The role of forests in global climate change: whence we come and where we go

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It is widely acknowledged that rising concentrations of atmospheric carbon dioxide (CO_2) are driving changes in climate patterns. Industrialization and economic development have resulted in a sharp rise in emissions of CO_2 and other greenhouse gases (GHGs).[1] But human-induced emissions are not limited to industrial or energy-related processes. Photosynthesis binds CO_2 and stores it as carbon in plants. Forests act thus as carbon storehouses and play an important role in influencing our climate. When forests are cleared, they release carbon and act as a source of GHG emissions. When they are restored, they sequester carbon and become a sink of carbon. The use of forests can therefore add to the problem of climate change, but it can also be a tool in formulating ways of mitigating it.

The international community negotiated the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol with the objective of confronting the trend of rising GHG concentrations in the atmosphere and ultimately reversing it. The two treaties provide a negotiation platform, an institutional framework and the technical infrastructure necessary to define international solutions to climate change. However, neither the UNFCCC nor the Kyoto Protocol went far enough to bring about a substantial reversal in emission trends. The UNFCCC formulates the ultimate objective of stabilizing GHGs in the atmosphere,[2] but does not mandate any binding action as to how to achieve that goal. The Kyoto Protocol imposes only moderate targets on industrialized countries for the limitation of emissions for the period from 2008 to 2012, the so-called first commitment period.

In December 2005 negotiations on a post-Kyoto agreement started in the context of the UNFCCC and Kyoto Protocol annual meetings. To create an efficient instrument moving humanity further towards the stabilization of atmospheric GHG concentrations, a number of issues need to be addressed. On one hand, a comprehensive and at the same time differentiated system of limiting industrial carbon emissions needs to be established and supported by all major emitting

[1] J. T. Houghton, Y. Ding, D. J. Griggs, M. Noguer, P. J. van der Linden and D. Xiaosu, eds, *Climate change 2001: the scientific basis, contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)* (Cambridge and New York: Cambridge University Press, 2001).

[2] United Nations Framework Convention on Climate Change (UNFCCC), 1992, art. 2, FCCC/INFORMAL/84, http://unfccc.int/resource/docs/convkp/conveng.pdf, accessed 20 July 2006.

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countries. On the other hand, the significance of carbon storage and release in biological systems makes it mandatory to include emissions from biomass in any post-Kyoto regime.

During negotiations on the Kyoto Protocol and further negotiations on a framework for forestry projects, parties did not reach consensus on how to integrate forestry-related carbon fluxes into the protocol. Negotiators underestimated the importance of the role of forestry in achieving a political agreement in Kyoto. Scientific knowledge was limited and negotiators were poorly informed.[3] How to account for forestry removals and emissions became chronically controversial. As a result, the reference to forestry activities in the Kyoto Protocol is limited to a number of accounting rules and the possibility of implementing forestry projects under the protocol's flexible mechanisms. These mechanisms allow industrialized countries with emissions targets to implement projects that reduce emissions in developing and transition countries.[4] Once these reductions are quantified, measured and verified by environmental auditors, they can be credited towards the emission targets of the investor country. The Clean Development Mechanism (CDM) is the instrument that involves developing countries by allowing the transfer of 'certified emission reductions' from activities in developing countries to industrialized countries. Joint Implementation (JI) is the mechanism that defines a similar crediting tool for projects implemented (mostly) in east European transition economies.

CDM and JI allow credits to be acquired not only for reduced emissions, but also for projects that help in the sequestration of carbon dioxide. The climate community—never shy in creating new acronyms—refers to the changes in terrestrial biomass as 'land use, land-use change, and forestry' or 'LULUCF'. At present, LULUCF-related projects in developing countries are limited to specific 'afforestation and reforestation' (A&R) projects. In principle though, LULUCF projects could include the implementation of other sustainable agricultural practices such as conservation farming, or forest or wetland management. Most importantly, neither the UNFCCC nor the Kyoto Protocol includes a mechanism to reduce emissions from deforestation, which alone is responsible for about one quarter of global GHG emissions.

Because the Kyoto Protocol does not address forest conservation or the prevention of deforestation, tropical countries are restricted in their opportunities to benefit from the CDM. A fair and complete post-Kyoto regime will have to expand the existing system by creating a framework encompassing all LULUCF-related changes in carbon stocks. Developing countries act as stewards of many of the earth's biological resources. They will have to be integrated into an incentive framework which rewards forestry conservation, sustainable forest management and afforestation.

[3] E. Trines, 'Possible role of land use, land-use change and forestry in future climate regimes: an inventory of some options', study commissioned by the Ministry of Agriculture, Nature and Food Quality of The Netherlands, 2004, http://www.rainforestcoalition.org/documents/EUFinalReport9November2004.pdf, accessed 20 July 2006.

[4] These countries are listed in Annex I of the UNFCCC. The emission targets are formulated in Annex B of the Kyoto Protocol. Most commonly the parties with emission targets are referred to as 'Annex I' countries.

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The objective of this article is to contribute to the discussion on how future international instruments can create such an incentive structure to protect standing forests and motivate reforestation. We will first briefly summarize the linkage between biological storage of carbon in forests and climate change. We will then review the history of LULUCF negotiations in the context of the UNFCCC. In the next section we will give an overview of the status of carbon crediting for forestry projects. From there we will look to the future and discuss how a broader incentive system for protection of forests can be included into a future climate regime. The article ends with a summary of main points and an outlook for the forthcoming climate negotiations.

The impact of forests on climate change

Carbon dioxide is constantly exchanged between the atmosphere, the oceans and terrestrial ecosystems. Vegetation and soils can accumulate carbon, thus reducing the rate of CO_2 build-up in the atmosphere that is responsible for climate change. This opportunity and its potential implications for climate protection started to be recognized in the late 1980s in the discussions leading to the global environmental summit that took place in 1992 in Rio de Janeiro.[5] Ever since, this topic has figured on the agenda of international climate negotiators.

Forest ecosystems contain the majority (approximately 60 per cent) of the carbon stored in terrestrial ecosystems.[6] Thus the world's forests sequester and conserve more carbon than all other terrestrial ecosystems and account for 90 per cent of the annual carbon flux between the atmosphere and the earth's land surface.[7] The carbon is stored both in the form of biomass (trunks, branches, foliage, roots, etc.) and in the form of organic carbon in the soil. Globally, the soil carbon exceeds the carbon stocks in vegetation by a factor of about five, but this ratio varies among different ecosystems. For tropical forests the ratio is almost balanced, which aggravates the effect of the current and continuing loss of tropical forests.

Over time forests accumulate carbon through the growth of trees and the increase of soil organic carbon unless major disturbances occur. Immature forests sequester carbon at high rates, while in mature forests carbon sequestration eventually equals decomposition; that is, the carbon balance of the ecosystem reaches a steady state. The forest is a 'carbon reservoir', but no longer acts as a carbon sink.[8] This means that whether forests act as reservoirs, sinks for carbon from the atmosphere, or sources of GHGs depends on several factors such as the age of the forest, the management regime, other biotic and abiotic disturbances (e.g. insect pests, forest fires, etc.) and human-induced deforestation.

[5] Information Unit on Climate Change (IUCC), Noordwijk ministerial declaration on climate change, (Châtelaine, Switzerland: UNEP, 1993), www.cs.ntu.edu.au/homepages/jmitroy/sid101/uncc/fs218.html, accessed 20 July 2006.

[6] IPCC, *Land use, land-use change, and forestry: a special report of the IPCC* (Cambridge and New York: Cambridge University Press, 2000).

[7] J. K. Winjum, R. K. Dixon and P. E. Schroeder, 'Forest management and carbon storage: an analysis of 12 key forest nations', *Water, Air, and Soil Pollution*, 70: 1–4, 1993, pp. 239–57.

[8] The UNFCCC defines a sink as 'any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere' (art. 1.8).

To give an example, at present, temperate forests are considered to act as a sink for carbon from the atmosphere because of reduced harvest levels, increased regeneration efforts and administrative set-asides, as well as changes in the environment such as CO_2 fertilization effects.[9] In the tropics, however, forests are still reported to be a net carbon emitter as a result of mainly human-induced land-use change.[10] Globally, the clearing of forests has reduced forest area by almost 20 per cent in the last 140 years.[11] By far the greatest sources of forestry-related emissions are clear-cutting and logging in forests. These activities are responsible for about 20 per cent of global, human-induced emissions.[12]

Besides the key role that forests play in the carbon cycle, they provide many goods and services that society values highly. These include timber and non-wood products (e.g. fuel and fibre) as well as food and medicines, biodiversity, soil and water conservation (e.g. protection against erosion) and recreational resources. Climate change will have an effect on most of these goods and services, in turn causing significant effects on socio-economic systems.[13] The magnitude and direction of those impacts are not easy to foresee.

Various scenarios exist today predicting, among other things, a change in the geographical distribution of forests, an increased risk of forest fires resulting from droughts, the migration of species, and geographical shifts of pathogens causing plant diseases and insect infestations. Climate change is likely to increase the frequency of forest fires and the areas of forest burned as a result of an increase in the number of days with severe burning conditions, a generally prolonged fire season and an increase in lightning activity. Likewise, changes in drought conditions play an important role in forest insect and pest outbreaks. Pathogens causing canker, for example, become more dangerous for forest ecosystems with a decreased bark moisture content caused by drought.[14]

On a worldwide scale, the pressures of change in climate, land-use practices and atmospheric chemistry are increasingly affecting the supply of goods and services from forests. Land-use change and deforestation loom large among those

[9] E. D. Schulze, J. Lloyd, F. M. Kelliher, C. Wirth, C. Rebmann, B. Luhker, M. Mund, A. Knohl, I. M. Milyukova, W. Schulze, W. Ziegler, A. B. Varlagin, A. F. Sogachev, R. Valentini, S. Dore, S. Grigoriev, O. Kolle, M. I. Panfyorov, N. Tchebakova and N. N. Vygodskaya, 'Productivity of forests in the Eurosiberian boreal region and their potential to act as a carbon sink: a synthesis', *Global Change Biology* 5: 6, 1999, pp. 703–22. Plant growth and hence carbon sequestration can be fertilized to a certain extent by higher ambient CO_2 concentrated in the atmosphere.

[10] R. A. Houghton, D. L. Skole, C. A. Nobre, J. L. Hackler, K. T. Lawrence and W. H. Chomentowski, 'Annual fluxes of carbon from deforestation and regrowth in the Brazilian Amazon', *Nature*, 403: 6767, 2000, pp. 301–304. It is important to note that deforestation rates have been slowing in the last decade. However, Soares-Filho et al. describe a potential increase of deforestation in Amazonia over the coming decades: B. Soares-Filho et al., 'Modeling conservation in the Amazon basin', *Nature* 440, 2006, pp. 520–23.

[11] Food and Agriculture Organization of the United Nations, *Global forest resources assessment 2000: main report* (Rome: FAO, 2000).

[12] R. A. Houghton, 'Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management', *Tellus* 55, 2003, pp. 378–90; R. S. DeFries, R. A. Houghton, M. C. Hansen, C. B. Field, D. Skole and J. Townshend, 'Carbon emissions from tropical deforestation and regrowth based on satellite observations for the 1980s and 1990s', *Proceedings of the Nairobi Academy of Sciences* 99, 2002, pp. 14256–61.

[13] IPCC, *Climate change 2001: impacts, adaptation, and vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge and New York: Cambridge University Press, 2001).

[14] IPCC, *Climate change 2001*, p. 290.

pressures on forests, as noted above. Up to now, neither the UNFCCC nor the Kyoto Protocol has offered adequate proposals on how to address, in particular, tropical deforestation. Planting forests (afforestation and reforestation) clearly provides an opportunity to sequester carbon in vegetation and soils. However, it takes decades to restore carbon stocks that have been lost as a result of land-use changes. Reducing the rate of deforestation is the only effective way to reduce carbon losses from forest ecosystems.

An agreement on the lowest common denominator: background and history

Despite the fact that neither the UNFCCC nor the Kyoto Protocol sets out a system that creates strong incentives for carbon storage and mitigation of emissions from tropical forests, both instruments acknowledge the vital role that forests play for the global climate. Several Articles in both agreements make explicit reference to sinks. The UNFCCC recognizes that all sinks and reservoirs of GHG have an important impact on terrestrial and marine ecosystems.[15] Among the desired means of attaining the convention's objective of 'stabilization of greenhouse-gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' is use of the capacity of sinks to reduce the concentration of GHG in the atmosphere.[16]

How to deal with forest conservation under the Kyoto Protocol has always been a source of disagreement among negotiators. Fundamentally, the parties were divided about the role of LULUCF in meeting their commitments. Should parties be allowed to offset emissions occurring in other sectors with carbon removed through LULUCF, or should the effort to combat climate change be concentrated strictly on the reduction of emissions from, primarily, the use of fossil fuels?

At the root of concern about all forestry projects is the issue of the permanence of carbon storage. All LULUCF-related activities differ in one significant way from emission reducing activities in other sectors. Whereas a tonne of emission reductions, once achieved, remains a benefit to the atmosphere, a tonne of sequestered carbon is of benefit to the atmosphere only as long as it remains sequestered. If a tree is felled, stored carbon is released and the temporary climate benefit reversed: in other words, the benefit is 'non-permanent'. Those in favour of sinks point to the massive quantities of carbon exchanged between the atmosphere, vegetation and soils every year—an amount that exceeds emissions from fossil fuels 30-fold[17]—and emphasize

[15] UNFCCC, preamble, para. 4.

[16] UNFCCC, art. 2. In addition, the following articles are of especial interest: art. 4.1(a) obliges parties to establish inventories of anthropogenic GHG emissions by sources and removals by sinks; art. 4.1(b) prompts the formulation of regional programmes to mitigate climate change by addressing emissions by sources and removals by sinks; art. 4.2(c) stipulates cooperation in the development and transfer of technology that reduces emissions from, among other things, forestry; and art. 4.1(d) promotes the sustainable management and the conservation and enhancement of carbon sinks and reservoirs. In art. 4.2(d), finally, the parties to the UNFCCC committed themselves to adopt national policies to mitigate climate change by protecting and enhancing their GHG sinks and reservoirs.

[17] R. T. Watson and I. R. Noble, *The global imperative and policy for carbon sequestration: the carbon balance of forest biomes* (London: Garland Science/BIOS Scientific Publishers, 2004).

that omitting sinks would therefore leave out a major exchange of carbon, which could swamp any gains made through fossil-fuel reductions under the Kyoto Protocol. Opponents point to the scientific insecurities, the missing accounting rules and the permanence problem.

The crediting of LULUCF emission reductions and carbon storage also divide the NGO community. Debates on forestry in the context of the climate change negotiations were seldom led by calm rationality. Moral judgements often prevailed over scientific conclusions, and NGO presentations starting with dramatic statements on the gravity of climate change continued with a condemnation of sinks and the suggestion that anybody who favoured sinks was not genuinely concerned about climate change.[18] European climate NGOs have traditionally opposed the inclusion of sinks in any climate regime. According to the views of these 'anti-sinks' NGOs, climate change is a problem that should be addressed primarily through reducing the world's dependence on fossil fuels. The inclusion of forestry in the climate debate would distract attention from that objective. Crediting countries for sinks would allow them to implement cost-efficient compensation measures that would let them off the hook in respect of more complicated energy projects. Also, the more technical problems of carbon accounting and monitoring and the issue of 'leakage' of emissions (see the section below on 'Carbon credits for forests') would introduce intolerable insecurities into the system.[19] Opposing sinks became an article of faith for many EU NGOs, identified with the moral high ground to the point that rational discussions became almost impossible. Many EU countries integrated these views into their negotiation positions. Claiming to be motivated by environmental concerns, they adopted the views of the critical NGOs, whose campaigns carried a great deal of credibility with the public. However, broader geopolitical issues related to fuel and energy prices and the competitiveness of EU industries are likely to have entrenched the European negotiating positions.[20]

Despite the disputes in 1997, the Kyoto Protocol negotiators managed to refine the relatively non-committal UNFCCC, and industrialized countries agreed to reduce aggregated GHG emissions to at least 5 per cent below the level of 1990. The parties decided that 'direct human-induced' net changes in GHG and removals by sinks since 1990 could be used to meet part of the parties' emission commitments.[21] Countries either must (Article 3.3 Kyoto Protocol) or may (article 3.4 Kyoto Protocol) account for the change in carbon stock in forests. This involves first defining the applicable activities, and then identifying the land units on which these activities occur. Next, the change in carbon stocks on these land units during the relevant period is determined and added to or subtracted from a country's commitment.[22]

[18] P. M. Fearnside, 'Saving tropical forests as a global warming countermeasure: an issue that divides the environmental movement', *Ecological Economics* 39, 2001, pp. 167–84.

[19] K. Richards and K. Andersson, 'The leaky sink: persistent obstacles to a forest carbon sequestration program based on individual projects', *Climate Policy* 1: 1, 2001, pp. 41–54.

[20] Fearnside, 'Saving tropical forests'.

[21] Those 'net changes' must be 'measured as verifiable changes in carbon stocks in each commitment period'.

[22] Article 3.3 stipulates that emissions reductions resulting from afforestation activities will be added and emissions from deforestation activities will be subtracted from the amount of emissions that a Party may emit

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Furthermore, articles 6 and 12, which define the project-based mechanisms JI and CDM, refer directly (JI) or at least indirectly (CDM) to carbon sinks. With respect to JI the parties decided that the overall liability of a country to meet its targeted amount of emissions would act as sufficient insurance against the potential loss of carbon due to 'non-permanence'.[23]

For the CDM the issue became more complicated. It took almost six years of assessment and negotiation before a final agreement on the definitions and modalities for the use of LULUCF projects in the CDM was reached at the ninth session of the Conference of the Parties (COP-9) in 2003 in Milan.[24] LULUCF in the CDM was limited to afforestation and reforestation projects, and sinks in developing countries could be used to meet only 1 per cent of a country's Kyoto obligations.[25] The protection of existing carbon pools (that is, avoiding deforestation) was finally declared to be non-eligible as a CDM project category. The international community failed to reach agreement on this most important LULUCF issue.

Despite the sometimes fairly cumbersome regulatory framework, the CDM still creates incentives for developing countries to participate in the international climate regime and lays the foundation for global emissions trading. However, the complicated rules make CDM project development expensive, and the EU further reduced demand when it decided not to recognize forestry credits as counting towards compliance with emission targets for private entities in the EU. These barriers further limit developing countries' participation in the economic and development benefits of emissions trading.

Carbon credits for forests

The CDM and JI allow industrialized parties to acquire carbon credits by sponsoring projects in developing (CDM) or transition (JI) countries. Under JI all LULUCF-related activities are eligible, while in the CDM only afforestation and reforestation projects may be counted.

While countries in compliance with the Kyoto Protocol's reporting regulations can essentially self-certify sequestration projects under JI, CDM projects must obtain prior approval from an independent body, the CDM Executive Board. Most rules applying to forestry CDM projects are similar to those that apply to the CDM

over the commitment period (2008–2012). Art. 3.4 introduced 'additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories'. For a long time it was unclear and debated which particular activities should be included under this Article. At the resumed COP-6 (in Bonn in 2001) parties agreed to include 'forest management', 'cropland management', 'grazing land management' and 'revegetation' as eligible LULUCF activities during the first commitment period, provided those activities occurred after 1990 and are human-induced. In addition, a new and non-bankable LULUCF-related unit was established, the removal unit (RMU), which accounts for all forest-management-related activities in Annex I countries in the first commitment period.

[23] These reductions in emissions and removals have to be both 'additional' to what would otherwise have occurred without the project and 'supplemental' to domestic action aimed at meeting the parties' respective reduction commitments.

[24] All rules governing A&R projects apply to only the first commitment period of the Kyoto Protocol and will have to be revisited before the second commitment period.

[25] See decision 17/CP.7 on 'Modalities and procedures for a clean development mechanism', FCCC/CP/2001/13/Add.2, paras 7(a) and (b).

in general. For each project a Project Design Document (PDD) must be submitted that employs an approved methodology, including baseline and monitoring methods. The PDD describes the project, illustrates how the methodology will be applied, and estimates the sequestration of CO_2 and the socio-environmental impacts of the project.[26]

However, particular concerns (i.e. non-permanence) relating to CDM forestry projects have led to a number of tailor-made rules for those projects. These rules do not apply to JI. If a JI project releases previously stored carbon back into the atmosphere, the cap still applies and the country is held liable for the loss as it appears in the country's accounting system.[27] The CDM, on the other hand, is implemented in countries without binding emission targets. This means that, all other things being equal, any loss of carbon *after* the transfer of carbon credits creates 'paper tonnes', that is, carbon credits that no longer refer to actually sequestered carbon – the permanence problem.

In summary, the following aspects have to be addressed in CDM project development.

The *permanence problem* is being addressed by the creation of temporary credits. Certified Emissions Reductions (CERs) arising from CDM afforestation and reforestation projects will be issued with a defined expiry date, but can be reissued or renewed every five years after an independent verification has confirmed that sufficient carbon is still sequestered by the project to account for all credits issued.[28] Using temporary credits for compliance can therefore be compared with 'renting' compliance for a certain period in time.

Additionality is an important, and often confusing, concept in the Kyoto Protocol. For projects carried out in countries that do not have targets under the Kyoto Protocol (i.e. CDM projects in developing countries), it must be demonstrated that the carbon sequestration or emission reduction would not have occurred without the incentives provided by the existence of the Kyoto Protocol. Without this test there would be no benefit to the atmosphere.

Leakage refers to a change in activities or behaviour outside the project area that partially or totally offsets the climate gains of the project. These changes may lead to reduced sequestration or increased emissions outside the project boundary, negating some of the climate benefits of the project. Critics of the CDM were concerned, for example, that it would result in widespread establishment of plantations that would drive people off their land only to deforest areas elsewhere,

[26] For more detail, see T. Pearson, S. Walker and S. Brown, *Sourcebook for land use, land-use change and forestry projects* (BioCF and Winrock International, 2005), http://carbonfinance.org/docs/LULUCF_Sourcebook_compressed.pdf, accessed 15 July 2006).

[27] S. Scholz and I. Noble, 'Generation of sequestration credits under the CDM', in D. Freestone and C. Streck, eds, *Legal aspects of implementing the Kyoto Protocol mechanisms: making Kyoto work* (Oxford: Oxford University Press, 2005), pp. 265–80.

[28] Decision5/CMP.1 2005, Annex, section A, gives the following definitions: para. 1(g), '"Temporary CER" or "tCER" is a CER issued for an afforestation or reforestation project activity under the CDM which . . . expires at the end of the commitment period following the one during which it was issued'; para. 1(h), '"Long-term CER" or "lCER" is a CER issued for an afforestation or reforestation project activity under the CDM which . . . expires at the end of the crediting period of the afforestation or reforestation project activity under the CDM for which it was issued'.

or that local people, having been denied access to one area of forest, would be forced to clear forests elsewhere, negating the carbon reservoir protection. Project developers must address leakage in the project design,[29] or otherwise account for it by subtracting it from the project performance.

Scientific complexity, insufficient data and the *challenge of monitoring* LULUCF projects have also led to criticism of such projects. The accounting rules for carbon removals therefore mandate a conservative approach in measuring and monitoring sequestration activities. Full carbon accounting, that is, the assessment of carbon fluxes within all compartments of a forest ecosystem, can be achieved by choosing between various scientific models, which have been developed by the IPCC and the FAO in collaboration with scientific forestry research institutions.[30] Applying state-of-the-art remote sensing techniques in combination with terrestrial surveys guarantees the accurate monitoring of activities and impacts during the project's lifetime. In many countries geographic information systems exist that provide useful information on the history and development of natural resources, and facilitate monitoring.

Any CDM project should create additional local *sustainable development benefits* beyond the global atmospheric benefits. When the Kyoto Protocol was first negotiated, some NGOs expressed concern that the CDM might unwittingly promote the development of LULUCF projects that were detrimental to local communities and the environment. It was feared that the CDM would foster insensitively managed monoculture plantations, which sequestered carbon cheaply, but at the expense of sustainable livelihoods and biodiversity. However, the CDM additionality test means that typical large-scale timber plantations, which are economically viable without carbon finance, are not eligible for crediting. Furthermore, all CDM PDDs must describe the socio-economic and environmental impacts of the project. Individuals, groups or communities affected by the proposed CDM project activity must be consulted. Host governments are expected to deny approval to projects that do not further the country's sustainable development goals.

To address project impacts further, qualitative criteria such as the Climate, Community and Biodiversity (CCB) Standards can be used to design and evaluate land-use-based carbon projects.[31] CCB-certified projects are independently verified to ensure that they conserve biodiversity and support local communities in addition to benefiting the global climate. Besides that, most major founders/donors have their own sustainability screening criteria, which include environmental and social assessments to ensure the integrity of the projects they support.

Experience has demonstrated that sustainable development has generally

[29] Project developers can use a landscape management approach to identify pressures that lead to land-use change (e.g. deforestation actions) and, where possible, remove or reduce these pressures, thereby minimizing potential leakage. In addition, by integrating sustainable livelihood programmes into the project design, the risk of leakage occurring from shifted human activities outside the project boundaries can be diminished.

[30] See J. Penman, M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, B. Leandro, K. Miwa, T. Ngara, K. Tanabe and F. Wagner, eds, *Good practice guidance for land use, land-use change and forestry* (IPCC National Greenhouse Gas Inventories Programme, Technical Support Unit, 2003). This document sets out supplementary methods and good practice guidance for estimating, measuring, monitoring and reporting on carbon stock changes and GHG emissions from LULUCF activities under all relevant Articles of the Kyoto Protocol.

[31] http://www.climate-standards.org/, accessed 28 Aug. 2006.

benefited rather than suffered from the implementation of LULUCF projects. An examination of projects currently in the CDM pipeline makes it clear that the LULUCF projects being put forward do, by and large, deliver impressive environmental and socio-economic benefits on both the global and the local scale.

China: Pearl River watershed management

The Pearl River watershed management project has been developed by the World Bank's BioCarbon Fund. The project will afforest 4,000 hectares of land in the Guangxi Zhuang Autonomous Region, which includes half of the Pearl River basin. The sites selected for planting are shrub land, grassland, and open partly wooded land with tree cover below 20 per cent. The vast majority of the species planted will be native ones. The restoration of the forests along the middle and upper reaches of the Pearl River will help develop and demonstrate models for watershed management and the prevention of erosion. The sale of carbon credits from the project will generate income for local communities. The project is expected to sequester around 0.34 Mt CO_2e by 2012 and around 0.46 Mt CO_2e by 2017.[32]

Moldova: soil conservation

The Moldova soil conservation project is reforesting approximately 20,000 hectares of degraded and eroded state-owned and communal agricultural lands spread over Moldova, one of the poorest countries of Europe. The reforestation proposes to restore degraded lands through improvement in the vegetative cover and sustainably to enhance supplies of forest products to local communities. The project uses around 40 different tree species that have been selected as suitable for the various site conditions. These species can be grouped in different types according to growth characteristics and management requirements. No reforestation site is planted with only one species, and shrubs are also planted to improve floral diversity. The project is expected to sequester about 1.07 Mt CO_2e by 2012 and about 2.22 Mt CO_2e by 2017.[33]

Finally, it would be negligent to conclude this section without mentioning the many forestry-based carbon transactions that create credits outside a regulated context. In these transactions, the agreement between the participants and the underlying contracts define the respective carbon rights and regulate the measure-

[32] For more detail, see the BioCarbon Fund website and the original description of the project: http://carbonfinance.org/Router.cfm?Page=BioCF&FID=9708&ItemID=9708&ft=Projects&ProjID=9629, accessed 28 Aug. 2006.

[33] For more detail, see the Prototype Carbon Fund website and the original description of the project: http://carbonfinance.org/Router.cfm?Page=PCF&FID=9707&ItemID=9707&ft=Projects&ProjID=9612, accessed 28 Aug. 2006.

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ment, verification and transfer of such rights. No other sector of the carbon market includes as many voluntary carbon transactions as the LULUCF sector.

Before the adoption of the final CDM and JI rules, the majority of all carbon transactions were forest-related transfers of carbon credits outside any obligations and regulatory regimes. Today, industrial- and energy-related emission reduction projects have dwarfed these earlier voluntary efforts. However, the trading of voluntary carbon offsets is again on the rise. Retail stores offer 'carbon neutral' products, sports events seek to offset their emissions, and companies invest in environmental and social projects to 'green' their image. Carbon buyers and investors participate in projects and initiatives as part of their commitment for sustainability, to offset company emissions, or simply for marketing purposes.

Disappointed expectations

The agreement forged at COP-9 gave developing countries, in particular African nations, hope that they could benefit from significant forestry opportunities under the CDM. They had been assured that the complicated rules would address the concerns relating to monitoring and permanence, and that these rules would allow market access for CDM forestry projects.

But the demand for credits from forestry CDM projects remained disappointingly low. Most governments are reluctant to acquire forestry credits, which have created so much controversy in the past. While today most governments show a more realistic attitude towards forestry projects and the inclusion of forestry in the system created by the Kyoto Protocol, old fears and concerns are deeply rooted, which goes some way towards explaining the lack of enthusiasm to engage in forestry transactions.

The private sector is cautiously supportive of LULUCF projects. While many companies are still worried about the additional complications accompanying the implementation of such projects,[34] increasing numbers would be prepared to test the waters and purchase carbon credits from forestry. But private sector demand is actively discouraged by the fact that forestry credits cannot be used towards compliance with obligations under the EU emission trading scheme.[35] A recent survey revealed that 40 per cent of the participating private sector entities would invest in forestry projects if the resulting credits were recognized under the EU emission trading scheme. When the trading scheme was developed the exclusion of LULUCF credits was justified by the uncertainties with regard to the accounting of emission removals by carbon sinks. Since then, however, the international

[34] C. Dannecker, 'Evaluation of a survey about the market for certified emission removals from forestry projects: a report by EcoSecurities Ltd', 2006, on file with the authors.

[35] Directive 2003/87/EC of the European Parliament and of the Council (13 Oct. 2003), establishing a scheme for GHG emission allowance trading within the Community and amending Council Directive 96/61/EC, published in the *Official Journal of the European Union* on 25 Oct. 2003: L 275, 25/10/2003 P. 0032–0046. On 23 July 2003 the Commission of the European Communities released the first draft of a 'Proposal for a directive of the European Parliament and of the Council, amending the directive establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms', COM (2003) 403 final.

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framework has evolved, and COP-9 and the Executive Board adopted clear rules on monitoring and accounting for forestry projects. A workshop in March 2006 in Brussels organized by the World Bank showed more and more countries supporting the opening of the EU Emission Trading Scheme for forestry credits.[36]

LULUCF in the forthcoming UNFCCC negotiations

Objectives

Where do we need to go from here? Hampered by widespread controversies and a lack of knowledge, the Kyoto negotiators agreed to too little too late. They created a system that takes no account of a large proportion of forestry-related emissions in developing countries. At the same time it has become clear that any attempt at stabilizing atmospheric GHG concentrations will have to bring LULUCF emissions and removals into the equation. According to the 2000 IPCC special report on land use, land-use change and forestry, a combination of preventing deforestation, restoring fragmented and degraded landscapes, and implementing best practices in the agriculture and forest products sectors could contribute as much as 25 per cent of the emission reductions necessary to stabilize GHG concentrations by 2050.[37] Therefore any post-Kyoto agreement must include among its objectives:

- the creation of a system that rewards:
  – decreasing deforestation;
  – sustainable forest, land and wetland management;
  – restoration of forests;
  – sustainable use of biomass;[38]
- the establishment of a reliable accounting system that includes the flux of biological carbon;
- the promotion of sustainable development and an inclusive climate regime;
- harmonization with the Convention on Biological Diversity and the Convention to Combat Desertification.

A separate LULUCF protocol?

The future LULUCF framework could either lead to a separate protocol or be integrated in a single post-Kyoto framework. Separating the LULUCF issue from the main cluster of negotiations would have the benefit that negotiations could be more focused, allowing LULUCF experts to come up with a dedicated forestry

[36] The workshop summary can be downloaded on the website of the BioCarbon Fund under the World Bank's carbon finance website: www.carbonfinance.org, accessed 28 Aug. 2006.

[37] IPCC, *Land use, land-use change, and forestry*; Conservation International, 'Reducing emissions from deforestation in developing countries: approaches to stimulate action, 31 March 2006, http://unfccc.int/resource/docs/2006/smsn/ngo/012.pdf, accessed 20 July 2006.

[38] B. Schlamadinger et al., 'Options for including LULUCF activities in a post-2012 international climate agreement', a workshop report, 2006, p. 10, http://www.joanneum.at/Carboinvent/post2012_/Bird/Schlamadinger_et_al_2005.pdf, accessed 20 July 2006.

protocol.[39] There are disadvantages to this, however. One is that singling out a particular issue of a global problem in this way makes it difficult for countries to negotiate package deals spanning several issues. Another is that any protocol under the UNFCCC is binding only for those countries that ratify it; so countries that either feel at a disadvantage under a forestry protocol or are just not interested in such a treaty might well simply not sign it, significantly reducing support for the protocol.

Negotiating one single post-Kyoto framework will be complicated. But it will allow the creation of an interlinked incentive framework under which each country, or group of countries negotiating jointly, will be able to secure negotiating successes. The result is likely to be a complex treaty. However, complex provisions in one treaty can be much better harmonized than individually and distantly negotiated clauses in a separate and fragmented set of agreements.

Common but differentiated responsibilities

Any post-Kyoto regime needs to create a mechanism that includes developing countries while ensuring that those countries are rewarded for their participation according to the UNFCCC's guiding principle of 'common but differentiated responsibilities'.[40] Developing countries administer the majority of the world's environmental resources. They provide a vital global public good by maintaining global environmental assets.[41] With increasing pressure on development and use of resources, they can hardly be expected to provide these services for free. By maintaining their rainforests, tropical countries provide an invaluable global service, one for which they have to be compensated.

Design choices

Negotiators further need to make some strategic choices regarding the means they wish to employ to achieve the listed objectives:

- Shall the future agreement base its instruments on emission trading and tradable credits?
- If so, shall these credits be fungible, with emission allowances allocated to industrialized countries?
- Shall the agreement be global and apply to all countries?
- Shall it single out particular ecosystems or apply to the whole territory of a country?

[39] However, negotiations under the United Nations Forum on Forests (UNFF) have so far failed to establish a forest convention aiming at forest protection, so it is doubtful that a separate LULUCF protocol in the post-Kyoto framework would easily achieve this goal. See also R. Persson, 'Where is the United Nations Forum on Forests going?', *International Forestry Review* 7: 4, 2005, pp. 348–57.

[40] UNFCCC, preamble and arts 3.1, 4.1.

[41] J. Stiglitz, 'Cleaning up economic growth', Project Syndicate, 2005, http://www.project-syndicate.org/commentary/stiglitz59, accessed 20 July 2006.

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- What would be the scope of such a regime? Shall it cover only emissions from deforestation, or shall it be integrated in a broader LULUCF regime?

Emission trading as one design choice

We consider market mechanisms that rely on payment for environmental services the most promising tools to create the necessary financial transfers to motivate conservation and restoration of forests in developing countries. Countries have earned valuable experience with the implementation of the CDM. Scientific and methodological insecurities have decreased. The current LULUCF CDM provides a useful learning tool to educate government negotiators, in very much the same way that the 'Activities Implemented Jointly' under the UNFCCC informed the framework of the flexible mechanisms under the Kyoto Protocol.

It is important to emphasize, however, that not all commentators favour a mechanism based on market forces. Some claim that allowing emission credits from reduced deforestation to enter the international emissions trading scheme would reduce the ability of the system to drive technological change in the energy sector in both industrialized and developing countries, as well as introducing further uncertainties into the market.[42] Alternative proposals for a post-Kyoto LULUCF regime include the establishment of compensation funds which would be replenished by governments on a model similar to the Global Environment Facility.

By creating tradable carbon removal/reduction assets, emission trading delinks the achievement of an environmental benefit from the obligation to achieve such benefit. Any future emission trading system should rely on a number of basic principles, such as enforceable and internationally recognized emission rights, and uniform monitoring and verification standards. At the same time, the system will have to take into consideration national and/or regional circumstances. Countries vary widely in their technical capacities, enforcement structures, political priorities and access to private capital.

There are a number of possible scenarios for a future LULUCF emission trading scheme. Emission trading can be based on the allocation of emission rights under an overall cap (such as the system of Assigned Amounts under the Kyoto Protocol). Alternatively, the system can rely on a baseline and credit system under which emission reductions are measured against a previously established counterfactual baseline (as, for example, under the CDM). Finally, mechanisms can be designed as a hybrid of both conceptual approaches. Joint Implementation is an example of such a hybrid mechanism.

Voluntary or mandatory system?

The involvement of developing countries in a LULUCF scheme could be voluntary or mandatory. We consider a flexible and voluntary scheme the more promising

[42] Friends of the Earth, 'International submission addressing approaches to reduce emissions from deforestation', March 2006, http://unfccc.int/resource/docs/2006/smsn/ngo/006.pdf, accessed 20 July 2006.

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alternative. The success of any activity depends on the commitment of the participating countries. However, once a country has agreed to participate in a particular scheme or mechanism, the acceptance of the rules governing this system becomes mandatory.

Two ideas on how to mitigate tropical deforestation

At COP-11 in 2005, Papua New Guinea and Costa Rica, on behalf of a coalition of rainforest nations, put forward a submission to consider further whether and how incentives to reduce tropical deforestation could be included in the future climate regime under the UNFCCC or the Kyoto Protocol.[43] They suggested creating a framework under the UNFCCC that would reward developing countries for bringing deforestation emissions under management. The submission created a lot of interest and attracted almost unanimous support. In order to stimulate ideas and debate further, the COP issued a call for ideas on how the climate change convention could promote incentives for avoiding further loss of tropical forests. Below we present two ideas in response to this call. These approaches, individually or jointly, form the basis for concrete mechanisms that may show the path for further discussions. But they also amply illustrate the complexity of the problem.

Compensated reduction

A group of scientists from various institutions (the Amazon Institute for Environmental Research (IPAM), Instituto Socioambiental (ISA), Environmental Defense, CPTEC/INPE and Woods Hole Research Center) have developed a 'compensated reduction of deforestation' approach.[44] The mechanism would award compensation to developing countries that avoid further deforestation. It would not be linked to the execution of specific projects, but would rely on a commitment between countries.

Participating countries that elected to reduce their emissions from deforestation during a commitment period would receive financial compensation for the emissions avoided. Emission reductions would be calculated against a baseline of average historical deforestation. The reduction would be negotiated in advance for a future commitment period. If a country reduces its deforestation rate and achieves the target set, it would be eligible for compensation. Compensation would come retrospectively, after technical verification of effective emissions reductions, regardless of how the reduction had been achieved. In order to raise

[43] FCCC/CP/2005/MISC.1.

[44] M. Santilli, P. Moutinho, S. Schwartzman, D. Nepstad, L. Curran and C. Nobre, 'Tropical deforestation and the Kyoto Protocol', *Climatic Change* 71, 2005, pp. 267–76; Instituto de Pesquisa Ambiental da Amazônia (Amazon Institute for Environmental Research), 'Reduction of GHG emissions from deforestation in developing countries', 2006, http://unfccc.int/resource/docs/2006/smsn/ngo/007.pdf, accessed 20 July 2006; Environmental Defense, 'Reducing emissions from deforestation in developing countries: approaches to stimulate action', 2006, http://unfccc.int/resource/docs/2006/smsn/ngo/009.pdf, accessed 20 July 2006; P. Moutinho and S. Schwartzman (Instituto de Pesquisa Ambiental da Amazônia), *Tropical deforestation and climate change* (Washington DC: Environmental Defense, 2005); Santilli et al., 'Tropical deforestation and the Kyoto Protocol'.

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advance payments, the host country could either issue government bonds or negotiate loans with a financial institution that would be willing to lend against the reduction promise of the host country.

Funds received as compensation would be earmarked to contribute further to the goals of the FCCC and the Kyoto Protocol. In particular, funds could be used for defining economic alternatives to the extensive felling of forests.

Participation in the mechanism would be voluntary, but once a country had agreed to a certain target rate it would be obliged to reduce the loss of forests to meet that target. If a country were unable to meet this obligation, the shortfall would be added to the target for the following commitment period.

The compensation reduction model foresees the establishment of base periods according to country-specific historical deforestation rates. Since the model is based on national commitments and fixed compromises, additionality is not an issue. The authors of this proposal describe the mechanism as a pure government-to-government mechanism.[45] Private sector entities would not actively participate in the trades. Under this proposal temporary credits would not be necessary since the host country would assume liability for replacement.

Carbon stock approach

The carbon stock approach has been developed by the Center for International Sustainable Development Law in cooperation with Climate Focus and Forest Carbon.[46] Like the compensated reduction model, the carbon stock approach moves away from the CDM baseline-and-credit system and replaces it with a cap-and-trade system that will allow developing countries to access carbon finance by establishing protection systems over their forest resources.

All participating countries holding forest reserves receive an allocation of carbon stock credits (carbon stock units or CSUs) that corresponds to their tropical forest carbon stock in a certain reference year. The issuance of carbon stock units would resemble the allocation of Assigned Amounts to industrialized parties under the Kyoto Protocol. If a country wishes to participate in the trade of carbon stock units, it will have to prepare an inventory of LULUCF emissions and removals and establish a national registry, similar to the existing registries of industrialized countries. Participation in the mechanism would be voluntary.

A trading country would have to hold a certain percentage of its carbon stock constant as a 'carbon reserve'. This carbon reserve would correspond to particular areas of land (e.g. non-threatened forests). The protected reserve would be set by the affected country on the basis of internationally formulated criteria. The remaining amount of carbon stock units reflects the amount of credits that could be made available for trading under the 'Carbon Reservoir Mechanism' (CRM).

[45] While the submission of Environmental Defense appears to contemplate private sector participation, IPAM's submission considers private participation as a risk rather than an opportunity.

[46] S. Prior, C. Streck and R. O'Sullivan, (Center for International Sustainable Development Law), 'Incentivizing avoided deforestation: a carbon stock methodology', http://unfccc.int/resource/docs/2006/smsn/ngo/005.pdf, accessed 20 July 2006.

Countries could sell CSUs if they demonstrate that defined areas of forest are put under protection. They could also authorize private entities to participate in the trades. The Carbon Reservoir Mechanism is modelled on the existing Joint Implementation mechanism. A given volume of carbon units can be sold only if a corresponding area of specific forest is set aside and protected from deforestation. An independent entity (akin to JI's accredited independent entity) would verify the robustness of the conservation measures put in place.

Carbon Reservoir Units could be issued under a temporary crediting system similar to the current LULUCF CDM rules. The temporary nature of the credits would then allow project developers to sell the removals of the forest repeatedly over time (as long as the forest is still in place), which creates a continuing incentive for protecting the forest. This would imply, however, that the replacement obligation would pass from the selling to the acquiring country.

Comparison

The two models briefly reviewed above are both based on a market mechanism. Under both models, carbon credits are issued and transferred. However, under the compensation reduction model the credits are issued and transferred only at the end of each allocation (or commitment) period. This creates a financing problem since the participating country will have to mobilize resources to implement protection measures. The carbon stock approach, on the other hand, relies on individual projects implemented in the context of a general allocation of credits to the forestry country. Carbon credits can be sold as soon as the project developer has proved that the necessary systems are in place to guarantee the long-term protection of a certain project area.

The carbon stock approach is based on private involvement and hopes to motivate private entities to participate in conservation projects. The private entities would then enforce the protection of the forest. The compensated reduction approach, on the other hand, does not (or not primarily) foresee the participation of private entities in the protection measures. The compensation payments are made not directly to private project developers, but over intervals of several years to the host country.

The challenge of the carbon stock approach lies in the establishment of the percentage of credits that can be traded. The country would be held liable for any loss of carbon in the reserve area, which would result in a suspension of eligibility to trade further under the CRM. Temporary crediting would overcome issues of permanence in the absence of binding caps, as is the case in JI.

The compensated reduction approach, on the other hand, relies heavily on governmental enforcement structures, political will and the availability of finance.

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Table 1: A comparison of three approaches to mitigating tropical deforestation

Current LULUCF CDM	Compensated reduction	Carbon stock	Expanded LULUCF CDM (Crediting reforestation)
Private sector driven	Government driven, no private sector participation	Private sector driven similar to JI	Private sector driven
No targets	Negotiated baseline	Negotiated assigned amounts	No targets
Project based	Independent from individual projects	Conservation measures are project based	Project and programme based
Usually payment on delivery	Payment on delivery	Initial payment upon delivery of an approved and credible protection system, subsequent payment on proof of maintenance	Probably payment on delivery
Payments linked to GHG removals from afforestation projects	Compensation payment linked to achievement of negotiated country target	Compensation payment linked to the protection of forests in a defined project area	Includes all removals from sink projects, not limited to afforestation and reforestation (e.g. land, wetland, and forest management also eligible)
Temporary credits max 60 years of lifetime	Permanent credits	Temporary credits, unlimited	Temporary credits, unlimited
Acquiring country is liable for loss and replacement	Forest country is liable for loss and replacement	Forest country is liable for loss and replacement. If temporary credits are being issued the liability would pass to the acquiring country	Acquiring country is liable for loss and and replacement
Under implementation	Could start immediately. Early action can be taken when negotiating the first target	Early action could be taken into account under the 'prompt start' clause	Can be implemented only once the scope of the CDM has been formally expanded

Crediting reforestation

The two proposals discussed above—compensated reduction and the carbon stock approach—both aim to provide incentives to reduce emissions arising from tropical deforestation. Whereas the carbon stock approach, as its name implies, could be applied to the whole carbon stock of a country (in a manner similar to measures under articles 3.3. and 3.4 of the Kyoto Protocol), the compensated reduction mechanism is limited to the conservation of tropical forests. It addresses emission

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reductions, not removals of carbon from the atmosphere. In order to maintain and increase the motivation to implement forestry projects, such a mechanism should be complemented by an expanded CDM. Additional project classes (such as land management) could be made eligible under the CDM, and sectoral and programmatic project classes could be allowed to receive credits. The mandatory replacement obligation for temporary credits should be abolished as it creates the perverse incentive to clear-cut the forest and cash in the timber after the carbon money ceases to flow. Alternatively, A&R projects under the CDM could be subsequently recognized and credited under a carbon stock approach.

Outlook

During the negotiation of the Kyoto Protocol no consensus could be reached on the divisive issue of how to integrate forestry-related emissions in the framework of the protocol. The compromise reached after years of negotiations is a limited LULUCF CDM which restricts eligible projects to afforestation and reforestation only. This decision leaves out the 20–25 per cent of global anthropogenic GHG emissions that result from deforestation.

Defining a comprehensive system that values forests and biological biomass will be essential for the successful negotiation of a post-Kyoto regime. Not only is it likely to be one of the conditions for bringing the US on board to support an international climate regime, if the emissions from deforestation are not adequately addressed in the post-Kyoto regime, they will undercut the gains made in reducing emissions from the industrial sector.

There is reason for hope. Since COP-11, the discussion on how to assess the monetary value of standing forests has moved beyond expert circles and modest progress is being made in the international arena. But talks are not sufficient. If any proposals are to be credible, it is important that industrialized governments and private entities start sending signals to developing countries today that they support forestry projects, investing in CDM forestry credits now and exploring the limited possibilities of the forestry projects in the CDM.

Testing the rules of forestry in the CDM today is essential to learn how to implement a larger-scale scheme in the post-Kyoto world. Any experience will inform the debate on how to credit avoided deforestation. What is clear is that as long as threatened primary tropical forests are excluded from the international carbon markets, market biases will tend to accelerate their destruction and loss.

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