Forestry and Carbon Sequestration[1]

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Introduction

This paper will focus primarily on the topic of carbon sequestration, and how the development of international agreements, national policies, and private market mechanisms might result in new incentives for forestry practices in North America. Please note the term Amight.@ Much of the detail is still caught up in current political debate, and until those debates reach some consensus, much of this information must be treated as somewhat conjectural.

But it is fair to say that the progress in defining carbon sequestration credits, and including them in the calculation of forestry benefits, has proceeded to the point where we can be fairly sure about what can be achieved. There are active private market tests underway, as well as new programs in the recent Farm Bill. Several organizations are actively designing and implementing forestry projects to achieve measurable carbon credits (often called Carbon Sequestration Units or CSU=s) and convert those credits into financial return to the landowners. These tests and studies are identifying what is possible and feasible. Hopefully, those experiences will help shape workable policies, but as we all know, policy formulation is a complex process that can produce unintended outcomes. Whether or not policies will eventually create a climate in which forestry projects are given new impetus remains, for the moment, an open question.

The bottom line, however, is that the carbon sequestration opportunity in forests must be included in any scientifically credible approach to measuring national efforts to reduce greenhouse gas emissions. That is consistent with the recent decisions made on the international front, and even though there are many more steps in the decision making process, I expect those decisions to hold firm. If that is true, carbon credits can be the basis for both public programs and private markets that provide new incentives for forest management practices that increase the amount of stored carbon in soils and woody crops. Those incentives could provide an important added impetus for the implementation of good forest management practices.

I must include some caution, however, because it is easy to get so focused on the carbon situation that we lose sight of the context in which foresters operate. Future carbon incentives, taken by themselves, are likely to be fairly modest in terms of financial return to the landowner. In every case I have analyzed, the other benefits of good forestry practices are more important than the carbon benefit, and dominate the landowner=s decision process. Where carbon benefits are most critical is at the margin, where one more dollar of income can make the difference in getting a practice installed.

The second caution is that the carbon benefits of changing forest management practices are often small on a per-acre, per-year basis. That means that, in order to attract market or policy attention, large areas will need to be brought into the program and maintained for many years. For non-industrial private forests, that means large numbers of landowners willing to make significant commitments. The institutional challenges involved in assembling large numbers of individual owners into any program are not lost on this audience and remain, in my view, the most

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challenging aspect of this situation.

The Basic Biological Context

I suspect that the basic science in this topic is well known in this audience, but we should begin with a quick review. Scientific evidence continues to demonstrate a link between the amount of atmospheric greenhouse gases and climate change. While not the most effective heat-trapping compound on a molecular basis, carbon dioxide is by far the largest of the contributing greenhouse gases, estimated to represent over 85 percent of the global warming potential contained in U.S. emissions for 1998.

Carbon dioxide moves from the atmosphere into terrestrial ecosystems through the process of photosynthesis; then moves back into the atmosphere through respiration, decomposition and combustion. Thus, it is possible for land managers to either reduce or increase the annual flux of CO_2 between earth and sky through changes in the way plants are grown, harvested, and utilized.

Terms that will be commonly used to describe these transfers will be Asource@ and Asink.@ Those refer to the process as it would be viewed from the atmosphere. A source is transferring carbon from the earth to the sky, and a sink is removing more carbon from the air than it is releasing.

These biochemical transformations between gas and solid compounds raise an issue for analysts that can sometimes cause errors. In most of the scientific literature, the amount of carbon contained in wood and soil compounds will be expressed as the weight of elemental carbon, usually expressed in terms of metric tonnes per unit area. On the other hand, atmospheric concentrations are usually expressed as CO_2. National emissions data and mitigation targets may be expressed in either CO_2 or C. The ratio between the two is simply the molecular weight B a ton of C is equivalent to 3.67 tons of CO_2, so either expression can be readily changed to the other. But it is easy to lose track of which term is being used in a given context, and when that happens, a 4-fold error in an estimate can occur.

The International Political Process

While there are uncertainties about the linkage between the buildup of greenhouse gases and climate response, there is one absolute certainty. To the extent the problem exists, it is a global problem, and must be addressed by global action. The international political process to shape action has been underway now for almost 20 years. While much progress has resulted, the process is far from complete. Many critical decisions lie ahead.

In order to follow the process, it is helpful to know some of the players, and some of the acronyms that are commonly used. The United Nations Environmental Program (UNEP) was founded in 1972. In 1985, the ozone hole over Antarctica was discovered, and it became clear that human activity was having impact on the global environment. In 1988, the Intergovernmental Panel on Climate Change (IPCC) was created. It has involved over 3,000 of the world=s top scientists in a series of studies designed to help identify scientific and technical aspects of the climate change issue. IPCC findings were instrumental in encouraging 154 nations to sign the U.N. Framework Convention on Climate Change at the first AEarth Summit@ in Rio de Janeiro in 1992. That launched a continuing process, where the nations who signed the Protocol meet in a series of AConference of Parties,@ or COP meetings. Today, there have been 7 COP sessions. The 3rd produced what is known as the AKyoto Protocol,@ which called for legally binding reductions in emissions. The U.S. and Canada both signed the Kyoto Protocol, but political opposition in the United States has led President Bush to withdraw the United States from participation on the grounds that the Protocol would impose unacceptable economic impacts.

In 1999, the IPCC was asked to produce a special report on the scientific and technical issues involved in implementing the Kyoto Protocol articles pertaining to carbon sinks in agriculture and forestry. That special report, on which I had the honor of being lead author of one of the chapters, was released in June, 2000. In general, it pointed out that the inclusion of full accounting for the carbon exchanges between the earth and atmosphere would capture a major aspect of the issue, but that there were very important decisions to be made regarding how these activities would be defined and how the accounting systems would work.

Although the U.S. has dropped out of the Kyoto process, it remains involved in the basic Climate Convention and continues to develop policy on carbon sequestration. The recently-passed Farm Bill, for example, contains important new programs that will promote carbon sequestration projects on non-industrial forest lands. We won't know the details of those programs for a while, but new attention to the issue seems certain.

The Potential for a Market Process

Actions in the business community indicate that there will be a market for greenhouse gas reduction credits whether or not the Kyoto Protocol is ratified. The international attention to this issue, and the pressure from many governments for effective action, weigh heavily on multi-national corporations. Regardless of what the U.S. does, no large company can afford to be seen as an environmental laggard in the international arena where it does business.

Many companies in the U.S. have been experimenting with carbon credit trades to gain experience and help speed the emergence of workable market mechanisms and policies. Much of the leadership has come from the electric power industry, where many of the leading companies are convinced that some form of carbon dioxide emission limits will be imposed in the next decade. These companies want to be ready, and they want to have the practical experience to speak authoritatively when new policies and programs are being shaped.

A new trading center – the Chicago Climate Exchange – is operating to facilitate trading. It was formed under a grant from the Joyce Foundation and administered by Northwestern University's Kellogg School. Through it, companies now have the chance to engage in a voluntary, clearly defined formal market. As companies begin to seek to become carbon credit buyers, opportunity opens up for others to become sellers.

There are organizations working on that aspect, as well. For example, I work with the National Carbon Offset Coalition to develop partnerships with Resource Conservation and Development Areas, Conservation Districts, Indian Tribes, and other organizations in the U.S. These organizations work directly with landowners to develop carbon credit projects in agriculture, agroforestry, and forestry. The NCOC assembles these small projects into a larger portfolio and markets them through market trading experts. One forestry project has already been developed and sold; others are in the planning stages. A great deal of work is under way to establish guidelines and methods for these projects, and we are in the final stages of developing a project planning handbook that will help foresters through the steps of calculating the carbon sequestration impact of forestry activities.

Basic Requirements and Issues in Projects

Projects designed to reduce the amount of atmospheric greenhouse gases can include both those practices that reduce emissions and those that increase the sequestration of carbon in stable forms such as wood or soil organic matter. In forestry, we are primarily concerned with the latter type – increasing the amount of carbon stored in the system.

Carbon stored in forested ecosystems is usually measured in four Apools.@ They are:

- Above- and below-ground woody material in live trees
- Litter, understory plants, and small debris on the forest floor
- Dead snags and large woody debris
- Soil organic compounds (not counting large roots or surface debris)

In determining how carbon will be measured in a project, it is important to decide which of these pools merits the cost and effort of measurement. Since the objective of a carbon sequestration project is to increase the amount of carbon stored in the system, we need to think about the likelihood of a pool changing significantly under the proposed new management. If we are confident that the pool will change little, if at all, it will not be worth measuring as part of project activity. If we can demonstrate that the pool will not shrink, we can safely ignore it in the measurements.

In a forest project such as afforestation (tree planting on formerly unforested land), it is common to ignore the litter, understory, and dead snag pools in project measurements, since they are likely to be small and the change, while modest in a young forest, will be positive. By leaving these pools out of the measurements, we reduce the cost of monitoring and provide a bit of added Abonus@ carbon that is not claimed in the project accounting.

Clearly, we would count the aboveground wood and the large roots. They were zero at the start of the project, but will grow throughout the project=s life span and provide the bulk of the net gain in carbon. Most of our aboveground carbon data in forestry comes from the growth and yield models for various species created by forest research over decades. These models, which were developed to estimate merchantable timber yield, can be expanded to include the entire tree biomass, including branches, stumps, and large roots, so they reliably estimate the total amount of biomass in the forest over the period of the project.

Once we know the total amount of woody biomass in a tree or a forest, we can calculate the amount of carbon fairly easily. If the biomass is given in cubic feet or cubic meters of woody material, we multiply that by the dry weight of a cubic foot or cubic meter to get the dry weight of biomass. There are specific gravity data for most tree species from which those weights can be calculated. We then multiply by 0.5, since most dry wood is about half carbon. These factors have been well researched and are readily available in the literature.

Creating marketable Carbon Sequestration Units (CSU=s) in a project requires attention to some basic project planning needs, as well as followup monitoring and reporting. Again, not all of these methods have become widely published and accepted, but the general pattern seems to be fairly consistent.

The plan starts by developing a Base Case that describes the proposed project location and area, the current land use and condition, and current estimates of carbon in the pools to be considered. It establishes a project life, and estimates the change that will occur in those carbon pools over that period of time in the absence of any project action.

The plan then describes the proposed project activities and provides an estimate of how much carbon will be stored in the various pools over the project life. The amount of increased carbon stored in the wood and soil pools as a result of the project (the project amount minus the base case amount), normally expressed in metric tonnes of C or CO_2 equivalent, becomes the amount that may qualify for CSU status. In most cases, landowners are given credit and payment for CSU=s at the time of installing the practice or project, and some provision is made for adjustments if future monitoring shows that the actual amounts differ significantly from the planned amounts.

The plan needs to also address some issues that have become a common part of the climate change and CSU debates. Those include:

$ Transparency B the methods and calculations used to establish both the base and project cases should be clear to a knowledgeable reader. It should be possible to re-do the carbon calculations using accepted procedures, with the information presented, and come to similar results. For most buyers or policy makers, saying that you calculated the amount of CSU=s in a Ablack box@ proprietary model won=t be acceptable.

$ Monitoring, verification, and reporting B There needs to be periodic monitoring to assure that the project and its practices are functioning as planned. Some of this monitoring and reporting will be done on an annual basis by the landowner. Periodically, it will be necessary to develop measurements through sampling, cruising, or other accepted forms of developing carbon estimates. The frequency of these measurements will usually be established either by public policy or buyer demands, but will probably be every 5 years or so for woody plants and every 10 years or so for soil carbon. Most CSU contracts also require periodic audits by an independent 3rd party to increase credibility. The plan should set out how the monitoring, verification, and reporting will be done, who will do it, and with what frequency.

$ Additionality B This is a term you will encounter in the carbon credit literature that stems from the international debates. It basically means that CSU=s need to represent increases in the carbon pools that happened as a result of human activity rather than as the normal change in ecosystems over time. This is usually a non-issue in tree planting projects, where everything is the result of human action. Where it can become an issue is in the management of existing forests, where the forest can be expected to change with or without management. If the base case adequately illustrates the carbon changes that would have occurred in the absence of project activity, that should take care of the issue.

$ Leakage B This is another term stemming from the international debates. It refers to the fact that some projects may cause changes on non-project land that will either increase or decrease the carbon on that non-project land. The classic illustration is the forest protection project that forces people out of the forest to stop timber harvest. Unless the need for timber is addressed in some way, the people simply move elsewhere and cut other forests. From the global point of view, the project accomplished little or nothing in reducing carbon emissions or increasing total forest carbon pools. This is an issue where we need to consider cause and effect. Will the project cause changes elsewhere? Chances are that leakage will seldom occur in most forestry projects. The fact that a farmer plants trees is unlikely to cause a forest elsewhere to be removed. It will probably be important, however, for any CSU plan to consider the possibility of leakage and, where it exists, explain how it will be addressed. If it cannot be addressed, the amount of carbon increase created in the project needs to be reduced by the amount of associated leakage, and only the net gain would qualify for CSU status.

Opportunities and Challenges for Forestry Projects

In addition to standard tree planting projects, there may be several other kinds of opportunities that will produce significant carbon sequestration benefits.

Riparian forest buffers offer significant opportunities, and the addition of carbon credit payments may encourage landowners to widen buffers, straighten outside boundaries, and convert them into fairly large riparian forests. Where that is done, the fact that these are on the most productive area in the ecosystem, with good moisture and nutrient levels, is an indication that growth rates and carbon accumulation will be excellent.

Fast-growing wood crops for energy production offer a major carbon opportunity, where the wood will reduce coal or petroleum combustion. Those crops produce a large carbon increase on an area basis, and even small areas may produce significant carbon credits. Again, whether or not to include soil carbon will depend on the initial condition of the soil when the project is initiated.

Buyers of CSU's are going to demand a degree of legal certainty that the practices were installed and maintained over a long period, and that the carbon stored has been accurately documented. Particularly in those CSU's that are entered into a private trading market, the need for maintaining a credible basis beneath the CSU is important. That may mean long-term contracts, conservation easements, or other binding instruments that landowners may not readily accept. Thirty to fifty years is an eyeblink in the global cycle, but much longer than the average tenure on farm and forest land, so these contracts must become a part of the land title, and follow it through many transactions. Permanent easements are likely to meet landowner resistance, as well as raise legitimate questions as to whether or not they can be considered valid.

The main wild card at this stage, of course, is the political dimension. Will the U.S. take a leadership role, and will that role include policies that provide incentives for landowners to establish forestry practices as carbon sinks? Will it establish a cap and trade system to spur the development of market incentives? I believe the answer to both questions is yes. It will be messy, but almost certain to happen in this decade.

The bottom line is that carbon credits are likely to become a potential for additional incentives in establishing good forestry practices in the future. The amounts of additional financial support are likely to be modest, and there will be additional costs involved, so don't look to carbon payments to become the driving force for forest management. What they will be is one more tool in the toolbox of the forester who can understand, promote, and support their appropriate inclusion in landowner activities.