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Sustainable growth, environmental goods and services and market failures in agriculture

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Optimizing Land Use for Sustainable Growth: a CAPI Dialogue

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PRELIMINARY RESULTS – DO NOT CITE

Outline

1. What constitutes an externality?
2. Negative externalities
3. Positive externalities
4. Policy implications

Negative externalities

- Greenhouse gases
- Ammonia
- Particulate matter
- Nitrogen water pollution
- Phosphorous water pollution
- Coliforms and pathogen contamination
- Soil
- Biodiversity and wildlife
- Human health

Positive externalities

- Erosion control
- Biodiversity and wildlife habitation
- Landscape aesthetic
- Nutrient recycling

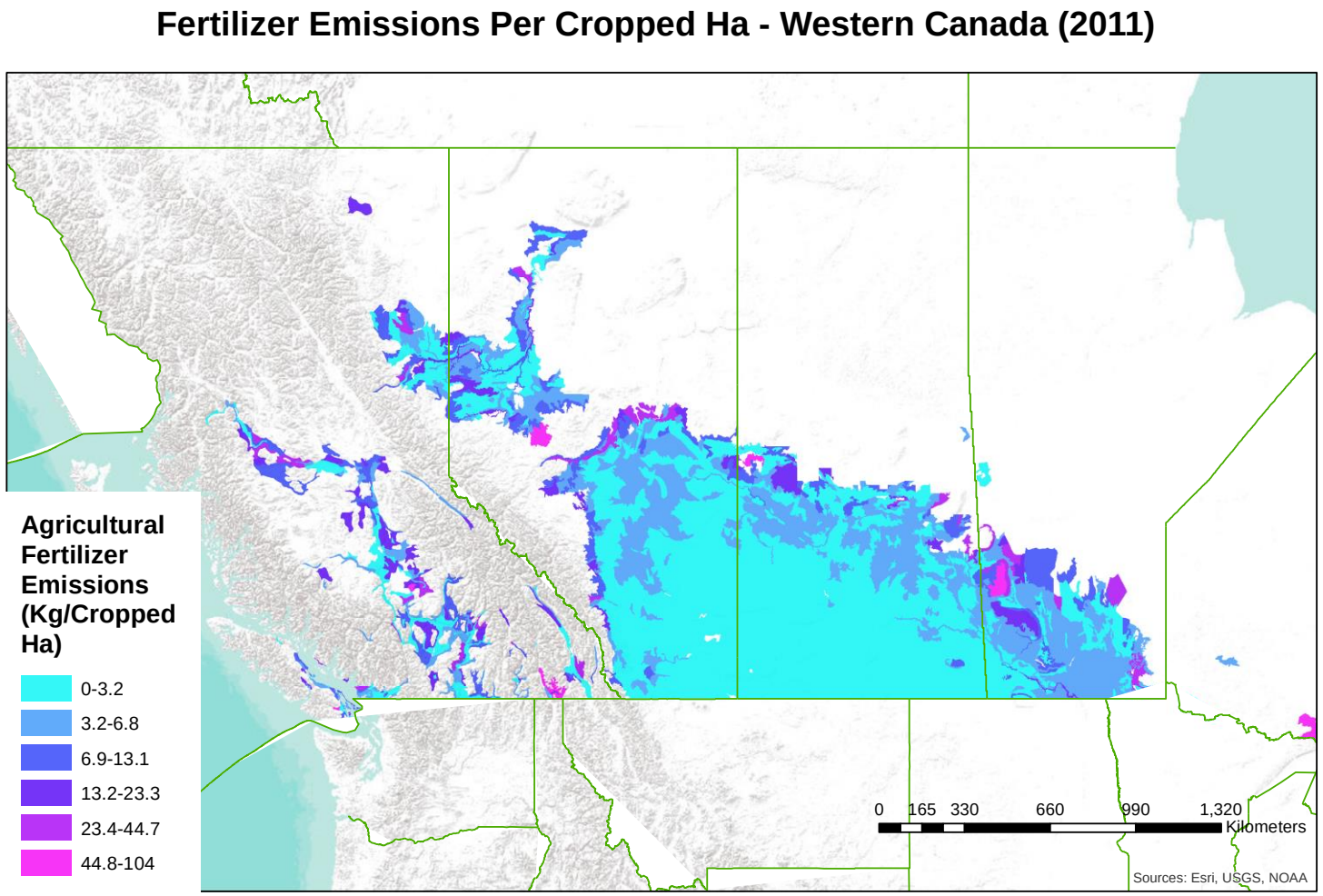
Defining externalities

OECD Definition:

Environmental externalities refer to the economic concept of uncompensated environmental effects of production and consumption that affect consumer utility and enterprise cost outside the market mechanism.

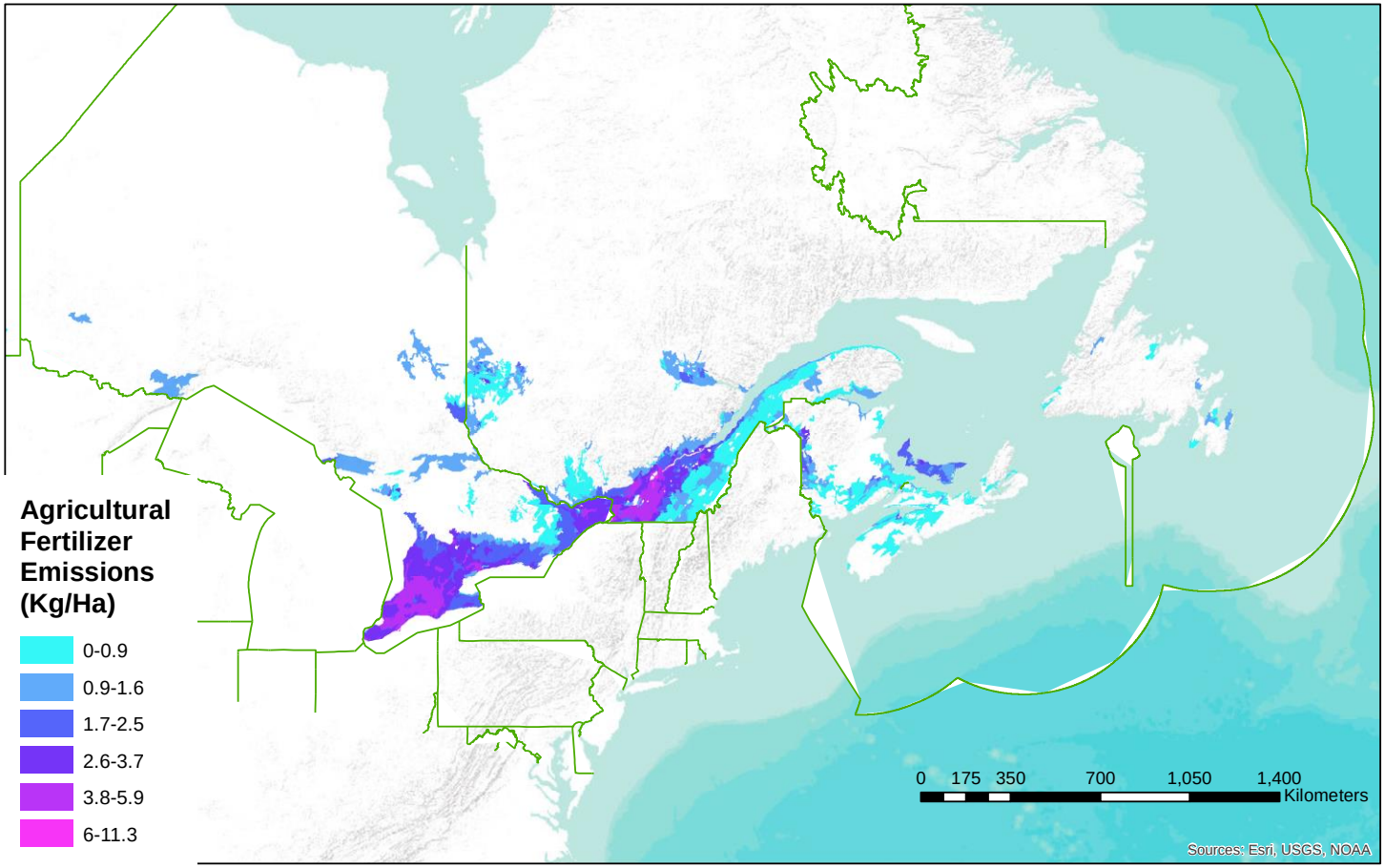
As a consequence of negative externalities, private costs of production tend to be lower than its “social” cost. It is the aim of the “polluter/user-pays” principle to prompt households and enterprises to internalize externalities in their plans and budgets.

Fertilizer Intensity – A Driver of Externalities

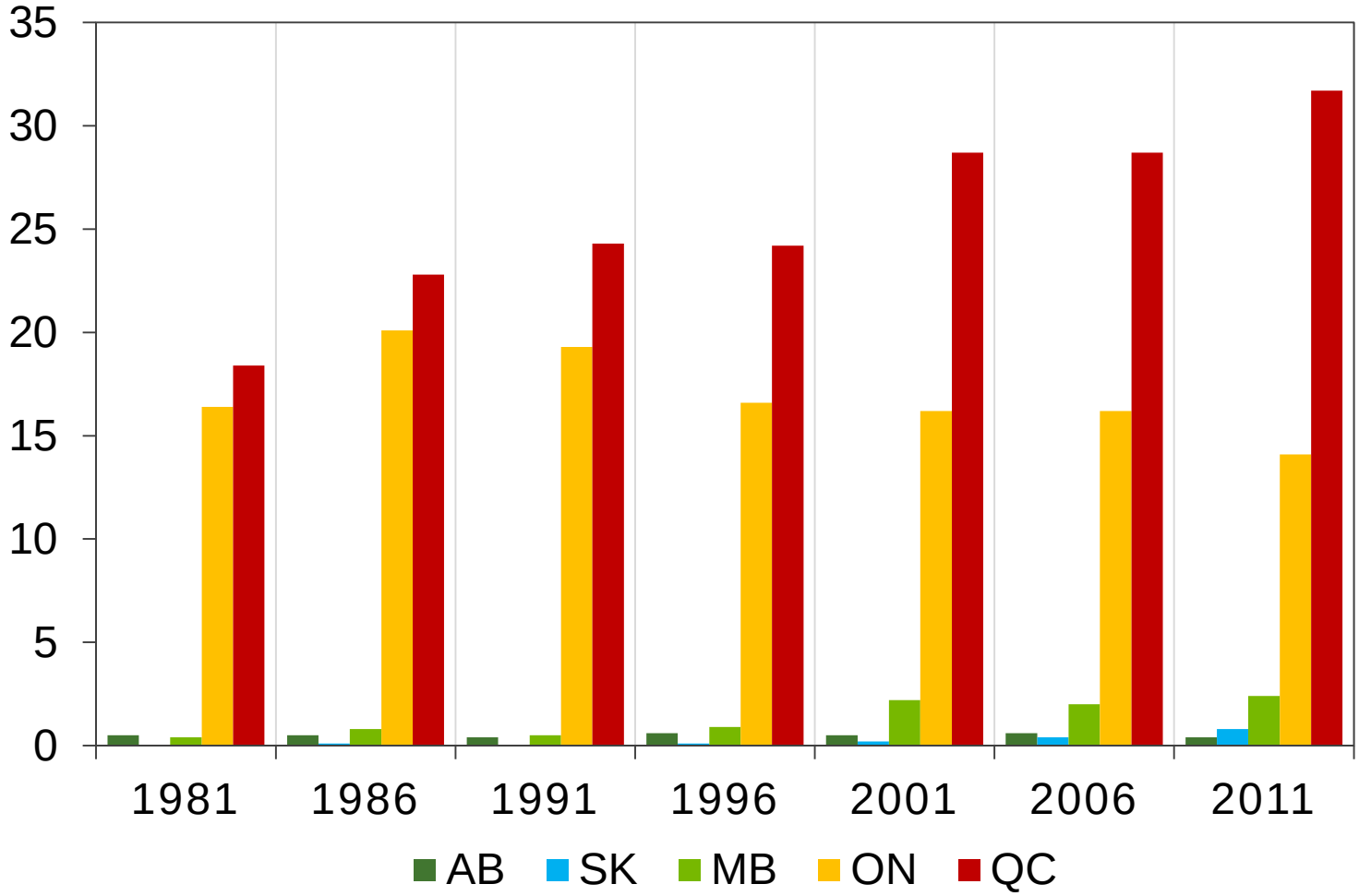


Fertilizer Intensity – A Driver of Externalities

Fertilizer Emissions Per Ha (2011) - Central and Eastern Canada



Kilograms of nitrogen lost per hectare



Particulate Matter

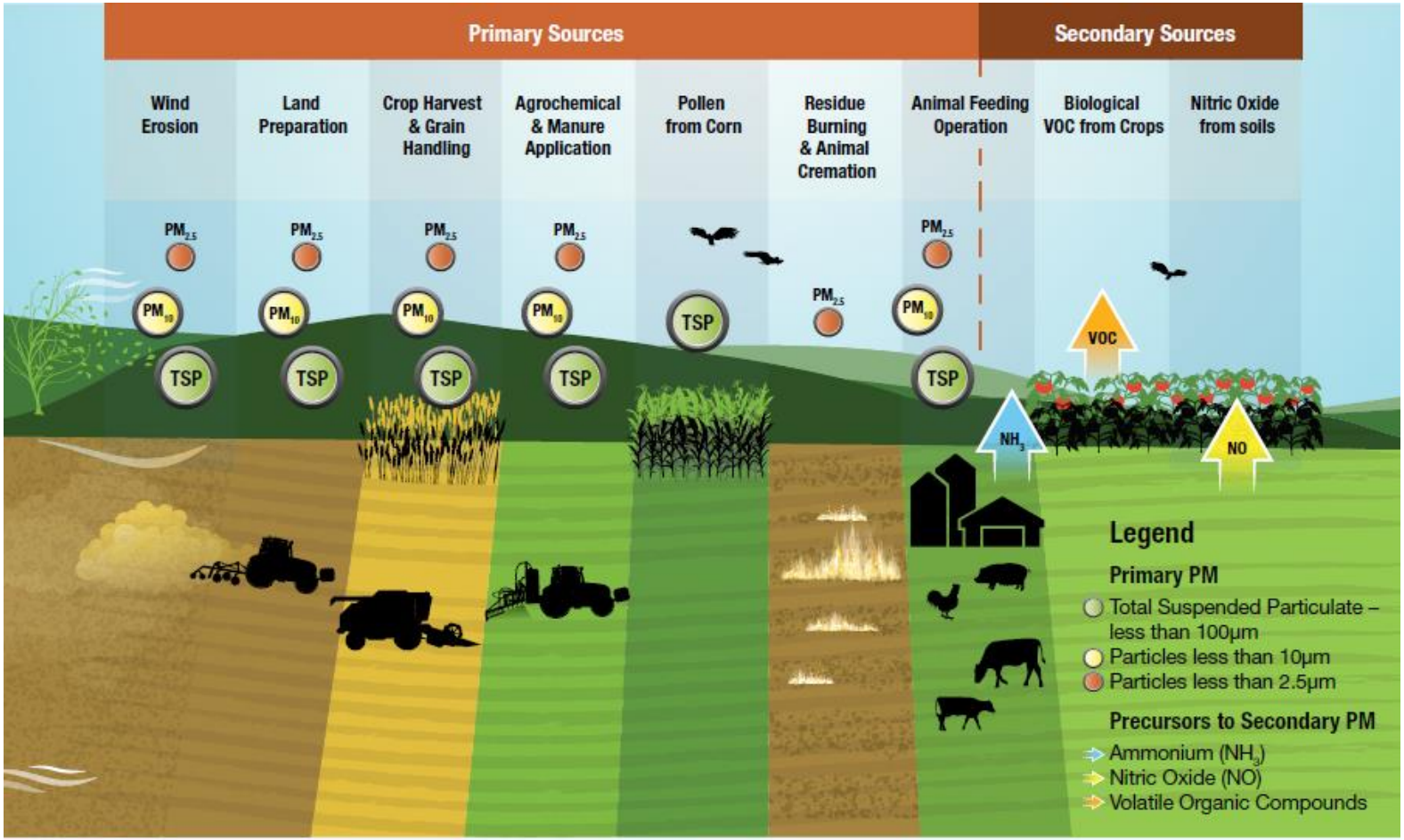


Figure 17–1: Main activities and factors contributing to primary and secondary PM emissions in agriculture

Source: AAFC

Particulate Matter - Valuation

Muller and Mendelsohn (2007) estimate the marginal damage of particulate matter emissions from the U.S.

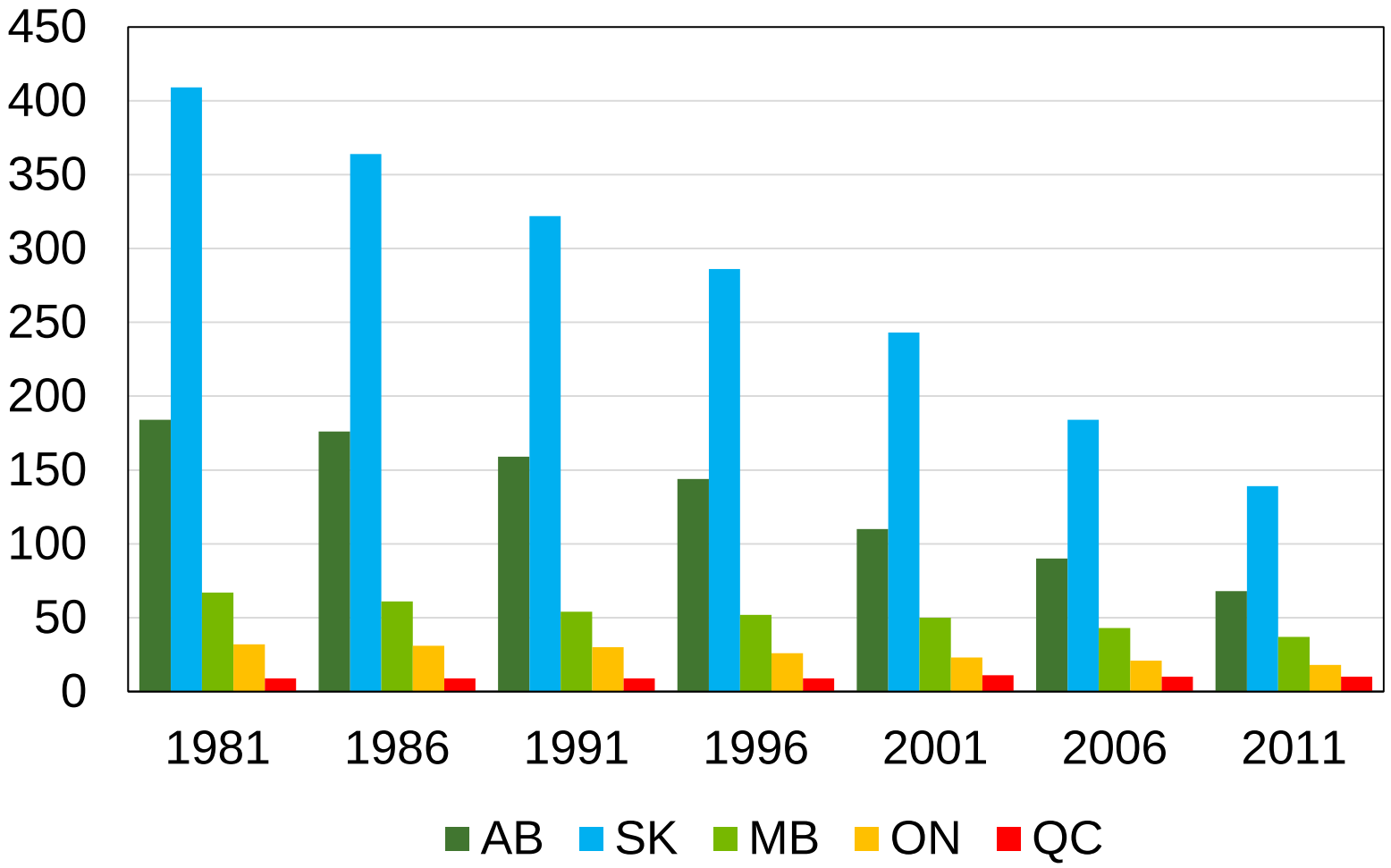
In 2011 Canadian dollars:

- $2,083/tonne (rural areas)
- $6,247/tonne (urban areas)

Why are these figures so large?

- Estimates reflect the reduction in lifespan using the value of a statistical life ($6.2 million USD)
- Statistically significant relationship between particulate matter emissions and adverse human health effects

Particulate Matter ($PM_{2.5}$) – Kilo-tonnes per year



Water quality

Nitrogen

- Estimates of average N loss per hectare by province
  - Estimate of N leaching into ground and surface water
  - How much does it cost to treat N at a water treatment plant?
    - Between C$3.6/kg and C$8.50/kg

Phosphorous

- WTP study from Larue et al. (2017) suggesting a 10% reduction in phosphorous in Quebec would be worth C$1.20/ha

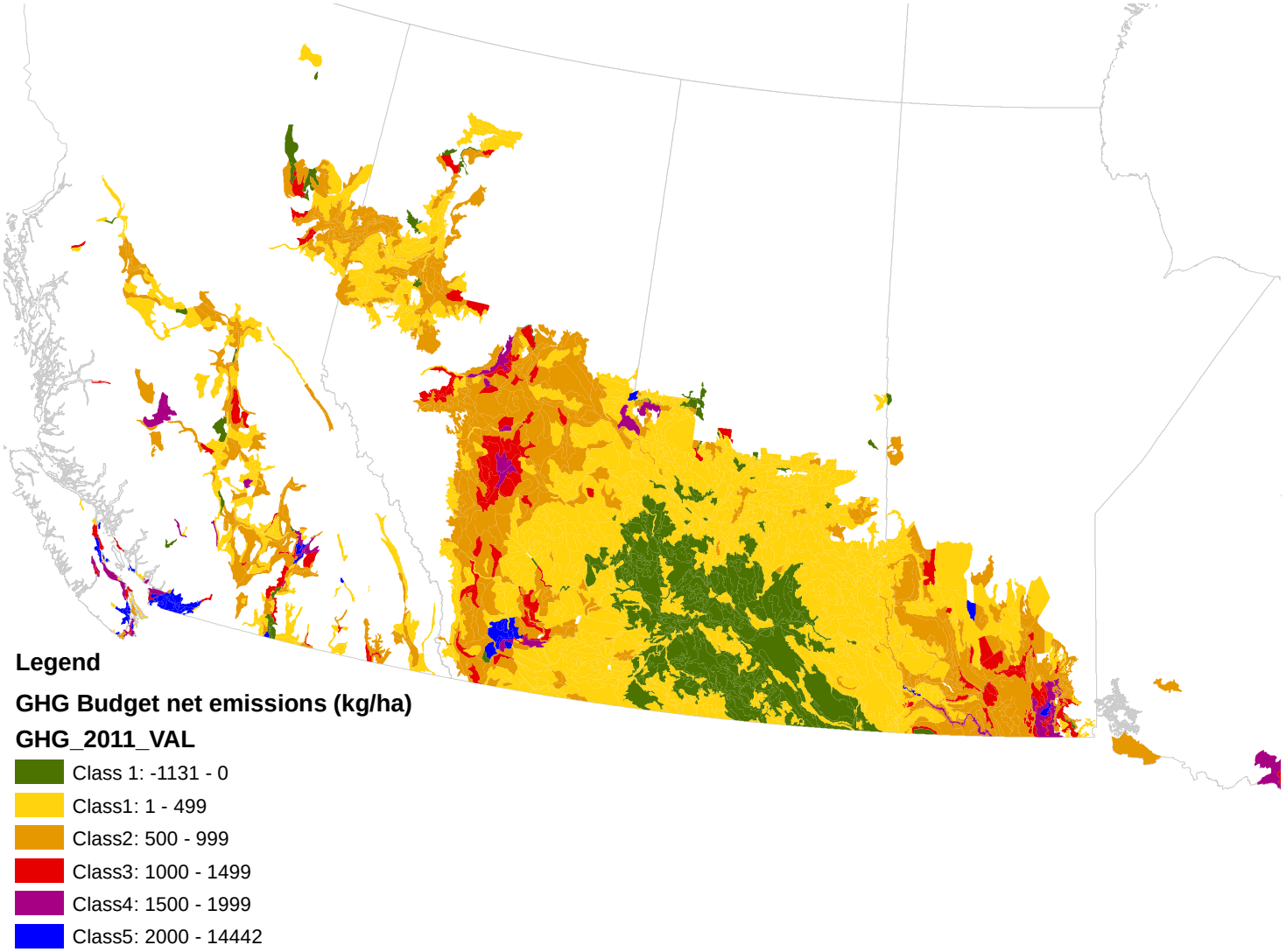
Pesticides

- WTP from Brethoura and Weersink (2001): C$79.4/household/year

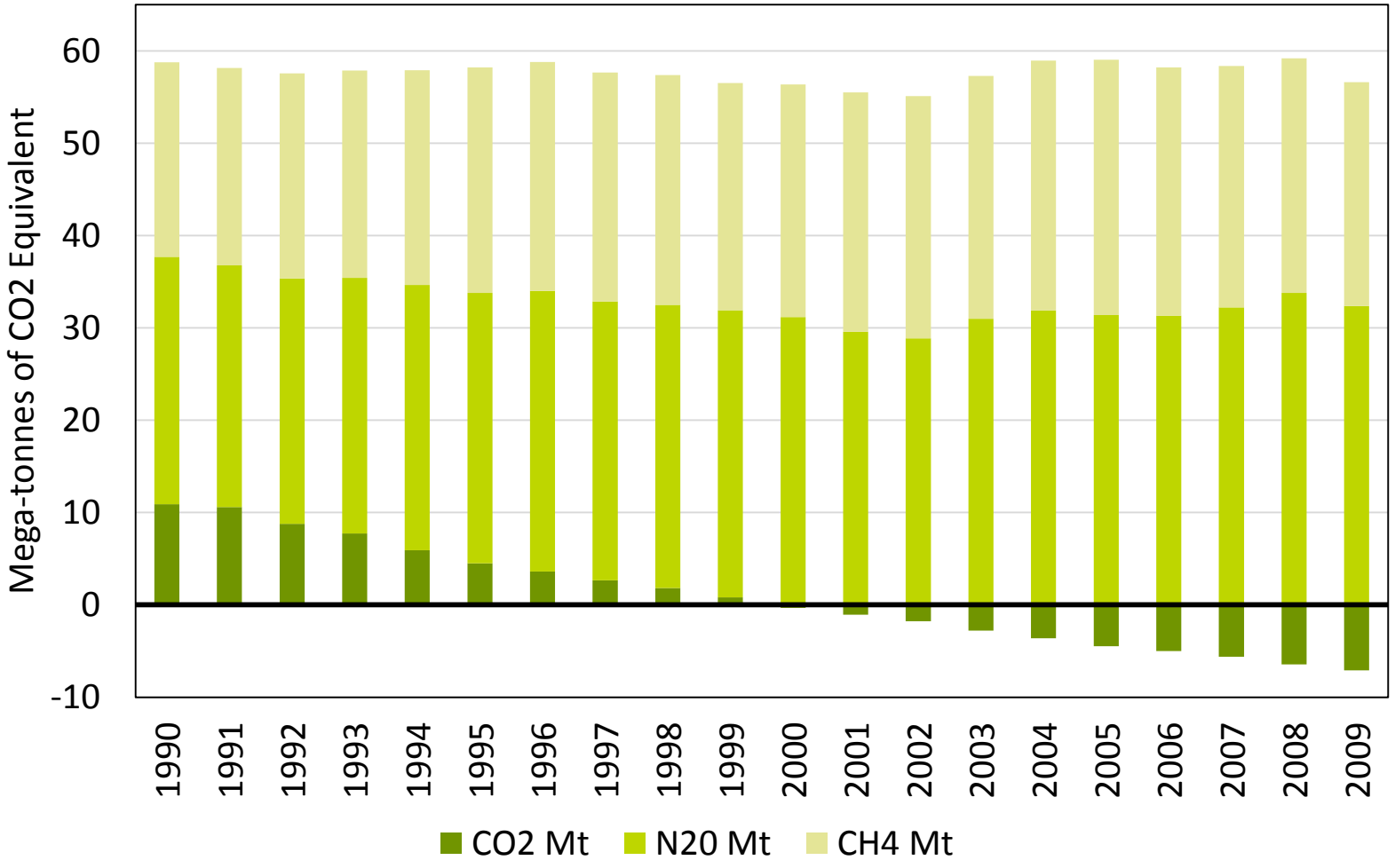
Coliforms

- WTP from Larue et al. (2017) suggesting a 10% reduction in coliform contamination is worth C$0.68/person/year

Net agricultural GHG emissions – Western Canada



Canadian On-Farm Net Emissions from Primary Agriculture



Greenhouse gas valuation

Social Cost of Carbon

- What is the cost to society from emitting one more unit of CO2-eq?
- Estimate used by Environment and Climate Change Canada:

C$41/tonne

- For example, in SK, total agricultural GHG emissions in 2011 were 1.8 MT, resulting in an externality of **C$73.8 million.**

Negative Externalities – Summary

Environmental impact	Prairies ($1,000 CAD)		
	Crops	Livestock	**Total**
Ammonia (NH3)	153,136	284,395	437,531
Greenhouse Gas (GHGs)	354,978	555,222	910,200
Particulate matter (PM)	3,816,399	424,044	4,240,443
Nitrogen Water contamination	374,811	-	374,811
Phosphorus water contamination*			34,598
Pesticide water contamination	20,702	-	20,702
Coliform water contamination		4,003	4,003
Soil Erosion	2,127,285	-	2,127,285
Wildlife and biodiversity*			79,394
Human health*			28,094
Wildlife habitation			6,219

Positive Externalities – Summary

Environmental impact	Prairies ($1,000 CAD)		
	Crop	Livestock	**Total**
Positive Externality			
Erosion control			1,854,425
Nutrient cycling			2,490,227
Landscape aesthetics			3,844,175
Wildlife habitation			6,219
Sub-total			***8,195,046***
Net-benefit			**-62,017**

Policy Considerations

- The heterogeneity in the results suggest the need for spatially-specific agri-environmental policy to mitigate negative externalities.
- Because efficient input use results in low emissions, policies that enhance efficiency, both in crop production and livestock, will be crucial in reducing GHG emissions.
- The estimated values could also help to identify policy priorities – which policy is more effective in mitigating negative externalities and increasing positive externalities?
- The role of farm financial conditions (next slide)

Net Market Income by Quintile: Canadian Crop Production