Cobenefits of Terrestrial Carbon Sequestration in the PCOR Partnership Region

Capturing and storing carbon in biomass and soils has gained widespread acceptance as a potential greenhouse gas mitigation strategy. The Plains CO_2 Reduction (PCOR) Partnership region is home to a variety of land-use options that present an opportunity for carbon sequestration. Many of the region's important and highly productive ecosystems have been altered by agricultural and commercial development. Terrestrial carbon sequestration on these diminished lands can be enhanced by implementing practices such as introducing cover crops on fallow land, the conversion from conventional tillage to conservation tillage, and the restoration of grasslands and seasonal wetlands. Landowners adopting these practices could generate a new source of income while at the same time revitalizing a suite of ecosystem functions that were either nonexistent or greatly reduced.

Recent work by the PCOR Partnership team indicates that landscape restoration in the extensive Prairie Pothole Region (PPR) of the northern Great Plains represents a major opportunity for terrestrial carbon sequestration.

What Are Ecological Goods and Services?

Ecosystem functions such as water quality control, nutrient cycling, soil stabilization, wildlife habitat, disturbance regulation, and atmospheric regulation create ecological goods and services that have both direct and indirect value to society. Examples of ecological services include biodiversity, carbon sequestration, water filtration, flood and storm buffering, and enhanced outdoor recreation opportunities, while food production or timber products would be ecological goods.[1] The creation of terrestrial carbon sequestration projects will enhance other ecological assets associated with the ecosystem, providing numerous cobenefits at no additional expense or effort.

Cobenefits of Carbon Sequestration Land Management

The range and magnitude of cobenefits derived from sequestration practices depend in part on the form of land restoration employed. The immediate cobenefits of sequestration activities are derived from the cessation of conventional agricultural practices: improved soil water retention and filtration causing a reduction in soil erosion and nutrient runoff. The combined effect of nutrient runoff and

sedimentation from agriculture are the primary cause for watershed impairment in the PCOR Partnership region.[2] The consequences of these impairments result in higher water filtration costs, decreased recreational opportunities, diminished fish and wildlife habitat, elevated health risks, and lower aesthetic values requiring greater expenditures by municipalities and households to mitigate these effects. The cobenefits derived from the protection of grasslands and wetlands of the PPR are of particular importance to migratory and resident wildlife species dependent on this ecosystem. The prairie potholes are essential breeding and migratory grounds for waterfowl, shorebirds, grassland songbirds, and other forms of wildlife. The PPR annually produces up to 70% of the ducks in North America.[3]

What It's Worth

Attempts to measure the cobenefits of terrestrial sequestration projects have demonstrated their substantial collective value. Nationwide, the reduction in soil erosion in response to farmers adopting conservation tillage is estimated to improve the benefits of swimming, fishing, boating, and other water-based recreation activities by US$175–US$242 million a year.[4] The development and maturation of forest stands provide unique wildlife habitat and outdoor recreation opportunities beyond soil management whose collective value is estimated to exceed that of carbon sequestration.[5] Grazing management practices of rangelands can enhance carbon sequestration while increasing forage availability and the animal-carrying capacity of the land, ultimately improving the profitably of the operation to the rancher.[6] One potential management practice is converting cropland to perennial grass by planting switchgrass

Benefits of Carbon Sequestration

Sequestering carbon is a win-win strategy for agriculture and the environment. The practices used to maximize carbon sequestration have numerous benefits:

- **Sequestration helps mitigate global climate change concerns by storing CO_2 in soils.**
- **Soil restorative measures can increase soil quality and biomass production.**
- **Sequestration projects can improve biodiversity.**
- **Conservation practices which sequester carbon simultaneously enhance water quality by helping to reduce runoff.**
- **Conservation practices enhance the wildlife and recreational values of the land.**

(*Panicum virgatum*), a grass species native to the prairies that is an ideal biomass crop because of its high yield, low nutrient intake, and positive conservation benefits.[7] Proper harvesting techniques of switchgrass can retain the desired reduction in soil and nutrient runoff and enhanced wildlife habitat benefits, while producing a salable crop that results in a net sequestration of carbon. With the expected growth in biofuel technologies, the PCOR Partnership region is expected to see farm incomes increase $310–$919 million annually from the sale of bio-crops, including switchgrass, poplar, and willow.[8]

Opportunities for the PCOR Partnership Region

Traditionally, landowners incurred the entire cost of adopting a conservation practice even though the benefits would be distributed across the region. Initial attempts to redistribute the benefits of conservation-oriented land management include federal programs aimed at soil conservation, such as the Conservation Reserve Program in the United States and the Permanent Cover Program in Canada. Recent state/private programs such as the U.S. Conservation Bank, Minnesota's Native Prairie Bank Program, and conservation efforts by nonprofits, such as Ducks Unlimited's land preservation program, provide financial compensation to landowners for placing their land under perpetual easement to keep native ecosystems intact. Carbon sequestration opportunities exist for both landowners and investors on agricultural lands, native prairie grasslands, wetlands, and properties planted in grasses facing expiring government contracts.

Marketing Cobenefits

Research continues on how markets for carbon, water quality, water temperature, biodiversity, and other eco-assets relate to each other. At present, the most established eco-asset market in North America is the U.S. Wetland Mitigation bank. The regionally operating banks allow landowners to receive credits for the creation or enhancement of wetlands on their land, which are then sold to a third party to mitigate the destruction or impairment of wetlands within the watershed. Another ecosystem market likely to develop in the near future is the water-quality, or nutrient credits, market. Water-quality trading provides industry and regulators with a low-cost approach to meeting, and often exceeding, total maximum daily load objectives, as required by the U.S. Environmental Protection Agency. In 2005, there were over 70 water quality trading initiatives in the United States, with six in the PCOR Partnership region.[9] A nutrient trading program inclusive of farmers in the Upper Mississippi River Basin, encompassing much of the PCOR Partnership region, is seen as a necessity for the reduction of the hypoxic dead zone in the north Gulf Coast of Mexico.[10]

What's Next?

As part of the PCOR Partnership Phase II Program, Ducks Unlimited Inc., the U.S. Geological Survey's Northern Prairie Wildlife Research Center, and North Dakota State University will be demonstrating optimal practices for sequestering CO_2 through the restoration of PPR wetlands and surrounding grasslands at a site in north central South Dakota. The project results are intended to serve as a model to promote and implement terrestrial sequestration across the PPR.[11]

The PCOR Partnership will continue to develop and refine the science for estimating carbon sequestration rates in prairie wetlands and grasslands and quantify the cobenefits of sequestration practices on agricultural lands. This science will support the development of protocols for terrestrial carbon trading that could be used in a market-based carbon emission reductions credit market.

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The Plains CO_2 Reduction (PCOR) Partnership is a group of public and private sector stakeholders working together to better understand the technical and economic feasibility of sequestering CO_2 emissions from stationary sources in the central interior of North America. The PCOR Partnership is managed by the Energy & Environmental Research Center (EERC) at the University of North Dakota and is one of seven regional partnerships under the U.S. Department of Energy's National Energy Technology Laboratory Regional Carbon Sequestration Partnership Initiative. To learn more, contact:

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