The Canadian Metrics Project Overview

Karen Churchill
Project Manager, CRSC
Toronto, Ontario
May 18, 2017

crsc

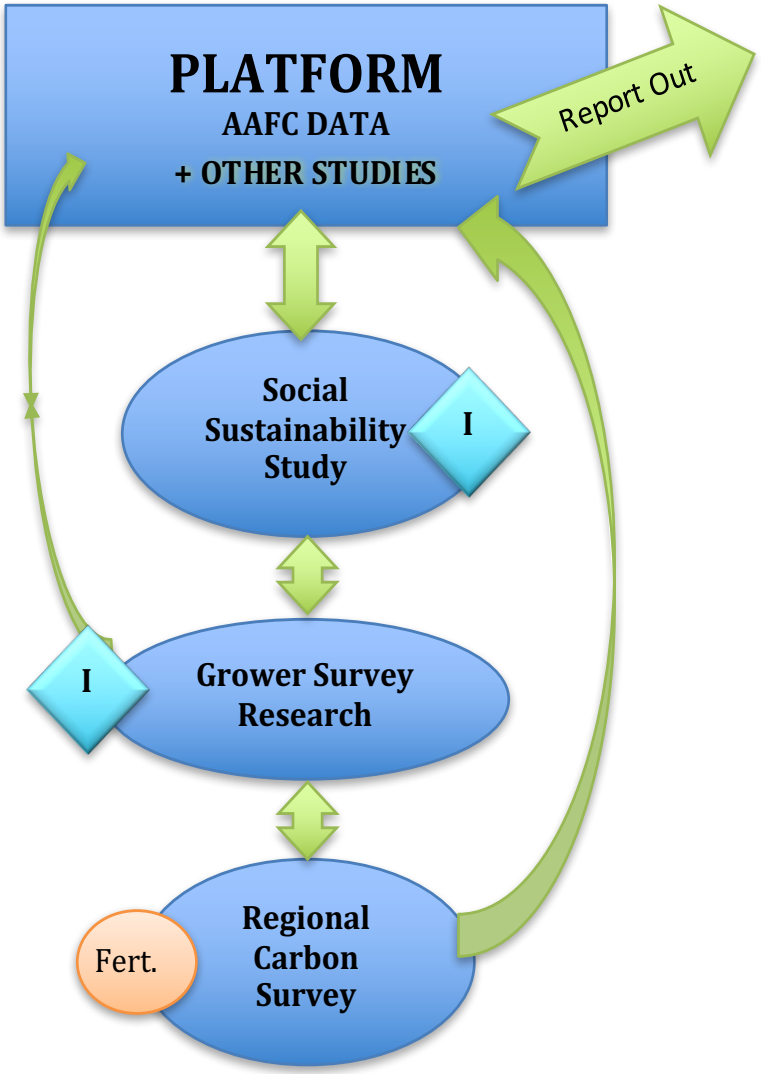
Sustainability Metrics Platform Project

OBJECTIVE

- Establish a definitive, reporting platform on Sustainability Metrics
  - National in scope
  - Includes all Canadian “grains”
    - Wheat, Durum, Canola, Barley, Oats, Field Peas, Lentils, Corn, Soybeans, Flax
  - Using regional or ‘macro’ data

Project Outline

- Four Inter-related Activities
  1. Platform Development
  2. Carbon LCA
  3. Social Study
  4. Grower Survey



Sustainability Metrics Platform

- What is a platform?
  - A catalogue of data which will inform the industry regarding the sustainability of Canadian farmers' grain cropping practices

Three Pillars of Sustainability

- PCI framework (Principle/Criteria/Indicators)
- Indicators and Metrics for each Pillar
  - Social
  - Environmental
  - Economic
- Scientific Data to support each area

Social Indicators Study

- How are we doing in the Social Pillar?
- Identified a need for information to support our perception of the Canadian good news story
- Information/data could address various global market place requirements

Social Indicators Study

- What schemes, frameworks and indicators are out there and may impact Canada?
  - 54 Schemes reviewed, 16 rated as relevant
- Which indicators are relevant?
  - Catalogue of indicator areas, across all schemes, rated as to importance
  - 23 Indicators selected for further analysis
- What law, regulations and studies address these indicators?

Social Indicators Study

1. Provide safe, fair and respectful working conditions to all employees on farm
    1. Worker Safety
        1. Worker training * Pest management practices / other hazards * Use of protective clothing * Health and safety procedures * First aid and medical assistance
    2. Labour Relations
    3. Working Conditions
    4. Working Environment
2. Promote responsible community relations
3. Ensure legal compliance and adoption of Good Business Practices

Social Study – Conclusions

- Very few (if any) indicators are market-driven.
  - However, the vast majority are regulated to some extent
  - Compliance could someday be associated with the sector's social license
- There is a significant lack of data regarding farmers' compliance with the regulations.
  - No documenting studies of social on-farm practices or regulatory compliance
  - Not possible to make claims that Canadian grain farmers are complying with the regulated indicators

Social Study – Conclusions

- There are gaps between what is expected from regulation and farm practices.
- There is a gap in the perception of what is of significance for the sector and what is required in the sustainability schemes.
  - e.g. worker contract, collective bargaining, child labour, etc.
  - They were not considered relevant in Canada. Yet are regulated or addressed in the schemes, in addition to being promoted as good practices by many Canadian farming organizations.

Environmental/Economic Metrics Study

- Summary of the indicators required by the market
- Data to describe the performance of the Canadian grains sector
  - NEFP, 4R Fertilizer Plans, CFPI
  - AAFC

Environmental Criteria Areas

1. Agrochemical management
   - Use of agrochemicals, Selection of agrochemicals, Plans and procedures, Application of agrochemicals, Documentation, Storage, Equipment, Cleaning and disposal of spray mix and containers, Facilities
2. Integrated pest management
3. Nutrient management
4. Soil quality, productivity
5. Water quality, quantity
6. Biodiversity
7. Air quality and GHG emissions
8. Energy consumption
9. Waste and pollution
10. Planting material management
11. Environmental responsibility

Economic Criteria Areas

1. Financial viability
2. Business relations
3. Safety, quality and transparency adoption

Grower Survey

Objectives:

- Strategically gather information based on our current gaps as determined by previous projects:

Ideally would cover all

1. Collect statistically relevant data to populate gaps in the Platform dataset for certain Indicators
2. Capture producer reaction to proposed Indicators
3. Discover the gap between the Indicator measure and actual practices by producer

- Administered in spring 2017

Platform – What Value Can it Provide?

- An inclusive, one-stop centralized source for 'science based' Canadian Information that supports the sustainability of grain cropping practices
  - Data the project has collected
  - Links or data provided by other groups
- Designed for who? What does it look like?
- How? Interactive – ability for users to extract the information they need:
  - Obtain a benchmark of current status of sustainable agriculture practices in Canada
  - Provide information to address Indicators in a users scheme (reducing on-farm requests)
  - And…

The Carbon Footprint of Canadian Grain Crops

Karen Churchill on behalf of
Don O'Connor
(S&T)^2 Consultants Inc.
Toronto, Ontario
May 18, 2017

crsc

Carbon LCA Study

- OBECTIVES:
  - A comprehensive carbon analysis
    - i.e. analysis of the balance of greenhouse gas emissions and removals)
  - Canada wide - Using the regional approach (RU's)
  - For each of the grains for which such values do not yet exist.

Why Conduct a Carbon Study?

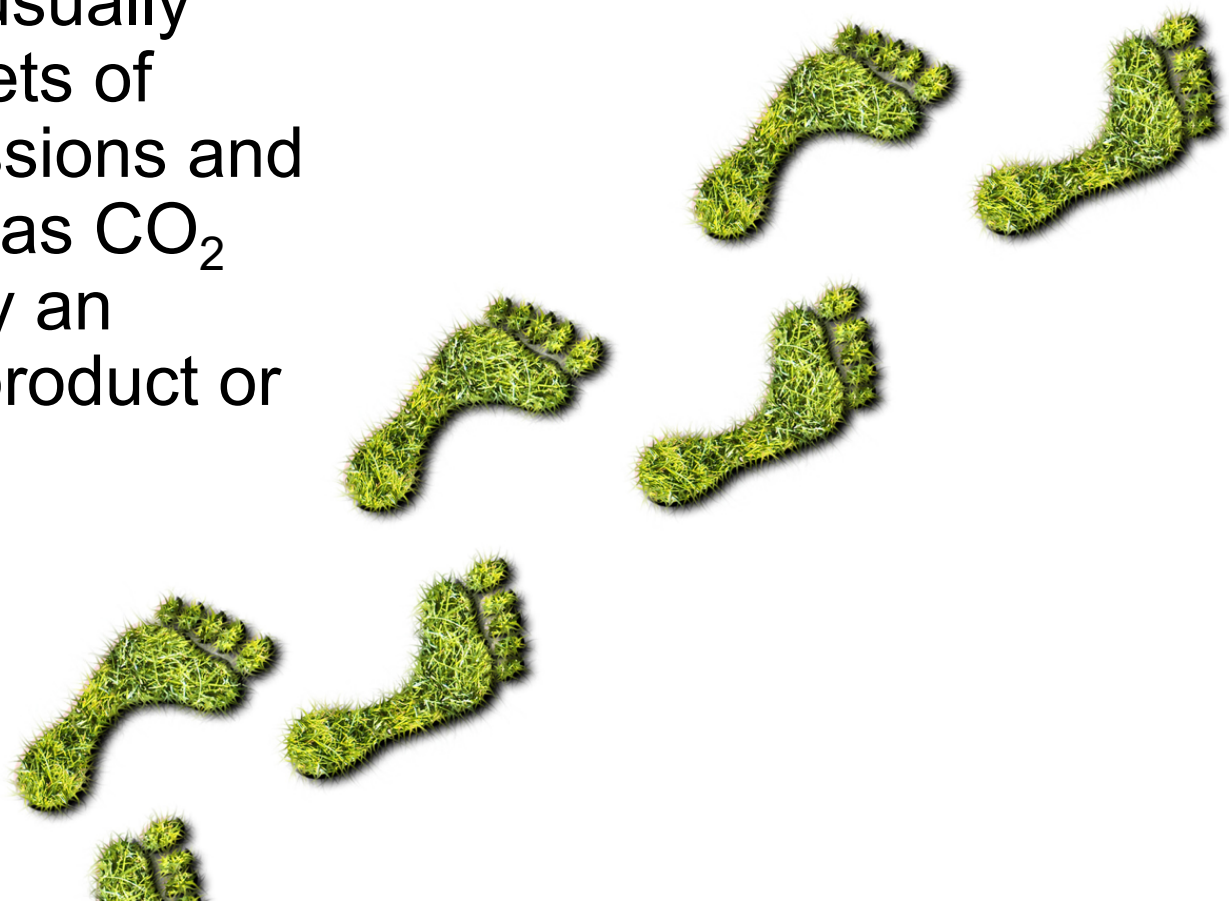
- CO_2 emissions important measure (quantifiable)
- Existing data incomplete
- Canadian source data
- One method
  - Allows direct comparisons
  - Updatable
    - (allows us to keep current as new data becomes available)

Topics

- What is a Carbon Footprint?
- System Boundaries
- Regional Approach
- Crops Studied
- Data Collection
- Some Results
- Closing Thoughts

Carbon Footprints

- A carbon footprint is usually defined as the total sets of greenhouse gas emissions and removals (expresses as CO_2 equivalent) caused by an organization, event, product or individual.



Carbon Footprint Standards

- There are three main Product Carbon Footprint standards applied worldwide:
  - **PAS 2050** - developed by the British Standards Institution (BSI)
  - **The GHG Protocol** product standard - developed by the World Resources Institute (WRI)/World Business Council Sustainable Development (WBCSD)
  - **ISO 14067** - released by the International Standards Organization as a Technical Specification

Carbon Footprint Standards

- All three systems provide requirements and guidelines on the decisions to be made in a carbon footprint study.
- Decisions involve LCA issues:
  - goal and scope definition
  - data collection strategies
  - reporting
- Provide requirements on specific issues relevant for carbon footprints, including:
  - land-use change,
  - carbon uptake,
  - biogenic carbon emissions,
  - soil carbon change, and
  - green electricity.

System Boundaries

- What is included and what is not?
  - This is the area of the primary difference between the three standards.
- This work follows the ISO 14067 Technical Specification.
  - It includes changes in soil carbon
  - It uses the methodology used in Canada's National Inventory Report as recommended in the standard
  - It does not include any emissions associated with the capital infrastructure.

System Boundaries

- For this work the system boundary includes;
  - The seeds, fertilizers and pesticides, including the GHG emissions associated with the production, transportation and application of these crop inputs.
  - The fuel and energy consumed in the field work (tillage, seeding, fertilizing, spraying, and harvesting activities) and the transportation of the product from the field to the on farm storage bin, includes the emissions associated with the production and use of the energy products.
  - The emissions from the decomposition of the applied fertilizer products and the crop residues that are left on the field after harvesting the grains and oilseeds.
  - Changes in soil carbon resulting from changes in land management. This is consistent with ISO 14067 and the GHG protocol.

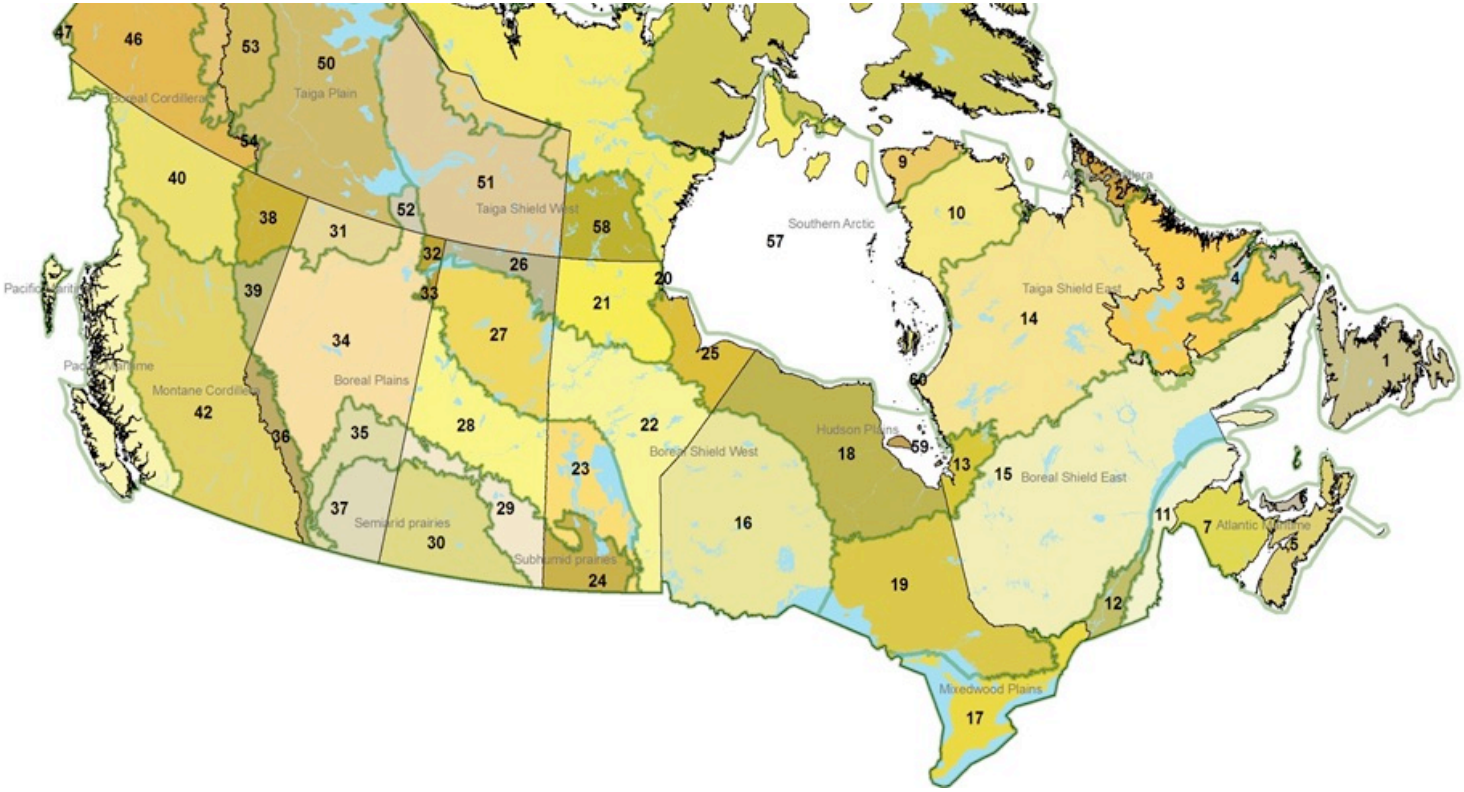
System Boundaries

- The activities that are **not** included in the system boundary include:
  - The manufacture, maintenance and decommissioning of capital equipment.
  - The emissions associated with ancillary operations such as lighting and heating of indoor work areas.
  - The disposal of process wastes and products. These are very minor quantities in most instances and would typically only include packaging wastes.
  - On-farm production of renewable energy including, for example, solar, wind, biogas or biomass combustion.
  - Transportation and processing of the products beyond the farm gate. This would be included in the use phase of the products.

Regional Approach

- Previous work, (carbon footprinting of western Canadian canola and barley) has shown that there can be significant differences in the GHG emissions for crop production across the Prairies Provinces.
- This variation can be due to production practices, soil conditions, and climate, it is appropriate to look at the GHG emissions and removals on a regional basis.
- One appropriate means of regionalizing the calculations is to use the reconciliation unit (RU) approach, which has been developed by AAFC and Environment Canada

RUs


Taiga Plain
Taiga Shield West
Southern Arctic
Taiga Shield East
Boreal Plains
Montane Cordillera
Boreal Shield West
Hudson Plains
Boreal Shield East
Semiarid prairies
Subhumid prairies
Mixedwood Plains

Crops Studied

- Carbon footprints are calculated for the ten major crops in Canada.
- A major crop is considered to be a grain or oilseed with more than 500,000 tonnes of annual production.
- An RU was considered for calculation if it had more than 10,000 ha of cropland.

Production Matrix

RU	Prov	Wheat	Durum	Corn	Oats	Barley	Soybeans	Canola	Flax	Dried Peas	Lentils
5	NS	X		X	X	X	X				
6	PE	X		X	X	X	X				
7	NB	X		X	X	X	X	X			
11	PQ	X		X	X	X	X				
12	PQ	X		X	X	X	X				
15	PQ	X		X	X	X	X				
17	ON	X		X	X	X	X				
19	ON	X		X	X	X	X				
22	MB	X		X	X	X	X	X	X	X	
23	MB	X		X	X	X	X	X	X	X	
24	MB	X		X	X	X	X	X	X	X	
28	SK	X	X		X	X		X	X	X	X
29	SK	X	X		X	X		X	X	X	X
30	SK	X	X		X	X		X	X	X	X
34	AB	X	X		X	X		X	X	X	
35	AB	X	X		X	X		X	X	X	X
37	AB	X	X		X	X		X	X	X	X
39	BC	X			X	X		X		X	
41	BC	X			X	X		X			
42	BC	X			X	X		X		X	

Data Collection

- A variety of sources were used.
  - Statistics Canada.
    - Yield and production.
    - Fertilizer type by province.
  - AAFC
    - N_2O emission factors and soil carbon changes by RU
  - Crop insurance management programs
  - Cheminfo fertilizer manufacturing carbon footprint study
  - Other Canadian government sources, e.g. pesticide sales
  - Some USDA ARMs survey data
  - Private surveys
  - Peer reviewed literature.

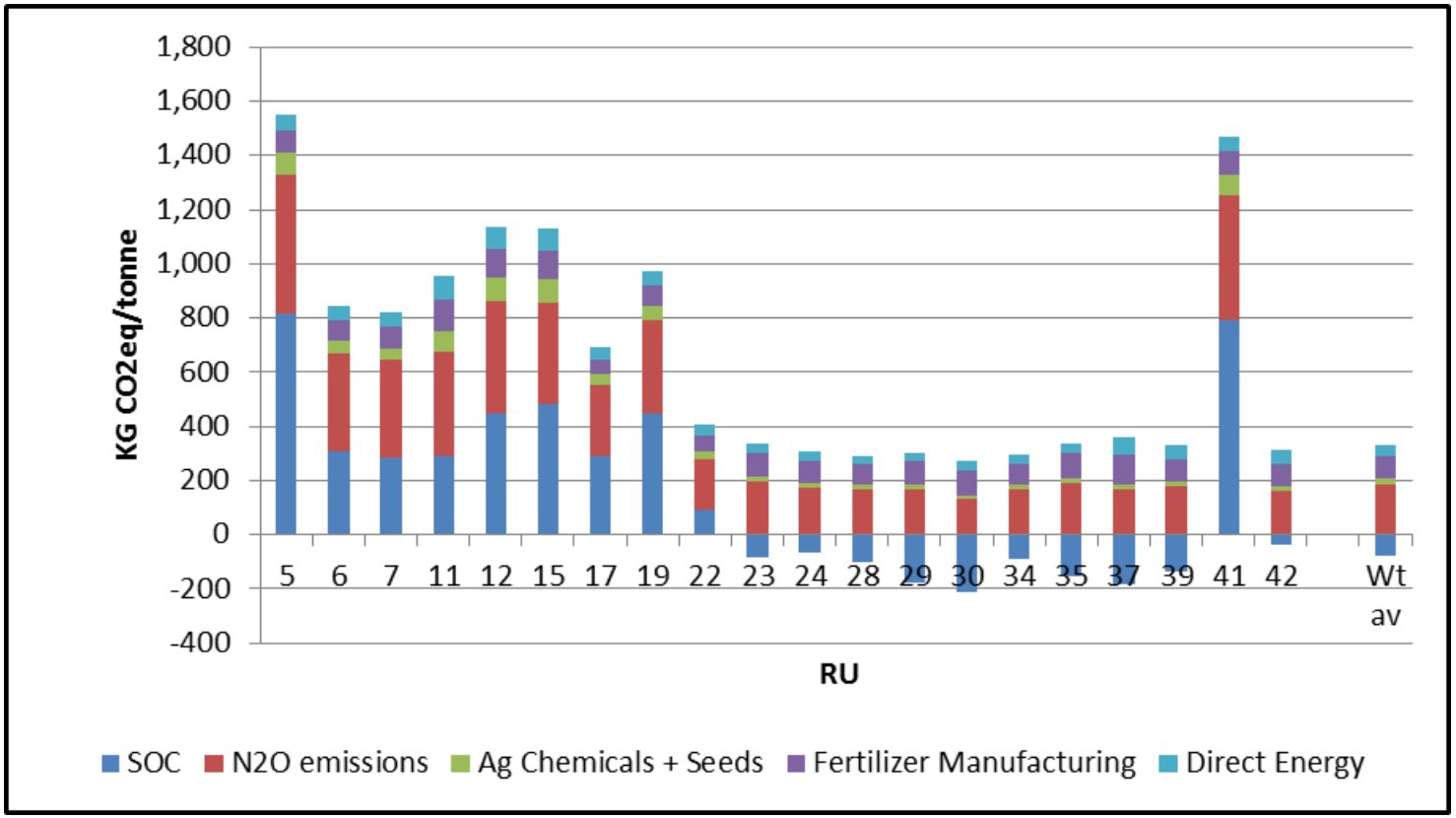
Canadian Fertilizer Study

- A key parameter of the GHG footprint of a crop is fertilizer
- Two aspects
  - The use by growers of fertilizer by type and application rate on the fields
  - The ”upstream’ footprint of the fertilizers produced
    - Can vary from one country to another
    - Therefore important to have verifiable data for fertilizer production in the Canadian context
- Study provided a full lifecycle greenhouse intensity estimates
  - Included all emissions from the well, or mine, to the plant gate

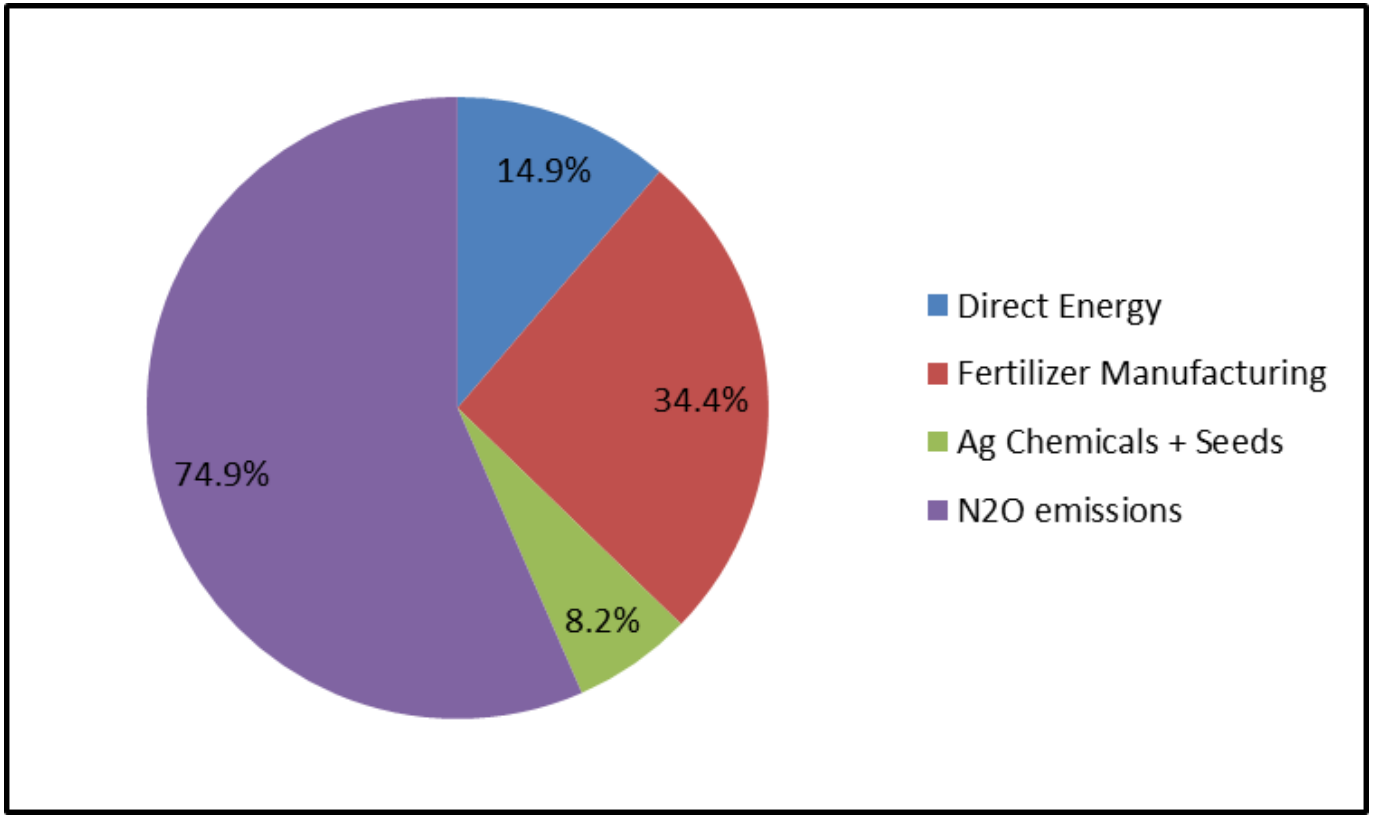
Results

- Large differences in results between RUs.
- Some of the differences are reflective of production practices.
- Some of it is due to changes in soil organic carbon.

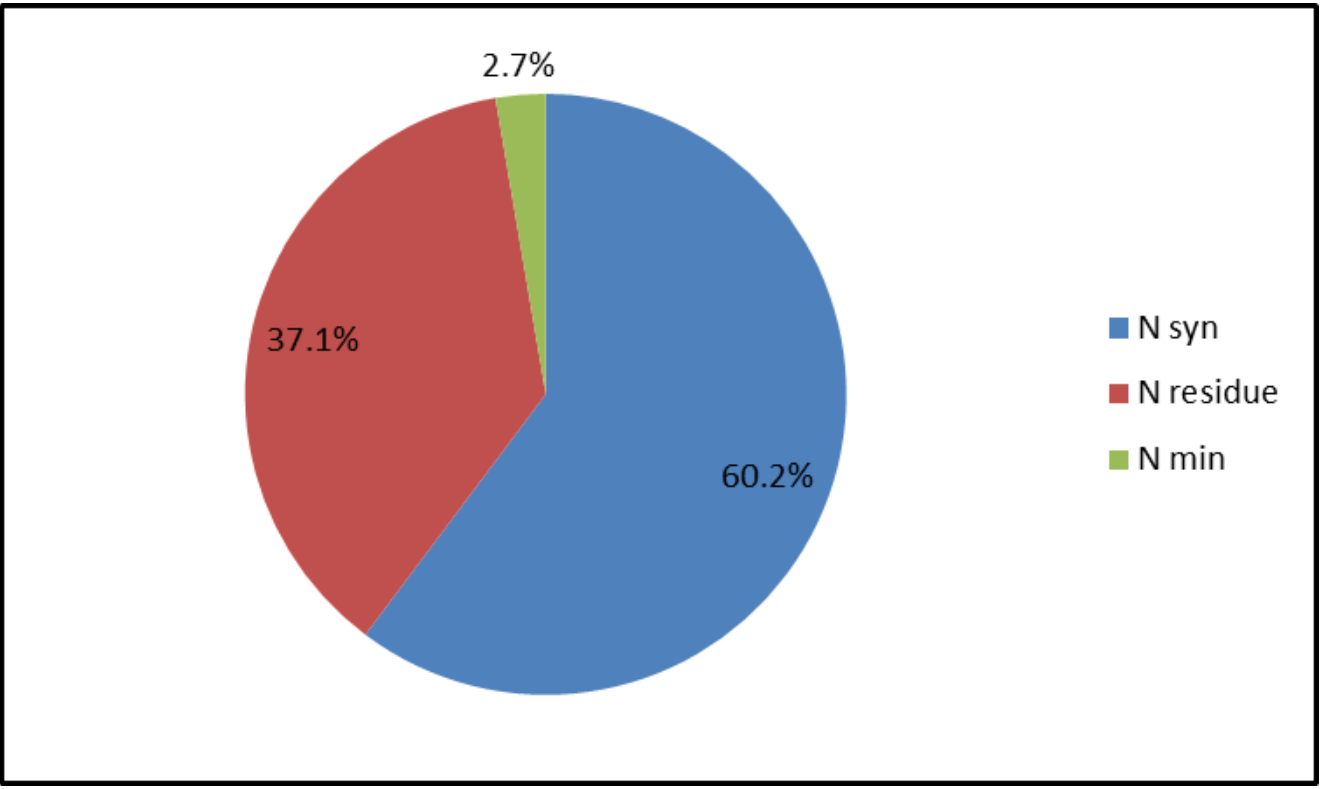
Oats


1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
-200
-400
KG CO2eq/tonne
5 6 7 11 12 15 17 19 22 23 24 28 29 30 34 35 37 39 41 42 Wt av
RU
SOC
N2O emissions
Ag Chemicals + Seeds
Fertilizer Manufacturing
Direct Energy

Oats – source of CO_2eq emissions



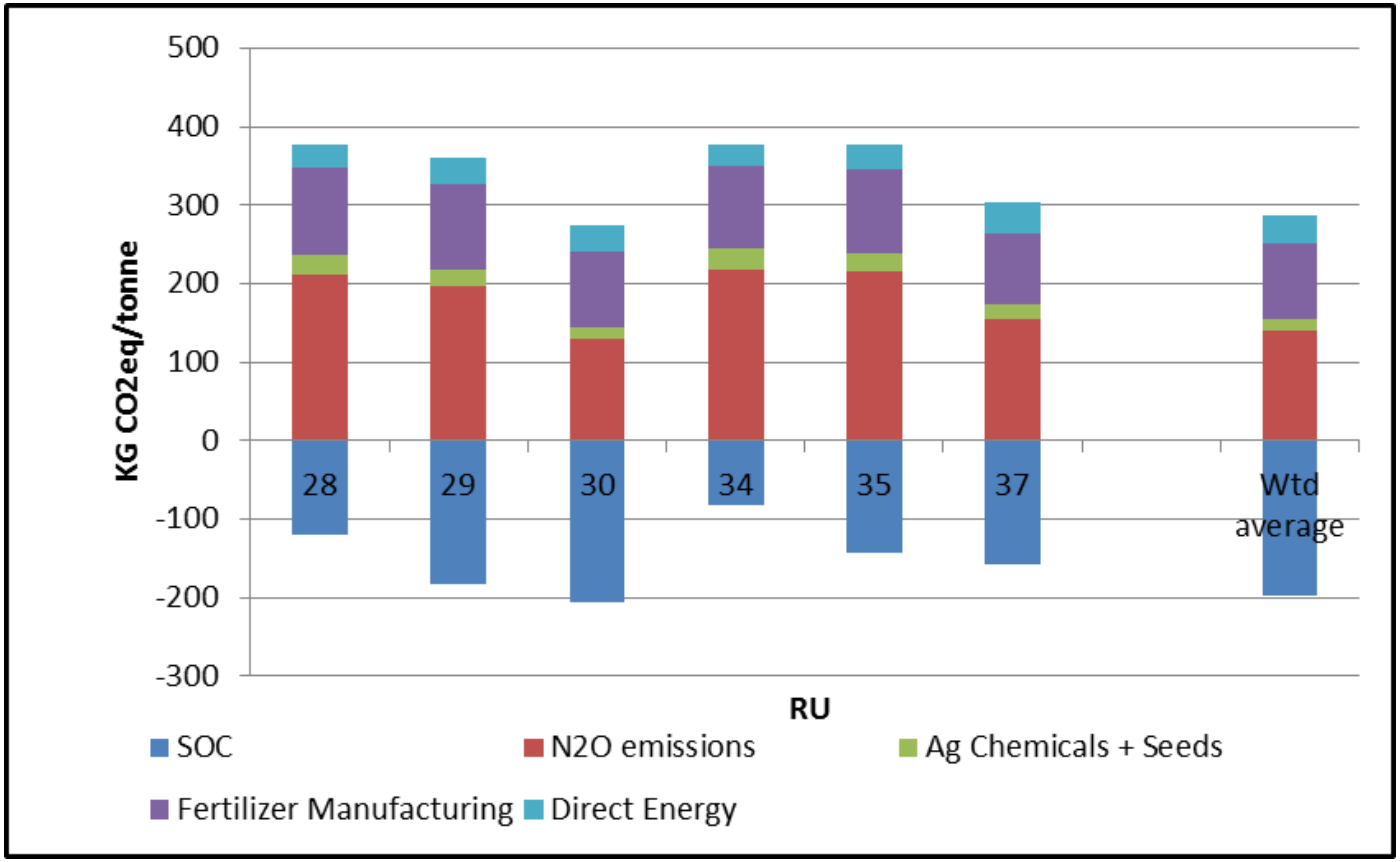
Oats N_2O



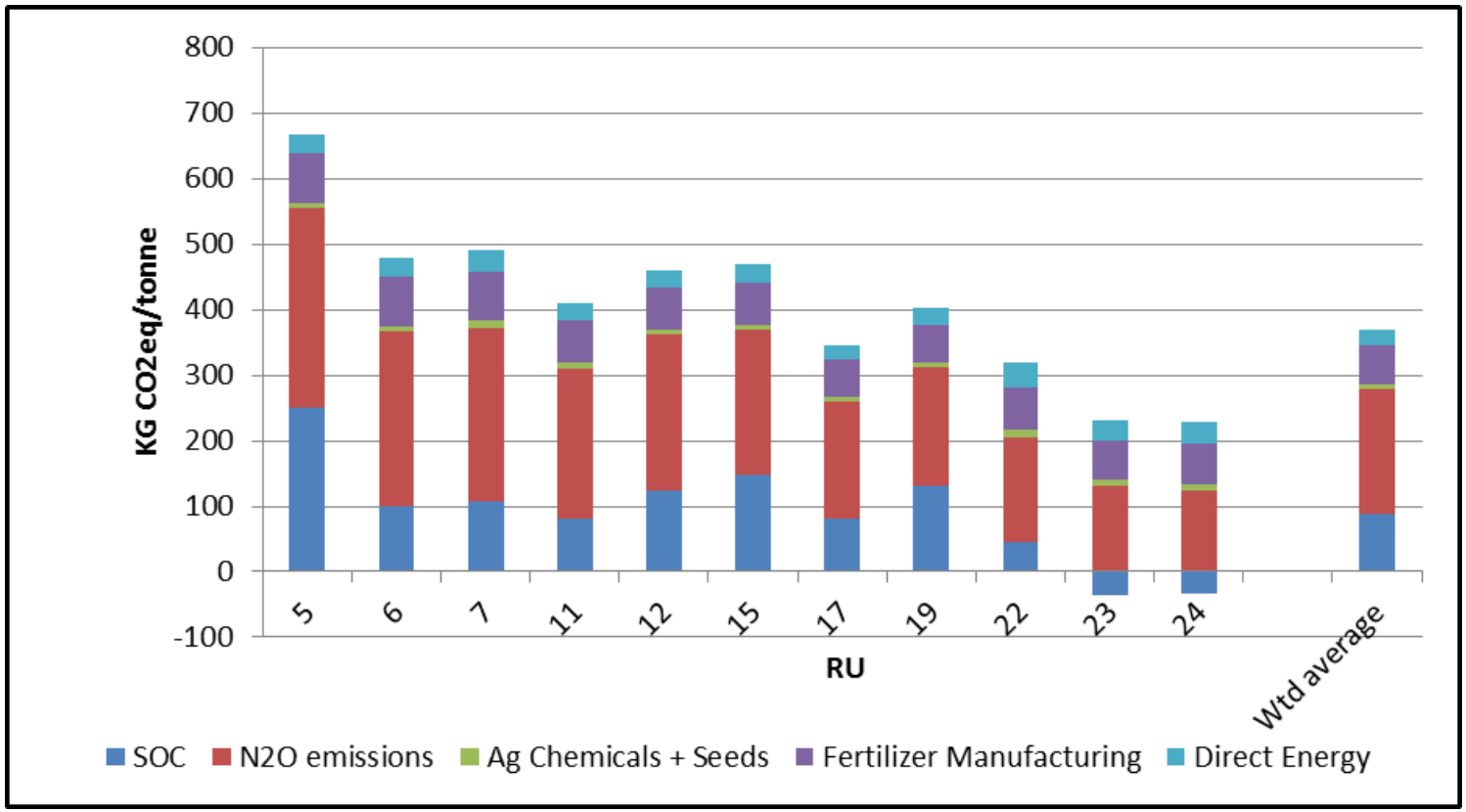
Carbon Study - Comparison to Other Studies [Oats]

Researcher	Year	Region	Value
			kg CO_2eq/tonne
This work	2014	Canada avg	245
This work	2014	Canada avg	325[1]
Nelson et al	2004	USA	335-540
Adom et al	2009	USA	580-1240[4]
Rajaniemi et al	2010	Finland	540-570[4]
Bonesmo et al	2008	Norway	560[4]

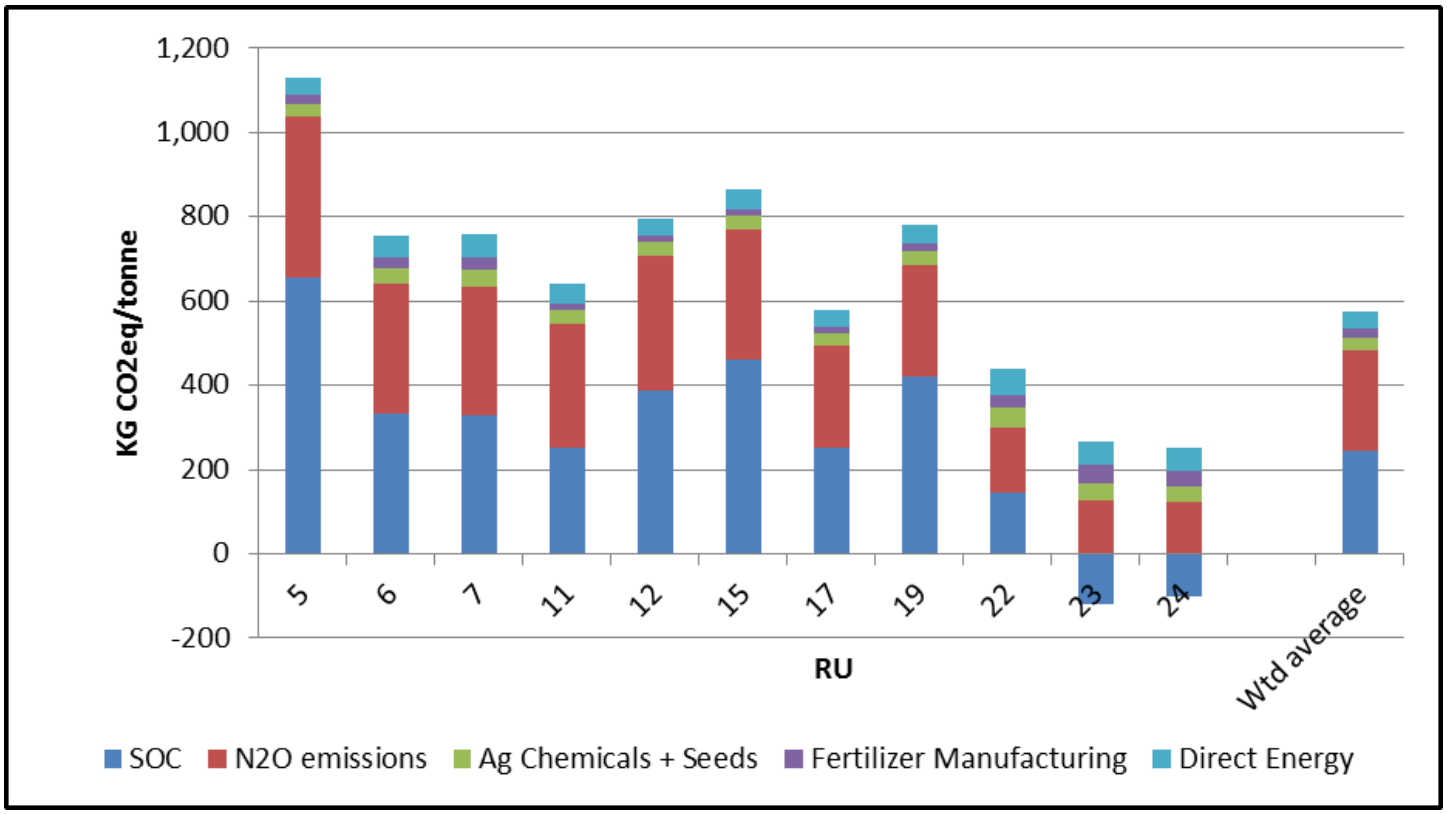
Durum


500
400
300
200
100
0
-100
-200
-300
KG CO2eq/tonne
28
29
30
34
35
37
Wtd average
RU
SOC
N2O emissions
Ag Chemicals + Seeds
Fertilizer Manufacturing
Direct Energy

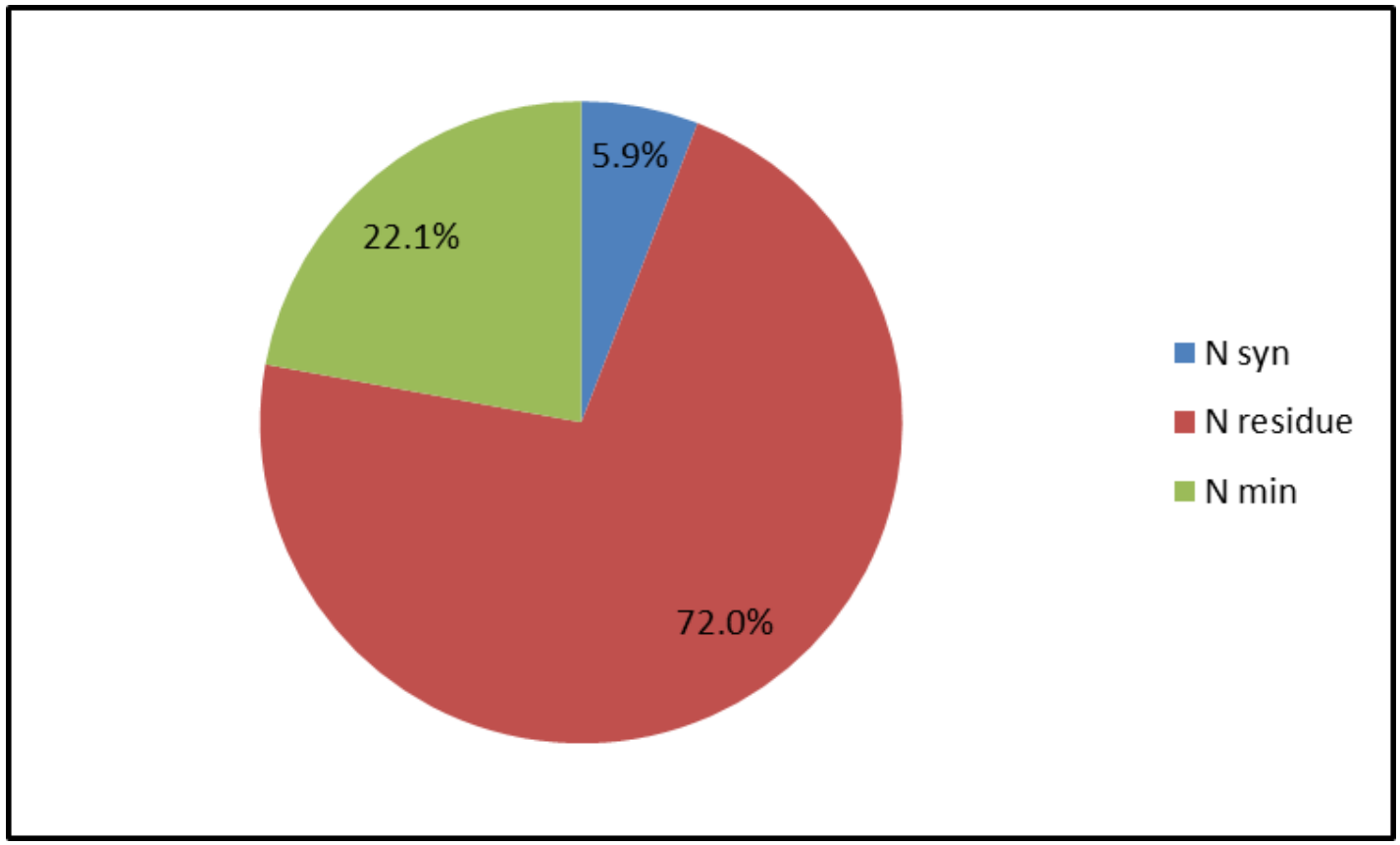
Corn


800
700
600
500
400
300
200
100
0
-100
KG CO2eq/tonne
5
6
7
11
12
15
17
19
22
23
24
Wtd average
RU
SOC
N2O emissions
Ag Chemicals + Seeds
Fertilizer Manufacturing
Direct Energy

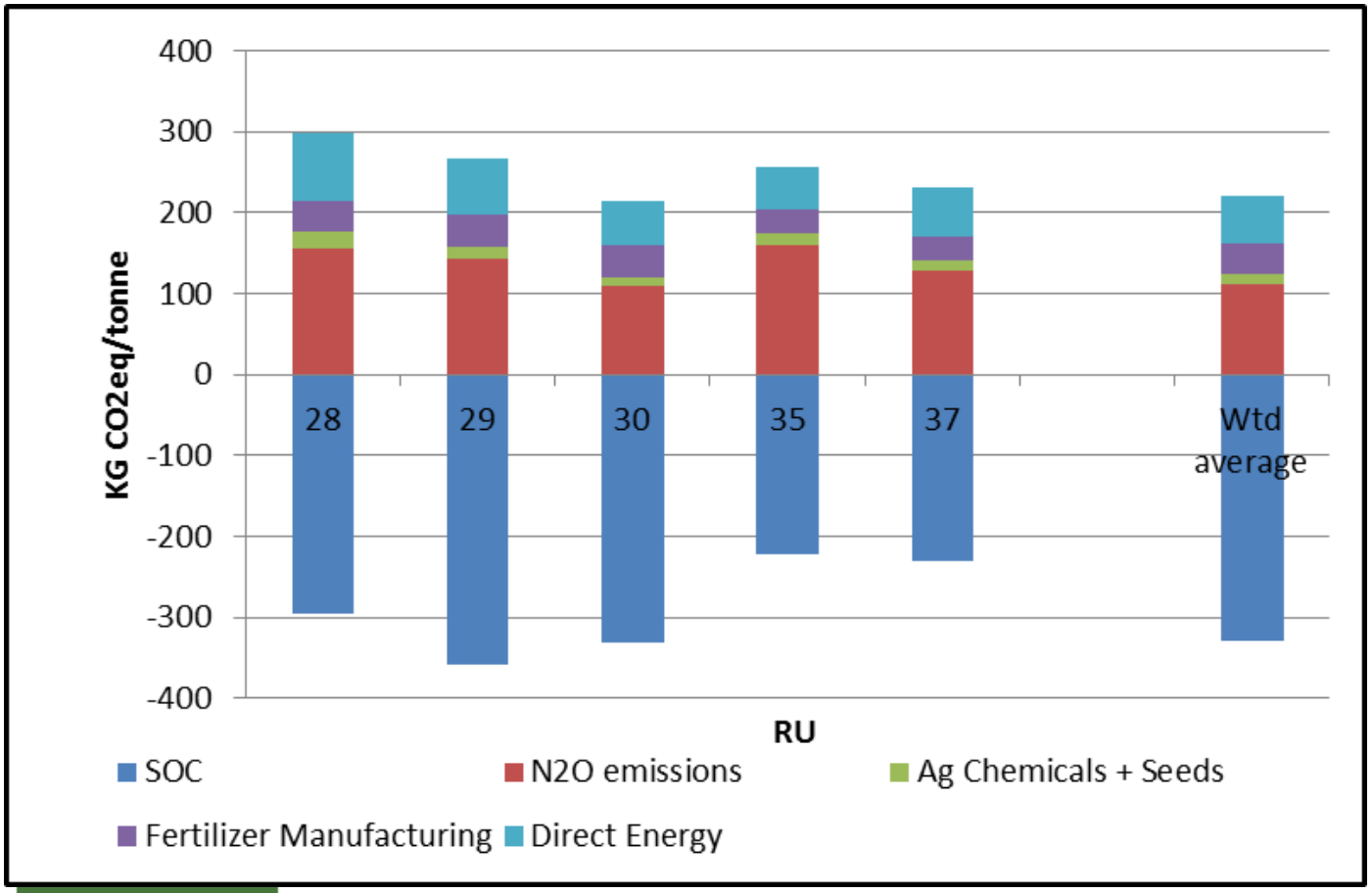
Soybeans


1,200
1,000
800
600
400
200
0
-200
KG CO2eq/tonne
5
6
7
11
12
15
17
19
22
23
24
Wtd average
RU
SOC
N2O emissions
Ag Chemicals + Seeds
Fertilizer Manufacturing
Direct Energy

Soybeans N_2O



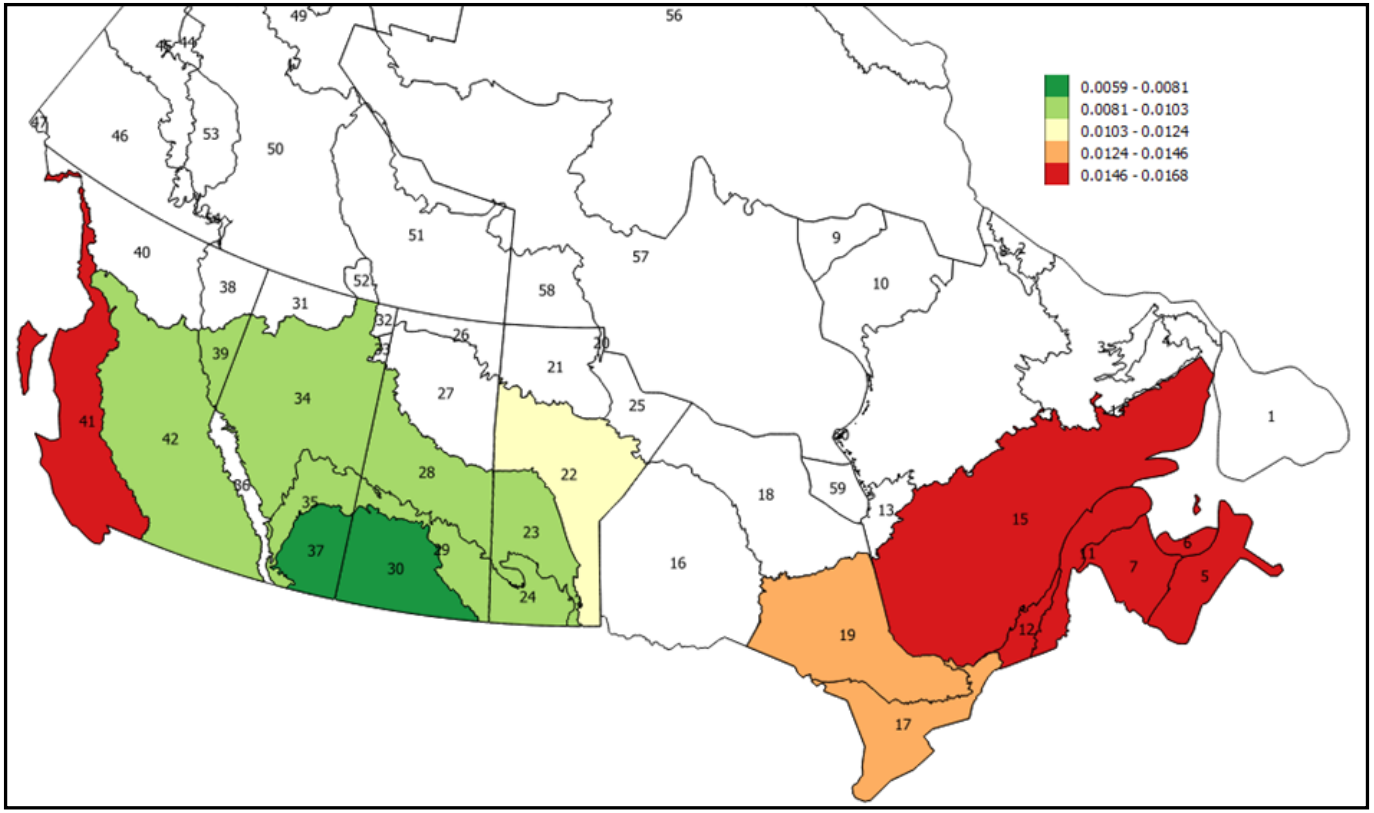
Lentils


400
300
200
100
0
-100
-200
-300
-400
KG CO2eq/tonne
28
29
30
35
37
Wtd average
RU
SOC
N2O emissions
Ag Chemicals + Seeds
Fertilizer Manufacturing
Direct Energy

N_2O Emissions

- The global warming potential of N_2O is 298 and N_2O emissions are a major source of emissions for all crops.
- There is significant regional variation in N_2O emission factors across Canada.
  - Precipitation has a strong influence with the higher moisture areas having higher N_2O emissions

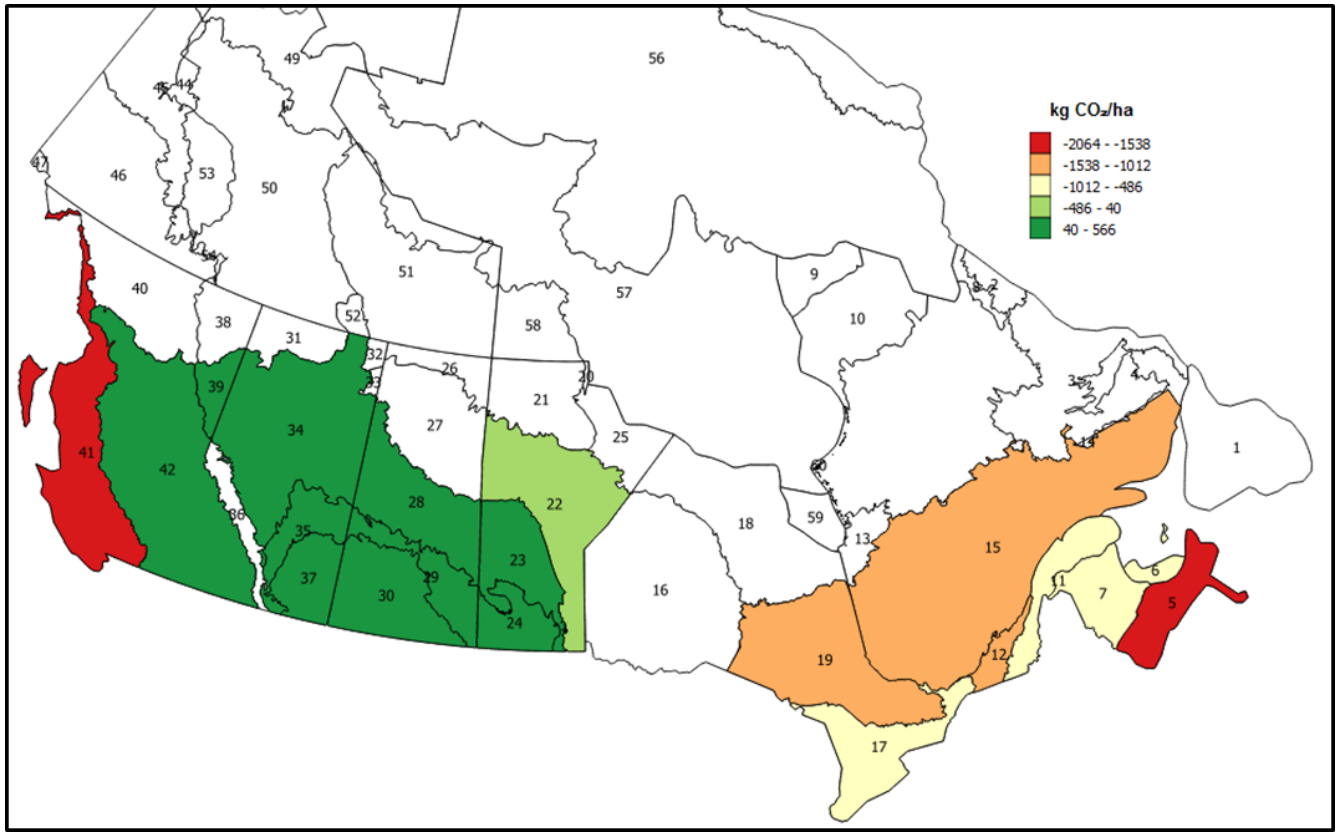
N_2O Emissions



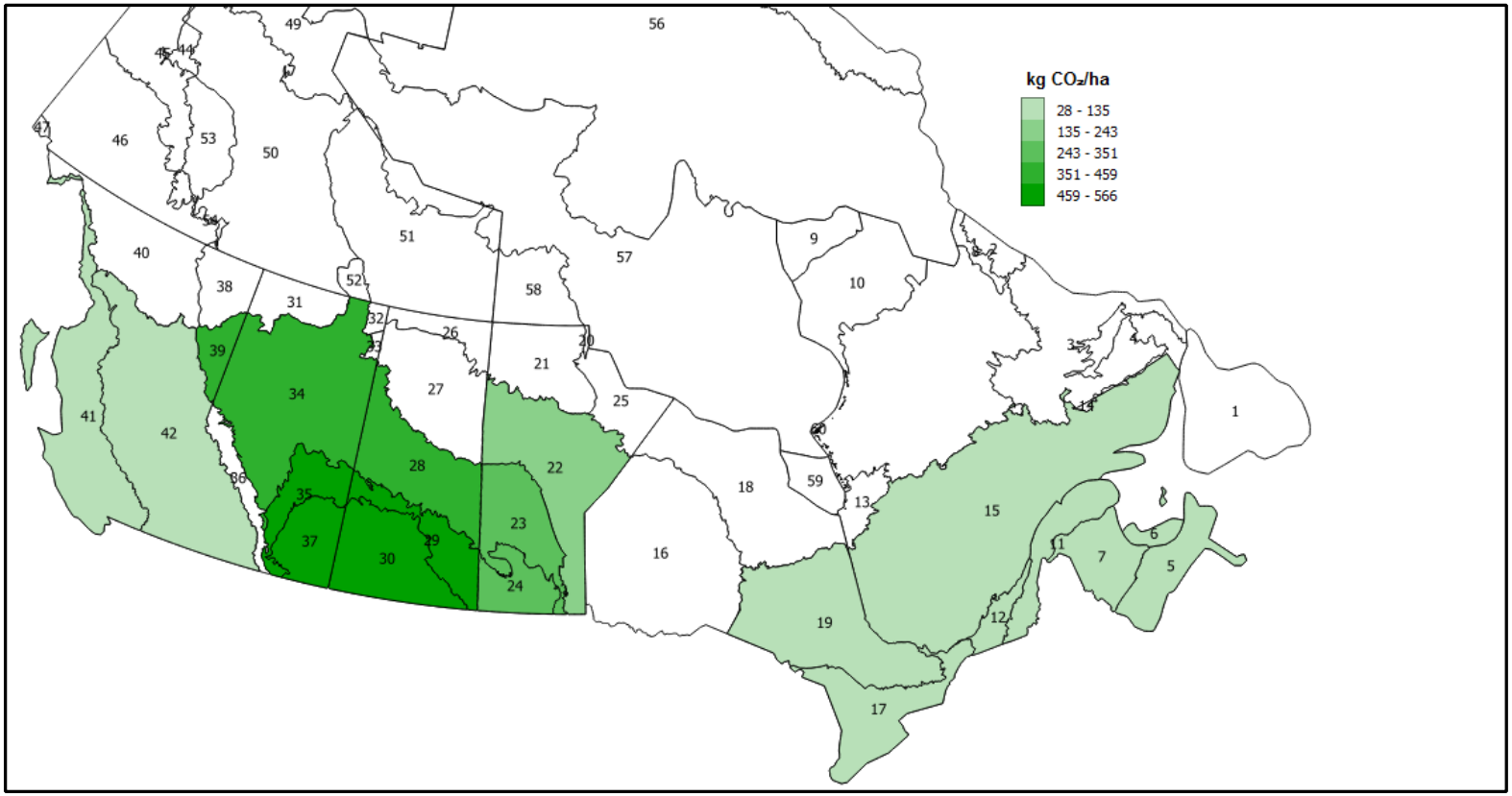
Soil Organic Carbon

- Land management changes can cause increases or decreases in SOC.
- Reduced tillage and summerfallow increase SOC.
- Perennial to annual transitions reduce SOC, annual to perennial changes increase SOC but you can’t attribute that to an annual crop.

Soil Organic Carbon



Tillage and Summerfallow



Comparison to Other Reports

- Each crop is compared to carbon footprints in the peer reviewed literature.
  - Methodology can be different, especially soil carbon approach.
  - Values in this work are often lower than reported by others, especially for western Canadian crops.
  - Tillage practices reduce fuel use and build SOC and the semi-arid climate results in low N_2O emissions.

Data Gaps

- Compared to other carbon footprinting done in Canada this project has benefited from the development of the Canadian fertilizer manufacturing footprints and much more detailed information on fertilizer application rates.
- The quality of data does vary across the country and no one region has a complete data set.
- Canadian data on actual fuel consumption is very limited.
- Pesticide application rates by crop is only available for Ontario and the participation in the last survey was not that high.
- Data on fertilizer application rates ranges from very good to non existent.

THANK YOU!

Any Questions?