UNH Institute for the Study of Earth, Oceans, and Space

New Study Shows Reforestation of Agricultural Land Played an Important Role in Reducing Greenhouse Gases over Last Century

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DURHAM, N.H. -- The reforestation of former agricultural land over the last century has played an important role in reducing the accumulation of greenhouse gases in the atmosphere, according to scientists at Princeton University, the University of New Hampshire and the U.S. Forest Service.

The scientists, publishing in the Nov. 10 issue of Science, report that changes in land use have been critical in allowing North American forests to regrow and soak up large amounts of carbon dioxide.

"Changes in the way we manage our land have had a real impact on the global environment," says the paper's lead author, John Caspersen, research scientist in Princeton's department of ecology and evolutionary biology.

The finding makes it clear, however, that this benefit will not continue indefinitely, because the regrowth of forests will slow as they mature.

"There is independent evidence that U.S. ecosystems are a carbon sink, and that forests are a large part of that sink," says one of the study's co-authors, George Hurtt, research assistant professor in UNH's Institute for the Study of Earth, Oceans and Space. "Identification of the causes of the forest sink is important because different potential causes have different implications for the future."

"This study suggests that forest regrowth from prior land use, as opposed to climate change or fertilization, is the major explanation for the current forest sink," adds Caspersen.

Scientists have been trying for more than a decade to track the fate of carbon dioxide pumped into the atmosphere as a result of burning fossil fuels. Early studies showed that despite six billion tons of the gas emitted each year, only three or four billion tons accumulate in the atmosphere.

Landmark studies from Princeton and UNH showed that trees and other land plants, which absorb carbon dioxide during photosynthesis, were taking up a large part of the "missing" carbon. A Princeton-led group in 1998 reported that much of this absorption was happening in the United States and neighboring countries -- a phenomenon called the "North American carbon sink."

Still, it was not clear what was causing North America to absorb so much carbon. Some evidence suggested that carbon dioxide itself would stimulate plant growth, thus causing more carbon dioxide uptake. Increased nitrogen pollution and global warming also could stimulate plant growth. Studies published in recent years have estimated that these "enhancement" effects account for 25 percent to 75 percent of the forest carbon sink.

This new study puts that figure at only 2 percent, with the rest coming from the recovery of forests on land cleared for agriculture in the 1800s. In collaboration with the U.S. Forest Service, the researchers performed an analysis of inventory data in five states -- Minnesota, Michigan, Virginia, North Carolina and Florida -- comparing recent growth rates to historical growth rates. The analysis showed that forests have been growing at nearly the same rate for most of this century, ruling out major enhancement effects.

"Identifying the cause of the extra carbon uptake in forests allows us to better predict the future of the sink," says Caspersen. Understanding how the sink will evolve could be important in making plans to reduce greenhouse emissions.

Negotiators from around the world are due to meet in The Hague this month in a push to resolve details of the Kyoto Protocol, which seeks to limit the production of carbon dioxide and other greenhouse gasses. Among the chief issues, according to the United Nations, is deciding on "rules for obtaining credit for improving 'sinks' (by planting new trees to absorb carbon dioxide

from the atmosphere, for example, thus offsetting emissions)."

The result of this study is also important for scientists developing computer models of ecosystems and climate. Many of these models only take into account physiological processes, such as the supply of nutrients and carbon dioxide, whereas the dominant factor governing carbon uptake in North American forests is historical changes in land use.

"Competing hypothesis for the cause of the U.S. forest carbon sink have different implications for the future, but are difficult to test," says UNH's Hurtt. "This study is important because it brings an extensive ground-based data set to bear on deciphering the cause."

"It will be difficult to gain an accurate understanding of how our climate is changing without coming to terms with the effects of land use changes," concludes Caspersen.

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