INTERNATIONAL POLICIES TO PROTECT THE TROPICAL RAIN FORESTS[+]

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ABSTRACT - This paper discusses alternative international policies to protect tropical rain forests with regard to these policies' ecological effectiveness and economic efficiency. It is argued that developed country transfers, either financial or real, are necessary to support national efforts and compensate tropical countries for protecting the global public goods necessary to stabilize the world's climate and maintain biodiversity. In contrast, protection of the tropical rain forests through the use of trade restrictions limiting tropical timber commerce is both ecologically ineffective and economically inefficient. Moreover, such trade restrictions shift the cost of tropical rain forest protection to tropical countries and are not acceptable from a distributional point of view.

Key words: Tropical rain forests, international protection policies

INTRODUCTION

The protection of tropical rain forests is a focal topic at international, environmental policy discussions. At the 1992 "Earth Summit" in Rio de Janeiro and the 1997 "Rio Plus 5" conference in New York, rain forest discussions lead to open conflict between developed countries and tropical countries. Developed countries called for increased efforts to conserve tropical forests and preserve these forest's global ecological function, while tropical countries stressed the need

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for intensive utilization of their forests to increase national income. However, tropical countries may also benefit from long term, sustainable forestry to provide both economic benefits and certain public goods, such as erosion protection. The political conflict between developed countries and tropical countries might be exaggerated as both parties have an interest in protecting the tropical rain forests. From this hypothesis of mutual benefit, a range of possible global instruments leading to improved tropical forest management can be identified.

TRADE RESTRICTIONS ON TROPICAL TIMBER

In recent years, environmental associations in industrial countries have called upon consumers to boycott tropical timber products. Import bans, quantitative restrictions, qualified import bans (for non-sustainably produced timber), and prohibitively high import tariffs have been suggested as methods that developed countries can employ to protect the tropical rain forest.[1] In general, these measures can only contribute significantly to tropical rain forest protection if the value of the tropical timber exported is sufficiently high enough to motivate the tropical county to modify its rain forest policies.

According to FAO figures, about 84 percent (about 1.343 billion m3) of the tropical countries' total wood production is used as fuel,[2] about 16 percent (258 million m3) is used for industrial purposes (Table 1); and approximately 28 percent (71.97 mil. m3) of this in-

[1] Austria's attempt to increase import tariffs for tropical timber from 8 percent to a prohibitive 70 percent on September 1, 1992 is the most prominent but not the only example in this category (Chase 1993: 760-763). In the meantime there have been several attempts on the subnational level to restrict tropical timber imports. For example, some 200 city councils in Germany and more than 50 percent of Dutch municipalities had banned the use of tropical timber in public buildings. In the United States, a number of cities and at least three states - Arizona, California, and New York - had banned or proposed a ban on the use of tropical timber in public construction projects (Varangis et al. 1993: 17).

[2] The term fuelwood comprises all wood that is used as an energy source, including the share that is transformed into charcoal (according to FAO: 10 percent). It is important to notice that the use of fuelwood plays no role in the destruction of humid tropical forests but is a problem in savannas (Diehl 1993: 105).

dustrial timber is exported (Table 2). Considering that the average biomass loss in forestry is between 10 and 15 percent of total biomass losses, timber exports contribute about 3-4 percent to worldwide biomass losses. Thus, a waiver of tropical timber imports would reduce tropical deforestation by no more than 4 percent.

Table 1 — Wood production and use, 1991

	Total Production mil. m^3	Fuelwood mil. m^3	percent	(Industrial) Timber mil. m^3	percent
Tropical Africa	495,2	450,7	91	44,4	9
Tropical America	375,3	279,6	75	95,7	25
Tropical Asia	731,4	613,2	84	118,2	16
Total	1601,9	1343,5	84	258,3	16
World	3429,4	1830,2	53	1599,3	47
Share of tropics (percent)	46,7	73,4		16,2	

Source: FAO (1993)

Table 2 — Exports and imports of tropical timber and timber products[a], 1991

	Roundwood		Sawnwood		Veneer sheets		Plywood		Total	
	RWE[b]	%	RWE	%	RWE	%	RWE	%	RWE	%
Exports										
Asia	22,82	83,5	13,65	77,3	1,10	67,9	24,50	96,5	62,07	86,2
Malaysia	19,46	71,2	9,06	51,4	0,91	56,2	2,74	10,8	32,17	44,7
Indonesia	1,43	5,2	1,44	8,2	0,04	2,5	18,86	74,3	21,77	30,3
Other Asian countries	1,93	7,1	3,15	17,9	0,12	7,4	2,90	11,4	8,10	13,3
Africa	4,07	14,9	2,18	12,4	0,34	21,0	0,09	0,4	6,68	9,3
Latin-America	0,43	1,6	1,80	10,2	0,17	10,5	0,81	3,2	3,21	4,5
Brazil	0,05	0,2	0,87	4,9	0,10	6,2	0,69	2,7	1,71	2,4
Other Latin-American countries	0,38	1,4	0,93	5,3	0,08	4,9	0,94	3,7	2,08	2,9
Total	27,32	100,0	17,64	100,0	1,62	100,0	25,39	100,0	71,97	100,0
Imports										
East Asia	18,94	85,1	4,33	42,2	0,30	38,5	9,04	60,1	32,61	67,5
Japan	11,25	50,6	2,51	24,5	0,23	29,5	6,60	43,9	20,59	42,6
South Korea	3,85	17,3	1,07	10,4	0,02	2,6	1,70	11,3	6,64	13,7
Taiwan	3,84	17,3	0,75	7,3	0,06	7,7	0,74	4,9	5,39	11,2
USA	0,02	0,1	0,50	4,9	0,04	5,1	3,04	20,2	3,60	7,4
European Union (UE)	3,29	14,8	5,41	52,8	0,44	56,4	2,97	19,7	12,11	25,1
Total	22,25	100,0	10,25	100,0	0,78	100,0	15,04	100,0	48,32	100,0

[a] Excluding final products, e.g. doors, windows, furniture. – [b] RWE = roundwood equivalents (m^3); conversion factors: 1 m^3 sawnwood = 1,82 m^3 roundwood, 1 m^3 veneer = 1,90 m^3 roundwood, 1 m^3 plywood = 2,30 m^3 roundwood.

Source: Calculated from FAO (1993).

A complete tropical timber importation ban would have the greatest impact on the Southeast Asian countries of Malaysia and Indonesia. When combined, these two countries account for three-quarters of world tropical timber exports. African and Latin American tropical countries account for two-thirds of all tropical deforestation but have only a small share of the world export market, about 14 percent. These figures show that trade barriers curtailing the export of Latin American and African tropical timber would have no significant impact on total rain forest destruction.

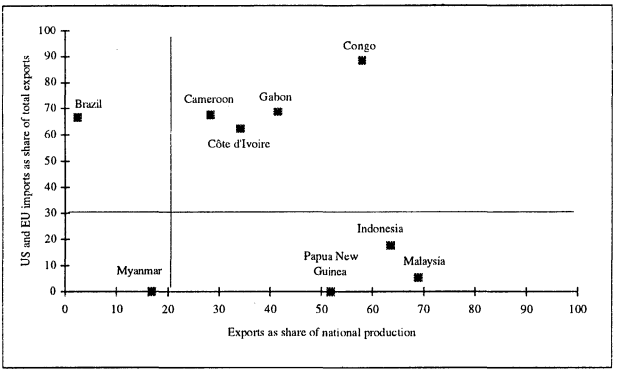
Whether tariffs actually reduce tropical timber import demand depends upon tropical timber price elasticity of demand and the ease of non-tropical for tropical timber substitution in the importing countries. Recent estimates of long-run tropical timber import demand elasticities for the period 1968-1988 (Barbier, Burgess et al. 1994: 281) indicate that these elasticities are very low for round-wood (-0.16) and sawn wood (-0.74). Consumers do not respond dramatically to price changes for rough or slightly milled tropical timber, and increased tariffs should not be expected to induce significant import quantity reductions. [3] When accessing the effectiveness of import bans and boycotts, it has to be kept in mind that unilateral trade restrictions may have several negative effects with regard to the intended objective (Amelung 1989: 156 ff.). First of all, an import ban initiated by a small country that is incapable of influencing world prices and traded

[3] One explanation for the very low elasticity of global demand for logs is that over the 1968-88 period many major tropical timber producers implemented policies to restrict log exports. As a result, total supply of exports grew slowly, relative to demand. On the import side, this would mean that real prices of logs would rise faster than the quantity imported which would translate into a low long-run elasticity of import demand. Such a scenario suggests that over the 1968-88 period there were not many substitutes for tropical logs. On the other hand, the higher elasticities for sawnwood and, in particular, plywood imports (-1.14) would suggest that there may have been more substitutes available for these products in importing markets. This is not surprising, given that many of the major importing countries of these products also produce their own processed products, especially plywood, from either the non-coniferous logs they import or from timber (largely coniferous) which they produce themselves. In Southeast Asia, it appears that the elasticities of demand for log exports are higher than for plywood and sawnwood exports (Barbier, Blockstael et al. 1994: 258). It is not surprising, therefore, that these countries have moved to restrict log exports in favour of expanding exports of processed products, notably plywood.

volumes will be ineffective. Only import restrictions by large countries or trade blocks that import considerable quantities of timber, such as Japan, the USA, and the European Union, (Table 2) can lead to a meaningful reduction of traded volumes through unilateral actions. However, if the USA and the EU enforced the import bans called for by their environmental associations, only a couple of relatively small African tropical timber exporters would be significantly affected.

Figure 1 illustrates the dependence of several tropical timber producers on exportation to the USA and the EU. The affect of unilateral trade restrictions applied by the EU and the US on a producer country is determined by the producer country's market orientation (as measured by exports as a share of national production) and its market dependence on the EU and the USA (as measured by the exports to EU and the USA, as a share of total exports). As Figure 1 shows, the dominate tropical timber exporting countries, Indonesia and Malaysia, would not be directly affected by unilateral import bans by the EU and the US, since they export a large percentage of their production to East Asia. Although together the EU and USA account for more than 65 percent of Brazil's timber exports, only a little over 2 percent of Brazil's timber production is actually exported to these two destinations. Only the African producers, Congo, Cameroon, Gabon, and Cote d'Ivoire, depend heavily on market entry into the EU and US. In these African countries, unilateral import bans may lead to a significant reduction in timber production.

Figure 1 — Exporting country dependence on imports by the USA and the EU (percent)



This, however, does not preclude an increase in the international volume of traded tropical timber caused by trade diversion. The imposition of trade barriers by a large country may lead to producer price decreases and resultant trade diversion to another large country that has a very price elastic demand for tropical timber. In a similar way, demand reduction in one country might be compensated for by growing demand in a number of small Southeast Asian countries. Southeast Asia already accounts for a relatively high proportion of world timber imports. Thus, the volume of tropical timber traded on world markets might remain constant or even increase if world market supply is sufficiently price inelastic.

Trade diversion can only be avoided using a multilateral approach. However, it is highly questionable whether global import restrictions, which are difficult to enforce given the divergent political interests, would lead to sustainable protection of tropical rain forests. First, the reduction of foreign demand resulting from a worldwide boycott might be overcompensated for by increasing domestic demand stemming from increased construction or wood manufacturing.[4] This would occur if domestic demand is more price responsive than foreign import demand. Several producer countries, among them Brazil, Indonesia, and Malaysia, have enlarged their wood processing capacities. A tropical timber import ban could induce these countries to increasingly produce and export more highly valued final products rather than raw materials. An effective import ban should cover all downstream forestry activities. Second, a drastic reduction in timber imports could lead to drastically reduced timber prices at the producer level making alternative use of tropical forest land economically attractive. This can be seen in the Amazon region where a large part of the tropical forest is destroyed by agricultural slash-and-burn and flooding caused by hydroelectric projects.

Besides their limited effectiveness, protectionist measures often lead

[4] Limited domestic processing capacities may lower bucking. However, since export restrictions increase the profitability of local processing, additional local processing capacities will be built up in the medium to long-run which replace or even overcompensate for the loss of foreign processers.

to inefficiencies and are highly questionable in a distributional sense. Regardless of whether a producer country is willing to supply the resource at lower prices or protect it, a global import ban would always involve an income transfer from the developing to the developed country. The developing country would be forced to pay the costs for conservation of the global climate and biodiversity. Trade restrictions are second-best instruments in terms of efficiency as there are other effective comparable instruments with lower economic costs (Primo Braga 1992: 188-192). These restrictions are designed to protect tropical forests and are not directed towards the source of the market failure; therefore, they induce distortions elsewhere and lead to additional economic costs. In summary, interventions into tropical timber trade cannot be justified from either an economic or distributional point of view.

Import bans and boycotts, at least as currently contemplated, are almost certainly GATT illegal. First, they are prohibited because they discriminate between tropical and non-tropical timber suppliers (a violation of the most-favored-nation requirement) and because there are no possible comparative restrictions on "like domestic products" (violation of the national treatment obligation). Second, import restrictions on tropical timber are largely processed-based and therefore not covered by Articles XX(b) and XX(g) of GATT.[5] Finally, the suggested tropical timber trade interventions are not "necessary" as that term is used in Article XX(b), because there are less discriminatory measures such as certification schemes.[6] The establishment of GATT-conforming import restrictions may be possible through international agreement under Article XX(h) of the GATT (ESE 1992:65). However, only some endangered timber species, such as rosewood, are excluded from commercial trade through use of the Washington Convention for International Trade in Endangered Species.

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[5] See the US-Mexico "non-dolphin-save-tuna" dipute. This dispute is seen as a landmark for interpretation of Article XX GATT. Unilateral trade restrictions to enforce environmental objectives in third countries are not covered by Articles XX(b) and XX(g) GATT.

[6] The following discussion of tropical timber certification is based on Brockmann et al. (1996).

CERTIFICATION SCHEMES

Specialists from science and industry, citizens' action committees, and environmental associations have increasingly recognized the negative effect of boycotts and import bans. The most prominent environmental associations refrain from supporting boycotts, instead pleading for timber and timber products certification schemes created by environment-friendly forestry associations.

Timber certification refers to the application of an eco-label identifying timber products that come from sustainable, well-managed forests. As a result of certification, environmentally concerned consumers can include both the value of the timber and the value of the ecological services of tropical trees in their consumption decision. A certification program will lead to segmentation within the tropical timber market.

A tropical timber certification program is effective if it discourages production using environmentally unfriendly methods. This will be the case if the latent demand for environmentally-friendly timber goods exceeds supply (Mattoo and Singh 1994). Given the increasing concern of consumers in developed countries about climatic change, biodiversity loss, and the low volumes timber now produced using sustainable forestry methodology this condition can be fulfilled.[7] Unfortunately, a tropical timber certification program established in the western developed countries (excluding Japan) - a first step towards a global certification program - would generate only a small impetus to-

[7] Currently, at most 1 percent of all tropical forests are sustainably managed (FAO 1993: 50). About one third of tropical roundwood is exported to industrialized countries in raw or processed form. Even if only 5 percent of the consumers there are latent consumers for sustainable produced timber, this condition is met.

ward sustainable forestry (Varangis et al. 1995: 17-20). This type of certification program would protect less than 5 percent of the endangered tropical forest area.[8]

Assuming that an effective certification program is established, a question arises as to the costs associated with this program. In practice, a timber certification scheme entails two types of costs. First, the cost for the establishment and maintenance of the institutions responsible for granting eco-labels and for monitoring compliance. Second, the costs incurred by timber producers for managing the forests in a sustainable manner according to agreed on principles and criteria.

A certification system can also provide producer benefits if consumers are willing to remunerate producers for sustainable forest management. First, certified timber exporters may avert further loss of market share in those countries that are currently preparing legislation or voluntary initiatives to restrict non-certified timber importation. Second, certified timber may generate a higher willingness to pay, i.e., certified timber may command a higher price than uncertified timber (Varangis et al. 1995: 21-28). Consumers of tropical timber products may also realize benefits by internalizing external effects. The certification system will induce consumers to pay a premium for the preservation of formerly public goods, the "CO2-sink" and "biodiversity." In the absence of a certification scheme, there would be no market for these public goods; which may limit the supply of ecological services provided by tropical forests. Therefore, a certification scheme can theoretically contribute to globally efficient resource allocation. However, a non-voluntary certification program accompanied by an import ban on non-certified timber may provide incentives to slash-and-burn the unmarketable tropical forests to create more land for livestock and other agricultural production (Shams 1995: 144).

[8] The percentage of timber coming from closed tropical forests which is exported either in unprocessed or processed form to nontropical countries is about 30 percent (71.97 mil. m3/ 258.3 mil. m3; see Tables 1 and 2). Almost all of these exports go to industrialized countries, part of it after processing in other tropical countries. Since forestry is responsible for about 15 percent of deforestation and degradation, certification of tropical timber products would involve at most 5 percent of the endangered area. This estimate does not consider that timber producers in a post-labeling situation might look for new consumers of unsustainable produced timber in domestic markets and that dismissed forestry workers search for land, thereby causing additional pressure on tropical forests. (Diehl 1991: 216).

DEBT-FOR-NATURE SWAPS

The exchange of foreign debt for natural resource conservation, so-called "debt-for-nature swaps," were developed to transform the commercial debt of developing countries into financing for environmental protection. The underlying argument is that natural resources are excessively exploited by highly indebted countries. These countries must generate foreign exchange in order to keep their debt-servicing obligations current (Enquete-Kommission 1990: chapter 3; Oberndörfer 1988; Page 1989). The attempt by tropical countries' to contain the risk of costly loan default by exporting tropical timber and meat is considered to result in deforestation and environmental degradation. Proponents of debt-for-nature swaps argue that debt reduction provides a means of financial compensation for conservation. Creditor concessions would remove the disincentives associated with environmental protection; disincentives that stem from a high foreign debt burden.

From a theoretical point of view, such debt-for-nature swaps contain a fundamental contradiction. If the high foreign debt burden of tropical countries actually fosters the destruction of tropical rain forests, then debt relief would be the only effective tropical rain forest protection instrument; debt-for-nature swaps are unnecessary. However, it is questionable whether the excessive exploitation of natural resources in developing countries can be traced back to their high foreign indebtedness. Regression analyses reveal no statistically significant relationship between various debt indicators and the degree of deforestation (Nunnenkamp and Amelung 1991; Shafik 1994; Capistrano 1994). Tropical deforestation in highly indebted countries is no higher than in other countries, and deforestation rates do not increase with increasing foreign debt. Rather, it is to be suspected that the debt crisis and the environmental crisis both stem from the same root. In both instances, the culprit was an attempt to increase consumption above levels that the economy and the environment could sustain (Shilling 1992: 28). Thus, debt relief removes only some of the incentives for deforestation.

Debt-for-nature swaps are transfers connected with environmental obligations. The relationship between foreign debt and environmental degradation is of secondary importance. The transfers are an exchange of debt for user rights to tropical forests. Typically, the swaps involve three steps (Nunnenkamp 1993: 135). First, tropical country foreign debt titles are purchased in the secondary market at a discount to their face value. These debt titles are then presented to the debtor country and converted into domestic currency, whereby the total amount of outstanding foreign debt is reduced. Finally, the domestic currency equivalent is used to finance environmental projects in the debtor country.

Debt-for-nature swaps, which initially have been financed exclusively by non-governmental organizations, are likely to be small in relation to both the overall need of environmental funding and the foreign debts. Since the first debt-for-nature swap was completed for Bolivia in 1987, following their debt crisis, a further 16 swaps in eight countries have retired nearly US$ 100 million in external debt (Weltbank 1992: 209).[9] US$ 60 million in local currency was generated for conservation purposes (Nunnenkamp 1992: 15). However, the financial compensation achieved by debt-for-nature swaps, is much lower than these figures suggest, and may be even negative. Foreign debt relief was offered only if the buyer of the debt title realized a greater discount on the face value than could be obtained by the debtor country through a direct buyback and if the higher discount were passed on to the debtor country. The debtor country does not benefit from secondary market discounts if the foreign debt title is converted at par into domestic currency. Under such conditions, debt-for-nature swaps may lead to an additional fiscal burden on the debtor country if the government issues domestic debt papers to redeem the foreign debt and if domestic real interest rates exceed the international rate.

Financial compensation through debt-for-nature swaps further declines if this instrument is used on a larger scale. An increased demand for debt titles would reduce the secondary market discounts thereby

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[9] Amelung (1991: 4) provides an overview on the swaps completed in the eighties.

[10] Even though swap operations remained fairly small in the past, secondary market prices increased significantly as soon as market participants expected a swap to take place (Hansen 1989).

diminishing the potential for debt relief.[10] Furthermore, broader implementation of debt-for-nature swaps may result in greater macroeconomic instability in debtor countries. Inflation could be fueled if the domestic currency equivalent of the foreign debt is raised by money creation. Alternatively, if domestic capital markets are tight, domestic debt may replace foreign debt and the fiscal situation would deteriorate.[11]

Free-rider behavior plays an important role in debt-for-nature swaps. Donations to environmental organizations contribute to improve the environment, which benefits not only the donors but the whole world community. As a result, there is an incentive to refrain from donating and let others pay since everyone receives the benefits of environmental protection. Therefore, overall donations will be less than optimal.

Furthermore, less indebted tropical countries are not directly affected by the swaps, a consequence of the swap's underlying debt-environment linkage. Broad implementation of debt-for-nature swaps by highly indebted countries could induce two different reactions in less indebted countries: first, some countries may accelerate forest degradation to increase world market prices for tropical timber; second, there is an incentive for less indebted countries to increase their foreign debt in order to benefit from swap operations.

It can be concluded that the financial compensation to be achieved by a debt-for-nature swap remains limited at best. This instrument cannot significantly contribute to the protection of tropical rain forests because it gives debtor countries only minimal incentive to protect the forest environment. The governments of tropical countries would also be tempted to violate the ecological conditions attached to the swap, because they can hardly be sanctioned effectively once the swap operation has been completed and the foreign debt title has been fully redeemed.

[11] In three quarters of the swaps new "conservation bonds" issued by local governments in exchange for external debt had a value of about 90 percent or more of the original debt.

COMPENSATION PAYMENTS

In principle, financial compensation for the global negative externalities of deforestation can take two forms. Following the polluter-pays-principle, the tropical countries can compensate all other countries for the negative external costs associated with deforestation. On the other hand, affected countries could pay transfers to the tropical countries as an inducement to protect their forests. Since it is impossible to ascribe damages to individual countries and since tropical countries can not be sanctioned because there is no international jurisdiction, environmental economists regard transfer payments as a useful tool for tropical rain forest protection. The use of transfers to induce tropical forest protection is reasonable. These forests contribute to climate stabilization and the preservation of biodiversity, and thereby increase the welfare of individuals outside the tropical countries (Box 1).

Private institutions and environmental organizations are limited in their ability to disburse, negotiate, and administer the payment of transfers; and they often depend on donations for financing. Besides these financial restrictions, private organizations often do not have the bargaining power necessary for successful international negotiations. Since there is no unequivocal administration of the law at the international level, State power is a necessary condition for the enforcement of international agreements.

The costs of environmental damages and the costs of abatement must be determined in order to facilitate international environmental negotiations. Abatement costs are easier to calculate than damage costs because the former can be identified in the market. This holds true for raw material deposits as well, though their market value can often be only roughly estimated. Environmental damages are more difficult to estimate because specific damages, such as climate change, cannot be traced back exclusively to deforestation. Even if the imputation problem can be solved, there is still the problem of putting a value on certain legal claims, such as the human living condition. Some public goods, like landscape preservation or climate conditions, also cannot be estimated in a satisfactory way. The value of these goods is therefore determined on a political level, again involving national governments

during the transfer negotiation and disbursement process.

Another problem that arises when designing transfers is whether transfers should be made recurring or non-recurring. From an economic point of view, the latter is more problematic. The use of a non-recurring transfer causes a "principal-agent problem."[12] The beneficiary of the transfer (agent) has no incentive to monitor and comply with the conditions attached to the transfer; the "obsolescing bargain" problem. The beneficiary country has an incentive to break a contract when economic conditions change, i.e., if the opportunity costs of tropical forest protection increase as a result of unexpected increases of timber prices. This would necessitate further negotiations to improve compliance A non-recurring disbursement could render subsequent negotiations difficult because the beneficiary is given no incentive to take up negotiations if this might involve the repayment of transfers.

Using recurring transfers, developed countries issue debt titles with a market rate of interest. The tropical countries receive only the interest rate payments, which themselves could be tradable. If the developing country does not comply with the conditions attached to the transfer, there is room to unilaterally decrease the transfer by decreasing the face value of the debt titles. Another advantage of using recurring disbursements is that they incur a smaller budgetary burden than a non-recurring, one lump sum, disbursement.

Using either type of transfer payment, negotiations between donor countries are needed to coordinate payment distribution and determine individual donor contribution levels. In this context, it could make sense to use an international environmental authority to coordinate this task. Theoretically, each donor country's share of transfers of would be determined by it's share of global environmental damage costs, but that would be very difficult to implement. Many poor developing countries would be obliged to pay transfers, and the imputation problem prevents a clear-cut regional distribution of global environmental protection costs. For these reasons each countries share of global transfer payments would probably be determined with respect to economic indicators, e.g., per-capita-income.

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[12] This problem always arises if there is a relationship between an agent and a principal and if the agent has the possibility to maximize benefits at the cost of the principal.

BOX 1 — Determinants used for the level of compensation payments

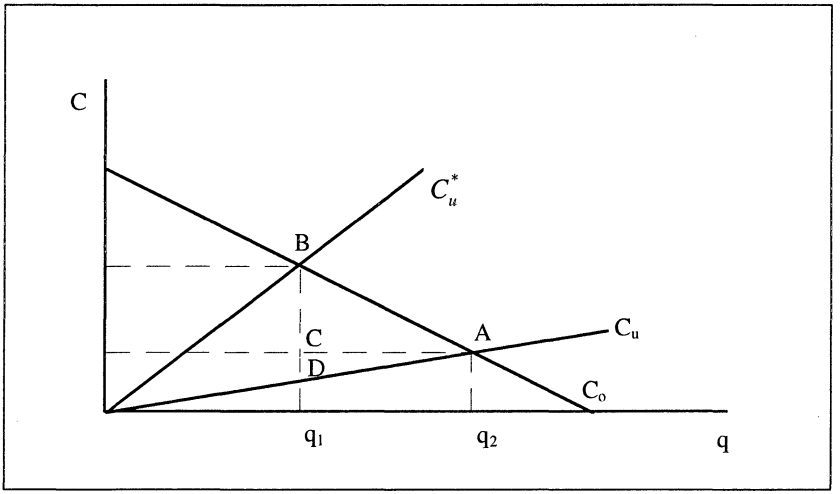
The figure below shows which factors determine the level of compensation payments to a tropical country. The vertical axis measures the marginal costs of deforestation and tropical forest protection respectively. The extent of deforestation is measured along the horizontal axis. For the tropical country two types of costs determine the optimal extent of deforestation. On the one hand there are opportunity costs (C_o) associated with forest protection. These abatement costs result from unrealized benefits of the rain forest production factor and include foremost unrealized revenues from forest harvests and the costs of alternative land use for agriculture and livestock. These marginal abatement costs decrease with increasing deforestation. The reasons are:

- The productivity of the factor land decreases with increasing deforestation because more and more marginal land with lower productivity and insufficient transport facilities has to be opened up.
- With increasing degradation forests are opened up with lower timber quality or higher transport costs than in already deforested areas.

Decreasing marginal abatement costs correspond with increasing marginal costs of deforestation (C_u). The shape of marginal cost curve results from the fact that with increasing rates of deforestation climate damages and erosion will lead to more than proportional increases in deforestation costs. With a sufficiently high deforestation rate the potential of forests to regenerate is unused. Moreover, with a higher deforestation rate some environmental damages, such as land erosion and climate changes, occur earlier. Since environmental costs are discounted future costs, the environmental costs increase more than proportionally with deforestation because all future environmental damages are included.

From the tropical country's point of view the optimal deforestation rate is given at point A, the intersection of the two marginal cost curves C_u and C_o. In this case the area deforested is q_2. However, if the global (national and international) marginal costs of environmental damages - marginal cost curve C_u^* in the figure - are taken into account the intersection with the abatement cost curve C_o determines another global optimum at point B with lower deforestation q_1. At any deforestation rate q the slope of the global marginal cost curve C_u^* is higher than the slope of the national marginal cost curve because industrial countries use a lower interest rate than tropical countries to discount future environmental costs. This implies that future global environmental damages have a higher value in industrial countries.

In order to induce the tropical country to choose a deforestation rate q_1 that corresponds with the global optimum at point B compensation payments equal to the area ABC are required from abroad. The tropical country's contribution to environmental protection is given by the area ACD. This own contribution is justified because the tropical country also benefits from lower environmental damages due to reduced deforestation.



C_o Marginal abatement costs of forest protection; C_u National marginal costs of deforestation; C_u^* Global marginal costs of deforestation; q Deforested area; C Marginal costs

Source: Amelung (1989.

JOINT IMPLEMENTATION

Article 4 (2a) of the Framework Convention on Climate Change states that developed country parties and other parties included in Annex 1 may implement policies and measures to reduce emissions of greenhouse gases jointly with other parties. Accordingly, it has been suggested that signatory nations with national emission targets that invest in abatement or conservation in other countries should receive credit for the resulting reduction in emissions or the increase in conservation. Such bilateral or multilateral deals are called "Joint

Implementation." In practice, so-called CO_2 offsets between industrialized countries and tropical countries are becoming increasingly popular,[13] especially because they have led to cost efficient achievement of emission targets. Box 2 describes the functioning and efficiency of Joint Implementation in a most elementary case.

The possibility of implementing measures abroad constitutes a direct investment and can lead to international cost-savings. Each CO_2 emitter finances tropical forest protection measures, or reforestation measures if the costs incurred are lower than domestic abatement costs (e.g. the tax burden after an increase of CO_2 taxes). In this way, Joint Implementation can contribute to increase the efficiency of CO_2 emission reduction strategies.

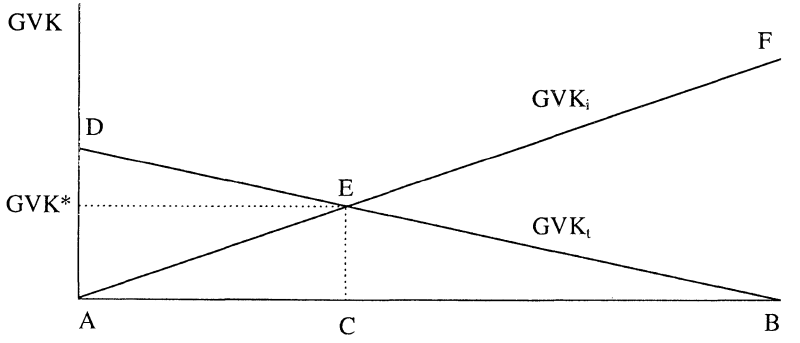
The ecological effectiveness of Joint Implementation is not guaranteed. The CO_2 reduction resulting from an offset deal may be negated if one of the partner countries has no clear and enforceable environmental policy to insure that the reduction in one area is not compensated for by increased emissions elsewhere. (Heister, Stähler 1995: 227) In other instances, the emission reductions may not genuine as they would have occurred in any case (Pearce 1994: 14).

[13] The first CO_2 offset was implemented by the Dutch FACE Foundation (of the national electricity authority) and the Malaysian Innoprise Corporation. The FACE Foundation wants to plant enough trees to compensate the carbon emissions of a 600 megawatt power station with a life-time of 25 years. For this purpose, 150,000 hectares of tropical forests are required. In a first step, the deal commits Innoprise to reforest 2,000 hectares of its concession area within three years. The Dutch pay US$ 1.3 mil. for this initial period. If the experiment is successful, the Foundation wants to afforest another 23,000 hectares within the next 23 years (Die Zeit 1994). Pearce (1994: 10f.) summarizes additional carbon offset deals between developed and tropical countries.

BOX 2 — The functioning and efficiency of Joint Implementation

In order to illustrate the functioning of Joint Implementation two countries are assumed, an industrial country i and a tropical country t. The two countries have different marginal abatement cost curves (GVKt and GVKi). The emissions of the industrial country are measured on the horizontal axis from point B to the left, those of the tropical country from point A to the right. In the initial situation, without regulations and emission abatements (therefore, no emission abatement costs), both countries emit the maximum quantity (AB) of carbon dioxide because there are no restrictions on the use of the atmosphere. If the total quantity of emissions has to be restricted to AB, one possibility would be a commitment by the industrial country to avoid all emissions..

In the case of Joint Implementation, the necessary emission reduction AB is realized by both countries together, whereby the marginal abatement costs are equalized in the optimum (point E). The level of reductions in each country depends on the shape of the respective marginal abatement cost curves. The marginal abatement cost curves also determine the level of abatement costs in the optimum. Under the assumptions of the figure, the industrial country will reduce its emissions by AC because marginal abatement costs are higher in the industrial country than in the tropical country by assumption[14]. Comparing the costs of the two alternatives shows the advantage of Joint Implementation. If the total emission reduction is borne exclusively by the industrial country this would cause costs equal to the area below the marginal abatement cost curve GVKi, i.e. area ABF. If the reduction is realized, cost minimization in both countries, total costs would be area BCE plus ACE. The total cost saving BEF can be shared by the two parties according to negotiated agreement . The marginal abatement costs will finally reach GVK* because the tropical country emission reductions, BC, are just equal to the reductions needed by the industrial country.



Source: Pearce (1994).

[14] For the results of the analysis, it is irrelevant whether the marginal abatement cost curves differ or not. However, the case in which marginal abatement costs in the developed country exceed those in the tropical country is more relevant in practice and, therefore, is shown in Box 2.

These problems have led several authors (e.g., Klaassen 1994; Bohm 1994) to argue that Joint Implementation should be limited to the signatory states listed in Annex 1 of the Framework Convention on Climate Change (developed economies and economies in transition) because these countries have generally recognized emission targets. Non-annex 1 developing countries have more general obligations. Offsetting this view, the inclusion of non-signatories would enhance the comprehensiveness of any agreement and thereby increase potential cost-savings. However, this may not be a serious concern since about 70 percent of worldwide CO_2 emissions emanate from signatory countries; and abatement costs in these countries differ significantly.

In principle, Joint Implementation could involve augmenting the tropical forest CO_2 sink or securing an emissions reduction. The existing offsets (Pearce 1994: Table 2) are generally of the kind where emissions are traded for afforestation, reforestation, or efficient forest use. In reality, such deals are capable of manipulation by all parties in their own interest. A host country might refuse to afforest and thus claim that "no afforestation" defines its baseline for negotiations. It can then attract an afforestation Joint Implementation project and claim that newly planted trees genuinely contribute to CO_2 fixation. The situation might be still worse if Joint Implementation is extended to "avoided deforestation;" threats to deforest could then be rewarded by Joint Implementation deals. The donor agent in the industrialized country also has an incentive to exaggerate the extent of host country emissions reduction or CO_2 fixation since then the donor agent would gain more emission credits.

CONCLUSIONS

Actions must be taken in three policy areas to insure sustainable management of tropical forests. In order to correct for market failure, durable and enforceable property rights have to be established with respect to tropical forests. The remaining environmental externalities can be internalized by instituting resource taxes or by fixing upper limits for the use of forest resources. From such measures considerable

biomass increases may be expected. However, these measures would be accompanied by income losses, at least in the short- to medium-run, because it takes some time for the ecological benefits of conservation to materialize in economic values, such as increased agricultural productivity. Therefore, it is unreasonable to hope that the decision makers in tropical countries will approve and enforce isolated conservation measures. To address this problem, transfers by developed countries are needed to compensate tropical countries for their protection of the global public goods, climate protection and biodiversity. Through transfers, abatement costs are shared between developed and developing countries and are more likely to be accepted by tropical developing countries. This is in contrast with tropical timber import restrictions which shift most abatement costs to tropical countries and were rarely ecologically effective.

It should be possible to formulate policy packages for most tropical countries that contain an adequate combination of national and international measures. These policies must avoid conflict between ecological and economic objectives in order to be enforceable.

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