TROPICAL DEFORESTATION AND THE KYOTO PROTOCOL

An Editorial Essay

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Abstract. The current annual rates of tropical deforestation from Brazil and Indonesia alone would equal four-fifths of the emissions reductions gained by implementing the Kyoto Protocol in its first commitment period, jeopardizing the goal of Protocol to avoid "dangerous anthropogenic interference" with the climate system. We propose the novel concept of "compensated reduction", whereby countries that elect to reduce national level deforestation to below a previously determined historical level would receive post facto compensation, and commit to stabilize or further reduce deforestation in the future. Such a program could create large-scale incentives to reduce tropical deforestation, as well as for broader developing country participation in the Kyoto Protocol, and leverage support for the continuity of the Protocol beyond the 2008–2012 first commitment period.

1. Deforestation and Carbon Emissions

Tropical deforestation may be decisive in global efforts to stabilize greenhouse gas (GHG) concentrations at levels that avoid dangerous interference in the climate system. The combined effects of clear-cutting, forest regrowth on abandoned land, and logging may have released from 0.8 ± 0.2 to $2.2 \pm 0.8\,\mathrm{Pg\,C\,yr^{-1}}$ in the 1990s, 10–25% of global, human-induced emissions (Houghton, 2003; Achard et al., 2002; DeFries et al., 2002). These emissions may be increasing. Forest clear-cutting in the Brazilian Amazon increased ~30% from 2001 (18,165 $\mathrm{km^2}$) to 2002 (23,266 $\mathrm{km^2}$) and 2004 ($23{,}750 \pm 950\,\mathrm{km^2}$) (INPE, 2004). This upward trend may be expected to continue as all-weather highways are paved into the core of the region and cattle pasture and mechanized agriculture expand (Nepstad et al., 2001).

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TABLE I

Carbon emissions from fossil fuel, tropical deforestation, forest fires (Brazil and Indonesia), fires and emission reductions targeted by the Kyoto Protocol

Country	Source	Carbon emission ($PgC\ yr^{-1}$)	Reference
Brazil	Fossil fuel (year: 2002)	0.09	–[a]
	Deforestation	0.2 ± 0.2	Houghton et al. (2000)
	Forest fire (El Niño year: 1998)	0.2 ± 0.2	de Mendonça et al. (2004)
	Forest fire (Non El Niño year: 1995)	0.02 ± 0.02	de Mendonça et al. (2004)
Indonesia	Fossil fuel (year: 2002)	0.08	–[a]
	Deforestation	0.2 ± 0.2	Siegert et al. (2001); Holmes (2002); Pinard and Cropper (2000)
	Forest Fire (El Niño year: 1997–1998)	0.4 ± 0.5	Page et al. (2002)
	Peat Fire (El Niño year: 1997–1998)	0.2 ± 0.2	Houghton et al. (2000)
Global	Fossil fuel	6.3 ± 0.4	Prentice et al. (2001); Marland et al. (2003)
Tropical	Land use change	(0.6 ± 0.2) to (2.2 ± 0.8)	Houghton (2003); Achard et al. (2002)
Global	Fire (El Niño year: 1997–1998)	2.1 ± 0.8	van der Werf et al. (2004)
Kyoto target		0.5	–[b]

[a]Energy Information Administration, EIA; (http://www.eia.doe.gov/pub/international/iealf/tableh1.xls).
[b]Carbon emissions forecast for 2010 for industrialized, Eastern European and former Soviet Union countries (4.610 billion tons) (http://www.eia.doe.gov/oiaf/ieo/tbl_a10.html) minus the total annual reduction target established by the Kyoto Protocol for the same year (3737 billion tons) (Energy Information Administration-EIA, DOE/EIA-0573/99, DOE/EIA 0219/99).

Annual deforestation in Indonesia, some 17,000 km^2 from 1987–1997, increased to 21,000 km^2 in 2003, with carbon emissions similar to those in the Amazon (Houghton et al., 2003). Continued deforestation at current rates in Brazil and Indonesia alone would equal four-fifths of the annual reductions targets for Annex I countries in the Kyoto Protocol (Table I).

These estimates do not include the effects of tropical forest fires on carbon emissions, which are much more difficult to measure. When the 1997–1998 El Niño episode provoked severe droughts in the Amazon and Indonesia, large areas of tropical forest burned, releasing 0.2 to 0.4 Pg of carbon to the atmosphere (de Mendonça et al., 2004; Siegert et al., 2001; Page et al., 2002; Table I). If droughts become more severe in the future through more frequent and severe El Niño episodes (Trenberth and Hoar, 1997; Timmermann et al., 1999), or the dry season becomes lengthier due to deforestation-induced rainfall inhibition (Nobre et al., 1991; Silva-Dias et al., 2002) or there are rainfall reductions due to global warming (White et al., 1999; Cox et al., 2000), then substantial portions of the 200 Pg of carbon stored globally in tropical forest trees could be transferred to the atmosphere in the coming decades. Recent estimates put global carbon emissions from fires during 1997–1998 El Niño at 2.1 ± 0.8 Pg C (van der Werf et al., 2004) and South and Central America contributed ~30% of these global emissions from fires. Furthermore, it is very likely that the undisturbed forests of the Amazon currently act as a sink for atmospheric carbon dioxide (Malhi et al., 2004), removing an amount of carbon that can be larger than emissions due to deforestation (on the order of 0.4 ± 0.3 Pg C yr^{-1}). The decrease of tropical forest cover, then, may contribute to diminishing the strength of the terrestrial biotic sink.

2. The Kyoto Protocol and Developing Countries

On February 16, 2005, the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) entered into force. The 37 most industrialized countries of the 146 nations ratifying the accord have agreed to reduce their GHG emissions below 1990 levels during an initial commitment period of 2008 through 2012. Negotiators made little headway toward agreement on post-2012 rules in the Buenos Aires Conference of the Parties in December 2004. Although large developing countries such as China, India and Brazil emit substantial and increasing amounts of global GHGs, developing countries currently have no obligation to reduce emissions. The issue of developing country commitments was already contentious at the last three Conferences of the Parties to the Climate Convention (COPs 8, 9 and 10). The continuity of the Kyoto Protocol beyond 2012 may depend on Annex I and developing countries coming to agreement on this issue.

Annex I countries are allowed to achieve some emissions reductions by investing in energy and tree planting projects (reforestation and afforestation) that cut GHG emissions in developing countries through the "Clean Development Mechanism." But countries undergoing or at risk of large-scale deforestation, such as Brazil, Indonesia, Bolivia, Peru, Columbia, and central African nations, have no incentive to reduce or avoid emissions from deforestation. There is a clear need for substantial incentives for developing countries to meaningfully participate in emissions reductions in the near term, while respecting the UNFCCC's guiding principle of "common but differentiated responsibilities."

3. Compensated Reductions

We suggest the concept of *compensated reduction* as a means of both reducing the substantial emissions of carbon from deforestation and facilitating significant developing country participation in the Kyoto Protocol framework. Developing countries that elect to reduce their national emissions from deforestation during the 5 years of the first commitment period (taking average annual deforestation over some agreed period in the past, measured with robust satellite imagery techniques, as a baseline), would be authorized to issue carbon certificates, similar to the Certified Emissions Reductions (CERs) of the CDM, which could be sold to governments or private investors. Once having received compensation, countries would agree not to increase, or to further reduce, deforestation in future commitment periods (provided that Annex I countries fulfill their obligations). A country that committed to reducing deforestation and was compensated, but instead increased deforestation, would take the increment increased as a mandatory cap in the next commitment period.

4. Baselines

Baselines should be designed in accordance with different regional dynamics of deforestation in the tropics. In the Amazon with ~80% of original forest cover, and high current deforestation rates, a baseline of the average annual deforestation in the 1980s (since 1990 is the year of reference for the Kyoto targets) would be adequate. Any historical average since the 1970s over a sufficient time period to compensate for anomalous yearly highs and lows would be adequate, provided that the baseline refers to a period prior to adopting compensated reductions, so that no incentive to increase deforestation in order to get credit for reductions is created. The specific period (1980s, 1990s, 1995–2005) will determine how much deforestation must be reduced in order to obtain credit, and so will necessarily be a political negotiation. Countries with substantial tropical forests, but relatively little deforestation to date (e.g., Peru, Bolivia) might be allowed baselines higher than their recent deforestation rates (along the lines of Australia's "growth cap") as an inducement to participate and avoid future increases. For heavily logged regions such as Kalimantan, Sumatra and Sulawesi, for example, where 70–80% of lowland dipterocarp forest cover has been removed in logged areas and conversion to oil palm plantations is underway a baseline could be expressed in terms of existing carbon stocks at some point in the past, with crediting for any increase in total carbon stocks between 2008–2012, making reforestation or re-growth an alternative to oil palm plantations. Specific baselines or mechanisms could be designed to take advantage of particular opportunities. Preventing fires in peat forests is an example. Burning peat forests released between 0.81 to 2.57 Pg of carbon and vast amounts of sulfur oxides into the atmosphere in 1997 (Page et al., 2002; Houghton et al., 2001). Peat swamps are low value lands unsuitable for agriculture that sequester enormous quantities of carbon, and peat fires are easily located and monitored via satellite. The principle in all cases is to set baselines in terms of historic deforestation or destruction of carbon stocks and create incentives for progressive reductions, or avoiding future increases. As a motivation for countries to continue reducing their deforestation rates, the historic baseline might be revised downwards in 20 years, a plausible time period for a nation such as Brazil to re-order its land use practices.

5. Leakage, Additionality and Permanence

Calculating reductions against a national baseline and monitoring system for deforestation addresses the problem of leakage that have vexed the CDM. Deforestation does not "leak" into the energy or transport sectors, and if reductions in one region are equaled or exceeded by increases in another, this will be apparent in comparing national rates over time. Deforestation can be measured at the beginning and end of a commitment period just as can national emissions for Annex I countries. International "market leakage" for timber exports, where a participating country ceases to export timber to get carbon investments, and a non-participating country increases its exports correspondingly, is an issue. But international market leakage is potentially a much bigger issue under current Kyoto Protocol rules – forest sinks, and activities that increase carbon stocks in Annex I countries are credited, but developing country forest destruction is not debited (Niesten et al., 2002). An Annex I country could in principle cease timber harvests altogether at home and replace them with tropical imports and still receive credit under Article 3.3 of the Kyoto Protocol. Enlisting any tropical forest countries to compensated reduction programs would, by creating a framework for engaging tropical countries in emissions controls, begin to address this problem. Leakage of deforestation from one country to another (e.g., Brazilians who cease clearing in Brazil and move to Bolivia) could in principle occur if only one or a few countries elect to participate in compensated reductions. The same risk, however, obtains for all sectors as long as only some countries have emissions caps – multinational corporations might for example reduce emissions in Kyoto countries and invest in high-emissions operations in non-Kyoto countries. While remote sensing monitoring of deforestation rates could be used to mitigate international leakage, ultimately only drawing more major emitters into an international reductions regime will solve the problem.

The most recent and thorough deforestation studies (PRODES; DeFries et al., 2002; Curran et al., 2004) offer no suggestion that deforestation is decreasing, either of its own accord or in consequence of policy interventions; to the contrary, increasing global integration of markets and demand for agricultural commodities appears to be driving substantial increases in deforestation rates. Hence, there is no need to show that sustained reductions in deforestation rates would not have occurred without compensated reductions, even though deforestation rates will eventually decline as forests disappear. Deforestation in all major tropical forest regions can certainly be expected to continue for the 20 years following 2008, after which time compensated reductions baselines should be adjusted, and global time horizons for forest carbon crediting based on total forest carbon stocks should be calculated.

The security of emissions offsets, or "permanence," would be assured by the provision that participating countries that increased deforestation above their baseline take the increment as a mandatory target in the following commitment period.[1] The security of emissions offsets could be enhanced by a system of "banking" forest carbon credits: a portion of the reductions achieved in a 5-year commitment period could be made available for emissions offsets in the following period, while others could be banked for use in future commitment periods (unlike CERs, which are only valid for the first commitment period under the Marrakech Accords[2]). Banked carbon credits could be used to insure offsets. Permanence of reductions is also an issue for all sectors – a country that meets commitments in the first period might opt out of the second and increase emissions. Carbon insurance mechanisms for all emissions offsets should be developed, and their costs incorporated into emissions trading.

6. Reducing Deforestation

Tropical country governments can reduce deforestation through adequate funding of programs designed to enforce environmental legislation, support for economic alternatives to extensive forest clearing (including carbon crediting), and building institutional capacity in remote forest regions, as recently suggested in part of the Brazilian Amazon (FEMA, 2001; Nepstad et al., 2002; Fearnside, 2003). Moreover, substantial forest can be saved in protected areas if adequate funding is available (Bruner et al., 2001; Pimm et al., 2001; Nepstad et al., in press). More developing countries will be likely to use these mechanisms if they have access to the financial resources necessary to pay for them. Countries that want advance financing for deforestation reduction could make agreements with bilateral or multilateral financial institutions, or attract private sector investments for this purpose. Public financing should not, however, be diverted from existing development assistance, as agreed in the Marrakech Accords. Countries might also issue discounted carbon bonds, redeemable in 2012, but conditioned on verification and certification of reductions. Compensated reductions differs from previous forest protection programs and agreements in that it promises to give governments, forest communities, and private owners access to a market for forest ecosystem services, creating the economic value for standing forest long understood as essential for large scale forest conservation (Kremen et al., 2000; Bonnie et al., 2000).

7. Developing Country Participation

The issue of developing country participation is central to Annex I countries' concerns over the future of the Protocol. Non-Annex I countries account for a substantial and increasing proportion of global GHG emissions – clearly no reductions regime can be successful without meaningful developing country reductions. At the same time the principle of "mutual but differentiated responsibilities" by which Annex I countries agreed to begin reductions first is central to the political equation that has allowed negotiations to proceed. Progress towards an effective emissions reductions regime will require unprecedented international consensus. Compensated reductions is a voluntary mechanism that offers tropical countries access to substantial market incentives for reducing emissions, while respecting their sovereignty in selecting means and investing returns. It is in essence a strategy for an equitable global distribution of the costs and allocation of benefits for reducing deforestation. It may thus allow negotiators to move beyond ineffective good intentions on one hand and unacceptable mandatory targets for developing countries on the other.

8. Conclusions

The prospect of meaningful developing country participation in international efforts to address global warming and the availability of high quality carbon credits (resulting from reductions already achieved and demonstrated) in the future would constitute a significant incentive for Annex I countries to negotiate binding post-2012 rules, itself an extremely important signal for governments and economic actors. The principle of *compensated reduction* suggests new avenues for addressing both issues.

The approach would consequently also further the goals of the Convention on Biological Diversity.[3] While there are many non-forest options for reducing GHG emissions, conserving tropical forests is essential to maintaining species diversity. Compensated reduction could help to resolve potential conflicts between the Climate and Biodiversity Conventions, as well as suggesting one potential mechanism for implementing the Biodiversity Convention.

Adopting an instrument of this kind in the context of the Protocol would promote adoption of policies for controlling deforestation in developing countries, and would allow tropical nations to take a meaningful role in preventing dangerous interference in the climate system. The future of the Kyoto Protocol is indeterminate, but the contribution of tropical deforestation to global climate change is not. There is still time for scientists and policy makers to seize what is surely among the greatest opportunities for the global environment today – international carbon emissions trading for the protection of tropical forests – before the gains of the Kyoto Protocol go up in smoke.

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Notes

[1]We assume that that a second, post 2012 (and further) commitment period(s) will eventually be negotiated. The concept of compensated reductions, however, applies to any international emissions reductions regime under which at least some countries have mandatory emissions limits.

[2]Report of the conference of the parties; FCCC/CP/2001/13/Add.2; http://unfccc.int/resource/docs/cop7/13a02.pdf.

[3]The CDB, in Decision VI/15 calls for the Climate Convention to address deforestation: "... the United Nations Framework Convention on Climate Change is encouraged to give priority to incentives to avoid deforestation, as a substantial amount of greenhouse gas emissions is due to the destruction of forests, the greatest terrestrial repository of biological diversity." (Annex II, para 14).

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