



Agriculture and
Agri-Food Canada

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Climate Change:

Evidence, Impacts, Public & Private Responses, Future Exigencies and Policy Options

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Pacific Food System Committee
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Canada

- enumerate and examine evidence of climate change within Canada
- discuss how Canada's agri-food system is or might be impacted upon
- provide some insights and examples as to how the private and public institutions are responding
- consider future exigencies and conceivable scenarios
- explore present and future policy options

Evidence of climate change

Current Situation

- The number of storm events appear to have increased, as has their intensity
- The frequency and severity of droughts have increased
- Several of the past ten years have ranked among the warmest on record
- Glaciers and permafrost are in decline, while Arctic waterways are becoming more passable
- Number of “frost free” days and “degree days” have increased, winter kill declining
- Diseases and pests have been surviving recent, more moderate, winters
- Forestry, fisheries and other marine sectors are already showing some signs of impact



Photo Credit: Parks Canada (circa 1898)

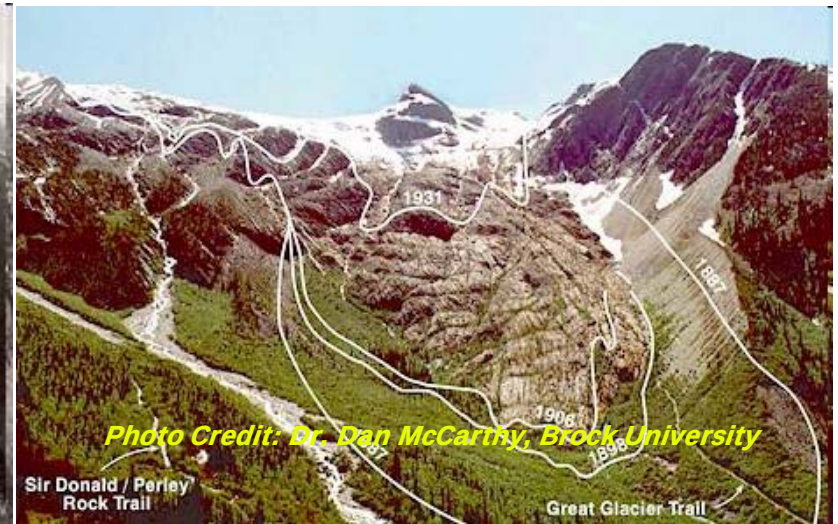


Photo Credit: Dr. Dan McCarthy, Brock University

Evidence of climate change

Prospects

- With rising incidence and intensity of storms, accelerate coastal erosion and flooding may result, affecting coastal communities, infrastructure and industries.
- Water resources will come under increasing pressure as conditions shift and demands change in response to both climatic and non-climatic factors.
- Impacts on marine fisheries will extend beyond fish species to other sectors like transportation, marketing, occupational health and safety.
- While higher temperatures and longer growing seasons could benefit agriculture and forestry, associated increases in disturbances and moisture stress pose concerns.
- In central Canada, climate-related events, such as extreme weather, heat waves and smog episodes look likely to result in ecological changes, support the spread of vector-borne diseases, posing health risks to plants, animals and humans.
- The frequency and severity of fires and pest infestations look likely to rise if strategies for mitigation are not embraced.

Current and prospective impacts

- Climate change has and will impact upon all economic sectors, eco-systems, infrastructure, and plant, animal and human health.
- For the agri-food sector there will be a series of impacts, but their incidence and magnitude depend on current policy choices.
- Therefore, future paths and outcomes will be affected by the actions we take or fail to take now. Consequently, national and international efforts have often focussed on a range of possible outcomes or exigencies.

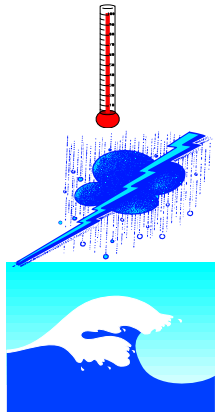
The future is not some place we are going to, but is one we are helping to create. The paths to it are not found but made, and this activity of making them changes both the maker and the destination.

- John Schaar

Current and prospective impacts

Impacts are multi-dimensional

Climate Changes

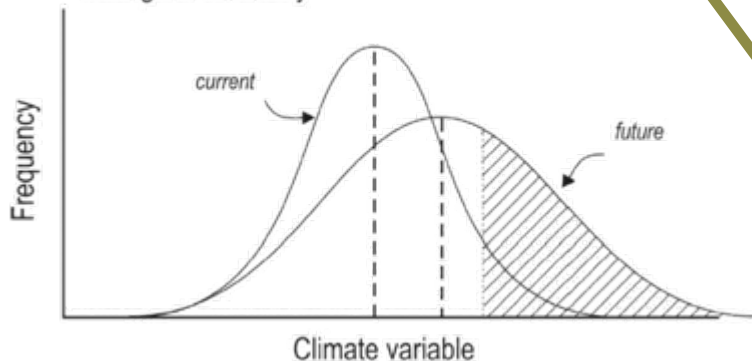


Temperature

Precipitation

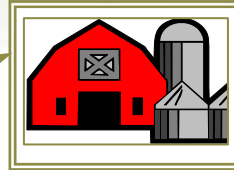
Sea Level Rise

Change in mean
Change in variability



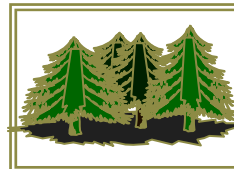
Health Impacts

Weather-related Mortality
Infectious Diseases
Air Quality-Respiratory Illnesses



Agriculture Impacts

Crop yields, Livestock performance
Input requirements, Irrigation demands



Forest Impacts

Change in forest composition
Shift geographic range of forests
Forest Health and Productivity



Water Resource Impacts

Changes in water supply
Water quality
Increased competition for water



Impacts on Coastal Areas

Erosion of beaches
Inundate coastal lands
Costs to defend coastal communities



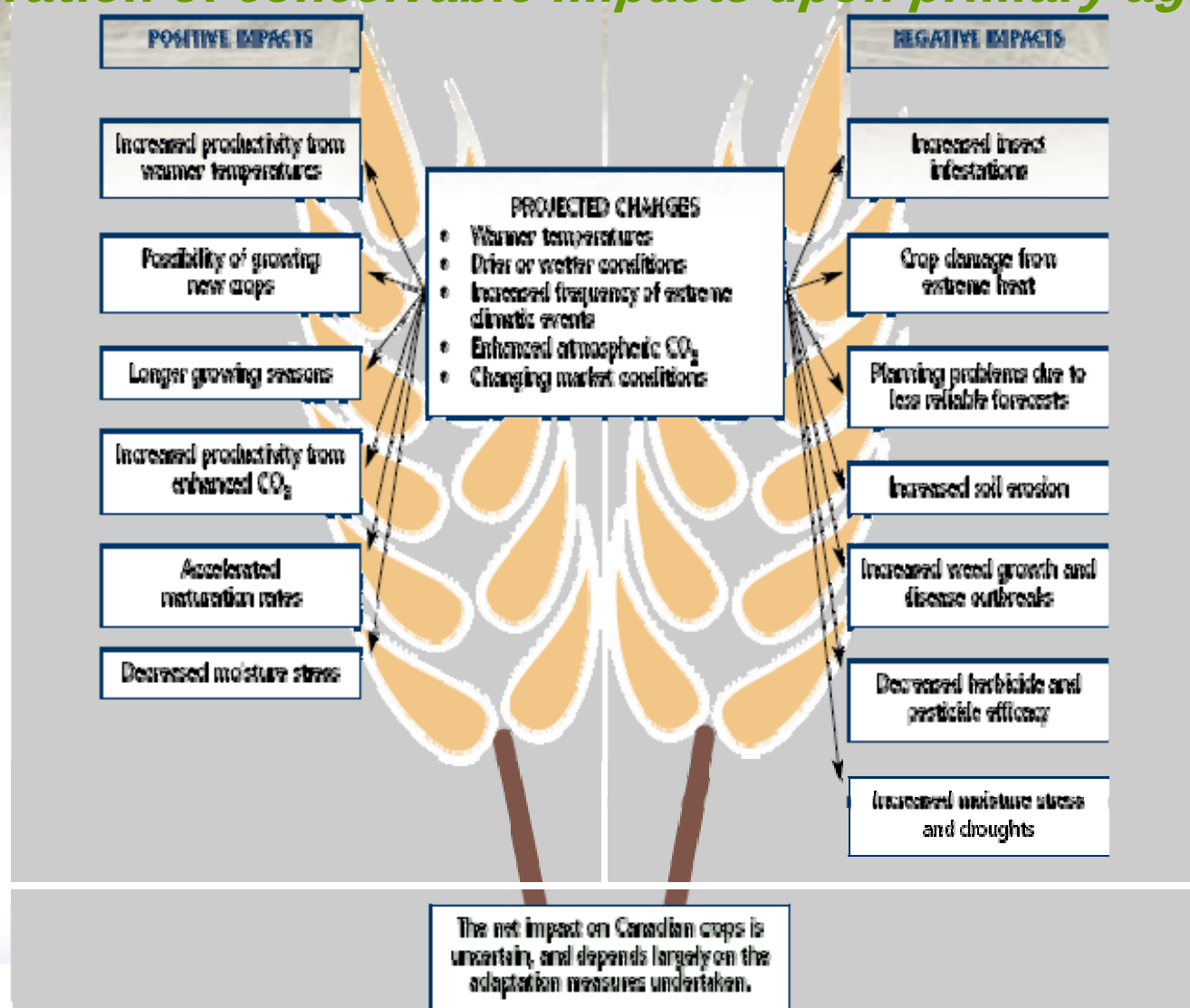
Species and Natural Areas

Shift in ecological zones
Loss of habitat and species
Spread of invasive species

Source: adapted from the U.S.
Environmental Protection Agency

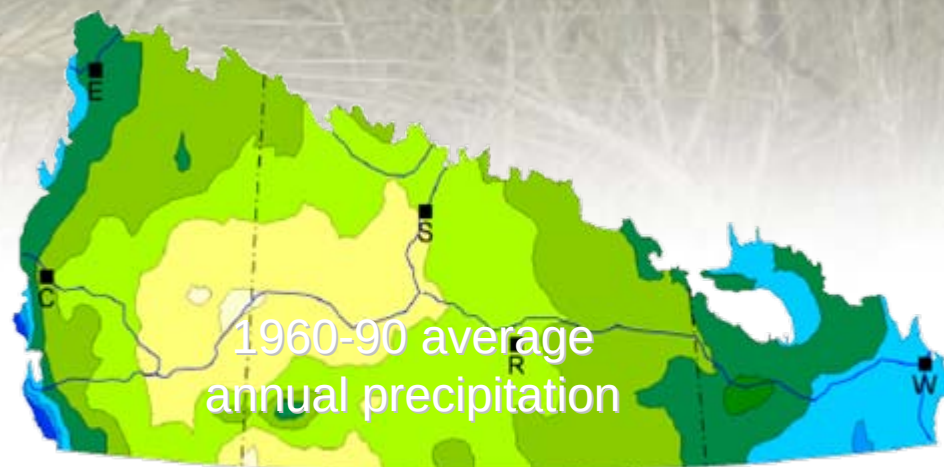
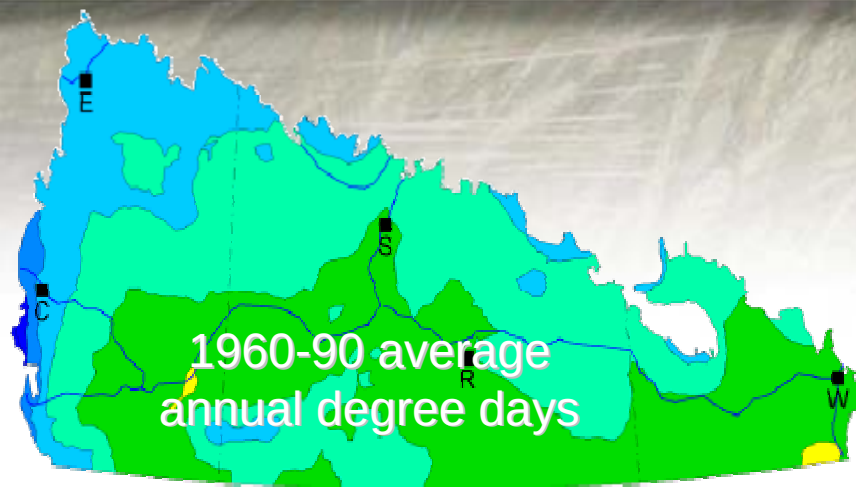
Current and prospective impacts

An enumeration of conceivable impacts upon primary agriculture

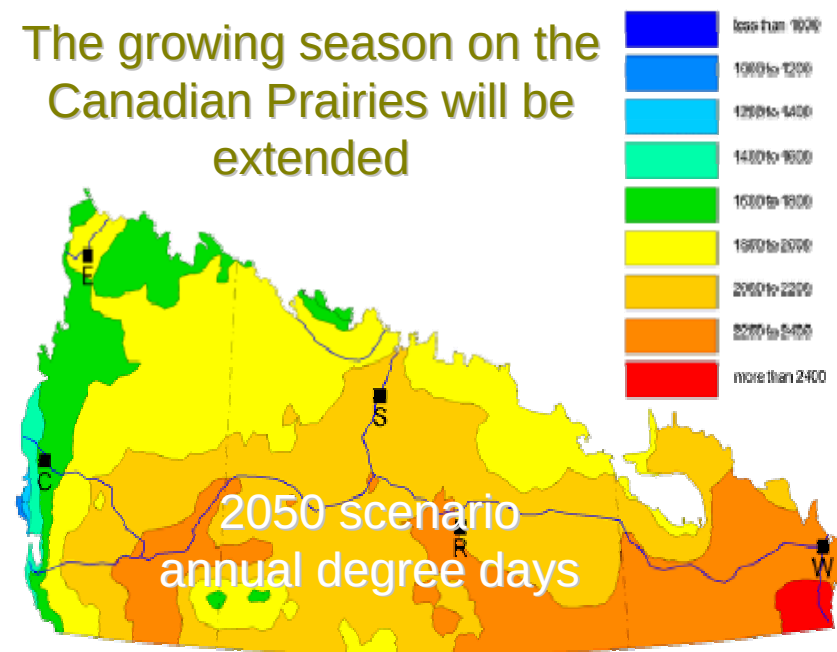


Source: Agriculture and Agri-Food Canada, Government of Canada

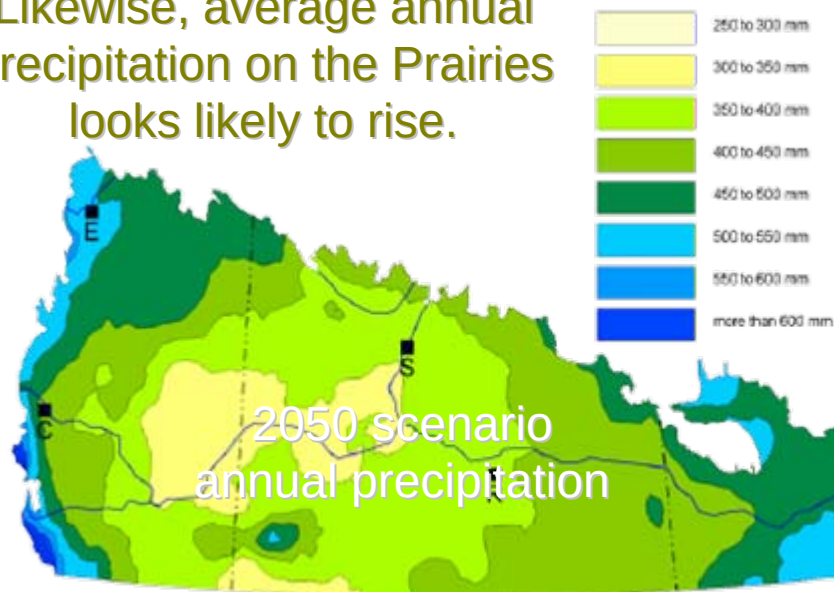
Current and prospective impacts



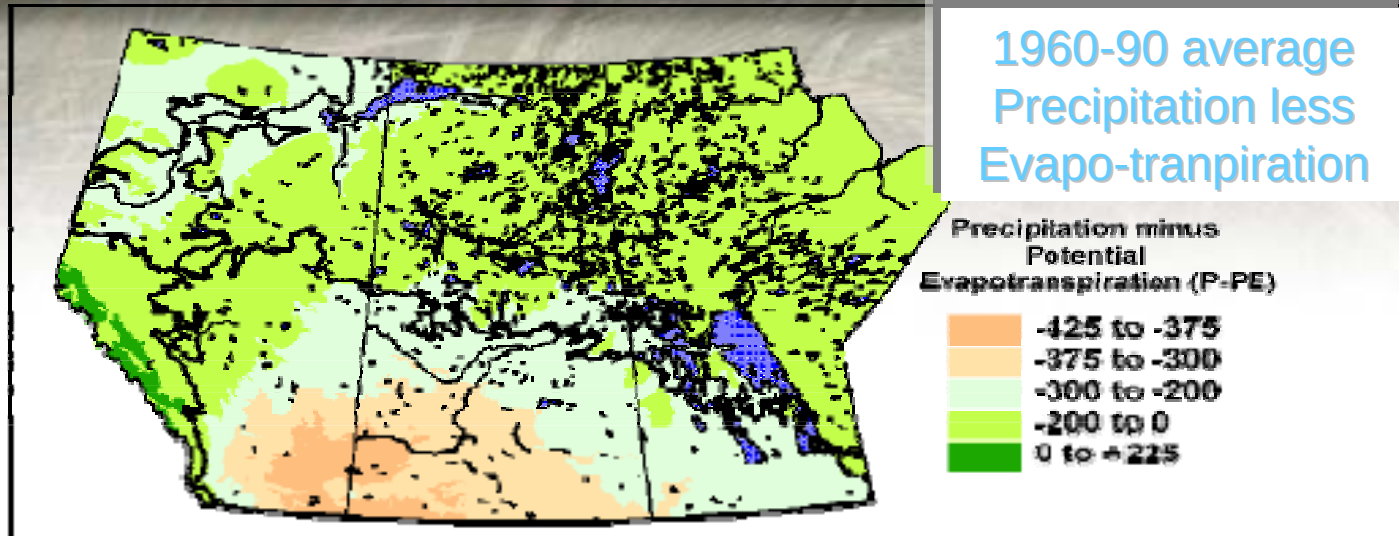
The growing season on the Canadian Prairies will be extended



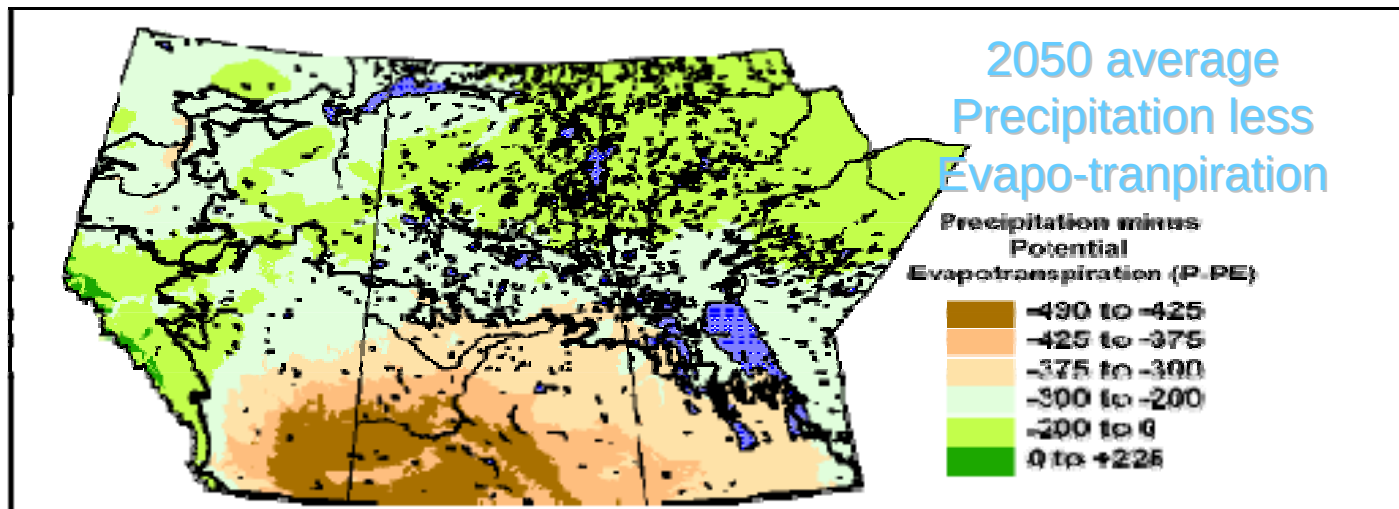
Likewise, average annual precipitation on the Prairies looks likely to rise.



Current and prospective impacts



But the frequency and magnitude of water scarcity on the Prairies may rise due to evapotranspiration

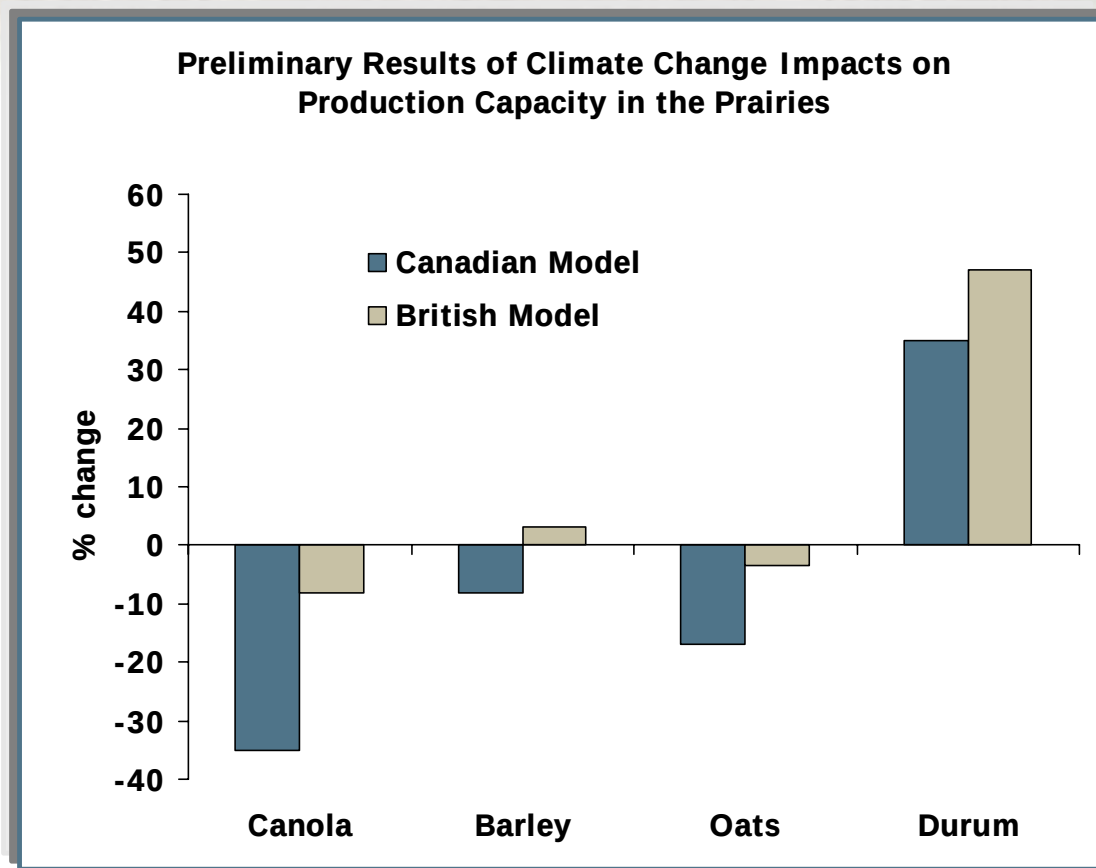


Current and prospective impacts

Different impacts are anticipated for different sectors

Based on the “a world divided into economic regions” IPCC scenario II, with no adaptation

- The Canadian General Circulation Model generates a more extreme outcome with annual mean temperature increases by 2.0—4.5 degrees Celsius from a 1961-1990 average.
- The British Model generates a more moderate outcome with annual mean temperature increases of 1.5—3.0 degrees C from a 1961-1990 average.
- Preliminary results indicate that if farmers only respond to changes in yield, with no changes in prices and technology:
 - ❖ Production of durum would increase as it likes the more arid conditions
 - ❖ Production of canola would decrease due to the more arid conditions in parts of the Prairies



Current and prospective impacts

60 to 70
50 to 60
40 to 50
30 to 40
20 to 30
10 to 20
0 to 10
0 to -10
-10 to -20
-20 to -30
-30 to -40



Ontario will also experience increases in the frequency and magnitude of water scarcity.

Source: Ontario Ministry of Natural Resource

Current and prospective impacts

Water scarcity and other water governance issues are of critical concern to agriculture and supporting sectors in light of climate change

Potential Impacts of climate change on water resources

Region	Potential changes	Associated concerns
Yukon and coastal British Columbia	Increased spring flood risks (BC), impacts on river flows caused by glacier retreat and disappearance	Reduced hydroelectric potential, ecological impacts (including fisheries), damage to infrastructure, water apportionment
Rocky Mountains	Rise in winter snowline in winter-spring, possible increase in snowfall, more frequent rain-on-snow events	Increased risk of flooding and avalanches
	Decrease in summer streamflow and other changes in seasonal streamflow	Ecological impacts, impacts on tourism and recreation
Prairies	Changes in annual streamflow, possible large declines in summer streamflow	Implications for agriculture, hydroelectric generation, ecosystems and water apportionment
	Increased likelihood of severe drought, increasing aridity in semiarid zones	Losses in agricultural production, changes in land use
	Increases or decreases in irrigation demand and water availability	Uncertain impacts on farm sector incomes, groundwater, streamflow and water quality
Great Lakes basin	Possible precipitation increases, coupled with increased evaporation leading to reduced runoff and declines in lake levels	Impacts on hydroelectric generation, shoreline infrastructure, shipping and recreation
	Decreased lake-ice extent, including some years without ice cover	Ecological impacts, increased water loss through evaporation and impacts on navigation
Atlantic	Decreased amount and duration of snow cover	Smaller spring floods, lower summer flows
	Changes in the magnitude and timing of ice freeze-up and break-up	Implications for spring flooding and coastal erosion
	Possible large reductions in streamflow	Ecological impacts, water apportionment issues, hydroelectric potential

Public and Private Responses

Public and private actors employ a range of actions, ranging from attempts at mitigation to doing nothing, from adaptation and adjustment to efforts at building resilience in the face of wide-ranging exigencies.

Adaptation strategies

Category	Explanation	Example
Bear the costs	Do nothing to reduce vulnerability and absorb losses	Allow household lawns and gardens to wither
Prevent the loss	Adopt measures to reduce vulnerability	Protect coastal communities with seawalls or groins
Spread or share the loss	Spread burden of losses across different systems or populations	Crop insurance
Change the activity	Stop activities that are not sustainable under the new climate, and substitute with other activities	Make ski resort a four-season facility to attract tourists year round
Change the location	Move the activity or system	Move ice fishing operations farther north
Enhance adaptive capacity	Enhance the resiliency of the system to improve its ability to deal with stress	Reduce non-climatic stresses, such as pollution

Public and Private Responses

Existing and potential responses can be placed into the following categories:

- **technological developments**
- **farm production practices**
- **farm financial management**
- **government programs & insurance**

Technological developments and Research Emphasis

- **new crop varieties**
- **water governance innovations**
- **improving weather and climate information systems**
- **soil conservation**
- **drought tolerant emphasis**
- **building “resilience” into agronomic systems**
- **resource management innovations to deal with changing temperatures, precipitation and other climatic and agronomic conditions**

Public and Private Responses

Farm production practices

- **crop diversification**
- **diversify livestock types, alter production approach**
- **irrigation, water allocation and management, building in resilience under drought conditions**
- **new approaches to deal with diseases & pests**
- **land use may be altered to reflect changing growing conditions and water scarcity**
- **Fallow and tillage practices**

Public and Private Responses

Farm financial management

- ~~extremes will be more frequent~~ and of greater amplitude
- diversify crops grown and crop shares to spread risk
- invest in crop shares and futures trading to reduce risks of income loss
- diversify sources of household income to mitigate climate related income risks
- participate in business risk management programs to reduce risks of income loss
- adapt or adjust into or out of farming depending on whether climate change has beneficial or detrimental agronomic and weather-related impacts

Public and Private Responses

Programs, Policies and Insurance

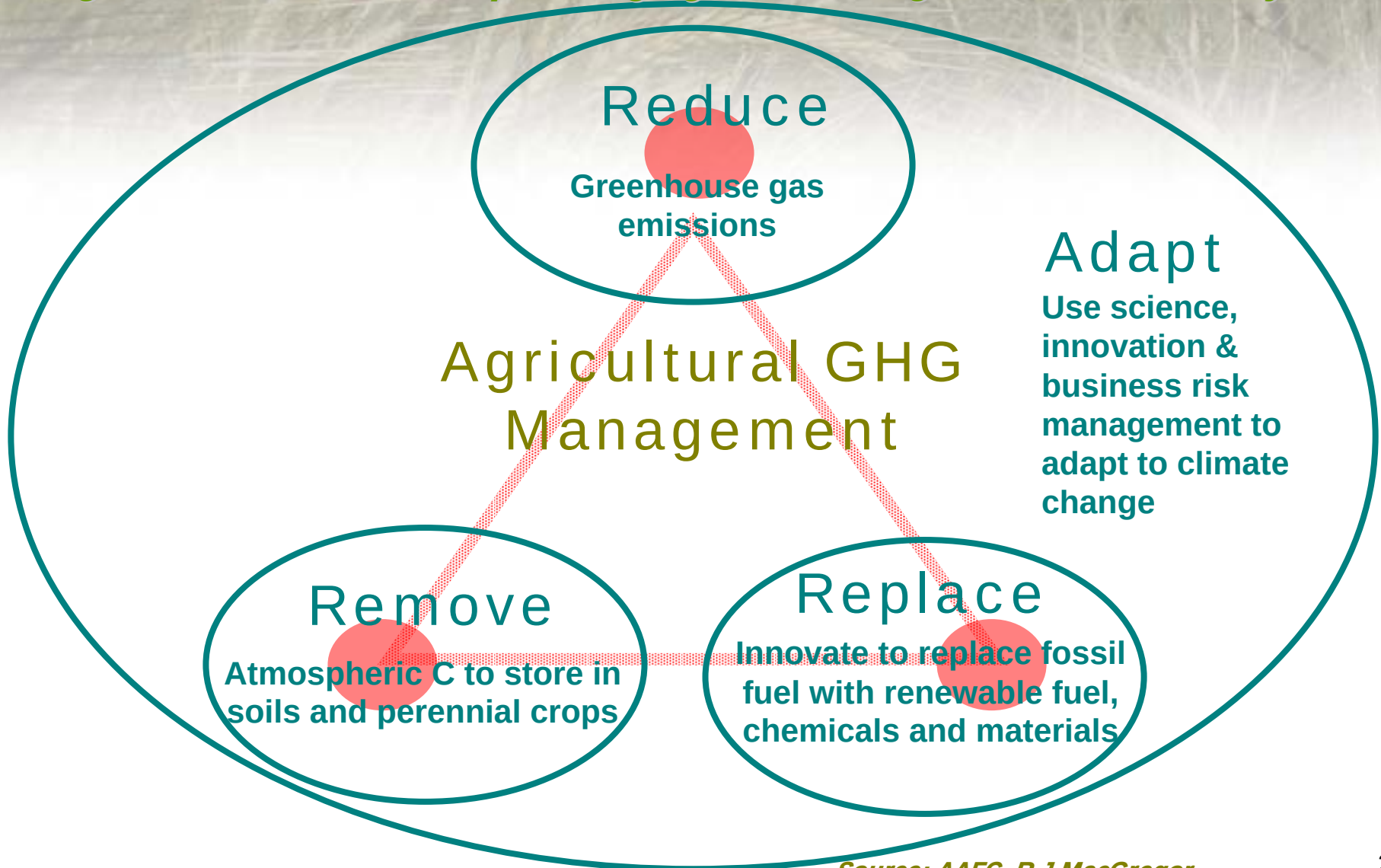
- **Agricultural policies**
 - ❖ **Modify to influence husbandry practices/ risk management related to climate change**
 - ❖ **Importance of production and market neutrality under new incentive systems**
 - ❖ **Safety nets which do not limit choice as to crops, enterprises or production technology are preferable as they enable rather than preclude adaptation and adjustment**
- **Resource management programs**
 - ❖ **Implement programs which positively influence resource (land, water) use and management practices**
- **Inspection regulations and services need to reflect new pests and disease risks**
- **Income insurance, production insurance**
 - ❖ **Modify to influence farm level risk management practices. Encourage private insurance which will help deal with climate related risks to production, infrastructure and income**

Prospects, Exigencies, Future Policy Options

- Climate change is about managing carbon and nitrogen cycles globally
 - ❖ **All nations, industries and citizens need to learn to sustainably manage carbon, nitrogen and other sources of greenhouse gases**
- Agriculture is based on using energy from the sun for photosynthesis to transform carbon & nitrogen into food, fibre and bio-products for the consumption of humans and domestic livestock
 - ❖ **Agriculture has an important role in GHG cycles, accounting for 1/5th of global emissions. It also can serve as a “sink”, if appropriate incentives are in place.**
 - ❖ **The challenge is to learn to profitably recycle rather than extract carbon and nitrogen**
- National policies link goals for environmental management and innovation to better manage natural resources, based on carbon and nitrogen cycles

Prospects, Exigencies, Future Policy Options

The agri-food sector can help manage greenhouse gases in several ways...

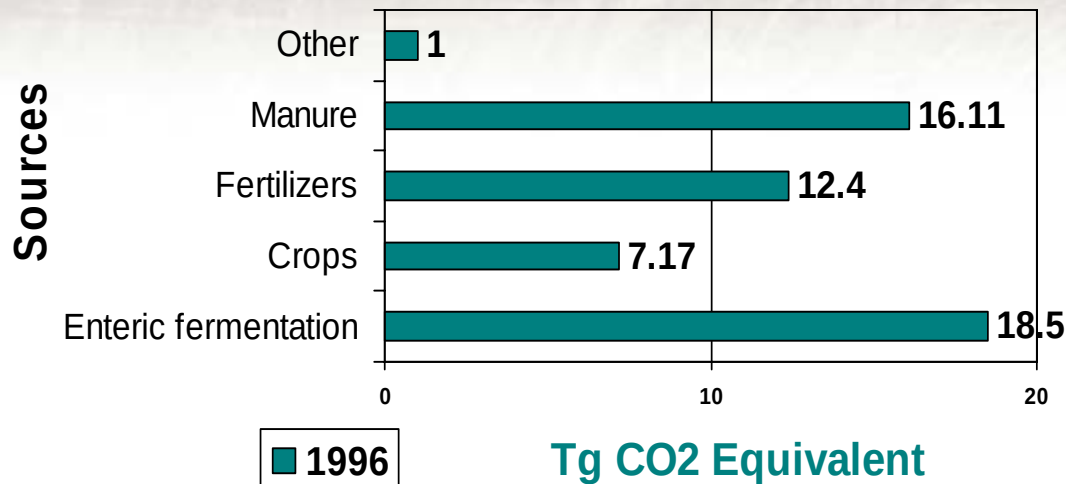


Source: AAFC, R J MacGregor

Prospects, Exigencies, Future Policy Options

... as agriculture's biological processes make it different from other energy users

Agriculture Emission Sources



Gas	% of Emissions
CO ₂	3%
CH ₄	41%
N ₂ O	56%

Agriculture's primary energy source is the sun, not fossil fuels.

Perspective: emissions actually represent the inefficient use of resources:

- ❖ *Increasing efficiency can concurrently improve economic performance and reduce agriculture's environmental footprint. "Dirty Farming" is not in the sector's or farmers' collective interests as it affects their bottom line.*
- ❖ *So, initiatives which improve nutrient use efficiency in crops or the efficiency of livestock feeding also have positive environmental impacts.*

Prospects, Exigencies, Future Policy Options

So, agriculture has some emissions mitigation or reduction capabilities

Action	Estimated Result(2008-12)
• Current role as a carbon sink	10 Mt/y
• Current programs	
❖ AP2000, Greencover, APF & Growing Forward	5.8 Mt/y
• Prospective emissions reductions	1 Mt/y
• Incentives to expand sinks / enviro services	9 Mt/y
TOTAL	24.8 Mt/y

Source: AAFC, R J MacGregor

Prospects, Exigencies, Future Policy Options

Offsets have recently been embraced as a positive incentive mechanism

- The agri-food sector indicated they preferred a market mechanism to suasion, fiat and more traditional regulatory and policy instruments
- The “door is open” to developing an offset system that will work for agriculture domestically. Kyoto article 3.4 was a key to unlocking this door
- Work is now underway to construct an operational system.
 - ❖ Offsets must be real
 - Need to provide sinks or emission reductions that will count and be counted
 - IPCC rules will be important
 - ❖ Offsets must be measurable and verifiable
 - Science is key. We have a start, but more required

***Suasion and good intentions alone have not been adequate.
To be successful, offsets must make economic sense, as well as
environmental sense.***

Prospects, Exigencies, Future Policy Options

In looking forward, it is worthwhile thinking about the pace of change, vulnerability and the determinants of “resilience” and adaptive capacity

Determinant	Explanation
Economic resources	Greater economic resources increase adaptive capacity Lack of financial resources limits adaptation options
Technology	Lack of technology limits range of potential adaptation options Less technologically advanced regions are less likely to develop and/or implement technological adaptations
Information and skills	Lack of informed, skilled and trained personnel reduces adaptive capacity Greater access to information increases likelihood of timely and appropriate adaptation
Infrastructure	Greater variety of infrastructure can enhance adaptive capacity, since it provides more options Characteristics and location of infrastructure also affect adaptive capacity
Institutions	Well-developed social institutions help to reduce impacts of climate-related risks, and therefore increase adaptive capacity Policies and regulations have constrain or enhance adaptive capacity
Equity	Equitable distribution of resources increases adaptive capacity Both availability of, and entitlement to, resources is important

Source: Smit et al

Prospects, Exigencies, Future Policy Options

Some thoughts as to things that could be worked on going forward.

- **Agriculture & Mitigation.** To the extent that agriculture serves as a GHG “sink”, this needs to be encouraged, as do other means of mitigating / reducing emissions.
- **Water Governance** issues will be key going forward. Advance thinking as to how to prioritize and resolve circumstances of competition and conflict is warranted.
- **Building Resilience.** Develop crops, cropping systems, rotations, management approaches that are more resilient in the face of stresses and changing conditions.
 - ❖ Drought tolerance and diversity will be key.
 - ❖ Treating soil, water, organic matter, species and hybrids more holistically.
- **Harness the Market.** It is important to harness market forces and not displace them. Efforts to internalize externalities in commercial decisions are warranted.
 - ❖ Measures which incorporate “carbon footprints” and “water footprints” into market signals have the potential to foster desirable behavior while keeping administrative burden low.
- **Safety Nets** need to reflect and respond to the new realities.
 - ❖ Attempts to “pick winners” are unlikely to be successful. Whole farm approaches will not get in the way of moves to “resilience” as they are less likely to retard adjustment to the new environment than commodity specific programs.

Perspective

- ***We need to motivate change to develop and promote the use of today's best technology & practices. This will make us more efficient.***
- ***Programs and policies can motivate change. They also need to assist with the adjustments needed to make them economically and politically tolerable.***

A photograph of a grassy field with a white horizontal line across the middle. The grass is green and yellow, and the sky is blue.

Thank you!