Taking Credit: Canada and the role of sinks in international climate negotiations

World leaders charged with finalizing the Kyoto Protocol on global warming will struggle with the issue again during international climate change talks in July 2001.

The decisions made at this critical meeting will attempt to define the final substance of the Kyoto agreement, which sets targets for cutting greenhouse gas emissions by industrialized countries.

In November 2000, the sixth Conference of the Parties (CoP6) – the supreme body of the UN's Framework Convention on Climate Change – fell apart in the final hours. A major reason talks broke down was the refusal by Canada, the United States, and Japan to move from their controversial position of expansive crediting for carbon sinks rather than focussing on reductions in greenhouse gas emissions. In March 2001, the U.S. announced that it would not support the Kyoto Protocol, making negotiations even more difficult.

Despite the absence of U.S. support, the July round of talks will reconvene in Bonn, Germany after being adjourned for several months. Canada is expected to continue to push for high levels of crediting for sinks and substantial use of the Protocol's "flexibility mechanisms." Together, these would allow Canada to technically meet the terms of the Protocol while avoiding significant carbon emission reductions here at home.

Taking Credit examines the science and policies surrounding controversial Protocol clauses that deal with carbon sinks. Forests and soils act as carbon reservoirs by storing or "sequestering" carbon that might otherwise be emitted to the atmosphere. They can also act as carbon "sinks" when they remove carbon dioxide from the atmosphere. Under the Kyoto Protocol, some sinks will be counted towards Canada's emission-reduction goals and would reduce the requirement to cut emissions from fossil fuel use and other sources.

The issue of carbon sinks is fraught with complexity, particularly in the ambiguous context of the Kyoto Protocol. *Taking Credit* shows that sinks could make a limited, but valid, contribution to Canada's overall effort to meet the Kyoto target if certain, strict conditions are followed. However, inappropriate crediting for sinks could lead to an increase in greenhouse gas emissions.

CARBON SINKS: THE DEBATE AND CANADA'S POSITION

There are two ways to avoid increasing carbon dioxide concentrations in the atmosphere:

1. Reduce emission *sources* (such as burning fossil fuels);
2. Enhance carbon sinks (by storing or sequestering additional carbon in sinks and reservoirs, including forests, soils and vegetation).

Kyoto Protocol

The Kyoto Protocol was negotiated in Japan in 1997 and commits industrialized nations to cut greenhouse gas emissions by an average of 5.2 per cent from 1990 levels between 2008 and 2012. These cuts are seen as a first step towards the approximately 60 per cent reduction scientists say is necessary to protect the climate.

Canada agreed to a six per cent cut, but in the last three years, little concrete action has been taken to meet that commitment. Canada's greenhouse gas emissions were 13 per cent higher in 1998 than they were in 1990 and, in the face of rising fossil fuel use and production, are projected to rise 44 per cent above Canada's Kyoto target by 2010 unless significant action is taken.

Canada has been one of the most aggressive proponents for the use of sinks and was the only country to publicly state that it will not ratify the Kyoto Protocol unless all sink-related activities are included. Yet scientific and policy concerns remain about the reliability, measurement and permanence of sinks.

CONCERNS

The European Union, the Environmental Integrity Group (South Korea, Mexico and Switzerland), the Association of Small Island States and other developing countries have stated that significantly expanding credit for forest and agricultural soil sequestration during the first commitment period could reduce the overall integrity of the Kyoto Protocol. Concerns raised include fears that:

- Accounting rules could allow a significant increase in global emissions without any additional increase in the amount of carbon sequestered by soils and forests. This would increase concentrations of greenhouse gases in the atmosphere, exacerbating climate change;
- Storage of carbon in forests and soils may only be temporary and could transfer risks and responsibilities to future generations;
- The uncertainties of accurately measuring carbon removed by trees, soils and other sinks could make reduction commitments more difficult to verify;
- Credit from sinks could delay the implementation of emission reduction strategies that are needed to achieve deep, long-term emission reductions.

THE NEED FOR PERMANENT REDUCTIONS

Sinks proponents argue that avoiding a tonne of emissions from deforestation or sequestration through changes to agricultural practices has the same impact on the atmosphere as avoiding a tonne of emissions from fossil fuel use. This is true only if the carbon is sequestered permanently – a result that is difficult to achieve in many situations.

Carbon dioxide can be re-released to the atmosphere through natural respiration, fire, pests, logging or tillage. The time that carbon can be stored in sinks or reservoirs varies from short-term to several centuries, unlike fossil fuels which if left unused, will continue to store carbon indefinitely.

Reliance on sinks can increase the risk of higher future greenhouse gas emissions if sequestration is used as a substitute for more permanent emission reductions. This is especially true where forest and soil sequestration is impacted by climate change itself. If Canada is allowed to emit additional greenhouse gases because it has temporarily sequestered carbon in trees or soils, responsibility for reductions will be passed to future generations, and more total carbon may eventually be released into the atmosphere.

COSTS

Canada also argues that its sinks should be broadly used as a bridge until low-cost alternatives to fossil fuels are developed. This, however, wrongly assumes that low-cost emission reductions are not currently available. In fact, energy efficiency offers immense potential for immediate cost reductions.

In addition, the use of sinks and the corresponding avoidance of mechanisms to reduce emissions may encourage continued capital investment in inappropriate areas – from oil sands plants to energy-inefficient buildings and equipment. Long-lived investments of this sort force a continued reliance on high-energy inputs for decades, and make a transition to new, low-energy technologies more difficult and expensive. This delay in encouraging investments in new technology is particularly significant when viewed in the context of the enormous reduction in emissions necessary to stabilize the climate.

POTENTIAL LOOPHOLES

Enhancing carbon sinks may, in the short term, help prevent carbon dioxide concentrations from increasing in the atmosphere.

However, large amounts of carbon are already removed from the atmosphere by the forests and soils of industrialized countries. Currently, almost all of this sequestration is natural or the result of past practices, and it would occur without climate mitigation efforts. Therefore, because this sequestration is neither new, nor additional, crediting would allow emissions to increase, undermining the Protocol's objective of reducing industrialized nations' emissions to five per cent below 1990 levels.

If not properly designed, the sinks provisions of the Protocol could create "windfall credits" or "loopholes" for countries seeking to avoid or delay making the more fundamental shifts in energy and technology needed to ultimately achieve the goals of the Protocol. In such instances, greenhouse gas emissions and concentrations could increase, not decrease.

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The objective of the Kyoto Protocol is to avoid dangerous, human-caused changes to the earth's climate. There are deeply-held concerns by many members of the international community that this objective is being pushed into the background by the current negotiating focus on sinks and other flexibility mechanisms. Such mechanisms, critics argue, are at their core an effort by Canada and the United States to avoid the politically more difficult step of sharper reductions in fossil fuel emissions.

There is no question that the use of carbon sinks will be an important tool in the struggle to maintain a tolerable climate for the earth. However, that can only be done within the context of the very large emission reductions that are needed to protect the climate, and a more thorough understanding of the legitimate concerns around permanence, verification and additionality.

Without that sound context, countries arguing for more than minimal crediting of sinks during the first commitment period of 2008–2012 will remain subject to intense international criticism.

Recommendations

Before Kyoto Protocol "credits" for carbon sinks become a more broadly accepted strategy in the fight against global warming, three key issues must be addressed:

1. **Permanence:** Right now, the *permanence* of carbon storage remains a concern. Short-lived sequestration will increase future atmospheric concentrations of greenhouse gases if it is not offset by corresponding reductions. The impermanence of carbon sequestration transfers additional risk and responsibility to future generations, which will then have to make even more difficult decisions to cut emissions more rapidly and deeply.
2. **Verifiability:** There must be increased reliability in the measurement of carbon sinks in order to *verify* reduction gains. The rates at which agricultural and forest ecosystems gain or lose carbon vary. These changes need to be accounted for with improved accuracy before changes in land-use practices are credited for inclusion in the Kyoto Protocol.
3. **Additionality:** Credit must only be given for sequestration that is *in addition* to levels that would occur under business as usual practices in forestry, agriculture and land use. No credit should be given for sequestration that occurs because of factors such as the changing age structure of forests or rising carbon dioxide levels and temperatures that may accelerate forest growth in the short term.

CONCLUSION

Carbon sinks require further scientific clarification and broadly accepted, effective means of implementation within the United Nations Framework Convention on Climate Change and the Kyoto Protocol. While clearly not a complete remedy, storing carbon is part of a menu of actions – all of which will eventually be required in the effort to stabilize and reduce carbon dioxide in the atmosphere.

However, an overly strong emphasis on sinks will continue to divert resources away from actions required now that permanently reduce emissions from the energy, industrial and transportation sectors and that are essential for long-term climate protection. It will also prevent us from enjoying the local benefits of reducing fossil fuel emissions, such as reduced smog, improved air quality and human health. If the use of sinks and flexible mechanisms allows fossil fuel production and use to continue increasing, we can expect the other negative impacts of fossil fuel pollution to increase as well.

Drastic impacts from global warming can be prevented. To do so, we must significantly reduce our greenhouse gas emissions by moving to renewable energy sources and investing in energy efficiency, as well as continuing to address the scientific and policy issues that surround carbon sinks.

This position paper, based on the findings of *Taking Credit*, was drafted by the David Suzuki Foundation and West Coast Environmental Law. The full report can be found at www.davidsuzuki.org and www.wcel.org.

TECHNICAL SUMMARY

Taking Credit: Canada and the Role of Sinks in International Climate Negotiations

Slowing and preventing human-induced climate change requires substantial reductions in the rates at which carbon dioxide (CO_2), methane and nitrous oxide are accumulating in the atmosphere. There are two major ways to achieve these reductions. First, by reducing emissions of these gases from the combustion of fossil fuels, certain industrial and agricultural processes, and deforestation. Second, by changing from land use practices that promote the conversion of organic matter into these gases, to land use practices that retain organic matter as plant material and in soils.

Although achieving a one tonne emission reduction by reducing fossil fuel combustion might appear to be equivalent to removing one tonne of CO_2 from the atmosphere and storing it as organic carbon in a terrestrial ecosystem, they are, in fact, different. Avoiding the combustion of a unit of fossil fuel allows it to remain deep underground where it will never be released to the atmosphere except by deliberate human intervention. The CO_2 stored as organic carbon in a terrestrial ecosystem, however, may soon be converted back to CO_2 through natural respiration processes, through natural phenomena such as fire or pests, or through human intervention such as logging or tillage. The time that organic carbon resides in a terrestrial ecosystem, or in the plant-derived products, varies from short-term to several centuries, unlike unused fossil fuel deposits which reside undisturbed for millions of years underground.

Determining how changes in land use practices contribute to carbon removals under changing environmental and market conditions is one of the biggest challenges in the Kyoto Protocol negotiations. *Taking Credit* explores many aspects of this debate in order to facilitate informed discussion. The authors recognize that for land use practices to be credible and to contribute to the environmental effectiveness of the Protocol, they must meet the principles of permanence, additionality and verifiability. Adhering to these principles requires complex measuring, monitoring and verification systems, many of which have yet to be designed, accepted or implemented.

> The earth's atmosphere contains small amounts of CO_2, methane, nitrous oxide and other gases that help moderate temperature. In essence, they function as the glass in a greenhouse, trapping some of the sun's heat that would otherwise be dispersed into space. As such, they are known as "greenhouse" gases. Since 1958, remote measuring stations in places such as Antarctica and Hawaii have collected CO_2 data to determine how atmospheric concentrations are changing. In addition, glacial ice cores have been analyzed to determine the historic atmospheric concentration of CO_2. These measurements and analyses indicate that current carbon dioxide levels are 23 per cent higher than at any time in the last 420,000 years.
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> Prior to the Industrial Revolution, with its increased use of fossil fuels, the amount of carbon dioxide in the atmosphere was kept relatively constant by natural exchanges between the ocean, the atmosphere and land-based ecosystems. These exchange processes are known as the "carbon cycle." Massive increases in the use of coal, oil and gas to power industrial society, coupled with human impacts on land-based ecosystems through deforestation and the expansion of tilled croplands, have altered that exchange. Since 1850, 405 billion tonnes of carbon have been emitted into the atmosphere as a result of these human activities. Scientists attribute 67 per cent of those emissions to fossil fuel combustion and 33 per cent to human impacts on ecosystems. About 40 per cent of the carbon released has remained in the atmosphere, while the rest has been absorbed by the ocean and terrestrial ecosystems.

International Climate Negotiations

In 1988, the World Meteorological Organization and the United Nations Environmental Program established the Intergovernmental Panel on Climate Change (IPCC). The purpose of the IPCC is to assess scientific information regarding increases in greenhouse gases and climate change, and to formulate realistic potential response strategies. In 1990 the IPCC concluded that, in order to stabilize carbon dioxide concentrations at 1990 levels, emission reductions of 60 per cent would be necessary. The most recent assessment report of the IPCC indicates that, under current growth trends in fossil fuel use, global temperatures could rise between 1.4 and 5.8 degrees over the 21st century and that "there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was developed as an international treaty aimed at preventing climate change. The objective of the UNFCCC is the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-induced] interference with the climate system." To achieve this objective, developed countries agreed to adopt national policies to reduce emissions of greenhouse gases and to conserve and enhance greenhouse gas sinks and reservoirs. A sink is defined as a process or activity which removes a greenhouse gas from the atmosphere, while a reservoir is a component of the terrestrial/ocean carbon system where a greenhouse gas is stored. Subsequent to the ratification of the UNFCCC, the Kyoto Protocol was negotiated in 1997. The Protocol includes national targets and timetables for achieving greenhouse gas reductions. These targets are to be achieved over a five-year period encompassing 2008–2012.

Sections of the Protocol recognize a limited number of actions to protect reservoirs, or enhance sinks, as ways to achieve reduction commitments. Article 3.3 of the Protocol states that countries will be credited or debited for verifiable changes in carbon stocks due to afforestation, reforestation and deforestation. Under the Protocol, deforestation refers to activities in which a forest is cleared and converted to another land use, such as a farm, while reforestation refers to converting deforested land back to forests. Industrial logging practices such as clearcutting a forest and replanting the area are not included in this definition, so no debits or credits are attributed to this activity under Article 3.3.

Article 3.4 states that parties to the Protocol will decide on how, and to what extent, other activities related to forestry, agriculture and land use changes will be included in later commitment periods. Once these decisions are made, a country may choose to apply these criteria to the Kyoto commitment period. While the language of the Protocol appears to be straightforward, there are many areas of interpretation and aspects of implementation which are both complicated and controversial, particularly with respect to sinks. In particular, there is an ongoing debate as to if and how forest management, including the full harvest and replanting cycle, should be accepted as an additional activity under Article 3.4.

Several proposals for including forest and agricultural management as additional sinks activities have been developed by individual countries, groups of countries and officials. *Taking Credit* shows how these proposals impact the targets set out in the Protocol. For example, if Canada's proposals to include reduction credits for all net sequestration from agricultural soils and forest management were adopted by the parties, then many countries could be allowed to increase their fossil fuel emissions. This would seriously compromise the intent of the Protocol. In addition, if reduction commitments are largely met through sequestration, there is an increased risk that future emissions of sequestered carbon will shift responsibility onto future generations.

The science of sinks

Globally, there are about 760 billion tonnes (760 Gts) of carbon in the form of CO_2 in the atmosphere, 800 Gts as organic matter in vegetation, 1,650 Gts as organic matter in soils, and 40,000 Gts as dissolved CO_2, and plankton in the oceans. Terrestrial ecosystems convert atmospheric CO_2 into organic carbon and convert organic carbon back into CO_2. The conversion of CO_2 into organic carbon occurs through photosynthesis by plants. The biological conversion of organic carbon back into CO_2 occurs through two basic processes: (1) respiration by plants and (2) respiration by microorganisms and larger fauna, mostly in the soil, resulting in the decomposition of organic matter and the recycling of the carbon and nutrients that it contains. Organic carbon can also be converted back into CO_2 through non-biological disturbances such as fire, soil tillage or harvesting. In addition, methane (CH_4), a more potent greenhouse gas, can be released from the decomposition of organic material under oxygen-deprived conditions known to occur in water-logged soils, manure storage lagoons and landfills.

Environmental conditions determine the rate at which the interchange between organic carbon and atmospheric CO_2 occurs. These conditions include: temperature, amount of sunlight, availability of nutrients, soil quality, atmospheric CO_2 concentrations and availability of water. To the extent that some environmental conditions can be modified through changes in land use practices, plant productivity can be increased – potentially leading to enhanced sinks and reservoirs. However, policy makers and decision makers should bear in mind that each of these environmental conditions is likely to be impacted by global climate change and other human activities. Climate model predictions suggest that large amounts of carbon currently sequestered in soils and forests could possibly be released over the next century, accelerating future climate change. This additional level of uncertainty and risk must be considered when evaluating the long-term effectiveness of carbon sinks as part of a climate mitigation strategy.

Taking Credit examines the processes by which ecosystem carbon is converted to and from CO_2, and identifies, discusses and addresses key concerns and issues with respect to land use changes including the following:

PERMANENCE OF CARBON STORAGE

A general requirement for permanence is the continuity of the land use practice that raises carbon storage. The adoption of such a land use practice for a few years, followed by reversion to the former practice, contributes little or nothing to carbon storage or emission reductions. Several obstacles to continuity of land use practices, especially in agricultural ecosystems, have been identified. Raising carbon storage requires that farmers change from known practices, such as risk-averse summer-fallow systems with conventional tillage, to possibly riskier continuous cropping systems with reduced tillage and potentially higher costs for weed control and fertilizers. If weeds cannot be controlled, or if there is a need to exploit nutrients sequestered in organic matter, then tillage of the soil may occur, leading to a rapid loss of any carbon storage from the earlier land use change.

Farmers must be shown that it is to their long-term advantage to continue conservation practices that promote carbon storage because these practices also contribute to better structured and less erodible soils, and to a more sustainable supply of nutrients. Future developments, such as deeper-rooted annual crops with more biologically resistant plant residues, could also help make terrestrial storage more permanent.

Addressing the issue of permanence requires long-term commitments to changes in land use. These commitments need to be in place if such changes are to be used to meet the Kyoto Protocol targets and earn reduction credits.

NATURAL DISTURBANCES

There is a risk that large-scale conversion of forest carbon to CO_2 can occur through natural disturbances by fire or insect infestation. Currently two-to-four million hectares (Mha) of Canada's 418 Mha forest area are consumed by natural disturbances each year. According to many climate analyses, the magnitude of these disturbances is likely to increase due to rising temperatures. While natural disturbances are under limited control by humans, and so are not currently included in the Kyoto Protocol, they do pose a threat to terrestrial carbon stocks and affect their permanence. By combusting all, or most, of above-ground biomass and much of the surface litter, a fire can destroy in a single day all the carbon accumulated by a forest over many decades. An average fire releases approximately 7.5 and 5.7 tonnes of carbon per hectare of plant and soil carbon respectively. At average rates of regeneration, these losses would require about 30 years to be replaced. Insect damage is less visible, but can reduce production of new plant material by 25 per cent during the year of an outbreak. Subsequent losses from respiration of plant residue left by fire or insects can be as great as those during the initial disturbance.

TIME DEPENDENCE OF CARBON STORAGE

The rates at which agricultural and forest ecosystems gain or lose carbon under a given set of land use practices depends on the length of time that the practices have been in place. For example, maximum annual plant productivity in a forest may not be achieved for several years following harvest. In agricultural ecosystems, changes in carbon storage are thought to be most rapid during the first 30 to 50 years following a land use change, and to become slower thereafter. Such changes, in relation to time, need to be accounted for if changes in land use practices are to be meaningfully assessed and appropriately credited under the Kyoto Protocol.

FULL SYSTEM ACCOUNTING OF CARBON STORAGE

Land use practices are but one component of complex production systems in forestry and agriculture. Changes in these practices often involve changes in other components of these systems. For example, increases in the use of chemical fertilizers to enhance plant yields and eventual carbon storage in the soil also cause increases in carbon emissions from fertilizer manufacture, and increases in nitrous oxide emissions from soils on which fertilizers are used. These emissions must be deducted from any increases in carbon storage resulting from fertilizer use. Similarly, conversion of croplands to pastures for low-quality grazing by ruminants could cause increases in methane emissions that would offset some of the gains in soil carbon storage. Changes in carbon storage attributed to a change in land use must therefore be calculated to include all components of the production systems affected by the changes.

VERIFICATION

Depending on soil depth, current techniques for measuring soil carbon have an uncertainty of as much as five per cent in agricultural soils, and perhaps less in forest soils. If a soil contains 50 tonnes of carbon per hectare, then changes of less than five per cent, or 2.5 tonnes per hectare, are difficult to corroborate from direct measurement. Yet a change in land use may require 10 years or more to raise carbon storage by this amount. Therefore, changes in soil carbon attributed to changes in land use can only be measured with any confidence in long-term research plots or with continuous monitoring and detailed sampling and analyses of agricultural fields. Such plots or fields are costly and difficult to maintain, and so are limited in number. Therefore, improved methods for measuring and calculating changes in the amount of carbon stored in terrestrial ecosystems need to be developed and applied. Such methods will be vital to the verification and accurate crediting of terrestrial carbon sinks in both agriculture and forestry.

ENVIRONMENTAL INTEGRITY

Credit for increased carbon sequestration can provide negative incentives with respect to environmental conservation. For example, monocultures of fast-growing species may be used to replace native grasslands or forests, which in some circumstances could deplete soil and ground water. Similarly, forest fire suppression can lead to loss of fire-dependent ecosystems and the intensification of pests. The rules regarding credit for enhanced sequestration must ensure that such credit encourages only sustainable practices and be consistent with treaties protecting biodiversity and wetlands.

Conclusion

In conclusion, national estimates of the changes in carbon storage for Canadian forest ecosystems during the first Kyoto commitment period depend critically on assumptions about the time required for recovery of forest growth after logging, and about areas of land that can be afforested. Within the range of reasonable assumptions, this change could be positive or negative. National estimates of the change in carbon storage for agricultural ecosystems during the first Kyoto commitment period depend critically on assumptions concerning the rates at which improved land use practices are adopted and the availability and effectiveness of incentives for adopting them. Since the Kyoto Protocol uses a 100-year timeframe for evaluating the global warming potential of greenhouse gases, any credit attributed to such changes would have to be appropriately discounted to be consistent with this long-term perspective.

Based on the analysis and research presented in *Taking Credit*, carbon sequestration by sinks should only be considered equivalent to emission reductions if it meets the three key scientific principles of additionality, permanence and verifiability. In other words it must be:

1. The result of new activities undertaken to raise terrestrial carbon storage beyond current rates.
2. Of sufficient duration to have a meaningful effect on atmospheric CO_2 concentrations.
3. Measurable in terms of its effect on carbon storage.

Taking Credit: Canada and the Role of Sinks in International Climate Negotiations was commissioned by the David Suzuki Foundation and written by:

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The full report, including glossary, can be found at the following websites: www.davidsuzuki.org and www.wcel.org

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