

# Keeping the forest for the climate's sake: avoiding deforestation in developing countries under the UNFCCC

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## Abstract

A process for reducing emissions from deforestation in developing countries has been initiated under the UNFCCC. Efforts to agree on a legally binding instrument to halt deforestation have previously failed in other international fora. The magnitude of the social, economic, technical and political complexities underlying deforestation have led to negotiations being challenging. What policy instruments could provide incentives to reduce deforestation, and how could these instruments be framed, under the UNFCCC? This article analyses the advantages and disadvantages of the available alternatives within and outside of the Kyoto Protocol. Staying within the Kyoto framework means low institutional development costs, established but limited incentives for action, and low flexibility. Alternatives outside the Protocol provide higher institutional development costs, uncertainties with regard to the incentives, but greater flexibility. We argue that a separate protocol may be the most viable option, as it could offer the necessary flexibility and avoid some technical and political pitfalls that would be likely to beset new efforts under the Kyoto Protocol. The article also presents the concept of 'committed forests' as a means of defining geographically where the reduction of emissions from deforestation can take place.

*Keywords:* LULUCF; Deforestation; Kyoto Protocol; UNFCCC; Incentive mechanisms; Greenhouse gases; Forest

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## 1. Introduction

The eleventh session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) initiated a process for reducing emissions from deforestation in developing countries. The agreed text requests the Subsidiary Body for Scientific and Technical Advice (SBSTA) to consider this issue and to report by the end of 2007 any conclusions on the

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establishment of incentives to stimulate related action.<sup>1</sup> Should the SBSTA be successful in agreeing on a viable way forward in addressing this issue, this will mark an important milestone in the history of international environmental policy-making.

Forest loss and degradation are rooted in complex environmental, social, political and institutional realities. They are of vital interest to many governments, international organizations, NGOs and other constituencies but, despite the enormous interest in setting a global agenda on deforestation, no international legally binding agreement is in place to date. In fact, the complexities underlying the development of such an agreement may have prevented fora such as the United Nations Forum on Forests (UNFF) from establishing a sound mechanism. Even within the UNFCCC, dealing with deforestation has proved to be a difficult bull to ride despite its great contribution of greenhouse gases (GHG) to the atmosphere. As a developing-country issue, controversy has been particularly significant within negotiations on the clean development mechanism (CDM), where all attempts to include avoided deforestation as an eligible activity eventually faded away.

Despite past failures, the importance that the international community has attributed to halting deforestation has kept international efforts alive, with the expectation that an international instrument will be agreed upon one day. Is this likely to happen within the UNFCCC? What would discussions be like? Answers to these questions are likely to emerge over the next two years. Discussions within the UNFCCC may first consider broadly how incentives relating to deforestation could be accommodated under the Convention. This article presents a preliminary assessment of issues that may be initially considered by the SBSTA; in particular, available policy instruments to set incentives to halt deforestation, and the form that these could take within the UNFCCC. It starts with a background on the drivers and extent of tropical deforestation, emphasizing that incentives should operate in a defined portion of a nation's forests. Taking into account this information, Section 3 discusses available policy instruments that could potentially be incorporated into the UNFCCC. Finally, Section 4 focuses on the form these instruments could take and provides a brief analysis of the available alternatives. While analysing the advantages and disadvantages of each, this article does not provide a value judgement, as the best option will be the result of intensive negotiations within the UNFCCC arena.

## 2. Deforestation as an international issue

### 2.1. Tropical forests and the deforestation splurge

Tropical forests provide vital goods and services for the countries where they occur, such as wood and other forest products, and the conservation of soil and water. They also contribute globally to protecting biodiversity, storing carbon and regulating climate. According to the Forest Resources Assessment (FAO, 2005), the global forest area is about 4 billion hectares, half of which is found in the tropics and subtropics. Tropical deforestation and forest degradation have dramatically increased in the last 100 years, and have accelerated since the 1960s as a result of mechanization, improved transport, the globalization of markets and other factors. Between 1990 and 2005, tropical deforestation progressed at an average rate of 11.3 million ha/annum<sup>2</sup> – a rate of 0.65%.<sup>3</sup> Generally speaking, the conversion of forested land to uses such as agriculture represents a radical change in the ecology of an area. Knowledge of the longer-term implications of large-scale changes in the forest landscape – at national and global levels – is limited. However, there is evidence that deforestation and poverty are linked (see Grainger, 1993; Kaimowitz et al., 1998) and that

deforestation causes changes in local site conditions that can exacerbate natural disasters (Blaser and Husain, 2001).

Emissions from deforestation since 1850 have contributed to 90% of the emissions from land-use change, resulting from a 20% decrease in forest area (Houghton et al., 2001). Deforestation and forest degradation may have released between 0.8 and 2.2 PgC per year during the period 1990–2000, corresponding to 10–25% of the global human-induced GHG emissions in that decade (Houghton, 2003; DeFries et al., 2002). In addition, forest fires contribute to the release of GHG; for example, forest and peat fires in Indonesia in 1997/1998 may have released the equivalent of one-third of the aggregated annual anthropogenic carbon emissions in that period (World Bank, 1999; Page et al., 2002). Table 1 lists the countries with the highest total and relative deforestation. It shows that the four countries with the highest annual deforestation together accounted for 51% of total tropical deforestation between 1990 and 2005.

Estimates using data from 78 tropical developing countries indicate that the highest average deforestation between 1990 and 2005 occurred in Tropical South America (4.44 million ha/year),<sup>4</sup> followed by Africa (4.1 million ha/year),<sup>5</sup> and Tropical Asia and the Pacific (2.8 million ha/year)<sup>6</sup> (see Figure 1).

In relative terms, the highest annual deforestation rate is observed in Tropical Asia (0.88%), followed by Africa (0.69%) and Tropical America (0.53%). Subregions with the highest annual relative loss of forests between 1990 and 2005 were West Africa (1.65%) and Central America (1.05%). A special case is observed in the Caribbean,<sup>7</sup> with a gain in forest cover of 0.82% relative to 1990 (see Figure 2).

Tropical deforestation and forest degradation patterns are heterogeneous due to a wide array of drivers, where socio-economic factors play the greatest role in shaping local deforestation. Due to social, environmental and political complexities, the indirect nature of many of the causal relations and the wide diversity of situations, any attempt to generalize the causes of deforestation and forest degradation is difficult and ‘invites criticism’ (Kaimowitz and Angelsen, 1999). Nevertheless,

Table 1. The ten countries with the highest absolute and relative deforestation rates in the world

Country	Deforestation (ha) (average per annum 1990–2005)	Country	Deforestation (% of 1990 forest cover)
Brazil	2,821,900	Burundi*	6.0
Indonesia	1,871,500	Togo*	5.2
Sudan*	589,000	Honduras*	3.9
Myanmar*	466,500	Nigeria	3.7
DR Congo*	461,400	Niger*	3.6
Zambia*	444,800	Philippines	3.2
Tanzania*	412,300	Benin*	2.8
Nigeria	409,700	Uganda*	2.4
Zimbabwe	312,900	Ghana	2.3
Venezuela	287,500	Indonesia	2.1
Other 68 countries	3,257,400		
Total	11,334,900	Average 78 tropical countries	0.65

\*LDC countries in the UNFCCC.

Source: based on data of the Forest Resource Assessment 2005 (FAO, 2005).

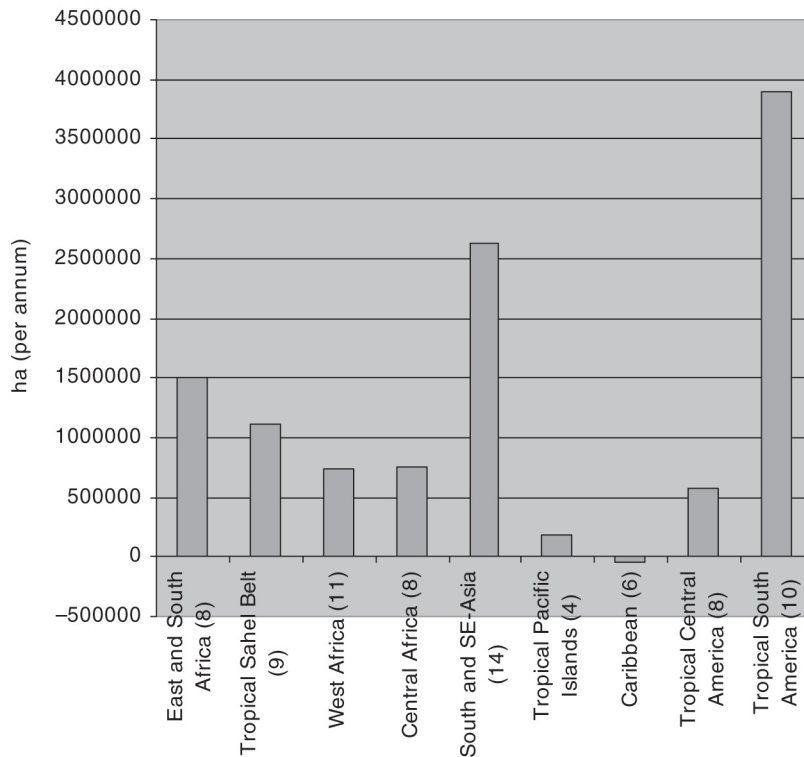


Figure 1. Average annual loss of forest cover (ha) for the observation period 1990–2005. Source: FAO database (FAO, 2006). Brackets indicate the number of countries counted in the analysis.

it is known that policies and market failures often lead to deforestation and forest degradation (Blaser and Douglas, 2000) and, more specifically, that these relate to activities outside the forest sector, such as agriculture, migration and infrastructure development (Kaimowitz and Angelsen, 1999; Geist and Lambin, 2002). Table 2 presents a rough attempt to describe the different drivers of deforestation in different regions. It further illustrates the great differences in the causes of deforestation in the tropics.

## 2.2. Avoiding deforestation: committing forests as carbon reservoirs

Public international concern related to deforestation has been fuelled by research indicating that deforestation is not likely to be reversed in the near future and that it will have irreversible consequences on livelihoods, biodiversity loss and the atmosphere (Grainger, 1993; CFAN, 1999). Deforestation has received a great deal of attention in international politics and has even become an emotive and divisive issue with the general public. However, it continues unabated despite its prominence and the numerous efforts to reduce it. This has occurred in the face of international negotiations dealing with the fate of the world's forests, and despite the input of substantial resources through World Bank lending, and grants from donors, the Global Environment Facility (GEF) and the International Tropical Timber Organization (ITTO).

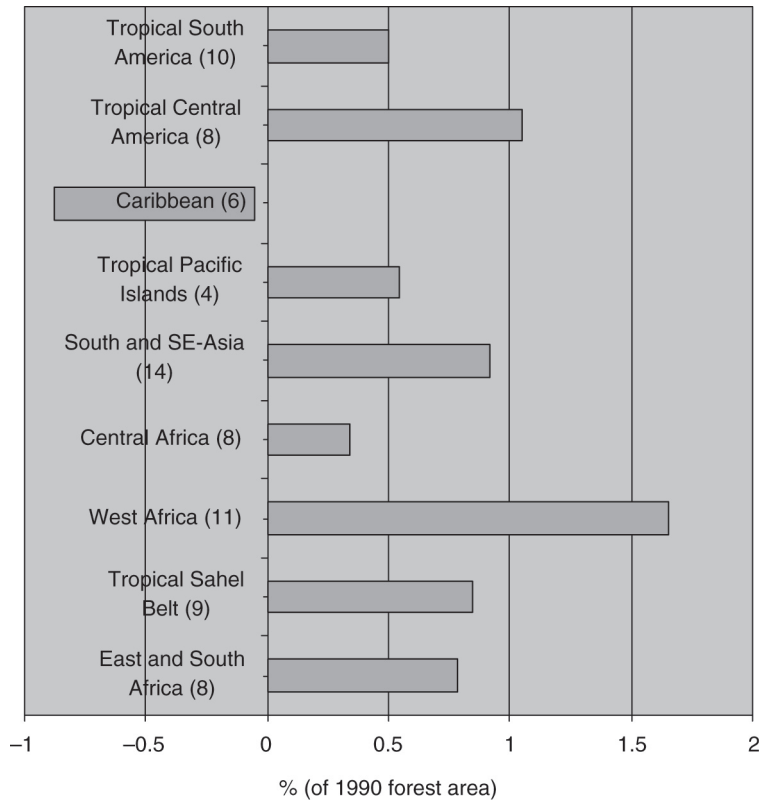


Figure 2. Relative average rates of annual deforestation per year, expressed as percentage of 1990 forest area, for the observation period 1990–2005. Source: FAO database (FAO, 2006). Brackets indicate the number of countries counted in the analysis.

Over the past 15 years, the international community has failed to reach consensus on a legally binding agreement to curb tropical deforestation. Since the early 1990s, an international dialogue on forests has taken place, first under the Intergovernmental Panel on Forests, followed by the Intergovernmental Forum on Forests and finally under UNFF. Furthermore, ITTO negotiated an agreement in 1994 and again in 2006 which aims to promote, among other things, the sustainable management of tropical timber-producing forests. Yet, none of them have reached their goals in respect to deforestation so far.

The debate on how to shape an international regime on forests is ongoing; however, its mandate and scope remain vague. The main reasons why it has been difficult to agree on a binding international instrument include the fact that forests *per se* are not considered as a global good – even though some of the services provided are undoubtedly counted as such – but are seen as being under full sovereignty of the nations that possess them. Second, the fact that the interests on forests are manifold, and often incompatible, makes it difficult to find compromises that are acceptable to all governments.

Meaningful attention to deforestation within the UNFCCC might have been delayed, on the one hand, by a focus on GHG emissions from fossil fuels and, on the other, by the politics surrounding deforestation in other fora. Today, greater awareness and political pressure, primarily fuelled by the

Table 2. Drivers of deforestation and their importance in the main tropical regions

Drivers	Tropical Sahel Belt	West Africa	Congo Basin	East and South Africa	South and SE Asia	Pacific Islands	Central America	Tropical South America
Institutional drivers:								
Development Strategies <sup>a</sup>	–	++	++	++	+++	+	+	+++
Migration <sup>b</sup>	+	+	+	–	++	–	+	++
Economic drivers:								
Small-scale agriculture	+	+++	+	+++	++	+++	+++	+++
Agrobusiness: soya, oil palm, rubber, cattle	++	+++	+	++	+++	++	++	+++
Timber extraction	+	++	+++	+	++	++	+	+
Pulp, plantations	–	++	+	+	+++	+++	+	++
Fuelwood extraction	+++	++	+	++	+	++	++	+
Mining and oil	+	++	+	++	+	–	–	++
Social drivers:								
Opportunities <sup>c</sup>	–	++	+	+	++	–	+++	+++
Poverty	+++	++	++	++	+	+	+++	+
Armed conflicts	++	++	++	+	–	–	+	–

+++ strong influence; ++ medium influence; + low influence; – no influence at all.

<sup>a</sup>Development strategies include government policies to create incentives for land-use other than forests, infrastructural development and macroeconomic policies at the detriment of forests.

<sup>b</sup>Migration includes planned transmigration programmes, incentive programmes to displace families and unplanned colonialization of forest land.

<sup>c</sup>Opportunities include land speculation, taking advantage of short-term economic shortfalls, etc.

coalition of rainforest nations<sup>8</sup> and some NGOs, have initiated a process that could lead to adding the reduction of emissions from deforestation to complementing efforts already in place. However, simply transferring the approaches followed in the area of fossil fuels to reducing emissions from deforestation could fail because of the above-mentioned social, economic and political complexities. Furthermore, due to differences within forest lands across the globe in terms of legal status, use and location, not all forests are likely to be affected in the same way by established incentives to counteract deforestation. Finally, forests and climate change are linked in other ways, such as the stress on forest ecosystems due to effects of climate change and the fact that sustainable forest management could enhance the capacity of society to cope with climate change (Robledo and Forner, 2005).

Although controversial, social and economic needs and pressures make it inevitable that substantial areas of natural forest in the tropics will be converted to agriculture and other uses (Blaser and Douglas, 2000). The decision on which forests should be converted is a crucial question in land-use planning. Yet, this decision is often made on an *ad-hoc* basis with a disregard for sustainable development and effective and transparent participatory mechanisms. Most tropical countries have classified their forest estates according to their long-term land-use priorities, i.e. by defining areas which should remain under forest cover in the long-run (permanent forests)<sup>9</sup> and those forested areas that will most probably be converted to other land uses (conversion forests)<sup>10</sup> (see Table 3).

Table 3. Estimate of the total and the permanent forest area in 33 ITTO producer member countries

	Total forest area (1000 ha)	Permanent forest area (1000 ha)	% of total forest (1000 ha)
Tropical America	880,000	550,000	62
Tropical Africa	255,000	105,000	42
Tropical Asia	300,000	175,000	60
Total	1,435,000	830,000	58

Source: ITTO (2006).

In many cases, deforestation and forest degradation take place within permanent forests. A challenge lies in setting effective policies and implementing activities that reduce emissions from deforestation in these areas, in particular, whenever environmental and socio-economic impacts from deforestation and forest degradation are significant. An international instrument to reduce emissions from deforestation could provide flexibility by allowing Parties to define a portion of their permanent forest estate where policies and activities to reduce deforestation would be implemented. These *committed forests* could be defined by each country according to agreed criteria such as the degree of deforestation threat in a specific locality, and be registered by the relevant national entities as being eligible for reducing the emissions of GHG. Hence, a 'committed forest' could be defined as a subset of the permanent forest estate specifically classified as a long-term carbon reservoir that falls in an area threatened by deforestation and forest degradation.

Based on a first rough estimate,<sup>11</sup> about 420–750 million hectares of tropical forests could be defined as committed forests (see Appendix 1). The great bulk of the area would presumably fall under the land-use category 'Accessible multi-use forest areas'. Such areas are characterized by a high threat of deforestation, mainly through social drivers, lack of law enforcement, weak tenure arrangements and low attractiveness for investment in sustainable management.

In summary, international policy to reduce emissions from deforestation will only be successful if its design considers local and national socio-economic and political realities. Policies and activities should target 'committed forests' under the threat of short-term deforestation or degradation, which have been selected by the host countries on the basis of defined criteria and national development priorities. The following section analyses the available policy instruments that could be used to provide incentives to reduce deforestation in such areas.

### 3. Instruments for environmental policies

International policies to reduce emissions from deforestation need to set effective incentives for governments from countries with high deforestation rates. Domestically, incentives need to be transmitted to actors on the ground to influence the decision to clear land or to support interests in preserving forest cover.

Instruments that can be used include direct regulation, transfer payments and market mechanisms. They rely on government laws and regulation that determine rules for the behaviour of businesses and individuals. Their choice and design is typically made not only on the basis of cost-effectiveness, but also on the basis of ease of implementation, institutional capacities, political feasibility (Hahn and Stavins, 1992), as well as the distribution of costs, benefits and responsibilities – especially where the implementation of these instruments directly affects livelihoods. The instruments presented here are not necessarily exclusive and can generally be used as complements.

### 3.1. Direct regulation

The classic instrument for policy implementation is direct regulation, also referred to as ‘command and control’, whereby authorities directly prescribe parameters for allowable actions. At the national level, it is the most commonly used policy instrument for land use, such as zoning regulations or protected areas defined by law. In fact, a portion or all of the areas that countries define as ‘permanent forests’ are, in one way or another, covered by some form of direct regulation. Identifying ‘committed forests’, as defined above, would imply direct regulation which could be complemented by setting additional incentives to prevent land clearance.

The effectiveness of regulation depends entirely on enforcement, typically done through fines or prosecution in the case of non-compliance. Regulatory instruments often suffer from poor enforcement, especially where governance and state institutions are weak. In many tropical countries where deforestation rates are high, laws against deforestation exist but are not fully enforced. This traditionally results from various kinds of policy failures such as lack of institutional capacity or the unintended side-effects of agricultural or infrastructure development policies which are often considered to be more important for national development (Kaimowitz et al., 1998; Contreras-Hermosilla, 2000; Geist and Lambin, 2002). Where government institutions and governance structures are weak, such problems can be pervasive (Pierce and Resosudarmo, 2002).

At the international level, a number of environmental agreements have used a regulatory approach, the most prominent example being the Montreal Protocol on Substances that Deplete the Ozone Layer. The establishment of quantified emission limitation or reduction commitments under the Kyoto Protocol is also a form of regulation, but flexibility is provided by mechanisms like emissions trading or the CDM.

### 3.2. Market mechanisms

Market mechanisms convey a price signal to agents and are increasingly used as instruments for environmental policy. They typically rely on legal instruments to establish the framework for an incentive system, but offer greater flexibility in compliance than traditional regulatory instruments. The main market mechanisms for public policy are taxes and subsidies, and permit trading. They can, in principle, achieve a desired environmental outcome at least cost, as they equalize the marginal costs (or benefits) of environmental actions. In contrast, in the absence of market mechanisms and under direct regulation it is difficult, or even impossible, to achieve the equalization of marginal costs, due to informational and practical constraints.

Economic instruments tend to pose more demanding requirements for monitoring and enforcement than direct regulation and, therefore, may be less attractive or feasible in developing countries (Blackman and Harrington, 2000). In the context of deforestation, requirements may include an institutional framework to regulate, administer and promote the instruments, and a monitoring system to accurately estimate the extent of deforestation and the resulting GHG emissions. Nevertheless, it should be noted that new mechanisms under the UNFCCC and the Kyoto Protocol have encouraged and supported improvements in institutional arrangements for participating in the international emissions market.

A *tax* acts as an incentive to reduce undesired activities (for example, forest conversion), while a *subsidy* can be used to provide positive incentives (for example, protection of committed forests). For tax-based policies to work, strong enforcement mechanisms are necessary, and there may be significant political difficulties inherent in raising revenue from taxes. For example, raising taxes from dispersed

and informal forest dwellers or small farmers may be neither socially desirable, nor possible (Kaimowitz et al., 1998). Subsidy schemes, on the other hand, are often unfeasible because of a lack of funds. Furthermore, tax/subsidy schemes require that the owners or users of forests be clearly identifiable in order to be taxed or subsidized; in many traditional forest settings, this may not be possible. At the international level, no environmental treaty of significance relies on taxes or subsidies: these instruments are politically contentious and difficult to administer if implemented internationally.

*Permit trading* is another market mechanism used for environmental policies. Under 'cap-and-trade' schemes, a fixed overall quantitative limit for an activity is set. Permits amounting to this overall cap are allocated to agents who can then trade them as needed. Just as with taxes or subsidies, permit trading could achieve environmental outcomes at least cost by letting the market find the lowest-cost options and equalizing marginal costs. Permit trading is most commonly used for pollution control; for example, for carbon dioxide emissions in the European Union's energy sector. At the international level, the Kyoto Protocol allows permit trading between Annex I Parties. Under any permit trading scheme, the distribution of costs, benefits and responsibilities is determined principally by the initial distribution of permits (or 'targets') between countries or agents, and by whether the permits are sold or given away.

Given that permit trading already operates under the Kyoto Protocol and for domestic GHG schemes, it might seem an obvious choice for providing incentives for reducing deforestation. However, as a domestic policy instrument, it demands institutional and technical requirements which may not be met in the case of land-use change in developing countries. Permit trading requires accurate accounting for GHG emissions, but estimates of GHG emissions from tropical deforestation are less reliable than estimates of emissions from fossil-fuel combustion (Schlamadinger and Marland, 2000; Royal Society, 2001). The CDM illustrates this, where the link to emissions trading requires accurate accounting of emissions, as well as credible baselines. In addition, administrative and transaction costs diminish the potential efficiency gains from permit trading schemes (Tietenberg, 2006). Permit trading, therefore, is usually best suited for situations with a limited number of traders, as transaction costs may otherwise become overwhelming, and very small landholders may simply not have access to permit markets.

Finally, under international permit trading, a binding national emissions target imposes a large potential liability on a country. Risks from deforestation targets may be large, given the uncertainty about future rates of deforestation, and particularly if emissions from deforestation constitute a sizeable share of a country's overall emissions. Such risks may be politically unacceptable for governments in many developing countries.

### 3.3. *Transfer payments*

Payments in return for specified activities or outcomes can also be used as incentives to reduce deforestation. The most common arrangement is for beneficiaries of environmental action to pay (compensate) those who implement measures that benefit the environment. Although some market mechanisms involve transfers (e.g. under the CDM, payments for the purchase of CERs generated in developing countries), there is a distinction: transfer payment schemes, as defined here, are not market mechanisms because no market force underlies the transfer. Due to their selective nature, they are likely to be less cost-effective, but they are an attractive option in situations where it is difficult to implement market mechanisms because of institutional constraints, or where market mechanisms have undesirable distributional impacts.

Examples of such *beneficiary pays* schemes at the national level include payments from water users to upstream landholders, and user charges for conservation areas, which have successfully been used in developed and developing countries (Richards, 2000). Payment for environmental services (or PES) are a specific type of transfer payment by which the beneficiaries of an environmental service from forests compensate landowners for preserving that forest. They are defined as 'voluntary, conditional transactions with at least one seller, one buyer, and a well-defined environmental service' that could provide direct incentives for conservation to cover small opportunity costs, for example forests in slow-moving agricultural frontiers (Wunder, 2005). Although PES could be an effective mechanism to halt deforestation due to its 'directness', criticisms include the fact that the weakest actors are often marginalized, property rights are often not well defined, and that transaction costs are high (Rosa et al., 2003, cited in Wunder, 2005).

The Global Environment Facility is an example of transfer payments for environmental purposes at the international level. It provides funding for the incremental costs of activities in developing countries that are expected to benefit the global environment and is, in turn, financed through contributions by industrialized countries. GEF thus offers incentives for project activities with international externalities that would not necessarily be in line with the self-interest of the host country. The fund is, amongst others, active in the areas of climate change, biodiversity and land degradation, all of which are potentially connected to deforestation. It is also the main funding channel within the UNFCCC, where guidance by the COP has established potential links to deforestation, in particular, whenever guidance<sup>12</sup> on adaptation and vulnerability explicitly makes a reference to forests and fragile and mountainous ecosystems (Lodefalk and Whalley, 2002).

A final example of transfer payments used for forest conservation is debt-for-nature swaps, where foreign debt is bought off and the proceeds used for conservation measures. Such deals have been seen as a possible template for more systematic and broader international transfer payments for environmental objectives (Jha and Schatan, 2002).

In the case of land-use change policies, transfer payments offer the considerable advantage that they do not necessarily require stringent rules for estimating emissions reductions, and so may be used to provide conservation incentives where market mechanisms, and possibly direct regulation, do not reach. Transfer payments could be used to *buy off* commercial interests that drive inappropriate deforestation by making it more profitable to keep forests. Contracts for transfer payments would need to be designed flexibly to deal with particular causes of deforestation and the different actors involved. For example, payments could be made to local communities, businesses or, in some cases, security forces, to influence land-use change. Concerns about the long-term consequences could be solved with annual payments or 'rental' schemes. Their cost-effectiveness largely depends on the quality of project selection processes, the magnitude of payments for a given environmental outcome, and on monitoring and verification to ensure that the desired outcomes are in fact achieved. Challenges include, first, to ensure that sufficient funds are available and, second, that transfer payments do not only benefit the central government and national elites, but that livelihoods and environmental conditions at the local level are improved.

### 3.4. Policy instruments for deforestation at the national and the international levels

The main challenge for any new policy framework on deforestation is to put in place an architecture at the international level that supports or requires the establishment of incentive mechanisms at the national level. It is crucial to design incentives so that local agents – from forest dwellers

through local companies to regional governments – benefit from modifying their land-use change activities. Domestic instruments suitable at the national level may well differ from those used at the international level.

Land-use change in developing countries poses difficult political, technical and institutional challenges that will affect the choice of instruments for curbing deforestation. Institutional constraints may limit the scope of instruments that will work in practice, and policy instruments will have to be tailored to each country's circumstances, taking into account the causes of deforestation, as well as institutional, economic and political structures.

To control deforestation at the national level, regulatory instruments will succeed only if there are strong enforcement mechanisms. Lack of enforcement is what allows deforestation to proceed in many forested areas that are already protected by law. Incentives at the international level could encourage national governments to implement regulations for forest protection, or to strengthen domestic enforcement mechanisms.

For an international agreement, by contrast, regulation is suitable only for very well-defined issues that allow consensus on the regulatory measures to be implemented. It is difficult to see, in the case of deforestation, how an international agreement on direct regulation could be achieved, given the stark differences in countries' circumstances. A direct regulatory approach at the international level would require an agreement over specific provisions for what conversion is and is not allowed. This may be politically impractical, as well as difficult to achieve, in multilateral negotiations.

Taxes and subsidies are likely to be at disadvantage, primarily because they face difficult hurdles at the international level. As discussed above, these hurdles range from requirements for monitoring and enforcement to political unacceptability – which may equally affect their suitability as domestic policy instruments.

Transfer payments could, in many cases, generate domestic incentives for reducing deforestation, as discussed above. At the international level, transfer payments to provide incentives for deforestation avoidance could build on existing institutions such as the GEF, and use the experiences gathered in debt-for-nature swaps and PES schemes. More systematic approaches to distributing funding to recipient countries than under the GEF could be devised (see, for example, Grafton et al., 2004). Non-climate objectives such as biodiversity conservation or poverty alleviation could also be taken into account.

In summary, there is a wide range of policy instruments that could be used to curb deforestation. All have advantages as well as disadvantages, and require that different conditions be met in order to be effective. The regulatory framework that uses them to set incentives plays a key role in determining their success. The next section discusses available options to frame these instruments within the UNFCCC.

#### **4. Framing policy instruments for deforestation within the UNFCCC**

A policy instrument within the UNFCCC that sets incentives to reduce emissions from deforestation at the national level needs to be implemented in accordance with the general provisions of the Convention; in particular, its objectives, definitions and commitments. This section analyses four options to this end.

The first, and most straightforward, alternative lies within the Kyoto Protocol (or any successor). Instruments to reduce GHG emissions within this Protocol have been established by a combination

of agreed emission targets<sup>13</sup> and three flexibility mechanisms. Of the latter, the CDM is the only one that provides incentives for the reduction of GHG emissions in developing countries. The Protocol offers two options for setting deforestation-related incentives. The first is to define the reduction of emissions from deforestation as an eligible activity under the CDM, and the second is to establish these incentives through a separate flexibility mechanism which can take the form of an annex to the Protocol.

The third option, outside the Kyoto Protocol, is a second protocol with the specific objective of reducing emissions from deforestation in developing countries. Finally, incentives to reduce emissions from deforestation in developing countries could be set by guidelines and recommendations contained in COP decisions. This last option, also referred to as *soft law* (Sands and Peel, 2005), could target provisions of the UNFCCC on the protection of natural sinks and reservoirs<sup>14</sup> but would not set binding commitments.

Although each option is analysed separately, the possibility of combining two or more is not excluded. For example, a stepwise approach could allow Parties to take on voluntary and non-binding commitments as a first stage to later agreeing on binding ones. The following subsections provide a brief analysis of these options by elaborating on their likeliness to cause controversy and polarize views by Parties; how likely it is that they will be effective in providing incentives for action; and whether they could incorporate sustainable development considerations.

#### 4.1. An eligible activity under the CDM

Although avoided deforestation was excluded from the CDM under the Marrakech Accords, future negotiations could define reducing emissions from deforestation as an ‘eligible activity’. As already explained, this option entails the payment for an environmental service through the issuance of a credit that can be traded and used by Annex I Parties to meet commitments. The benefit from that payment will depend on the international price for carbon relative to the costs of producing and selling the credit.

On the positive side, the institutional framework of the CDM is in place and is itself a credible international mechanism. Thus, resources for the development of policy would only be needed for developing specific modalities and procedures. Experience with the CDM to date demonstrates its capacity to provide incentives to reduce GHG emissions, as can be judged by the large number of projects in the pipeline.<sup>15</sup> To the extent that the market price covers the opportunity cost of land as well as CDM and transaction costs, the CDM could provide an incentive to halt local deforestation in defined areas. For example, a project to preserve a forest could be established in an area with high deforestation rates. Certified emission reductions (CERs) could be issued on the basis of avoided emissions from deforestation, calculated relative to a baseline. Revenue from the CERs would be the main incentive to undertake such a project.

However, the extent to which the CDM could induce real reductions of emissions from deforestation is questionable. First, demanding regulatory requirements from the negotiation process may result in high transaction costs. Second, CDM projects must define a methodology for the calculation of additional reductions or removals and comply with the CDM regulation. Observing such requirements may prove to be challenging, as discussed in Section 3.2. Proving additionality and addressing leakage may be additional obstacles. Moreover, even if the instrument is effective at the project level, this may not necessarily be the case at the national level. It is likely that the CDM would cover only a fraction of total areas under threat of deforestation, with scattered

distribution of projects. The limitations with regard to coverage and short-term horizons for projects are further pitfalls for the CDM in terms of significantly reducing emissions from deforestation at the national level.

The ability of the CDM to contribute to sustainable development in terms of equity and benefiting the poor has been widely discussed, for example, in the context of the concentration of projects in some countries (see Cosbey et al., 2005; Silayan, 2005). While the CDM has provided incentives for investments in the private sector, there is no indication to date that it could promote poverty alleviation. Contrary to GHG emissions from fossil-fuel combustion and industrial processes, a significant proportion of the emissions from deforestation is linked to poverty. As market forces drive the CDM, this instrument is blind to the underlying causes of deforestation. The reduction of emissions from deforestation would rely primarily on the market price for carbon, which is likely to favour 'cheaper' projects that may not pay attention to sustainable development concerns.

Finally, political controversy is perhaps the major downside of including deforestation under the CDM, primarily because general concerns over the role of land use, land-use change and forestry (LULUCF) activities within the Kyoto Protocol are still being voiced. Such controversy arose from the concern generated by allowing developed countries to lessen their national effort to reduce GHG emissions by accounting removals from forestry and credits generated in developing countries. Furthermore, some delegations were of the opinion that committing forests to Kyoto would have implied a transfer of commitments from Annex I to non-Annex I Parties and were concerned over the implications for sovereignty (Fearnside, 2001). Other concerns, often unspoken, concerned the effects of large emission reductions from deforestation inundating the carbon market and crowding out efforts in the energy sector.

When modalities and procedures for the CDM were under negotiation, political controversy over LULUCF was resolved by limiting eligible activities to afforestation and reforestation<sup>16</sup> and a cap on CERs of 1% of base-year emissions for each Annex I Party. Having this agreement as a precedent, it is highly improbable that an agreement on an additional eligible activity can be reached.

#### *4.2. A flexibility mechanism*

This option consists of the creation of a new mechanism at the same level as the CDM, joint implementation (JI) or emissions trading (ET), linked to compliance with Kyoto targets through, for example, the issuance of credits. A mechanism without such a link would, on legal grounds, be possible and would respond to the COP/MOP; however, in practical terms, it would be similar to a separate protocol, which is discussed below.

An additional mechanism entails an amendment to the Kyoto Protocol. Once agreed, it will require work to develop policy to define, for example, the type of incentive, the body in charge of its administration, and rules and procedures. The so-called 'compensated reduction', under which developing countries would be compensated for reducing national deforestation relative to previously documented levels (Santilli et al., 2005) is an example of a possible new additional mechanism. It could be established by a separate annex to the Kyoto Protocol that specifies those developing countries that agree on a target to reduce emissions from deforestation. Achieving such a target could allow the issuance of credits without any non-compliance consequences.

The ability of a separate mechanism to provide incentives depends on its architecture. The creation of a new mechanism offers flexibility to establish incentives and develop a structure that

is able to link national incentives (transfer payments, law enforcement and others) with international ones (funding). It can also allow the implementation of non-project-based actions aimed at reducing deforestation rates at national or regional levels: selling credits or other types of carbon allowances could provide an incentive in a similar way as the CDM does, without necessarily coming from project-based activities. This flexibility also applies to sustainable development concerns, as they can be addressed in the policy-making stage.

However, flexibility in the design of a new mechanism is constrained by the accounting rules of the Kyoto Protocol; in particular, on reporting GHG inventories and those that regulate fungibility (e.g. the equivalence between different types of carbon credits). On the one hand, reporting under Kyoto follows resource-intensive methods in terms of data collection and management systems. On the other, credit issuance will be subject to the provisions already established for accounting credits from the CDM or JI.

Finally, political controversy will depend to a large extent on how accounting the reduction of emissions from deforestation would lessen efforts in reducing fossil-fuel emissions and what the consequences of non-compliance would be. Nevertheless, the making of a new mechanism would allow for these issues to be considered afresh.

#### 4.3. A second protocol

A second protocol could specify substantive obligations which are directed at meeting the objectives of the UNFCCC. In other words, it could provide guidance so that the incentives to stimulate action for reducing emissions from deforestation in developing countries contribute to ‘stabilizing GHG concentrations in the atmosphere’.<sup>17</sup> Such a separate protocol could encompass the ‘compensated reductions’, referred to above, with the difference that it does not need to be linked to emissions targets within the Kyoto Protocol. Moreover, the form of compensation would be other than Kyoto-type credits, for example, direct payments from an established fund.

Agreeing to develop a separate protocol may not entail significant controversy at the initial stage. However, controversy is likely to arise on the specifics; for example, the type of incentive, the sources of funding, the specification of commitments and others. Developing a protocol is a lengthy exercise that starts when Parties agree, through a COP decision, on a mandate to develop it. Past mandates have identified a committee in charge of elaborating a proposal that, once approved, may further need the development of decisions to regulate the protocol (for example, the Marrakech Accords).

As with the establishment of a new mechanism, the ability of a protocol to provide incentives for action depends on its architecture. This option offers additional flexibility for the design of the institutional framework, as it will not be bound to the one established for the Kyoto Protocol, thus allowing consideration of issues and incentives specifically related to deforestation, as discussed in Section 2. The same applies to sustainable development considerations, which can also be addressed within the policy-making stage.

#### 4.4. COP decisions (‘soft law’)

This option entails the adoption of decisions that neither set binding commitments and targets, nor specify deadlines. COP decisions provide guidance for Parties to implement commitments under the UNFCCC in a harmonized way. A wide range of issues, such as national communications and funding under the Convention, are regulated through such decisions.

Controversy around the adoption of a decision usually depends on its contents and scope. However, controversy would be likely to be less if compared to the options discussed above, as Parties tend to have a less defensive attitude to negotiating if there are no targets and timetables involved. Given that provisions within the UNFCCC that could relate to deforestation are general (for example, Article 4.1(d) provides for the promotion of the sustainable management of sinks and reservoirs), decisions that regulate these could also be general without the need to specify concrete targets. This option could request Parties to, for example, target financial assistance and enhance cooperation for the establishment of policies and measures to reduce deforestation. The more general the decision is, the less controversy it is likely to cause. However their general character may also make them less effective in practice.

Soft law options generally supplement binding commitments (Sands and Peel, 2005) and implementation is voluntary. For this reason, they may provide little room for substantial incentives in the case of reducing emissions from deforestation. Conversely, effective policy mechanisms may require visible commitment by the international community through the specification of concrete commitments, targets and deadlines.

#### 4.5. Discussion

It is clear that a major disadvantage of the first two options lies on their likelihood of causing political controversy, which is liable to make an agreement difficult or vulnerable to excessively detailed rules and procedures. Setting this aside, assessing the best option is a matter of weighing up alternatives under the Kyoto Protocol against options outside it. The former offers lesser costs from institutional development, established – but limited – incentives for action, and a generally low degree of flexibility, while the latter may mean higher costs of institutional development and some uncertainty with regards to the incentives, but flexibility in the design (see Table 4).

Table 4. Main positive and negative sides of each option

Option	Advantages	Disadvantages
An eligible activity under the CDM	Proven ability of the CDM to provide incentives for action Institutional framework already in place	A political agreement is not likely Technical hurdles Limited to project-based action International price for carbon is major driver for action
A mechanism under the Kyoto Protocol	Ability of the GHG market to provide incentives for action Flexibility within Kyoto Protocol limits	Controversy could lead to less flexibility in the design Technical hurdles as for the CDM
A second protocol	Easier to negotiate Flexible to accommodate realities beyond climate change (i.e. biodiversity)	No institutional framework exists
'Soft law'	Easy to negotiate	Provides only weak incentives for action

Table 5. Applicability of policy instruments at the international level, under different options under the UNFCCC

	Policy forms within the UNFCCC			
	Kyoto-type		Non-Kyoto	
Incentives	An activity under the CDM	A separate mechanism	A second protocol	COP decisions
Direct regulation	Not applicable Credits are issued relative to a baseline No targets or deadlines are specified	In principle, a separate mechanism could establish targets and deadlines.	Applicable It could establish, for example, targets for deforestation	Not applicable Soft law is not binding and, hence, no direct regulation can be established
Taxes/subsidies	Not likely to be an international instrument for different reasons			
Permit trading	Not directly applicable While the reduction of deforestation could generate tradable permits, trade only operates within Annex I Parties: in the absence of commitments, developing countries, rather, receive a payment		Applicable It could establish a permit trading mechanism	Not applicable
Transfer payments	Applicable Transfer payments will result from the selling of credits	Applicable A mechanism could establish a targeted fund	Applicable It could establish a targeted fund	Not applicable in isolation Decisions may revisit funding under the Convention

The process of selecting the most suitable policy framework should also consider the compatibility between each framing option and applicable incentives. Table 5 summarizes the compatibility between the instruments described in Section 3 and the options for framing them. It illustrates that options within the Kyoto Protocol are less flexible and open to accommodating a wider range of incentives, while options outside the Protocol offer more flexibility and may accommodate a wider range of instruments, including mechanisms for the articulation of international as well as national schemes.

Based on the discussion above, it is suggested that a separate protocol could offer the best way forward for the political process. This is because it provides full flexibility to address the specific problems and features of deforestation, and because it can circumvent the requirement for accurate estimation of emissions reductions that would be necessary for inclusion in the CDM, or for linking it with emissions trading. What is more, a separate protocol could also avoid the polarization of views between those seeking alternatives for the protection of forests and those who fear that action on emissions from deforestation could undermine incentives to modernize energy systems.

## 5. Conclusions

Deforestation is a process resulting from different drivers. At the national level, where deforestation can be tackled, reducing emissions through avoiding deforestation should be mainstreamed into

the broader sustainable management of forests. The concept of committed forest, as presented in this article, provides an alternative for systematically defining the area where measures for reducing emissions from deforestation could take place.

This article has analysed several options within the UNFCCC to set incentives for reducing emissions from deforestation in developing countries. Options under the Kyoto Protocol would be to either define the reduction of emissions from deforestation as an eligible activity under the CDM or to establish a separate flexibility mechanism on avoiding deforestation. Outside the Kyoto Protocol, this article has examined the option of establishing a second protocol with the specific objective of reducing emissions from deforestation in developing countries, as well as using guidelines and recommendations within COP decisions ('soft law'). While all the options have their advantages and disadvantages, a preliminary analysis suggests that a separate, new protocol under the UNFCCC may have the greatest potential to deliver the flexibility needed to provide incentives to curb deforestation, while avoiding some technical and political pitfalls that would be likely to beset new efforts under the Kyoto Protocol.

The start of all political processes is usually characterized by great interest and motivation. A crucial decision needs to be taken on what direction the process to establish incentives on deforestation should take: whether incentives will be negotiated under the Kyoto Protocol or independently. The success of any instrument will very much depend on whether the hurdles identified in this article are overcome and how the positive aspects of each option can be enhanced. Some fundamental issues will determine the success of any international agreement on reducing emissions from deforestation within the UNFCCC. We highlight the following:

- Because of the complexities underlying deforestation as well as its uneven distribution across the globe, flexibility in the design will be key to incentive action globally. Binding instruments that impose risks of non-compliance by developing countries are not likely to be politically viable.
- Incentives established at the international level need to take due account of the direct causes of deforestation. The challenge is to design global incentives that result in effective incentives being put in place locally, which are compatible with overall aspirations for development.
- Deforestation is best addressed at the national level, driven by international policies and, possibly, financial transfers. However, Parties should have the option of identifying a portion of their forests where efforts to reduce emissions from deforestation will be concentrated.

The ultimate source of effectiveness will always be the interest and willingness of Parties to commit themselves to action. Hopefully, and in the interest of protecting forests for the benefit of future generations, discussions on reducing emissions from deforestation will not be contaminated by the controversies that have usually plagued forestry-related discussions within and outside the UNFCCC process. Combating deforestation must be seen as a global quest, not as a national burden.

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## Notes

- 1 See conclusions reached by COP-11. Reducing emissions from deforestation in developing countries: approaches to stimulate action [draft version available at <http://unfccc.int/resource/docs/2005/cop11/eng/102.pdf>].
- 2 Source: FAO (2006), average calculated using data from 78 tropical countries.
- 3 Based on data from 78 tropical countries.
- 4 Data from 10 countries.
- 5 Data from 36 countries.
- 6 Data from 18 countries
- 7 This is due to the high forest cover reported by Cuba to FAO for the 2005 Global Forest Resources Assessment.
- 8 See Coalition for Rainforest Nations [available at <http://www.rainforestcoalition.org/eng/>].
- 9 ITTO defines permanent forests as ‘certain categories of land, whether public or private, that are to be kept under permanent forest cover to secure their optimal contribution to national development’ (ITTO, 2006).
- 10 Conversion forest is defined as ‘forest which will be converted to other land uses by planned actions within a foreseeable future’ (Poore et al., 1989).
- 11 This figure was estimated using the authors’ judgement on the basis of FAO data for the state of the forest in more than 30 developing countries.
- 12 See, for example, decisions relevant to the special climate change fund or the adaptation fund, including, 5/CP.7, 6/CP.7, 7/CP.7 and 5/CP.9.
- 13 Article 3 of the Kyoto Protocol requires Annex I Parties to comply with a quantified emission reduction or limitation commitment (QERLC), specified in Annex B in terms of a percentage relative to aggregated GHG emissions in, for the majority of Parties, 1990.
- 14 See, for example, Articles 4.1 (a), (b), (c) and (d), and 4.1 (a) and (b) of the UNFCCC.
- 15 As of 2 August 2006, 256 projects were registered.
- 16 See Decision 17/CP.7 and 11/CP.7 and the attached COP/MOP decisions.
- 17 Objectives of the UNFCCC, Article 2.

## References

- Blackman, A., Harrington, W., 2000. The use of economic incentives in developing countries: lessons from international experience with industrial air pollution. *Journal of Environment and Development* 9(1), 5–44.
- Blaser, J., Douglas, J., 2000. A future for forests? Issues and implications for the emerging forest policy and strategy of the World Bank. *Tropical Forest Update* 10(4), 9–14.
- Blaser, J., Husain, S., 2001. The World Bank: mitigating natural disasters through effective forest and non-forest sector policies. Paper presented at the IUCN World Conservation Congress, October 2000, Amman, Jordan.
- CFAN, 1999. Deforestation: Tropical Forests in Decline. CIDA Forestry Advisers Network [available at <http://www.rcfa-cfan.org/english/issues.12.html>].
- Contreras-Hermosilla, H., 2000. The underlying causes of deforestation. Occasional Paper No. 30. Center for International Forestry Research, Bogor, Indonesia.
- Cosbey, A., Parry, J., Browne, J., Babu, Y., Bhandari, P., Drexhage, J., Murphy, D., 2005. Realizing the Development Dividend: Making the CDM Work for Developing Countries. International Institute for Sustainable Development, Canada [available at [http://www.iisd.org/pdf/2005/climate\\_realizing\\_dividend.pdf](http://www.iisd.org/pdf/2005/climate_realizing_dividend.pdf)].
- DeFries, R.S., Houghton, R.A., Hansen, M.C., Field, C.B., Skole, D., Townshend, J., 2002. Carbon emissions from tropical deforestation and regrowth based on satellite observations for the 1980s and 1990s. *Proceedings of the National Academy of Sciences* 99, 14256–14261.
- FAO [Food and Agriculture Organization of the United Nations], 2001. Global Forest Resource Assessment 2000. FAO Forestry Paper 140. FAO, Rome.
- FAO [Food and Agriculture Organization of the United Nations], 2005. Global Forest Resource Assessment 2005: Progress Toward Sustainable Forest Management. FAO Forestry Paper 147. FAO, Rome.
- FAO [Food and Agriculture Organization of the United Nations], 2006. FAOSTAT [available at <http://www.fao.org/forestry/site/29420/en>].

- Fearnside, P., 2001. Saving tropical forests as a global warming countermeasure: an issue that divides the environmental movement. *Ecological Economics* 39(2), 167–184.
- Geist, H., Lambin, E., 2002. Proximate causes and underlying driving forces of tropical deforestation. *Bioscience* 52(2), 143–150.
- Grafton, R.Q., Jotzo, F., Wasson, M., 2004. Financing sustainable development: country undertakings and rights for environmental sustainability (CURES). *Ecological Economics* 51(1/2), 65–78.
- Grainger, A., 1993. *Controlling Tropical Deforestation*. Earthscan, London.
- Hahn, R.W., Stavins, R., 1992. Economic incentives for environmental protection: integrating theory and practice. *American Economic Review* 82(2), 464–468.
- Houghton, J.T., Ding, Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Maskell, K., Johnson, C.A., 2001. Summary for policymakers. In: *Climate Change 2001: The Scientific Basis*. Cambridge University Press, Cambridge, UK, pp. 2–20.
- Houghton, R.A., 2003. Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management. *Tellus* 55, 378–390.
- ITTO [International Tropical Timber Organization], 2006. *Status of Tropical Forest Management 2005*. ITTO, Yokohama, Japan.
- Jha, R., Schatan, C., 2002. Debt for nature: a swap whose time has gone? Working Paper, Social Science Research Network [available at <http://ssrn.com/abstract=243755>].
- Kaimowitz, D., Angelsen, A., 1999. The World Bank and non-forest sector policies that affect forests. Background Paper for the World Bank's Forest Policy and Strategy. Center for International Forest Research, Bogor, Indonesia.
- Kaimowitz, D., Byron, N., Sunderlin, W., 1998. Public policies to reduce inappropriate tropical deforestation. In: E. Lutz, H. Binswanger, P. Hazell, A. McCalla (Eds), *Agriculture and the Environment: Perspectives on Sustainable Rural Development*. World Bank, Washington, DC, pp. 302–322.
- Lodefalk, M., Whalley, J., 2002. Reviewing proposals for a world environmental organisation. *World Economy* 25(5), 601–617.
- Page, S.E., Siegert, F., Rieley, J.O., Boehm, H.-D.V., Jaya, A., Limin, S., 2002. The amount of carbon released from peat and forest fires in Indonesia during 1997. *Nature* 420, 61–65.
- Pierce, C.J., Resosudarmo, I.P. (Eds), 2002. *Which Way Forward? Forests, Policy and People in Indonesia*. ISEAS, Singapore.
- Poore, D., Burgess, P., Palmer, J., Rietbergen, S., Synnott, T., 1989. *No Timber Without Trees*. Earthscan, London.
- Richards, M., 2000. Can sustainable forestry be made profitable? The potential and limitations of innovative incentive mechanisms. *World Development* 28(6), 1001–1016.
- Robledo, C., Forner, C., 2005. *Adaptation of Forest Ecosystems and the Forest Sector to Climate Change*. FAO Series on Forests and Climate Change, Working Paper, 2. FAO, Rome.
- Royal Society, 2001. *The Role of Land Carbon Sinks in Mitigating Global Climate Change*. Royal Society Policy Document 10/01. Holbrooks Printers, London.
- Sands, P., Peel, J., 2005. Environmental protection in the twenty-first century: sustainable development and international law. In: S. Axelroad, D. Downie, N. Vig (Eds), *The Global Environment: Institutions Law and Policy*. CQ Press, Washington, DC, pp. 43–63.
- Santilli, M., Moutinho, P., Schwartzman, S., Nepstad, D., Curran, L., Nobre, C., 2005. Tropical deforestation and the Kyoto Protocol. *Climate Change* 1, 267–276.
- Schlamadinger, B., Marland, G., 2000. *Land Use and Global Climate Change: Forests, Land Management and the Kyoto Protocol*. Report of the Pew Center on Global Climate Change, Arlington, VA, USA.
- Silayan, A., 2005. *Equitable Distribution of CDM Projects among Developing Countries*. HWWA Report No. 225. Hamburg Institute of International Economics, Hamburg, Germany [available at <http://www.hwwa.de/Publikationen/Report/2005/Report255.pdf>].
- Tietenberg, T., 2006. *Emissions Trading: Principles and Practice*. Resources for the Future, Washington, DC.
- World Bank, 1999. *Ensuring a future for Indonesia's forests*. Paper presented to the Consultative Group on Indonesia, Paris, 29–30 July.
- Wunder, S., 2005. *Payment for environmental services: some nuts and bolts*. CIFOR Occasional Paper No. 42. Center for International Forestry Research, Bogor, Indonesia.

## Appendix 1

### *Forest land-use categories and estimate of the potential committed forest area*

Forest land-use category <sup>a</sup>	Importance of the forest land-use category to sustain livelihoods	Estimated total forest area (million ha) <sup>a</sup>	Estimated potential permanent forest area (million ha)	Estimated potential committed forest area (million ha)	<i>Deforestation threat</i>
Unused forests (non-accessible forests)	+ (in particular for indigenous communities)	250	250	0	<i>Low</i>
Accessible multiple-use forests <sup>b</sup>	+++ (often only accessible forest areas for the poor)	1300	850	300–500	<i>High</i>
Timber production forests	+ (restricted livelihood use, but income for work forces )	150	150	20–50	<i>Medium; Low if sustainably managed</i>
Used forest soils (low tree cover, cleared forest land and planted forests under threat)	+++ (if ownership situation unclear, freely accessible and widely used)	900	250	100–200	<i>Medium (generally deforested or used for A/R)</i>
		<i>2600</i>	<i>1500</i>	<i>420–750</i>	

<sup>a</sup> Based on FAO's Global Forest Resource Assessment 2000 (FAO, 2001); ITTO (2006). Basis: 45 tropical countries.

<sup>b</sup> Includes all accessible production and protection forests; forests are often degraded or in a successional stage (secondary forests).