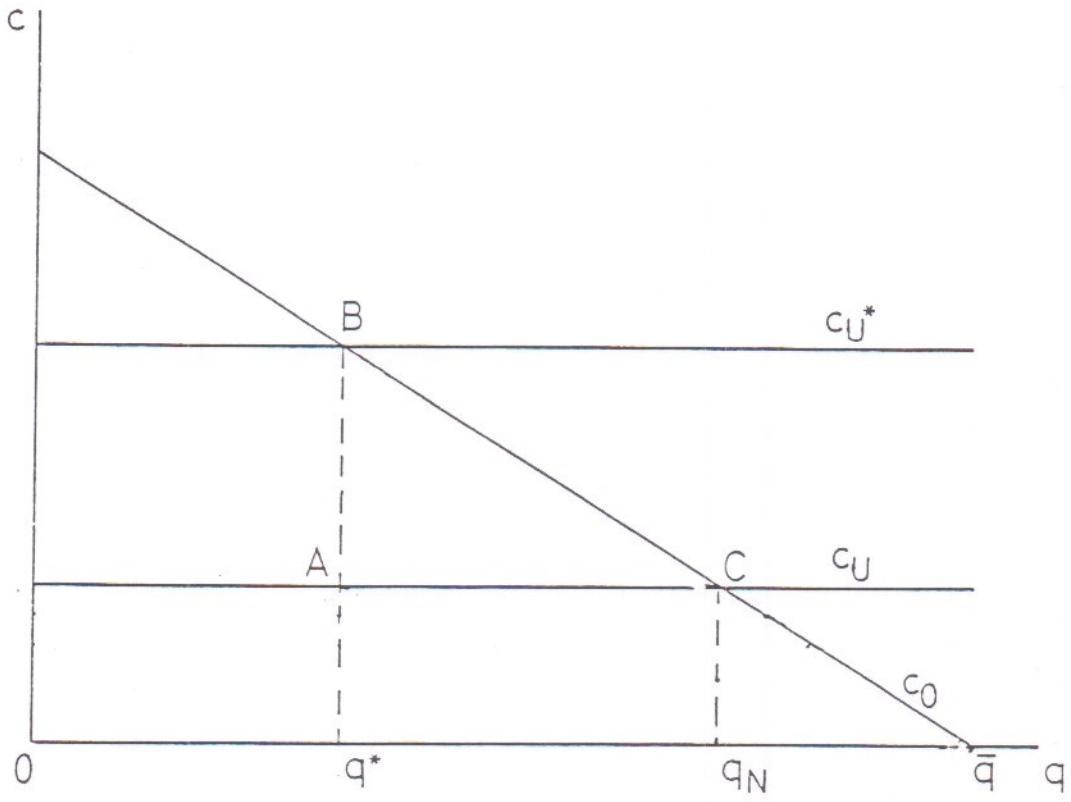
Furthermore, some coordination between industrialized countries is needed in order to determine the contribution of each tropical country and to arrange the side payments between industrialized countries, as the international distribution of creditors eligible for DNS must not coincide with the international allocation of compensation obligations. These side payments are redundant, when compensation is given by direct transfer payments instead of DNS. In the next section, it will be discussed how these transfers have to be arranged in order to compensate the tropical countries for the conservation of tropical forest areas.

6. International Funds Financing Direct Compensation Payments

The establishment of an international fund financing the conservation of tropical rain forests has been discussed since 1986.¹⁶ Tropical countries are supposed to contribute to this fund by turning a part of their forest reserves into protected areas, while the industrial countries have to pay fresh money into the fund, which is used for financing the establishment of protected rain forest areas and environmental protection. Yet, there has been little discussion in economic theory how the level of transfer payments is to be determined.

A simple model illustrating the effects and the determinants of compensation payments is depicted in Figure 1. On the vertical axis the marginal costs of deforestation and forest conservation are depicted, while the horizontal axis shows the quantity of deforestation. From the viewpoint of the tropical country two cost components determine the optimal

Figure 1



level of deforestation. On one hand, there are the costs resulting from environmental damages. The marginal costs of environmental damages are depicted as c_u in Figure 1. Hence, the costs of environmental damages increase proportionally with the size of the deforested area. On the other hand, the tropical country incurs opportunity costs of conservation, if it deliberately decides to refrain from deforesting, thus renouncing the economic benefits from the exploitation of rain forest areas. These opportunity costs for protected forest areas include

- the revenue from logging in that area;
- costs of substituting energy sources like hydropower potentials or charcoal for other energy sources;
- revenues from the exploitation of mineral sources located in the protected area;
- value of arable land that could be converted into agricultural holdings;
- costs of protecting forest reserves and enforcing property rights.

As Figure 1 shows, the marginal costs of conservation c_o decline with increasing deforestation. There are several reasons for that. Firstly, agricultural productivity will decline with increasing deforestation. Given increasing conversion of tropical rain forests into agricultural land, increasingly less productive soils enter production, thus reducing agricultural productivity and profits. In the same vein, the exploitation of mineral sources tends to begin at the most profitable sites, so that increasing deforestation facilitates access to less profitable mineral sources. Secondly, deforestation in remote areas is more costly because of the lack of infrastructure. As the economic use of these additional deforested areas is less profitable, additional deforestation is accompanied by lower marginal opportunity costs of conservation.

For the tropical country, the optimal degree of deforestation is q_N . Given this quantity the marginal costs of conservation equal the marginal costs of environmental damages, as it is the case in C. However, the marginal cost curve c_u does not reflect all costs resulting from deforestation. If one adds the environmental costs due to climate changes and the extinction of biological species outside the tropical country, a new marginal cost curve c_u^* emerges, revealing the worldwide ecological costs of deforestation. The intersection of c_u and c_o in B yields the worldwide optimum, which corresponds to a lower deforestation of q^* .

If the industrial countries want the tropical country to reduce its deforestation to q^* , they have to pay a compensation amounting to the triangular ABC. The tropical country receiving the compensation agrees in an obligation to reduce the deforestation to q^* . Given this compensation payment, the tropical country faces the same costs as in its national optimum in q_N .

In practice, however, there is the problem of quantifying the different cost components. The opportunity costs of conservation can be calculated, since underlying opportunity costs can be proxied by using market prices for the respective raw materials. Even for mineral reserves such proxies can be easily obtained. By contrast, the costs of environmental damages are extremely difficult to assess, since environmental costs involve damages for a variety of goods lacking price equivalents (for instance health, the value of human life, the beauty of a landscape etc.). For this reason, the value of these goods has to be determined at the political level by elections, revealing the preferences of a country's citizens. The assessment of the worldwide ecological costs is even more difficult, as it is not yet clear, to what extent the deforestation in tropical countries contributes to changes in the global climate given also other sources of climate change. However, taking into account the irreversibility of the ecological damages a

system of compensation could even be established, when there is uncertainty in expectations and causal links. Given irreversibility economic agents tend to be more risk averse, thus stressing the risk of deforestation relative to economic benefits.

In addition to the negotiations between tropical countries and non-tropical countries, the latter have to negotiate among themselves their contribution to the fund required for the compensation of the tropical countries. In theory, countries with higher ecological costs caused by deforestation have to pay the largest share of the compensation. However, under the present uncertainty in climate research, one can think also of other cost sharing systems.¹⁷ For instance, the Socialdemocrat Party of West Germany has proposed to impose taxes on energy consumption and import duties on tropical timber. This key would sanction those countries with larger contributions to the Greenhouse effect. Moreover, the Norwegian government has proposed that industrialized countries pay 0.1 percent of their GNP into a fund financing the conservation of tropical rain forests. This key can be also justified on economic grounds. The GNP can be splitted up into two components, namely the population size and the per-capita income. The higher the population size the more demand for the public good climate can be expected in the country, assuming that all men benefit equally from the stabilization of the global climate. The per-capita income can serve as a proxy for the social discount rate in the respective countries. Poorer countries can be assumed to give a preference to their present well-being, thus discounting future benefits from a stable climate and future costs due to environmental damages by a higher discount rate.

Finally, there remains the question, whether compensation should be given through once-for-all payments or continuous periodical transfers. Recent proposals by the Ministry of Agriculture and the respective Enquete Commission of the

parliament in West Germany seem to suggest that payments should be made only for a limited period of time.¹⁸ However, once-for-all payments incur some problems with respect to the intertemporal stability of the agreements between industrialized and tropical countries. Once-for-all compensation suffers from the principal-agent problem. Once a tropical country (agent) has received the compensation payment, it has no incentive to stick to the conditionality imposed by those countries paying the compensation (principle). Hence, the tropical countries could simply default and continue to destroy tropical forest areas.

Moreover, negotiations of compensations take place under a state of uncertainty and lack of information. Thus, there is the problem of obsolescing bargain. For instance, a tropical country will not be inclined to fulfill its obligation due to the conditionality of the compensation payment, if new explorations indicate substantially higher mineral reserves than it was expected at the time, when the once-for-all compensation was settled. This means that the tropical country has higher opportunity costs of conservation. Thus, the c_o curve in Figure 1 would turn to the right leading to a new world optimum to the right of q^* altering the compensation. In the same vein, climate research comes to the conclusion that deforestation in tropical countries has a less than anticipated destabilizing effect on the world climate. Consequently, the c_u^* curve would shift downward, thus reducing the amount of the compensation payment. In both cases there is an obsolete bargain which has to be renegotiated in order to make sure that both parties stick to the terms of the compensation contract. However, since the tropical countries cannot be forced to repay a part of their once-for-all compensation payments, the compensating countries will be hardly prepared to engage in an once-for-all compensation agreement.

The principle-agent problem as well as the problem of renegotiation disappears, when one introduces periodical payments instead of once-for-all compensations. For instance, one can think of an arrangement in which the tropical country does not receive the once-for-all transfer in the form of government bonds issued by the compensating countries. Thus, the tropical country becomes the creditor of the industrialized countries. As long as the tropical country sticks to the conditionality imposed by the compensation contract, interest rates will be paid to the tropical country. If the tropical country defaults and allows more deforestation than it was negotiated in the agreement, the compensating country can reduce the nominal value of its government bonds. In the same vein, the book value can be adjusted, when new information on cost curves require renegotiations. Yet, this kind of arrangement has another advantage. As the financial needs and risks are lower compared to those of the once-for-all payments, this system can be institutionalized in the short-run.

As far as the conditionality of such arrangements is concerned, the industrialized countries should refrain from imposing conditions on the use of the compensation payments. Such an attempt will be rejected as an interference into the domestic affairs of tropical countries and rather complicate the negotiations. The compensation payments automatically create incentives for environmental protection and facilitate costly domestic policy adjustments. Since the reasons of deforestation are quite different across countries, the tropical countries themselves should decide, how to use the compensation payments. There are a lot of policy measures that can be thought of depending on the preferences of the particular tropical country:

- establishment of institutions for the management and protection of primary forests,

- establishment of social insurance systems and introducing of social benefits for the poor thus avoiding shifting cultivations in tropical forests,
- government compensation for expropriation facilitating a land reform,
- vocational training and education in order to increase, employment in those industry sector that do not exploit the tropical rain forests;
- financing of infrastructure needs for areas with high population density in order to prevent migration into tropical forest areas.

These examples show that there are a variety of policy measures that could be undertaken given the required financial capacity. This, however, does not mean that the tropical rain forest areas should not be eligible for economic use. By contrast, the establishment of a compensation system creates incentives for developing methods to use the primary tropical rain forest as a renewable resource.

7. Concluding Remarks

The conservation of tropical rain forests serves the needs of both the tropical countries and the industrialized countries. For this reason, the deforestation is not a domestic problem of the tropical countries, that could be solved by domestic environmental policies, but it is rather a global issue calling for international cooperation and coordination.

The current deforestation in primary tropical rain forests can be attributed to the economic exploitation of rain forest areas. Depending on the country or the regions there are several economic sectors using the tropical rain forests as a non-renewable economic resource. For this reason, those economic policies concentrating on a single economic sector are not likely to be effective. In addition, the economic causes of deforestation are quite different across countries. An effective international policy approach, therefore, has to take into account all possible economic uses of tropical rain forest reserves. For this reason, it can be hardly argued that current multilateral initiatives like for instance the Tropical Forest Action Plan and the ITTO programmes are sufficient policy instruments to foster the conservation of tropical rain forests. These multilateral activities seem to focus on the forest sector, thereby neglecting that only a very small share of global deforestation can be attributed to the forest sector. For the same reasons, import barriers for tropical timber can be expected to reduce the current rate of deforestation.

By contrast, compensation payments for tropical countries that are prepared to protect their primary forest reserves could be an appropriate international policy measure. This policy instrument takes into account all possible uses of the rain forests and does not question the sovereignty of the tropical countries with respect to their forest reserves. Compensation can be justified on economic grounds, because the conservation of tropical rain forests creates positive international externalities, thus increasing economic welfare both in industrialized and in tropical countries. However, it is not advisable to give compensation payments in the form of debt-for-nature swaps, since such a policy approach would automatically exclude countries with high credibility or negligible external debt. Moreover, large-scale debt-for-nature swaps cannot be institutionalized because of the small size of secondary markets. Instead compensation should be paid directly to the tropical

countries depending on their opportunity costs of conservation, their forest reserves and their national interest in environmental protection. For a number of reasons, continuous periodical payments are easier to implement than once-for-all payments. Such a continuous compensation is reasonable, as tropical countries protecting their rain forest make a contribution to the stability of the environment. This service is also exported, as basically all other countries benefit from it. In this respect, the compensation cannot be viewed as an element of development aid but rather as payment for the production and export of a service.¹⁹

Footnotes

- 1 See Crutzen et al. (1989), Houghton et al. (1987), Hall et al. (1989), Myers (1988) and Deutscher Bundestag (1990), p. 248. The impacts of deforestation on the microclimate are analyzed in Bruenig (1987).
- 2 See Oberndörfer (1989) and Bruenig (1989).
- 3 These estimated figures have been calculated in an extensive fact-finding study by Bruenig (1989).
- 4 See Lanly (1982).
- 5 See Deutscher Bundestag (1990), p. 190.
- 6 See Bruenig (1989).
- 7 See Bruenig (1989).
- 8 See WRI (1985) for a broader survey on plans and projects envisaged in the TFAP.
- 9 See Guppy (1983) and Gillis (1988).
- 10 An overview on the current discussion about trade restrictions for tropical timber can be obtained from Amelung (1989), Deutscher Bundestag (1990) and Bundesministerium für Ernährung, Landwirtschaft und Forsten (1990).
- 11 See Lanly (1982).
- 12 A recent study by Kumar (1986) has shown that domestic demand elasticities are not below unity, while supply elasticities tend to be very low. For more upstream products, supply elasticities are even negative.
- 13 A more detailed description can be obtained from Schreiber (1989) and Reilly (1990). A theoretical analysis on the effects of DNS is given in Borregaard and Meyer (1988).
- 14 See Reilly (1990).
- 15 Hansen (1988) has shown that the secondary market price of bonds has increased substantially, once the WWF revealed that it planned to negotiate a DNS.

- 16 In 1986, it was Dr. Tolba, executive director of the United Nations Environmental Programme (UNEP), who stipulated such an international forest conservation fund. In West Germany, the Green Party and the Social Democratic Party have become major proponents of this solutions. Similarly, the Government of the State of Amazonia (Brazil) and the Indonesian government have supported compensation payments at the international level (see Amelung (1989)). In the economic literature, the compensation concept is due to Oberndörfer (1989) and Amelung (1989) and (1990).
- 17 See Deutscher Bundestag (1990), pp. 434-435.
- 18 See Deutscher Bundestag (1990), pp. 435 and Bundesminister für Ernährung, Landwirtschaft und Forsten (1990).
- 19 See Amelung (1990).

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