



## Maximizing Carbon Sequestration

### Soils contain over three times the quantity of organic carbon found in vegetation and double that of the atmosphere. - Intergovernmental Panel on Climate Change<sup>1</sup>

Agriculture emits greenhouse gases, but also has a unique capacity to act as a carbon dioxide sink, removing atmospheric carbon and incorporating it into soil. Increasing carbon levels in soil, (referred to as soil organic carbon or SOC), not only helps to mitigate climate change by reducing atmospheric carbon, it also improves soil health with benefits to crop yields and the ability of soil to hold water-useful for adapting to both drought and extreme rainfall events made more frequent by climate change.

In 2015, the French government proposed the “4 per mille” initiative (4p1000.org) based on the premise that given the estimated 8,900 Mt of annual, global GHG emissions at that time, if the soil around the world could sequester just 0.4 % of the total pool per year, it would offset current annual fossil fuel emissions.<sup>2</sup>

In Canada, there is interest in finding ways to support farmers to increase carbon sequestration on agricultural lands. For example:

- The Saskatchewan Soil Conservation Association’s Soil Carbon Advisory Committee developed a position paper recommending that if a carbon tax penalizes GHG emissions, those removing GHGs through carbon sequestration should be compensated in equal measure<sup>3</sup>
- The Organic Value Chain Roundtable developed a Carbon Sequestration Task Force report with recommendations for how organic producers can be supported to increase carbon sequestration
- The Canadian Forage and Grasslands Association is leading a national research project to demonstrate to farmers the carbon sequestration potential of their farmlands and assess how best to connect farmers with carbon markets<sup>5</sup>

In the US, and beyond, a range of policies and programs, both government-backed and private, already encourage carbon sequestration through incentives from carbon market offsets to cost sharing for soil health improvements.<sup>6</sup>

### Unintended Impacts

Practices that can successfully build up soil organic carbon may have other impacts that negate their contribution to GHG reduction strategies or cause negative environmental impacts. For example, in recent decades, soil organic carbon levels have increased across the Prairie provinces largely due to adoption of no-till production and reduced summerfallow. But at the same time, the use of fertilizers, pesticides and herbicides has increased dramatically, resulting in little change in net emissions and increased potential for nitrogen run-off in waterways or reduction of pollinator populations.<sup>7</sup> For example, between 2006 and 2015, the use of herbicides<sup>8</sup> and nitrogen fertilizers<sup>9</sup> in Canadian agriculture nearly doubled.



**Practices for carbon sequestration with estimated soil organic carbon rates<sup>10</sup>**

Cropland practices	SOC sequestered (lb/acre/year)	References
Regenerative cropping systems	2,400	Aguillera et al, 2013; Gattinger et al, 2012, Teague et al, 2016
Conservation agriculture	600 - 1,000	Lal, 2016
Cover crop with no-till	440 - 800	Lal, 2015
Organic system, long term field crop farming system trials	400 - 600	Coulter, 2012; Delate et al., 2015; Cavigelli et al, 2013; Rodale, 2015
Continuous no-till	510	West and Post, 2002
Diversified crop rotation (e.g. 4 year, 4 crops vs. 2 year corn-soy)	180 - 470	West & post, 2002; Alhameid et al, 2017; Lehman et al, 2017
Cover crop (NRCS practice)	135 - 195	Chambers et al, 2016
<b>Grazing lands practices</b>		
Adaptive multi-paddock grazing (AMP)	2,400	Machmuller et al, 2015; Wang et al, 2015; Teague et al, 2016
Prescribed grazing (NRCS practice)	150 - 400	Chambers et al, 2016
<b>Perennial conservation plantings</b>		
Agroforestry, tropical region	6,320	Feliciano et al, 2018
Agroforestry, temperate region	3,700	Feliciano et al, 2018
Conservation Reserve Program (NRCS)	3,600	Manale et al, 2016
Agroforestry, arid to semi-arid regions	2,400	Feliciano et al, 2018
Converting cropland to grassland/ prairie	>2,000	Jones, 2010
Field border, filter strip, other herbaceous perennial conservation planting (NRCS)	375 - 850	Chambers et al, 2016



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## References:

- <sup>1</sup> Intergovernmental Panel on Climate Change (2000). Nebojsa Nakicenovic and Rob Swart (Eds.) Emissions Scenarios. Cambridge University Press, UK.
- <sup>2</sup> Initiative 4 per 1000. (Accessed, June 2019) [4p1000.org](http://4p1000.org)
- <sup>3</sup> Saskatchewan Soil Conservation Association (2017) Soil Carbon Position Paper <http://ssca.ca/images/pdf/Soil-Carbon-Position-Paper-Version-1---August-2017.pdf>
- <sup>4</sup> Agriculture and Agri Food Canada (2019) Agricultural Greenhouses Gases Program - Approved Projects <http://www.agr.gc.ca/eng/programs-and-services/agricultural-greenhouse-gases-program/approved-projects/?id=1508423883267>
- <sup>5</sup> Donlan, D. (2017) Six States Tapping into Soil Solutions, <https://soilsolution.org/2017/07/6-states-tapping-into-the-benefits-of-carbon-farming/>
- <sup>6</sup> Clearwater, R. L., T. Martin, and T. Hoppe, editors. (2016) *Environmental sustainability of Canadian agriculture: Agri-environmental indicator report series – Report #4*. Agriculture and Agri-Food Canada, Ottawa, ON. [http://publications.gc.ca/collections/collection\\_2016/aac-aa/c/A22-201-2016-eng.pdf](http://publications.gc.ca/collections/collection_2016/aac-aa/c/A22-201-2016-eng.pdf)
- <sup>7</sup> Smukler, S. (2019) *Managing Canadian Croplands to Maximize Carbon Sequestration and Minimize Other Ecosystem Service Trade-Offs*. Prepared for the Canadian Agri-Food Policy Institute.
- <sup>8</sup> Food and Agriculture Organization of the United Nations, (Accessed June, 2019) <http://www.fao.org/faostat/en/#data/RP/visualize>
- <sup>9</sup> Food and Agriculture Organization of the United Nations, (Accessed June, 2019) <http://www.fao.org/faostat/en/#data/RFN>
- <sup>10</sup> Schonbeck, M., D. Jerkins and L. Snyder (2018) *Soil Health and Organic Farming: Practices for Climate Mitigation, Adaptation and Carbon Sequestration*. Prepared for the Organic Farming Research Foundation.