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Carbon Sequestration: What's the Best Approach?¹

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Abstract

While there are many details and negotiating points remaining, it appears likely that the future may hold the opportunity for landowners to realize financial value from practices that increase the stable carbon content in agricultural, grassland, and forest soils, as well as carbon from agricultural and forest crops and/or residues that are converted into long-lived, stable products or burned as a substitute for fossil energy. In contrast to past conservation incentives, there is the possibility that some of these incentives could come from a private market value for sequestered carbon, as well as public cost-sharing or other incentives driven by National policies aimed at mitigating climate change. While the negotiations are under way, and the details still unclear, it is useful to consider how such opportunities may affect the Nation's soil and water conservation programs, present new scientific, technical, or institutional challenges, and produce revenue that can be re-invested in land and water resources.

In the midst of these discussions, it is useful for conservationists and landowners alike to take time to think through some of the lessons learned from years of effort to assist farmers and ranchers in applying and maintaining conservation practices on their land. What have we learned that might help in managing carbon credits in the future? What is the best way to approach this new opportunity?

This paper will urge a combined public-private approach that takes advantage of the inherent advantages of each. Attracting major private funding can only occur in light of government action – specifically, national regulation of greenhouse gas emissions. Making agriculture and forestry economically competitive for private landowners to produce carbon credits may mean technical and institutional assistance programs that will probably need public support, both in terms of policy and budget. Public investment to support private carbon credit trading programs will almost certainly, however, gain the Nation a level of greenhouse gas emission reductions and offsets at a public cost significantly

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below an all-public effort.

Introduction

Discussions about the role of agriculture and forestry in addressing climate change concerns have been under way for a decade now, but the situation could change significantly in the next few months. The next Conference of the Parties (COP) to the U.N. Framework Convention on Climate Change meets in November, 2000, in The Hague, Netherlands, to make decisions about the role of carbon sinks under the Kyoto Protocol. Those decisions will be extremely important in whether or not and, if so, how, the countries will be able to count carbon sinks in agricultural soils and forests toward their national commitments under the Protocol. For the purposes of this conference, the importance is clear: For carbon sinks that can be included, the United States will almost certainly turn to the private sector – farmers, ranchers, foresters and industry – to help meet its Kyoto commitments. That should spur the development of private carbon markets, as well as the possibility of public incentive programs for landowners.

Although the outcome of those negotiations (and the U.S. response) is by no means assured at this point, this paper will assume that positive decisions are made, and that a market for carbon credits begins to emerge. The questions then revolve around how projects that produce carbon credits can be handled by landowners and the private businesses and public agencies that deal with them.

There are many technical questions involved. The recent “Special Report on Land Use, Land-use Change and Forestry” produced by the Intergovernmental Panel on Climate Change discussed many of those. It revealed how the manner in which different activities are defined, and the ways in which the accounting systems are structured, are of enormous importance in determining whether or not carbon sinks can be accurately and fairly measured. Again, we don't know how those will come out, but we will assume that the COP will encourage feasible scientific approaches.

There are political questions, as well. The U.S. Senate has not ratified the Kyoto Protocol, and until the Nation is committed to reducing its carbon emissions, it is hard to see major national policy emerging. And new policy is essential to a future program. There will be no private carbon credit market of any consequence if there is no need for anyone to purchase credits. That need will arise if the United States requires certain carbon-emitting industries to reduce emissions, and approves a carbon trading system as one mechanism for compliance. At that point, the regulated industry faces either a change in their production practices or, if it is cheaper, the purchase of offsite carbon sink credits. Those credits, in turn, must be recognized as legitimate by the U.S. government in order to be valid as mitigation. Thus, the emergence of a private market depends almost entirely on the development and direction of public policy at the federal level. Again, we are being optimistic that these events will eventually occur.

On one point, however, the following discussion is not optimistic. In many discussions around this issue, the future value of carbon credits (normally posed as the value of increasing and maintaining soil or forest carbon by one metric ton) has predicted fairly high prices. It is my guess that carbon credits, even under optimistic scenarios, will trade at fairly modest prices. The purchasers of carbon credits will pay prices slightly cheaper than what they might realize through industrial engineering changes, at that won't be a very high price per ton. At the other end of the bargain, landowners are not going to enter into long-term carbon management contracts without some economic incentive.

That suggests that a major challenge is to get as much of the money as possible from the purchaser to the producer. The “middle” costs for technical design, monitoring, verification, accounting, registration, etc., need to be done as efficiently as possible. With the unusual nature of carbon credits as a saleable commodity, that is not going to be easy, but that is where we must concentrate to find the “best” way.

The Carbon Cycle: Pools, Stocks, and Flows

The manner in which carbon moves between terrestrial ecosystems and the atmosphere is fairly well

known and methods of measuring it are available. For most agricultural crops that are not producing forage for energy production, the only significant amount of carbon change occurs in the soil. Thus, changing the rate at which carbon flows into and out of the soil becomes the important factor.

At this point, some definitions might be helpful. A carbon *pool* refers to the total amount of carbon in a specific part of the ecosystem. We can refer to the soil carbon pool, the live wood pool in trees, underground wood in roots, or the dead litter pool on the forest floor. To measure all the carbon in an ecosystem, we identify and measure all of the separate pools. The system is divided into portions that can be measured separately with known techniques.

A carbon *stock* is also a quantity of carbon. We add 20 tons of animal manure per acre to a crop field, and it will raise the soil carbon pool by some amount after it has been incorporated into the soil.

A carbon *flow* is a measure of the rate of change. Here, we have to have an amount, an area, and a time measure. We can say that soil carbon is being increased at the net rate of one ton per acre per year. That doesn't tell us anything about the total amount of carbon in the soil pool; only that it is being increased by that rate. Carbon *sequestration* refers to the process of removing gaseous carbon from the air and fixing it in soil or woody material. It, too, is most often measured in terms of the rate at which the net flow of carbon is being altered. Since the process can move in either direction, we refer to a system that is *emitting* carbon to the atmosphere as a *source* of additional atmospheric carbon and a system that is *sequestering* carbon from the atmosphere as a carbon *sink*.

One can visualize an area of soil as a container, with flows of carbon coming in largely through plant roots and residues or other imports such as animal waste, and flows of carbon moving out as organisms decompose organic matter and expel carbon dioxide gas, as fire burns vegetation, or as wind or water erosion carries soluble carbon or soil containing organic matter away from the site. The carbon level in the soil pool can increase or decrease, depending on the flow balance. When more is coming in than moving out, the level in the pool rises. When more is going out than coming in, the pool shrinks. It works just like a water reservoir. The same molecules of water do not necessarily remain in the pool, as they continuously cycle in and out. That doesn't matter. What matters is the pool level itself, as affected by the net effect of the various flows.

With woody crops, the soil pool will be affected by plant roots, litter fall, and decomposition processes much like a conversion to grass, but the wood also represents a long-term carbon storage, so it is possible to count both the soil changes and the woody growth as a means of estimating carbon credits. In choosing the most effective carbon project for a given area of land, this can mean a significant difference at times.

With some agricultural and woody crops, the idea is not just to store carbon, but to use it for energy production as a way of reducing the burning of fossil fuels. In those projects, we may be able to count not only the net changes in the carbon pools on the land, but also the offset that occurs when the crops are utilized for energy.

It is also useful to recognize that, under a given set of environmental conditions, most carbon pools have upper limits. If we try to force more carbon into the pool than it would normally hold, we need to do something to change those environmental conditions. If a soil is properly irrigated, for example, it will grow more crops and store more soil carbon. Discontinue the irrigation, however, and the soil carbon pool will drop back to the lower level, as the net rate of inflow and outflow re-adjust.

Although there are varying degrees of difficulty involved, and the costs are proportional to the amount of precision and accuracy demanded, soil and plant scientists have developed ways of measuring these carbon flows and pools that can be used in project planning, monitoring, and verification. With the soil pool, for example, soil samples sent for laboratory analysis to determine the amount of total carbon in the soil. Technical determinations are needed to decide sampling location and density, how deep to sample, etc. There are obvious tradeoffs between accuracy and costs. The more samples, and the deeper the soil is sampled, the higher the cost. Those tradeoffs can be accurately described by soil scientists.

With woody crops, the standard types of forest measurements will usually work well to identify the amount of woody carbon involved. One problem that is being addressed is the need to estimate growth rates and wood production of tree species that have not had much research because they are not commercially valuable. This may prove some challenges in work with riparian forest buffers, for example, but we believe the technical guidance for these species can be fairly rapidly developed.

Often, estimates of carbon flows are derived from periodic measurements of carbon pools. By taking measurements 10 years apart and determining the total change in the carbon pool, then dividing that by 10, we produce a rough estimate of the average annual carbon flow into or out of that particular pool.

Methods of Increasing Carbon Pools

Agricultural soils that have been cleared from grass or trees and plowed lose organic carbon as a result of that cultivation. The loss in the soil carbon pool is due primarily to three factors: the reduction of plant roots and residue return as grass and trees give way to crops, the increase of biological decomposition as soil aeration is increased by cultivation and soil temperatures rise due to loss of shade, and any increase in soil erosion that carries carbon-rich soil materials from the site. The carbon decrease is often most rapid in the first few decades of cultivation, then levels off as a rough equilibrium is achieved in the system.

Where we have this situation, the means of increasing the soil carbon pool are fairly straight-forward: 1) increase organic matter return to the soil through planting grass or trees, improving residue utilization, fertilizing, improving water management, adding animal manures, etc.; 2) decrease decomposition by reducing tillage and leaving more plant litter on the surface to shade and cool the soil; and, 3) reduce soil erosion. Since these practices are all compatible with the soil and water conservation mission, and with most local conservation priorities, it is possible to say that improving soil and water management can, in almost every case, have the added value of increasing soil carbon. This carbon increase becomes an added bonus to the soil and water conservation achieved, at little or no additional effort by the landowner.

Carbon Credits as a Commodity

Part of the challenge in developing an effective carbon credit market for landowners lies in the unusual nature of carbon credits as a commodity. Unlike a bushel of corn or a pound of beef, the carbon changes counted for credit do not move off the land. The buyer, instead of purchasing a delivered commodity, is buying the environmental service that the commodity produces by staying where it was produced. The buyer gets a certificate saying that the carbon was added to a measured carbon pool, and that the pool is being managed so that the increase remains in place for a length of time. That's a little like me selling you a horse, but keeping the horse at my place while assuring you that it is well fed and cared for.

It is not that this transaction can't be done; the point is that it takes some forms of assurance between the buyer and the seller that a straight commodity transaction does not need. It is that assurance that we will concentrate upon today. How can the buyer of carbon credits be adequately assured that those credits are valid? And how can that assurance be produced at a cost that does not strip so much of the buyer's money out of the transaction that the landowner opts out of the deal?

There is also a difference between carbon credits and the conservation practices that have been cost-shared in the U.S. for many years. In conservation cost-sharing, the payment was made on the basis of whether or not the practice was properly planned, installed, and maintained for the agreed-upon term. That same will hold true for carbon credits, but with an additional factor: In carbon credits, the practice's performance will be measured. The change in the carbon pool from before the practice was installed until the end of the contract period will be the basis for the carbon credit payment. So, it won't be enough to just install the practice; it will also be necessary to produce the product.

Addressing Risk in Carbon Credit Transactions

One way to think about carbon credit transactions is in terms of risk. What kinds of risk does the buyer face when a credit is purchased, and how can those risks be managed to be acceptable to the buyer? *Performance risk* is the risk that the landowner does not do what the contract calls for. The conservation practices are not carried out, or they are carried out wrong. The trees don't get planted, or they die and don't get replaced. Over many years in the conservation program, these problems have been solved. Most landowners are honest and when they make a deal, they perform. But that doesn't rule out the fact that they can honestly do something that's technically wrong. Here, conservation districts and NRCS have often been the backstop. Conservation planning and technical assistance have helped landowners fit the right practice to the soil, install it correctly, and maintain it well. In forestry, State forestry agencies have done the same. We can, therefore, say that most of the performance risk can be addressed through the same approaches we have developed over more than a half-Century in the U.S.

That does not address the issue of cost. Who pays for these organizations and agencies to assist these landowners? We will return to that later.

Maintenance risk. Once a practice for carbon sequestration is in place, it will need to be properly maintained. Conservation tillage, for example, is one of the ways in which soil carbon can be increased. But a few years of conservation tillage, followed by a year of plowing and cultivation, may set the system back to where it started, as the soil carbon buildup from the conservation tillage is lost during the plow year. If this occurs, serious errors in estimating carbon credits arise. Let's assume, for example, that we have estimated that conservation tillage will increase the soil carbon pool by one ton per acre per year. Over a 10-year period, therefore, we would estimate an increase of 10 tons per acre, and the buyer may purchase certificates for 10 tons. If the actual situation, however, means that the farmer does conservation tillage most years, but clean-tills in the 4th, 7th, and 10th years, the measured difference in soil carbon over the decade may be negligible. The farmer may think, "I did it 7 out of 10 years, so I should have at least a 7-ton credit," but that may not be the case when the soil carbon changes are actually measured.

These risks are addressed by monitoring and verification during the term of the contract. If the practices do not perform as predicted in the plan, or required by the contract, some adjustments may be in order. Most contracts will have language about when and how such adjustments are made, but there is still the cost of adequate monitoring and verification that must be added to the total transaction costs.

Opt-Out Risk. The carbon credits have a value because they represent a ton of carbon held in the soil or wood for a period of time, thus delaying the return of that carbon to the atmosphere. The time involved is part of the contract, so it can be any length agreed upon. Whatever the term, however, the buyer wants assurance that the seller will not opt out during the contract. That could happen because the seller changes their mind, or dies, or sells the land to someone else. Generally, the contract itself will speak to how these changes can be made, but if there is no monitoring and verification process to alert the buyer to the fact that the situation has been altered, problems may emerge.

One of the tools used has been conservation easements that are officially filed with the title to the land. That assures that the carbon credit agreement runs for its full term irrespective of ownership change. When a landowner sells ground with an easement on it, whether that easement is for a power line or for a tree planting, the buyer assumes these contracts along with the land. But easements are not self-enforcing, and often they can be overlooked. Conservation easements are often enforced by land trusts or other non-governmental organizations, but there are costs involved that the carbon credit purchaser needs to cover.

Disaster Risk. No matter how well every person performs under a carbon credit agreement, there are always disasters that can overwhelm the best efforts. Floods, fires, insect and disease epidemics, and similar things can set back or destroy the best land management system. The answer here, more than

likely, is some form of disaster insurance. Similar to crop insurance, it will probably be necessary to develop insurance for carbon credit projects. Insurance companies will need to evaluate the extent of these risks to price the policies, so may need the technical advice of land management professionals.

Political/ Technological Risk. There is one risk for which there seems little ability for prediction or protection. If a new election produces political leaders that cancel or change existing programs, eliminate funding, or otherwise drastically change the policy involved, a transaction could easily be “caught in the middle.” That has happened in the past, and could happen again. How to predict it is anyone’s guess.

Technology and economics could change as well. Biomass energy projects were given a boost, and long-term contracts and pricing were developed, on the prediction that fossil energy prices would rise. Instead, natural gas prices dropped, and many contracts became uneconomic. Most were bought out and cancelled. A similar thing could happen in carbon. If a segment of industry that had been buying carbon credits to meet reduction goals is suddenly presented with a technology breakthrough that lets them change their industrial process and get lower emissions and higher profits, they will adopt the new technology. That could have a dramatic effect on future carbon credit values, and might cause some buyers to revisit old contracts. Again, there’s probably no way to predict these events, so these become the kind of risks that must simply be assumed by the buyer and factored into the original price they are willing to pay.

Managing Transaction Costs

The carbon credit market is going to mean more work to plan, install, monitor, and verify carbon projects. Buyers will want assurance from a credible third party that agreed-upon activities are producing the carbon sinks that were contracted. They need to know that the credits are recognized as legitimate by the federal government. Third party auditors, either private contractors or public agencies, will be needed. The critical factor is credibility, in assuring the buyer that claims are accurate, and having the trust of the seller when the third party comes onto the land to do auditing work.

In many ways, this sounds like the way the conservation cost-sharing programs have worked for years. Third-party technical assistance from NRCS or State Forestry Agencies has been involved, with the costs largely borne by the program. Contracts based on plans became the basis for long-term agreements in the Conservation Reserve. The precedents and the levels of trust are in place for a shift to carbon credits.

It is my view, however, that carbon credits will best be integrated into this program if they become an additional conservation objective. A set of practices that adds carbon to the soil is almost certain to reduce soil erosion, protect water quality and, in many cases, add to wildlife habitat and other values. The plan for managing a piece of land does not need to be a carbon management plan; it should be a total land management plan incorporating all of the aspects needed to achieve a healthy, sustainable system. The addition of a carbon sink element will make a few additional measurements and estimates necessary, but it shouldn’t change the basic planning task all that greatly.

Having the Conservation District, NRCS, or State Forestry assist a landowner with a plan should, therefore, represent only a modest increase in the training of field personnel and the incorporation of carbon elements in the plan. In any situation I can imagine, carbon credit buyers would recognize the technical quality of those plans. Hopefully, the federal and state appropriations that support those institutions will support budgets adequately to fund this additional effort.

Monitoring and verification present a different challenge. These activities provide buyer assurance and cover the risks of a private financial transaction. It is much harder to make the case for public funding of these activities. Here, the buyer needs to specify the levels of monitoring and verification that they require, and pay for what they want. They may use local Conservation District staff to do an annual field review to assure that the agreed-upon practices are in place, and they may hire a private consultant to do a thorough verification and re-measurement every 10 years or so. There are non-governmental organizations that seem

ready to assume these roles if a private market emerges. In the final analysis, these “assurance” activities are up to the buyer. Whatever they determine is needed will have a cost. The more often, and the more intensive the activity, the higher the cost. The buyer can make those tradeoff decisions and the market can adjust accordingly. That's one virtue of a market.

Brokering Deals

In all likelihood, there will need to be a “middle man” between the landowner and the ultimate purchaser of carbon credits. If a trading market for carbon credits develops, it seems logical that most buyers will purchase fairly large blocks of credit to meet their needs. At the same time, most landowner opportunities present small blocks. Either the acreage involved is modest, or the amounts of carbon sequestration are fairly small. In this case, someone needs to assemble many landowner contracts into one portfolio, which can become a feasible trading block.

That is a function that seems possible for a variety of local agencies, ranging from conservation districts and land trusts to regional efforts such as RC&D Areas. In my view, the key criteria here will be how well local landowners trust the organization. These are long-term contracts, with fairly rigorous requirements for monitoring and verification. Landowners are going to study them carefully, and only go into those that look like a good deal. If they don't understand or trust the organization proposing this idea, they will likely reject it on those grounds alone.

In my view, these are functions that the federal agencies need to avoid assuming, particularly agencies like NRCS and Forest Service who are developing technical standards and assistance. Just as they do not inject themselves into a landowner's commodity sales or business decisions, it seems they must avoid these program administration roles where the private market is involved.

Conclusion

The conclusion that emerges, of course, is that there is no one “best approach.” There are many, depending on how technology, policy, and the market work together in the future. The general approach, however, seems to fall along some well-established lines.

- The existing conservation programs in the United States provide patterns and models for a carbon credit market system.
- Technical credibility, standards, and protocols can come from USDA programs and agencies.
- A major factor will be the trust that landowners place in the system. If buyers send a bevy of lawyers out to talk to landowners, the prospect for carbon contracts is pretty dim. If the local conservationist or forester says “Let's integrate this carbon idea into your total program,” the prospects brighten.
- Existing public agencies and programs can incorporate carbon management practices and calculations into conservation and forestry plans, provided that the carbon is considered as part of a total resource management plan being developed by a landowner.
- Those public agencies require adequate funding for their activities, and recent years have not been kind. We will have to reverse this trend, or their ability will be limited.
- The additional activities designed to assure a buyer that carbon credits are being supported by actual carbon stock changes on the land will most likely need to be part of the private financing of the carbon credits. This will allow buyers, sellers, and their contractors to adjust the amount and cost of these activities within a market context, which is the most efficient way to reach the proper balance.

The bottom line is that the best approach seems to be a merging of public and private programs into a coherent carbon credit effort. Public agencies can work with landowners, explain options, develop technical estimates, and prepare resource management plans. Landowners can work either with local agencies or contractors to install planned practices. Tools such as conservation easements can provide

long-term assurance, and they can be enforced by either public or private institutions. Third-party monitoring and verification (periodic re-measurements and program audits) can be provided by either private contractors or local organizations. Local program management can be done by institutions such as conservation districts, Resource Conservation and Development Areas, or others. The “best approach” is the one that best utilizes the competence and mission of existing institutions and arrangements, instills trust in landowners, provides technical credibility for buyers and policymakers, and minimizes unnecessary costs. How will it look in the end? Only time will tell.