by Peter J. Parks and Ian W. Hardie ■ In Short

Forest Carbon Sinks: Costs and Effects of Expanding the Conservation Reserve Program

The gathering of 120 nations in Berlin last year to discuss mitigating carbon dioxide emissions makes it clear that global warming is an international issue. Several participants in the Berlin meeting proposed to sequester atmospheric carbon by planting new forests, in addition to reducing carbon dioxide emissions. They believe growing trees is a feasible and cost-effective complement to the abatement of fossil fuel combustion. This view also has gained currency in the United States, where sequestering carbon in forests has become an element of U.S. climate policy (Clinton and Gore).

The Conservation Reserve Program (CRP) provides financial incentives to private landowners who remove highly erodible cropland from farm production and plant it to grasses or trees. By 1993, farmers enrolled in this program had planted forests on 2.5 million acres. Carbon stored in these tree plantations could offset roughly 0.05 percent of total annual U.S. carbon emissions. The potential exists to expand CRP tree planting to become an effective part of a national carbon sequestration program.

Costs of Storing Carbon

We have simulated the costs of expanding forests on CRP acreage and the resulting amount of carbon stored (1995). Our analysis *(a)* divided the U.S. into geographic regions, *(b)* determined the potential acreage available for forestation in each region, *(c)* transformed this acreage into tons of sequestered carbon, and *(d)* estimated the subsidies needed to get the potential land in each region converted into a carbon sink.

Figure 1 shows the regional distribution of 116.1 million acres of crop and pasture land potentially suited to grow trees. For comparison, 36 million acres were enrolled in CRP as of 1993. Figure 2 shows the total government payments required to encourage owners to plant trees on these 116.1 million acres under the assumption that all of the eligible acreage in each region will be forested. We relax this 100 percent participation assumption in the next section.

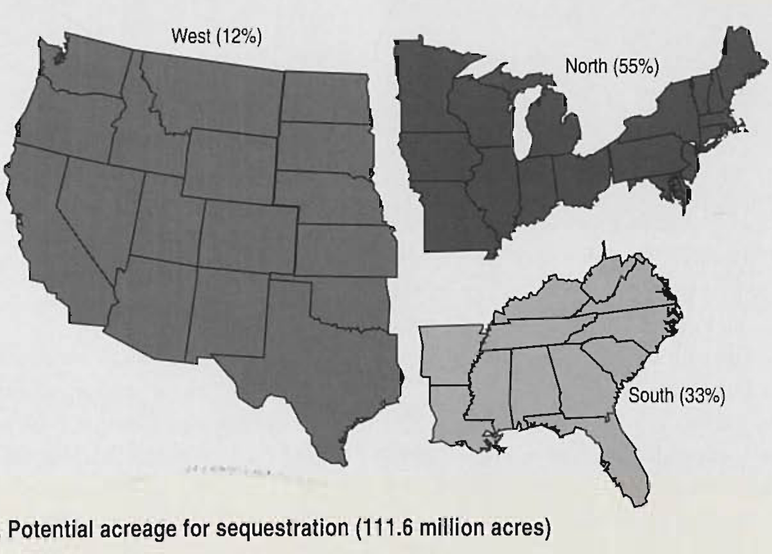

Figure 1. Potential acreage for sequestration (111.6 million acres)

If all of the eligible acres were planted to trees, roughly 150 million tons of carbon could be sequestered in an average year of growth. The average growth of these new forests would remove about 10 percent of annual U.S. carbon emissions each year. The total discounted cost to the government for this carbon storage would be $67.4 billion, about 1 percent of 1994 gross domestic product.

If all of the eligible acres were planted to trees, roughly 150 million tons of carbon could be sequestered in an average year of growth.

Figure 3 shows average and marginal costs for the same simulation. Costs rapidly increase when stored carbon exceeds 90–100 million tons per year. Marginal costs are $340 per ton to sequester 90 million tons per year, but rapidly increase to over $2,300 per ton to sequester 149 million tons per year. (For comparison with other studies—for example, Moulton and Richards, and Adams et al.—these costs may be converted to an annual equivalent basis by multiplying by 0.1233. See Parks and Hardie, table 1). The cost effectiveness of planting new forests to store carbon decreases rapidly once carbon storage exceeds the 90–100 million ton per year "threshold."

We can explain this threshold by examining the regional distribution of planted acreage. Spending $30 billion in the most cost-effective manner would

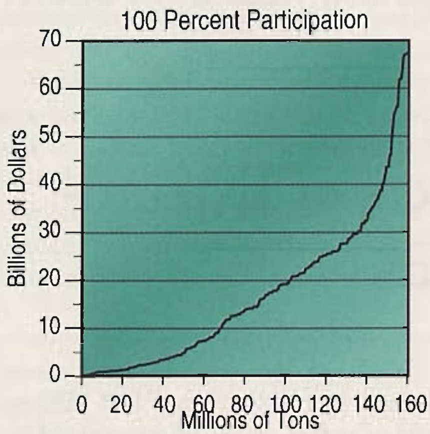

Figure 2. Total cost of carbon sequestration

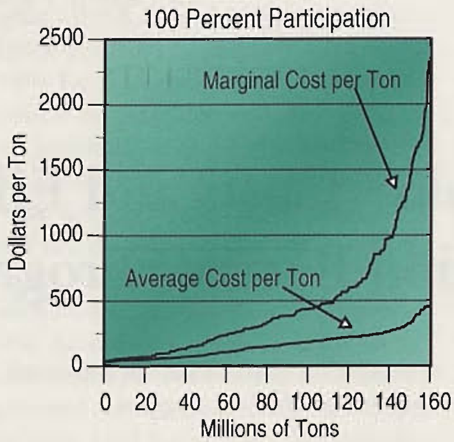

Figure 3. Average and marginal costs

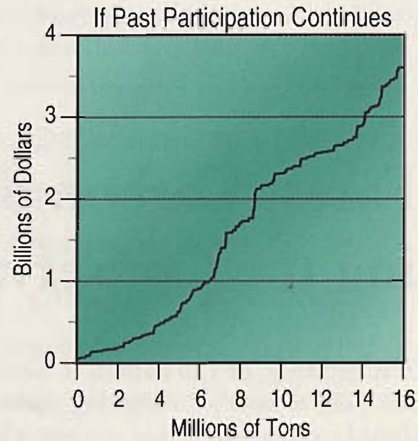

Figure 4. Total cost of carbon sequestration

place virtually all of the eligible acreage in the West and South into carbon production. Additional carbon storage, resulting from larger government expenditures, would be located almost entirely in the North. This additional storage would be accomplished by converting acreage in the Corn Belt, where farming has a considerable economic advantage over forestry. The rapid increase in marginal costs per ton reflects the difficulty that the government would face in convincing landowners in this region to forego farm production and to plant trees on their land.

Carbon could be stored most cost-effectively in the South. This region has some of the lowest net opportunity costs (agricultural land rent minus forest land rent) of converting land from farm to carbon production in the United States (near $50 per ton of carbon sequestered). Carbon storage in this region is a major reason why the total and marginal cost curves remain relatively flat for total storage of up to 120 million tons. For example, with a $50 billion expenditure level, the South would account for nearly half of the total amount of stored carbon.

Cost schedules based on predicted CRP participation rates

A 100 percent rate of participation by landowners with eligible acreage has not been observed in the CRP, and is unlikely in a carbon sequestration program. Since incentives in our simulated program are comparable to those in the existing CRP tree-planting component, it seems reasonable to expect that owners of the newly identified eligible acreage will exhibit participation rates similar to owners who were eligible under the existing program.

Figure 4 shows dramatic reductions in both cost and sequestration when predicted participation rates replace the 100 percent participation assumption (compare figure 2 with figure 4). When average predicted rates of participation are used, the maximum quantity sequestered falls from 149 million tons per year to 14.67 million tons per year. Total discounted program costs fall from $67.4 billion to $3.6 billion. Instead of 10 percent, participation at average predicted rates would result in a program that would sequester up to 1 percent of total U.S. carbon emissions in an average growth year.

Conclusions

Planting new forests on farmland has the potential to abate carbon emissions in the United States. Enough farmland with appropriate physical characteristics exists to sequester up to 10 percent of U.S. carbon emissions in an average growth year. However, the costs of a forestation program to accomplish all of this abatement may be prohibitively high.

The cost effectiveness of a forestation program rapidly decreases after reaching threshold levels of carbon storage. Conversion of some of the potentially eligible farmland (in regions such as the Corn Belt) is uneconomic. Expanding the CRP in other regions (such as the South) appears to be a cost-effective means to store carbon.

Our estimates indicate that 1 percent of U.S. carbon emissions may be removed at participation rates experienced in the existing CRP. Farmer incentives to promote additional participation could significantly increase carbon storage. ■

Enough farmland with appropriate physical characteristics exists to sequester up to 10 percent of U.S. carbon emissions in an average growth year.

■ For more information

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