Forestry after the Kyoto Protocol:  
A review of key questions and issues

Mark C. Trexler, Laura H. Kosloff, and Rebecca Gibbons  
Trexler and Associates, Inc.

Abstract
Forestry is a valuable piece of the climate change mitigation portfolio. Human activities related to forests and soil are responsible for approximately 20% of the total anthropogenic emissions. The ongoing loss and degradation of forests and soils will not only contribute to future climate change; it also imposes tremendous environmental, economic, and social costs, particularly on the peoples and resources of many developing countries. These costs include loss of species and biodiversity, degradation of watersheds, silting of hydroelectric facilities, declines in agricultural productivity, and increasing scarcity of fuelwood. This paper discusses the current status of forestry as a mitigation strategy and its potential treatment under the Kyoto Protocol and beyond. It is based partially on the 1997 Biotic Offsets Assessment Workshop in Baltimore, the purpose of which was for forestry and offset experts to come to some agreement regarding the state of the science and policy of forestry-based offsets. An appendix of the primary conclusions for policymakers from the Baltimore conference is included.

Introduction
In early literature about climate change mitigation, forestry was heralded as a potential panacea. In recent years, discussion of forestry’s mitigation role has become more pragmatic and sophisticated. The credible literature no longer refers to forestry as a “solution” to the problem of climate change, but continues to cite forestry and other land use measures as a valuable piece of a global mitigation portfolio.

In the aftermath of the Kyoto Protocol, however, signed at the fourth Conference of the Parties to the UN Framework Convention on Climate Change (FCCC), the future role of forestry for mitigation purposes remains unclear. Although sinks are clearly built into the “netting” of Annex B countries’ emissions under Article 3 of the Protocol, treatment of sinks in project-level mitigation interventions undertaken under Articles 3, 6, or 12 has been left for further clarification. To some extent, the ambiguities in the Kyoto Protocol are the result of the brevity of the Kyoto conference. To a significant degree, however, the Protocol’s ambiguous treatment of sinks is the result of policy and technical issues being raised by inter-
est groups and countries that are critical of relying on forestry and related mitigation interventions as a means of achieving the Protocol’s reduction mandates. This issue is discussed later in this paper.

At the same time that critics are asking questions, numerous studies, including those of the Intergovernmental Panel on Climate Change (IPCC), have concluded that forestry-based and other biotic climate change mitigation measures should play an important role in mitigating greenhouse gas (GHG) emissions and climate change. According to the IPCC, forestry and other biotic measures can slow carbon emissions to the atmosphere by reducing rates of deforestation and forest degradation. In addition, these measures have the potential to increase the incremental sequestration of carbon in terrestrial biota through activities such as reforestation, assisted regeneration, and agroforestry.

A review of the climate change literature and debate on the subject of forestry and sinks inevitably leads to the conclusion that there is a great deal of misunderstanding about forestry as a potential climate change mitigation strategy. This paper poses a series of questions important to forestry’s current status as a mitigation strategy and to its potential treatment under the Kyoto Protocol and beyond. The paper is based partially on the work of the Land Use and Biotic Mitigation Policy Project (Project), a policy and technical initiative undertaken by Trexler and Associates, Inc. in 1997 with the primary objective of significantly advancing the technical and policy understanding of whether and how forestry and related biotic climate change mitigation measures can credibly and effectively contribute toward societal objectives in the climate change arena. The Project is working to develop technically and politically credible answers to questions being raised in the climate change debate and to improve understanding of the underlying issues.

Many workshops have been organized around the theme of carbon offsets, particularly around joint implementation (JI) and the “activities implemented jointly” (A11) pilot phase. Forestry projects and issues routinely play a role in these meetings and workshops, but rarely have forestry and land use issues been given exclusive attention. In 1997 the Project convened a workshop that brought together nearly 30 international experts to consider key questions regarding the use of forestry for climate change mitigation purposes. The goal of the Biotic Offsets Assessment Workshop in Baltimore was to bring together well-informed and influential forestry and offset experts who would seek to come to some agreement among themselves regarding the state of the science and policy of forestry-based offsets. The Baltimore workshop focused on project-level forestry-based mitigation strategies, rather than incorporation of forest-cover changes at the national level into a country’s baseline or future emissions budgets (the so-called “netting” approach). The workshop participants were a diverse and uniquely qualified set of individuals from the academic, government, not-for-profit, and private sectors. The workshop’s conclusions are used to help shed light on some of the questions posed below.

Are forestry and land-use change important to the problem of climate change and climate change mitigation objectives?

Since before the Industrial Revolution, land-use changes, first in temperate and later tropical zones, have been key contributors to rising levels of greenhouse gases in the atmosphere. Indeed, carbon emissions associated with land-use change
have been responsible for almost one-third of the net increase in atmospheric loading of carbon dioxide since the Industrial Revolution. Currently, the relative importance of land-use change based emissions is declining as fossil fuel emissions continue to rise. Yet, even today human activities are estimated to emit between 1 and 2 gigatonnes (Gt) of carbon annually from the world’s forests and soils. This is approximately 20 percent of total anthropogenic emissions. In many developing countries, land use-related emissions continue to significantly exceed fossil fuel emissions. Additionally, land use change contributes to methane and nitrous oxide emissions, primarily as a by-product of biomass burning.

The links between land-use trends and potential climate change go well beyond the fact that deforestation and forest degradation are an ongoing and significant source of greenhouse gas emissions, thus accelerating the buildup of greenhouse gases in the atmosphere. Several other important linkages that continue to be the focus of intensive scientific and political debate are:

• *The apparent importance of CO₂ fertilization to slowing the buildup of CO₂ in the atmosphere.* The CO₂ fertilization effect—in which rising levels of CO₂ in the atmosphere contribute to enhanced plant growth—is believed to be responsible for the sequestration of a billion tons of carbon per year in the world’s forests, thus slowing future climate change. There is some question, however, as to how long this fertilization effect will play this climate change mitigation role.

• *The potential importance of intentionally undertaken forestry and other land-use based climate change mitigation measures.* Numerous studies, including those of the IPCC, have confirmed the potential importance of mitigation measures in this sector. One particularly notable example is the potential role biomass energy could play in substituting for fossil-fuel emissions in industrialized as well as developing nations.

• *The potential for increased land use-based GHG emissions in future years due to climate change-induced alterations in temperatures, fire regime changes, soil carbon oxidation rates, and other variables, and the associated importance of understanding how biological systems may adapt to climate change.* It may require great efforts in some areas just to maintain the forest cover we already have.

This is a brief review of the ways in which forestry and land use change are linked to the larger subject of climate change. This review should illustrate the need for careful consideration of these issues as facets of the effort to understand future climate change, mitigate future climate change, and adapt to climate change.

**What is the projected future contribution of deforestation and land use change to greenhouse gas emissions?**

There is no reason to believe, under “business-as-usual” circumstances, that the absolute contribution of deforestation and forest degradation to global GHG emissions will decline significantly any time soon. Vast stretches of tropical forest, currently a storehouse for hundreds of billions of tons of carbon, remain threatened by deforestation or degradation. According to the IPCC’s 1995 Second Assessment Report, more than 650 million hectares of forest are likely to be lost by 2050. More than 75 Gt of carbon are likely to be emitted from deforestation alone.
In addition, hundreds of millions of additional hectares of forest and agricultural land will be degraded, resulting in the release of a portion of the carbon currently stored there to the atmosphere.

The ongoing loss and degradation of forests and soils will not only contribute to future climate change; it also imposes tremendous environmental, economic, and social costs, particularly on the peoples and resources of many developing countries. These costs include loss of species and biodiversity, degradation of watersheds, silting of hydroelectric facilities, declines in agricultural productivity, and increasing scarcity of fuelwood.

**How can forestry and land use-based measures contribute to climate change mitigation goals?**

Numerous studies over the past 10 years have discussed how forestry measures could or should contribute to climate change mitigation efforts both in industrialized and developing countries. These studies have included work by the IPCC, government agencies, research institutes, and nongovernmental organizations such as the World Resources Institute. Much of this research supports forestry as a mitigation strategy both for its climate change potential and for the additional environmental and socioeconomic benefits that would accompany reduced deforestation rates and expanded reforestation programs on suitable lands. Forestry and land use-based interventions that have the potential to significantly contribute to climate change mitigation options fall into one of three major categories:

- **Protecting existing carbon reservoirs** from losses associated with deforestation, forest and land degradation, urbanization, and other land management practices.
- **Enhancing carbon sequestration and expanding carbon stores** in forests, other biomass, soils, and wood products (including through reforestation, afforestation, and forest management efforts).
- **Using biomass to substitute for fossil-fuel use**, whether directly (production of biomass energy) or indirectly (substituting wood for steel, cement, or other fossil fuel-intensive products).

International policymakers have repeatedly called for slowing the loss of forests and restoring forest or tree cover. In 1989, 68 environmental ministers from around the world signed the Noordwijk Declaration in the Netherlands, calling for a net increase in global forest cover of 12 million hectares per year to help slow climate change. Similar ideas are reflected in international policy initiatives including the Tropical Forestry Action Plan, the Global Forestry Program, the Intergovernmental Panel on Forestry, and the Convention on Biological Diversity. The FCCC and the Kyoto Protocol also explicitly mention these objectives.

The literature surrounding forestry-based mitigation efforts places heavy emphasis on reforestation potentials, both in tropical and temperate zones. However, efforts to slow deforestation and to manage existing forests are probably more important for long-term climate change mitigation than efforts to accelerate reforestation. Even critics of plantation forestry acknowledge forest conservation as a priority. Barnett (1992) concludes, “protection of existing forests [over the planting of new ones] should be a priority action in combating climate change. This vitally important consideration must be recognized wherever the issues of climate change and forest conservation emerge.” While slowing deforestation rates
is by no means easy, large-scale reforestation efforts must grapple with severe eco-
nomic and infrastructural constraints and even environmental concerns. Indeed,
because protection of threatened forests can serve many environmental, eco-
nomic, and social interests, many analysts argue that forest protection offers one 
of the most socially cost-effective climate change mitigation technologies.

Nevertheless, reforestation and variants on the reforestation theme—including 
natural regeneration in cases where fire can be controlled in grasslands and 
other areas—does have major mitigation potential. Large amounts of land are 
potentially available for reforestation in both temperate and tropical zones. 
Options being explored include:

- pasture, cropland, degraded or arid land reforestation;
- reforestation of recently harvested stands;
- planting along highway rights-of-way and riparian corridors; and
- planting in windbreaks and other agroforestry applications.

Using forest-based or other biomass fuels to displace or substitute for existing 
or future fossil fuel use also has tremendous potential as a climate change mitiga-
tion strategy. Opportunities exist, for example, to utilize large quantities of agri-
cultural and forest residues that otherwise would go to waste. There are also 
opportunities to develop specialized biomass crops primarily for energy produc-
tion. If tied to efforts to increase both the efficiency with which biomass is con-
verted to energy and consumed by end-use users, in principle biomass energy 
could supply a large proportion of commercial energy demand in tropical coun-
tries in coming decades. It has to be recognized, however, that such a project faces 
daunting technical and economic challenges.

What has the IPCC said about forestry’s potential to help mitigate climate change?
In its Second Assessment Report in 1995, the IPCC identified forestry and other 
land use-based mitigation measures as capable of slowing carbon emissions by 
reducing rates of deforestation and forest degradation while increasing the incre-
mentary uptake of carbon by terrestrial biota through means such as reforestation, 
regeneration, and agroforestry (Brown et al. 1996). The IPCC concluded that inter-
vention could realistically reduce cumulative net anthropogenic emissions over 
the next 50 years by more than 70 GT of carbon. Between 1995 and 2050, by slow-
ing deforestation, promoting natural forest regeneration in the tropics, and imple-
menting a global forestation program, the IPCC concluded that 12 to 15 percent of 
cumulative fossil fuel carbon emissions could be offset.

What are the technical concerns being raised regarding the use 
of forestry and land-use projects for climate change mitigation?
The debate over forestry’s potential role in climate change mitigation efforts has 
varied widely over the last decade, from the assertion that forestry could virtually 
solve the climate change problem to the position that there is absolutely no role for 
forestry in a portfolio of mitigation policies and measures. Although many issues 
have been raised in this debate, they can be broadly grouped into several categories:

- Whether forestry and land use change projects can be reliably quantified, mon-
tored, and verified.
- Whether land use-based mitigation measures might be prematurely lost, lead-
ing to reversal of their mitigation benefits.
• Whether pursuit of forestry and land use change mitigation efforts impede basic economic development or result in negative environmental impacts in developing countries.
• Whether pursuit of forestry and land use change mitigation efforts impedes progress on achieving actual emissions reductions and technology transfer objectives in the energy sector.

This following section addresses the technical issues relating to the use of forestry and land use-based mitigation efforts. The discussion reflects conclusions of the previously mentioned technical workshop on biotic mitigation options.

**Are there particular difficulties associated with quantifying, monitoring, and verifying the performance of forestry and land use-based offsets?**

Substantial progress has been made in defining and refining approaches and methods for monitoring forest carbon stocks and flows. Experience with a small number of J1 projects and monitoring field tests suggests that some of the key challenges are being met and that forest carbon monitoring can be done at a reasonable cost with relatively high levels of accuracy and precision.

Workshop participants agreed that there continues to be a need for standardized methodologies that project developers can relatively easily and consistently apply to potential projects. Participants concluded that the absence of standardized methodologies is attributable to the evolution happening in the field, rather than to evidence of what is technically feasible.

**How significant are benefit permanence and associated biotic risk factors for biotic mitigation projects?**

*Additionality*

The supplementarity of individual mitigation projects continues to be a source of debate for most project types. Notably, additionality has rarely been raised as a concern for forestry projects, since so few existing projects have been economically motivated. There is little question that many forestry projects will be able to meet or exceed whatever additionality standard is agreed upon in the future.

*Leakage*

The possibility that indirect and feedback efforts occurring outside a project’s boundaries will reduce a project’s benefits is commonly identified as a concern for mitigation projects. Although leakage is a potential problem for almost all types of mitigation projects, forestry projects are often characterized as “leakage-prone.” Current thinking suggests, however, that the options available for dealing with leakage are similar across mitigation project types, including forestry.

*Reliability*

The different risks faced by some types of forestry mitigation projects make project reliability and benefit permanence particularly relevant. Projects intended to be permanent (e.g., forest conservation, watershed and natural forest regeneration, soil restoration) face risk factors that could interfere with that permanence. Interventions not intended to be permanent (e.g., reforestation or agroforestry for timber and other economic products) raise questions the value of delay and the length of time needed for an intervention to be considered equivalent to an emission reduction measure. For some forestry mitigation options (e.g., wood prod-
uct substitution for energy-intensive building materials, biomass energy), the
issues are no different than those facing other kinds of mitigation projects.

Forestry critics frequently raise the issue of the permanence of land use-based
mitigation projects. There is very little literature or analysis available, however, on
the subject. There is little systematic assessment of biotic risk variables that may
interfere with the permanence of a project’s benefits even when a project is
designed to generate permanent benefits. Benefit permanence becomes particularly
complex when considering projects involving harvesting of timber or other
biomass. The fate of harvested carbon becomes crucial in determining the long-
term or “permanent” impacts of the project or type of measure involved. Par-tici-
pants at the workshop quickly concluded that permanence is probably the trick-
est issue in forestry-based mitigation efforts. Participants also determined that
although it can be framed technically, the permanence debate is fundamentally
policy-based. Policymakers ultimately will need to determine what permanence
means for offsets and how these definitions will apply to forestry and land use-
based projects.

Quantifying, monitoring, and verifying project benefits
The ease and accuracy with which the benefits of mitigation options can be quan-
tified, monitored, and verified varies widely. Forestry and land use-based options
fit this pattern. A range of approaches are available for monitoring changes in
forest carbon, including remote sensing and ground-truthing, inventory-based
monitoring, and research-based monitoring. An area of particular confusion that
should be avoided is equating quantification of national-level sinks through so-
called netting with project-level benefit quantification. The issues involved are
very different.

It is important to recognize that not all forestry types and not all forestry pro-
jects are interchangeable in the context of accomplishing climate change mitiga-
tion objectives. Different forestry types and projects will have different mitigation
characteristics. It is as inappropriate to lump all types of forestry together as it is
to group together other large categories of mitigation options. In either case, mit-
igation interventions vary dramatically in their quantifiability, cost-effectiveness,
and long-term outcome.

Do forestry-based mitigation strategies advance or detract
from countries’ sustainable development objectives?
Some critics of forestry initiatives express concern that forestry projects could
impede socioeconomic development in developing countries, or even cause envi-
ronmental damage. Issues commonly raised include:

• that the land occupied by forestry offsets would somehow deprive countries of
  alternative economic development opportunities and potentially impede
  national sovereignty over their natural resources; and
• that resources going into forestry offsets would somehow displace funding that
  otherwise might become available for activities more directly beneficial to eco-
  nomic development.

These potential problems are most commonly linked to the prospect of large-
scale forest plantations being pursued for climate change mitigation. However,
there is no reason to anticipate that massive tropical reforestation projects will be
a favored approach to climate change mitigation. Beyond the political and environmental issues raised, it is far from the most cost-effective mitigation approach. Thus far, no forestry project that has been implemented for climate change mitigation involves the types of plantations that have been a primary source of concern for forestry critics.

Often overlooked in this debate is the tremendous role that forestry-sector projects, appropriately designed and implemented, can play in societal priority areas such as biodiversity conservation, sustainable development, watershed protection, and food production. Inclusion of biotic carbon offset projects among the strategies for addressing international concerns about climate change may increase available resources to support sustainable land-use and forestry practices, both of which are unlikely to be adequately funded in the absence of such a mechanism. Indeed, biotic carbon offset projects, which include both forestry and land-use management options, provide an opportunity to support efforts to reduce deforestation and protect vulnerable forest ecosystems, many of which will be lost or degraded in the near to mid terms (many within 20 years) without additional support.

Forestry critics, while raising the concerns cited, acknowledge that forestry projects can result in environmental and social benefits, including improved food supply security, availability of raw materials to industry, protection of hydrological services, conservation of biological diversity, and soil protection (Barnett 1992). Workshop participants concluded that while one could design forestry projects to maximize negative benefits, as some cited examples might suggest, it should not be particularly difficult to avoid this outcome during project design and approval. They also felt that the potential benefits of existing forestry projects are significant and observable enough that it is inappropriate to focus excessively on hypothetical negative impacts.

One workshop participant noted that a primary problem with the current debate is that participants often have visions of project extremes rather than trying to work with the bulk of projects on the middle ground. He commented, “I see two sets of types of projects. We are interested in projects that are at the intersection of these two types. We don’t want simple plantations, and we don’t want projects that are so social in nature that the carbon benefit is ‘virtual.’ In between are kinds of projects that can be done, can be verified, and are socially relevant projects. The problem is that people have visions of extremes, and it tends to overly influence policy discussion.”

**Will forestry offsets impede progress on achieving actual emissions reductions and technology transfer objectives in the energy sector?**

Some observers of forestry-based climate change mitigation efforts express concern that pursuit of forestry and land use change mitigation efforts will impede progress on achieving actual emissions reductions and interfere with technology transfer objectives. Forestry is sometimes portrayed as a negative contributor to climate change, even when the technical ability of individual forestry projects to offset CO₂ emissions is undisputed. This concern involves three assumptions:

- Land use-based emissions reductions are somehow less significant than other reductions. There is no dispute, however, that land-use changes release more than 1 Gt of carbon to the atmosphere annually. The need to reduce these emissions is just as real as that for other kinds of emissions.
- Forestry-based mitigation opportunities will supersede other mitigation pro-
Forestry projects offer few or no technology transfer opportunities. To the contrary, combinations of forest management, reduced impact logging, forest conservation, and reforestation measures provide ample opportunities for technology transfer.

Many of these technical and policy issues can in all likelihood be addressed through development and dissemination of improved information about the role of biotic offsets in a global climate change mitigation strategy. There is little doubt that appropriate land-use projects can advance rather than impede a country’s economic and environmental objectives.

**Why are “co-benefits” so emphasized in forestry and other land-use mitigation projects?**

The term “co-benefits” has been coined in the forestry debate to better describe the significant non-carbon benefits often accompanying biotic offset projects. Literature and professional discussions rarely focus on the benefits of biotic options beyond cost-effectiveness. Yet the non-carbon benefits associated with biotic options are significant.

Many forestry interventions offer tremendous opportunities to advance biodiversity conservation, soil and watershed conservation, rural economic development, and the interests of indigenous peoples. Climate change mitigation funding has the potential to dramatically expand the funding for these goals and improved forestry practices, all of which are likely to otherwise remain underfunded.

Participants in the Biotics Workshop concluded that co-benefits have not been sufficiently factored into the offsets and climate change mitigation debate. This omission has been to the detriment of land use-based mitigation opportunities. Participants drew several conclusions regarding co-benefits:

- Based on experience with existing offset projects, the co-benefits of available forestry mitigation options are plentiful.
- Co-benefits are of interest to both environmentalists and developing countries and may generate support for certain forestry-sector mitigation options.
- Co-benefits allow developing countries to meet multiple objectives, including biodiversity and rural development objectives. This situation is analogous to the commonly accepted technology-transfer co-benefits of energy projects.

The threat of climate change is only part of the equation in motivating a renewed political interest in tropical forestry programs. Just as important is the perception that the large-scale use of forestry for climate change mitigation would inject much needed resources into the forestry sectors of countries around the world. Slowing forest loss and land-use degradation can advance sustainable development, energy production, and environmental goals in tropical countries, while adding to terrestrial carbon stores. It is conceivable that billions of dollars could be spent annually on forest protection, forest management, reforestation, and biomass energy programs intended to help mitigate global climate change. Much of
this money would almost certainly flow from industrialized to non-industrialized countries, whether through direct nongovernmental investment, government-to-government payments, debt relief, or other means.

**How much experience has been accumulated through existing forestry and land use-based mitigation efforts?**

Since the late 1980s, more than two dozen pilot climate change mitigation projects have been implemented in the forestry sector, involving commitments of more than US $50 million. This figure may be small by the standards of international aid and capital flows, but it is significant in the context of climate change mitigation spending. There are several reasons that forestry has been a popular climate change mitigation option:

- Early offset funders wished to clearly differentiate their offset projects from their day-to-day energy-sector business activities.
- Forestry-based offsets were seen as cost-effective and easily implemented at the pilot project scale.
- In a strictly voluntary mitigation regime, the many co-benefits of forestry projects have been particularly appealing to offset funders.

Forestry and land-use mitigation projects are underway in both industrialized and developing countries. They have been based on a range of forestry and other land-use change interventions, including:

- reforestation and agroforestry;
- protected area establishment or reinforcement;
- expansion of sustainable forestry;
- reduced impact logging;
- conservation easements;
- soil carbon enhancement; and
- research and development on fast-growing trees.

A brief introduction to the experience with these categories of projects is provided below:

**Temperate reforestation**

Well over a dozen projects are underway in Annex I countries including the United States, Russia, the Czech Republic, and the Netherlands. Although individual projects are generally modest in size, overall, thousands of hectares are involved. Lands targeted by these reforestation projects are ecologically or economically sensitive, and include national parks, other public lands, and non-industrial private landholdings. Project benefits include soil and water conservation, enhancement of wildlife habitat, and rural economic development. Long-term carbon contracts, sometimes up to 99 years, ensure that the projects’ carbon benefits are long-lived.

**Tropical reforestation**

Reforestation projects are underway in several tropical countries. This group of projects includes the first carbon offset project, an agroforestry and sustainable development project in Guatemala that was initiated almost 10 years ago. Lands involved in these reforestation projects include national parks, other public and communal lands, and private lands. As with temperate reforestation projects, the
benefits of tropical reforestation projects include soil and water conservation, enhancement of wildlife habitat, and rural economic development.

**Forest and harvest management**

Of these, perhaps the best known is the Malaysia Reduced Impact Logging (RIL) Project, which was initiated in 1994. Estimates suggest that through careful planning and personnel training carbon emissions during harvesting could be reduced by as much as 50 percent in some regions of the world. Extensive research has been carried out to document these benefits. RIL components can also be found in the Rio Bravo Conservation and Forest Management Project in Belize and the Noel Kempff Mercado project in Bolivia.

**Tropical forest conservation**

Although this project category constitutes the most widely discussed forestry climate change intervention, the number of projects underway in this area is quite small. Current projects include the Rio Bravo Conservation and Forest Management Project in Belize, the ecoland project in Costa Rica, the Mbaracayu project in Paraguay, and the Noel Kempff Mercado Project in Bolivia. Each project involves a different approach. Examples of these approaches include:

- the purchase of private inholdings within a national park;
- buying out timber concessions and doubling the size of a national park; and
- the purchase and transfer of private lands to long-term public protection.

Each project includes significant biodiversity benefits, as well other project co-benefits. Host country support for these projects has been strong. In several cases, it is expected that the carbon benefits will be shared between the host country and project funders. Most of the projects have demonstrated the ability of forestry-sector projects to conform to carbon offset evaluative criteria.

In addition to these individual project-based interventions, several broader innovative forestry initiatives and programs are being pursued for climate change purposes. One example can be found in Costa Rica, which has established its Certified Tradeable Offsets (CTO) program. The CTO program is based on a national system of forest protection and reforestation incentives. Another example is the Forest Resource Trust in the state of Oregon in the United States, in which large numbers of individual reforestation interventions will be aggregated into a statewide and risk-insured carbon pool.

**Biomass utilization**

A small number of projects are underway in both industrialized and developing countries to experiment with and demonstrate opportunities for commercial utilization of biomass in the energy sector as a means of displacing fossil fuels.

**Soil Carbon Enhancement**

A few projects are pursuing enhancement of soil carbon reserves. One project, in Saskatchewan, Canada, pays landowners to pursue no-till agricultural practices. The proposed Halophyte Cultivation Project in Sonora, Mexico, would also result in significant soil carbon replenishment.

These brief examples provide some insight into the range of measures being pursued around the world for offset purposes. Through these projects a great deal is being learned about the use of forestry for climate change mitigation. This expe-
How do forestry and land use-based mitigation projects systematically differ from energy-based mitigation projects, if at all?

Most observers evaluate climate change mitigation projects through their ability to address several key questions:

- Are they additional to what would have happened but for the project?
- Are the project’s benefits reliable and long-term?
- Can the project’s benefits be accurately quantified, monitored, and verified?
- Do the projects provide significant co-benefits?

Forestry and land use-based mitigation measures are often discussed as if they are fundamentally different from mitigation projects undertaken in the energy arena. Participants in the Baltimore Workshop generally agreed that many biotic offsets would be of comparable mitigation quality. They also concluded that implementation of land-use initiatives would involve the same degree of difficulty as most energy projects.

Workshop participants did, however, express some concern over the controversy surrounding the general characteristics of different types of mitigation interventions and associated assertions that some categories are inherently better than others. In the case of forestry interventions, this debate was contributed to by a naive community of forestry experts who have openly shared the strengths and weaknesses of measurement capabilities with a policy community that is not sufficiently prepared for interpreting this discussion. As one participant said: “We [forestry experts] have done some damage in getting too involved in technical discussions. As a result, we have confused policymakers. The technical issues for forestry are no more perplexing than they are for energy offsets.” Voicing support for this view, another participant stated that “the central issue we need to address is not what our confidence level in our forestry measurements is, but to make it clear that forestry offsets can accomplish the same levels of accuracy as energy at equivalent levels of effort. The issue is comparability.”

As a result of these discussions, a primary conclusion of workshop participants was that forestry-sector offset projects are not dissimilar to energy-sector projects. There are relatively few systemic differences between the project categories, and they can run in different directions (e.g., additionality vs. permanence). Participants concluded that it is not feasible to make blanket statements at the sectoral level about the comparable quality of energy-sector and forestry-sector projects. Participants concluded that forestry projects should not be held to higher performance standards than energy-sector projects, nor should they be generically discounted against energy-sector projects. Workshop participants concluded that the specific characteristics of individual projects need to be taken into account when judging compliance with any crediting system that is established for climate change mitigation. Whether a project is within the forestry sector or the energy sector, it should be required to prove individual compliance with offset standards.

How are forestry and land-use projects treated under the FCCC and the Kyoto Protocol?

Reducing land-use changes resulting in high GHG emissions and enhancing land-
use sinks are important components of the FCCC and the Kyoto Protocol. Relevant provisions of the two instruments include:

- **FCCC Article 4(2)(a):** Parties shall adopt national policies and take corresponding measures on the mitigation of climate change by . . . protecting and enhancing its greenhouse gas sinks and reservoirs.

- **Kyoto Protocol, Article 2.1(a)(ii):** Annex I Parties shall implement policies relating to protection and enhancement of sinks and reservoirs, and promotion of sustainable forest management practices, afforestation, and reforestation.

- **Kyoto Protocol, Article 3.3:** Industrialized Parties shall net out forestry sources and sinks in calculating their emissions.

- **Kyoto Protocol, Article 6.1:** Any Annex I Party may transfer or acquire emission reduction units from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks.

- **Kyoto Protocol, Article 12.3(b):** Annex I Parties may use the certified emission reductions accruing from project activities to contribute to compliance with part of their quantified emissions reduction commitments.

With regard to forestry-based mitigation strategies, the outcomes of the third Conference of Parties (COP-3, at which the Parties adopted the Kyoto Protocol) are widely regarded as ambiguous. The discussions of sinks at COP-3 were not generally in the context of project-based mitigation efforts. Rather, they focused primarily on sinks within the context of whether and how forestry would be netted against fossil-fuel emissions for the purpose of determining compliance with emissions reduction targets.

The forestry outcomes of the Kyoto Protocol can be summarized as follows:

- Reforestation, afforestation, and deforestation since 1990 will be netted against other GHG emissions by Annex B (former Annex I) countries.

- Reforestation and afforestation “sinks” projects that can meet an unspecified “but for” or “additionality” test will be eligible for crediting under Article 6 of the Protocol (joint implementation), albeit not until the first budget period.

- The Clean Development Mechanism (CDM) provides for crediting of “certified emissions reductions,” but does not define the types of emissions reductions that will be included. While some environmental organizations and developing countries have argued that this means that forestry-sector projects should be excluded, this opinion is widely disputed. It is interesting to note that a number of potential forestry interventions do constitute “emissions reduction” projects rather than sink enhancement projects.

The first response to the ambiguity surrounding land-use projects left by the Kyoto Protocol occurred at the follow-up Subsidiary Body meetings in June 1998 in Bonn, Germany. One of the few areas in which progress was made was in the land-use change and forestry area. Even so, advances were procedural rather than substantive. As a result of the Bonn meetings, the IPCC was charged with preparing a special report on several key land use and forestry issues. This special report, in conjunction with the IPCC’s treatment of forestry options in its ongoing Third Assessment Report, should significantly contribute to the discussion of the role sinks are able to play under the Kyoto Protocol both domestically and internationally.
What is the difference between “netting” sinks in estimating national GHG emissions (Article 3.3 of the Kyoto Protocol) and pursuing individual sinks projects (Articles 6 and 12)?

When considering the role of land use-based emissions reduction and sequestration projects, it is important to differentiate between national netting of emissions under Article 3.3 of the Protocol and pursuit of forestry and other mitigation measures at the project level. Article 3.3 delineates how forests fit into industrialized calculations of compliance with emissions reduction targets:

The net changes in greenhouse gas emissions from sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation, and deforestation since 1990, measured as verifiable changes in stocks in each commitment period shall be used to meet the commitments in this Article of each Party included in Annex I.

There is still considerable uncertainty as to how this paragraph will be applied. What is clear, however, is that language of Article 3.3 applies to the “netting” of certain categories of land use change and forestry interventions in Annex B countries against those countries’ fossil fuel emissions for purposes of evaluating compliance with Parties’ obligations under Article 3.3. There is a clear difference between quantifying benefits at the national level for this type of netting, vs. the quantification of benefits at the project level. The methodologies are different, the uncertainties are different, and the accuracy and precision of the quantification process is likely to be quite different. Of particular importance, the fear of large loopholes in the Protocol is likely to be significantly greater in the case of national-level netting than it is in project-by-project benefit quantification. As a result, the policy and technical concerns and debates that have characterized discussions of netting before and during the Protocol development process cannot simply be transferred over to the discussion of project-based mitigation interventions.

How much of a role will forestry play in future climate change mitigation efforts?

Historical land-use change has been a key contributor to anthropogenic emissions of CO₂, totaling almost one-third of all emissions since the Industrial Revolution. Forest loss and degradation will continue to release more than a billion tons of carbon to the atmosphere each year into the indefinite future. This clearly creates a place for forestry in the societal menu of climate change mitigation options. Both the FCCC and the Kyoto Protocol acknowledge forestry’s importance.

As with most mitigation options, the total potential of forestry measures depends on many variables and is difficult to reliably predict. A range of studies suggests that 1 to 2 GT of carbon benefit per year is achievable through temperate and tropical forest conservation, regeneration, and reforestation. Expanded commercial biomass utilization for energy and products could add to this figure. Even when not permanent, the benefits of biotic projects can help slow the rise in atmospheric concentrations of CO₂ for several decades or more.

Many forestry interventions offer tremendous opportunities to advance biodiversity conservation, soil and watershed conservation, rural economic development, and the interests of indigenous peoples. Climate change mitigation funding has the potential to dramatically expand the resources to meet these goals and improve forestry practices, which would otherwise be likely to remain underfunded.
As the priority level of climate change mitigation efforts continues to increase, more attention will be focused on the need to pursue the full range of available mitigation options. More interest groups are recognizing the importance and value of forestry and land-use mitigation measures. Dozens of environmental, conservation, and sustainable development organizations, as well as private-sector entities, have demonstrated increasing awareness of the value of forestry options by signing the Call for Inclusion of Forest-Based Joint Implementation in the Kyoto Protocol, which urged delegates not to overlook the many benefits of forestry sector interventions.

As with most mitigation measures, in-depth work is required for forestry-sector interventions to develop the protocols and modalities by which project-level mitigation efforts can be reliably and consistently implemented. How can forest areas truly under threat of loss be identified? How can they be effectively protected for the long-term? How can reforestation and other projects effectively contribute to long-term climate change mitigation goals? These questions deserve concentrated political and analytical attention. The Land Use and Biotic Mitigation Policy Project is starting to provide such attention and has reached several preliminary conclusions:

• For land use-based emissions reduction and sequestration, it is important to differentiate between national netting of emissions under Article 3.3 of the Protocol and pursuit of forestry and other mitigation measures at the project level.
• The issues facing forestry interventions are often the same ones facing other mitigation options. In most cases, the challenges facing forestry and other project-level mitigation efforts require policy rather than technical solutions (e.g., defining additionality, leakage solutions, permanence).
• Some issues, such as quantification of project-level benefits, pose less of an analytical problem than is widely believed because accurate measurement techniques are increasingly available and remaining uncertainty can be effectively addressed.

From the standpoint of a host country, forestry deals will be implemented if project benefits, to either the government or private landowners, are larger than those from alternative land uses (e.g., logging, pasture). In other words, the benefits of the carbon offset must be greater than the costs of opportunity. Benefits might include biodiversity conservation, watershed protection, enhanced ecotourism potential, and expanded marketing of non-timber forest products. These co-benefits will be weighed against the opportunity costs of diminished timber sales and secondary processing opportunities, such as value-added revenues, employment and other multipliers.

What are the priorities for moving forestry issues forward?
Most of the priorities for advancing project-based mitigation objectives in the forestry sector are the same as those in other project-based mitigation sectors. Based on the conclusions of the Baltimore workshop referenced in this report, however, the following prioritization of issues can be put forward:

• \( \text{CO}_2 \text{ Benefit Permanence} \): Permanence was identified by workshop participants as perhaps the most technically challenging of the issues considered. It is also the issue most commonly flagged by forestry critics. Permanence is also fundamentally a policy issue that requires additional consideration with regard to
technical issues such as the value of delaying emissions, “how long is long enough,” and how to incorporate risk factors (e.g. fire) into project benefit quantification and evaluation.

- **Standardization of Guidelines and Criteria Across Project-Based Mitigation:** Workshop participants concluded that most issues facing forestry-based offsets are the same issues facing other types of offsets. Lack of standardization in the field contributes to the concern and confusion surrounding forestry-based offsets. Once standardization begins, it will become easier to systematically evaluate the performance of forestry-based offsets against other project types and determine the degree to which forestry efforts can be integrated into a larger post-Kyoto climate change mitigation regime.

- **Leakage:** Leakage concerns may pose a significant threat to incorporation of forestry-sector mitigation efforts into a credit-based regime. Although leakage also affects energy-sector projects, there is disagreement as to whether some types of leakage are unique to forestry projects and whether the magnitude of the leakage issue is greater for forestry than for energy-sector projects. Just as important, the issue of whether project-specific leakage assessment is even appropriate remains unresolved in both the energy and forestry sectors.

- **Protocols for Dealing with the Fate of Forest Products:** The treatment of forest products for forestry-sector mitigation is linked to all three priorities already identified. It is also an important issue in its own right, and one for which no process for standardization has been attempted.

- **Forestry Project Benefit Quantification, Monitoring, and Verification:** A great deal of benefit quantification, monitoring, and verification work has recently been carried out for forestry-sector mitigation options. Nevertheless, few, if any, standardized protocols have been developed in a way that is accessible to either project developers or climate change policymakers. Extensive practical work in this area is still needed. At the same time, project quantification issues are seemingly becoming less important to the future of forestry mitigation as an issue.
Appendix: Conclusions for policymakers from the Biotics Assessment Workshop, Baltimore, Maryland, September 1997


Workshop participants felt strongly that certain conclusions from this unusual gathering of forestry-related expertise should be reported to the policy community. During the course of the workshop, participants also concluded that a number of technical issues and questions that have been raised in connection with the feasibility and appropriateness of forestry and land use-based offsets can be straightforwardly addressed based on existing technical knowledge. The following conclusions reflect these two categories of findings.

Forestry and land use-based carbon offset projects can be an effective tool that can provide an important component of any domestic or international climate change mitigation strategy.

There was strong general agreement that biotic offset projects could provide important and cost-effective contributions to national or global climate change mitigation strategies. Participants felt that one particular benefit of forestry is that it can be done on a small scale. It was cautioned repeatedly, however, that biotic offsets are not a panacea or “the” answer to climate change and that forestry and other land use-based projects are likely to be a small component of an overall global mitigation portfolio. At the same time, biotic mitigation strategies have an inherent flexibility that can build on experience and be adapted to the special circumstances of a particular location, culture, or political situation.

There are three types of forestry and land use-based offset projects: those aimed at protecting existing carbon reservoirs and sinks (e.g., avoiding carbon emissions from deforestation and other land-use changes); those aimed at adding to existing carbon reservoirs; and those aimed at substituting biomass for fossil-fuel-based products (e.g., energy, cement, and steel products).

Participants recognized that it is important to avoid treating forestry mitigation options as a monolithic block and that is inappropriate to group all biotic mitigation technologies under the same tent for purposes either of embracing or dismissing their climate change mitigation potential. Many different potential forestry-based mitigation strategies currently exist. Slowing deforestation, for example, can be as real a CO₂ emissions reduction project as a fossil-fuel substitution or demand-side management project in the energy sector.

There is no question that forestry-based carbon offset projects can help slow the rise in atmospheric concentrations of CO₂ for several decades or more. This will provide time to implement CO₂ mitigation policies and measures that require long lead times, including conversion to more efficient electrical generation technologies.

Workshop participants agreed that biotic carbon offset projects can help provide time to make long-term investments and changes. Even the short-term removal of carbon from the atmosphere provided by some forestry-based offset projects can have an impact on the rise in atmospheric concentrations of CO₂. It was agreed that while permanence of the carbon benefit is important and should not be ignored, one
service that biotic offsets can provide—buying time while delaying GHG emissions—is a significant scientific and policy benefit. It was also agreed that one can look at certain forestry projects as being permanent in the sense of ensuring carbon storage or sequestration over a very long period of time.

Inclusion of biotic carbon offset projects among the strategies for addressing international concerns about global climate change may increase resources available to support sustainable land-use and forestry practices, both of which are unlikely to be adequately funded in the absence of such a mechanism.

Workshop participants coined the term “co-benefits” to better describe the significant non-carbon benefits often accompanying biotic offset projects. The group discussed how debate on this issue tends to take the position of why forestry “isn’t all that bad.” Rarely does one hear in the literature or professional discussions why biotic options are good for reasons other than cost-effectiveness (e.g., advancement of biodiversity goals). Yet non-carbon benefits associated with biotic options are significant. It was agreed that biotic options provide significant ancillary benefits and that there are many reasons why these options should be pursued. As some in the group noted, the carbon offset could in actuality be considered the ancillary benefit: the reasons for pursuing these projects often are—or often should be—other reasons that promote environmental and socioeconomic goals.

Biotic carbon offset projects, which include both forestry and land-use management options, provide an opportunity to support efforts to reduce deforestation and protect vulnerable forest ecosystems, many of which will be lost or degraded in the near to mid terms (within ~20 years) without additional support.

Workshop participants felt strongly that biotic offset projects can provide a mechanism in support of sustainable development practices in developing countries. Inclusion of biotic options among the strategies for addressing international concern about global climate change will increase resources available to support sustainable land-use and forestry practices. It was also agreed that time is of the essence, since many forests face severe threats in the near future. Workshop participants felt that JI is a unique funding mechanism that could help save threatened areas while they still exist. Time is crucial in this respect. Several participants agreed with the observation that “It will be a lost opportunity if we don’t catch it while it’s there. The question is not whether we can capture the benefit later, it’s whether we can capture it at all.”

Forestry and energy carbon offset projects both provide carbon benefits over different timeframes. Some give relatively immediate but long-term benefits (e.g., forest protection), whereas others provide most of their offset benefits over several decades (e.g., long-rotation forest plantations). However, as with energy-sector projects, the carbon benefits of projects should not be credited to the project until it has actually accrued and is verifiable.

Biotic offset projects can provide both short- and long-term benefits. The issue of perpetuity in connection with biotic offset projects—the timeframe over which a project offers its benefits—has been contentious and is often raised by critics. It was noted that even energy projects cannot claim to yield perpetual emissions reductions; a 200-year timeframe before gas reserves are depleted (and gas that is conserved today is emitted) would still only be a delay of emissions.
The precision with which we can measure carbon accumulation in onsite vegetation associated with forestry carbon offset projects is very high—up to (10%, with a confidence of 95% in most situations. A project’s carbon benefits can be measured with a high degree of precision. A number of the workshop participants, with extensive fieldwork experience in this area, felt confident that a ±10% figure is achievable. The effort to reach this high level of precision will vary among projects. Workshop participants noted that this level of precision is comparable to that found in many energy-sector carbon offset projects.

Whatever the concern associated with the level of measurement precision achievable for a given project, it is always possible to report the net carbon benefit based on the lower bound of the achieved confidence interval. Doing so makes the carbon benefits claimed highly credible in relation to energy projects, for which estimates may be more precise.

Participants felt strongly that even though some forestry projects will be unable to match the quantification precision of many energy projects, this is no basis for arguing that forestry projects should not play a role in mitigation efforts or in a CO2 trading regime. If considered appropriate by policymakers, means are readily available to adjust the quantified benefits of different project types for uncertainties of this sort. Where appropriate, such adjustments should be applied to energy sector as well as forestry-sector projects.

It is relatively easy, and the cost is often modest, to measure on-site carbon stored or sequestered as a result of a forestry carbon offset project. Measurement is similar to the cost and ease of measuring carbon savings associated with many energy carbon offset projects.

Participants concluded that as a technical and practical matter, the cost of measuring carbon in biotic offset projects is not significant; in any event, it is comparable to the technical and practical cost issues associated with many energy offset projects. It was generally agreed that this was a non-issue despite being commonly raised by critics.

Some categories of biotic projects are capable of meeting a crediting regime, whatever that regime might be.

Workshop participants felt that while the characteristics of forestry-based offset projects vary widely with respect to quantifiability, leakage, persistence, and other variables, there are forestry-based measures that can successfully conform to any crediting regime that might be developed in the future.

Accounting for the leakage of carbon benefits, if any, associated with biotic carbon offset projects is similar to that associated with many energy projects.

Participants concluded that leakage is an issue to consider in both energy and forestry-based projects and that the potential sources of leakage facing both categories of projects are often similar (although magnitudes may differ).
Third-party verification of accrued carbon presents similar technical issues in both forestry and energy projects. For both types of projects, verification improves the accuracy of carbon claims; it can enhance and verify the environmental and social benefits of biotic offset projects.

Participants generally agreed that third-party verification is desirable for offset projects generally. Some questioned whether such a mandate might not simply add another bureaucratic layer to offset projects. Participants observed that third-party verification is an issue of credibility of measurement and analysis, rather than one of standard-setting.

References and selected readings


Mark C. Trexler is the President of Trexler and Associates, Inc. (TAA), a privately owned Climate Change Mitigation Service Company. Prior to establishing Trexler and Associates, Inc., Dr. Trexler directed research on carbon forestry as a climate change mitigation option at the World Resources Institute. He was also instrumental in the development of the AES/CARE Guatemala Agroforestry and Carbon Sequestration Project, the first carbon offset project. He has published extensively, including Minding the Carbon Store, a comprehensive study of carbon sequestration options for the United States, and Keeping It Green, an assessment of the potential of tropical forestry to mitigate global climate change.

Laura H. Kosloff is an Attorney and a Senior Analyst at TAA whose area of expertise is domestic and international environmental law. From 1989 to 1991, Ms. Kosloff served as a trial attorney in the U.S. Department of Justice’s Environment and Natural Resources Division. She has extensive environmental litigation and negotiation experience, and has lectured and published on topics of national and international environmental law.

Rebecca Gibbons is a Policy Analyst with TAA. She participates in a wide range of TAA’s energy and climate change-related projects, and is actively involved with TAA’s forestry mitigation work. Ms. Gibbons holds a BA in political science with a concentration in Environmental Policy from the University of Connecticut.

Trexler and Associates, Inc.
1131 SE River Forest Road
Portland, OR 97267-3513
USA
Tel.: 1-503-786-0559
Fax: 1-503-786-9859
info@climateservices.com
www.climateservices.com