Climate Change and Organic Agriculture:

Investment in Organic as Part of Ontario's Climate Change Action Plan

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Introduction

Ontario's Climate Change Action Plan 2016 - 2020 identifies a number of ways Ontario's agricultural sector can aid climate change mitigation efforts. This document outlines some of the key ways Ontario's organic sector can contribute. With support, the organic sector can help Ontario

1. **maximize carbon storage from agriculture** (Action 52.3),
2. **adopt low-carbon technologies in the agri-food sector** (Action 37.2), and
3. **increase our understanding of how agricultural lands emit and store carbon** (Action 52.2).

Organic Agriculture can Help Ontario Maximize Carbon Storage from Agriculture

What is Carbon Sequestration?

"Sequestration means maximizing the carbon dioxide pulled from the atmosphere by plant growth and minimizing the loss of that carbon once it is stored in soil." - Rodale Institute

Carbon sequestration is the term for the process by which carbon is removed from the air and stored in the soil as organic matter. This happens continually in healthy ecosystems: plants naturally pull carbon from the atmosphere through respiration, and use it to grow. They store the carbon as leaves, stems or roots and later, leave it behind to decompose and become part of the soil, feeding soil microorganisms and, more importantly, mycorrhizal fungi. Healthy soil biota and the presence of mycorrhizal fungi are vital to effective soil carbon storage.

A carbon sink is defined by the Food and Agriculture Organization of the United Nations as a process or an activity that removes greenhouse gas from the atmosphere. When an agricultural system sequesters more carbon in the soil than is removed through harvest and tillage, it can be thought of as a carbon sink.

How does organic agriculture encourage carbon sequestration?

In order to increase the amount of carbon being stored by soil, the farming method must "(a) increase the amount of carbon entering the soil as plant residues and (b) suppress the rate of soil carbon decomposition."

Most organic farmers choose to add compost (fully decomposed animal or plant waste) to soils as a primary means of returning organic matter to the soil. Many organic farmers also employ additional means of adding organic matter, such as cover crops, which also deposit nitrogen

and are often tilled back into the soil. Studies have shown that the most effective way of building and protecting the soil's organic matter are conservation tillage, cover cropping, crop rotations, and compost.

Many organic and conventional systems reduce the loss of organic matter by adopting "no-till" or "low-till" practices, or exercising a preference for perennial crops. While a reduction in tillage can slow decomposition and reduce carbon loss, it *must* be accompanied by soil building measures if carbon sequestration is to be achieved. Many no-till systems rely on chemical fertilizers, herbicides and heavy equipment to function, and therefore do not build the soil's organic matter. Studies have shown that organic practices are better at building soil than no-till alone, "because the use of manure and cover crops more than offset losses from tillage." Chemical-based fertilizers may, in fact, have a negative impact on soil biology, further reducing carbon sequestration.

In contrast, modern "conventional" agriculture methods often do not include practices that return carbon to the soil. When they do, it is not necessarily part of a system designed to build soil organic matter. According to the Rodale Institute, modern conventional farming practices, including "synthetic nitrogen fertilization, tillage, monocropping, and yield-based management systems" have accelerated the depletion of soil carbon stocks. **A depletion in soil carbon stocks implies an increase in greenhouse gas (GHG) emissions.** Thus, an industry-wide shift toward the types of practices common in organic farming will support the reduction of GHG emissions from agriculture. Part two of this paper discusses the effect chemical fertilizers have on emissions.

The Canada Organic Standard (COS) exists to ensure that soil-building practices are continually employed by organic farmers. Many practices that lend to maximum soil carbon sequestration are *required* by the COS. Often, dedicated organic farmers go above and beyond the basic requirements, and include practices such as conservation tillage, cover cropping, manuring, diverse cropping systems, mixed farming, and agroforestry, which are known to build soil carbon.

What is the potential of carbon sequestration to affect climate change?

A 2004 study suggests that "carbon sequestration has the potential to offset fossil fuel emissions by 0.4 to 1.2 gigatons of carbon per year, or 5 to 15% of the global fossil-fuel emissions." Cropland and rangeland represent more than half of that potential. In its 2014 article, "Regenerative Organic Agriculture and Climate Change," The Rodale Institute suggests that "if sequestration rates attained by exemplar cases were achieved on crop and pastureland across the globe, regenerative agriculture could sequester *more than our current annual carbon dioxide (CO2) emissions*."

In other words, the potential for carbon sequestration in agriculture to affect GHG emissions is

huge. Ontario can make a significant impact on its emissions targets by encouraging organic practices on all farms.

Organic Agriculture can Help the Agri-Food Sector Adopt Low-Carbon Technologies

How does organic agriculture already reduce emissions?

According to a 2008 report by the World Bank, "agriculture contributes about half of the global emissions of two of the most potent non-carbon dioxide greenhouse gases: nitrous oxide and methane." Although the Climate Change Action Plan focuses primarily on carbon emissions, a major benefit of organic is its reduction in N_2O emissions. The US Environmental Protection Agency estimates that N_2O has a global warming potential (GWP) of *265–298 times that of* CO_2.

Currently, the inefficient use of nitrogen fertilizers contributes not only to groundwater pollution via runoff, but also to GHG emissions. A 2010 article from the Trade and Environment Review explains that "only 17 per cent of the 100 [megatons] of industrial nitrogen produced in 2005 was taken up by crops," and "high levels of reactive nitrogen (NH_4, NO_3) in soils may contribute to the emission of nitrous oxides, and are a major source of agricultural emissions."

Farming itself contributes 30 to 70% of total food chain energy use, while transportation contributes about 11%.

By its very nature, organic agriculture has a higher degree of energy efficiency than mainstream agriculture. This is because the substances organic producers omit from their production practices are *precisely those which demand the most energy*. These are: synthetic nitrogen fertilizers, which "account for more than 50% of the total energy input" of conventional agriculture; other minerals, such as phosphorus and potassium; and manufactured food concentrates for livestock.

Similarly, the practice of composting manure through passive aeration (required in organic farming), rather than storing it as slurry or in stockpile (more typical in conventional livestock and dairy operations) emits far less methane gas (CH4) than the other storage methods. A 2003 study showed that if all of the cattle manure in Canada was composted aerobically, and not stored as "slurry" or "stockpile" (currently common practice), a reduction of 0.70 [megatonnes of carbon dioxide equivalent per year] would be achieved.

Simply by encouraging the adoption of non-synthetic fertilization methods and encouraging organic practices, Ontario could greatly reduce its agriculture-related greenhouse gas emissions.

How can the organic sector help others adopt low-GHG practices?

While exciting technological innovations such as nitrification inhibitors and methane digesters can help reduce GHG emissions from agriculture, the best way to encourage a widespread reduction in emissions are the accessible (i.e. low-tech) ones. Organic producers have been devising ways to improve soil health and increase yields to levels comparable with those of conventional agriculture for decades. The organic sector is well-poised to provide expertise in other methods of reducing GHG emissions in agriculture.

Some commonly touted methods of reducing emissions through reduction of high-GHG inputs include integrated pest management, integrated nutrient management, conservation tillage, agroforestry, aquaculture, water harvesting, livestock integration. These techniques are a step in the right direction, but can only do so much to mitigate emissions. Mainstream agriculture must borrow more techniques typically embraced by organic farmers, that are designed to return carbon to the soil and optimize carbon sequestration and GHG emissions reduction. Techniques such as composting, green manure, cover cropping, and intensive rotational grazing can reduce the inputs required to produce food, while improving soil health. This can make the food production system more energy-efficient. Integrated pest and nutrient management, for example, helps to reduce a crop's susceptibility to pests by encouraging optimal soil health through cover cropping, increasing soil organic matter, and use of green manure. A crop's ability to resist pests is closely tied to soil health. Interestingly, these methods of improving soil health are also effective methods of carbon sequestration.

What kinds of technology can the organic sector contribute?

While there is ample evidence to confirm that, on the whole, organic methods can reduce GHG emissions, there is great value in clearly quantifying the reduction. To that end, a team of researchers in the Organic Science Cluster (OSC) have modelled technology that would allow farms to track GHG emission reductions during transition. This can help producers see the direct effects of their actions, and provide the government with a method of tracking on-farm contributions to emissions reductions.

Related OSC projects have developed technology to measure the amount of nitrate in runoff from cover crops of legume green manure, and determine the GHG emissions of feces deposited by livestock on pastures. These types of projects are just the beginning, and most are not being funded or performed within Ontario.

By investing in organic technology that will support farmers in measuring and finding effective methods of reducing GHG emissions, Ontario can make real progress toward achieving the goals of the Climate Change Action Plan.

What about emissions from transportation?

Another area where the organic sector can support reduced emissions is transportation. Transportation accounts for 11% of the carbon emissions created by agri-food. Currently, Ontario's organic demand is larger than its supply, which means that much of Ontario's organic food supply is being imported from the US. If Ontario's organic sector does not grow to meet the increasing demand, overall agri-food imports will increase, and transportation emissions will too.

By supporting the organic sector and building a more localized food system that supports Ontario's farmers and promotes local production over imports, Ontario can reduce some of the emissions created through agri-food transportation.

Another important way to reduce transportation emissions is season extension. When crops can be grown locally throughout the year, energy waste from transportation can be reduced. Some recent projects of the OSC are identifying technologies and solutions for making organic greenhouse growing more profitable and increasing the energy efficiency of greenhouse growing. This includes a study of geothermal energy as an energy source, one that increases energy efficiency by re-using the crop effluence as a nutrient source, and another that seeks to optimize fertilization and irrigation management for a closed greenhouse growing system.

Organic Agriculture Can Help Ontario Increase Our Understanding of How Agricultural Lands Emit and Store Carbon

What is Farmer-led research and how does Ontario organic already do it?

A number of Canadian research projects designed to improve our understanding of and ability to sequester carbon and reduce emissions from agriculture using organic methods have been performed in the past, many through the Organic Science Cluster: a federal government partnership with the Organic Federation of Canada and Dalhousie University's Organic Agriculture Centre of Canada. Ontario has done little to encourage further research and to involve the farmers, who hold a great deal of knowledge, in these research efforts.

With the leadership of the Ecological Farmer's Association of Ontario (EFAO), Ontario's organic sector independently encourages farmer-led research in order to identify research priorities that are relevant to Ontario's organic growers. Current projects are practical in nature, and include topics like: a study of quick-turnaround cover-crops and the benefits they provide to late-season brassicas, a comparison of soil-tests to determine their usefulness for organic farms, a comparison of meat chicken breeds, a study of the efficacy of foliar sprays, a pasture amendment comparison and a vegetable nutritional quality assessment.

This type of research, while highly valuable to all farmers, is dependent on volunteers and non-profit resources, and relies on support from resource-limited organizations like OCO and EFAO. In order to make farmer-led research more effective and complete, an official, government-sponsored partnership between Ontario's organic associations, their organic farmers, and a reputable academic research institution is needed.

What kinds of supports are needed to deepen Ontario's soil carbon knowledge pool?

Through a government-backed research partnership between an academic institution and Ontario's organic associations, clear and rigorous research priorities could be identified in order to expand our regional ability to employ organic agricultural practices that can reduce emissions and carbon sequestration.

In our response to OMAFRA's 2016 discussion paper, Sustaining Ontario's Agricultural Soils, OCO outlined additional key actions the government could take to help increase our understanding of the soil organic carbon system and its effects on climate change. We asked for:

- A mechanism for the collection of baseline soil health data and a plan for future monitoring of farm contributions.
- Subsidization of soil specialists, agronomists and farmers specializing in soil health and organic production for extension services they offer related to soil health best management practices.
- Financial support for producers pursuing organic certification.
- Financial support for researchers and projects involving organic producers attempting to optimize their carbon sequestration.
- A carbon offsets program that specifically recognizes organic practices and certification as contributing to the carbon sink.

Investing in Organic Agriculture is an GHG Reduction strategy.

The Organic Council of Ontario understands that it is not reasonable or viable to expect all farms to transition to full-fledged organic practices in the near future. However, as we have illustrated here, the organic sector has much to offer agriculture at large, especially with regard to furthering emissions reductions and supporting climate change mitigation efforts through practices that, whether labeled "organic" or not, are employed by most organic producers.

We propose that the provincial government consider the following actions:

- Enact legislative changes that will allow for the organic sector support its own growth,

- Support organic farmer-led research partnerships with research institutions that will further explore the potential carbon sequestration and emissions reduction benefits of organic agriculture,
- *Identify an increased level of soil organic carbon as a carbon offset eligible for reimbursement under the new Cap and Trade system.*

Ontario Organic Agriculture and Climate Change Resources:

In addition to the works linked to in this paper, the following Ontario research and literature reviews that have benefitted our understanding of soil organic carbon storage and emission:

- *The Carbon and Global Warming Potential Impacts of Organic Farming: Does It Have a Significant Role in an Energy Constrained World?* Lynch, D.H.; MacRae, R.J.; and Martin, Ralph C.; 2011.
- Improving Energy Efficiency and GHG Mitigation Potentials in Canadian Organic Farming Systems. MacRae, R.J.; Lynch, D.H.; and Martin, Ralph C.; 2010.
- *Carbon Sequestration Potentials in Temperate Tree-Based Intercropping Systems, Southern Ontario, Canada*. Peichl, M.; Thevathasan, N.V.; Gordon, A.M. et al.; 2006.
- *Variability in carbon sequestration potential in no-till soil landscapes of southern Ontario*. VandenBygaart, A.J.; Yang, X.M.; Kay, B.D.; and Aspinall, J.D.; 2002.
- *Rotation and tillage effects on soil organic carbon sequestration in a typic Hapludalf in Southern Ontario.* Yang, X.M. and Kay, B.D.; 2000.