Forest 'Sinks' as a Tool for Climate-Change Policymaking:

A Look at the Advantages and Challenges

by Roger A. Sedjo

Forests can trap or "sink" large amounts of atmospheric carbon, believed to be a primary cause of global warming. Scientists are now looking at this natural process as a low-cost mitigation strategy that will buy humanity a few decades to make more fundamental changes. But as a policy tool, forest sinks pose implementation challenges that will require planning and diplomacy to resolve.

The degree to which natural processes can mitigate the build-up of atmospheric carbon has generated considerable debate among the countries that have been drafting the detailed rules to implement the Kyoto Protocol, the international climate-change treaty. While the Kyoto process may now collapse following the withdrawal of support by the United States, the concept of forest "sinks" offers advantages that are likely to make it important in any successor policy to address climate change. Since President Bush has also moved away from support of caps on carbon dioxide (CO_2) emissions because of his concerns about energy supply, while acknowledging that climate change is a "real problem," this could mean that sinks are all the more important, particularly in the early phases of any long-term comprehensive carbon mitigation plan.

The fundamental science of carbon sinks is well understood—biological growth binds carbon in the cells of trees and other plants while releasing oxygen into the atmosphere, through the process of photosynthesis. Ecosystems with greater biomass divert more CO_2 from Earth's atmosphere and sequester it; forests in particular can absorb large amounts of carbon. Under the Kyoto Protocol, a forest is a carbon sink and a new or expanded (through human effort) forest is allowed to generate credits for removing carbon from the atmosphere.

The most recent round of Kyoto Protocol negotiations, held last November in The Hague, came to a standstill in part because a compromise over carbon sinks failed. American and European negotiators could not reach agreement on the extent to which carbon captured in biological sinks, would be given credit in meeting country carbon-reduction targets as agreed to earlier at Kyoto.

At first glance, the idea of providing carbon credits for forest sinks sounds easy to implement, but a number of questions have been raised:

- Should existing forests count?
- Is there an agreed measure of absorption?
- How long will it take for a newly planted forest to start absorbing CO_2 and at what rate?

- Should a country receive CO_2 credits if it develops forests in a country other than its own?
- What are the politics of sinks?
- What are the economics of sinks?

Some experts claim that there seem to be no precise answers to these and other questions about forest sinks. (It's important to point out that a substantial amount of carbon is sequestered in the oceans as well as modest amounts in soil.) So, in the context of strategy to control climate change, how important is the sink issue and what compromises may be necessary to prevent sinks from fouling up the grand design?

Let us address these questions one at a time.

Should existing forests count?

In general, the view is that existing forests have inadvertently served as sinks and thus should not count under the Kyoto Protocol. However, there may be some exceptions to this rule. For example, it may be sensible to provide carbon credits for protecting forests that would otherwise be converted to other uses, such as agriculture. In many cases, the value of the carbon credits would exceed the value of the land in nonforest uses. In addition, if existing forests continue to grow and sequester additional carbon, particularly as a result of forest management, then one can argue that credits should be provided for the additional carbon. This is sometimes referred to as a "baseline" problem—deciding which measures are considered over and above what would have happened anyway.

Is there an agreed measure of absorption?

Yes. The amount of carbon held in the forest depends on the amount of dry biomass there. Most developed countries have accurate forest inventories that can provide the baseline for estimating forest biomass. About 50% of the dry weight of the biomass will be carbon. Different tree and plant species have different densities, but these differences are well known, and forest biomass is easy to estimate by using sampling techniques.

How long will it take for a newly planted forest to start absorbing CO_2 and at what rate?

The rate of carbon absorption depends on the amount of dry biomass in the forest. Trees typically grow slowly at first, then at an increasing rate until growth begins to level off as they approach maturity. The growth pattern depends on species, climatic conditions, soil fertility, and other factors. In some parts of the world, certain species grow quickly and can accumulate substantial biomass in less than a decade.

Should a country receive CO_2 credits if it develops forests in a country other than its own?

Forest growth is much more rapid in some regions than in others. Resource conservation would dictate that most of the carbon-sequestering forests should be located in regions where carbon can be absorbed efficiently. Thus, it is sensible for one country to invest in the forests of another—with permission, of course—as a way to earn carbon credits. Additionally, such an approach may transfer large amounts of capital from developed countries to developing countries, thus promoting their economic development.

What are the politics of sinks?

Forest sinks appear to offer the potential of low-cost carbon absorption. However, not all countries are equally blessed with these resources. Much of Europe consists of even-aged growth in what are called "regulated" forests. The expected potential for additional forest growth there to absorb carbon is limited. In fact, many observers argue that European forests are likely to experience some decline over the early decades of the twenty-first century. Thus, it is not surprising that European countries would resist the inclusion of forest sinks for carbon monitoring under the Kyoto Protocol.

By contrast, many countries outside of Europe, including the United States, expect their stock of managed forests to increase during the first decades of the twenty-first century. The United States, Australia, Canada, and Japan are keen to use forest sinks to meet any climate treaty obligations. Many environmental groups appear to believe that meeting carbon targets should be painful and thus view forest sinks as insufficiently austere. However, other environmental groups view carbon credits from forests as offering the potential to help protect tropical forests from destruction and from forestland conversion to agricultural and other uses.

What are the economics of forest sinks?

Most studies indicate that the costs associated with sinks appear to be modest compared with the costs of making the necessary changes in the energy sector. Forest sinks often have other associated benefits, such as erosion reduction, watershed protection, and biodiversity protection of existing native forests.

However, their potential to offset carbon emissions is limited. At best, the potential of forests and other terrestrial systems that act as carbon sinks to offset emissions is probably not more than one-third of current net emissions.

Additionally, as the volume of forest sinks increases across the globe, their costs will rise and their additional potential will decline. Thus, perhaps the best way to view sinks is as a temporary low-cost mitigation strategy that can buy humanity three to five decades to make more fundamental adjustments.

Looking Ahead

Carbon sinks appear to offer substantial potential to assist humankind in addressing the challenge posed by climate change but they are more than just forest ecosystems. Grasslands, wetlands, and agriculture all offer the potential to absorb carbon. Although grasslands do not build up a large aboveground mass like forests do, they are effective in the sequestration of carbon into the soil. Wetlands, too, hold large amounts of carbon in storage. Agricultural lands can contribute to carbon absorption if proper management is followed. No-tillage agriculture offers the potential to restore large volumes of carbon to agricultural soils and contribute to the absorption of carbon from the atmosphere.

Forests appear to offer the greatest potential because they can absorb large volumes of carbon both above and below the ground. Furthermore, the measurement and monitoring of aboveground forest carbon is reasonably simple. The condition of the forest can readily be ascertained visually and with standard forest inventorying procedures, which have been used for decades—indeed, centuries. Carbon can be estimated from the standard forest inventories with only modest additional data requirements. Furthermore, if payments are made for carbon absorbed in the forest biomass, they typically do not reflect the true values because the forest soils also sequester carbon.

As a policy tool, forest sinks pose some distinct challenges. Suppose that a huge reforestation effort is driven by the desire to absorb carbon and that many of these trees would also be suitable as timber. Timber producers, which annually plant an estimated several million hectares of trees for industrial wood purposes, are going to reconsider their tree-growing investments. After all, with all of these new forests being created, the outlook for future timber prices must appear to be bleak. Thus, many timber producers may decide to reduce their own investments in timber growing. The net effect will be to offset some of the increased planting for carbon purposes with the reduction in industrial forest-growing investments. This reduction—that is, the impacts that are precipitated by carbon-absorbing forest projects but are external to those projects—is called *leakage*.

A second form of leakage is associated with protecting threatened forests, as often is proposed for the tropics. Suppose that a particularly valuable forest is threatened with conversion to agriculture. Intervention may be able to save this forest and thus claim credits for the carbon that is prevented from being emitted. However, such an action might simply deflect the deforestation pressure from one forest to another, with no net reduction in carbon emissions.

It should be noted that leakage is not unique to forest sinks. Potential leakage is pervasive throughout many of the proposed climate remedies. Consider the proposal to tax carbon emissions from fossil fuels in developed countries as a way to provide financial incentives to assist developed countries in meeting their emissions reduction targets. Such a policy would increase energy prices in the developed world and energy-intensive industries would have incentives to move to the developing world, where no emissions targets or carbon taxes exist, and hence energy is cheaper. The net effect could be the transfer of emissions from developed countries to developing countries without a significant reduction in global emissions. This leakage in the energy sector could be substantial and could have significant implications for the world economy.

Can such an outcome be avoided for both carbon sinks and energy? Yes, but it would require implementing similar rules across countries so that leakage is not created through circumvention outside a project or outside a particular country. One step would be to allow sink credits only on a country's net carbon sink increases, and debits for net sink reduction.

Overall, forest sinks have the potential to play a valuable role in carbon sequestration. Although sinks are only a partial solution to anticipated global warming, they do appear to have the potential to sequester 10 to 20% of the anticipated build-up of atmospheric carbon over the next 50 years. Furthermore, sinks can accomplish the task at relatively low costs compared to many other approaches.

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Putting People in the Picture

Roger Sedjo, a senior fellow in the Energy and Natural Resources Division, is the director of RFF's Forest Economics and Policy Program, which, in addition to doing research, brings visiting researchers and consultants to RFF. The program's principal goal is to support and disseminate public policy research in forestry and related areas.

Sedjo's research interests include forests and global environmental problems, climate change and biodiversity, public lands issues, long-term sustainability of forests, industrial forestry and timber supply and demand, global forest trade, forest biotechnology, and land use change.

"Forests have always been viewed as a source of fiber and other local outputs, such as watersheds and recreational opportunities," Sedjo said. "It is now clear, however, that forests also play an important role in both stabilizing global climate and sustaining global biodiversity, which needs to be better understood."

Sedjo currently serves as the co-convener of a team of scientists, including economists, from around the world who are writing a chapter on forest sinks for the International Panel on Climate Change's (IPCC) Third Assessment Report, which will be issued early this fall. The IPCC was established by the United Nations in response to the rise in the global average temperature in recent decades.

The Third Assessment Report—which will consist of three sections, on the state of the science, adaptation options, and mitigation possibilities, each prepared by a separate Working Group—is being prepared by several writing teams. Representatives of Working Group III, which is compiling a broad review and update of the current states of science regarding climate mitigation possibilities and options, recently met in Accra, Ghana, with delegates of 85 countries to finalize the document summary. This document will be used to inform the discussion and negotiations regarding appropriate actions and responses by government and others.

Sedjo was recently a member of the Committee of Scientists, which was created by the Secretary of Agriculture to make recommendations about the planning of the National Forest System, which is managed by the Forest Service. Their report was submitted to the Secretary in 1999.

Sedjo has also been a consultant to the World Bank, the Asian Development Bank, the U.S. Agency for International Development, and other international organizations in more than a dozen countries, including Argentina, Indonesia, New Zealand, Russia, and Thailand. He also serves as the president of the Environmental Literacy Council.

Sedjo has written or edited 13 books related to forestry and natural resources, in addition to scores of journal articles. His most recent publication, *A Vision for the U.S. Forest Service: Goals for Its Next Century*, was published last fall by RFF Press.

With contributions from scholars, policymakers, and forestry officials, this volume provides broad reflections on the agency's past and future, contemporary perspectives about the use and stewardship of public lands, and analyses of the science involved in the practice of "scientific management." As the lead editor, he recently received the Best Book Award for 2000 from the Section for Environmental and Natural Resources Administration of the American Society of Public Administration.

Roger Sedjo, RFF (left), and Robert Watson, IPCC Chairman, at the Third Assessment Report meeting in Accra, Ghana, March 2001.