

Sustainability Advances in Saskatchewan Agriculture

Advancements in Agriculture
Research Presentation

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Thank You To My Stakeholders



Economic sustainability drives adoption



Market incentives are more effective at changing behaviour than regulations

Sustainability – Economic or Environmental?

- Environmental sustainability is capturing headlines globally
- In 2022, the UN held conventions on climate change in Egypt and on biodiversity in Montreal – about 60,000 attended both
- Media and environmental NGOs increasingly fixated on improved environmental sustainability
- However, without economic sustainability, environmental sustainability improvement will be impossible
- If farmers aren't profitable, improvements in the environmental are a non-starter

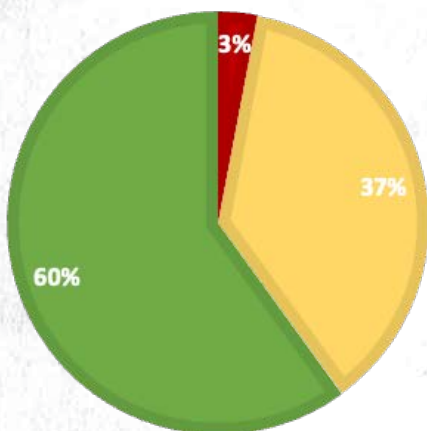
EU Farm to Fork Strategy by 2030

- Reduce the use and impact of pesticides by 50%
- Reduce fertilizers use – including animal manure – by at least 20%
- Increase organic farming to reach 25% of agricultural land, the current level is 8%
- Organic chemicals are far more toxic than synthetic ones, but will be exempt
- Not a single one of these strategies is based on any supporting empirical evidence

Tillage: Canada vs EU

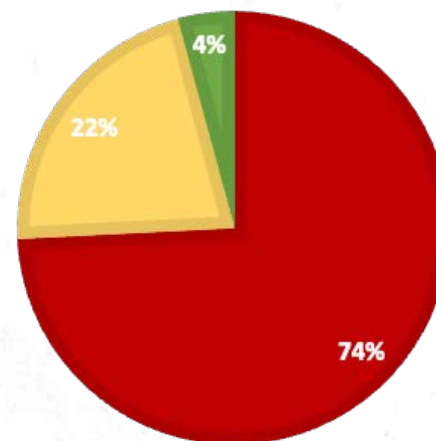
SASKATCHEWAN TILLAGE PRACTICES 2016-19

■ Conventional Tillage Ha ■ Minimum Tillage Ha ■ No-tillage Ha



EU TILLAGE PRACTICES - 2016

■ Conventional Tillage Ha ■ Minimum Tillage Ha ■ No-tillage Ha



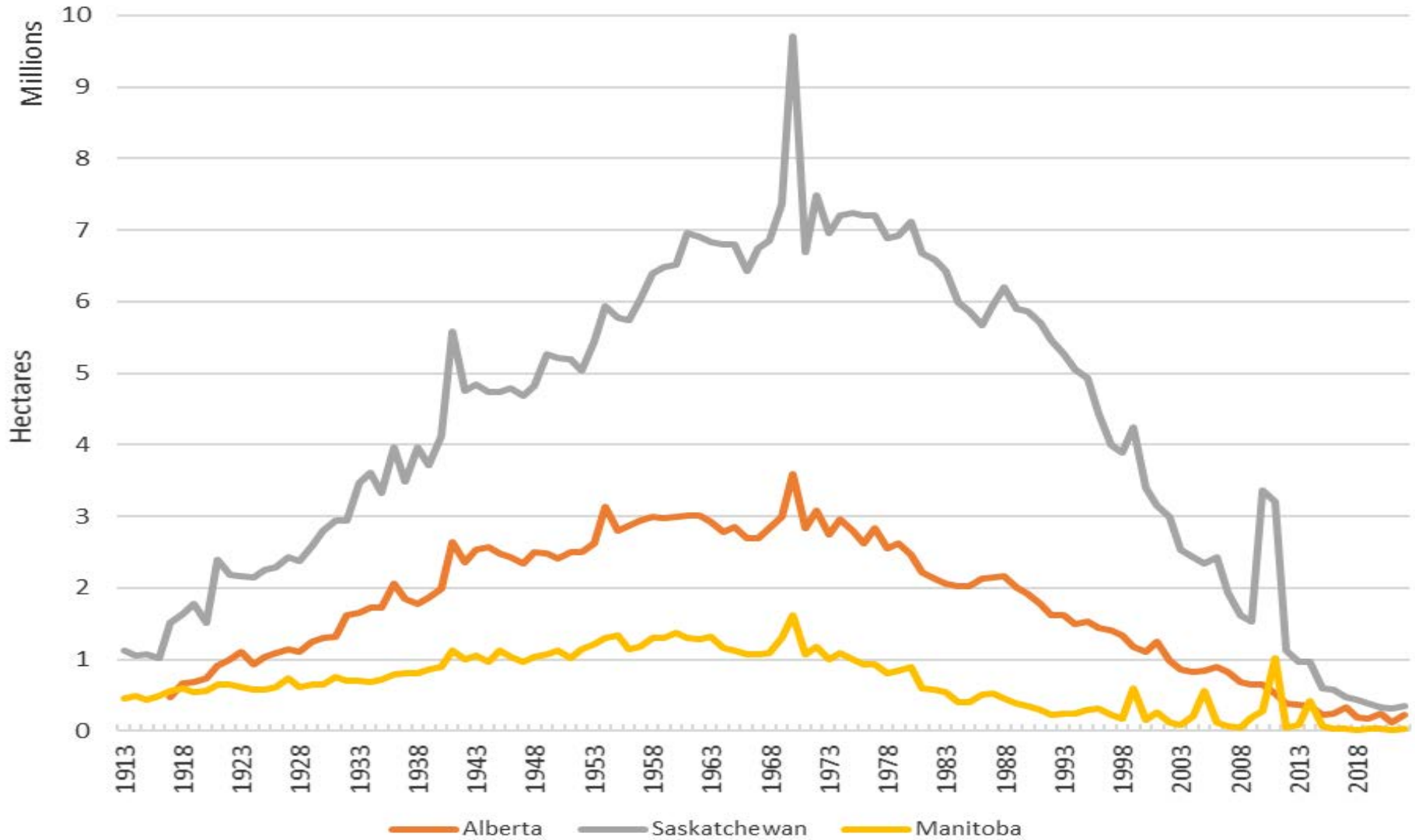
EU Farm to Fork Strategy: 2030 Goal

- Increase organic farming from 8% to reach 25%
- Implications for tillage practices? Yields? Soil erosion? Carbon sequestration?

SK Source: Sutherland et al. 2021. <https://www.mdpi.com/2071-1050/13/21/11679>

EU Source: Eurostat. 2020. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Figure1_Share_of_tillage_practices_in_the_EU27_2016.png

Prairie summerfallow hectares, 1913-2022



Change in soil erosion risk, 1981 to 2016



Legend:

Large decrease

Decrease

Little or no change

Increase

Economics of weed control

- Superior crop yields depend on efficient weed control
- An average wheat plant produces 25-30 seeds, while kochia produces 25,000 seeds
- Historically, in-crop weed controls were limited and often of moderate effect
- Typically, farmers relied on summerfallow as their most effective means of controlling weeds
- Three-year rotations of cereal-cereal-summerfallow were common in high moisture areas of the prairies
- Significant portions had two-year rotations, wheat-summerfallow

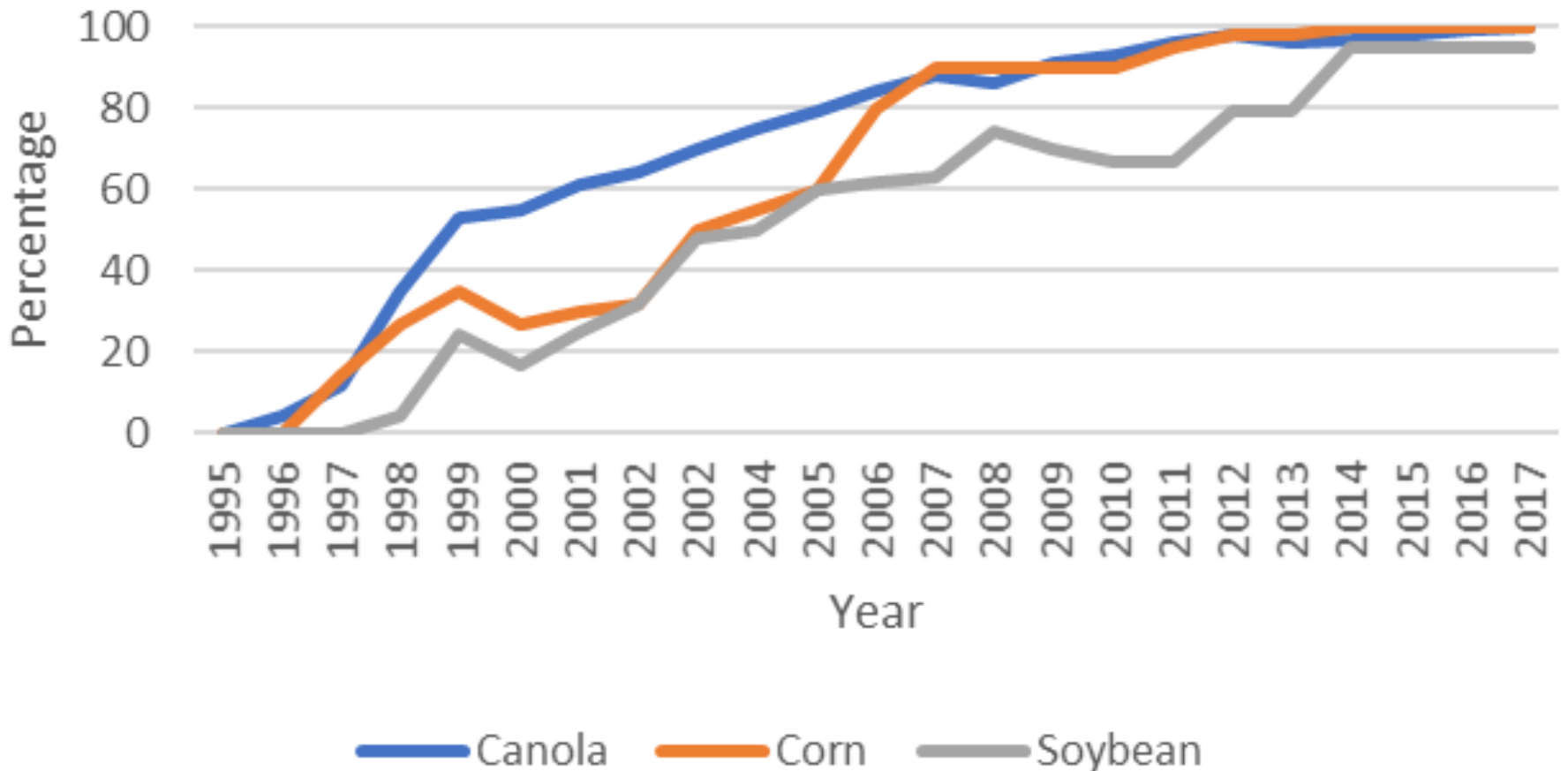
Crop loss factors

Crop	Weeds	Insects	Plant disease	Total loss
Vegetables	8-13%	4-21%	8-23%	20-55%
Soybeans	10-37%	0-11%	40-60%	50-100%
Corn	50%	15-50%	8-14%	73-100%
Wheat	5-20%	5-20%	0-16%	10-56%
Canola	40%	10-50%	18-99%	68-100%
Range	5-50%	0-50%	0-99%	

- Left uncontrolled weeds, insects and disease can completely decimate the production of soybeans, corn and canola

Transforming technology

Canadian GM Crop Percentage



Prairie adoption benefits - 2006

- 85% of the canola grown on the prairies utilized minimum or zero tillage
- 83% of producers experienced increased soil moisture
- 86% experienced a reduction in soil erosion
- 41% were seeding canola onto erodible land
- 95% of farmers reported that weed control improved or stayed the same following GM canola
- 75% of farmers reported that the management of herbicide resistance in weeds was less of an issue

Sustainability drivers

To what extent do you believe each of these technologies facilitated the adoption of reduced tillage and summerfallow? (1 = did not at all facilitate, 10 = played a major role in facilitating)

	HT Canola (n=95)	Glyphosate (n=95)	Other HT Crops (n=90)
Mean	7.3	9.1	5.3

What percentage of your land would include summerfallow management in the absence of HT crops? (n=84)

Mean	24%
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Sask fertilizer use changes – 1991-94 & 2016-19

Period	Crop yield (bu/ac)	Fertilizer applied (lbs/ac)	Fertilizer rate (lbs/ac)	Crop acres (M)
1991-94	40	231	6	33.3
2016-19	51	467	9	40.5
Percent increase	28%	102%	50%	22%

- The intensity of fertilizer use has increased 29%, all achieved by market signals without the need for regulation

Changes in fertilizer components

Period	Nitrogen (N)	Phosphorus (P)	Potassium (K)	Sulfur (S)	Total (lbs/bu)
1991-94	4.1	1.4	0.7	0.8	7
2016-19	5.3	1.8	0.8	1.3	9.2
Percent increase	29%	29%	14%	63%	31%

- A 30% reduction of fertilizer emissions by 2030 is not, in any way, possible

Changes in fertilizer application

- From 1991-94, most fertilizer was applied as a pre-seed treatment or in conjunction with seeding
- The lack of equipment capable of in-crop application prevented fertilizers being applied at this time
- 45% of nitrogen applied was done post-harvest, increasing the potential to end up in watersheds
- From 2016-19, fertilizers are applied throughout the entire season, from pre-seed to post-harvest
- Nitrogen application – pre-seed (29%), with seed (27%), in-crop (13%) and post-harvest (31%)

Reduced chemical environmental impact

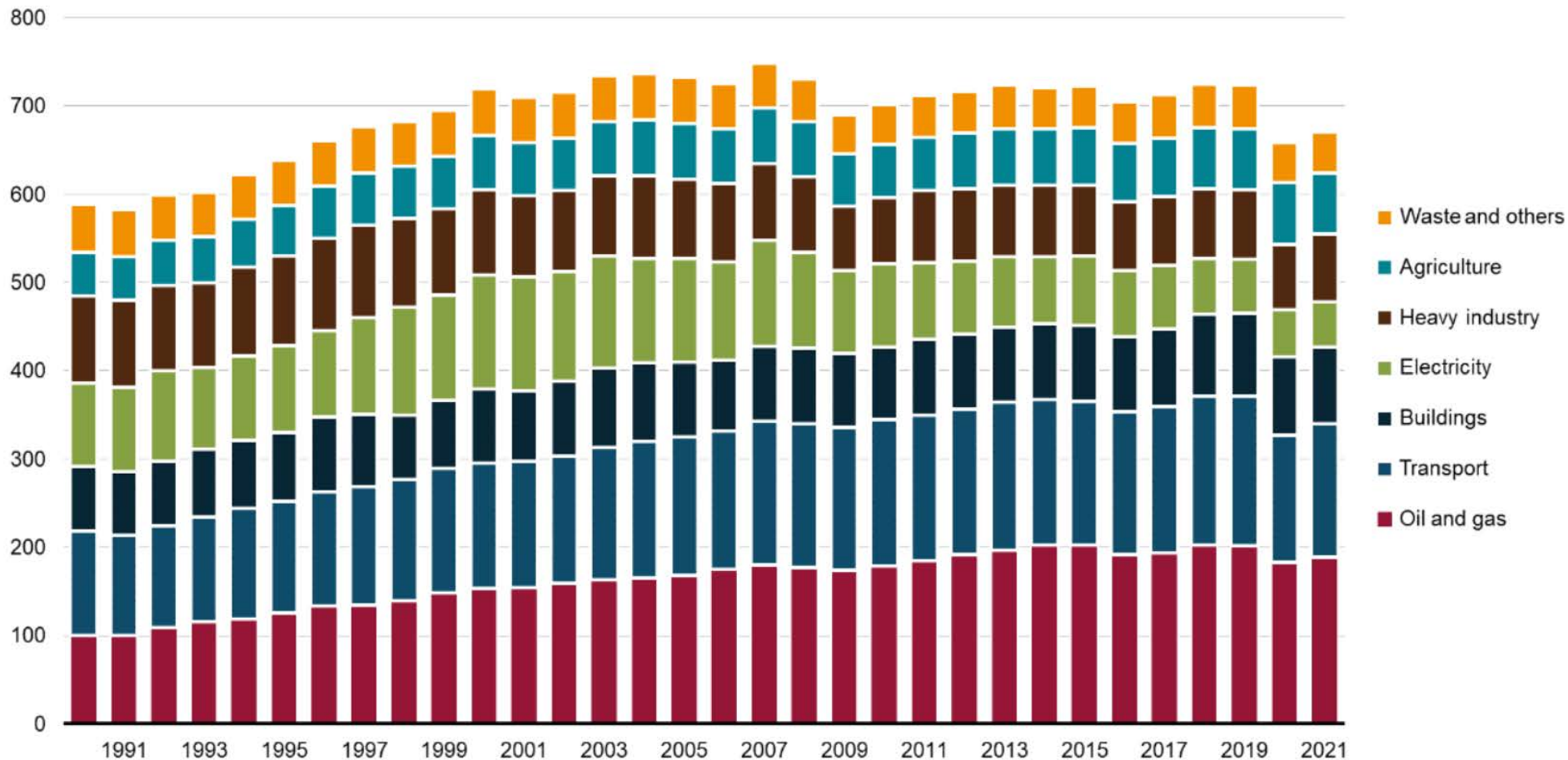
Comparison	1991-1994	2016-2019	Percentage change
EIQ/acre	2,733	954	-65%
EIQ _{farmers} /acre	2,062	528	-74%
EIQ _{consumers} /acre	727	235	-68%
EIQ _{ecology} /acre	5,390	1,972	-63%
Grams of ai/acre	215	118	-45%

GHG emission reductions

- Average Canadian car burns 2,000L of gas/year = 4,600 kg of CO₂ emissions/year
- 1,000 ha Sask farm in 1991-1994 would emit 21 times more carbon/year than the average car from tillage practices. By 2016-2019, this farm would be sequestering emissions from 98 cars
- Same farm would have sequestered emissions from 17 cars/year in 1991-1994 from removal of summerfallow, and by 2016-2019, from 336 cars
- Between 1991-94, a 1,000 ha farm would have released the emission from 4 cars/year, while producing crops
- Between 2016-19, this farm would have sequestered the emissions from 432 cars

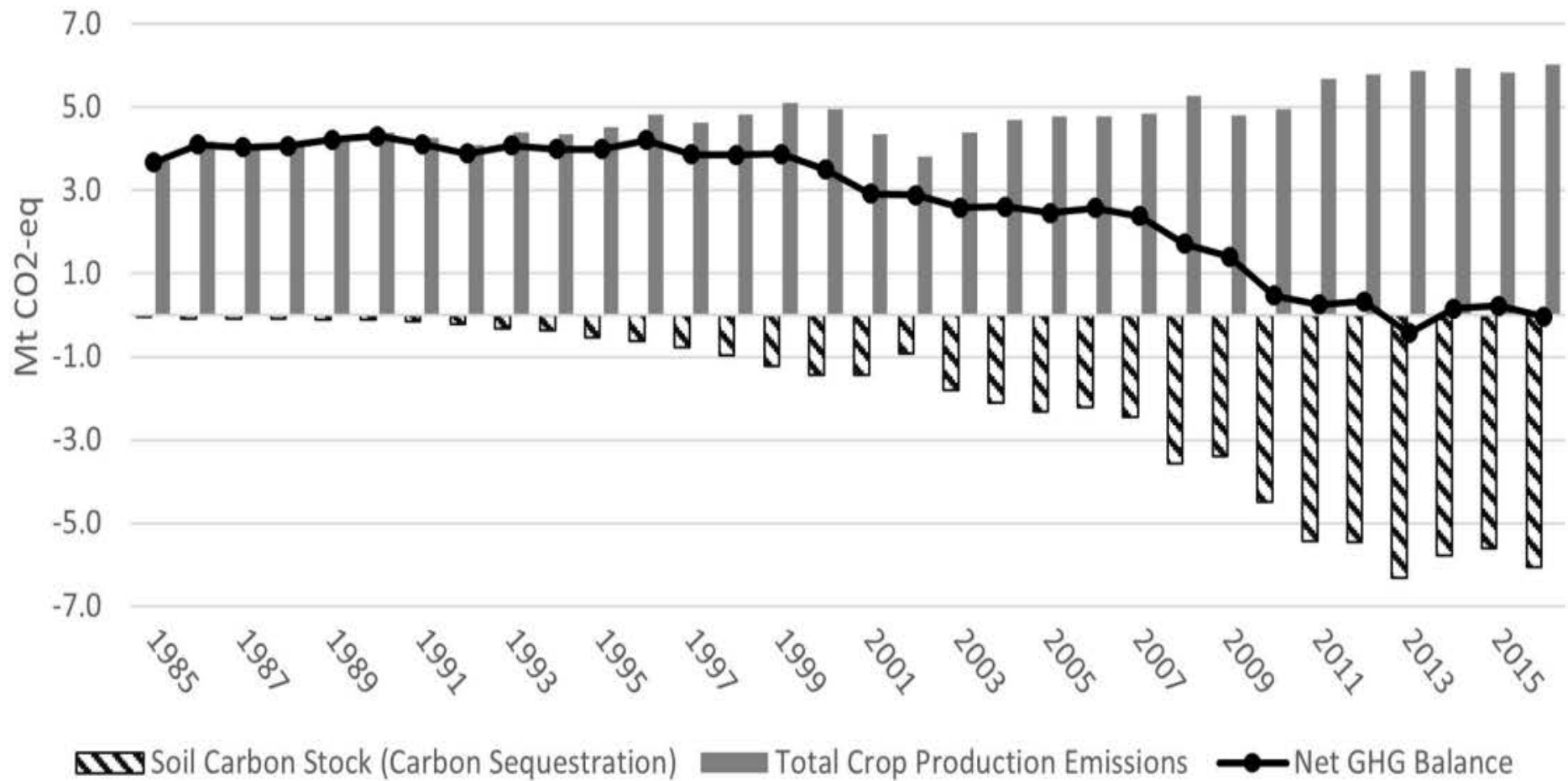
GHG emissions in Canada

Megatonnes of carbon dioxide equivalent



Source: ECCC 2023. <https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions.html>

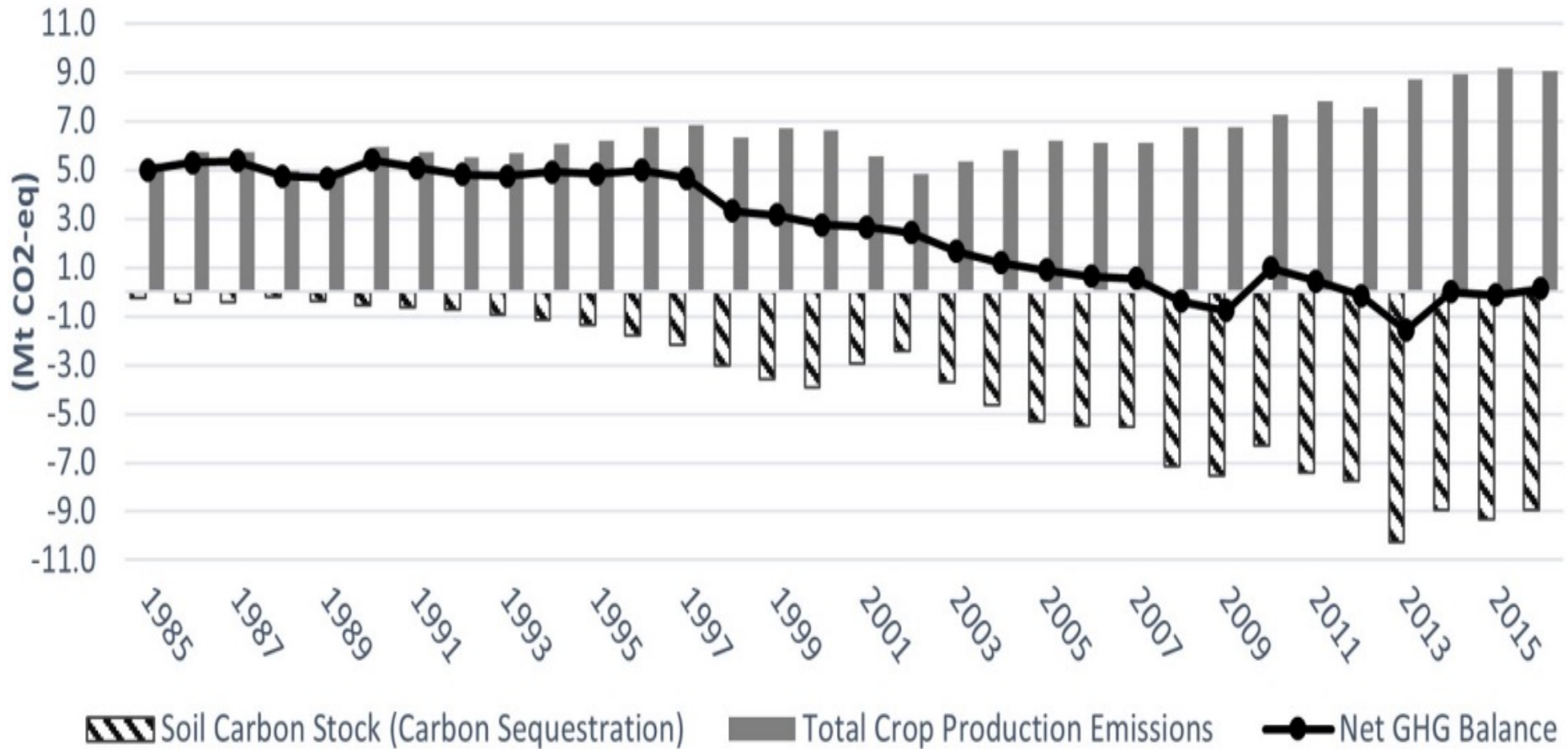
GHG changes in Alberta crop production



Reference: Awada et al. 2021.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0260946/>

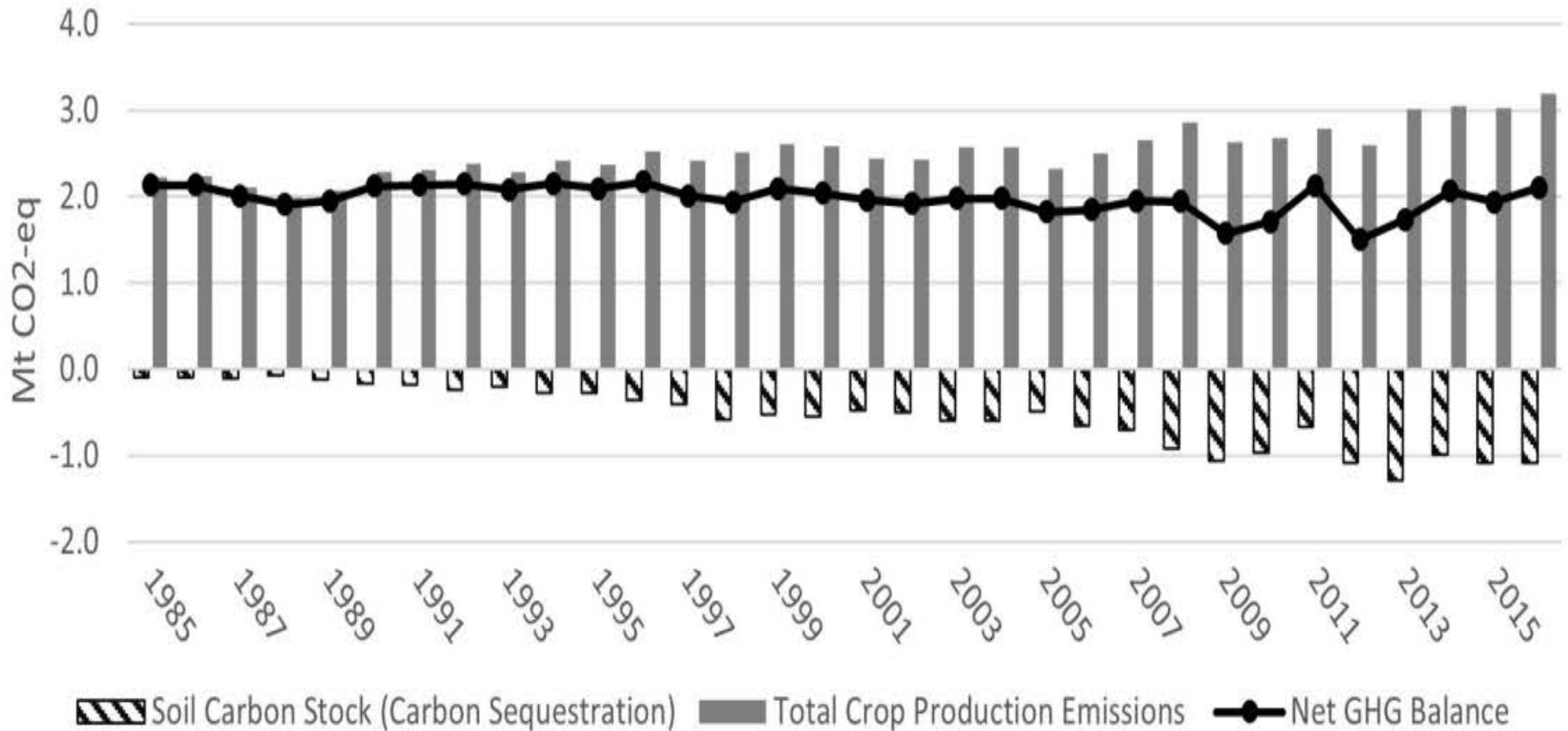
GHG changes in Sask crop production



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GHG changes in Manitoba crop production



Reference: Awada et al. 2021.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0260946/>

Prairie agriculture and the Paris Accord

- The Paris Accord uses 2005 as the baseline for Canada's Paris commitment
- Net prairie emissions have decreased by 53% since 2005
- This surpasses the 30% requirements to achieve the 2030 target
- Prairie agriculture needs to be recognized for this significant achievement
- Tillage is commonly used in many other provinces

Food system transformations

- A great deal of international and national discussion is underway regarding complete overhauls of food systems
- In 2021, the UN held a global Food Systems Summit to discuss how to transform food production
- We already have transformed our food systems
- We produce higher yields
- We use less fertilizer per bushel of food produced
- The impacts of chemicals are half of what they used to be
- The sustainability of food has never been higher
- How much more transformation is required?

Systems approach is essential

- Increased crop and food sustainability is based on an integrated systems approach
- Starts with cutting edge plant breeding technologies like genetically modification and gene editing
- Requires efficient use of fertilizer and chemical inputs
- Enhanced by adoption of variable rate application equipment, soil testing and field mapping
- Regulatory burdens or restrictions on one component will have adverse impacts on the entire system, resulting in reduced sustainability

Carbon smart agriculture

- Carbon is going to be an increasingly important market
- Through ECCC, Canada reports to the International Panel on Climate Change
- Prairie crop agriculture is a net carbon sink, yet gets no recognition for this
- If voluntary mandates aren't based on evidence, what happens when they can't be met?
- Soybean research in the USA has produced a variety that sequesters 10% more carbon and has 25% higher yield

Transforming food system knowledge

- The public is clearly indicating they prefer to purchase sustainably branded food products
- Canadian agriculture has made significant sustainability advances
- We now need to communicate this in ways that resonate with Canadians
- Need to communicate on platforms where consumers look for information, i.e. Twitter, Facebook, Instagram, etc.

Key take aways

- Risk appropriate regulation is crucial
- Canadians are willing to support innovations like gene editing if they see the sustainability benefits
- Evidence refutes NGO messaging and surveys confirm the public responds to academic science communication
- Canadian agriculture is among the most sustainable anywhere and we need to better brand it as such

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INDUSTRY FUNDED RESEARCH CHAIR IN AGRI-FOOD INNOVATION