Biodiversity, climate, and the Kyoto Protocol: risks and opportunities

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Climate change is occurring at the same time as another problem of global and historical proportions – the sixth mass species extinction crisis in the history of life on earth. Wide-scale deforestation is fueling climate change and biodiversity loss, and is expected to greatly accelerate biodiversity loss and species extinctions. Recognizing the intimate interconnection between these two global problems and designing resilient actions that address both simultaneously is more important than ever; humanity has neither the time nor the financial resources to treat these challenges separately and sequentially. We must establish an international framework to encourage synergistic actions that capture multiple benefits while avoiding negative trade-offs. The Kyoto Protocol, as currently written, does little to advance such convergent solutions, and in many ways could unwittingly promote further biodiversity loss. Here we outline the risks associated with this climate treaty and suggest possible approaches that could capture otherwise lost opportunities.

Front Ecol Environ 2003; 1(5): 262–270

Human activity has resulted in the release of nearly half a trillion tons of greenhouse gas (GHG) emissions over the past 100 years, and, under some business-as-usual scenarios, an additional trillion tons could be released this century (IPCC 2001a). This trend is driving climate change, and is likely to result in enormous losses of both economic and natural capital if not properly addressed (Figure 1).

The Kyoto Protocol on Climate Change, framed in 1992 and expected to come into force in the near future, represents an important milestone in tackling this pressing global problem. Although many scientists believe that the Protocol's initial emissions targets represent only a tiny fraction of the reductions that will ultimately be needed to stabilize the atmospheric concentrations of GHGs, it is widely seen as a valuable first step in building the kinds of international institutions and cooperation that will be necessary to adequately address this unprecedented challenge.

However, as it is currently written, the Protocol could be interpreted in ways that are counterproductive with regard to another acute problem of global magnitude: the large-scale destruction of important ecological habitat and biodiversity.

In a nutshell:

- Deforestation is a major contributor to climate change and biodiversity loss
- The current Kyoto Protocol fails to adequately include carbon mitigation options that could reduce ecosystem and species destruction, while encouraging others that may result in adverse trade-offs
- Policy makers have the opportunity to promote actions that simultaneously protect climate and biodiversity, while achieving substantial ecological, cost, and sustainable development benefits
- The prevention of deforestation, ecological restoration of fragmented landscapes, and reforestation on degraded lands are examples of such synergistic solutions

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Biodiversity loss and climate change

Human-induced land use, land-use change, and forestry (LULUCF) activities worldwide currently account for 20–25% of annual global GHG emissions, or roughly 1–1.5 billion tons of carbon (Watson *et al.* 2000). This encompasses influencing flows within the carbon cycle from activities such as forest removal, hydroelectric damming, road expansion, urban sprawl, and soil degradation and losses from agriculture, ranching, and logging. It also includes the annual destruction of an estimated 6–10 million ha of tropical rain forest, harboring some of the planet's most biologically diverse and abundant flora and fauna (Watson *et al.* 2000; Figure 2).

The rapid loss of forests is not only contributing to the buildup of atmospheric carbon dioxide (CO_2), but is also directly undermining the world's biological resources, ultimately precipitating species extinctions and biodiversity loss. This, in turn, jeopardizes the climate adaptation services which many complex ecosystems deliver, further exacerbating the potential impacts of climate change.

Maintaining high biodiversity has been linked to ecosystem resilience in the face of common climate change-related shocks such as storms, floods, fires, and droughts (Abramowitz 2001). Ecosystems that have more diversity in terms of species, structure, and function provide more alternatives for transferring energy and nutrients, and have a greater capacity for resisting and reacting resiliently to such shocks compared to systems with low biodiversity, which are more likely to decline or even collapse and not recover (Folke *et al.* 2002). Furthermore, on

Figure 1. *(left) Threatened blue poison dart frog* (Dendrobates azureus) *and (right) orangutan* (Pongo pygmaues). *Climate change is already impacting biodiversity and is expected to greatly accelerate species loss, since many plants and animals are unable to adapt to such rapid environmental changes (IPCC 2001b).*

a local level, forest protection can help moderate climate variability directly. For example, trees and vegetation can provide climate regulation services by trapping moisture and cooling the earth's surface (Krieger 2001).

Problematic Kyoto Protocol provisions

The Intergovernmental Panel on Climate Change (IPCC) has indicated that improving LULUCF activities could prevent, reduce, or offset 60–90 billion tons of carbon (tC) emissions by 2050 (IPCC 2001c; Watson *et al.* 2000). This represents 6–9% of the roughly one trillion tC reductions needed, according to some scenarios, to stabilize atmospheric GHG concentrations at 550 ppm, twice the preindustrial level (IPCC 2001a).

Among land-based activities, forest protection represents one of the most cost-effective carbon mitigation options (Trexler and Haugen 1995; Niles *et al.* 2002), and also delivers valuable collateral benefits, such as slowing biodiversity loss and protecting valuable ecosystem services. However, post-Kyoto negotiations have resulted in a climate treaty in which the prevention of deforestation is not considered a creditable activity under the Clean Development Mechanism, the key framework covering mitigation activities in developing countries.

As currently written, the Kyoto Protocol allows emissions reductions to be met through just two types of LULUCF activities: reforestation (the conversion of recently deforested land to forestland), and afforestation, the conversion of land which has not been forested for at least 50 years to forestland. In some cases, these activities can benefit conservation and mitigate climate change. However, if these projects are carried out with inadequate or ill-conceived rules, guidelines, and standards, there is a high risk of actually increasing emissions while also causing negative ecological and socioeconomic impacts.

The conversion of tropical lands to plantations is a case in point. Planting inappropriate flora or invasive exotic species can exacerbate soil erosion, water loss, and pest and pathogen attacks (Figure 3). In addition, as

Figure 2. *Human-induced forest fires are major contributors to climate change and species loss.*

Figure 3. *Clearing intact forests for crop plantations often leads to a host of unintended and undesirable outcomes, such as soil erosion and compromised watersheds.*

noted in the IPCC Third Assessment Report, nitrogen fertilizers used in tropical ecosystems (which are often phosphorous- rather than nitrogen-limited) can result in the release of substantial amounts of N_2O (nitrous oxide), a potent greenhouse gas. In phosphorous-limited ecosystems, such applications can generate 10–100 times the emissions compared to the same fertilizer input in nitrogen-limited ecosystems (IPCC 2001a).

Wetlands, natural grasslands, heathlands, and other non-forest habitats are also threatened by afforestation, even though research indicates that more carbon may be released than is absorbed when some of these habitats are replaced with trees (Watson *et al.* 2000). The introduction of exotic, fast-growing, single-species plantations, managed for rapid productivity through the infusion of fertilizers, biocides, irrigation, and genetic modification, may also adversely change the surrounding native floral and faunal composition (UNDP 2000).

Beyond the conversion of native ecosystems to plantations or other non-native systems, primary forests are at great risk of being severely fragmented, degraded, and lost. This stems from the Protocol's problematic definitions (and lack of definitions) of what constitutes forests, deforestation, and degradation. Deforestation, for example, may be preceded by degradation until just 10% of the original forest cover and an equivalent amount of carbon remains. If this remnant were then deforested, only the final 10% of the original carbon pool would be counted as emissions (Schulze *et al.* 2002).

Ecological restoration is also limited by Protocol rules. For example, where 30% of the land is already covered by forests, projects are likely to be ineligible for reforestation credit, according to the most recent Marrakesh Accords, since they are already considered to be forests. With such rules in place, many projects seeking to restore biodiversity corridors that link fragmented landscapes will not receive credit, even though such corridors can be critical to maintaining viable populations of species.

As the above examples illustrate, the Kyoto LULUCF rules could unwittingly lead to several negative outcomes. A greater long-term concern is the failure to include the conservation of endangered biodiversity habitat as a creditable and tradable GHG mitigation option in future mandated reductions (Niles 2002). This could result in the irreversible loss of many globally important floral and faunal species, and require more costly carbon mitigation substitutes.

Figure 4. *Given projected bioenergy demands and current climate treaty incentives, the rapid growth of biomass plantations such as this sugarcane estate could lead to the conversion of many intact rainforests and other valuable ecosystems.*

Renewable energy pitfalls

In addition to the potential risks described above, the Kyoto Protocol's crediting of renewable energy options that displace GHG-intensive fossil fuel resources poses another potential threat to biodiversity, most notably from the expansion of hydropower and bioenergy.

The United Nations Development Programme indicates that an additional 800 million ha of land would be needed this century to support the projected biomass requirements under a medium-growth energy scenario (UNDP 2000; Figure 4). These space demands, along with the chemical inputs used to increase biomass crop productivity, may cause considerable negative ecosystem and biodiversity impacts. Furthermore, when forests are cleared to grow bioenergy crops, most of the carbon previously stored in the intact ecosystem is released into the atmosphere.

Land- and water-use conflicts could arise if large-scale, water-intensive biomass plantations compete with food production needs. By 2100, an additional 1700 million ha of land may be required for agriculture. When combined with the 800 million ha of additional land needed to support the medium-growth bioenergy scenarios, this will greatly increase threats to intact ecosystems and biodiversity-rich habitats. Given that water shortages could seriously affect about half the world's population as early as 2025, aquatic and highly water-dependent species also face increased threats from water diversion projects.

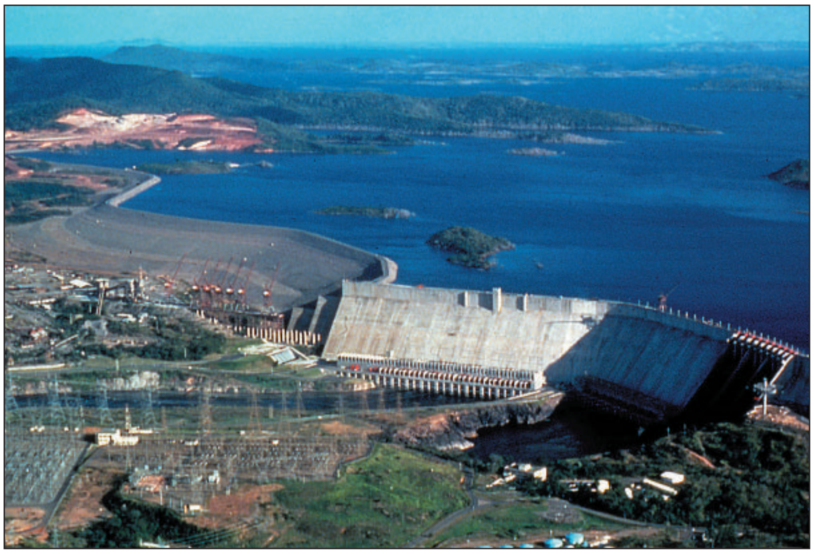

Figure 5. *The Guri reservoir in Venezuela is an example of the kinds of large, shallow dams that can generate greater net carbon emissions than their fossil fuel alternatives.*

In addition to biomass production, hydropower can also cause considerable problems for existing ecosystems and biodiversity. Hydropower has grown explosively this past century, and is frequently singled out as a top "green" energy option; however, it is often not as climate-friendly as people believe. Recent research indicates that hydropower dams account for roughly 7% of total global GHG emissions and this could increase to 15% given projected growth, yet such emissions are not fully accounted for in the GHG inventories relied upon for the Kyoto Protocol (St Louis *et al.* 2000).

According to data prepared for the World Commission on Dams, the Amazonian floodplain in its natural state releases about 800 $gC/m^2/yr$, and a tropical forest absorbs about 300 $gC/m^2/yr$. In contrast, large dams release between 2000 and 4000 $gC/m^2/yr$ (WCD 2001). In the case of hydropower facilities with large, shallow dams located in warm climates, the associated biomass decay can mean that the climate benefits are actually negative relative to the fossil-fueled generation they displace (Figure 5). For example, recent measurements made at Brazil's Tucurui dam indicate that this hydroelectric project releases 1.4–2 million tons of CO_2 per terawatt-hour generated (tCO_2/TWh), which compares poorly with typical bituminous coal plant releases of 0.8–1.2 million tCO_2/TWh and natural gas-fired combined-cycle plant releases of 0.3–0.5 million tCO_2/TWh (Fearnside 2002; WCD 2001).

Brazil is already the world's third largest producer of hydroelectric energy, accounting for 90% of the nation's supply, and there is still considerable unexploited hydroelectric potential. The rivers in the Amazon Basin contain about a fifth of the world's fresh water, with enough flow for about three times the current hydroelectric output. Additional capacity has been growing at roughly 6500–7500 MW/yr. Hydroelectric expansion in the Amazon threatens to fragment aquatic ecosystems, and to provide an infrastructure that could lead to further fragmentation of the surrounding terrestrial ecosystems.

Not surprisingly, such diversion and fragmentation has contributed to serious species loss from riparian and aquatic habitats (Rockström *et al.* 1999). The World Conservation Union estimates that at least 20% of aquatic species, more than 10 000 species in total, are threatened with extinction worldwide (IUCN 2002), while more comprehensive national and regional assessments indicate far greater proportions of threatened species and populations (TNC 1998; Bräutigam 1999).

Historically, hydroelectric project planners have not addressed or adequately dealt with environmental impacts (McAllister *et al.* 2000; McCartney *et al.* 2000; Pringle 2001; WCD 2001). An internal survey of World Bank hydroelectric dam projects found that 58% were planned and built without any consideration of downstream impacts, even when those impacts could have been shown to cause coastal erosion, pollution, and other problems (Dixon *et al.* 1989). Table 1 summarizes some of the threats which certain climate-friendly activities can pose to terrestrial, freshwater, and marine biodiversity.

■ Convergent solutions

Protecting climate and biodiversity

Concerns about adverse biodiversity impacts from poorly designed and implemented carbon mitigation projects are being expressed by a growing body of biodiversity scientists, environmental experts, and economists (eg Frumhoff *et al.* 1998; IUCN 1999, 2000; Anisimov 2001; Gillison 2001; Noss 2001; Swingland *et al.* 2002).

The United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, and the Ramsar Convention on Wetlands are beginning to address the eradication of primary forests and other natural

Table 1. Potential threats to biodiversity associated with certain climate-friendly activities

Ecosystem	*Activity*	*Potential biodiversity trade-off*
Terrestrial	Bioenergy farms Monoculture tree plantations	Biodiversity loss if planted on intact, sensitive, or high-value ecosystems Soil erosion and river contamination Agrochemical runoff of fertilizers and biocides
	Coal–CO_2 aquifer sequestration	Contamination from coal extraction wastes
	Natural gas exploration and pipelines	Roads into wilderness areas and human encroachment
Freshwater	Hydropower Irrigation for higher yielding bioenergy farms	Aquatic species loss and riparian ecosystem fragmentation and destruction Reduction of ecological flows
	Water for coal-bed methane/ aquifer sequestration	Contamination of watershed
Marine	Deep ocean CO_2 sequestration Ocean fertilization	Large-scale mortality of deep-sea organisms with potential disruption of the biogeochemical cycles on which they depend Changed ocean ecology Deep ocean hypoxia or anoxia Alteration of ocean food webs

biomes by promoting biodiversity-friendly approaches to carbon mitigation. The Kyoto Protocol could follow their lead by encouraging actions that avoid trade-offs and secure multiple benefits, as indeed the IPCC explicitly recommended in its Third Assessment Report (IPCC 2001a).

Certainly, LULUCF carbon options are not viewed as a panacea for stabilizing atmospheric GHG concentrations, but they could help mitigate at least a portion of the emissions associated with this sector. In addition, carefully developed biodiversity protection projects, such as the prevention of deforestation, the ecological restoration of fragmented landscapes, the sustainable improvement of agro-ecological systems, and the expansion of new growth on degraded lands, often result in substantial ancillary benefits:

(1) Preventing the extinction of globally important plant and animal species that may occur in the wake of the projected degradation or destruction of 50–100 million ha of intact ecosystems in this decade, and several times this amount over the next several decades (Myers *et al.* 2000; Myers and Knoll 2001)
(2) Protecting the valuable ecosystem services provided by these habitats, including soil conservation, water retention and purification, conservation of genetic resources, and pollination services (Daily 1997; Balmford *et al.* 2002; Figure 6)
(3) Capturing some of the lowest-cost carbon mitigation opportunities available
(4) Spurring sustainable economic activity in the underdeveloped regions where biodiversity-rich habitats exist, by generating project-associated employment opportunities and a revenue stream from trading the "carbon services" derived from these protected habitats (Petsonk 1999; Tietenberg *et al.* 1999; Bonnie *et al.* 2002)
(5) Maintaining resilient ecosystems (Folke *et al.* 2002; Walker *et al.* 2002) that can adapt to the effects of climate change and provide society with flexible, higher-quality response options (Fisher 2002; Hannah *et al.* 2002)

Focusing on tropical developing countries that are financially poor but rich in carbon and biodiversity offers a tremendous opportunity to simultaneously advance biodiversity and climate protection, while fostering sustainable economic development. Table 2 illustrates this point. The top 20 candidate tropical countries shown are not only among the most biodiverse, but also offer the opportunity to store between 20 and 60 billion tons of carbon through deforestation prevention, ecological restoration, and reforestation on degraded lands (Trexler and Haugen 1995; Niesten *et al.* 2002).

The potential role forests and land-use change could play in helping to mitigate climate change is controversial. Some critics worry that carbon emitters could use such offsets as a way to avoid making the necessary changes to reduce their energy-related emissions. Others are concerned about the accurate measurement and verification of GHG fluxes in the land-based sector.

The Kyoto Protocol deals with this first issue by capping LULUCF offsets at 20% of the total first-round emissions reductions, thereby ensuring that these offsets will not exceed the 20–25% of global emissions contributed by this sector (Watson *et al*. 2000). Furthermore, the physical limits of carbon sequestration will, in most cases, place lower limits than these on the reductions that can be achieved through forestry activities. For example, studies have shown that, for the US, only about 16% of the required reductions could be achieved through domestic forestry options (Brown 1998). With such physical limits and the Kyoto cap in place, carbon emitters must primarily work to reduce their fossil fuel use in order to achieve their climate commitments. Indeed, many conservation proponents acknowledge that the prevention of deforestation and restoration of fragmented corridors of globally important biodiversity would probably amount to, at most, 5% of the total GHG reductions that may be necessary this century. Their main concern, however, is one of timing, since the failure to prevent deforestation over the next decade will result in substantial lost opportunities for both climate and biodiversity protection. From this perspective, prematurely imposing an artificial limit while such opportunities still exist means we will unnecessarily forego realizing these valuable benefits.

Figure 6. *Ghanaian villagers collecting water. Forest conservation projects can protect important ecosystem services, such as water retention and purification, which are critical to the sustainable livelihoods of communities throughout the world.*

The second concern is being tackled by Kyoto stakeholders and negotiators through the establishment of rigorous methodologies for the measurement, verification, and reporting of GHG reductions, for both land- and energy-based projects (Watson *et al*. 2000). Key issues that must be addressed include the accuracy of measurements, establishment of a reference (baseline) case, the permanence or persistence of reductions, and the loss of GHG reductions due to displacement of emitting activities from the project site to another location (leakage).

In addition, some carbon buyers, investors, and nongovernmental organizations are proposing the establishment of a "blue chip" standard against which land-based climate protection projects could be evaluated. Such a standard is in-tended to ensure that only the highest quality projects, delivering tangible climate, biodiversity, and sustainable development benefits, would be pursued for credit. Projects earning this designation would have to satisfy all Kyoto criteria, as well as generating positive biodiversity and sustainable development outcomes.

Carefully developed "blue chip" projects have the potential to deliver triple-win outcomes. First, billions of dollars in revenues could accrue to local communities and regional eco-nomies for their "carbon services", through a global carbon-trading market. Second, invest ing companies could minimize their carbon mitigation costs by capturing some of the lowest-cost climate services. Finally, the protected biodiversity habitats would help safeguard both globally important species and the ecosystem services generated by these habitats.

Mitigating hydroelectric and bioenergy impacts

Given the high current levels of fossil fuel consumption, and the prospect of two- to fourfold increases in the use of these fuels this century under business-as-usual scenarios (UNDP 2000), we need to substantially scale up climate-friendly energy alternatives. However, serious biodiversity trade-offs could occur if certain renewable trends are realized, most notably the projected expansion under some scenarios of hydropower by 100–250% and biomass energy by as much as 12 000% (UNDP 2000).

Fortunately, there are ways to avoid such biodiversity and climate trade-offs and mitigate negative ecological impacts. For example, research suggests that the ecological damage from biomass expansion could be minimized by limiting bioenergy crop growth to the 0.5–1 billion ha of unused or degraded agricultural and abandoned lands worldwide (while avoiding areas that are essential for relinking fragmented landscapes into biodiversity corridors), and by growing perennial rather than annual crops – preferably ones that consume little water. The net effect of these strategies would be to reclaim a lost land resource while radically reducing erosion and nutrient leaching, thereby regenerating soil fertility and dramati-

Table 2. Top 20 tropical countries that have the potential to store carbon while also protecting globally important biodiversity

Rank by carbon storage potential	*Country*	*Low carbon estimate**	*High carbon estimate**	*Indicators of biodiversity importance†*				
				Mammals	*Birds*	*Reptiles*	*Amphibians*	*Higher plants*
1	Brazil	5400	14 000	4 (7)	4 (4)	6 (5)	1 (1)	1 (<5)
2	Indonesia	5400	14 000	1 (1)	1 (3)	3 (4)	10 (6)	<5 (4)
3	Democratic Republic of Congo (formerly Zaire)	1700	2500	18 (3)	21 (8)	...	9 (11)	... (19)
4	India	880	1900	12 (9)	13 (9)	5 (6)	9 (11)	<10 (<15)
5	Malaysia	1000	1900	14 (19)	...	17 (14)	18 (15)	15 (14)
6	Mexico	460	1700	3 (2)	8 (15)	2 (2)	3 (5)	<10 (5)
7	Philippines	840	1600	6 (...)	3 (...)	7 (25)	16 (...)	<20 (25)
8	Colombia	630	1300	16 (10)	11 (1)	10 (3)	6 (1)	<5 (2)
9	Vietnam	620	1300	...	...	22 (...)	25 (...)	<25 (20)
10	Papua New Guinea	630	1200	9 (...)	7 (24)	12 (12)	10 (11)	... (17)
11	Côte d'Ivoire	590	1100	...	...	...	...	...
12	Lao PDR	530	1000	...	...	...	...	...
13	Cameroon	520	970	... (6)	... (18)	...	14 (...)	...
14	Myanmar	390	950	... (19)	... (11)	23 (23)	...	...
15	Peru	600	950	10 (3)	5 (2)	11 (10)	12 (4)	<10 (11)
16	Venezuela	440	940	23 (13)	15 (6)	19 (15)	13 (10)	10 (7)
17	Tanzania	200	870	... (15)	21 (14)	20 (17)	17 (18)	... (21)
18	Ethiopia	300	720	17 (21)	17 (...)	...	24 (...)	...
19	Ecuador	320	640	19 (18)	16 (5)	8 (7)	5 (3)	<15 (9)
20	Thailand	170	630	...	...	... (10)	... (24)	... (16)

* Million tons of carbon storable through new growth and slowed deforestation (1990–2050)

† Country's worldwide ranking by species endemism (and richness).

Groombridge 1994; Trexler 1995; Myers et al. *2000; Groombridge and Jenkins 2002; Mittermeier* et al. *2002.*

cally reducing the need for agrochemicals. Biocide applications per ha are typically 5–20 times lower for perennial energy crops than for food crops such as cereals (Hall 1997), and soil losses are 90% lower (Pimental and Krummel 1987).

Obviously hydropower (and dams for irrigation) will continue to be developed, particularly in developing countries where rivers are abundant, large populations are without adequate power and water access, and growth rates for electricity demand and agriculture expansion are high. A key question is whether these countries are equally well endowed with other energy (and water) service options that can be economically tapped into. This would enable some selectivity, deferring development of projects that may fragment or destroy biodiversity habitats of global significance.

Awareness is growing that many dams would be rendered unnecessary if the focus were shifted to the efficient delivery of water services at the usage end, rather than maintaining the traditional emphasis on expanding water availability (Wong *et al.* 1999; Gleick *et al.* 2002). This is analogous to the shift, in recent decades, away from unnecessarily expanding the energy supply and instead "delivering" lower-cost energy services (eg lighting, heating, cooling, refrigeration, and mobility) by improving the efficiency of energy-consuming devices.

For example, efficiency services are currently providing one-quarter of US energy needs (Lovins and Lovins 2002). Total energy use per capita in the US in 2000 was almost identical to what it was in 1973, while economic output (GDP) per capita increased 74% over the same period. If the US had not dramatically reduced its energy intensity over the past 27 years, consumers would have had to spend at least $430 billion more on energy purchases in 2000 (Geller 2001), and would have consumed the equivalent of an additional 20 million barrels of oil per day.

Likewise, improving efficiency throughout the entire water delivery cycle offers important opportunities for cost savings. For example, in Latin America, water distribution losses have been estimated at some 9 trillion m^3/year, or one-third of the total water collected and treated. Analysts indicate that such losses could be cut by three-quarters if international water delivery standards were achieved (Savedoff and Spiller 1999).

■ Conclusions

Biodiversity loss and climate change are two of the greatest global environmental challenges facing humanity.

Although the Kyoto Protocol represents an important first step in addressing climate change, the treaty as currently written discourages the prevention of deforestation, while unwittingly encouraging some actions that could result in the destruction of ecosystems and their associated biodiversity.

Over the long term, failure to ensure that climate-friendly initiatives are also biodiversity-friendly could inadvertently accelerate the major global extinction crisis that is presently underway. Moreover, the loss of such biodiversity could undermine the climate adaptation services which complex ecosystems often deliver. This will further exacerbate the impacts of climate change, disproportionately affecting some of the most vulnerable populations in the developing world, where the greatest rates of biodiversity loss are being experienced.

The Kyoto Protocol provisions are problematic for biodiversity protection in two main ways. First, without a framework for avoiding trade-offs and minimizing negative ecological outcomes, the treaty encourages potentially damaging afforestation and reforestation projects while excluding the most ecologically valuable deforestation prevention options from earning credit. Second, without fully accounting for the carbon emissions associated with some hydroelectric and bioenergy projects, the Protocol promotes the development of such projects, even though their overall climate and biodiversity impact can often be negative.

Kyoto policy makers have the opportunity, at forthcoming negotiations, to follow the IPCC's recommendation to promote projects that avoid trade-offs between climate protection and other global problems while capturing multiple benefits. By promoting convergent solutions which address climate change and biodiversity loss, policy makers could foster actions that tackle both problems simultaneously. Projects that offer some of the greatest synergies include the prevention of deforestation, the ecological restoration of fragmented landscapes, the sustainable improvement of agro-ecological farming systems, and the expansion of new growth on degraded lands.

In addition to their positive climate outcomes, such projects have the potential to reduce overall carbon mitigation costs, to protect threatened and endangered species and habitats which deliver critical ecosystem and climate adaptation services, and to provide sustainable development opportunities to local communities. Adoption of the "blue chip" standard being proposed by some environmental NGOs, companies, and carbon investors is one way to ensure that only the highest quality forestry projects, delivering the greatest number of benefits, will earn certification and credit.

With such rapid loss of biological diversity, there is a small window of opportunity to obtain the low-cost carbon mitigation benefits associated with forest protection. Timing is critical, since unrealized opportunities will probably result in higher carbon mitigation costs in the future and the loss of substantial ancillary benefits. Preventing deforestation in the first place is much less expensive than ecological restoration after the fact – if that is even possible.

By establishing appropriate accounting methods, mitigation frameworks, and definitions, Kyoto policy makers have a unique opportunity to foster actions that could tap the tremendous synergies that exist between climate and biodiversity protection.

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