# Decreases in Net GHG Emission Levels from Saskatchewan Crop Production

*Agri-Food Innovation & Sustainability Enhancement Chair Policy Brief*
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## Event

Over the past 30 years, grain, oilseed, and pulse production across the prairies has undergone fundamental change. Prior to the mid-1990s, summerfallow and conventional tillage were common for weed control practices, as there were fewer in-crop herbicide options as compared to today. As a result, the soil was tilled multiple times during the fallow year to prevent weeds from growing and germinating. Intensive tilling contributed to increased soil erosion and reduced moisture conservation, as tilling releases soil organic carbon (SOC) from the soil that was stored by the previous crop. When soil carbon sequestration is greater than emissions, the land is a net carbon sink; and when the opposite is true, the production system is a net carbon emitter. Advancements in plant genetics, pesticides, and machinery have fostered a shift to zero-tillage practices, resulting in prairie crop production being a net carbon sink.

## Significance

Through photosynthesis, crops take carbon from the air and store it in the soil where it becomes SOC. After harvest, the breakdown of plant matter into the soil enables carbon sequestration by building SOC. This process also generates carbon dioxide ($CO_2$) emissions, which is the metric used to measure greenhouse gas (GHG) emissions. Agriculture accounts for roughly 10% of total Canadian GHG emissions. With the vast majority of crop land no longer being tilled annually, this land has been able to continuously sequester carbon, helping Canada meet the 2015 Paris Accord commitment, which requires Canada to reduce its GHG emissions by 30% below 2005 levels by 2030. Evaluating changes in GHG emissions to meet Paris Accord targets without taking into account the sequestration capabilities of crop production results in an overestimation of net agriculture GHG emissions.

## Analysis

A carbon modelling exercise, by Awada et. al, (2021), has quantified crop land GHG emissions and sequestration for Alberta, Saskatchewan, and Manitoba from 1985-2015. Estimating soil carbon stock, calculated as the difference between emissions and sequestration of carbon from agricultural soils, was the primary focus of the study.

Nitrogen is also an important factor in agricultural emission modelling. The use of nitrogen fertilizer, summerfallow, and crop residue retention, releases nitrogen into the atmosphere. Nitrogen fertilizer emissions are accounted for based on application rates and adjusted for the climate in each prairie province. Similarly, emissions from summerfallow and residue decomposition are indexed from regional coefficients to ensure variances in climatic conditions are properly accounted for. Increased soil moisture, soil nitrogen, and carbon content alongside higher temperatures can result in higher levels of nitrogen emissions, especially during periods of summerfallow. Net emissions are estimates of: 1) the amount of carbon emitted or sequestered, or changes in soil carbon stock; 2) carbon emissions from other sources; and 3) nitrogen emission converted to $CO_2$ equivalents.

Declines in summerfallow and the adoption of zero-tillage systems are critical components of increased environmental sustainability in crop agriculture. These changes were facilitated by numerous innovations and fostered the elimination of tillage and summerfallow. Namely, the adoption of genetically modified herbicide tolerant crops and the use of glyphosate to control weeds in continuous crop rotations has enabled this transition.

## Conclusion

Agriculture accounts for 10% of Canadian GHG emissions. Saskatchewan was the first province to reach net GHG sink status in 2007, followed by Alberta in 2012. The results indicate that Manitoba has not reached a net sink status and remains a GHG emitter. Since 2013, GHG emissions have been relatively consistent in Alberta and Manitoba, while Saskatchewan's have been stable since 2014. Emission levels have stabilized as crop producing acres have annually increased, corresponding to the near removal of summerfallow acres, lowering emission intensity by producing greater volumes of crop per tonne of GHG emission.

When comparing these results to Canada's climate targets in the Paris Accord, a 30% reduction in emissions by 2030, using 2005 emissions as a baseline, the results are definitive. Since 2005, emissions from prairie crop production have decreased by 53%, demonstrating the strong environmental performance of the Canadian prairie crop production sector. The results of this rigorous research confirm the progress in crop production systems in the Canadian prairies. Prairie crop producers have taken on sustainable production methods that exceed the goals of the Paris Accord, while producing safe, sustainable, and high quality crops and food. To view this research in its entirety please use the following URL: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0260946.