# Adjusting the intensity of farming can help address climate change

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We have little chance of tackling climate change and reducing biodiversity loss without a redesign of the world's largest industry: agriculture and food.

Source: Red Zeppelin via Unsplash

While shifting to more plant-based diets and reducing food waste will be critical steps, what occurs at the farm level will matter more. There, it will be the choices made around technology and intensity that will matter.

*Agricultural practices, like regenerative farming, can help address climate change.*

## Agricultural intensity

With crops grown in farm fields, more intensive management means a reduction in the diversity of crops grown, combined with increased application of nutrients and use of mechanical soil tillage on the farm.

In eastern Canada, cropping has intensified by becoming less diverse.

Common cash crops, such as soybean, leave very little residue (which is mostly carbon) to add to the soil to help reverse CO2 accumulation in the atmosphere. This intensification has led to a continuing decline in the amount of carbon in soil.

Canadian farmers, with support of federal and provincial programs, are responding to the climate change challenge with a host of cropping interventions, all of which fall under the umbrella of "nature-based climate change solutions."

These new practices aim to improve soil health, return more carbon to soil, improve nitrogen efficiency and reduce greenhouse gas losses.

While zero-tillage (avoiding disturbing the soil for planting) does not enhance soil carbon in Eastern Canada — unlike in Western Canada — cover cropping, crop diversification and maintaining perennial pastures are recommended.

Cover crops — that help the soil recover — can also enhance cash crop productivity by supplying nutrients.

## Maintaining ecosystem biodiversity

What about maintaining biodiversity? Should we maximize farming intensity and farm land efficiency to preserve more natural lands as reservoirs of biodiversity? Gauging a farming system on the basis of how productive it is alone, risks not sparing land from losses of soil carbon and soil.

Less intensive cropping systems can benefit biodiversity both above and below ground on farmed land. Opting for a productive but moderate range of farming intensity is thus ideal for preserving both soil, its carbon content and biodiversity.

As we have recently shown, a spectrum of intensity of cropping management is also found within regulated farming systems that follow an operating standard such as certified organic farming.

While organic farms are, in general, less intensive due to a greater diversity of crops grown and reduced nutrient application, they differ widely in the diversity of cropping and the level of nutrients added to the soil.

## Managing nitrogen and carbon

Improving the retention of carbon and management of nitrogen are important, and there are various management approaches.

Led by the fertiliser industry, a 4-R approach to nitrogen fertilizer nutrient management uses the right fertilizer source, at the right rate, at the right time and at the right place. This approach is being widely promoted across Canadian agriculture with the goal of improving nitrogen use efficiency on farms and reducing nitrogen-derived greenhouse gas emissions.

But what about carbon? Half of the land on earth is now devoted to agriculture, and so reversing CO2 accumulation in the atmosphere through redesigning cropping systems is essential.

A recent standardized global framework for measuring and monitoring soil carbon on farms outlines the approaches needed for soil sampling and analyses to effectively measure what are often slow changes in soil carbon in response to improved cropping practices.

But for most farmers, closely managing soil carbon is a recent endeavour, and an unfamiliar element — it is now even possible to farm carbon as a source of revenue.

Other than broad recommendations to sustain organic matter in soil, which is 50-55 per cent carbon, carbon seldom appears in long-established farm nutrient or resource management guidelines.

Changes in soil carbon are the net balance between carbon added (like crop residues and manures) minus carbon lost through organic matter decomposition. We can conceive a parallel 4Rs framework for its management that takes into account: rotation of crops, residue management, return of manure, and rate of tillage intensity. Rotation refers to the sequence of crops and cover crops.

Residue management acknowledges that benefits to soil carbon of diverse crop rotations can be lost if most of the crop residues are removed. Type and frequency of disturbance through tillage determines how much-added decomposition of soil organic matter occurs.

## The role of agriculture

Agriculture plays a central role in employing nature-based solutions to climate change. Developing climate-smart agriculture requires understanding the intensity at which all farms operate. Innovative economic programs, incentives and credits are needed to support farms aligning their practices with climate-related goals.



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