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Carbon and Forest Ecosystem Management

by Stephen Kull

We have all been hearing about the element carbon and how we need to start managing ecosystems. Carbon is one of the basic building blocks of all life forms on this planet and around on the planet since its formation.

It is found in the atmosphere, biosphere and oceans of the world - amounts in each depend or exchanges between these pools. Researchers have studied the carbon cycle for decades, w unravel its mysteries, intricacies and human-induced changes.

In the atmosphere, carbon is found in gaseous form, mostly as carbon dioxide (CO2) w amounts of other gases such as methane (CH4). In the biosphere, carbon is sequestered atmosphere by vegetation through the process of photosynthesis, and stored in biomass. For four cubic metres of wood contain approximately one tonne of carbon. This biomass may be e stored by other living organisms, which eventually transfer the carbon to the atmospl biosphere. Biomass carbon may also move back to the atmosphere or into soil after forest become stored in wood products after they are harvested. Biomass carbon that survives suc eventually decays, returning some carbon to the atmosphere and some to soils.

Over time, most of the carbon in this decaying organic matter is released to the atmospl hundreds to thousands of years. Under the right conditions, and in combination with other ç and physical processes, a small amount of the buried organic matter will transform into coal, p and other fossil fuels over thousands to millions of years.

Ice-core research, which studies earth's climatic and atmospheric history, and other research e recent measured data have shown that atmospheric CO2 concentrations in this century are highest levels in the last 420,000 years—possibly in the last 20 million years. Scientists from ai world on the United Nations Intergovernmental Panel on Climate Change (IPCC) have exam research and determined the main sources of this increase of atmospheric carbon to be i human activities—mainly the burning of fossil fuels and deforestation. Carbon in the earth's atı contributes to climate change by acting with a number of other greenhouse gases to trap solar and raise global temperatures.

For Canada and for other countries around the globe, climate change is expected to significar the environment. Rapid ecological and habitat shifts, habitat and species losses, melting of pe and ice sheets, shoreline erosion due to rising sea levels, increased frequency of storms ar increased severity and frequency of forest fires, insect and disease outbreaks, and drougl possible because of climate change.

Although the primary focus for mitigating climate change is on reducing fossil fuel burninç resource management also plays a role. Foresters can, through forest and ecosystem man protect existing carbon stocks in forests and sequester additional carbon from the atmosphere.

also prepare and manage forests and ecosystems for the expected impacts of climate change.

A few strategies that foresters and others can use to sequester more carbon from the atmosp forest ecosystems include:

- Afforestation of previously forested agricultural lands and other non-forested lands,
- Using harvest techniques that reduce damage to residual trees and minimize soil disturbance,
- Rapid replanting following harvest,
- Increasing forest productivity,
- Increasing forest protection against fire, insects and disease outbreaks,
- Extending rotation lengths for stands producing lumber,
- More intensive forest management for pulpwood stands,
- Permanent retention of large old canopy trees in selectively cut forests,
- Intensively managing stands on poor soils through soil preparation, weed control, and fertilization,
- Leaving logging slash on sites,
- Thinning to increase vigor and protect against insect pests and disease,
- Switching from clearcut logging to shelterwood or selection logging,
- Giving preference to the regeneration of trees used in long-lived wood products
- Replanting forest lands covered by species with low carbon sequestration abilities with spe sequester higher amounts of carbon,
- Increasing the protection and use of natural regeneration.

Foresters can help mitigate impacts of climate change while sequestering additional car strategies such as:

- Planting species adapted to conditions predicted under climate change,
- Planting drought-resistant (deep-rooting) species in drought-prone habitats,
- Planting species that are more efficient at carbon sequestration,
- Establishing plantations that help species migrate with climate shifts,

- Establishing gene-bank plantations to assess genetic variations and ability to adapt to climate
- Maintaining genetic and biological diversity,
- Using climate-based seed zones.

Of course, these strategies must be weighed against sustainable forest management practi management objectives, impacts on other forest values, and financial costs versus benefits.

Tools are becoming available to enable forest managers to assess impacts of management str carbon stocks and carbon-stock changes on their lands. Natural Resources Canada, Canadi Service's Carbon Account Team, in partnership with the Canadian Model Forest Network, has the operational-scale Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3). complex but user-friendly tool, users apply their own stand (or landscape) level forest ma information to calculate carbon stocks and stock changes for the past (monitoring) or into (projection). Users can also create and simulate various forest management scenarios in order impacts on carbon.

Results of forest ecosystem carbon analyses using the CBM-CFS3 can be used for various reporting requirements. In Canada, many jurisdictions require reporting on criteria and indicat include carbon indicators, for forest management plans in order to comply with sustaina management guidelines. CBM-CFS3 results can also be used to report on carbon in a simil order to acquire forest certification. For example, the Canadian Standards Association requir objectives, indicators and targets for ecosystem contributions to global ecological cycles, a reporting on carbon uptake and storage, in order for a managed forest to meet sustaina requirements of certification.

Managing natural resources within an ecosystem context is challenging. An understanding of in among climate change, ecosystems and the carbon cycle is becoming increasingly imp successful forest ecosystem management. Further study into the intricacies of the carbon continue, including research into better forest management methods and silvicultural techr carbon sequestration, impacts of managing carbon on other forest values, risk and u associated with carbon management, and the long-term effects and economics of carbon mar The IPCC warns that climate change is probably irreversible in any time of direct human however, efforts by foresters across Canada to manage and sequester greater amounts of carl forest ecosystems, when summed together with other greenhouse gas emission strategies, c significant role in mitigating potential impacts of climate change on our planet, our forest ec and our lives.

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