

A new trajectory: Climate change rapidly impacting Canadian agriculture

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Western professors Hugh Henry and Yanping Li share their insights on the way climate change is affecting Canadian agriculture. Credit: Julide Cakiroglu/Western Communications

The planet is getting warmer and climate change—not surprisingly—impacts the way we feed the world. In Canada, especially, our warming planet alters growing conditions, affects crop yields and shifts the types of crops that can be cultivated in different regions of the country.

"Warmer temperatures and changes in [precipitation patterns](#) can lead to increased [water stress](#), both from droughts and flooding, and can exacerbate soil erosion and degradation," said Yanping Li, Canada Research Chair in Climate Change Risk and Resilience.

"Heat stress during critical periods of crop development may reduce yields. But extended growing seasons in some regions could potentially allow for the cultivation of new crops or double cropping."

Climate change and farming get along like a hand and a blister. Quite simply, we need to adapt.

"Different planting and harvest dates, different crops or crop varieties, genetically modified crops: These are all on the table," said Hugh Henry, director of Environmental Sciences Western field station. "The advantage with agriculture is many of the things we grow are annual crops so farmers can change strategies relatively rapidly. In the absence of adaptation, we're going to experience reduced yields in many cases and, at worst, complete crop failure."

As the world's second largest country in terms of square kilometers (behind only Russia), there's a lot of real estate where the impacts of [climate change](#) will vary significantly across Canada's diverse regions.

"In the Prairies, increased temperatures and reduced precipitation can exacerbate drought conditions, impacting water availability for irrigation. Conversely, Eastern Canada may experience increased precipitation, leading to waterlogging and delayed planting," said Li, an Earth sciences professor.

And while "We the North" is considered by some basketball fans as a rallying cry here in Canada, warming intensifies with each line of latitude climbing closer to the Arctic Circle. That's a problem.

"The Northern regions might benefit from longer growing seasons but will also face challenges related to thawing permafrost and changes in pest populations," said Li.

Face the strange

Climate change may cause more [severe weather events](#), including [extreme precipitation](#), wind disturbance, heat waves and drought. In 2023, Canadian wildfires burned 184,961 square kilometers or about 5% of the entire forest area of Canada.

But despite the potential for mass destruction, climate change does not necessarily have negative consequences for all farmed fruits and vegetables. It just means change, says Henry, who studies how plants and microorganisms interact to regulate seasonal changes in soil nutrients, like nitrogen.

"Extreme events can stress plants, so they will grow less, but when pushed far enough past a certain threshold you get mortality, and the opportunity for other species to move in and replace the former species," said Henry, a biology professor. "This can set plant communities off on a new trajectory, which is particularly meaningful for forests, because trees live so long. It takes a long time for forest recovery, but disturbance also can set things on a different path."

Plants, including fruits and vegetables, are also affected by flooding as roots need to breath, and climate change—in some extreme cases—is literally choking them out like a mixed martial arts fighter.

"Waterlogging can stress or even kill plants," said Henry. "The other concern regarding extreme precipitation is soil erosion, which is caused by oversaturation and fast-moving water. Plant roots help stabilize the soil, providing it with structure like reinforced concrete. When plants are

removed by disturbance, it can make the soil more vulnerable to erosion."

Henry, who works with farmers and industry partners, suggests more sustainable agricultural practices must be deployed to adapt and combat climate change. Many are already happening, like adding or retaining soil organic matter, reducing tillage and using cover crops.

Flooding and drought also severely affect crop production. Floods can damage crops, wash away topsoil and delay planting, while drought can limit water availability for crops, reducing yields. Heat stress, which causes dehydration in plants just like humans and animals, is also a major concern.

High temperatures can reduce crop yields by impairing photosynthesis and increasing evaporation, said Li, an expert on irrigation who recently studied the impact of temperature stress on spring wheat.

It can also lead to booming pest populations, bringing disease that further hurts quality and yield.

Severe weather, like the extreme events investigated by Western's Northern Tornadoes Project and Northern Hail Project, can also cause physical damage to crops and infrastructure.

Civilization rests upon soil

There are two sides to every coin, so climate change could still bring some benefits for the agricultural sector in certain regions of Canada.

"Warmer temperatures and longer growing seasons may enable farmers to grow warmer-weather crops and possibly increase productivity. Regions that were previously limited by shorter growing seasons may

find new opportunities for agriculture, such as double cropping or cultivating crops that were not viable before," said Li.

While there are places in Canada where productivity of crops could be increased by extending the growing season, extreme weather events and variability remain a threat.

And then there's the soil.

"As you expand northwards you encounter different soil types," said Henry, who leads the WINTER warming and Nitrogen addition in Temperate Ecosystems Research project (WINNTER).

The Canadian Shield and rockier areas don't provide the same fertile ground as southern Ontario's farmbelt.

Increased carbon dioxide (CO₂) concentrations can likewise have both positive and negative effects on plant and crop growth.

"Higher CO₂ levels can enhance photosynthesis and water-use efficiency in some crops, potentially increasing yields," said Li. "However, these benefits may be offset by the negative impacts of higher temperatures, increased pest and disease pressures and extreme weather events."

Li, who modeled irrigation systems in the Canadian Prairies and U.S. Midwest in a [2021 study](#), said some farmers may need to adopt new water practices to keep their crops from drying out.

"Conversely, regions experiencing wetter-than-normal springs may face challenges such as delayed seeding and increased [soil erosion](#). Both scenarios entail significant costs and potential production losses."

Massive upheaval or mitigated risk?

Climate change will likely lead to substantial changes in Canadian agriculture, affecting how we farm, distribute and consume food.

From new crops to new planting and harvesting schedules, farmers will be forced to adapt.

"These changes will ripple through the food supply chain, potentially impacting the availability and cost of fruit, vegetables, legumes, meat and dairy products," said Henry, who thinks Canadians are up to the challenge.

Henry sees efforts—and progress—everyday at the Environmental Sciences Western Field Station.

Take the researchers at the Institute for Chemicals and Fuels from Alternative Resources (ICFAR), for example. Western engineering professors Franco Berruti and Cedric Briens and their teams are converting waste to resources and producing new soil supplements such as biochar, a form of lightweight charcoal that can sequester carbon removed from the atmosphere.

Meanwhile Joshua Pearce, the John M. Thompson Chair in Information Technology and Innovation, and his Free Appropriate Sustainability Technology (FAST) research group are making great strides in the field of agrivoltaics.

This technique uses solar panels to generate electricity on a farm still growing food, which not only contributes to more sustainable and cost-efficient farming operations, but also creates a potential new revenue stream for farmers. Pearce and his team are also extending berry season by growing the fruit indoors in an agrotunnel.

"We should be changing our practices dramatically to reduce climate

change," said Henry. "There are many emerging technologies, and so much of it is focused on addressing the root causes of climate change while also producing more sustainable agriculture."

Provided by University of Western Ontario

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