Can the Kyoto Protocol Support Biodiversity Conservation? Legal and Financial Challenges

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The Kyoto Protocol,[1] negotiated in December 1997, is the first major step toward implementation of the United Nations Framework Convention on Climate Change (UNFCCC). The Protocol sets targets for industrialized nations to reduce their emissions of greenhouse gases over the next 10 years. It offers four means to achieve those targets: domestic action and three international market-based instruments. These mechanisms work through emissions reductions or through enhancements in the ability of terrestrial ecosystems to absorb carbon.

This Dialogue focuses on the Protocol's provisions to enhance the ability of terrestrial ecosystems to absorb carbon. These provisions may create incentives and financial mechanisms for more effective and sustainable management of forests and associated biodiversity. Whether this potential can be realized, however, depends on effective resolution of a number of outstanding issues. Some of these are legal issues related to further refinement of the intent and precise meaning of the Protocol itself. Others, of equal importance, are financial, concerning how to develop the efficient market for carbon offsets necessary to generate funds for improved forest and biodiversity management. This Dialogue reviews both sets of issues, to provide a clear picture of what actually will be required if the Protocol is to fulfill its potential as a source of funds for improved forest management.

The Dialogue begins by providing background in two key areas: the place of forests in the carbon cycle and the forest-related provisions of the Protocol. It then considers five issues that will arise regarding the impacts of the Protocol on forests: (1) key unresolved issues among the forest provisions of the Protocol; (2) externalities, such as biodiversity and watershed protection, that may be associated with implementation of the forest provisions of the Protocol; (3) risks associated with carbon sequestration projects; (4) financial mechanisms that may help reduce those risks; and (5) the possible role of forests in an emissions permit trading system.

The Global Carbon Cycle

The Carbon Cycle and the Role of Forests

Climate change is expected to result from a variety of human activities, the most prominent of which is the release of carbon dioxide (CO2) into the atmosphere. The accumulation of CO2 in the atmosphere is due to the fact that more carbon is emitted than is removed by terrestrial ecosystems and the oceans. Two sources of CO2 are especially important in terms of climate change--the combustion of fossil fuels and deforestation.

The global carbon cycle can be understood as a closed system in which carbon is stored in the atmosphere, the oceans, and terrestrial biota, and flows among them as an outcome of natural processes and human activities. Hundreds of billions of tons of carbon in the form of CO2 are absorbed from or emitted into the atmosphere every year through natural processes. These processes include plant photosynthesis, respiration, and decay, as well as absorption and release by the oceans.

When the cycle is in equilibrium, carbon flows are roughly in balance: carbon emitted to the atmosphere is offset by carbon drawn out of the atmosphere and the stock stored in each area is constant.

[1] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997 [hereinafter Kyoto Protocol].

Over the last 160,000 years, concentrations of atmospheric CO_2 have ranged between 200 and 280 parts per million (ppm).[2] High concentrations of atmospheric CO_2 have been associated with particularly warm climatic periods, while low concentrations have been associated with cooler periods.

Understanding the role of terrestrial biota in the carbon cycle is key to analyzing the impacts of the Protocol on forests. This involves both stocks--how much carbon is held in standing biomass--and flows--whether at a given point in time each ecosystem is a net absorber (sink) or emitter (source) of carbon. Given our concern with global warming--that is, with climate change caused by increased carbon stored in the atmosphere rather than in terrestrial ecosystems--our interest is to ensure that carbon will flow from the atmosphere into vegetation and be stored there rather than released back into the atmosphere.

Trees are a major storehouse of carbon, because they account for a huge amount of biomass. A mature forest stores carbon in the roots, trunks, branches, and leaves of trees. As they grow, trees absorb small additional amounts of carbon from the atmosphere. At the same time, the decay of organic matter on the forest floor and in the soil emits carbon back into the atmosphere. In an old forest, these emissions are less than the absorption by the trees, so the forest ecosystem is a net carbon sink.

Now suppose that the trees are harvested, after which young trees are planted. The harvested trees are converted to lumber, plywood, sawdust, paper, and other materials. Their roots--now dead--are left in the soil, as is some debris from the treetops. The lumber--up to one-half of the trees' biomass--may be used in home construction or furniture, and so will continue to store carbon for many years. The sawdust and paper, however, are likely to become waste fairly soon, ending up in an incinerator or landfill from which their carbon will return to the atmosphere after combustion or decay.

On the land, new trees were planted after the harvest. They are small and growing quickly, and they absorb carbon. However, the roots and debris from the old forest are still in or on the ground, decaying and emitting carbon. The new plantation forestry ecosystem will be a net emitter of carbon into the atmosphere, and will remain so for about a decade, until much of the decay is completed. Exactly how long it takes before the ecosystem reaches the turning point from carbon sink to source depends on the ecosystems and species in question and the history of the site. For example, a forest which spreads naturally into an abandoned agricultural field might become a carbon sink more quickly, because there are no old tree roots in the ground which decay and produce emissions. While it may take only a decade for the new forest ecosystem to become a net carbon sink, it can take as much as a century or longer before the carbon stock in the new ecosystem is as large as in the mature forest that was cut down.

This discussion highlights two key points to bear in mind in assessing the forestry activities authorized by the Protocol. First, while growing trees do absorb carbon, a young forest ecosystem will not always be a carbon sink. Second, even when it becomes a sink, the young, rapidly growing forest will still hold much less carbon than the older and more mature forest ecosystem which it might have replaced. Thus, even if the rate of carbon absorption is higher in the young forest than in the old one, it will be a long time before this compensates for the carbon lost to the atmosphere by destruction of the old forest.

[2] *See* Mark Trexler, Minding the Carbon Store 3 (World Resources Institute 1991).

Recent Change in the Carbon Cycle

Growing scientific evidence suggests that the global carbon cycle is once again out of balance. In the last two centuries, CO_2 concentrations have risen over 25 percent from about 280 ppm in 1750 to more than 350 ppm in 1989.[3] CO_2 concentrations continue to rise every year. In the absence of measures to mitigate this trend, carbon concentrations will approach 700 ppm by 2100, according to the Intergovernmental Panel on Climate Change (IPCC), the United Nations (U.N.) scientific body charged with representing the scientific community's consensus view of climate change.[4]

Global CO_2 Emissions by Region and by Activity, 1991

	Industrial	Land use	Total	Share of region in total	Share of land use in total
Total	22,339,408	4,100,000	26,439,408		16%
of which:					
Africa	715,773	730,000	1,445,773	5%	50%
Europe	6,866,494	11,000	6,877,494	26%	0%
No & C. America	5,715,466	190,000	5,905,466	22%	3%
S. America	605,029	1,800,000	2,405,029	9%	75%
Asia	7,118,317	1,300,000	8,418,317	32%	15%
Oceania	297,246	38,000	335,246	1%	11%

Source: WRI/UNEP/UNDP/World Bank, World Resources 1996-97. (New York and Oxford: Oxford University Press, 1996) Tables 4.1 and 4.2, pp. 326-329.

Human activities, including those dating back to well before the industrial revolution, are the primary force behind the carbon cycle's current instability. For centuries prior to the 1700s, stored carbon was released into the atmosphere and flows into terrestrial ecosystems were reduced as people converted temperate forests and grasslands into farms. Today, owing mostly to deforestation in the tropics, releases from land-based activities are probably greater than ever before, accounting for about 16 percent of carbon flows into the atmosphere in 1991.[5] In the coming years, as rates of deforestation continue to rise, CO_2 emissions from land use change are expected to increase even further.[6]

In the past few decades, the burning of fossil fuels has overtaken land-based emissions as a source of atmospheric carbon, quadrupling from 1950 to 1980. As the table below shows, however, the pattern of carbon emissions varies greatly by region and level of development. In Africa and South America, which account for only 14 percent of global carbon emissions, land use change is still a dominant source. In

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[3] *See* Climate Change: The IPCC Scientific Assessment (J.T. Houghton et al. eds., Cambridge Univ. Press 1990).

[4] *See* Intergovernmental Panel on Climate Change, Radiative Forcing of Climate Change: The 1994 Report of the Scientific Assessment Working Group of IPCC 14 (1994).

[5] *See* World Resources Institute et al., World Resources 1996-1997 326-29 (1996).

[6] This source of harm, from changes in land use and land cover, is sometimes referred to as the "land use change sector" or "LUCF"--land use change and forestry.

Europe and North America, in contrast, which account for almost one-half of world emissions, almost none is from land use change. These data do not factor in the carbon absorbed by the world's forests, but nevertheless they provide a useful picture of the major sources of carbon emissions worldwide.

The Kyoto Protocol

On December 11, 1997, delegates from some 160 nations agreed to the Kyoto Protocol, which includes the first ever legally binding limits on CO_2 and other greenhouse gases. The agreement calls on industrialized countries--the so-called Annex I countries--to reduce their emissions by an overall 5 percent from a 1990 baseline.[7] Compliance will be determined based on average emissions over a "budget period" from 2008 to 2012.[8] Annex I includes 39 developed economies and economies in transition, such as the United States, the European Union, Japan, Russia, Ukraine, and the Czech Republic. Developing countries have no emission reduction commitments under the Protocol.

The Protocol adopts a differentiated approach to countries' emission reduction commitments, in order to account for varying national circumstances. For example, the United States committed to a 7 percent reduction and the European Union countries as a group agreed to an 8 percent cap, while Japan committed to a 6 percent reduction.[9] Russia is only called on to stabilize its emissions, and Australia is allowed an 8 percent increase from its 1990 levels.[10]

Annex I countries have four means by which to meet their Protocol commitments, each of which potentially incorporates strategies that would impact forest and land use change practices. The first mechanism pertains to activities undertaken domestically within Annex I countries. It is described in Article 3.3, which states:

> *The net changes in greenhouse gas emissions from sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in stocks in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex I. The greenhouse gas emissions by sources and removals by sinks associated with those activities shall be reported in a transparent and verifiable manner and reviewed in accordance with Articles 7 and 8.*[11]

This allows countries to achieve their targets either by reducing domestic emissions or by enhancing domestic carbon sinks through a limited set of forest activities. Reducing emissions would require actions in the industrial and energy sectors, such as replacing fossil fuels with renewable energy. Forest sector activities are limited to afforestation and reforestation, both of which will sequester CO_2. Countries will be penalized for deforestation activities, as they will lead to increases in emissions. How a country implements these activities domestically--whether through regulatory or economic instruments, for example--is not discussed in the Protocol.

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7 *See* Kyoto Protocol, *supra* note 1, art. 3.1.
8 *See id.*
9 *See id.* annex B.
10 *See id.*
11 *Id.* art. 3.3.

The three other means of achieving the targets involve international market-based instruments that allow Annex I countries to buy, sell, or trade reductions in greenhouse gas emissions. The first is joint implementation (JI) among Annex I countries, authorized by Article 6 of the Protocol. JI allows one country to receive emission reduction credits in return for investing in projects to reduce emissions or enhance sinks in a second country. It is economically efficient, because through JI the needed reductions can be achieved wherever they are least expensive, rather than requiring them to occur in the first country. Article 6 states:

> *For the purpose of meeting its commitments under Article 3, any Party included in Annex I may transfer to, or acquire from, any other such Party emission reduction units resulting from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of greenhouse gases in any sector of the economy....*[12]

Such projects must provide "a reduction in emissions by sources, or an enhancement of removals by sinks, that is additional to any that would otherwise occur...."[13]

Article 6 explicitly includes both sources and sinks attributable to forestry or land use change. Unlike Article 3.3, it does not explicitly limit activities to afforestation, deforestation, and reforestation. Under Article 6, therefore, it may be permissible for other human-induced activities, such as conservation and management measures which increase carbon stocks in existing forests, to receive credit in Annex I JI projects.

The second market-based mechanism established by the Protocol is the Clean Development Mechanism (CDM), which allows Annex I countries to undertake projects to reduce emissions in non-Annex I countries. Through the CDM, Annex I countries assist non-Annex I countries in achieving sustainable development, while benefiting from the opportunity to invest in low-cost emissions reductions in the developing world rather than more costly ones at home. Article 12 of the Protocol, which creates the CDM, states that "[p]arties included in Annex I may use the certified emission reductions accruing from such project activities to contribute to compliance with part of their quantified emission limitation and reduction commitments under Article 3."[14] As under Article 6, such credit is given only for "[r]eductions in emissions that are additional to any that would occur in the absence of the certified project activity."[15]

The only other requirement for these certified emissions reductions is that they provide "real, measurable, and long-term benefits related to the mitigation of climate change."[16] However, unlike Article 6, Article 12 does not mention the enhancement of carbon sinks. It is not clear whether this omission was intentional. Even if it was intentional, this language may still allow credit to be granted for emission reductions in forestry, for example by reducing or preventing deforestation; this issue is still under debate. If the actual intent was also to permit activities to enhance carbon sequestration, the question will still be open as to whether they are limited to reforestation and afforestation, or could also include forest

[12] *Id.* art. 6.1.
[13] *Id.* art. 6.1(b).
[14] *Id.* art. 12.3(b).
[15] *Id.* art. 12.5(c).
[16] *Id.* art. 12.5(b).

conservation and management. However, as under Annex I JI, a clear baseline for all mitigation projects would have to be established in order to calculate the "additional carbon sequestration," and the condition of verifiability would have to be observed.

The third market-based provision authorized by the Protocol is trading in emission permits or allowances. Under the Protocol, each Annex I country has been allocated a certain quantity of emissions. With an emissions permit trading system, countries that reduce emissions beyond their commitment could sell their excess permits to countries unable to reduce emissions as easily. Article 17 of the Protocol provides for emissions trading in principle. The institutional requirements of the trading regime are not in place and will need to be negotiated in the future.

Unresolved Questions About Forest Activities Under the Protocol

The discussions prior to and during the Kyoto negotiations saw much controversy about how to include land use change and forestry in the Protocol. Discussion continued at the June 1998 meeting of the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA). The Parties to the UNFCCC requested the IPCC to address the technical issues in a special report to be prepared over the next 18 months; it remains unclear how other controversies over interpretation of the Protocol will be resolved.

Definitions of Afforestation, Reforestation, and Deforestation

The Kyoto Protocol, in Article 3.3, allows use of afforestation, reforestation, and deforestation to meet treaty commitments, but does not define those terms. The choice of definitions is crucial, because they could lead to perverse incentives to destroy mature standing forests and replace them with new plantations.

Afforestation and reforestation, but not deforestation, are defined in the glossary of the IPCC Guidelines for National Greenhouse Gas Inventories.[17] It is generally expected that these are the applicable definitions. The IPCC identifies afforestation as the establishment of forest where none had historically existed, whereas reforestation is identified as the establishment of forest where there was forest previously but the land had been converted to other uses. However, it is not clear how long a time lapse between forest harvest and forest planting is required in order to qualify as reforestation. In the absence of this, it is uncertain how forest harvest and planting fit into the accounting framework of the Kyoto Protocol.

The U.N. Food and Agricultural Organization (FAO) defines reforestation differently, so it is important to consider the implications if this definition were applied. The FAO identifies "reforestation" to include the immediate replanting of forests following harvest or a natural disturbance such as fire. It also has a definition of deforestation, unlike the IPCC. Deforestation in developed countries is defined as "[c]hange of forest with depletion of tree crown cover to less than 20%."[18] Following these definitions, clearcutting would be considered deforestation under the Protocol, but logging up to 90 percent of forest cover would not be considered as deforestation and so would not be counted as emissions in the budget

[17] *See* 1 IPCC--Intergovernmental Panel on Climate Change, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories 1 (J.T. Houghton et al. eds., 1997).

[18] U.N. Food and Agricultural Organization, State of the World's Forests (1997), *cited in* Methodological Issues: Issues Related to Land Use Change and Forestry, Note By the Secretariat (1998) (paper prepared for the eighth session of the SBSTA, Bonn June 2-12, 1998).

period. This would create an anomalous situation in which credits would be obtained for replanting, but no corresponding emissions would be counted from severe forest cutting.

If credits can be obtained for replanting, then harvesting should be categorized as deforestation and count as emissions. If this is not the case, then clearing old growth forests for the purpose of replanting fast-growing monocultures could lead to significant credits due to replanting, without the corresponding debit for the harvest of old growth forests. To resolve this issue, there needs to be a clear understanding of the length of time that land resides in other uses before it qualifies as reforestation, as well as a precise definition of deforestation.

One option proffered by environmental groups to deal with this problem is to identify reforestation and deforestation in a manner that would maintain symmetry between the activities.[19] In this approach, credit can be claimed for reforestation in any given area if, and only if, that area was not covered by forest in 1990 and is covered by forest in 2012. Credit is equal to the average annual amount of carbon sequestered over the five-year budget period, 2008 to 2012. Conversely, if a parcel of land had forest on it in 1990 and does not have forest on it in 2012, then deforestation has occurred and the decrease in carbon sequestered from the 1990 baseline to the average over the budget period must be reported as an emission.

Using this approach avoids creating a perverse incentive to clear forest in order to claim a reforestation credit by restricting credits to land that did not have forest cover in 1990. This is consistent with the definition of reforestation given in the glossary of the IPCC methodologies for national inventories. This approach also provides symmetry in the treatment of reforestation and deforestation. For example, a forest being managed under a steady-state rotation would be excluded from the accounting system.

Limits on Land Use Change and Forestry Activities

A second concern about the Protocol's language on forestry is that it limits credit for domestic land use change and forestry (LUCF) activities to afforestation, reforestation, and deforestation. In so doing, the Protocol clearly does not intend to provide credits for activities such as improved management and reduced impact logging, which may enhance the carbon sequestration capacity of an existing forest. Nor does it intend to count as emissions forest degradation, which leads to lower carbon sequestration capacity in a forest.

This is a particular concern in industrialized countries where most changes in forest cover--and, thus, in carbon sequestration--will not be picked up following the Protocol's rules. Forests in industrialized countries are often degrading in quality, due either to management practices or to pollution such as acid rain. These changes reduce their carbon sequestration capacity, but will not be counted as emissions in assessing progress toward targets under the Protocol.

Article 3.4 may offer an opportunity to broaden this list, however. It directs the Conference of Parties serving as the meeting of parties (COP/MOP) to

[19] *See* Letter from the Center for International Environmental Law, the Center for Sustainable Development in the Americas, the Environment and Energy Study Institute, the National Wildlife Federation, the Natural Resources Defense Council, Physicians for Social Responsibility, and the Union of Concerned Scientists, to Todd Stern, Assistant to the President for Special Projects, and Stuart Eizenstat, Undersecretary of State for Economic, Business and Agricultural Affairs 3-4 (Mar. 27, 1998) (on file with the authors).

decide upon modalities, rules and guidelines as to how and which additional human-induced activities related to changes in greenhouse gas emissions and removals in the agricultural soil and land use change and forestry categories, shall be added to, or subtracted from, the assigned amount for Parties included in Annex I .... Such a decision shall apply in the second and subsequent commitment periods. A Party may choose to apply such a decision on these additional human-induced activities for its first commitment period, provided that these activities have taken place since 1990.[20]

This article can be interpreted to mean that the COP/MOP is authorized to add conservation and forest management to the list of authorized activities in Article 3.3. If that is the case, however, it is not clear what is meant in Article 3.3, where it says that activities "*limited to* afforestation, reforestation and deforestation" may be used to meet commitments under the Protocol.[21] The possibility of including conservation and forest management through Article 3.4 also raises questions about additionality, or whether these activities will add to rather than replace ones that would have occurred otherwise. The activities permitted under Article 3.3 are evaluated relative to the country's 1990 baseline, so there is no need to require additionality, as is explicitly done under Articles 6 and 12. Article 3.4 says nothing about additionality. If the COP/MOP decides to allow credit for individual projects without explicitly requiring that they be additional, then countries could claim credit for all forests not destroyed between 1990 and the budget period as conservation activities.

Possible Loophole Under Article 6 JI

A third question about implementation of the Protocol concerns the precise workings of Article 6 JI. Some analysts of the Protocol have suggested that, although Article 6 does not specifically limit JI to the same forest-related activities as permitted for domestic activities, a strange anomaly could arise if it were in fact more flexible in practice. Without the limit, according to some, country A could fund a project (other than afforestation, reforestation, or deforestation) within country B and country B could fund the same kind of project within country A. Each could receive credit for those projects in each other's countries, though they could not receive credit for doing the same at home. For example, Canada could engage in a forest conservation project in the United States to offset emissions at home, while the United States would be unable to pursue the same activity at home and have it count toward its reduction target. This creates a possible loophole through which Annex I countries could try to work around the Article 3.3 limitations on forestry activities.

However, other analysts have argued that this loophole is precluded by Article 3.11 of the Protocol, which states that "[a]ny emission reduction units, or any part of an assigned amount, which a Party transfers to another Party in accordance with the provisions of Article 6 and of Article 17 shall be subtracted from the assigned amount for that Party."[22] This restriction means that countries would have no net gain from undertaking reciprocal activities in other countries. If country A paid for a conservation project in country B, B would not receive additional credits toward its own target for the activities, because this is not permitted by Article 3.3. When B transferred credits to A then, in accordance with Article 3.11, B would have to subtract them from its own target, making B worse off. Similarly, if B paid for a conservation project in A, A would transfer credits to B and subtract them from its own target. Each

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[20] Kyoto Protocol, *supra* note 1, art. 3.4.
[21] *Id.* art. 3.3 (emphasis added).
[22] *Id.* art. 3.11.

country would be in the same net position with regard to its target as before the projects, so there would be no reason to do this at all.

Soil Carbon

One final concern is that the Protocol does not explicitly say whether carbon sequestered in soils and other parts of the ecosystem is counted as part of afforestation, reforestation, and deforestation. Primary forests sequester large amounts of carbon in above-ground biomass, roots, litter, and soils. Most of this carbon begins to decay and return to the atmosphere when such forests are removed and replaced with plantations or other land uses. The IPCC guidelines for national inventories currently call for a complete carbon cycle accounting. However, as mentioned earlier, there is significant uncertainty regarding the accuracy of these measurements. Recall that Article 3.3 mentions that "[t]he greenhouse gas emissions from sources and removals by sinks ... measured as verifiable changes in stocks in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex I. The greenhouse gas emissions ... shall be reported in a transparent and verifiable manner."[23]

The key word here is "verifiable." Changes in carbon stocks can be used to meet the commitments of the Protocol *to the extent that they can be verified*. However, there would be no incentive to verify and report a loss of carbon stock from, for example, deforestation. Therefore, the need to report and verify all carbon losses--from soils, ground biomass, and so on--would have to be made obligatory by the Protocol.

Externalities

The primary objective of the UNFCCC and the Kyoto Protocol is to decrease the flow of carbon into the atmosphere and so reduce the harm anticipated from climate change. The mechanisms that may be used to accomplish this goal--such as reduction of fossil fuel combustion and increased protection of forests--also may generate a wide array of other environmental impacts and affect other socially desirable objectives. These impacts are sometimes termed "co-benefits," because the hope is to reap positive externalities at no incremental cost to climate change objectives. In fact, however, some of these associated environmental impacts could be harmful. The term co-benefits is somewhat misleading, therefore, and they are more accurately described as positive and negative externalities.

One such positive externality--the one of particular interest to the biodiversity community--is the opportunity provided by projects that improve carbon storage to also strengthen the conservation of habitat and biodiversity. In general, such projects might work in three ways: improving management of existing forests; restoring degraded forest areas; and reducing the rate of deforestation by decreasing demand for forest products such as charcoal and fuelwood. Among Annex I countries, projects are likely to focus in the first two areas. For example, in Canada, Russia, and the United States, improved forest management may offer large greenhouse gas reductions while at the same time conserve valuable ecosystem services of the temperate and boreal forests. For developing countries, all three strategies will be important. The CDM could provide incentives for improved management and conservation of existing tropical forests, mitigating climate change while conserving some of the world's key biodiversity hotspots. CDM projects could also strengthen demand for alternative cooking fuels, reducing the pressure on forest resources and contributing to habitat conservation.

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[23] *Id.* art. 3.3.

Carbon sequestration can also provide positive externalities of particular interest to other social action groups. Forest projects are likely to reduce soil erosion, protecting rivers from sedimentation, helping retain agricultural output levels in adjacent fields, and preventing siltation of reservoirs formed by downstream dams. Carbon sequestration projects also might make it possible for rural populations to improve their standard of living through economic activities that would otherwise be threatened by deforestation.

Emission offset projects also provide positive externalities that are of particular concern to social action and development groups. These projects can reduce other kinds of air emissions as well as greenhouse gases, and can provide local as well as global improvements in ambient air quality. This will lead to improvement in public health, economic gains, and an array of other benefits.

It is important to be aware that carbon sequestration projects under the Protocol can also create negative externalities. For example, although the Protocol creates an incentive to invest in new forests, in some cases this may lead to loss of biodiversity. In an area characterized by a wide mix of ecosystem types, including forest, grassland, and agricultural fields, projects might replace this diversity with a single forest ecosystem. This would provide more carbon sequestration than the mix of ecosystem types but support a less diverse mix of plant and animal species. Forests planted with the sole objective of maximizing carbon sequestration also might provide a less diverse habitat than natural forests. They often consist of fast-growing monocultures that absorb carbon quickly but do not offer habitat for diverse species. This is occurring in parts of Latin America, where plantation forests are replacing natural grasslands, threatening native biodiversity. Carbon sequestration projects should be designed so as to minimize or avoid these negative externalities.

In considering the externalities from JI and CDM projects, it is crucial to keep two key points in mind. There probably are some real win-win solutions where positive externalities can be achieved at no cost whatsoever to climate change objectives. However, advocacy groups whose primary interest is in one or another of the positive externalities--whether it be biodiversity, agricultural yields, or public health--may exaggerate the likelihood of achieving win-win solutions. They may at times support strategies that will further their objectives at the expense of some progress on climate change. A very cautious approach to garnering positive externalities is justified, therefore, with careful analysis of all possible costs of linking a number of different objectives into a single Protocol. The "slight" modifications that might make a carbon sequestration project work effectively for biodiversity conservation, for example, might in fact raise its implementation cost, limit its replicability, or in other ways cut back on its effectiveness in achieving its primary goal of reducing atmospheric carbon levels. Moreover, factoring in other requirements for project design, such as the need to ensure additionality and prevent leakage (see below) may limit the range of opportunities to work simultaneously for biodiversity conservation.

In addition to such trade offs between externalities and climate change goals, there also will be trade offs among the different externalities achievable through the Kyoto Protocol. The different views among environmental groups about how the Protocol should be implemented illustrate this possibility. Some groups working on biodiversity strongly support carbon sequestration projects, and therefore support international JI or the projects proposed under the CDM. Other environmental groups are opposed to such projects, however, because they believe on moral or equity grounds that polluting countries should be required to reduce their own emissions rather than reducing emissions elsewhere. For those holding this view, the Protocol provides an opportunity to further their principles of international equity and implementation of the polluter-pays principle. This is accomplished only if there is no international JI or CDM, however, and thus little opportunity to use the Protocol to achieve biodiversity externalities.[24] Thus, the two external objectives can be in direct conflict, irrespective of their impacts on the primary climate change goals of the Protocol.

For both of these reasons, we must be sure, in our eagerness to further other goals through the Kyoto Protocol, that we carefully analyze the linkages we propose, and do not run the risk of hindering the accomplishment of climate objectives in the process. Further empirical study is needed to determine the extent of opportunities to generate positive externalities through these projects.

Sources of Uncertainty in Carbon Sequestration

Among people working on climate change, doubt is often voiced as to whether it is realistic to give credits toward emission reduction targets for carbon sequestration activities. For a number of reasons, carbon sequestration is considered very risky, leading some experts to feel that credit should only be given for emission reduction activities. This section explores the risks posed by carbon sequestration, considering how significant they are and in particular whether they are worse for carbon sequestration than for emission offsets.

Measurement and Verification

As discussed above in the introduction to the carbon cycle, measuring carbon sequestration in forest ecosystems is not easy. It is feasible to measure stocks and flows of carbon in an individual tree over its life-span, to observe how much carbon is absorbed each year as it grows and how much is stored in its biomass. From this we can calculate the amount of carbon absorbed annually and stored by the trees in a forest, whether it be a young, fast-growing plantation or a mature, mixed-species old growth forest. However, understanding the carbon flows into trees is only part of understanding the carbon flows in the forest ecosystem. The surface debris, underground root systems, and organic matter in the soil all contribute to the carbon cycle impacts of a forest ecosystem. The flows of carbon into the atmosphere are much less well understood than the flows engendered by the above-ground portions of the growing trees, and they are much harder to measure.

At the level of an individual forest management project, it is possible to measure the full carbon flows into or out of the ecosystem as it grows and changes over time. This is being done on an experimental basis in pilot carbon sequestration JI. However, this is a detailed and costly process. Moreover, the results often cannot be transferred to other projects or used to estimate the carbon cycle impacts of a whole country's land use pattern. The particular carbon flows into or out of a forest are specific to that ecosystem, and will depend on its location, species composition, and the history of its management over perhaps the past century. Therefore it is difficult, at best, to generalize from the study of one ecosystem about the carbon cycle impacts of a whole country's forest stock.

The length of project cycles for carbon sequestration also makes measurement difficult. Such projects may not begin to affect carbon flows for years. Actually verifying the impact of such projects,

[24] Note that others would argue that international JI does embody the polluter-pays principle because firms pay to reduce global emissions even if they don't actually reduce their own.

rather than projecting them based on project design and the impacts of comparable activities elsewhere, will require long-term monitoring.

Measuring the impact of forests on carbon stocks and flows is distinctly different from measuring industrial carbon emissions. In a stand-alone plant, it is relatively easy both to estimate carbon emissions based on fuel inputs and to measure them directly using end-of-pipe sensors. Factory emissions are not expected to change over time; if changes do occur, for example due to changes in technology or in the carbon content of the fuel burned, they will be easy to identify and monitor. It also is easier to assess total industrial emissions for a whole country than to estimate the net impacts of the country's forests, because generalizations are not as unreliable. Moreover, emission project impacts will occur fairly quickly; as soon as new technology is installed, we can measure its impact on emissions, rather than having to track them for decades.

In a power plant connected to an electricity grid, however, the measurement problems will be considerably more complex. Efficiency improvements in one plant in the grid can affect power production and therefore carbon emissions throughout the grid. To observe the impact of a single project, therefore, it is necessary to monitor production and output throughout the system. Where two plants in the grid are modified the problem becomes even more complex, as it will not be possible to attribute changes in total carbon emissions to a specific project. Measurement and verification will thus pose significant difficulties in energy projects as well as in forest ones.

Additionality and Leakage

Articles 6 and 12 of the Protocol permit projects on the condition that the reduction in emissions or enhancement of sequestration be additional to what would happen otherwise. While at face value the meaning of "additionality" may seem simple, in fact it is difficult to define precisely and more difficult to guarantee in advance that it will be achieved. If there were nationwide baselines and targets for carbon sequestration, as there are for emissions in the case of JI between Annex I countries under Article 6, then national progress would be evaluated based on whether the target was achieved. However, because establishing such nationwide baselines is difficult, we must deal with additionality at the project level.

Imagine a hypothetical forest site threatened with destruction to make way for a coffee plantation. In the absence of the project, the forest would be bulldozed, the logs sold, and coffee planted. With the project, the forest is saved. If all goes as hoped, the local community which held the land before manages it sustainably, selling nontimber forest products to provide a needed increase in their incomes. Managed trees provide windbreaks which prevent soil erosion, increasing agricultural output. At the community scale, the project clearly provides additional carbon sequestration, since the alternative would have been coffee instead of forest.

This project-level test of additionality is the one that has been applied to approve carbon sequestration projects for inclusion in the JI pilot phase. Knowing that a particular forest area was threatened with destruction, alternate activities have been proposed that save the forest and establish a more sustainable management system that benefits local groups so they can keep the resources rather than selling to an outside buyer. Based on a project plan that explained how a specific threatened forest would be saved, the resulting carbon sequestration was considered to be additional to what would have occurred otherwise.

However, often a project that appears to be additional based on its design can turn out not to be, for a variety of reasons. This problem is referred as "leakage," when an activity is not prevented, but is simply displaced. The risk of leakage, and the difficulty of anticipating all mechanisms through which it might occur, are major arguments against carbon sequestration projects under the Protocol.

Suppose that the coffee grower in our hypothetical example finds an alternate plot of land to deforest for coffee. In this case the project actually is not additional; it has simply pushed the coffee plantation to a different site. It might even have moved the plantation to a less desirable site, where more land (and therefore more forest destruction) will be needed to grow the same amount of coffee. In this case it would actually cause a net decrease in carbon sequestration relative to the no-project scenario. Analogous shifts could occur at the national scale; if no domestic land is available, the grower might move over to the next country. One way to head off this risk may be to ask the specific developers to guarantee that they will not move their activities to a different site. However, this will not prevent their competitors from moving into the market to fill the void and clearing adjacent forest for coffee.

The emergence of leakage problems also will depend on the time frame within which the project's benefits must be additional. In the short run, a project may appear to be additional even over a large area of land. It may, however, be only a matter of time before the competing use bounces back and finds a way to establish itself. Both demand for and supply of coffee are likely to be growing due to population increase in consuming and supplying countries, so the plantation that might be displaced today by a carbon sequestration project may find it financially feasible to pay more for that land in the future. Thus, the net increase in sequestration provided by the project will be only short-lived. There will be a genuine addition to the amount of carbon sequestered, but if the displaced activity reestablishes itself in a few years it could be substantially lower than anticipated.

This problem is addressed in the debate over how to define the boundaries of a project area, and thus what activities must actually be considered leakage. Some would argue that leakage must occur within the project region; others prefer that it extend to the entire country; still others--those who oppose such projects altogether--argue that leakage must be monitored globally. More work is needed to develop accepted definitions of leakage and methodologies for monitoring it.

Widespread introduction of carbon sequestration could increase the pressure to convert the remaining land to other uses. As land is withdrawn from the market and put into carbon sequestration, the supply remaining for other uses will decline, possibly enough to raise its price. If the price rises, the opportunity cost of holding land in sequestration also will rise, creating pressure to convert remaining land to other uses more rapidly than would have occurred otherwise.

Whether such shifts actually occur will depend on the nature of the market for land conversion, how integrated the regional economy is, how freely capital can move to other comparable areas, whether other suitable areas for cultivation exist, and so on. The potential for leakage can be anticipated to some extent; this will provide one criterion for choice among proposed JI and CDM projects. However, it will clearly be difficult to predict fully whether or for how long a given project's carbon cycle impacts really will be additional.

Additionality and leakage will be issues for emissions projects under Articles 6 and 12, as well as for carbon sequestration. There are several dimensions to the comparison. First, as mentioned above, for stand-alone plants measurement of carbon emissions is fairly easy, and it should be feasible to establish project-level additionality. For power plants connected to an electricity grid, however, establishing the contribution of a single project to changes in output and emissions for the whole system will be very complex.

Even for a stand-alone plant, this will not be sufficient to establish whether the emissions reductions would have been undertaken in the absence of the project. Many projects to reduce carbon emissions also improve energy efficiency and, therefore, may be profitable for the firm. How do we know that the firm was not planning to reduce its emissions anyway, using other sources of funds? Moreover, in public enterprises such as power plants, foreign aid agencies sometimes invest in equipment to improve energy efficiency and reduce emissions. These funds, like those available under Annex I JI and the CDM, might simply displace investments that the government would otherwise have made itself, constituting a disincentive for the government to address the problems on its own. It will be hard to tell whether this is the case. The government has a strong incentive to show that it has no other resources available, lest it lose the foreign resources, so it will not be willing to make information available with which to assess additionality. In this respect, therefore, establishing additionality may be difficult.

Market-wide additionality also will be an issue under emission reduction projects. Such projects may convert power plants from coal to other fuels. This will reduce global demand for coal, possibly enough to push its price down and lead other enterprises to choose it over other more expensive fuels. While the net impact will be a drop in coal use, it may not be by as much as the reduced use from power plant conversion.

Project Failure

Because they are complex and their success depends more on biological and human systems than on engineering and machinery, carbon sequestration projects have a significant risk of failure. For example, carbon sequestration might be anticipated from replanting tropical hardwood species after harvest in the rainforest. If, in fact, those new trees do not do well and half of them die, then the project will be unsuccessful in accomplishing its sequestration goals.

Such project failure could occur because our biological knowledge was faulty; we planted the wrong species, or we did not understand how the seedlings take root. Often, however, it occurs because of other implementation problems; forest workers had no incentive to tend the seedlings properly, we overlooked the fact that villagers grazed their cattle on the clearcut forest sites, or we didn't know that farmers would plant crops on the cleared forest sites. Anticipating as fully as possible the social and economic context in which a project is to be implemented will be crucial to its success.

The extensive experience of development agencies with similar projects may offer us experiences from which we can learn about how to design and implement effective carbon sequestration activities. While development projects typically target agricultural sector output, sustainable management of natural resources, or rural incomes, rather than carbon sequestration, the logistics of their implementation are likely to be similar. Consequently, it will be important to look at the development assistance experience with natural resource management projects in order to identify strategies that work and pitfalls that can be avoided.

Project success is clearly an issue in industrial emissions reductions projects as well. Such projects require the collaboration of a constellation of conflicting stakeholders which can be as difficult as the complex of the human factors affecting forestry projects. Unanticipated problems in the management and maintenance of a plant may determine whether expected reductions are really achieved. In some cases, these may be easier to predict and manage than forest-related failures, because they may be contained within a single firm and run by a private enterprise, rather than depending on a community and on complex international and intercultural relationships. In many cases, however, projects designed to reduce industrial emissions could also fail to deliver as promised.

Financial Mechanisms to Reduce Risk

Articles 6 and 12 both allow Annex I countries to meet some portion of their targets by investing in projects internationally rather than by reducing their own emissions. Article 6 allows Annex I countries to invest in each other, while Article 12 allows them to invest in nonsignatory countries. Although it is not explicit in the language of the Protocol, it is assumed that these projects may involve either emissions reductions or enhancement of carbon sequestration.

These provisions take advantage of the economic gains that arise from reducing emissions or enhancing sinks in least-cost ways, rather than requiring each country to reduce its impact on the atmosphere through domestic responses. The effectiveness of this market-based approach will depend on the mechanisms for how it operates, however; if it is not streamlined and efficient, the world will not reap the welfare gains that are theoretically possible from such a system. From the perspective of environmental groups interested in these mechanisms as new financing sources for forest and other biodiversity conservation, they must work efficiently or the funds will not become available as hoped.

As we saw in the previous section, carbon sequestration projects do pose significant risks, which may be considerably worse than emissions reductions projects. As a result, firms seeking emissions credits may be reluctant to invest in carbon sequestration unless mechanisms can be designed to guarantee that they will receive the emissions offsets they seek and will not have any surprises once the carbon sequestration project reaches its mid-term or final evaluation. In addition, access to information could limit investment; firms seeking credits may not know how to find viable projects, so the transaction costs of undertaking carbon sequestration projects could be very high.

Clearly some of the strategies for reducing the risks of carbon sequestration are technical; conducting detailed research on the carbon flows associated by different ecosystems, developing reliable land use/land cover information systems, monitoring vegetation cover, and estimating carbon flows. However, even with current technical knowledge, risk also can be minimized through market mechanisms that will enable such projects to work.

The first institutional mechanism for reducing risk is developing a reliable international system for certifying carbon sequestration projects that will receive emissions credit. The Protocol calls for identification of one or several institutions responsible for certifying the emission offsets obtainable from CDM projects, but does not go into the mechanism in further detail. Several issues will be important in the certification system. First, although the Protocol only calls for certification of CDM projects, it is likely to be just as important for Annex I JI projects in order to attract investor interest. Certification through the CDM will provide some certainty that offsets really will be achieved, and investors are likely to want the same certainty under Annex I JI.

A related issue concerns who may certify Annex I JI and CDM projects. It is expected that under the CDM a group of institutions will be accredited to certify projects, such as the Forest Stewardship Council or the International Organization for Standardization. The same institutions could be asked to take on certification of Annex I JI projects as well. In addition, though, national governments that have implemented pilot JI programs already have established their own criteria and processes for certifying both carbon sequestration and emission reductions prior to approval. It is easy to imagine that investors will prefer to invest in projects certified by their own countries, to guarantee that their governments recognize their JI and CDM projects and will grant them emission offsets. Moreover, obtaining project certification through national governments may be more efficient than working through a large international organization. We might, therefore, expect to end up with a system wherein both international and national organizations certify CDM and Annex I JI projects, and agreements are developed to recognize each other's certifications. This would introduce some flexibility into the system, while also ensuring that all JI projects were certified by recognized institutions.

Another certification issue relates to what projects are certified for, and how project planners can design to the certification requirements. Presumably certification will cover several aspects of the project; how much carbon sequestration will be achieved, how many emission offsets may be granted, that the project is indeed additional, and that leakage is not expected. For project design to be efficient and effective, it will be helpful for an international institution, perhaps the one chosen to manage the CDM, to develop generally accepted guidelines that explain the certification system. Such guidelines should also reflect the limited experience to date with carbon sequestration projects and the much broader related experience designing and implementing forest-sector projects in the developing world.

Another certification issue likely to arise concerns timing. In order to obtain up-front JI or CDM funding, projects would have to be certified before they are begun, based on their plans; otherwise investors will consider the risk too great to commit their funds. However, it will not be possible to verify the sequestration actually achieved, and whether leakage in fact occurred, until the projects have been operational for some years. This may call for a double certification process, once at the start to obtain initial funding, and the second time at the end of the project to confirm that carbon sequestration has occurred.

A second mechanism that can make the market work more smoothly will be the growth of private brokers who specialize in matching firms seeking emissions credits with groups seeking funding for carbon sequestration activities. Such brokers will make information readily available, thereby reducing transaction costs to both investors and project developers. Under the pilot JI projects this has already begun to occur. Environmental groups and some private companies have designed carbon sequestration projects and sought private industrial investors interested in funding them to counter-balance their carbon emissions. This is likely to develop further as the Protocol is implemented. This role also may be played by the development agencies, which are already engaged in implementing projects that could be modified easily to provide carbon sequestration benefits, and so are well placed to become suppliers of emissions offsets.

The risk of carbon sequestration projects also may be reduced by grouping them into funds analogous to mutual funds, which would pay off in emissions credits rather than in financial dividends. The managers of such funds would identify projects certified by national or international certification boards. The returns on the fund would, over time, be based on the track record of the projects included. In order to build such a track record, the fund might need an initial influx of capital with which to invest in the first set of projects. Once some of the results were in and firms could be sure that the fund was reliable, they would be willing to put their own resources in, confident that they would indeed receive the intended offsets. Funds may further reduce risk by holding more potential offsets than they actually sell. This will provide a reserve in the likely event that some projects do not deliver their anticipated sequestration or turn out to have leakage problems.

Several examples of such funds already are in existence or have been proposed. Under the U.S. initiative on JI, a group of utility companies joined together to create Utilitree, a mechanism through which they pooled their resources to invest in JI projects and divide the risk of individual project failures. While this is not a publicly sold fund, it does clearly show that investors are aware of the reduced risk from investing in a group of projects, and suggests that carbon sequestration funds would find a market. The government of Costa Rica also has created a national carbon fund that invests in certifiable tradable offsets. The fund holds a significant reserve of projects beyond the amount of offsets sold, which they hope will be sufficient to cover them given their estimate of the probability of project failure.

The World Bank also has proposed the creation of a carbon investment fund, although it is not clear yet whether it would include carbon sequestration as well as emissions controls. The Bank is particularly well placed to set up such a fund because it already has hundreds of projects ongoing, financed through their conventional operating funds, which could easily be modified to provide carbon offsets. Consequently, they would not face a long start-up period for establishing the reliability of their projects, and could begin making offsets available relatively quickly.

Another mechanism for reducing the risk of carbon sequestration projects might be to make the suppliers of emission offsets--the project developers--financially liable for their own success. Investors (or funds) will put money into certified carbon sequestration projects expecting certain offsets to result. At the end of its life, when the project is re-evaluated, the anticipated sequestration might not be realized. With supply-side liability, project managers would have to purchase other carbon offsets on the market with which to compensate the initial investors. Such a shift in liability from the demand side to the supply side would also shift the risk from the investors in carbon sequestration to the institutions that receive and use their funds. It would immediately force much more rigorous standards on those wishing to receive JI or CDM funds to develop forest projects, possibly enough to decrease sharply the supply of projects and emissions offsets. To achieve some balance, perhaps liability could be shared by the investor and the project developer. Alternately, if the market becomes sophisticated enough, the insurance industry might find it financially interesting to create new instruments with which to insure against the failure of carbon sequestration projects, reducing risk to both investors and offset suppliers.

Emissions Permit Trading System

Article 17 of the Protocol authorizes the establishment of a trading system for carbon emission permits. Many possible models for a permit trading system could be envisaged; probably the best known is that used in the United States for trading in sulfur dioxide (SO2) emissions permits under the Clean Air Act.[25] All models would have a few elements in common. Each country participating in the system would establish a cap on total emissions in their country. National governments would issue emission permits to individual firms, up to the number permitted by the caps.[26]

[25] 42 U.S.C. §§7401-7671q, <bi>ELR Stat.<d> CAA §§101-618.

[26] These permits could either be given away for free at the start or auctioned off. Giving them away is more likely

All firms participating in the system would be required to hold permits to cover all of their emissions each year. Firms would have to install technology continuously to monitor their emissions, so that the sufficiency of their permit holdings could be verified. Permits would be bankable; that is, they could be used in the year in which they were awarded or purchased, or in any year after that. Firms with low abatement costs would reduce their emissions and sell their permits, whereas firms with high abatement costs would purchase additional permits beyond their initial allotment rather than making the expenditures necessary to reduce their emissions. Emissions could be traded on domestic markets within each participating country or internationally among firms in participating countries. The price of permits would settle at an equilibrium at which global emissions were reduced to the amount set by the total of the caps, although emissions in some countries might exceed their caps and emissions in others might be lower.

The question of interest to us is whether or how such trading systems could incorporate the carbon sequestration services of natural vegetation as well as industrial emissions reductions. Technically, carbon sequestration in forests clearly could offset some of the emissions caps required under a permit trading system; the issues that arise concern the structure of the system.

One strategy would be to expand the entire trading system to integrate fully the emission or sequestration of carbon from land cover along with emissions from combustion.[27] In this scenario, the land cover baseline would be determined based on the net flow of carbon into or out of each area of land included in the system. Forests that are now net sinks would have negative emissions, while those that are net sources would have positive emission rates. In theory, net emissions from land use would be added to those of industrial plants in determining the country's cap.[28]

In such a system, the initial allocation of permits would be to both emitters and sequesterers, for some amount related to their activities during a base period. Owners of forest sinks could harvest their timber, which would entail using up the permits that they had been awarded. Alternately, they could manage their forests so as to increase their sequestration rates, creating additional new permits. At any time they could sell their permits; however, if they were not holding permits when they chose to harvest, they would have to buy them just as would an industrial plant that increases its emissions. Owners of forests that are now sources rather than sinks could reduce their emissions by allowing the forests to grow steadily.

This system is quite elegant in theory, and would not raise questions about additionality when considering individual forest management activities. However, amassing the detailed carbon flow data needed to allocate starting permits or to award additional ones as the forests grow will be difficult in practice. As discussed above, measuring the actual flows of carbon into and out of forest ecosystems on a

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to make the system politically acceptable to powerful polluting industries; this factor led to SO2 emission permits being given away in the United States when that system was introduced. However, giving away the permits eliminates the possibility of tax shifting; that is, replacing other taxes with the proceeds from the permit auction. It also raises the issue of how to allocate permits at the start. While this strategic choice is crucial in many respects, it does not affect operations of the permit market or the potential role of forestry in such a market.

[27] This approach is briefly sketched in Commission for Environmental Cooperation, Analysis of the Potential for a Greenhouse Gas Trading System for North America, Phase 1: Institutional Analysis and Design Considerations 59-60 (1997).

[28] Note that such baselines and caps would be lower than those under the Kyoto Protocol, because under Kyoto forests are only added into the baseline if they are a net source of emissions, and their sequestration of carbon is not deducted either from the baseline or from the 2008-2012 target. *See* Kyoto Protocol, *supra* note 1, art. 3.7.

nationwide basis is very complex. This could make nationwide integration of forests into a trading system unworkable.

A less elegant but more practical alternative to integrating all forests into the system would be to include only certain forest sectors--those whose role in the carbon cycle can most easily be identified. This would be analogous to limiting the U.S. SO2 permit trading system to power plants, because they are the key players and it is relatively easy and cost effective to track their emissions. This kind of limited inclusion of forests in the trading system would not cover all land-based carbon flows, but it might pick up the most important ones, and might be easy enough to make estimation of all flows from the key sectors feasible. A proposal of this type was made at the Bonn SBSTA meeting by a group of Annex I countries termed the "umbrella group." Their scheme would allow new emission permits to be created by undertaking Article 3.3 forest activities; those permits could then be put on sale within the international trading system.

A third alternative is to integrate individual carbon sequestration projects into the international emission permit trading system. Under such an arrangement, firms could obtain more permits by investing in carbon sequestration projects in other countries--perhaps non-Annex I countries--as well as by buying them in the market. The carbon trading proposals developed by the Commission for Environmental Cooperation include such projects for international carbon emission offsets.[29] That paper explores the possibility of a North American carbon emissions permit trading system. It assumes that caps will be set for the United States and Canada, but that at the start Mexico would participate only as the recipient of JI projects. This could be a viable model for an international permit trading system under the Protocol, as well. Such a strategy would, of course, raise all the questions discussed above with regard to carbon sequestration under Article 6 JI and under the CDM: certifying sequestration achieved; risks of additionality, leakage, and project failure; and strategies to minimize financial risks and ensure that the market works smoothly; to name a few. In the short run, however, it may be the most realistic way to envision the integration of carbon sequestration into an international permissions permit trading system.

Conclusion

The Kyoto Protocol offers several clear opportunities to improve forest management and enhance biodiversity in the process. However, as they are written, the forest provisions of the Protocol may not be as effective as they could be in terms of climate change objectives, because they do not reflect the complexity of the role of forests in the carbon cycle. In particular, in giving credit for reforestation but not for conservation or sustainable management of standing forests, they may actually be encouraging development of land-cover patterns that are a net source of atmospheric carbon rather than a sink. Environmental groups concerned both with climate change and with biodiversity conservation should work to modify these provisions insofar as possible in upcoming meetings related to the Protocol.

While the Protocol does create opportunities to support biodiversity conservation, we must be careful that our interest in these positive externalities not lead us to argue for provisions that could hinder the primary objective of preventing climate change. Our review also suggests that there could be significant

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[29] *See* Commission for Environmental Cooperation, *supra* note 27, at 43-64.

risks to climate change objectives from carbon sequestration projects, although it is not clear that these are any greater than those resulting from emissions reduction projects. These risks can--and should--be minimized, both through technical mechanisms such as research and information systems development, and through introduction of financial instruments that can reduce both the risk and the transaction costs faced by would-be investors in carbon sequestration.