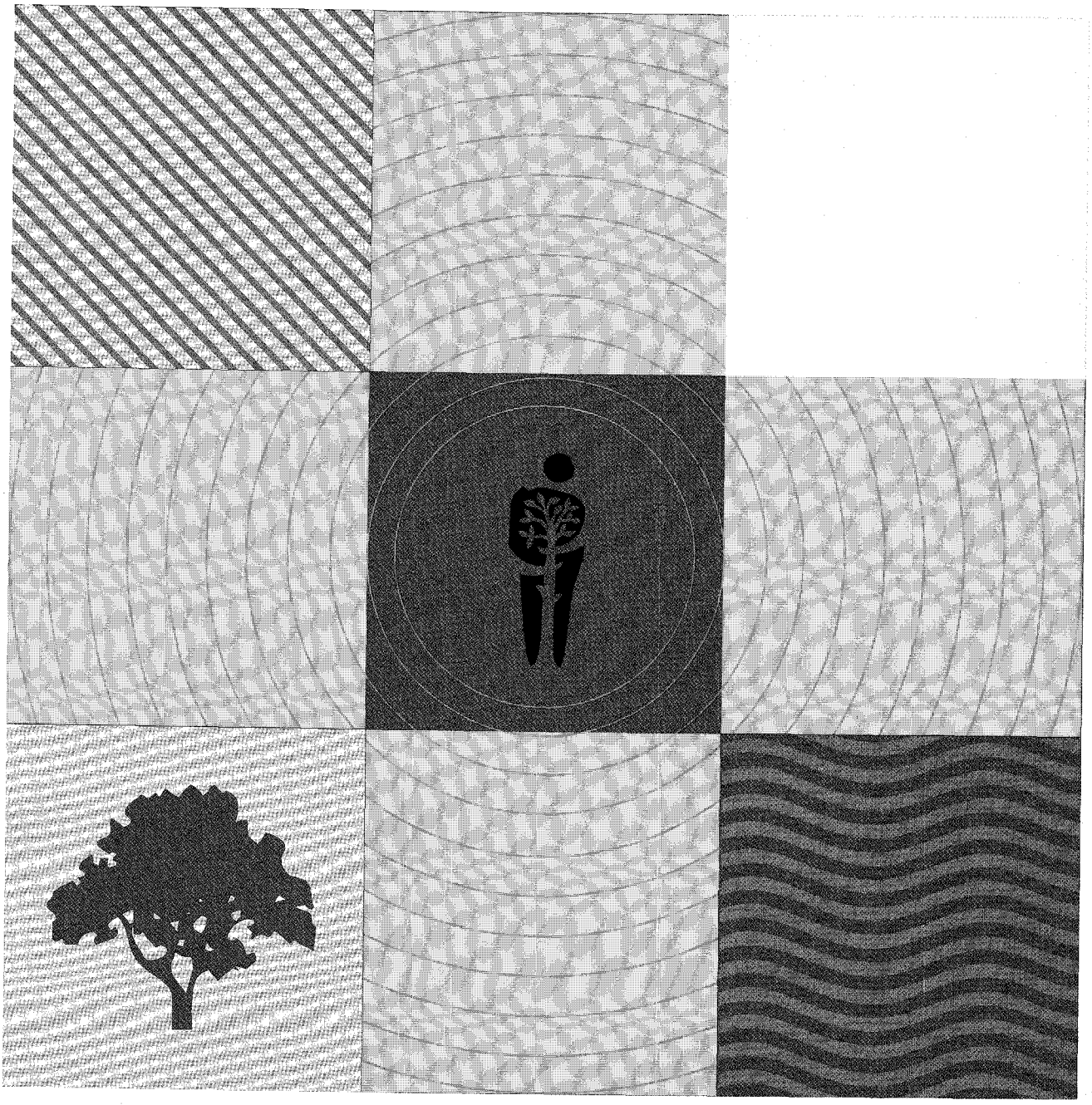
CLIMATE, BIODIVERSITY, AND FORESTS

Issues and Opportunities Emerging from the Kyoto Protocol

Paige Brown



WORLD RESOURCES INSTITUTE
FOREST FRONTIERS INITIATIVE
In Collaboration with
IUCN
The World Conservation Union

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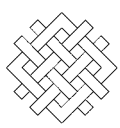
BY PAIGE BROWN

A Contribution to the
Forest Frontiers Initiative
and the
IUCN Climate Change Initiative



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IUCN
The World Conservation Union

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Designed by:
Papyrus Design & Marketing, Washington, DC

ISBN 1-56973-285-x
Library of Congress Catalog Card No. 98-88915
Printed in the United States of America on Recycled Paper.

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ACKNOWLEDGMENTS

This report is the result of a collaboration between WRI and IUCN–The World Conservation Union. The author would first and foremost like to thank Brett Orlando of IUCN–The World Conservation Union, who made this collaboration possible. Brett provided invaluable editorial input to ensure balance and clarity within the report. Additionally, he drafted the box on Potential Impacts of Climate Change. At WRI, the author is extremely grateful to Nancy Kete and Nigel Sizer for invaluable input and guidance that helped bridge the issues of climate and biodiversity. The report benefited greatly from the comments and suggestions of reviewers, both from within WRI, including Bruce Cabarle, Laura Lee Dooley, Paul Faeth, Nels Johnson, Tony La Viña, Gwen Parker, Walt Reid, and Frances Seymour, and from IUCN–The World Conservation Union, Andrew M. Deutz, Patrick Dugan, Scott A. Hajost, Bill Jackson, Rachel Kyte, Jeffrey A. McNeely, Simon Rietbergen, and Richard Tarasofsky. I would particularly like to thank Liz Cook for her contributions throughout the project. The comments of external reviewers Sandra Brown, Kenneth Chomitz, Darren Goetze, David Pearce, and Youba Sokona were exceedingly valuable.

The author is grateful to Hyacinth Billings and Carol Rosen for managing the publication process. The report also benefited from the editorial talents of Patricia Ardila and Robert Livernash. This author alone is, of course, responsible for the document's accuracy and recommendations.

FOREWORD

Over the past several decades, two profound global environmental issues–biodiversity loss and climate change–have often moved in wholly unconnected domains. After all, what possible connection could there be between the fate of unknown species in the Amazon rainforest and emissions of carbon dioxide from coal-burning power plants in industrialized countries?

A great deal, as we now know. At the first level, climate change is a major threat to efforts to conserve biodiversity. Some species already on the verge of extinction could be pushed over the edge as their habitats disappear because of climatic changes. More drought and floods that may be influenced by climate change will also make communities struggling to improve their livelihoods even more vulnerable. Another area where these two issues strongly intersect is in the carbon stored in the world's forests and other natural ecosystems. When forests are burned or otherwise destroyed, carbon is released into the atmosphere. For every forest or other ecosystem that is spared this fate, carbon is stored and kept out of the atmosphere. While energy sector emissions are the predominant contributor, forest conversion is also a significant part of the climate change problem, contributing some 20 percent of annual carbon dioxide emissions and, over the past 150 years, an estimated 30 percent of the atmospheric buildup of carbon dioxide.

In much of the world, far more forests are being lost than protected. This is bad news for climate change, and worse news for the world's biological resources. As a very rough guess, there are perhaps 14 million species in the world. At least 50 percent of these species may reside in tropical forests; some are restricted to a single patch of trees. Once the trees are gone, these species are gone forever. The rapid loss of forests thus is doubly damaging, adding to the global burden of atmospheric carbon dioxide and undermining the world's biological resources, which in turn reduces the resilience of ecosystems faced with a changing climate.

Can the world community respond to these dire threats to the global environment? The 1997 Kyoto Protocol to the Framework Convention on Climate Change is a key step towards the mitigation of climate change–it was the first international agreement to place legally binding limits on greenhouse gas emissions from developed countries. Although the Protocol significantly advanced the cause of climate protection, it left many questions unanswered, including the role of forests and land-use change in meeting obligations to slow global warming. Just as the negative effects on biological diversity of global warming and deforestation reinforce each other, there are considerable positive synergies between reducing greenhouse gas emissions and stepping up efforts to conserve forests. As the Conference of the Parties prepares to tackle these questions, this report offers timely insight into the potential of forests to advance both climate and biodiversity goals throughout the world.

Climate, Biodiversity, and Forests: Issues and Opportunities Emerging from the Kyoto Protocol examines why the role of forests and land-use change under the Kyoto Protocol remains controversial and attempts to clarify and separate the issues. For example, some perceive forests and land-use change as a distraction from reducing energy-related emissions, while others fear that greenhouse gas fluxes from forests and land-use change cannot be credibly quantified. It will require further research and careful construction of mechanisms created by the Protocol to resolve these issues and ensure that the treatment of forests and land-use change is consistent with credible greenhouse reductions and biodiversity and social benefits.

Without a much stronger commitment to solving climate change and biodiversity loss, we will bequeath to our children and grandchildren an irretrievably impoverished world. Such a fate can be avoided, but it requires a strong international commitment and concerted action. We hope this report helps to encourage such action.

We would like to express our gratitude to the AVINA Foundation, the John D. and Catherine T. MacArthur Foundation, and the United States Agency for International Development, whose support has made this work possible.

Jonathan Lash
President
World Resources Institute

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Director General
IUCN–The World Conservation Union

INTRODUCTION

For more than a decade, the community of nations has engaged in a difficult and crucial debate that has set the framework for international efforts to reduce the risk of climate change into the next century. That debate took a significant new turn in December 1997, when nations met in Kyoto, Japan, to forge a follow-on Protocol to the original 1992 Framework Convention on Climate Change. The Kyoto Protocol marks the first international agreement to place legally binding limits on greenhouse gas emissions from developed countries but leaves many issues to be resolved in future negotiations.

One of the most important areas yet to be resolved concerns how much of a role forests and land-use change will play under the Kyoto Protocol. They are both a part of the problem and of the solution of climate change. Saving or increasing forest cover, particularly of old-growth forests, stores carbon, thus keeping it out of the atmosphere and slowing global warming. Conversely, the global loss of forests plays a significant role in increasing the risks of climate change. Forest conversion has contributed an estimated 30 percent of the atmospheric buildup in carbon dioxide.[1]

This report focuses on the ways in which forests and land-use change can both exacerbate and mitigate climate change. It identifies the opportunities the Protocol presents regarding the conservation, improved management, and restoration of forests and considers some of the reasons the issue has proven controversial. Finally, the paper highlights key future decisions that will determine whether these opportunities are seized and examines how these decisions can be made to work for climate, forests, and biodiversity.

GETTING TO KYOTO

In order to better appreciate the issues and opportunities associated with land-use change and forests presented by the Kyoto Protocol, it is useful to understand the events leading up to it.

Climate change was initially recognized as a serious problem meriting international attention at the First World Climate Conference in 1979. At that time, a declaration was issued calling on the world's governments to prevent potential human-caused changes in climate that would adversely impact people's well-being.

Propelled by increasing understanding of global weather and evidence of growing concentrations of atmospheric carbon dioxide, in 1988 the UN Environment Programme (UNEP) and the World Meteorological Organization established the Intergovernmental Panel on Climate Change (IPCC). The IPCC is charged with assessing current information on climate change and its potential impacts and with framing strategies to mitigate or adapt to such change.[2] The IPCC contains three working groups: the first concentrates on the climate system, the second on impacts and response options, and the third on economic and social dimensions. Box 1 provides a chronology of key events.

1

CHRONOLOGY OF KEY EVENTS

1979. World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) convene First World Climate Conference and establish World Climate Program.

1988. WMO and UNEP establish the Intergovernmental Panel on Climate Change to assess threat of climate change.

1989. Noordwijk Declaration signed by 68 environmental ministers from around the world; it proposes increasing global forest cover to help slow climate change. (1)

1990. IPCC's First Assessment Report affirms scientific basis for climate change.

1990. The Second World Climate Conference calls for a treaty on climate change.

1990. United Nations establishes Intergovernmental Negotiating Committee that ultimately drafts the Framework Convention on Climate Change (FCCC).

1992. FCCC opened for signature at the Rio Earth Summit. Developed countries commit to return greenhouse gas emissions to 1990 levels by the year 2000 and to help developing countries respond to climate change through technology transfer and funding.

1995. First Conference of the Parties establishes that initial FCCC commitments are inadequate. It issues the "Berlin Mandate" that leads to the Protocol by the third Conference of the Parties.

1996. Second Conference of the Parties. The ministers endorse the Second Assessment Report of the Intergovernmental Panel on Climate Change, which states that the balance of evidence "suggests a discernible human influence on global climate."

1997. Third Conference of the Parties produces the Kyoto Protocol to the FCCC that includes legally binding limits on greenhouse gas emissions.

Note: 1. Ministerial Conference on Atmospheric Pollution and Climatic Change. 1990. The Noordwijk Declaration on Atmospheric Pollution and Climate Change.

The IPCC published its First Assessment Report on Climate Change in 1990. The report affirmed the underlying scientific basis of climate change. It noted fossil fuel combustion from vehicles and industrial activities as one of the main contributors to human-induced carbon dioxide emissions. It also explicitly recognized the historic, current, and future contributions of forests to climate change, focusing on emissions from deforestation and potential uptake from reforestation.[3]

At the close of 1990, the United Nations General Assembly accepted the first IPCC Report and established the Intergovernmental Negotiating Committee to begin discussing the terms of a Framework Convention on Climate Change. The United Nations Conference on Environment and Development, or Earth Summit, held in Rio de Janeiro in 1992, was set as the target for completing the negotiations. At the Earth Summit, 154 governments signed the United Nations Framework Convention on Climate Change (FCCC). The stated objective of the FCCC is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous, human-caused climate change.[4]

Although this paper does not provide full coverage of the FCCC, it does contain a general outline that focuses on its treatment of forests and land-use change.

All FCCC parties–developing and developed countries–agreed to submit "national communications" that would include inventories of human-caused emissions of greenhouse gases from sources such as vehicles, industries, deforestation, and removals such as reforestation. The national communications were also to describe programs that contained measures to mitigate climate change, with developed countries being required to describe specific policies and measures to implement their commitments.

The Climate Convention explicitly includes the role of forests and land-use change under commitments, stating that Parties shall promote and cooperate in the sustainable management, conservation, and enhancement of sinks of greenhouse gases, including forests and other terrestrial, coastal, and marine ecosystems.[5]

To aid Parties in preparing their national communications, in 1995 the IPCC issued a workbook containing guidelines for undertaking inventories with the aim of developing internationally agreed reporting, data gathering, and documenting methods for greenhouse gases.[6] In addition to industrial emissions, the IPCC workbook instructs nations to do a comprehensive inventory of the total emissions and removals from forest and land-use change activities. The workbook asks for the inventory to include three categories of emissions and removals: a) increases or decreases in biomass within a standing forest, such as from logging, fuelwood collection, or regrowth; b) conversion of forests or grasslands to other land uses; and c) sequestration from regrowth of abandoned land, such as pasture.

Parties using the IPCC reporting and accounting guidelines for national inventories identified several issues where further methodological work would be needed. In particular, Parties have identified the need to improve methods to track emissions from forests and land-use change. Several Parties requested further scientific work in measuring emissions and sequestration in order to reduce uncertainty in estimates.

Beyond overseas development assistance, industrialized countries also agreed to provide new and additional financial resources and to promote the transfer of environmentally sound technologies to assist developing countries in meeting their obligations.

The FCCC designated the Global Environment Facility (GEF) as an interim financing mechanism. The GEF, conceived in 1989, is intended to serve as a mechanism for providing financial resources to help developing countries address global environmental issues, including climate change and biodiversity loss.[7]

The FCCC also recognized the concept of Joint Implementation, that is, agreements between at least two parties (be it individuals, non-governmental organizations, governmental bodies, academic institutions, or the private sector in two or more countries) to offset greenhouse gas emissions by reducing, avoiding, or sequestering greenhouse gas emissions. For example, one project in Mexico distributed energy-efficient light bulbs, while a second project in the Czech Republic, funded by three American utilities, switched an electrical plant from high-emission coal to lower-emission natural gas. The concept is not limited to energy projects but also includes forest and land-use change sector offsets. Some forest and land-use sector carbon sequestration projects that illustrate this concept are described in Box 2.

2 FOREST AND LAND-USE CHANGE CARBON SEQUESTRATION PROJECTS

Early carbon sequestration projects such as the Reduced Impact Logging Project in Malaysia and CARE/Guatemala were primarily bilateral agreements between a single investor seeking to offset its greenhouse gas emissions and an implementing agency. Perhaps in response to concerns about risk of failure, more recent projects have moved away from bilateral agreements to either investor pools, such as Rio Bravo, or project portfolios such as those offered by Costa Rica.

■ **REDUCED IMPACT LOGGING IN SABAH, MALAYSIA**

In August 1992, New England Electric Systems of Massachusetts, a coal-burning utility, decided to provide funds to Innoprise Corp., of Sabah, Malaysia, a timber concession holder, to implement reduced-impact logging guidelines for 1,400 hectares of Innoprise's 1 million hectare concession (1). The project emphasized staff training to use existing technology and machinery in an environmentally sensitive way and to increase supervision of harvesting operations.

The harvesting guidelines include specifications for creating buffer zones for streams and roads, developing a formal harvesting plan, cutting climber vines before harvesting, planning and marking skid trails, marking trees for future harvests, and undertaking directional felling of marked trees to reduce residual damage to surrounding forest.

The project's potential benefits include reduced damage to the residual forest; decreased erosion, carbon emissions, and land degradation; increased capacity for future timber production; increased biodiversity protection; decreased incidence of fire; reduced weed infestations; and increased long-term ecological and economic productivity.

■ **THE RIO BRAVO CARBON SEQUESTRATION PROJECT, BELIZE**

Multiple utilities are investing in Belize's Rio Bravo Carbon Sequestration Project, implemented by the Programme for Belize and The Nature Conservancy, to stop forests from being converted to agricultural land. The project purchased approximately 6,014 hectares of endangered forest that would have been converted to mechanized agriculture and is developing a sustainable forest management component that will provide income to local people and increase the amount of carbon sequestered (2).

If the protected forest area had been converted to agricultural land, it would have separated currently protected forest areas, thus compromising their ecological integrity (2). The project area contains nine endangered mammals, among them the jaguar, ocelot, and Baird's tapir. Over its lifetime, the project is estimated to sequester slightly over 1 million tons of carbon.

■ **FORESTS ABSORBING CARBON EMISSIONS (FACE)/KRKONOSE NATIONAL PARK, CZECH REPUBLIC**

FACE was founded by the Electricity Generating Board (SEP) of the Netherlands to sequester part of the CO_2 it emitted from the use of fossil fuel for electricity generation in that country. The project area, in the Czech Republic, contains the only Norway spruce forest in Europe adapted to a montane climate. Because of this unusual flora, 38,500 hectares of this forest was designated a National Park in 1963. The park and its forests have become heavily degraded by air pollution. In 1984, the IUCN–the World Conservation Union listed Krkonose as one of the ten most threatened national parks in the world. FACE is financing the reforestation of 15,000 hectares of damaged and dead forest in Krkonose National Park (3).

■ **CARE/GUATEMALA AGROFORESTRY PROJECT**

A project proposed and implemented by CARE in Guatemala featured several components, including creating community woodlots, implementing agroforestry practices, terracing vulnerable slopes (thus improving agricultural productivity), and providing training for community forest fire brigades (4). WRI calculated that the project would sequester an estimated 11.2 million tons of carbon over 40 years through net addition to the standing inventory of biomass carbon, retention of standing forests as a result of demand displacement via woodlots and agroforestry projects, protection of some carbon in soils, and retention of some standing forests because of community fire brigades.

Notes: **1.** Michelle A. Pinard and Francis E. Putz. "Retaining Forest Biomass by Reducing Logging Damage." *Biotropica* 28, no 3 (1996): 5.

2. Programme for Belize, The Nature Conservancy, and Wisconsin Electric Power Company. "The Rio Bravo Conservation and Management Area, Belize. Carbon Sequestration Pilot Project Proposal." Submitted for consideration under the United States Initiative on Joint Implementations (November, 1994).

3. "Forests Absorbing Carbon Emissions, Annual Report" (Arnhem, The Netherlands, 1993). FACE Website: http://www.facefoundation.nl.

4. Paul Faeth, Cheryl Cort, and Robert Livernash. "Evaluating the Carbon Sequestration Benefits of Forestry Projects in Developing Countries" (Washington DC: World Resources Institute, 1994).

To gain experience and test the efficacy of Joint Implementation, the United States, Costa Rica, the Netherlands, and several other countries established experimental national programs to evaluate, approve, and, in some cases, fund projects.

Some environmental groups and various developing countries have been critical of Joint Implementation, arguing that it would allow developed countries to avoid making difficult changes domestically by buying cheap carbon offsets in developing countries.[8] As a result of the opposition to Joint Implementation, in 1995 the first Conference of the Parties established a pilot phase, termed Activities Implemented Jointly (AIJ). AIJ is similar to Joint Implementation in that both are based on greenhouse gas reduction projects among several countries. Any country may participate in AIJ, but no actual reduction credits can accrue during the pilot phase, which lasts until the end of 1999, when a review is scheduled. There are currently over 15 forest and land-use-based mitigation projects underway, and many more have been proposed.

Finally, in recognition of their historical responsibility for the buildup of greenhouse gases in the atmosphere, under the FCCC developed nations voluntarily committed to reduce emissions to 1990 levels by the year 2000. The FCCC instructed the first Conference of the Parties to determine whether developed country commitments were adequate.

At this first meeting the Parties concluded that the voluntary commitments under the FCCC were indeed inadequate, as it became clear that most developed countries would not meet them. Negotiators agreed to the Berlin Mandate that established the need for quantified limits on greenhouse gas emissions beyond the year 2000. The Berlin Mandate talks were given a significant push in 1995 when the IPCC issued its Second Assessment Report, concluding that "the balance of evidence suggests a discernible human influence on global climate."[9] A separate subsidiary body, the Ad Hoc Group on the Berlin Mandate, was created to draft a protocol for adoption at the third Conference of the Parties in 1997.

Kyoto Protocol Overview

On December 10, 1997, delegates from 160 nations completed negotiations on the Kyoto Protocol at the third Conference of the Parties. By providing that industrialized nations should adopt legally binding emission limits on greenhouse gases, the Kyoto Protocol took the significant step of moving from voluntary to binding commitments. While individual country commitments vary, the Protocol calls for reductions of aggregate industrialized country emissions by roughly 5 percent below 1990 levels.[10] Following the FCCC, the Protocol divides the world into two groups–industrialized, or "Annex I," countries which committed to greenhouse gas emission limits, and developing or "non-Annex I," countries with no binding limits. The Annex I group consists of 39 industrialized nations and economies in transition, including the United States, the European Union, Canada, Japan, the Czech Republic, and Russia.[11]

3 POTENTIAL IMPACTS OF CLIMATE CHANGE

By Brett Orlando, IUCN–World Conservation Union, Washington office

There is a growing scientific consensus that climate change could present a major threat to biodiversity at both the species and the ecosystem levels. The IPCC stated that human-induced climate change could bring about losses in biological diversity and in the goods and services that ecosystems provide society(1). Many ecosystems are already threatened by human activities such as pollution, increasing resource demands, and nonsustainable management practices. Human-induced climate change represents an important additional stress.

Species will be more vulnerable, and even where they are able to tolerate climate change, they could face new competitors, predators, diseases, and alien species for which they have no natural defense. Existing forested areas might undergo major changes: some may entirely disappear, while others might experience changes in species composition. Half of coastal wetlands of international conservation importance could be lost. Coral reefs and mangroves would be threatened by sea level rise, increasing temperatures, and changes in storm patterns. Small islands are particularly vulnerable to sea level rise, as much of the land mass could be lost, potentially displacing large numbers of people (2). Also, seven of ten areas with the highest percentage of threatened plants are on small islands, and climate change will only exacerbate these threats (3). Finally, carbon stored in forests could be lost as forests transition from one type to another under changed climate conditions, thus enhancing the greenhouse effect.

Human society is also vulnerable to climate change. For example, increased incidence of drought, triggered by climate change, could lead to threats to food security, particularly in arid and semi-arid regions. Communities that are currently struggling to improve their livelihoods are the most vulnerable to the potential impacts of climate change as they will have fewer resources for adaptation measures.

Notes: 1. Intergovernmental Panel on Climate Change. "Summary for Policymakers," in *Climate Change 1995. Impacts, Adaptations, and Mitigation of Climate Change: Scientific-Technical Analyses of Impacts, Adaptations, and Mitigation of Climate Change.* Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change.
2. "Summary for Policymakers," 36.
3. The IUCN Species Survival Commission. *1997 IUCN Red List of Threatened Plants.* Kerry S. Walter and Harriet J. Gillett, eds. Compiled by The World Conservation Monitoring Centre (Gland, Switzerland: IUCN–The World Conservation Union, 1998), xxxiv.

TABLE 1

Forest and Land-Use Change Under the Kyoto Protocol

ARTICLE	RELEVANCE TO LAND USE CHANGE AND FORESTS
Article 3.3	*Domestic Greenhouse Emissions by Industrialized Countries.* Defines which domestic emissions should be inventoried by industrialized countries during the 2008-2012 commitment period. The Protocol currently requires tracking greenhouse gas removals and emissions from human-induced afforestation, reforestation, and deforestation that have occurred since 1990.
Article 3.4	*Inventorying Additional Activities.* While Article 3.3 defines three activities to be inventoried, Article 3.4 states that later Conferences of the Parties may include additional activities such as forest harvest and management, or remove activities that must be inventoried.
Article 6 and Article 17	*Project-based Credit and Emissions Trading Between Industrialized Countries.* ■ Define two market mechanisms that allow industrialized countries to trade emission allowances with other industrialized countries. ■ Article 6 specifies project-based credit trading and explicitly refers to enhancing carbon storage and reducing emissions but does not specify which kinds of projects, such as those aimed at slowing forest degradation and tree planting, are allowed.
Article 12	*Clean Development Mechanism (CDM).* Allows industrialized countries to meet their reductions via activities in developing countries. There is no explicit mention of land-use change and forest projects, making it unclear what kind of endeavors will be allowed.

Under the Protocol, each Annex I country agreed to a specific greenhouse gas reduction target using its 1990 levels as a baseline. Parties negotiated these non-uniform targets in order to address varying national circumstances. For example, Japan and the United States committed to a 6 percent and 7 percent reduction from their 1990 emission levels, respectively, while Australia set its cap to an 8 percent increase. Japan received a lower target than the United States, as it is a relatively more energy efficient nation and therefore claimed that greater reductions would be more difficult than for the United States. Australia argued that its dependence on coal would make reductions, or even a stabilization at 1990 levels, too difficult.

The Protocol requires inventories of the six major greenhouse gases.[12] Carbon dioxide, the most prevalent of them, is emitted from energy production, transport, industry, and land-use conversion such as deforestation. Land-use changes primarily emit carbon dioxide, though methane and nitrous oxide are also emitted in trace quantities.

These reductions must be accomplished within the "commitment period," 2008-2012, which provides increased timing flexibility. For example, Japan's average yearly greenhouse gas emissions for 2008-2012 must be 6 percent below what they were in 1990. Emissions may be above the 6 percent reduction in any given year during the commitment period, but the average must be compensated in later years.

Annex I countries have four means by which to meet their Protocol commitments and to calculate their net emission inventory. (*See Table 1.*) They may a) take any domestic action to reduce emissions from their industrial sectors, such as replacing fossil fuel use with renewable energy sources; b) take domestic action through a limited set of forest-sector activities–afforestation and reforestation that count as reductions, and deforestation that counts as an emission; c) use two market-based mechanisms (emissions trading and project-based credit trading) that allow them to buy, sell, or trade greenhouse gas reductions and emission allowances from other Annex I countries; and d) use a third market mechanism that allows buying or trading of project-based credits from non-Annex I countries–e.g., the Clean Development Mechanism.

Synergies Between Climate Mitigation and Biodiversity Conservation

The FCCC explicitly recognizes the links between climate change and biodiversity conservation in both its objective and its commitments. The objective states the importance of preventing dangerous changes to the climate system within a time frame that would not allow ecosystems to adapt naturally. Box 3 describes some of the potential impacts of climate change on biodiversity and human society. The FCCC also commits nations to promoting sustainable management and conservation of forests and other terrestrial ecosystems. If ratified by the Parties, the Kyoto Protocol could offer incentives for the restoration, protection, and conservation of forests and other ecosystems within developed and developing countries, thus presenting clear synergies between climate mitigation and biodiversity conservation. Emissions from the conversion and degradation of forest and grassland ecosystems is not only a contributor to climate change but is also a significant driving force behind species extinctions and the loss of critical ecosystem functions and services such as regenerating watersheds, purifying water, slowing soil erosion, and providing food, fiber, and medicines.[13]

Temperate forests, most of which have already been converted and degraded, still offer important opportunities to protect biodiversity and slow climate change. For example, in the United States, where overall only 1-2 percent of native forest remains, the Pacific Northwest retains 13 percent of its old-growth forest, which provides critical breeding and feeding habitat to a range of species, such as the spotted owl and northern goshawk.[14] Old-growth Douglas fir forests in the Pacific Northwest are also one of the most efficient storehouses of carbon. Even after that length of time, natural forests store greater amounts of carbon than tree plantations and provide greater biodiversity benefits.

Boreal forests remain largely intact, with Russia containing nearly one fifth of the world's forest and Canada housing the second largest forest expanse, making these two nations critical carbon storehouses. The Russian Federation contains about 20 percent of the world's carbon stored in forest vegetation, meaning that further deforestation or degradation of Russian forests could potentially be a significant source of emissions.[15] An estimated 19 percent of Russian forests are currently under threat from logging and mining.[16] These same forests also harbor endangered animal species such as the Amur tiger and are the traditional homeland of indigenous peoples.

Carbon sequestration potential, endangered forest regions, and biodiversity "hot spots" often overlap, particularly in developing countries. This offers opportunities for synergies among the various concerns, as illustrated by Table 2, which lists the top ten countries in order of plant biodiversity in their frontier forests.[17] These countries exhibit an important link to a similar ranking of developing country carbon sequestration potential, shown in the far right column of the table.[18]

Because Annex I countries must limit their greenhouse gas emissions, the Protocol could create a disincentive for forest conversion and degradation. The three market mechanisms could potentially provide funds for carbon offset projects that provide alternatives to conversion or intensive use of forests, as Annex I countries seek to meet their emission limits. Box 2 describes forest and land-use projects funded and designed to reduce or sequester carbon. These carbon offset projects provide examples of actual Activities Implemented Jointly (AIJ) pilot projects and as such offer possible examples of the kinds of activities that might be allowed under the Clean Development Mechanism (CDM).

If the Protocol creates incentives to conserve and better manage forests in both developed and developing countries, tremendous climate and biodiversity benefits could be realized. However, a great deal of work remains to ensure that including forests and land-use change more fully within the Protocol results in credible greenhouse gas reductions.

Unresolved Issues that Impede Capturing Climate and Biodiversity Benefits

By not fully counting emissions and removals from forest management and by not defining deforestation, the Protocol has not yet seized the opportunity to provide incentives to improve forest management and possibly slow forest loss in developed countries. These omissions could lead to large uncounted emissions from Annex I nations that continue to deforest, or from countries with poor forest management policies. The Parties to the Convention will also decide whether forest and land-use change projects are eligible under the Clean Development Mechanism (CDM). In particular, decisions on project eligibility and guidelines will determine whether the CDM can provide assistance to slow deforestation, contribute to sustainable development, and reduce greenhouse gas emissions and biodiversity loss in developing countries. As the Parties decide how to incorporate forests and land-use change into the Protocol, they should seek greater collaboration with other international agreements, particularly the two that emerged from the Rio Earth Summit–the Convention on Biological Diversity and the Convention to Combat Desertification–with the purpose of ensuring that they neither contradict each other nor miss key overlaps.[19] (*See Box 4.*) If the opportunities to link actions to slow climate change with halting biodiversity loss and desertification are to be realized, the issues associated with fully accounting for emissions and reductions from forests and land-use change must be understood and addressed.

TABLE 2

Plant Biodiversity and Carbon Sequestration

PLANT BIODIVERSITY RANK	COUNTRY	CARBON RANK
1	Brazil	1
2	Colombia	8
3	Indonesia	2
4	Venezuela	16
5	Peru	15
6	Ecuador	19
7	Bolivia	Unranked
8	Mexico	6
9	Malaysia	5
10	Papua New Guinea	10

This paper examines the reasons why the above-described issues exist and how they may be overcome. The concerns relating to land-use change, forests, and global warming addressed in this paper fall into two broad categories: a) Annex I national-level inventories and actions to reduce greenhouse gas emissions, which relate only to countries that have accepted greenhouse gas limits, thus far limited to industrialized countries; and b) project-level estimates of net greenhouse gas reductions (the Clean Development Mechanism and project-based credit trading), which may relate to either industrialized or developing countries.

The next four sections will address each of the main issues, as follows:

- *Generic Issues Associated with Forests and Land-Use Change in the Kyoto Protocol.* These encompass national inventories and project-level accounting and are relevant to both Annex I and non-Annex I countries.
- *The Treatment of Forests and Land-Use Change in Industrialized Countries.* This examines issues related to national inventories of emissions and sequestration from land-use change and forests and briefly covers project-based credit and emissions trading.
- *The Role of Forests and Land-Use Change in Developing Countries.* This focuses on the Clean Development Mechanism as the primary means to influence emissions from developing countries under the Protocol.
- *Technical Concerns Associated with Measuring and Verifying Forest and Land-Use Change Emissions and Reductions.* These relate primarily to project-level emissions and reductions under project-based credit trading and the Clean Development Mechanism, aside from measurement accuracy, which also applies to national inventories.

4 MAXIMIZING SYNERGIES BETWEEN INTERNATIONAL AGREEMENTS

The four agreements emerging from the Rio Earth Summit–the Convention on Biological Diversity, the Framework Convention on Climate Change, the Convention to Combat Desertification, and the Forest Principles–call for policies, strategies, and solutions to mitigate the effects of climate change, biodiversity loss, desertification, and forest degradation and conversion, respectively. In particular, each document calls on countries to integrate these four objectives into national and regional development plans, policies, programs, and strategies. Coordinating policies and strategies between the Conventions and other international forest agreements will both enhance their impact and avoid actions on the part of one that contradict the objectives of another.

A number of international initiatives relating to forests have been launched, including the Intergovernmental Forum on Forests. The Forest Principles suggest principles and actions but do not provide guidance on issues. The Intergovernmental Forum on Forests is a continuation of the Intergovernmental Panel on Forests, established by the Commission on Sustainable Development to provide guidance on improving national forest policies, international coordination, criteria and indicators for sustainable forest management, and assessing the environmental implications of forest product harvest.

Synergies among the agreements clearly exist and should be fully exploited. For example, finding avenues to slow the loss of forests in areas that are high in biodiversity and are large carbon storehouses (in the Congo Basin and the Amazon) should be explored. Rehabilitating degraded rangelands and planting windbreaks both increases carbon storage and reverses desertification. Arid lands in developing countries may present a significant opportunity for carbon sequestration, since there are large areas requiring restoration. Even though arid areas sequester less carbon than some other land types, such as moist forests, such projects are still often more cost-effective than similar efforts in Europe or the United States, where land and labor are relatively more expensive. Similarly, replacing fuel sources in economies in transition can reduce the acid precipitation that damages and kills forests in Central and Eastern Europe, among other regions, while reducing greenhouse gas emissions (1).

Note: 1. World Resources Institute, in collaboration with the United Nations Environment Programme, the United Nations Development Programme, and the World Bank. *World Resources. A Guide to the Global Environment 1996-97* (New York: Oxford University Press, 1996).

GENERIC ISSUES ASSOCIATED WITH FORESTS AND LAND-USE CHANGE IN THE KYOTO PROTOCOL

This section describes the ways in which forest and land-use change climate mitigation efforts may have unintended negative consequences, including failure to sequester the estimated amount of greenhouse gases, thus diluting the Protocol's effectiveness in slowing global warming, or misuse that results in negative social or environmental impacts.

Forests as a Distraction from Reducing Energy-Related Emissions

For many national governments and environmental organizations, climate change is solely an energy issue, so they do not want the focus of the negotiations to shift from fossil fuel emissions to forest-sector emissions. They fear that if Annex I countries have broad latitude to utilize forests and land-use activities to meet their commitments, either domestically or through market mechanisms, then these nations can avoid making difficult changes in their fossil fuel consumption patterns by investing in relatively cheap projects to maintain rainforests in tropical countries, or by undertaking massive tree planting schemes domestically. If this proves to be the case, the Protocol's ability to induce the development of new climate-friendly technology in the industrial sector would be diminished.

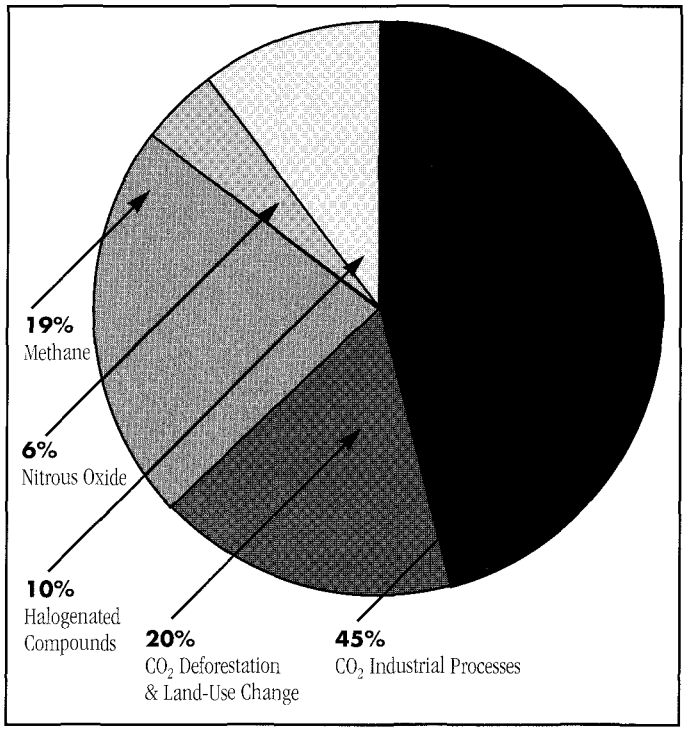
How much of a difference can land-use change and forest projects make? A significant amount, but hardly enough to allow nations to completely bypass the industrial sector. By 2050, land-use and forest options from all regions, including temperate and boreal, could reduce or sequester about 12-15 percent of cumulative fossil fuel emissions over the same period.[20] In the United States, domestic forest options could remove or conserve about 16 percent of the needed reductions over the commitment period.[21] Thus, the United States cannot rely solely on its domestic forest and land-use sector. Given the physical limits, the concern that forest and land-use projects will distract developed nations from the goal of reducing industrial fossil fuel use seems overstated.

While land-use change and forests may play a relatively small part in the solution to global warming, they are a part of the problem. During the initial period of economic development in Europe and North America, land-use change resulted in large releases of carbon dioxide.[22] Deforestation in tropical countries has contributed an estimated 23 percent of average annual global emissions of carbon dioxide.[23] Further, the buildup of carbon dioxide emissions in the atmosphere during the 1980's from land-use change and deforestation accounts for nearly 20 percent of the human-caused "radiative forcing" of greenhouse gases, an amount greater than that for nitrous oxide at 6 percent and about equal to methane at 19 percent.[24] (*See Figure 1.*) Radiative forcing describes a change in the energy balance of the Earth's atmospheric system in response to alterations, such as a change in the concentration of greenhouse gases. This energy balance controls the Earth's climate system.

The buildup of greenhouse gases in the atmosphere that causes climate change is primarily due to fossil fuel use; therefore, climate change can be avoided only by seeking changes in the world's use of fossil fuels. However, in tandem with, and in some cases prior to, these changes, emission reductions from other sectors, such as agriculture and manufacturing, that release the other greenhouse gases are also necessary, in order to avoid or slow climate change. Among other sources of greenhouse gases, forest and land-use change is most in danger of exclusion, despite the fact that it bears such a large historical, current, and future responsibility for emissions, and one that offers such important additional benefits to climate.

FIGURE 1

Greenhouse Gas Share of Radiative Forcing



Forest Options Could Become a Loophole

Forest options could become a loophole if, under the two project-based mechanisms, governments or other entities try to claim "credit" for activities they would have done anyway, regardless of the Protocol. Moreover, this issue is not confined to forest and land-use change projects but can also afflict energy-sector projects under the market mechanisms, where a recipient government or other agency claims an incorrect "reference" scenario (that is, the likely course of future development in an area if projects were not implemented).

For example, a country may claim that an area of forest would have been converted to agricultural use, although it is in fact not in danger of being converted. Climate mitigation funds would be used to protect the area, and an investor would gain unearned greenhouse gas reduction credits. Similarly, in the energy sector, a recipient country may gain funds to switch an electrical power station from high-emission coal to low-emission natural gas, but the municipality may have already been planning such a fuel switch. In both sectors, the CDM and project-based credit trading must establish guidelines requiring proof of prevailing management practices, trends, and legal requirements, all of which must be surpassed if the project is to claim credit.

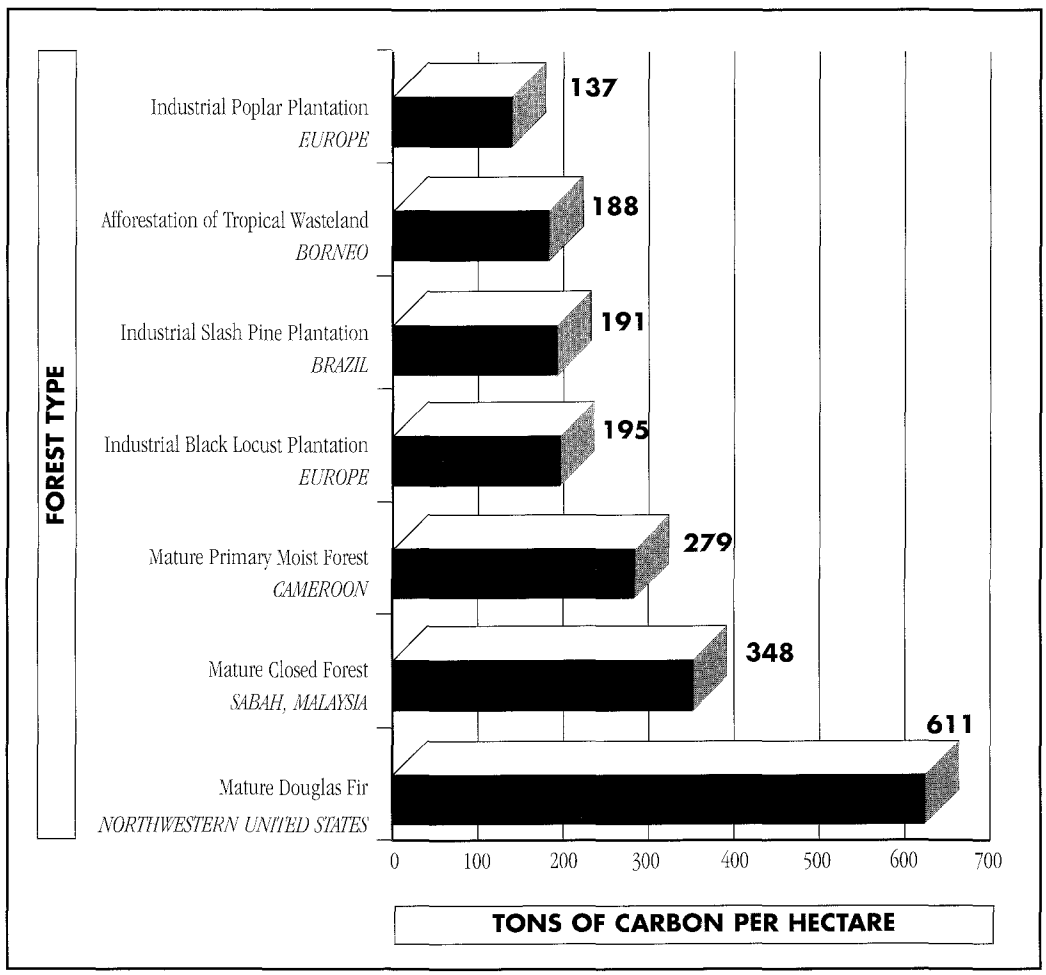
The Possibility of Negative Environmental Impacts

Some environmental groups are concerned that including forests and land-use change more fully in the Protocol will lead to some interpretations of its terms that result in negative environmental impacts for both market mechanisms and domestic reduction efforts.[25]

One prominent concern is that governments and forest products companies will attempt to claim reduction credits from the conversion of natural forests to fast-growing plantations. This concern stems from the common misconception that a rapid harvest and tree planting regime maximizes carbon removal.[26] Mature forests have often been accumulating carbon for centuries and store tremendous amounts relative to young, growing forests.[27] Further, new evidence is emerging that mature tropical forests continue to sequester small amounts of carbon, rather than becoming "overmature" and releasing carbon, as was previously thought.[28] Compared with forest conservation, tree planting is a less efficient carbon storage method, in terms both of cost per ton and tons per hectare.[29] (*See Figure 2.*) The carbon stored in the four plantation and afforestation sites includes both carbon stored in living biomass and wood products *after 300 years*.[30]

FIGURE 2

Comparison of Potential Biomass



Sources: Mark E. Harmon, William K. Ferrell, and Jerry F. Franklin. "Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests." *Science* 247 (1990): 699. Francis E. Putz and Michelle Pinard. "Reduced Impact Logging as a Carbon Offset Method." *Conservation Biology* 7, no. 4 (December 1993): 755-57. Sandra Brown, Andrew J. R. Gillespie, and Ariel E. Lugo. "Biomass Estimation Methods for Tropical Forests with Applications to Forest Inventory Data." *Forest Science* 35, no. 4 (December 1989): 895.

The market-based mechanisms and Annex I countries must incorporate guidelines that prevent greenhouse gas reduction credits from accruing at the expense of negative overall environmental impacts, even if the net result is positive for climate change. For example, converting open woodland or grassland to tree plantations may, in some cases, increase net carbon sequestered, but such a strategy would destroy a natural ecosystem.

Social and environmental criteria could serve as screens for projects under the mechanisms. Many public institutions involving international trade and investment regimes employ such environmental screens, with varying degrees of success. The Protocol also explicitly states that the Clean Development Mechanism must contribute to sustainable development, which, if defined appropriately, would require the screening of projects for negative social and environmental impacts, including biodiversity.

The Question of Property Rights

If the market mechanisms introduce new financing for forest and land-use projects, competition for control over forest resources may intensify as various users try to gain access to the new financial flows. These factors make it especially important that projects be screened and designed with potential social impacts in mind, so that their design and negotiation involve not only state governments or private entities but also local users. In many cases it will not be sufficient to contract with the host government entities for projects; it may also be necessary or preferable to negotiate and/or contract directly with local and indigenous users of the project area. From the Dayaks in Sarawak, Malaysia, to the Kyuquot People in Vancouver Island, Canada,[31] property and usage rights for forest resources are unclear or contested between the state and local or forest dwelling communities; this makes social screens an important part of both the CDM and the project-based credit trading regime.[32] Also, in some regions the state lacks the ability to enforce its ownership rights, leading to an "open access" situation in which many different users rely on forest resources without legally recognized rights. Projects should be screened to ensure that property and usage rights and the needs of local users are taken into account.

Threats to National Sovereignty

In part because the Protocol is an international legal agreement, both Annex I and non-Annex I countries have expressed concerns about the potential threat to national sovereignty. If Annex I countries ratify the Protocol, they will have to inventory and report emissions and be legally bound to meet their greenhouse gas limits; thus, some international oversight will be required. While the FCCC commits all Parties to implement programs that mitigate climate change, such as those that promote the sustainable management and conservation of forests, Annex I countries have resisted listing specific policies, such as carbon taxes, due to sovereignty and other concerns.

Similarly, some developing countries note that forest and land-use projects under the CDM may threaten national sovereignty. This concern stems from the perception that forest and land-use projects under the CDM, such as forest conservation activities, could preclude using that forest for other purposes, thus slowing development. However, this problem can be avoided if projects contain a strong social and community component that furthers national development priorities. Moreover, Article 12 specifies that participation in the CDM is voluntary and must be approved by each Party involved, including both investor and host countries.

THE TREATMENT OF FORESTS AND LAND-USE CHANGE IN INDUSTRIALIZED COUNTRIES

This section focuses on the current Protocol provisions regarding which forest and land-use change activities must be inventoried by industrialized countries, the methods that may be used to quantify them, and the potential role of such activities under emissions and project-based credit trading. Because many rules and guidelines are not set but will be finalized in later Conferences, this section can only describe the current status, options available to delegates, and possible implications of the decisions.

To assist delegates in finalizing the rules related to land-use change and forests, the Subsidiary Body for Scientific and Technical Advice to the FCCC asked the IPCC to prepare a Special Report on key forest and land-use change issues, to be completed by mid-2000. The Special Report will investigate defining terms in Article 3.3, which, if any, emissions from additional land-use activities should be inventoried by Annex I countries, and issues related to project-level accounting under the market mechanisms. If forest, biodiversity, and development experts participate in the IPCC Special Report process and other fora, they may contribute to the decision-making process relating to land-use change and forest trends by suggesting how, where, and whether they can be influenced for the betterment of both climate and biodiversity.

CURRENT PROTOCOL RULES FOR DOMESTIC INVENTORIES OF GREENHOUSE GAS EMISSIONS FROM FORESTS AND LAND-USE CHANGE

A clear interpretation of the Kyoto Protocol rules is difficult because many decisions remain to be finalized by later Conferences of the Parties. Three time periods are relevant to the role of forests and land-use change in estimating the domestic inventories of Annex I countries: the 1990 base year, the compliance period (2008-2012), and the interim period (1990- 2008).

THE 1990 BASE YEAR

Annex I countries adopted greenhouse gas limits during the 2008-2012 commitment period based on a percentage of their emissions in 1990. Therefore, a higher amount of emissions during the base year makes it easier to meet their commitments. For example, Japan agreed to a 6 percent reduction and thus its emissions during 2008-2012 must be 94 percent of 1990 emissions; therefore, the larger the 1990 emissions, the more that may be emitted during the commitment period.

In their national communications to the FCCC, most Annex I countries reported land-use change and forest sector as being a net sink for greenhouse gases (removals were greater than emissions). Therefore, it benefited most nations to exclude the land-use change and forest sector from their 1990 baselines because, if included, net 1990 emissions would be lower. As a result, forest and land-use change net emissions are only counted in the 1990 base year if they were a net source (emissions were greater than removals) in that year. If the land-use and forest sector was a net sink, countries may exclude it from their base year calculations. This construct allows Annex I countries to include net land-use change and forest-sector emissions only if it increases their base year emissions, but not if it decreases them. Australia and Estonia were the only two countries for whom the forest and land-use sector constituted a net source. Australia particularly benefited from including forest and land-use change emissions, as it significantly raised its 1990 emission level. (*See Box 5.*)

Interestingly, the Protocol contains an asymmetry between what is inventoried in 1990 and in the commitment period. The Protocol does not specify any restrictions on the forest and land-use activities inventoried in 1990. Countries included a wide variety of activities in their national communications, such as forest conversion, managed forests, and sequestration in peatland.

While most Annex I countries do not include emissions or sequestration from the land-use change and forest sector in 1990 because they were a net source, the base year inventories will be important for the commitment period. During the commitment period, Annex I countries must inventory emissions and sequestrations from afforestation, reforestation, and deforestation due to direct human activity since 1990. Therefore, to determine whether afforestation, deforestation, or reforestation has taken place since 1990, Annex I countries must determine what forests were present in 1990. Annex I countries will require a snapshot of the landscape in 1990 to establish what has changed during 2008-2012. Many countries have not yet reported adequate 1990 data. Canada, for example, has not yet reported emissions or sequestration from its forest and land-use sector.

5 THE CASE OF AUSTRALIA

During the Kyoto negotiations, Australia was granted two concessions that provide an example of how the Protocol may fail to induce changes in resource use. First, Australia may increase emissions by 8 percent. Second, including land-use change and forest-sector emissions in the base year primarily benefits Australia, only one of two countries that reported net emissions from their forests and land-use conversion in the 1990 base year. Forest and land-use-sector emissions increase Australia's 1990 base year releases by about 24 percent (1). Such a large base year increase will lighten Australia's burden during the commitment period, thus decreasing incentives to slow or halt deforestation and industrial emissions.

The Protocol provides little, if any, incentive for Australia to begin valuing its natural resources for more than the agricultural land beneath them. A more restrictive commitment might have prompted Australia to rethink land clearing policies or coal use. Further, the Protocol's emphasis on tree planting does little to encourage more benign, integrated land-use policies. The current approach encourages less-efficient carbon gains from tree planting rather than native forest protection.

Note: 1. Global Environmental Change Report. "A Brief Analysis of the Kyoto Protocol," in *Global Environmental Change Report* IX, no. 24 (December 24, 1997).

THE 2008-2012 COMMITMENT PERIOD

Article 3.3 of the Protocol requires Annex I countries to inventory afforestation, reforestation, and deforestation that have occurred since 1990, but the emissions and removals from these activities are only measured during the 5-year commitment period between 2008-2012. Article 3.4 then instructs the Conference of the Parties, with guidance from the advisory bodies,[33] to decide how and whether Annex I countries must inventory emissions and sequestration from additional activities, such as forest management or agricultural practices.

A significant barrier to bringing in additional forest and land-use change activities–even if proven to be quantifiable and a significant greenhouse gas source–is the uncertain impact on Annex I targets. Each Annex I country negotiated its limitation target based on a rough understanding of how the target would be reached. As certain gases or flexibility mechanisms were or were not included in the Protocol during negotiations, Annex I nations would adjust the accepted limitation target accordingly. Each negotiated item impacted these targets either higher or lower. For example, the United States would probably not have agreed to a 7 percent reduction target if "flexibility mechanisms" such as the CDM and emissions trading had not been incorporated into the Protocol.

As previously mentioned, national communications were not comprehensive regarding forest and land-use emissions, nor were they submitted by all Annex I countries. As a result, it was difficult for negotiators to incorporate into targets the positive or negative impact of including emissions or sequestration from forests and land-use change, and how they might change through time.

Incorporating additional activities in the first commitment period will be even more difficult than the original negotiations, since Annex I countries are now unable to adjust their agreed-upon targets.

THE 1990-2008 INTERIM PERIOD

As negotiators decide what activities should be counted during the commitment period, they will need to be cognizant of the potential impact of these decisions on actions taken during the interim period. For example, the Protocol may create an incentive to clear land during the interim 1990-2008 period, when emissions are not inventoried, later allowing them to gain carbon credit for replanting trees and inventorying their carbon uptake during the commitment period. This could occur because emissions from deforestation may be counted only during the 2008-2012 commitment period, but not during the period from 1990 to 2008. One way to avoid creating this incentive would be for negotiators to agree that credit should be given for reforestation or afforestation only if the area contained no forest in 1990.[34] If land was forested in 1990 and is not in 2012, then greenhouse gas emissions from deforestation should be reported and counted as a liability against compliance, unless a natural disturbance caused the conversion.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE GUIDELINES FOR DOMESTIC INVENTORIES OF GREENHOUSE GAS EMISSIONS FROM FORESTS AND LAND-USE CHANGE

The Protocol and the IPCC Guidelines for national greenhouse gas emissions inventories are inconsistent in some respects. The IPCC recommends inventorying emissions and sequestration under three broad categories of land-use change and forest management. These categories contain activities, such as logging and sequestration from natural regeneration, that are not listed under the Kyoto Protocol, which only requires inventorying afforestation, reforestation, and deforestation. The IPCC's Guidelines for National Greenhouse Gas Inventories [35] recommends tracking emissions and sequestration from the following categories:

Changes in forest and other woody biomass stock: These are carbon fluxes within a forest due to logging or fuelwood gathering, among other possible management practices.

Forest and grassland conversion: This involves emissions resulting from converting forest or grassland to other land uses, such as cropland or pasture.

Abandonment of managed lands: This is sequestration due to the abandonment of previously managed lands, so that they are "regrowing towards a natural state."

Part of the reason why negotiators of the Protocol delineated such a limited set of activities may be that while the IPCC workbook provided guidelines for inventorying emissions and sequestration from a broad range of activities, many countries did not provide their data. This lack of data hampered the negotiators in assessing how and whether to include a wide spectrum of forests and land-use change activities. Further, Parties reporting national communications noted problems with data generation and methodological issues. Several Annex I countries requested further scientific work to determine the appropriate methods for estimating emissions and sequestration from forests and land-use change.[36] To correct this lack of data and determine the importance of emissions and sequestration from forest and land-use change, Annex I countries should begin to systematically collect information on changes in these activities.

DEFINING AND TRACKING DEFORESTATION

Each activity required to be inventoried will need to be precisely and carefully defined, as Annex I countries will use these legal definitions to estimate their greenhouse gas emissions. Afforestation is defined as tree planting on lands that historically have not contained forests; reforestation is tree planting on lands that have historically contained forests, but have been converted to some other use. Deforestation is thus far undefined, leaving this to a later Conference of the Parties or IPCC research.[37]

Individual countries have been proposing definitions that may have little scientific basis. For example, one government proposed that deforestation has occurred only if a structure, such as a building or a road, replaces the forest, arguing that any other conversion, such as to agriculture, does not preclude the forest from growing back. This example illustrates the importance of constructing a careful definition; if defined too narrowly, Annex I countries will not be required to report emissions, thus creating a loophole.

A number of widely accepted definitions of deforestation exist. For example, the Food and Agriculture Organization (FAO) defines deforestation as a reduction of forest stand density to less than 20 percent of its original cover.[38] Yet another definition is the conversion of forest to "nonforest uses" and as such may be even more easily monitored than the FAO definition.[39] Even though greenhouse gas emissions from forest harvesting are not currently counted under Protocol rules, if human activities result in deforestation or severe degradation and the area is not replanted, then the activity should be labeled as deforestation and the emissions inventoried. For example, logging in some areas such as slopes, high altitudes, and boreal zones compromises a forest's ability to regenerate. Harvest in these areas amounts to deforestation. The Conference of the Parties should seek advice from forest and biodiversity experts in deciding which definition to adopt.

What Is Left Uncounted in National Inventories?

The Conference of the Parties will decide what, if any, additional activities should be inventoried, based on the work of the advisory bodies. Clearly, some of these omitted activities have a large impact on global greenhouse gas emissions. This section discusses activities not currently included under the Protocol and examines possible missed opportunities and risks of each.

FOREST HARVEST AND MANAGEMENT

The Protocol does not require inventories of emissions and sequestration in forests managed for wood harvest. Harvested forests may be carbon-neutral, if biomass regrowth balances biomass removal, but some harvest regimes may result in net emissions. Studies to date have shown mixed results. One study estimated that uptake of carbon from regrowth and storage in wood products (this is discussed below) was greater than emissions from harvest and product decay in Canada and New Zealand.[40] However, studies using national inventories mask important differences in forest types and management regimes. While the forest sector as a whole in the United States may be a net sink, one analysis shows that converting old-growth forests to younger forests results in net emissions of carbon.[41] If the Parties decide to require inventories of emissions and reductions from managed forests, a greater understanding of net greenhouse gas flows due to various harvest and management systems will be needed.

Because of the size of the forest products industry in Canada, the United States, and Scandinavian countries in particular, changes in forest management, (e.g. longer rotation times) may offer significant reductions in greenhouse gas emissions. Instituting sustainable forest management or reduced impact logging improves carbon storage, reduces the risk of fire, and offers environmental benefits such as diminished erosion and improved wildlife habitat.[42]

Many, though not all, nongovernmental organizations oppose requiring inventories of emissions and sequestration from forest management activities. They fear that the carbon fluxes are too difficult to estimate because they involve periodic losses and uptake of carbon. Some also worry that if forest management is inventoried, then large reductions will be claimed from replanted harvest sites, thus reducing the Protocol's ability to change developed countries' fossil fuel consumption.

However, at least an equal danger is that excluding forest harvest and management from Annex I inventories will result in uncounted greenhouse gas emissions and miss an opportunity to create incentives for improved forest management. If forest harvest and management are included, the Kyoto Protocol could create an incentive to manage for more mature, potentially more biologically diverse forests that generally store more carbon than younger forests.[43] Also, not counting emissions from forest harvest and management may create a loophole for Annex I countries, depending on how deforestation is defined.

Measuring and tracking changes within a forest stand are also technically feasible. Inventory methods for stand density and biomass have been developed.[44] Furthermore, new applications of global positioning systems, survey data, and remote sensing will aid in performing the required inventories, as they may more accurately measure forest biomass, rather than simply forest cover.

FOREST DEGRADATION

Because some forest management systems are neutral with respect to net greenhouse gas fluxes, the Parties may instead choose to require inventories of degradation, rather than all management systems. Degradation could be defined as the loss of biomass within a forest. Causes of degradation may include conversion of primary forests to secondary, or unsustainable harvesting of managed forests, pollution, or grazing. As previously discussed in this paper and elsewhere, and illustrated in Figure 2, converting primary forests to secondary forests can be a significant source of carbon emissions and biodiversity loss.[45]

Air pollution is a major cause of degradation in Annex I countries; it is estimated to have contributed to the loss of at least 100,000 hectares of forests in Central and Eastern Europe over the last 20 years.[46] However, the question is whether degradation from pollutants would be inventoried because the Protocol stipulates measuring emissions and removals from *direct* human activities. What constitutes a direct human activity has yet to be defined. While the greenhouse gas implications of degradation from pollution may not be inventoried, it does offer an example of further connections between global warming and biodiversity loss.

Sulfur dioxide emissions from coal-fired power plants are killing forests in Eastern Europe and acidifying soil so that regeneration is difficult or impossible. Acid-rain-damaged forests burn or die and decay, exacerbating these countries' greenhouse gas emissions and resulting in biodiversity loss. Converting power plants from coal to gas eliminates these sulfur dioxide emissions, thus decreasing acid precipitation and benefiting forests, in addition to offering human health benefits.

Incorporating forest degradation into the inventoried activities could potentially be accomplished by a sufficiently broad definition of deforestation.

STORAGE IN WOOD PRODUCTS

The IPCC workbook recommends the default assumption that all carbon in harvested biomass is released in the harvest year rather than stored or released over time. This assumption is clearly inaccurate, and studies have begun to explore inventory methods. These same studies suggest that the carbon stored in wood products is significant enough to warrant inclusion in national inventories.[47] However, important questions remain to be resolved such as how to account for decay over time and who is liable for emissions from products that are traded internationally.

There is also demonstrated interest in storing carbon in wood products as a greenhouse gas mitigation strategy.[48] (*See Box 6.*) Because wood products are the result of a greenhouse gas emitting activity–logging–more research is needed to differentiate between types of forests and management strategies to determine those that are a net sink, net source, or in balance over the long term. A review of studies shows a mixed result. For example in Russia, it is estimated that 33 teragrams (Tg) of carbon per year are stored in wood products, while 115 Tg are released from logging.[49]

As methods are improved and standardized, it may be prudent to inventory carbon in wood products, but, as was stated previously, the net carbon flux of the entire management system, from harvest to product, should be taken into account when devising emission reduction strategies.

Box 6 describes a U.S. proposal to increase logging intensity as a carbon sequestration strategy, despite the negative climatic and ecological consequences. Storage in wood products can be a useful climate mitigation strategy, particularly if efforts are undertaken to increase milling or logging efficiency by reducing wood waste, or under certain management regimes.

6 A U.S. PROPOSAL — CUTTING DOWN TREES TO SAVE CARBON

The U. S. House of Representatives recently passed a nonbinding measure to manage national forests to reduce greenhouse gases (1). The measure notes that CO_2 may be kept out of the atmosphere "by harvesting the forest before it begins to decompose or burn, thus storing the carbon in wood products." But this strategy is inconsistent with climate mitigation and other environmental goals. As noted in the text, a rapid harvest and tree planting regime is not a cost-effective carbon storage method, nor will it result in large amounts of sequestered carbon. Preventing harvest of primary forests or establishing a management regime that maintains older forests is more cost-effective, even when carbon in wood products from the increased harvests is included (2).

Ecologically, it is unwise to encourage converting older forests to young, even-aged stands, as the measure implies. Even-aged monoculture forests are less biologically diverse than older, uneven-aged, multispecies stands, so this measure would negatively impact biodiversity. Increased logging and tree planting for harvests on national forests is a losing strategy for both climate and biodiversity.

Unlike the IPCC Inventory Guidelines, the Kyoto Protocol does not require inventorying emissions and reductions from forest management; thus the strategies outlined in the House measure would not impact emissions measured under the current rules. It does, however, illustrate the dangers of inventorying a wider group of land-use change and forest activities but not fully accounting for their emissions, only their sequestration.

Notes: 1. House of Representatives. 1997. House Resolution 151. Regarding Management of National Forests to Reduce Greenhouse Gases. October 21.

2. Mark E. Harmon, William K. Ferrell, and Jerry F. Franklin. "Effects on Carbon Storage of Conversion of C¹d-Growth Forests to Young Forests." *Science* 247 (1990): 699.

Robert N. Stavins. "The Costs of Carbon Sequestration: A Revealed Preference Approach." CSIA Discussion Paper 95-06 (Kennedy School of Government, Harvard University, 1995).

FOREST FIRES

Forest fires are a massive source of uncounted greenhouse gas emissions, yet even those caused by human activities are not inventoried under current Protocol rules. In fact, if human-caused fires were inventoried, some countries' forest sectors, such as Russia's, might move from being a net sink to a net source. One study estimated that forest fires in Russia emit an estimated 137 million tons of carbon annually but did not distinguish between anthropogenic and non-anthropogenic fires.[50] It does note that forests stressed by pollutants, pests, and diseases are more fire-prone.

Despite the importance of emissions from forest fires, it may be difficult to determine whether a fire was the direct result of human activities. However, excluding fires from national inventories may open a loophole for Annex I countries, as the fire would not register as an emission, but reforesting the area would result in a credit for greenhouse gas removals.

Including wildfire may also be ecologically unwise, since much recent research suggests that fire is often part of a healthy disturbance regime. Carbon sequestration should not override natural ecosystem patterns.

SOIL CARBON

The Protocol does not require that carbon fluxes from soil due to land-use change be inventoried. This is problematic, as it is estimated that at least 75 percent of terrestrial carbon is stored in the soil and its organic layer as opposed to the vegetation, much of it being stored in nonforest ecosystems such as peatlands.[51] The percentage is higher in boreal forest soils, which hold about 84 percent of the total carbon. Some question whether soil carbon can be accurately measured and thus resist including carbon fluxes in national inventories. However, given the magnitude of carbon stored in soil, if standardized measurement techniques can be developed, as some suggest, then soil carbon could be an important piece of the puzzle.[52]

METHODS FOR INCLUDING ADDITIONAL ACTIVITIES UNDER DOMESTIC INVENTORIES

It appears that the Protocol negotiators attempted to resolve technical issues associated with forest and land-use change by allowing only three activities–afforestation, reforestation, and deforestation–rather than attempting to address them. As the advisory bodies weigh whether to include additional activities, they should consider the magnitude of the potential impact on greenhouse gas emissions or removals and the degree of scientific uncertainty in quantifying emissions. For example, given the potential greenhouse gas emissions from forest harvest and management and the available tools for inventories, the advisory bodies should consider requiring inventories of emissions from these and other activities.

One option that would enable Parties to explore the efficacy of inventorying additional activities would be to use a *project-based* greenhouse gas accounting system in the first commitment period. This would allow the Parties to determine what methods can be used to inventory emissions and what management practices and policies can reduce them. If the activities are found to be significant, they could be phased in during the first commitment period without distorting agreed-upon targets.

A project-based approach for currently excluded activities would resemble project-based credit trading, but function domestically. Emission reductions beyond a business as usual, or reference, case (such as from improving harvest practices) would count towards the limitation targets. The reference cases should be established by developing a minimum set of performance standards whereby only improvements over this minimum would be credited. For example, existing regulations for forest harvest in a given region could be required to be surpassed for crediting. One area may require 100-meter buffer zones along riparian areas, but the landowner creates a 200-meter buffer. Only the carbon stored on the additional 100-meter buffer could be registered as an emission reduction.

Under a project-based approach, sequestration under the reference scenario is subtracted; this means that only the incremental increase in sequestration or reduction in emissions is counted. Subtracting the carbon stored under the reference scenario ensures that the activity increases net carbon sequestered, since an activity that results in an annual uptake of carbon may not represent the optimal option compared with alternate activities. Figure 3 illustrates a proposed carbon mitigation project involving improved forest management. The reference scenario shows a positive annual uptake of carbon. However, better management brings an improvement from the reference case.

Using a project-based approach in conjunction with minimum performance standards would accomplish the following:

- Allow time to develop standardized methods for inventories and identify best management practices as later Conferences of the Parties decide whether to include additional activities.
- Limit the amount of greenhouse gas reductions claimed to only net improvements from a minimum reference case, based on minimum performance standards, thus reducing the danger that forests and land-use strategies would dominate reduction efforts.
- Ensure reporting rigor in estimating greenhouse gas reductions from project-level forest and land-use change activities, thus decreasing uncertainty in greenhouse gas reduction estimates. Such an approach would also require that reduction policies and strategies result in net climate benefits, thus possibly avoiding incentives to move to short rotation periods with young stands, which is not an efficient means to sequester carbon and does not yield the highest biodiversity benefits. (*See Box 6.*)

If "credit" were given only for incremental improvement, then incentives for increased environmental performance on public and private lands could be put in place. These new activities–such as managing for older forests and sustainable timber–generate increased biodiversity, climate, and watershed benefits, among others.

The Treatment of Forests and Land-Use Change Under the Market Mechanisms for Reductions Between Developed Countries

The Protocol describes three distinct market mechanisms, two of which are reserved for Annex I parties–project-based credit trading and emissions trading. It is unclear what types of forest and land-use change projects will be eligible under any of these mechanisms.

If Annex I countries sell greenhouse gas reductions through emissions or project-based credit trading, the seller nation must exceed its emission reduction target by at least the amount sold. One project from the Activities Implemented Jointly (AIJ) pilot phase illustrates how these two mechanisms may operate. The United States and Russia are undertaking a reforestation project in Russia, RUSAFOR, and dividing the emission reductions evenly. The project is estimated to sequester approximately 29,000 tons of carbon over its lifetime, half of which, 14,500 tons of carbon, will be transferred to the United States from Russia.[53] In order to do so, Russia's emissions reductions must exceed its commitment by the amount traded to the United States. Because rules and guidelines are not yet in place, it is unclear when Russia must show that it has met its commitments, or what sanctions will be in place if the seller country fails to meet its commitments.

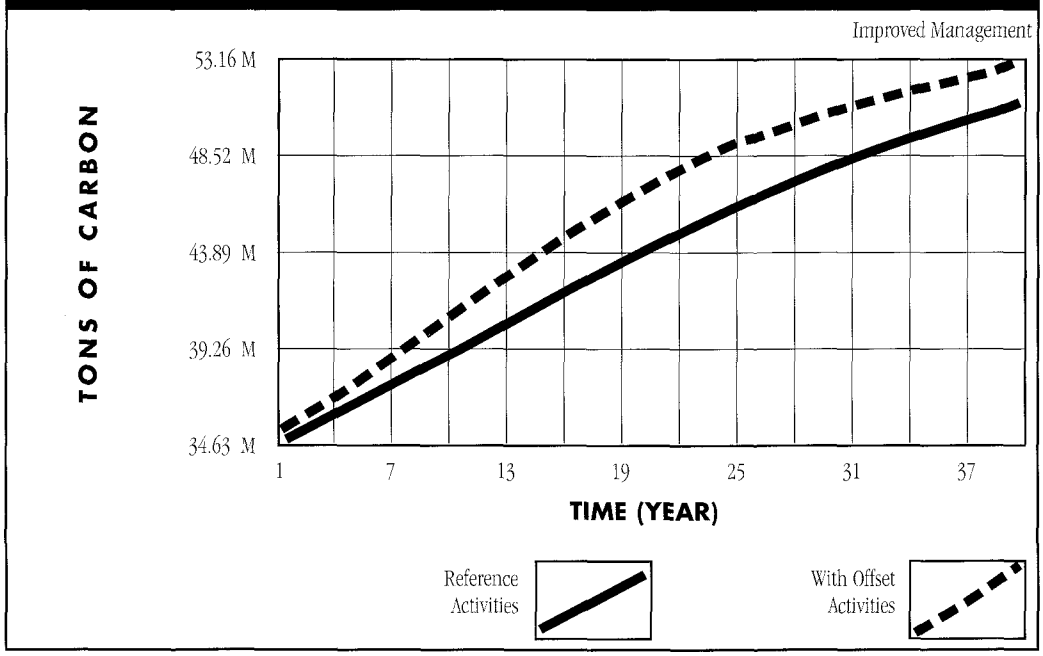
PROJECT-BASED CREDIT TRADING

Annex I countries may transfer to other Annex I countries greenhouse gas reductions resulting from projects that diminish, avoid, or sequester greenhouse gas emissions (Article 6). The FACE project in the Czech Republic, described in Box 2, offers an example of a likely mitigation project between Annex I countries. As with all of the market mechanisms, the rules have not been finalized, so it is not possible to know what types of projects will be eligible. If forest and land-use activities are eligible, they may be bound by decisions relating to Article 3.3 limiting them to afforestation, reforestation, and deforestation projects.

If the cost per ton of reductions is high relative to emissions trading, the Clean Development Mechanism, or domestic reductions, then project-based credit trading may be rarely used. But it could provide a new tool for slowing deforestation and encouraging restoration in Annex I countries such as Russia and Canada. The relative costs will be determined largely by transaction costs and varying costs of land and labor in different countries. Because this mechanism is project-based, it should not necessarily be bound by the restrictions of Article 3.3.

As described earlier, in order to sell reduction credits, the Annex I seller must have exceeded its total reduction commitments or kept its emissions below the amount transferred. A compliance mechanism will be required to create an incentive for the "seller" Annex I country to exceed its target by at least the amount of reductions it has sold. If at the end of the commitment period the country has failed to exceed its target, then it may be subject to sanctions.

FIGURE 3



EMISSIONS TRADING

Many aspects of emissions trading (Article 17) remain to be defined, including structure, rules, and guidelines. An emissions trading system is a complicated mechanism to create and monitor. There is very limited experience with pollution trading on a global scale, though frameworks and issues have been explored. There are variations of trading systems, but all start with binding commitments within an overall emission limit.

A target level of cumulative emissions for a prescribed period of time is developed and a defined group of trading members is established. Parties to the trading system can emit up to their limit or reduce emissions below their budget or cap and bank the reductions for future use or sell them. Conversely, Parties that exceed their budget or limits may purchase emission allowances.[54]

Depending on the system, group members could be nations or private entities from a greenhouse gas emitting sector, such as power producers.

As with project-based credit trading, another key element of an emissions trading system will be a compliance or liability mechanism; if a member of the trading group sells or exceeds its emission limits, it might be subject to some type of sanctions and trading privileges could be suspended.

The sulfur dioxide trading system in the United States is one functioning example of a trading system, but it covers only one pollutant within a single regulatory system. However, the emissions trading system that emerges from the Kyoto Protocol may build upon the monitoring, reporting, and verification successes of the sulfur dioxide trading system.

It is also likely that the greenhouse gas trading system under the Protocol would be developed incrementally, thus simplifying its implementation. Some have suggested creating "umbrella groups" of countries that comprise a trading group. For example, New Zealand, Canada, and the Czech Republic could form one group that establishes a trading system for a limited number of gases, such as CO_2, under the expectation that as an economy in transition, the Czech Republic may offer low-cost emission reductions.

The role of forests and land-use change under emissions trading will depend upon the type of system and the forest-related activity allowed by the Conference of the Parties. For example, a member may generate additional emission credits via reforestation and afforestation, which they may use or trade.

Forest harvest, which under some management systems is a net source, provides a second example. The timber industry could receive emission allowances. If they altered management practices in ways that reduced emissions below their allotted amounts, they could trade or save them for later use. Credits could also be accrued for regrowth following harvest, which could be used in later harvests or traded.

Other schemes may also provide a model for trading forest and land-use change reductions, especially in the early phases of the system. Non-point-source water pollution trading systems, for example, discount for uncertainty and establish area-specific management norms and minimum standards that must be surpassed to trade reductions.[55] The incremental improvement and resulting pollution reductions may then be traded.

The FCCC commits all Parties, both Annex I and non-Annex I, to implement programs that mitigate climate change. However, developing countries are not bound by limits on greenhouse gas emissions under the Kyoto Protocol. The FCCC describes these varying levels of commitments as "differentiated responsibilities."[56] In general, non-Annex I countries have resisted adopting any limits until Annex I countries demonstrate real emissions reductions themselves.

The CDM provides a significant opportunity in the Protocol to identify and finance lower-emission development paths in developing countries. It is also the first mechanism to become operational under the Protocol, possibly as early as 2000; thus work on the institutional and technical aspects of implementing, monitoring, and verifying projects is a priority.

As with many other parts of the Protocol, the decisions relating to the treatment of forests and land-use change within the CDM have yet to be finalized. The current text of Article 12 provides a skeletal outline of how the CDM should operate, thus its entire institutional structure remains to be constructed. (*See Box 7.*)

There is disagreement over the extent to which forest and land-use change projects are allowed under the Clean Development Mechanism, if at all. Several countries claim that, because forests and land-use change are not explicitly mentioned in the Protocol text on the CDM, they are therefore not included. Others claim that since there are no explicit limits placed on the CDM, any and all forest and land-use projects are eligible. The matter will have to be decided by negotiators.

7 OUTSTANDING ISSUES FACING THE CLEAN DEVELOPMENT MECHANISM

Most aspects of the CDM remain to be decided; however, the Protocol calls for a supervisory executive board to oversee it and for "operating entities" that will certify project activities. Unlike the current pilot phase, a share of the investments will cover administrative expenses for the executive board and operating entities, as well as assist developing countries particularly vulnerable to the impacts of climate change in meeting the costs of adaptation (such as the small island states). Because actions under the CDM may begin crediting in 2000, before any other mechanism, the urgency of setting up a workable system is greater than with emissions trading or project-based credit trading. Some critical unanswered questions are discussed here.

INSTITUTIONAL

- Who should serve on the supervisory executive board, and what should be its main functions? Should the board include technical experts only, or should key stakeholder representatives from non-governmental organizations, governments, and the private sector also be included? Some also have proposed that the executive board be sited in an existing body, such as the World Bank, while others argue for an independent and new institution.
- Who may serve as a certifying agency? The certification process will be an important determinant of project credibility, as it will bear responsibility for monitoring and verification of greenhouse gas reductions. Public agencies or a mix of private and public entities may be allowed to certify reductions. For example, SGS-Forestry, a for-profit firm, is monitoring Costa Rica's Certifiable Tradable Offsets.
- What should be the amount of the adaptation fee and administrative expenses? The administrative expenses will cover the cost of running the institution, such as housing and staffing the executive board. The adaptation fee was an important piece of the CDM, as countries strongly opposed to Joint Implementation felt that their needs were being addressed. However, a trade-off clearly exists between creating a fund that provides needed adaptation funds and increasing the costs of CDM projects such that they are no longer attractive options.

PROJECTS

- By what criteria and standards will proposed projects be evaluated (social, environmental, economic)? The evaluation may be based on a project-by-project review by the executive board or an operating entity; on a basic set of underlying standards, allowing for individual projects to be reviewed by different entities; or according to country-by-country criteria, with the reference case determined by standard practice within that country.
- What type of projects will be eligible? As this paper has discussed at length, there is a range of options within the forest sector with respect to what types of projects will be eligible for credits. The energy sector faces similar choices. For example, using clean rather than conventional coal results in greenhouse gas reductions, but coal power plants may not be made eligible. The types of eligible projects will in turn determine which of the current AIJ projects will be brought into the CDM.

ARRANGEMENT BETWEEN BUYERS AND SELLERS

- Should the CDM consist of a portfolio of projects waiting for support, or a series of bilateral agreements? A portfolio approach may consist of one or multiple clearinghouses that offer emission reduction certificates from a pool of projects, such as the case of Costa Rican Certifiable Tradable Offsets, perhaps offered by a non-Annex I country, the World Bank, or a private entity. A bilateral approach would involve individual agreements between private entities and/or countries, as is the case of the Rio Bravo and CARE/Guatemala projects described in Box 2. However, it is possible that both approaches may be allowed under the CDM.

The current AIJ pilot phase extends to the end of 1999, and additional greenhouse gas offset projects continue to be funded. The Conference of the Parties has yet to evaluate the pilot phase for lessons about issues and opportunities and what may be lost or gained due to decisions relating to project eligibility and institutional structure. As Parties make these decisions, an evaluation of the current AIJ pilot phase might provide valuable lessons, if undertaken in advance of the establishment of the CDM.

The Clean Development Mechanism

The Clean Development Mechanism allows project-based trading between developed and developing nations. The stated purpose of the Clean Development Mechanism is to assist non-Annex I countries in achieving sustainable development, to contribute to the ultimate objective of the Convention (stabilizing atmospheric greenhouse gas concentrations), and to assist Annex I countries in attaining compliance with their binding emissions targets. These purposes are to be achieved through three key elements outlined in the Protocol: certified emissions reductions from project activities in developing countries, a financial mechanism that funnels investments towards these emission reduction and sequestration activities, and the application or use of some or all of these certified reductions in meeting Annex I emissions limits. The difficulty lies in constructing an institution that achieves the stated purposes.

Because developing countries have no legally binding emission limits, the CDM offers a means to move investments in a more climate-friendly direction. If not carefully set up, however, the absence of emission limits or caps in the CDM could provide Annex I countries with a potentially limitless pool of reduction opportunities, rendering their limits virtually meaningless.

The CDM has the potential to meet the needs of both developing and industrialized countries. It responds to the needs of Annex I nations by offering lower-cost, more flexible options in meeting emissions constraints, while providing a source of capital for the financing of clean, energy-efficient economic development and for projects with the potential to reduce deforestation and forest degradation in non-Annex I countries.

While developing countries resist any actions they believe would stifle economic development, social and environmental benefits may be gained from strong commitments and pro-active policy reforms on the part of both industrialized and industrializing economies. The optimistic scenario is one where developing countries take a different path and minimize or in some cases avoid the choking smog and accompanying human deaths, massive deforestation, and species loss that developed countries experienced. Developing countries may find ways of sustainably using their biological resources so that livelihoods can be realized while maintaining resource productivity in terms of local and global climate, biological diversity, water purification, and myriad other services just beginning to be recognized.

Similarly, the CDM has the potential to fund "technological leapfrogging" that would enable developing countries to bypass the inefficient choices made by industrialized countries. While most examples of leapfrogging center on the energy sector, such as improving building efficiency, the forest and land-use sector also offers technology transfer opportunities. Some examples include: improving agricultural productivity through transfer of irrigation, management practices, or techniques to restore degraded agricultural land; increasing milling efficiency; and improving silvicultural practices or sustainable forest management techniques. Through carbon sequestration activities, the CDM may help slow the loss of biological diversity, protect critical watersheds, and accelerate the reforestation of degraded forests and the restoration of degraded agricultural land.

Project Eligibility

The Parties are beginning to make decisions about how to operationalize the CDM. One of the most important choices is whether forest and land-use change projects will have a place under the CDM.

Because such a large percentage of greenhouse gas emissions from non-Annex I countries comes from deforestation, excluding or narrowly defining the options to address deforestation will weaken the ability of non-Annex I countries to limit current and future emissions. Future trends show continuing forest degradation and loss, along with high carbon emissions, unless action is taken quickly.[57] The Clean Development Mechanism offers an opportunity to slow both greenhouse gas emissions and forest loss.

The types of activities allowed will impact future and current forest and land-use sector investments. Subsequent Conferences of the Parties, under guidance from the advisory bodies, may choose to exclude certain project activities, thus preventing some current projects from transferring to the Clean Development Mechanism. Conservation and forest management projects appear to be in question, as Article 3.3, which lists the forest and land-use activities that must be inventoried, may also apply to the Clean Development Mechanism.

Forest Harvest and Management

Projects involving sustainable forest management or reduced-impact logging in place of an intensive harvest regime have been shown to result in quantifiable carbon emission reductions.[58]

Some of these projects have been carefully monitored for their carbon gains and losses. It is relatively easy to estimate the net carbon sequestered due to such projects because of past research on logging practices and the ability of such activities to utilize control plots for reference cases. Six AIJ pilot-phase carbon projects involve sustainable forest management or reduced-impact logging. A current example of a reduced-impact logging project, described in Box 2, is underway in Malaysia and is estimated to have sequestered about 42 megagrams (Mg) of carbon per hectare.[59] At a minimum, before deciding project eligibility, the Conference of the Parties should investigate their efficacy and overall environmental impacts under the current AIJ pilot phase. Emerging institutions and efforts, such as the Forest Stewardship Council, may also offer lessons for monitoring and verifying improved forest management.[60]

To avoid rewarding poor logging practices by paying for improvements over a low reference case, minimum performance standards and practices for the reference case should be established. Minimum practices should consist of basic standards for harvesting; only avoided emissions due to improvement over these standards would be creditable. Without these minimum standards, the most destructive harvest operations would yield greater carbon credits than less destructive operations, due to a lower baseline. The minimum reference case should at least be equal to, or above, the existing laws of the host country.

If such efforts were allowed under the Clean Development Mechanism, sustainable forest management could become more profitable in developing countries than clearing forest for low-productivity agriculture.[61]

CARBON STORED IN WOOD PRODUCTS

As noted in the section on Annex I countries, the impact of harvest regimes "with" and "without" project intervention must be carefully considered. Increasing harvest in pursuit of storing carbon in wood products is not a prudent strategy for either climate or biodiversity because a relatively small percentage of the tree removed becomes wood product. WRI evaluated the net carbon sequestration potential of five forestry and land-use projects, some of which included storing carbon in wood products as part of their strategy.[62] Of the projects examined, the average amount of carbon in wood products as a percentage of total carbon sequestered was 1.5 percent, the maximum being 2 percent, while strategies focusing on storing carbon in living biomass yielded greater greenhouse gas reductions. These projects involved community forestry, not commercial timber operations, so the former may be less efficient. However, one study of tropical timber harvests found that a *maximum* of 31 percent of individual tree biomass became sawn timber, with the average being 25 percent, meaning that the remaining carbon previously stored in the tree returns to the atmosphere.[63] Additionally, harvesting typically damages the surrounding forest, resulting in carbon emissions. Most timber products are not long-lived, as only a small percentage of harvested wood goes into furniture or buildings; the majority becomes short-lived products such as shipping pallets that are used several times, then burned.

These factors indicate that increasing area or harvest intensity will not result in carbon gains, but they point to other opportunities for greenhouse gas reductions through projects that increase the use of mill residue for fuel or wood products, improved logging techniques that reduce damage to surrounding forest, increased milling efficiency to reduce wood waste through improved technology, and training of foresters.[64]

FOREST CONSERVATION

Conservation, or avoided deforestation, offers the greatest confluence of climate and biodiversity benefits and presents significant emission reduction opportunities.[65] However, some environmental organizations and developing countries seek to specifically exclude conservation projects. Their opposition is based on two concerns: a) it is too difficult to determine whether deforestation would have occurred in the absence of carbon offset activities; and b) the CDM may create an incentive to exaggerate threats to a forest.

However, under appropriate CDM guidelines, conservation projects can potentially result in reliable greenhouse gas reductions. First, the "without mitigation" or "reference" case must be confirmed, using local deforestation trends. Second, the underlying causes of these trends must be established.

Defining a reference scenario will require evidence of an imminent threat to the standing forest in the absence of action. The project activities should seek to address and counter the threats leading to land-use change by providing alternate income sources such as land purchase or payments, or substitutes for the alternate use of the forest land. For example, if fuelwood gathering is resulting in deforestation, the project should seek to provide alternate fuelwood sources in addition to protection.

Under these conditions, the project could combine enforcement of protected areas with alternatives to forest conversion. The Rio Bravo project in Belize combined forest protection with income from sustainable forest management to replace farming. In other cases, though not all, the value of carbon sequestration may be able to provide an income stream that competes with the value of forest conversion, such as the CARFIX project in Costa Rica.

Some fear that allowing conservation projects will give non-Annex I countries an incentive to exaggerate the threat to forests. If avoided deforestation projects are allowed under the CDM, it will be important to avoid constructing guidelines that inadvertently discourage governments from undertaking conservation efforts. For example, if conservation projects are allowed only in countries with almost no protected areas, it would penalize countries with significant protected areas. One option would be to allow conservation offsets only in countries that had designated a certain percentage, such as 10 percent, of their forests as protected areas.

Conservation projects could also be required to consist of multiple funding sources, of which carbon sequestration can be only a fixed percentage, and solely that percentage of greenhouse gas reductions could be credited. Or, conservation projects may only be allowed in certain areas, such as buffer zones of existing protected areas proven to be under threat.

IMPROVING AGRICULTURAL PRODUCTIVITY

Increasing agricultural productivity in developing countries can stabilize the agricultural frontier, thus slowing deforestation. Early carbon sequestration offset projects included increasing agricultural productivity as a component.[66] The connection between deforestation and agricultural land demand makes improving agricultural productivity an important strategy for reducing greenhouse gas emissions from non-Annex I countries.

The difficulty is that the connection between maintaining forest cover and increasing agricultural productivity is indirect, even if it is well understood.[67] If possible, the Clean Development Mechanism guidelines should be designed to allow projects that seek to increase agricultural productivity in conjunction with forest protection. An example of such a project, CARE/Guatemala, is described in Box 2.

FIRE SUPPRESSION

Huge swaths of Brazilian forest and Indonesian peat bogs have burned in human-caused conflagrations leading to massive carbon emissions.

In moist forests, human activities such as selective logging, shifting cultivation, and fuelwood gathering dry out the forest floor, increasing the risk of wildfires. [68] Several jointly implemented projects include decreased incidence of fire as an objective and benefit of the project. The CARE/Guatemala Agroforestry project includes a fire protection component, from funding fire brigades and moving from slash and burn agriculture to agroforestry. Not allowing projects that decrease the incidence of fire under the Clean Development Mechanism could remove an incentive for an important carbon reduction strategy. In many cases, however, fires appear to be the secondary impact of other activities, such as logging, pollutant-stress, or clearing for cattle pasture; therefore, if CDM projects and national policies discouraged these activities, then human-caused fires would decrease as well.

CONTRIBUTING ELEMENTS FOR A SUCCESSFUL CDM

The chances of realizing the potential benefits of the CDM would be enhanced, though not guaranteed, by consideration of several additional elements that go beyond institutional structure and project eligibility. First is the danger that the CDM will reward environmentally harmful policies and practices; second is the role of local benefits; and third is the need for data, improved methods, and monitoring systems for the quantification of greenhouse gas benefits.

If countries participating in the CDM have policies that exacerbate deforestation through subsidies, tax breaks, or below-cost sales, then carbon sequestration projects may only be mitigating the impact of poor policies. The same danger exists for energy offset projects as well, if countries offer subsidies for high-emission fuel sources. As was suggested previously for developed countries, minimum performance standards could help to avoid rewarding countries or private sector entities with extremely poor practices or policies by paying for management improvements over an exceedingly low baseline.

Social benefits are an important part of the CDM for two reasons. First, sustainable development is one of the purposes of the CDM. Its success will be measured both by achieving emission reductions and by sustainable development, as these represent the respective priorities of Annex I and non-Annex I countries.[69] Thus, land-use change and forest-related projects will be undertaken to the extent that they contribute to sustainable development, which will probably be defined by host countries' development priorities.

Secondly, the goals of emission reductions and sustainable development need not be in conflict. Providing economic benefits to people in the project region gives them a greater stake in the project's success.[70] Carbon alone will not be a sufficient motivator to ensure a project's longevity in the absence of strict oversight.

Although significant progress has been made, more research is needed to fully understand the calculation of greenhouse gas benefits. Concerns about accurately quantifying greenhouse gas reductions and emissions can in large part be solved by sharpening the IPCC methodology guidelines, establishing national-level inventory methods, instituting procedures for independent verification required under Article 12, and utilizing existing technology and data on forest cover and land-use change.

If the Convention Parties allow a broad range of projects and activities under the CDM, that will necessitate putting new systems and technologies in place that accurately monitor and verify regional forest and land-use change trends, a significant contribution in itself. To include forest and land-use change projects, the CDM will require putting in place monitoring and verification systems that can track regional and local changes in land-use. These systems could combine the use of remote sensing technologies with ground truthing, which would serve those concerned generally with the loss and degradation of forests and the accompanying greenhouse gas emissions. Many projects under the AIJ pilot phase are employing such techniques in their monitoring and verification protocols. If governments or certification agencies employ and install regional monitoring systems, then costs are likely to decrease.[71] The U.S. National Aeronautics and Space Administration (NASA) is currently testing and developing technologies that combine in situ measurements with current and planned satellite systems; these will be able to inventory global land cover and land-use change with the goal of providing policy-relevant data that will be applicable at the regional scale.[72]

Such a system could identify forest areas threatened with conversion and degradation, or candidate areas for restoration. A subset of the threatened forests could then become candidates for CDM projects, provided that the drivers leading to forest conversion could be replaced with lower-impact, lower-emitting activities. For example, in Costa Rica sustainable forest management is replacing conversion to relatively low-productivity cattle ranching.

The associated monitoring and verification costs should be considered integral to the project, not as unnecessary transaction costs to be eliminated. To realize the potential biodiversity and climate benefits of the CDM, it is critical to build it with appropriate project guidelines, as well as auditing and verification systems. These are better approaches than severely restricting project eligibility.

Most importantly, if the CDM couples credible guidelines for verification, accountability, and monitoring with a broad inclusion of forests and land-use change, including avoided deforestation and forest management, the Protocol's impact on both biodiversity and climate will be maximized.

This chapter was adapted from Paige Brown, Nancy Kete, and Robert Livernash, "Forests and Land Use Projects," in *Issues and Options: The Clean Development Mechanism*, José Goldemberg, ed. (United Nations Development Programme, 1998).

TECHNICAL CONCERNS ASSOCIATED WITH MEASURING AND VERIFYING FOREST AND LAND-USE CHANGE EMISSIONS AND REDUCTIONS

The key scientific and technical issues include concerns about the difficulty of quantifying and verifying greenhouse gas reductions from the forest sector, especially when compared with the energy sector. The main scientific and technical issues associated with forest and land-use mitigation activities include establishing a reference case, leakage, permanence of reductions, and measurement accuracy. Except for the last, these technical concerns remain to be fully resolved for energy-based projects as well. These concerns primarily apply to the market-based mechanisms, though measurement accuracy is an issue for national inventories as well as the market-based mechanisms.

Establishing a Reference Case

Determining the reference, or business-as-usual, case requires estimating what would have happened in the absence of greenhouse gas reduction efforts. The reference case will be a challenge for both energy and forest-sector projects.

The reference case is the foundation for determining net greenhouse gas reductions and emissions. In many cases, prevailing forest and land-use practices and conversion trends are well understood and can be documented. Some activities, such as the reduced-impact logging project in Malaysia and a more recent AIJ project in Bolivia (Noel Kempff), established control areas similar to the project site, which allow a direct comparison of "with-mitigation" and "without-mitigation" activities.[73]

Determining the business-as-usual reference case for any kind of project requires understanding barriers to improvements in practices over time. Parallel barriers exist between the energy and the forest and land-use sectors, suggesting that guidelines could be developed that cover both sectors. Typical barriers to improved practices include high, fixed, up-front costs, higher costs over time, or a need for technical assistance. For example, up-front fixed costs may be a barrier even if the project's costs over time are lower than under the conventional scenario. Switching from conventional light bulbs to compact fluorescents involves higher up-front costs but uses less energy and saves money in the long run. Similarly, adopting reduced-impact logging results in higher up-front costs, but over time economic benefits may be realized from increased yield and improved efficiency.[74] There are also opportunity costs due to foregone timber production while waiting for these benefits to accrue. In these cases, funding from greenhouse gas mitigation helps overcome the barriers.

Determining the reference may be more difficult in other cases. For example, under a reforestation project, it may be difficult to prove why the area would not have regrown under a business-as-usual case. Or, clear data and evidence of deforestation may exist, but determining the cause, and therefore the necessary response, may be difficult. For example, if farmers are converting forest to agriculture, the reference case may be based on migration fueled by government policies or the need for improved agricultural practices, among other possible drivers.

Recent and continued improvements in the monitoring and inventorying of regional and local land-use cover and change, which incorporate on-the-ground measurements, will help to develop reference cases. In 1997, the first global maps showing existing land cover were produced using satellite data.[75] Maps such as these can provide the basis for tracking future land-use changes.

Leakage

Leakage is the unexpected loss of anticipated greenhouse gas reductions due to the displacement of activities leading to carbon emissions. For example, in some cases, a reduced-impact logging project may lower timber output in the short term, temporarily causing increased harvests in another area to fill unmet demand.[76] Because of this displacement of the emitting activity, total greenhouse gas benefits will be lower than expected.

Preliminary research and project implementation experience, such as that of The Nature Conservancy, have pointed to some initial suggestions for project-level guidelines for avoiding leakage.[77] One study argues that leakage can be anticipated and prevented by properly designing projects or, if leakage does occur, net carbon estimates can be revised.[78] Leakage can be anticipated primarily based on whether the project activities displace the emitting activity or provide an alternative use or income source for the forest. The emitting activity will be displaced if the project does not in some way address the demands leading to land-use change, whether they be for agricultural land, fuelwood, or logging. These risk assessments should be codified within the market mechanism's certification systems so that leakage-prone projects can be identified and avoided.

Permanence of Reductions

The issue of permanence of reductions is unique to forests and land-use change. While replacing coal burning with natural gas results in a permanent emissions reduction, natural ecosystems are inherently dynamic, so sequestered carbon may not be held forever. Weather, climate change itself, pests, disease, or fire can all reverse efforts to reduce or sequester greenhouse gas emissions. Or, the contract could be reversed and the trees cut, thus losing carbon gains. To guard against this, a fixed ratio of greenhouse gas offset credits sold could be required to be held in a contingency pool that would be used if credits are somehow lost. This requirement would create a buffer of credits so that if one project fails, then the additional "buffer" reductions will cover any losses. Such an approach could also generate added funds for sustainable development projects. A similar scheme relies on ton-year equivalents to equate temporary carbon with perpetual carbon. The ton-year equivalence is based on the dispersion rate of the greenhouse gas and the social discount rate, thus equating carbon that may only be held for 20 years with that held in perpetuity.[79]

Using a portfolio approach under the market mechanisms may be a second strategy to reduce the risk of losing greenhouse gas benefits. In a portfolio approach, greenhouse gas reductions come from a pool of projects rather than individual ones. For example, Costa Rica recently established Certifiable Tradable Offsets, in which certified carbon sequestration activities are bundled under one of two national umbrellas–the Protected Areas Project and the Private Forestry Project. The portfolio approach to sequestration could mean that the failure of one project may be mitigated by a buffer if portfolios are required to hold a greater amount of reductions than are traded or sold.

While the question of permanence can not be completely solved, instruments such as discounting and portfolios can help ensure that there are real benefits to the global climate system.

Measurement Accuracy

Lastly, some question the ability to estimate accurately carbon losses and gains from vegetation and soils due to land-use and management strategies.

At the project level, mounting evidence indicates that measurement uncertainty is overstated.[80] The Intergovernmental Panel on Climate Change (IPCC) indicates a high confidence that site-level estimates of net carbon conserved or sequestered under specific management schemes are more certain than large-scale estimates of carbon fluxes, such as those at the national level.[81] Thus, project-based efforts, if well monitored, could yield measurable carbon losses and gains due to project activities. The IPCC defines high confidence as a high degree of consensus among the report's authors based on "substantial" evidence.[82]

The main hurdle facing accurate carbon accounting is the cost of obtaining the measurements. Any project or effort can be monitored and measured closely, but increasing accuracy raises costs. While there continues to be uncertainty regarding forest soil carbon, the majority of pilot offset projects have not included soil in their net carbon estimates.

Studies have pointed to both data sources and methods for tracking carbon flows over larger areas, which is required for national inventories. One U.S. study, for example, combined regional forest inventories undertaken by the U.S. Forest Service with ecosystem studies to estimate carbon storage for *major forest types in the United States*.[83] These data and methods could be used to track changes in carbon storage. However, some Annex I countries may lack the appropriate monitoring systems to track changes in land use and their subsequent greenhouse gas emissions and reductions, especially if they are not timber producers. Also, further research is required to determine greenhouse gas flows over time in forests under various management schemes. Measurement accuracy remains a key issue for improving national inventories of emissions and reductions from forests and land-use change.

RECOMMENDATIONS

Two next steps emerge that will help ensure that decisions taken by the Conference of the Parties lead to the best possible environmental outcome. First, the impact of forest and land-use practices on climate and biodiversity are often linked positively and negatively, so policy decisions should take each into account. Second, the Protocol's institutions, rules, and guidelines should be developed with wide participation of stakeholders from fields such as forestry, ecology, rural and agricultural development, and conservation. As the IPCC and the Subsidiary Body for Scientific and Technical Advice (SBSTA) undertake the research agenda relating to climate, land-use change, and forests, the expertise of the conservation and development communities should be tapped in terms of trends, measurements, and viable climate mitigation projects and policies.

The period for meeting Protocol commitments begins in ten years (2008), "demonstrable progress" must be shown in seven (2005), and credits from the Clean Development Mechanism may begin to accrue in two years (2000). The Protocol requires much substantive input between each of these milestones. We recommend the following actions.

Identify and exploit synergies between efforts to halt climate change and promote environmental stewardship, recognizing that responsible forest and land-use policies result in climate benefits.

Projects and policies should be coordinated among the Convention on Climate Change, the Convention on Biological Diversity, and the Convention to Combat Desertification, with international forest processes. Coordinating international environmental efforts under the Convention on Biological Diversity, the Convention on Climate Change, the Convention to Combat Desertification, the Forest Principles, and the Intergovernmental Forum on Forests, among other international forest processes, can help capture social and environmental benefits while slowing global warming. (*See Box 4.*)

The approaches of the three conventions and global forest processes are similar in that they call for capacity building and creating financing mechanisms to capture and promote nonmarket social and environmental values. Each stresses the importance of maintaining the productivity of genetic, agricultural, and forest resources while sustaining human development. Clearly, the implementation of these agreements should be better coordinated, as this will enhance their impact.

- Lenders and development agencies, such as the Global Environment Facility and the World Bank, should assign a high priority to those projects that allow countries to meet both climate and biodiversity convention objectives.
- The technical advisory bodies for the climate and biodiversity conventions should meet to compare research agendas and identify gaps and opportunities for coordination. For example, adopting a common definition for deforestation would be one avenue for beginning coordination.

Overlapping areas of high value to climate, biodiversity, or development should be identified and given a high priority. Ecosystems under threat offer double dividends for climate and biodiversity. Projects, activities, and policies that benefit climate, biodiversity, and human society should be identified and made a high priority, as should improvements in management practices that accomplish more than one goal. For example, removing riparian areas from agricultural production and reforesting them offers climate benefits and improves water quality and wildlife habitats.

The energy and forest sectors also intersect in some cases to offer climate, biodiversity, and social benefits. For example, a low-emission in-situ hydropower project may depend on forested riparian areas to avoid siltation. Also, introducing improved cookstoves can reduce fuelwood demand, resulting in less forest degradation. These synergies should be sought out and exploited, as they tend to magnify the impacts of individual efforts.

- Nongovernmental organizations and national governments should identify threatened forest areas of high value with respect to biodiversity, human culture, or ecosystem services that may become candidate CDM projects or protected areas in Annex I countries.

■ Nongovernmental organizations and development agencies should explore including carbon sequestration as part of the bundle of environmental services under integrated financing instruments for ecological stewardship, such as the biodiversity trust funds being explored for Guyana and Central America. Such funds serve as mechanisms that support the healthy development of ecosystems, often by combining protected areas with sustainable use. Incorporating carbon sequestration among the values supported by these funds could offer them an important additional source of income, thus increasing their effectiveness. The funds will be administered and implemented by groups with multiple objectives, such as biodiversity and social benefits, which will have a greater stake in the project's success. [84]

Annex I countries should reform national forest and land-use policies to ensure that they do not contradict the goals of the Kyoto Protocol, but further them. The Kyoto Protocol has given Annex I countries more reason than ever to provide incentives for the improved management of private and public lands. Just as abolishing fossil fuel subsidies is an efficient means of reducing emissions, so is ending subsidies that encourage logging on marginal timberlands and forest conversion to low-productivity agriculture or pasture.

■ Annex I policy-makers should reverse ill-advised policies that result in poor management and carbon emissions, such as subsidized harvest on public lands.

■ Annex I policy-makers should offer incentives that result in biodiversity and climate gains, such as encouraging restoration of areas high in ecosystem services and discouraging deforestation of old growth or primary forests on public and private lands.

Ensure that accounting methods, mitigation frameworks, definitions, and implementation of the Kyoto Protocol help meet climate, development, and environmental objectives.

Nations should ratify and implement the Kyoto Protocol and the United Nations Framework Convention on Climate Change to slow human-caused climate change. Rapid, human-caused climate change is likely to result in biodiversity loss by altering regional precipitation and temperatures that will affect the range and species composition of ecosystems, perhaps more rapidly than they are able to adapt.[85] Boreal forests and permafrost may be particularly vulnerable to shifting weather patterns.

■ Annex I countries should ratify the Protocol and implement policies that will reduce the risk of dangerous climate change such as those described in the Protocol: enhance energy efficiency, protect and restore forests, promote and develop renewable energy, and phase out subsidies of greenhouse gas emitting sectors.

If the Conference of Parties determines that additional land-use change and forest activities warrant inventorying in Annex I countries, they should be phased in under a project-based accounting method. Some additional activities, among them forest harvest and degradation, may prove to be an important source of emissions, especially in countries such as Russia, where new areas are being opened for logging. This delay will also allow time for improving national-level monitoring of biomass changes and exploiting synergies with forest certification systems such as that of the Forest Stewardship Council. A system of this nature will require the development of social and environmental criteria, such as disallowing afforestation on biologically unique lands to avoid perverse environmental outcomes.

■ Convention bodies should explore requiring inventories of emissions from additional activities, then, as appropriate, phasing them in on a project-level basis during the first commitment period; this is to avoid upsetting expectations on the meaning of the greenhouse gas targets. Phasing in activities will create incentives to manage more appropriately forest resources and allow time to develop the necessary monitoring systems for inventorying emissions during the second commitment period.

Emissions from land-use change and forests should be included in Annex A of the Kyoto Protocol, which lists sources that must be inventoried by industrialized countries. The most comprehensive solution is to count all carbon dioxide sources, both energy and non-energy. Deforestation, degradation, and land-use conversion, such as from forests or grasslands to agriculture, should be counted as emissions. Human-caused land-use emissions are no different than those from driving or electricity generation–all release greenhouse gases into the atmosphere.

■ Convention bodies should explore inventorying of a wide array of land-use change and forest greenhouse gas sources, such as those from forest harvest and management.

Deforestation should be defined appropriately, fully counted, and avoided where possible. Deforestation is a major source of both carbon emissions and biodiversity loss. Because of these two factors, it is critical that the Protocol create incentives to avoid deforestation in both developing and developed countries.

- Parties should review existing and accepted definitions of deforestation from the scientific community, such as the FAO definition described earlier in this report. Deforestation should not be narrowly defined so as to create a loophole that allows Annex I countries to avoid inventorying emissions from forest conversion by contending that deforestation has occurred only if a structure, such as a building, replaces the forest.
- Parties should not create an incentive to clear land during the interim period from 1990 to 2008 by giving credit for reforestation during the 2008 to 2012 commitment period but not inventorying deforestation between 1990 and 2008. To avoid this incentive, Parties should stipulate that credit for reforestation may only be given for land that was not forested in the 1990 base year.[86]
- If strict monitoring and verification guidelines and systems are developed, avoided deforestation should be considered for inclusion under the CDM.

Build the Clean Development Mechanism from the ground up, with involvement from a full range of nations and interest groups. Though this recommendation appears obvious, it bears repeating that Joint Implementation and its pilot phase faced opposition from developing countries in large part because each was seen solely as a tool of developed countries. This same fate could befall the CDM. The issues and questions relating to the Clean Development Mechanism are too complex for a comprehensive set of recommendations to be made in this paper. The Clean Development Mechanism must be constructed with input from a diverse and representative group of countries, nongovernmental organizations, and the private sector.

- To ensure that a broad array of stakeholders and perspectives is represented at decision-making fora, UN agencies, multilateral institutions, and development agencies should support representation of NGOs that may lack the resources to participate. In particular, they should support participation from developing country government and nongovernmental representatives that have expertise in forest and land-use change. In addition, such agencies should sponsor representatives at various workshops and decision-making fora concerning the CDM in particular.

Non-Annex I and Annex I countries should establish minimum performance standards for land-use change and forest-based domestic reductions and projects under the market-based mechanisms. Ideally, it would be possible to draw up a set of required national policy reforms in addition to minimum performance standards. However, such a process would be highly contentious. Alternatively, both Annex I and non-Annex I countries could establish a set of minimum performance standards for projects.

- Convention bodies should delineate a set of minimum standards and practices for eligible CDM projects. Only greenhouse gas improvements over this reference would be creditable.
- Convention bodies should also delineate minimum standards and practices, at least equal to or above existing domestic laws governing land use for project-based efforts pursued by Annex I countries. Any emission reduction credit must go beyond these performance standards.

Parties should implement project and policy guidelines that avoid merely displacing the drivers of land-use change and carbon emissions, referred to as leakage. Leakage, described earlier, is the loss of estimated carbon benefits, typically due to the displacing of carbon emitting activities, rather than substituting for carbon emitting activities.

- If climate mitigation policies or projects result in a reduction in timber output, Annex I countries should find alternative fiber sources through increased recycling, reforesting of abandoned land, or increasing wood-use efficiency. If reductions in output result in unmet demand for wood fiber, it will only displace demand onto other wood fiber sources, leading to higher emissions elsewhere.
- The project activities should seek to address and counter the threats leading to land-use change by providing alternative income sources, or substitutes for the alternative use of the forest land.

Research remaining issues concerning measurement, patterns of land-use change, and their underlying drivers to understand more fully the difficulties of including land-use change and forests and the implications of not counting them.

Evaluate the Activities Implemented Jointly (AIJ) Pilot Phase. Currently implemented mitigation projects should be reviewed for their climate impacts, uncertainties, issues, and benefits. Lessons from the AIJ pilot phase should inform the creation of the Clean Development Mechanism. The pilot phase will yield lessons regarding transaction costs, institutional structures and barriers, and standard setting.

- The Convention bodies should arrange for an independent project and institutional evaluation of the AIJ pilot phase before finalizing work on the CDM.
- Countries with established joint implementation pilot programs, such as the Netherlands, Costa Rica, and the United States, should also formally evaluate them. For example, the U.S. Initiative on Joint Implementation, one of the most active programs, stipulated that the program would be evaluated and assessed "within two years of its inception," which was 1993, or within six months of adoption of international criteria for Joint Implementation by the parties under the Climate Convention.[87] The evaluation has yet to occur. Given the developments under the Kyoto Protocol, an evaluation of the U.S. Initiative on Joint Implementation would be a useful input to the process of building the CDM.

Those with knowledge of and technical expertise in land-use change and forest trends should participate more widely in climate change fora. The IPCC Special Report on key forest and land-use change issues is to be completed in mid-2000. The IPCC Special Report will investigate the implications of defining terms, explore including inventories of additional land-use activities, and assess project eligibility under the market mechanisms. The upcoming Conference of the Parties and string of advisory meetings (*see Box 8*) offer opportunities for input from additional experts and interested parties. Additional advisory meetings, workshops, and conferences will be convened.[88] Wider participation and a higher profile can only help further the goals of the climate convention.

- Nongovernmental organizations and governmental agencies working on climate change should highlight the issues and opportunities in other fora, such as the Convention on Biodiversity and international forest meetings, thus increasing the number of individuals and institutions engaged in climate change policy.
- Lenders and development agencies should support greater involvement from developing country governmental and nongovernmental groups in decision-making meetings to the FCCC.
- National governments should ensure their delegations to the Conference of the Parties include participants with relevant forest-related expertise.

8 MAJOR DECISION POINTS AND COMMITMENT DATES

1990	Baseline year for calculating emissions.
1998	November–Fourth Conference of the Parties for the FCCC meets in Buenos Aires, Argentina.
2000	Certified emissions reductions in non-Annex I countries may be credited under the Clean Development Mechanism.
2000	IPCC scheduled to complete a Special Report on Land Use, Land-Use Change, and Forestry and Carbon Emissions.
2001	Third Assessment Report due from the IPCC. The Report will describe the state of scientific understanding on the impacts and status of climate change and address the role of land-use change and the forest sector in mitigating, slowing, or contributing to climate change.
2005	Annex I countries should have made "demonstrable progress" in meeting commitments.
2008-2012	Compliance period during which reduction targets must be reached.

Establish a monitoring and inventory system that identifies changes in land cover and intensity of use. A monitoring system that combines remote sensing with ground truthing is essential both to properly inventory carbon fluxes from Annex I country forest and land-use change sectors and to monitor and verify projects under the Clean Development Mechanism, if such projects are deemed eligible. Such a system will also be invaluable to governments, nongovernmental organizations, the private sector, and local communities as they seek to make informed decisions about the highest and best use of forest resources.

- National governments and international agencies, with established data gathering agencies, should begin to channel data into the greenhouse gas reporting systems and make it widely available. One example would be the Food and Agriculture Organization, which publishes every two years the *State of the World's Forests* report, giving an overview of the status of the world's forests.
- International and national-level policy makers should put increased resources into monitoring forest and land-use trends.
- Nongovernmental organizations tracking trends in forest conversion and intensity of use should channel that information into the climate processes.

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GLOSSARY

ACTIVITIES IMPLEMENTED JOINTLY (AIJ): The pilot phase of Joint Implementation, established at the first Conference of the Parties, ending in 1999.

ANNEX I COUNTRIES: The 39 industrialized countries that agreed to binding limitations on greenhouse gas emissions. The Annex I group includes developed economies such as those in the European community, Canada, and New Zealand as well as countries in transition to a market economy such as the Russian Federation, the Czech Republic, Hungary, and Poland.

CLEAN DEVELOPMENT MECHANISM (ARTICLE 12): The CDM mechanism will allow certified emission reductions from project activities that assist non-Annex I countries in achieving sustainable development, and Annex I countries in complying with greenhouse gas reduction limitations. Participation is voluntary by each party.

GREENHOUSE GASES: Those gases that comprise the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation.

JOINT IMPLEMENTATION: Activities undertaken voluntarily and cooperatively between at least two parties in two or more countries that reduce, avoid, or sequester greenhouse gas emissions.

NON-ANNEX I COUNTRIES: The group of developing countries that do not have binding commitments on greenhouse gas emissions.

PROJECT-BASED CREDIT TRADING (ARTICLE 6): Annex I Parties may trade "emission reduction units" resulting from projects that diminish greenhouse gas emissions or enhance removals.

SINK: Any process, activity, or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas from the atmosphere.

SOURCE: Any process or activity that releases a greenhouse gas, an aerosol, or a precursor of a greenhouse gas into the atmosphere.

NOTES

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10 For almost all industrialized countries, 1990 is the base year from which they calculate emissions limitations. However, some countries are allowed to use other base years that result in higher emissions. For example, Bulgaria may use 1989 as its base year, and Poland 1988. As stated earlier, the higher the base year emissions, the less onerous the reduction commitment during the commitment period.

11 The division of Annex I and non-Annex I countries was based on level of economic development and historical responsibility for the buildup of greenhouse gases in the atmosphere. Annex I countries are largely responsible for the current buildup of gases, and as such are the first group of nations to act towards reducing emissions. IPCC. *Climate Change 1995: The Science of Climate Change, Summary for Policy Makers.* Bert Bolin, John Houghton, and L. Gylvan Meira Filho, eds. (Rome: December 1995).

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16 Dirk Bryant et al. *The Last Frontier Forests: Ecosystems & Economies on the Edge* (Washington DC: World Resources Institute, 1997).

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United Nations. *United Nations Framework Convention on Climate Change* (United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, June 1992).
United Nations. *United Nations Convention on Biological Diversity* (United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, June 1992).
"Non-Legally Binding Authoritative Statement of Principles on the Management, Conservation and Sustainable Development of All Types of Forests" (United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, June 1992).
United Nations Commission on Sustainable Development. *Report of the Ad Hoc Intergovernmental Panel on Forests on Its Fourth Session* (United Nations, New York, 11-21 February 1997). While there are many forest agreements, most recently the Intergovernmental Forum on Forests was formed to pursue a consensus and formulate options consistent with the Forest Principles.

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88 For information on additional meetings and fora, see the Framework Convention on Climate Change website, which maintains a schedule (www.unfccc.de).

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The World Resources Institute (WRI) is an independent center for policy research and technical assistance on global environmental and development issues. WRI's mission is to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations.

Because people are inspired by ideas, empowered by knowledge, and moved to change by greater understanding, the Institute provides–and helps other institutions provide–objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development. WRI's particular concerns are with globally significant environmental problems and their interaction with economic development and social equity at all levels.

The Institute's current areas of work include economics, forests, biodiversity, climate change, energy, sustainable agriculture, resource and environmental information, trade, technology, national strategies for environmental and resource management, business liaison, and human health.

In all of its policy research and work with institutions, WRI tries to build bridges between ideas and action, meshing the insights of scientific research, economic and institutional analyses, and practical experience with the need for open and participatory decision-making.

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THE WORLD RESOURCES INSTITUTE FOREST FRONTIERS INITIATIVE

The World Resources Institute Forest Frontiers Initiative (FFI) is a multi-disciplinary effort to promote stewardship in and around the world's last major frontier forests by influencing investment, policy, and public opinion. The FFI team is working with governments, citizens' groups, and the private sector in Amazonia, Central Africa, Indonesia, North America, and Russia. We also take part in pressing international discussions on forest policy.

We are motivated by the belief that there is a responsible way to use forests. We also see growing interest in finding alternatives to forest destruction that take advantage of the full economic potential of forests, not just immediate revenue from logging and forest clearing.

For each frontier forest region, FFI builds a network of policy-makers, activists, investors, and researchers to promote policy reform. Efforts to minimize the negative impacts of road-building and forest-clearing for agriculture and to stop illegal logging are part of this work.

In collaboration with a variety of partners, WRI is creating Global Forest Watch–an independent, decentralized, global forest monitoring network – which will facilitate the collection of all relevant information on forests and how they are being used as well as provide mechanisms for making this information available to anyone with a stake in the forest.

Business has a leading role to play. WRI is working with the forest products industry and others to create greater production and demand for goods from well-managed forests. We are developing case studies with innovative firms to demonstrate to others the business impacts and opportunities that sustainability presents.

To get access to information about FFI findings and activities and to find out how to participate, visit our website at **http://www.wri.org/wri/ffi/** or write to:

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IUCN–THE WORLD CONSERVATION UNION

Founded in 1948, IUCN–The World Conservation Union brings together States, government agencies, and a diverse range of non-governmental organizations (NGOs) in a unique membership: 895 members in all, spread across 138 countries. As a Union, IUCN seeks to influence, and encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. A global secretariat and 35 regional and country offices coordinate the IUCN Programme and serve the Union membership, representing their views on the world stage and providing them with the strategies, services, scientific knowledge, and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 6,000 expert volunteers in project teams and action groups, focusing in particular on biodiversity conservation and the management of habitats and natural resources. The World Conservation Union builds on the strength of its members, networks and partners to enhance their capacity and to promote global alliances in support of conservation at the local, regional and global level.

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ISBN No.: 1-56973-285-x