Harvesting the Benefits of Carbon "Sinks"

by Roger A. Sedjo

Human effort to sequester more carbon—say, by growing more trees—is one way that countries can hold down the level of greenhouse gas buildup in the Earth's atmosphere. Climate policymakers recognized this fact at Kyoto, but more work is needed to make the most of this strategy.

When industrial countries agreed to cut down on their greenhouse gas emissions last December in Kyoto, Japan, they were also signing on to the staggering task of figuring out how. Although the Kyoto Protocol is historic, it is no detailed blueprint for getting the job done. The treaty affirmed the worthiness of some tools, but left much to the imagination on how to use them.

One of these tools is carbon sequestration, the accumulation (or "soaking up") of carbon in terrestrial as opposed to atmospheric forms. Carbon is stored in "sinks" that range from the world's oceans and forests to agricultural soils. How humans deal with these storage sites can affect global temperatures. The Kyoto Protocol recognizes the hand that humans have in sequestration, providing for nations to receive either credit or blame, depending on whether they act to expand or contract sinks.

But climate policy experts will have to spend more time at the negotiating table before sequestration is likely to be an effective national strategy. Too many policy questions still need answers, and the Protocol recognizes only one aspect of the sequestration that may be possible.

In the meantime, policymakers and analysts in the nations that signed the Kyoto Protocol are getting better acquainted with the basic concept of carbon sequestration and assessing its merits as a climate change tool. What is clear already is that creating new forests as carbon sinks on low-cost lands is among the least expensive ways to lower greenhouse gas buildup, especially in the short run.

What Is A Carbon Sink?

Carbon is stored in a variety of places. Natural stocks include oceans, fossil fuel deposits, the atmosphere, and the Earth itself where the element is present in rocks and sediments; in swamps, wetlands, and forests; and in the soils of forests, grasslands, and farmland. Human-created carbon stocks, which are expanding, include long-lived wood products and waste dumps.

A stock that is taking up carbon is a sink. A stock that is releasing carbon is a source of emissions.

Oceans, soils, and forests all have some potential for carbon sequestration. But, for now, forests offer the greatest immediate promise. Unlike many plants and most crops, forests accumulate carbon over decades and centuries. Their potential for accumulation is large enough that significant amounts of carbon may be sequestered in a matter of decades. Fortuitously, forests that people manage for timber, wildlife, and recreation sequester carbon as a matter of course. Forests may also be managed strictly as sinks. In any case, forest sinks are the only ones that the Kyoto Protocol explicitly recognizes as eligible for emissions reduction credits.

Of course, a forest can become a source as well as a sink. Carbon can be released quickly, for example, if a forest burns. Tree decomposition and logging reduce

forest biomass, also. If enough carbon is released, the forest will become a net source. If enough regrowth occurs, however, the forest will become a sink once again.

In many forests, natural disturbances such as fires create a cyclical pattern of growth (sequestration), disturbance (emission) and regrowth (sequestration) over periods of many hundreds of years. Even when a change in land use is deliberate, however, monitoring exactly what is happening to the carbon as the forest changes is necessary before a sink/source contribution can be determined—or before credits or debits can be assigned under a legal commitment like the Kyoto Protocol.

Measuring Activity in Forest Sinks

How helpful carbon sequestration will be in meeting emissions reduction targets will depend on how broadly the eligible activities—new forest creation (afforestation), re-establishment (reforestation), and destruction (deforestation) are ultimately defined. For now, it is clear that developed countries can take credit for sink accumulations that occur during the years 2008–2012 from forests established *after* 1990 on lands that, *prior* to 1990, were not forested.

Some analysts contend that the omission of forest management, conservation, and protection from the lists of activities eligible for credit implies that they will not qualify toward emissions reductions. Others contend that management and conservation are encompassed in the process of creating and rebuilding forests. But that interpretation leaves the problem of verification. And it is not clear how much of what is considered conservation and protection would even produce positive changes in verifiable carbon stocks. These activities may simply protect stocks that already exist. Indeed much of conservation's contribution to carbon sequestration is reducing forest destruction—and avoiding new debits in national emissions inventories in the first place.

The question of how commercial timber harvests are to be treated is also unclear. One interpretation is that harvesting simply has not been included in the Protocol and should be ignored. Once again, the answer may turn on how forest activities are defined. Most commercial timber harvest operations are closed circles that involve logging followed by regeneration. It is possible to see these harvests as neutral for purposes of the Protocol: the release and recapture of carbon cancel each other out.

Tapping Other Sinks

The Kyoto Protocol is silent on ways to earn carbon sink credits other than through forest creation and re-establishment. But the Protocol does leave open the possibility that other managed sinks may be recognized eventually.

Agricultural and grassland soils have substantial potential to sequester carbon, for instance. People may use these soils to manage carbon routinely, particularly as new approaches like conservation tillage are introduced. For the moment, however, the Protocol recognizes such soils only as carbon sources to be included in emissions inventories.

It is possible that emissions reduction projects that emerge under the Protocol's Clean Development Mechanism may not be as limited in what activities they may count toward credit; the potential categories are simply not clear.

A Glossary of Challenges

A number of practical issues need attention, too.

Baselines. These need to be established as points of reference for determining how much a given project contributes to the net carbon sink.

Additionality. Baselines are also needed to help substantiate that the carbon sequestration claimed is "real and additional," and the result of some forestry-based activity over and above what would have occurred in the absence of an emissions reduction program.

Thus far, "business as usual" baseline measures of the total stock of carbon in a defined area have proved scientifically challenging, particularly in cases where heterogeneous forest ecosystems are being examined. Evidence indicates that the measurement of total carbon is a complex process, and is likely to be expensive because forest ecosystems are unique.

In addition, there is a risk of unintended consequences. Monoculture plantations of trees known to sequester carbon rapidly may be more straightforward to measure and at much lower costs. Such convenience could well lead to the almost exclusive establishment of single-species tree plantations (which may render them more susceptible to single-species blights, such as Dutch Elm disease). Monoculture crops could outstrip biodiverse, heterogeneous forest ecosystems.

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To avoid such consequences, incentives could be put in place that reflect the entire set of social objectives to be met by a forest ecosystem, not just carbon emissions concerns.

It may turn out not to be necessary to evaluate the total terrestrial stock of carbon in a defined area. Assessors might focus instead on the carbon flows that result from land use changes in the area over a specified time. Changes that had long-term impacts on carbon sequestration would be included in a national inventory of carbon flows that could be compared with a national baseline.

Leakage. To receive credit for reducing greenhouse gas emissions, nations may protect some areas, but shift their emissions-creating activities to other locations so that no actual reduction occurs. Such circumvention of emissions targets is most likely to occur in cases where carbon sequestration is evaluated at the project level, rather than within the framework of a national carbon budget. Administered at the national level, a carbon budget program would monitor total additions and deletions to carbon stocks with reference to a defined baseline.

Verification. To verify forest-based carbon offsets, third-party audits are likely to be conducted, much like those now done to certify that timber is properly harvested from sustainably managed forests. If the scope of carbon sequestration develops to include agriculture and other land uses, verification methods will have to accommodate the potentially infinite number of land use portfolios that comprise the global carbon stock.

Opportunity Costs. Forest lands cost more to maintain or establish in some areas than they do in others. In the United States, losing an opportunity to use a piece of land other than as an undisturbed forest is often a high price to pay. Other parts of the world appear more promising as places to manage as carbon sinks. In certain regions forested land is located in remote and rugged terrain where logging would be an expensive proposition. Such land may be a prime candidate for conservation. As for afforestation, it tends to cost less to establish permanent tree cover in regions of low agricultural productivity—where the opportunity costs of land are low—than to carry out many other carbon offset projects. Indeed based on current knowledge, creating new forests on low-productivity agricultural lands is among the least expensive ways available to reduce greenhouse gas emissions, particularly in the near term.

In seeking to better identify the costs involved in using carbon sequestration as an emissions mitigation tool, researchers are also taking into account behavioral responses to alternative land-use values. The consequences of what may be an irreversible conversion, for example, may dampen a landowner's willingness to agree to a major land use change. Communities may be attached to traditional agricultural activities that may be hard to give up. When such factors are considered, the costs of carbon sequestration are higher.

Room to Grow

The Kyoto Protocol has provided an incentive to study carbon sinks and how humans might best make use of them to hold down the level of greenhouse gases in the atmosphere. However, the Protocol deals only with a small subset of the total carbon flow. Attention is limited to carbon fluxes caused by human activities involving the creation, re-establishment, and destruction of forests after 1990. The global climate treaty's

scope is further narrowed by its focus on changes in carbon stocks only in the commitment period of 2008–2012. In its current formulation then, the treaty is set up to ignore many changes, including positive ones that humans make to sequester carbon. Forest management, for instance, will generate far more carbon sequestration than credit received.

However, the Protocol does have provisions for enlarging its focus in time. Article 3.4 speaks to the possibility of adding other categories of land use changes and forestry activities in the future. Nations may eventually receive credit for sequestering carbon through a wider range of techniques, including the management of agricultural soils as sinks, which holds especial promise.

All things considered, carbon sequestration is likely to be one of several tools that countries add to their greenhouse gas emissions reduction kits. Once the ambiguities and limitations of its initial integration into the Kyoto Protocol are ironed out, care must be taken to recognize the true opportunity costs of alternative land uses. In many cases, social values other than carbon sequestration are also involved, and tradeoffs will be necessary.

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To download a copy of the related report "Carbon Sinks in the Post-Kyoto World: Part I," (RFF Climate Issue Brief No. 12) access *http://www.weathervane.rff.org*. Hard copies may also be ordered by mail; see page 18.

Further Readings

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