Creating a Market for Carbon Emissions: Opportunities for U.S. Farmers

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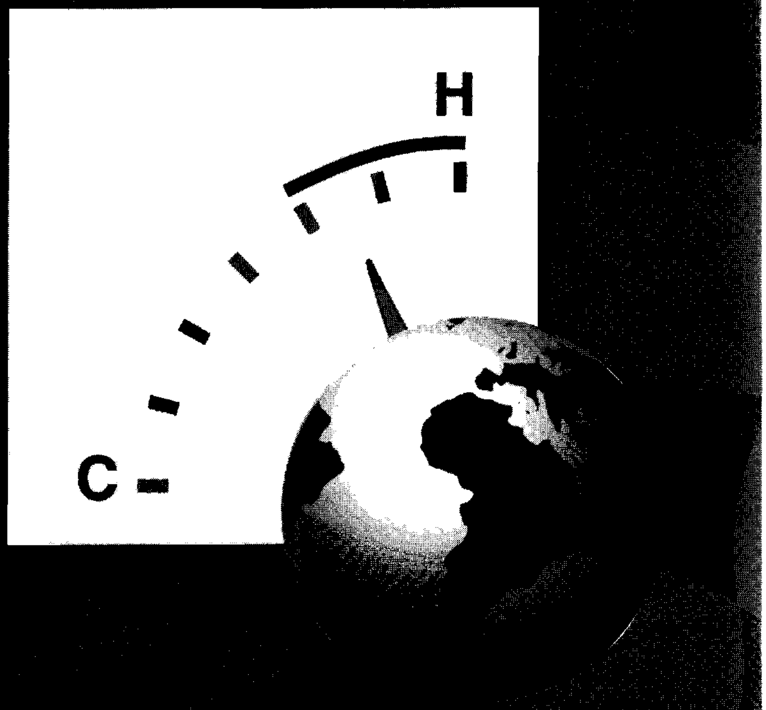

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Opportunities for U.S. Farmers

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Reducing greenhouse gases has become a major international objective. While the international community debates the Kyoto Protocol, a number of countries have already announced that they will reduce greenhouse gases. The November 1998 Buenos Aires meeting on the Kyoto Protocol helped advance the trading approach as one means for reducing greenhouse gases. Since carbon dioxide is a major greenhouse gas, creating a market for carbon emissions is under consideration. Should such a market evolve, U.S. farmers could be big winners.

Even though some in the scientific community do not believe carbon emissions contribute to global warming, everyone agrees carbon emissions are increasing rapidly. Since it is possible that carbon emissions increase the likelihood of significant climate change, a market should be at the top of the list of policy options to cost-effectively manage emissions. In effect, a carbon trading system may be cheap insurance against potentially large societal problems.

Sulfur emissions trading paves the way

Emission allowance trading is a straightforward concept that is already operational on a national scale. The U.S. sulfur dioxide emissions market provides a good example. Congress placed an overall restriction on power plant emissions nationwide, effectively allowing power plants to comply by either (1) investing in cleaner fuels or pollution control technologies, or (2) buying extra emissions rights from another power plant that made extraordinary emission cuts. Buying excess rights from a more efficient power plant allows the older and less efficient plant to meet its obligations at lower cost to consumers. In short, trading emissions permits allows industry to meet emissions goals in a least-cost way.

Title IV of the 1990 Clean Air Act Amendments cleared the way for trading sulfur emissions among 110 power plants. During the debate on this legislation, experts estimated that these emissions rights would command a very high premium. Some initial estimates ran as high as $1,500 per ton. Hahn and May report several pre-1992 estimates of forecasted per ton prices for sulfur emission allowances, ranging from $309 (Resource Data International) to $981 (United Mine Workers). In 1998, the Chicago Board of Trade (CBOT) auctioned off a large number of allowances at an average price of $115. Carlson et al. argue that many factors, in addition to trading of emissions rights, created low prices of sulfur emission allowances: improved technologies for burning low-sulfur coal, improved electrical generating efficiency, and lower fuel costs.

Evaluations of the sulfur emissions trading program suggest that it has been a success. By 1998 actual sulfur emissions averaged 30 percent below the allowable level. There has also been steady growth in the interutility trading of allowances, from 700,000 tons in 1995 to 2.8 million in 1997. The full effects of the trading have not been realized, as the market is still adjusting to this new innovation. Carlson et al. estimate that this innovation will save $784 million annually beginning in the year 2000. Further, they estimate the net cost of the cap and trade system is 43 percent of the estimated costs under a command and control system.

The potential of carbon trades for U.S. agriculture

If a market evolves for greenhouse gas emissions, those who are now contributing to carbon emissions may be willing to pay others to sequester carbon (remove it from the atmosphere) as a permanent offset to emissions, or as a means of buying time to invest in technologies needed to reduce emissions. When sequestering carbon costs less than reducing carbon emissions, the carbon market would provide a more efficient solution. Firms would likely use a combination of reductions in emissions and offsets with carbon trades.

A market would also motivate technological improvements to both sequester carbon and reduce emissions. For example, if prices signal farmers to sequester additional carbon, the market would respond with new technologies. Price incentives would encourage bio-engineering plants that more efficiently and effectively sequester carbon. Most soil organic carbon is in the upper meter of soil. Could plants with deeper roots sequester more carbon to deeper levels?

The agricultural sector provides a number of effective alternatives for sequestering carbon. Forests and cropland offer the most promise. A large number of solutions will be needed to offset the increase in carbon emissions, and a market offers the best way to orchestrate them. Agronomists (Lal et al.) estimate the overall potential for carbon sequestration using U.S. cropland to be 120–270 million metric tons of carbon per year (MMTC/yr). Around 100 MMTC/yr would come from increased use of Best Management Practices (BMPs). The remainder comes largely from acreage conversion and bio-fuels. Worldwide carbon emissions are growing by about 3,000 MMTC/yr. The U.S. emissions target under the Kyoto Protocol is roughly 600 MMTC/yr below the level projected by 2010 under current trends. Thus, U.S. cropland could be used to reduce the projected annual world increase in carbon by about 7 percent, or about 30 percent of the U.S. share under the Kyoto Protocol.

Most soils have a capacity for sequestering additional carbon. Tilling the soil, however, releases carbon into the atmosphere. Lal et al. report that Corn Belt soils likely have about 61 percent of the carbon that was present in 1907. Minimum and no-till systems can sequester more carbon. In 1997, about 37 percent of the arable land in the United States was under conservation tillage. Lal et al. estimate that using more BMPs (primarily reduced- and minimum-tillage systems) could sequester 5000 MMTC in cropland soils over the next fifty years. That converts to 100 MMTC/yr via wider use of BMPs, while other options offer the possibility of up to an additional 100 MMTC/yr.

Estimates of the value of carbon emissions allowances range from $15 per ton (Council of Economic Advisers) to $348 per ton (Energy Information Administration). Based on early market signals, Environmental Financial Products is using market values between $20 and $30 per ton of carbon. Without a market to trade carbon emissions, the lower prices (and the lower mitigation cost to society) will not be possible.

Using the low-end estimates of $20 to $30 per ton, paying farmers to sequester 200 MMTC/yr could add $4 to $6 billion of gross income to the farm economy—and possibly up to 10 percent of typical net farm income. The market for carbon could be a major supplement to the Conservation Reserve Program, and, if managed properly, opportunities in the international carbon market could soften farm income cycles by taking land out of crop production and putting it into conservation uses when relative prices favor carbon sequestering over food production.

BMPs increase the agronomic productivity of U.S. cropland, reduce soil erosion, and improve water quality and wildlife habitat. Thus, BMPs help both the global and local environments. The local benefits are consistent with the goals of the much discussed "green support payments" (Lynch and Smith). However, rather than using taxpayer dollars, this green support payment could evolve in a marketplace with more diligent monitoring and enforcement. Paying farmers to sequester carbon will heighten the stakes for verification that farmers make changes in their farming practices or that they are actually sequestering more carbon.

Lal et al. estimate the long-term nutrient value of an additional ton of soil organic carbon at $200. A ton of soil organic carbon can be added in four to five years. In four to five years the value of some of the country's most productive farmland could increase 10 to 15 percent. In summary, a carbon market could increase both income and net worth in the farming community by 10 percent or more.

Leading scientists expect that climate change brought about by increased greenhouse gases may bring more extreme droughts and floods. Thus, American farmers have an opportunity not only to sell a new "crop" in the international environmental service market but also to help solve, at least in a marginal way, long-term weather problems that affect farming.

Implementing a carbon emissions allowance trading program

A number of factors must be considered when designing a market for carbon emissions. In contrast to the sulfur market, carbon emission sources are less concentrated. In addition, sulfur can be reduced only by cutting emissions. A carbon market, on the other hand, could work through both outright reductions and sequestration. Considerable care must be taken to assure that incentives do not encourage farmers or others to change the baseline used to reward additional carbon sequestered. For example, in the short run a farmer or forester could release more carbon via changed practices so that they are ready to gain more when trading begins.

Low-cost systems to measure carbon in the soils are becoming more feasible. As the market develops, new technologies should emerge to make this task economically feasible. Lal et al. have provided estimates of the existing soil organic carbon for the lower forty-eight states, but improved estimates are needed. The existing base of carbon needs to be mapped. Only additional tons of carbon that are added to the baseline should be eligible for the market.

While many will get bogged down worrying about monitoring how much additional carbon is sequestered on an individual field, there are more effective means for monitoring and verification. Consider the opportunity for farmer cooperatives, grain merchandizers, biotech firms, and almost any agribusiness. Any of these firms could become a wholesaler for carbon sequestering. Estimates of the amount of carbon actually in the soil on an individual parcel may be flawed. However, the error likely has typical statistical properties, and conventional statistics apply—estimating many individual parcels and aggregating them into one measurement will improve the estimate considerably. The agribusiness firm would be responsible for monitoring the individual farmers, possibly with some advisory role from USDA on adoption of BMPs. Under this system farmers could be rewarded for adopting BMPs, and the agribusiness firm could be rewarded based on estimates of actual carbon sequestered.

Sandor, a student of the history of markets, has been heavily involved in inventing a number of new markets. He postulates a simple, seven-stage process for market development:

1. A structural economic change that creates a demand for new services;
2. The creation of uniform standards for a commodity or security;

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A technician prepares soil samples for their subsequent analyses for various soil carbon fractions. This will help tell scientists how much carbon plants have pulled from atmospheric CO_2 and stored in soil organic matter.

3. The development of a legal instrument which provides evidence of ownership;
4. The development of informal spot markets (for immediate delivery) and forward markets (nonstandardized agreements for future delivery) in commodities and securities where "receipts" of ownership are traded;
5. The emergence of securities and commodities exchanges;
6. The creation of organized futures markets (standardized contracts for future delivery on organized exchanges) and options markets (rights but not guarantees for future delivery) in commodities and securities; and
7. The proliferation of over-the-counter markets (p. 2).

Based on his experience, Sandor develops recommendations for implementing an international pilot program for carbon emissions trading. An international pilot is in keeping with the Kyoto Protocol which, during the first phase, puts the burden on developed economies. With trading, those in developed countries would also have the option of involving developing countries by funding low-cost emission reduction projects and by helping developing countries finance their efforts to prevent destruction of existing forests.

An effective carbon emissions market must have a clearly defined tradable commodity for greenhouse gas emissions—the standard measure to be traded must be agreed. An oversight body is needed, along with emissions baselines and clearly specified allocation and monitoring procedures. Once these standards are in place, existing exchanges and trading systems can be used to facilitate trades. Widely accepted standards will increase the credibility of the trades and help standardize the legal mechanics more quickly. All of these steps will lower the transaction costs in the new market.

With standardization and use of existing exchanges and trading systems, a carbon emissions market is very feasible. If we can trade corn on the Chicago Board of Trade, we can trade carbon. A system of quotes, hedging, and options will evolve. The market for carbon trades is, in fact, already evolving (Sandor). Niagara Mohawk (an electric power company in New York) and Arizona Public Service completed a swap of carbon offsets for sulfur dioxide emission allowances in 1996. Environmental Financial Products purchased rainforest protection carbon offsets from the Republic of Costa Rica in 1997. A subsequent 1.1 million acre program also includes assurance from the Costa Rican government that the area will be placed in a national preserve. In 1998, the Japan-based Sumitomo began converting coal-fired electric power plants in Russia to natural gas to earn carbon offsets.

The road to price discovery is being built. A market for carbon reduction services is now emerging. Carbon markets are being designed in the United Kingdom on the International Petroleum Exchange and in Australia at the Sydney Futures Exchange. Major companies such as United Technologies, British Petroleum, and Royal Dutch Shell have also committed to large and early reductions in their own greenhouse gas emissions. Therefore, regardless of whether the United States approves the treaty, firms in other countries may soon be willing to pay American farmers to sequester carbon. U.S. action to limit net carbon emissions would help make the benefits and incentives to U.S. agriculture even greater.

Carbon trading is feasible. The prospects of a market will increase this feasibility as new investments are made in technologies and research needed to monitor and standardize carbon measurement. Active trading of carbon could prove an inexpensive insurance policy against the unknown problems that may emerge because of the rapid increase in global carbon emissions. An effective and efficient market-based solution will become even more important as governments around the world tighten restrictions on carbon emissions.

U.S. farmers are well-positioned to help in sequestering more carbon. While helping to clean up the air, the benefits to the sector could be substantial. Farm income and land values should both increase. Local soil, water, and wildlife should benefit. All the while, carbon trading could also make the sector more resilient to other forces that have persistently created cycles in farm income through a market-based Conservation Reserve Program. ◘

■ For more information

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Note: *JAE* is the *Journal of Agricultural Economics; JARE* is the *Journal of Agricultural and Resource Economics.*