



Agriculture and  
Agri-Food Canada

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Agroalimentaire Canada

Canada



# Sustainability Governance of the Agriculture-based Bioeconomy in Canada

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IEA Bioenergy Inter-Task Project Meeting

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# IEA Inter-Task Project Objectives

- Project: Measuring, Governing and Gaining Support for Sustainable Bioenergy Value Chains
  - Obj. 2: To compare and assess the legitimacy, including the effectiveness and efficiency, of a variety of approaches on how to govern and verify sustainability of biomass and bioenergy supply chains in different conditions.
  - **Goal of this project: To describe the evolving approach to ensuring sustainability of agriculture-based bioeconomy in Canada**

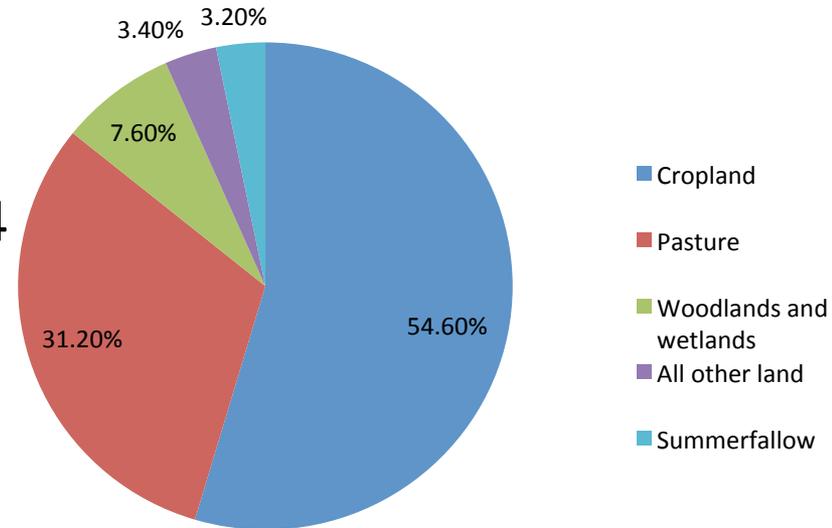
# Canadian Presentation

- Agriculture in Canada
- Agriculture-based Bioeconomy
- Legislative Context in Canada
- Environmental Management of Agricultural Production
- Sustainability Frameworks under development for Agricultural Production
- Sustainability Assessments of bioproducts/value chains

# Agriculture in Canada

- Stable land base of 64.8 million hectares (7.2% of total country land base)

- Agricultural and Agri-Food in 2014
  - \$108 billion; 6.6 % of GDP
  - Food and feed markets



- Export orientation: 58% of the value of primary agriculture production is exported, either as primary commodities or as processed food and beverage products

# Agricultural Production (2013)

Agricultural  
Crop  
Production

28.8 M ha area  
harvested for  
grain (in 2013)

6.1 M ha  
seeded for hay  
(in 2013)

GRAIN

TOTAL (Grain) – 96.9 M tonnes (2013)

Crop	Production (kt)
Wheat	37,530
Coarse Grains (barley, corn, oats, rye, mixed grains)	28,715
Oilseeds (canola, soybeans, flaxseed)	24,049
Special Crops (canary seed, chick peas, dry peas, lentils, mustard seed, sunflower seed)	6,649



Export  
+  
Domestic  
Use

Tame Hay Production –  
26.4 M tonnes (2013)

STRAW (wheat, barley, flax, oats, corn stover)

- Livestock Uses – 7.6 M odt
- > 30 M odt chopped and returned to field

# Ag-Based Bioeconomy

- Bioeconomy is currently a small market for agricultural biomass – but has significant potential to grow.
- Biofuels (ethanol, biodiesel) represent the major group of bioproducts from agricultural biomass.
  - Economic diversification driver with GHG benefits.
  - Ample supply of feed grade grains useful for bioproducts.
- Agriculture fibre for biomaterials
  - Some commercial production, several pilot-demo scale operations
- Bio-based chemicals from crop residues emerging
  - Succinic acid production by BioAmber
- Farm biogas for heat and power, and renewable natural gas

# Feedstock used for Bioproducts

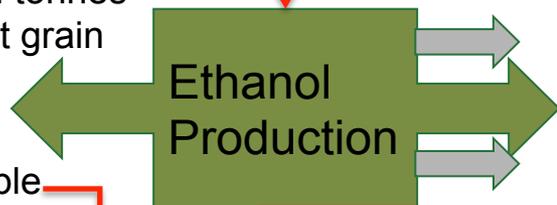
Feedstock Type	Total Canadian Production	Used for Bioproducts	% of total
Grain Corn	13.2 million tonnes (2016)	3.3 million tonnes to ethanol	25%
Wheat (all, except durum)	24 million tonnes (2016)	0.85 million tonnes to ethanol	3.5%
Canola oil	3.203 million tonnes of canola oil (2014)	0.007 million tonnes canola oil to domestic biodiesel (2013)	0.2%
Soybean oil	0.282 million tonnes of soybean oil (2014)	0.012 million tonnes soy oil to biodiesel (2013)	4.3%
Yellow Grease		0.030 million tonnes to biodiesel (2013)	
Inedible Fats		0.064 million tonnes to biodiesel (2013)	
Flax Straw	0.87 million tonnes (seed) or 0.698 million tonnes of straw (2014)	36,000 tonnes for specialty paper in 2014 (biomaterials)	5.1%

# Bioproduct Outputs + Co-products

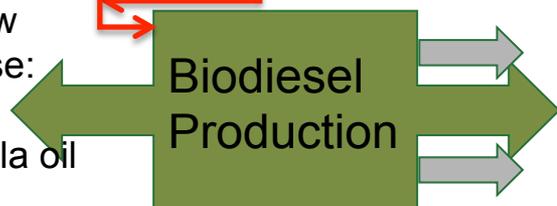
- Inputs to the bioeconomy
  - Feed grains & oilseeds, crop residues, livestock manure (waste)
  - Waste water from food systems
- Bioproduct Outputs
  - biofuels & biogas = bioenergy
  - biomaterials & biochemicals
- Co-products are mostly re-used in the feed industry
  - DDGs from ethanol and proteins from oilseeds can account for 25% of the grain volume
- Co-products are also used in downstream manufacturing
  - CO<sub>2</sub> by beverage industry; glycerol from biodiesel, etc.

(Data: 2013)

3.3 M tonnes  
of corn grain  
0.9 M tonnes  
wheat grain



Inedible  
Fats: 25.8  
Yellow  
grease:  
58.9  
Canola oil  
7.4  
(k tonnes)



Livestock  
Manure  
+  
Food  
Processing  
Waste



- 1.7 B litres Ethanol (blended with gasoline – transportation fuel)
- 1.3 M tonnes DDGS (animal feed)
- 0.6 M tonnes WDGS
- 0.2 M tonnes corn distillate
- CO<sub>2</sub> (industrial uses and greenhouse heating)
- Energy – Cogen, Heat (energy for facility)

- 124 M litres Biodiesel FAME (blended with diesel – transportation fuel)
- 13 M litres Glycerol (industrial uses, supplement for anaerobic digester, etc.)

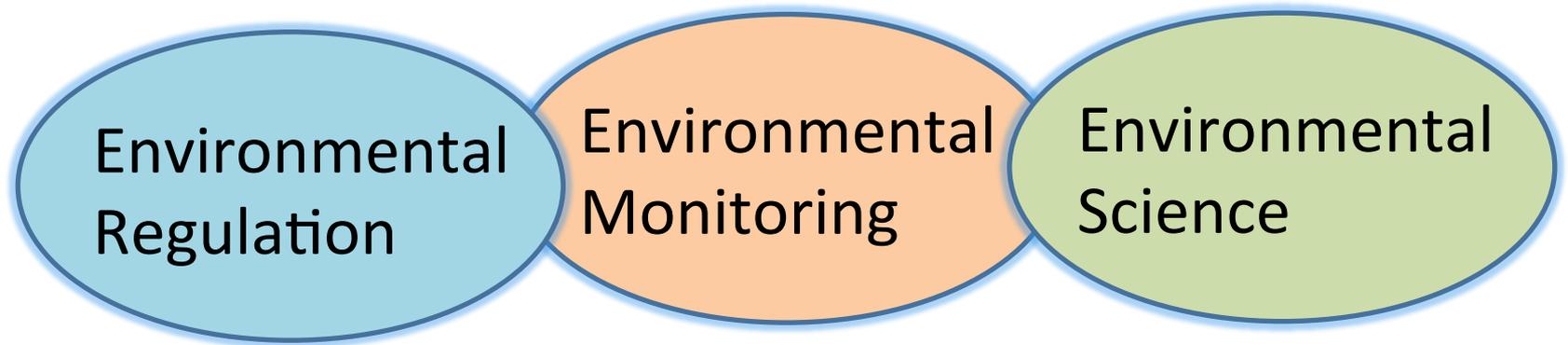
- Biogas (mainly used for electricity (19 MW); 160,000 GJ of renewable natural gas - RNG)
- Digestate – liquids (fertilizer applied to agricultural land)
- Digestate – solids (fertilizer applied to agricultural land)

↓ Crop production

# Potential Ag Biomass Pathways

Feedstock Type	Existing Bioproducts	Future Bioproducts
Waste <ul style="list-style-type: none"> <li>- Livestock manure</li> <li>- Food processing waste</li> <li>- Crop residues</li> </ul>	Biogas (heat, power)	Renewable Natural Gas DME
Grains & Oilseeds <ul style="list-style-type: none"> <li>- Cereals (corn, wheat)</li> <li>- Oilseeds (canola, soy)</li> </ul>	Biofuels (ethanol, biodiesel) <i>and animal feed</i> Industrial Starches Industrial Oils	Biojet fuel, renewable diesel
Crop Residues	<i>Animal bedding, animal feed, mushroom compost and Biomaterials</i>	Cellulosic sugars, cellulosic ethanol
Dedicated Crops		
<ul style="list-style-type: none"> <li>- Perennial grasses Miscanthus, switchgrass</li> </ul>	<i>Animal feed</i>	Biomaterials, Cellulosic ethanol, renewable diesel
<ul style="list-style-type: none"> <li>- Industrial oilseeds Camelina, Carinata</li> </ul>	<i>Animal feed</i>	Biojet fuel, renewable diesel, industrial oils

# Environmental Management *evolving into Sustainability*



Best Management Practices (BMPs)

Environmental Farm Plans

Sustainability Frameworks/Schemes

Sustainability Certification

Social +  
Economic  
Indicators



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# Agriculture – A Shared Responsibility through Canadian Constitution

- Federal – Provincial – Territorial Governments govern agriculture
- Water is shared responsibility with ownership of water rights determined when Provinces joined Canada
  - Early provinces did not obtain water rights but can control access to water including for agriculture
- Environmental regulations based on both federal and provincial legislation with inter-government agreements to avoid duplication
  - Environmental Assessment Act; Species at Risk; Pesticide Act...
  - Province can supplement...Nutrient Management Act, Water Resources Act, Environmental Protection Act....

# Environmental Legislation

- Federal *Fisheries Act* – protecting fish and fish habitat
- Federal *Pest Control Products Act* – regulates the use of pesticides
- Provincial:
  - PEI *Watercourse and Wetland Protection Regulations and Agricultural Crop Rotation Act*
  - Québec *Environment Quality Act – Agricultural Operations Regulation*

# Environmental Management

- International and North American Environmental Initiatives
  - Climate change, ozone layer, biodiversity, waterfowl management
- Federal and provincial legislation
- Best Management Practices or Voluntary Protocols
- Environmental Farm Plans (EFPs)
  - Environmental protection through farm risk assessments
  - Can be tied to funding (cross-compliance)
- Food certification systems in place for some grains & oilseeds
  - E.g. Roundtable for Responsible Soy (RTRS) certification
- Food systems defining sustainability with value chain inputs from farmers to retailers
  - E.g. Unilever Sustainable Agriculture Code 2015

# Sustainable Agriculture

- UN Brundtland Commission (1987) defined “sustainable development” as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
  - Farmers use land for 30 to 40 years then pass it on
  - Maintaining fertility is critical and need to manage environment
  - Grain yield increases are used as a barometer of success
  - Sustainability concepts are evolving to address societal concerns

# Status of Sustainability Development...

## From Awareness to Reporting

- **Canadian Roundtable Sustainable Crops...** “consumers are interested in where their food comes from and whether it was produced in a sustainable manner. In response, domestic and global markets are increasingly considering environmental, social and economic factors when sourcing product”
- **Canola Council of Canada** “Our mission is to advance the growth and profitability of the canola industry based on innovation, sustainability, resilience and the creation of superior value for a healthier world”
- **Ontario Pork Social Responsibility** “... stewards of the land... preserving ecosystems and resources, soil and water, implementation of beneficial agricultural practices...” - social protocol for community and workers and an annual report card

# Information/Documentation Gap

- Gap that the sustainability initiatives aim to fill
  - ❖ *Common information – good quality, up to date*
  - ❖ *Canadian data*
  - ❖ *Easy access*
  - ❖ *Low burden/cost to agriculture producers*
  - ❖ *Ability to comply with multiple schemes*

Agriculture producers face additional costs that can't be passed on!

# Local / regional level information for representative assessments

- Environmental indicators are a function of:
  - Soil type
  - Topography
  - Climate
  - Type of ag land use
  - Type of crop
  - Type of crop rotation
  - Type of livestock
  - Cropland management

Example: Soil Loss Estimation

*Limited to use Universal Soil Loss Equation as the field level information is not available to use the “better” Revised Universal Soil Loss Equation 2*

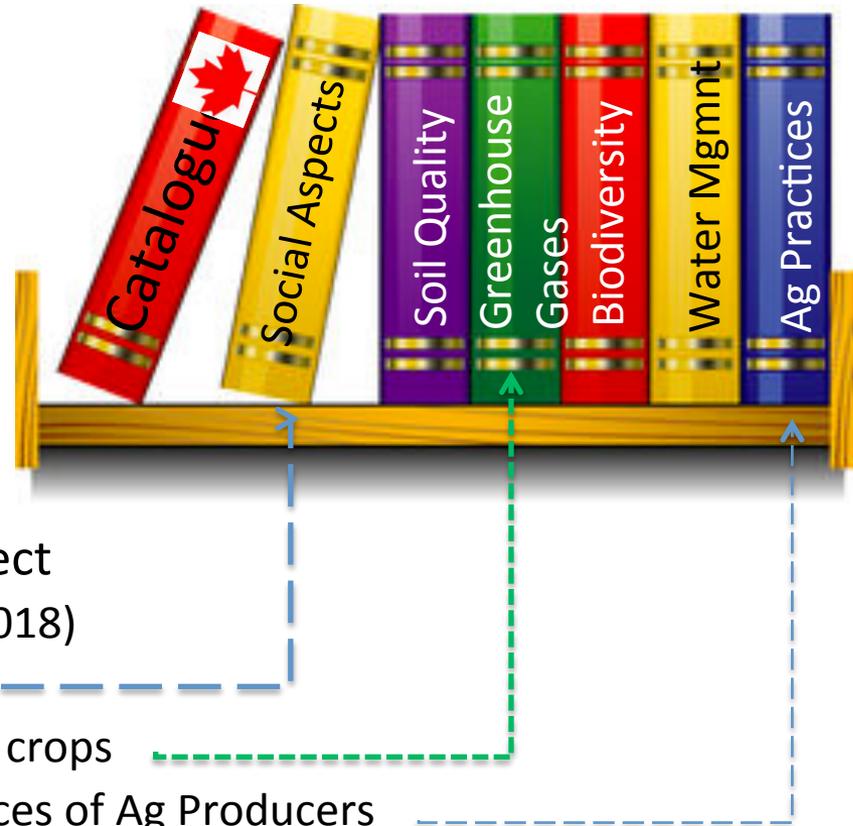
# Numerous Sustainability Initiatives

- Sustainable Agriculture Initiative (SAI) *international*
- Roundtable on Responsible Soy (RTRS)
- Canadian Roundtable for Sustainable Beef (CRSB)
- Canadian Roundtable for Sustainable Crops (CRSC)
- Canadian Field Print Initiative
- National Environmental Farm Plan
- 4R Nutrient Stewardship Program
- Sustainable Farm and Food Initiative
- Provision Coalition Traceability (food and beverage industry)

*Dynamic, Evolving Space*

# Canadian Roundtable for Sustainable Crops

- Agriculture industry organization
- “Single Canadian source of sustainability information”
- CRSC Projects underway:
  - Sustainability Metrics Platform Project
    - Platform Development (early 2018)
    - Social Indicators
    - Carbon Footprints for 10 major crops
    - Survey of Environmental Practices of Ag Producers
  - Agro-Ecosystem Project: sustainability goals to 2026 under development



<http://sustainablecrops.ca/>

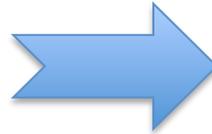
# Agri-Environmental Tools

- Environmental Farm Plan
  - Risk assessment of farm and fields
  - 23 Worksheets ... soil, air, water, biodiversity
- Best Management Practices
  - 4Rs, drainage, ground cover ...
- R&D supported by farm commodity groups
- Precision agriculture increasing nutrient use efficiency
- Use of satellite imagery to determine crop rotation, soil moisture and ground cover
  - Offers monitoring potential
- HOLOS 2.2: whole-farm GHG emissions model

# Bioproducts Value Chain

## Sustainability Assessment Tools

- Canadian Environmental Assessment Act
  - Project approval (e.g. construction of new facility)
- Provincial environmental permitting
- Environmental monitoring
- Applicable to all bioproduct value chains
  - Bioenergy (biogas)
  - Biofuels
  - New Biomaterials
  - New Bio-based Chemicals

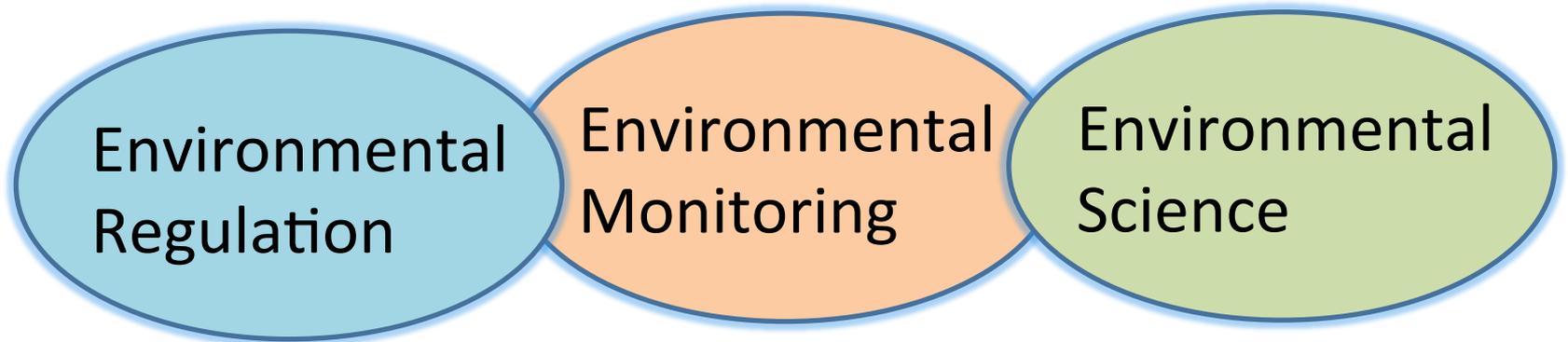


**To meet additional sustainability requirements of market, e.g. EU RED, US RFS, etc.**



Life cycle assessments  
GHG accounting  
Water footprint  
Air quality modelling, etc.

# Sustainability “Governance” *is under development*



Best Management Practices (BMPs)

Environmental Farm Plans

Social +  
Economic



Sustainability Frameworks/Schemes

Sustainability Certification

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# What is Next?

- Started in Jan 2017 & completed First Draft
- Incorporate feedback from IEA Bioenergy colleagues
- Complete Canada report on sustainability governance (summer 2017)
- A lot of work underway:
  - CRSC Sustainability metrics platform (Jan 2018)
  - Clean Fuel Standard (2018 – 2019)
- Comparative analysis with DEN and US
- Final report on sustainability governance (2018)

# For comments or more information:

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*Many thanks to Tat !*

# ANNEX

# Verification: Example - Environmental Monitoring

- Agri-environmental indicators reported since 1981 based on 5 year census data AAFC research driven for metrics
- National and Provincial results
- Environmental sustainability report card on indicator trends
- Broad categories include farmland management, species habitat, soil – water – air quality

# Biodiversity Compound Index: Soil Cover and Wildlife Habitat

## Farmland Management



Biodiversity  
Compound Index

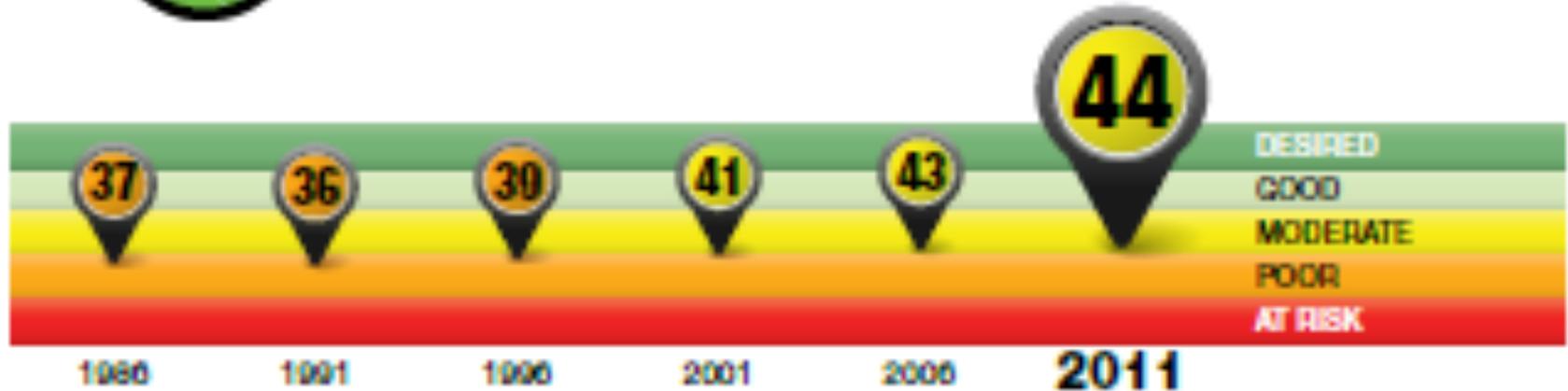


Figure E-1: Biodiversity Compound Index

# Soil Erosion + SOC + Salinization

## Soil Quality

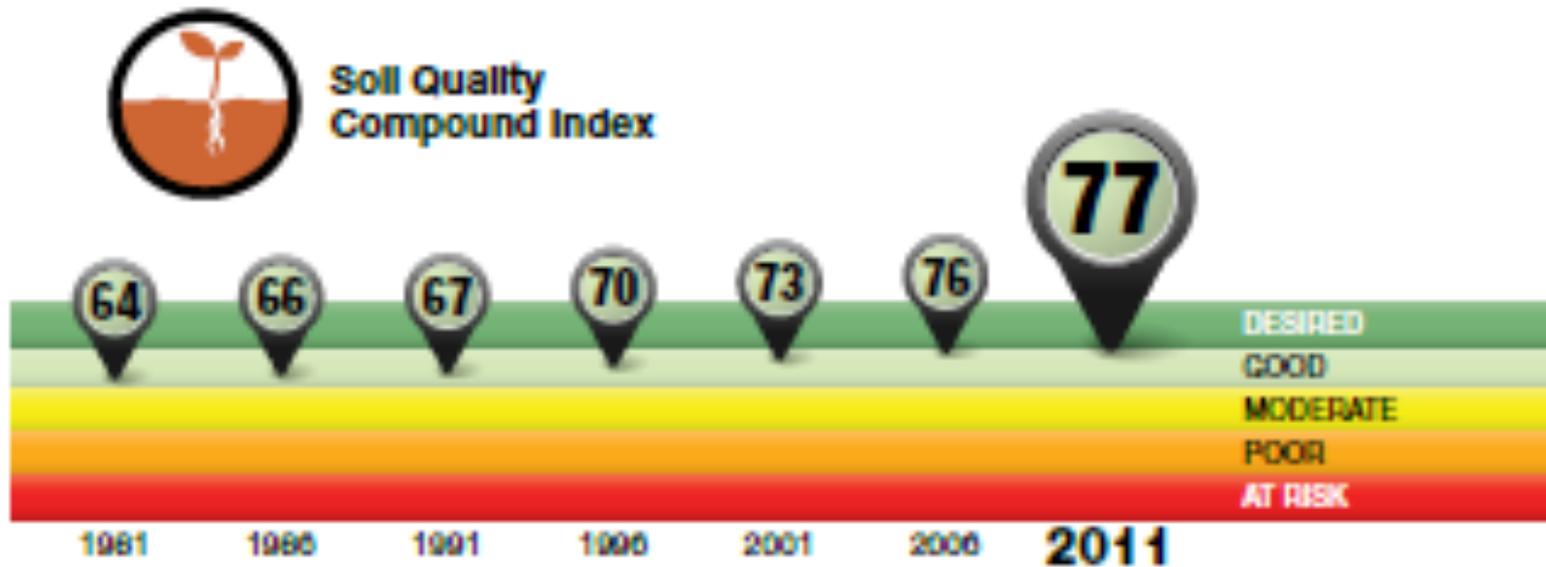


Figure E-2: Soil Quality Compound Index

Positive Influence of:

- Reduction in Conventional Tillage (conservation till/no till)
- Reduction in Summerfallow

# Water: N, P, coliform, pesticides

## Water Quality

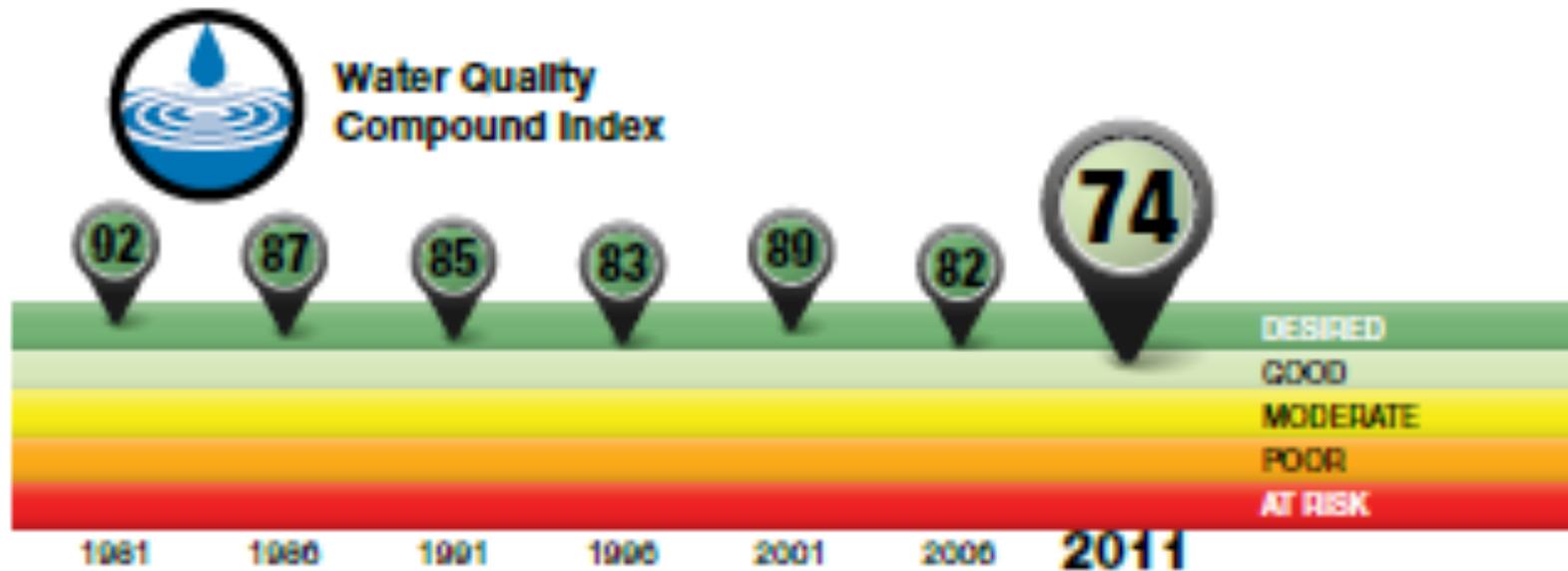


Figure E-3: Water Quality Compound Index

Quality has declined; Needs attention

# GHGs, Ammonia & Particulate Matter

## Air Quality

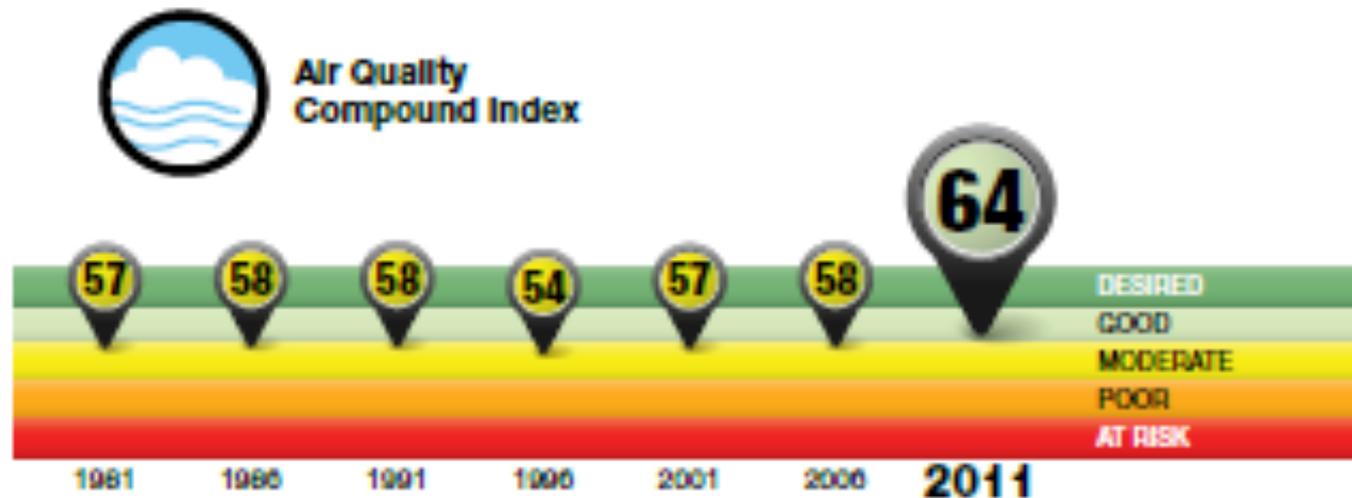


Figure E-4: Air Quality Compound Index

### Positive Influence of:

- Reduction in Conventional Tillage (conservation till/no till)
- Reduction in Summerfallow