



Is Canada's Forest a Carbon Sink or Source?

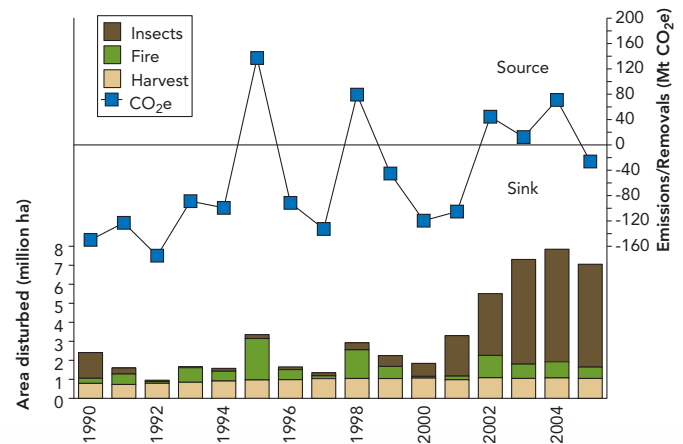
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The importance of forests in the global carbon cycle—the exchange of carbon dioxide between the atmosphere and the biosphere—is one reason why the Kyoto Protocol gave countries the option of including forest management in their Kyoto accounting for 2008–2012. Canada strongly supported this approach because it was believed that it could provide a positive incentive for sustainable forest management. It was also thought that the managed forest might help Canada meet its Kyoto target. However, the Canadian government did not want to decide whether to include forest management in its Kyoto accounting until it answered this question: Taking into account natural processes and human activities, and the accounting rules of the Kyoto Protocol, is Canada's forest a carbon sink or source and will that change in the future?

Forests store large amounts of carbon in the trees and soil. They accumulate more over time as they remove carbon dioxide, the major greenhouse gas, from the air and store the carbon in living trees and other plants. At the same time, some of this carbon is emitted slowly back into the air from decaying trees. In addition, forest fires cause rapid emissions of carbon dioxide and the more potent greenhouse gases methane and nitrous oxide. A forest is considered a **source** when, overall, it emits more carbon dioxide and other greenhouse gases than it removes from the air in a given time period. It is considered a **sink** when it removes more than it emits. These emissions and removals are not determined only by natural processes—forest management activities such as harvesting, tree planting, and efforts to fight fires and insects also have an impact.

Has the Forest Been a Sink or Source in the Past?

Canada's forest covers 310 million ha and 236 million ha of this is the managed forest where human activities affect forest carbon. Each year scientists with the Canadian Forest Service of Natural Resources Canada prepare estimates of the overall sink or source of the managed forest for reporting in Environment Canada's annual national greenhouse gas inventory report. Using these data, the following graph shows that between 1990 and 2005 Canada's managed forest was an overall sink except during five years when it was an overall source, due mainly to emissions from extensive natural forest fires. As well, since 1999, the mountain pine beetle (*Dendroctonus ponderosae*) has killed trees in about 10 million ha in central British Columbia, increasing emissions as the trees decay. Throughout most of this period, the area harvested each year remained fairly steady.



Managed forest sinks and sources 1990–2005.

What about the Future?

Before deciding whether to count the managed forest toward Canada's Kyoto target, the Canadian government wanted to know whether it was more likely to be a sink or a source in the near future. For this analysis, the Canadian Forest Service worked with scientific and provincial and territorial experts to gather the best available information and assumptions. A sophisticated forest carbon model that the Canadian Forest Service first developed in the late 1980s was improved and used for the assessment (www.carbon.cfs.nrcan.gc.ca).

Each year, the managed forest becomes a sink or source depending mainly on the extent of the area affected by fire and insects. Projections therefore required assumptions about the area that could be affected by fire and insects based on scientific and historical information, as well as the current conditions of the forest. But because the extent of future fires or insect infestations cannot be predicted with certainty, the model was run hundreds of times using different scenarios of the future to estimate the likelihood of the managed forest being a sink or a source.

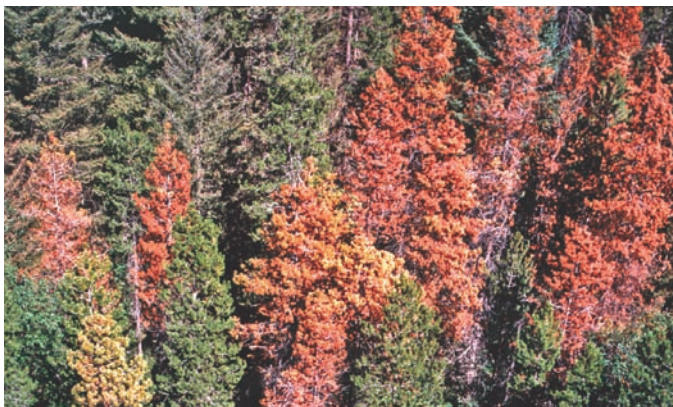
If the analysis had shown that Canada's managed forest was very likely to be a sink in 2008–2012, then its inclusion in Kyoto accounting would have made it easier for Canada to meet its Kyoto target. Instead, the analysis showed that there was a greater than nine in ten chance of it being a source in 2008–2012. Including the managed forest would very likely have made the Kyoto target even more

difficult to achieve. This high risk of a source led to the government's decision to not include forest management in Canada's Kyoto accounting.

The main reasons for the high risk are wildfires and the ongoing and anticipated insect outbreaks in several regions. In fact, the analysis did not include the potential impacts of a changing climate on fires or a possible expansion of the mountain pine beetle beyond British Columbia; therefore the results may underestimate the risk of a source. As the graph shows, harvests do not fluctuate very much over time and therefore do not contribute significantly



Crown fire. (Natural Resources Canada, Northern Forestry Centre)



Trees damaged by mountain pine beetles appear red in this photo.



The adult mountain pine beetle (*Dendroctonus ponderosae*) is less than 1 cm long. (D. Linton, Natural Resources Canada, Pacific Forestry Centre)

to the risk of a source. Harvests of course do remove carbon, much of which is then stored in forest products or used for bioenergy.

Can Canada's Forest Still Contribute to a Climate Change Solution?

Yes. The high risk that our managed forest will be a source in the future does not mean that we should stop considering how to reduce emissions or increase removals in these forests. Management activities to reduce fire and insect outbreaks and to ensure fast regeneration of forest after harvesting could help reduce the source. We can also reduce deforestation (the permanent removal of forest) and increase afforestation (the creation of new forests), the carbon impacts of which we must still include in our Kyoto accounting. And we need to consider the contribution of harvested wood. Wood products store substantial amounts of carbon while providing services to society, and renewable energy derived from wood fuels can substitute for fossil fuels.

The Kyoto accounting rules do not differentiate between the impacts of human management and natural disturbances, and in Canada the natural disturbance impacts are significant, even in the managed forest. The rules require us to define the area of forest that is subject to management (including parks, for example) and then to account for all greenhouse gas emissions and removals in those forests, regardless of the causes of the emissions and removals. Large natural fires and insect infestations occur in our forests and the rules require that all the resulting emissions must be included in the accounting. Although management activities can reduce emissions (for example, by fighting fires) or increase carbon removals (for example, by increasing tree growth rates), in many years, the natural effects can far outweigh the effects of management.

As countries discuss rules for international action on climate change after 2012, Canada and other countries will seek better rules for how forest carbon is counted, so that the rules result in positive incentives for sustainable forest management but do not punish or reward countries for emissions and removals that are beyond their control.

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