Canadian Field Print Initiative

Confidential Report for Farm 99, Alberta

Field 1 (NE-26-46-21-W4), 2013 Canola

report generated Jun 09, 2015

Summary of Field Data

The data for this report was submitted by CropConsultX on behalf of Farm 99 in furtherance of the objectives of the Canadian Field Print Initiative and to obtain information on the environmental sustainability of field crop production by Farm 99. The modelled outcomes in this report are only as accurate as the data received -- the information below summarizes the data inputs received specifically for the canola crop grown on Field 1 in the 2013 crop year.

Field 1 is located at NW-26-46-21-W4 and consists of 145 acres of land. It is assumed for modelling purposes that this land is in the black soil zone and has a clay loam texture. The land is assumed to fall into Ecodistrict 727 according to the National Ecological Framework. The field was reported to have been seeded to Canola and yielded 56 bu/ac. Nitrous oxide emissions are based in part on reported fertilizer application of 80 lbs nitrogen per acre and 77 lbs/ac of other fertilizer nutrients, as outlined below.

<u>Summary of Input Parameters</u>

Province	Alberta
Ecozone	Subhumid Prairies
Ecoregion	156
Ecodistrict	727
Soil zone	Black soil with clay loam texture; hummocky (or irregular) landform with moderate slopes (10 - 15 % gradient)
Tillage	Currently using a zero till tillage regime, since 2002

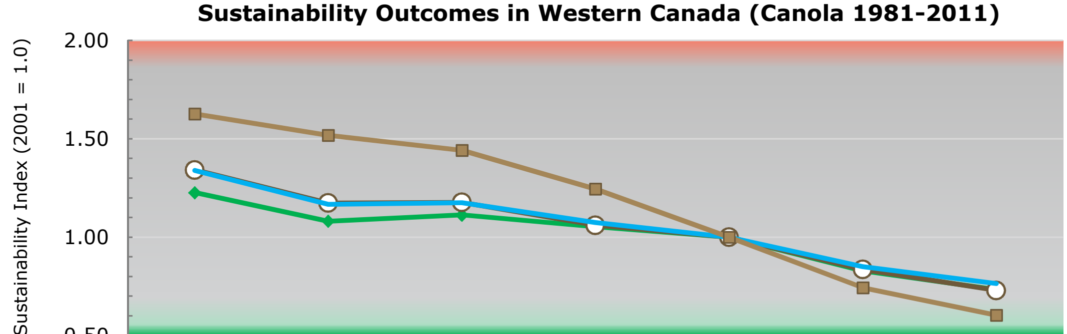
<u>Fertilizer applied (lbs/ac)</u>

Nitrogen	80	
Phosphorus	38	(P_2O_5)
Potassium	33	(K_2O)
Other	6	

Industry Sustainability Indicators

Growers have always been concerned about stewardship of their land. Production of crops in Canada, and specifically in Western Canada, has become considerably more sustainable over past decades through higher yields, reduced tillage, improved nutrient management, and changes in crop rotations. The Canadian Field Print Initiative has modelled the sustainability outcomes of Canadian field crop production in terms of land use efficiency, energy use, climate impact, and soil erosion risk. The diagram below gives an overview of the progress that has been made on these sustainability outcomes for canola in Western Canada over the past two decades.

Sustainability Outcomes in Western Canada (Canola 1981-2011)



	1981	1986	1991	1996	2001	2006	2011
Land Use Efficiency	1.23	1.08	1.11	1.05	1.00	0.83	0.73
Energy Use	1.34	1.17	1.18	1.06	1.00	0.84	0.73
Climate Impact	1.34	1.17	1.18	1.07	1.00	0.85	0.76
Soil Erosion Risk	1.63	1.52	1.44	1.25	1.00	0.74	0.60

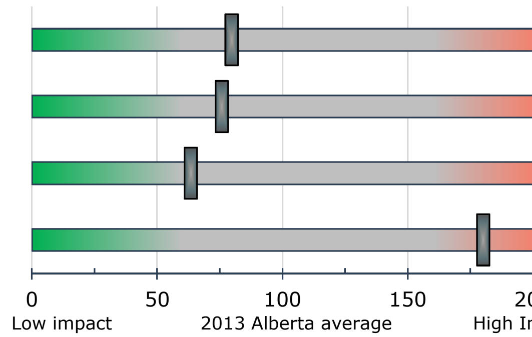
The diagram above shows the relative indicator outcomes using the year 2001 as an index of 1. For example, increasing yields have lead to significant improvements in Land Use Efficiency to the point where on average a tonne of canola required 27% less land to grow than it did a decade earlier. These estimates were developed using broad large-scale modelling algorithms and data sets including the Census of Agriculture conducted every 5 years by Statistics Canada.

The continuous improvement in sustainability outcomes on most of those macro-indicators lead the Canadian Field Print Initiative to develop this Field Print Calculator, as a way of measuring the specific sustainability outcomes using farm-level data to build estimates. While this section outlined the industry's improvement over time, the remainder of this report outlines the specific modelled results for Farm 99's canola crop on Field 1 in 2013. A full report for eleven crops in the provinces of Alberta, Saskatchewan, Manitoba, and Ontario is available online at www.fieldprint.ca.

Sustainability Indicator Overview -- 2013 Canola on Field

The fieldprint indicators below were calculated based on the data you entered in the Input Form and compared to estimated average impact for spring wheat in Western Canada and the province of Saskatchewan. The fieldprint values in the table below are relative indices on a scale of 0 to 200 that represent your resource use or impact per unit of output for each of the four indicators. In all cases, an index of 100 represents the average impact in your province for the same crop and year as your field.

Fieldprint Indicator	Alberta	This Field	Index
Land Use Efficiency	0.40 ha/tonne	0.32 ha/tonne	**79.7**
Energy Use	8.89 ha/tonne	8.45 ha/tonne	**75.7**
Climate Impact	1.29 ha/tonne	1.02 ha/tonne	**63.4**
Soil Erosion Risk	3.63 ha/tonne	6.54 ha/tonne	**180.1**



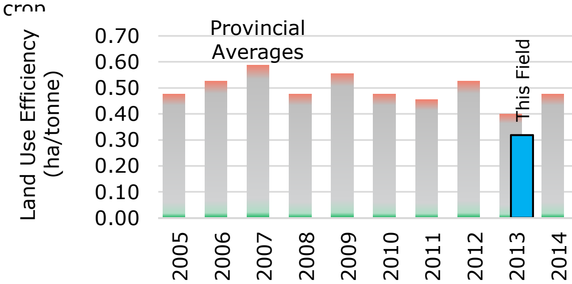
Land Use Efficiency Indicator

Land is a primary input for all agricultural production. Agriculture is in competition for land with other land uses, including forestry and urban uses. Crop production involves a large area of land, and a high level of productivity, leading to significant challenges and opportunities for sustainable land use.

The land-use efficiency indicator is an estimate of the amount of land required to produce useable crop product. It is essentially an index of the inverse of crop yield -- instead of measuring tonnes produced per hectare, land use efficiency measures the number of hectares required to produce a tonne of crop.

In the 2013 crop year on Field 1 your yield was 56 bu/ac (3.14 tonne/ha), so you used 0.319 hectares to produce each tonne of canola. The 2013 provincial average for Alberta was 0.4 ha/tonne, based on an average yield of 2.50 tonne/ha (higher than the three-year average of 2.20 tonne/ha).

The chart to the right shows the Land Use Efficiency of your 2013 crop on Field 1 in relation to the long-term provincial trend for canola in Alberta. A low LUE indicates relatively more sustainable production.



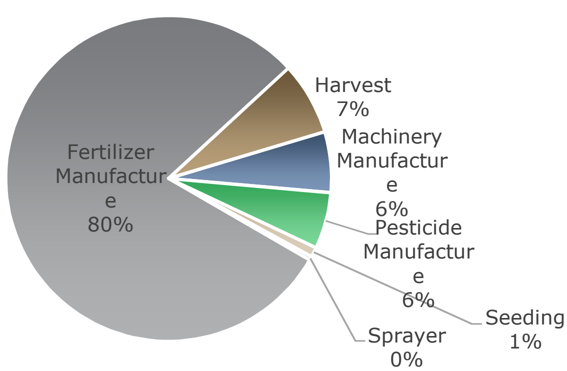
More information: Land Use Efficiency is calculated using data from CANSIM, Statistics Canada, Table 001-0010 - Estimated areas, yield, production and average farm price of principal field crops, in metric units, annual.

Energy Use Indicator

Crop production involves many uses of energy, from production of fertilizers and machinery to fuel burned to perform field work. The Canadian Field Print Calculator captures the major energy-intensive activities necessary for crop production, including fuel burned for farm field work and energy used for the manufacture of machiner, fuel, and fertilizer. As with the other CFPC indicators, emphasis is on modelling elements that are affected by management change. A balance has been struck to reduce administrative burden by only including elements that would be expected to have an appreciable impact on overall sustainability, without requiring inordinate amounts of data collection or searching. Fuel burn for crop drying, for example, has been omitted due to incomplete data from pilot participants.

Overall, the production of each tonne of canola on Field 1 in 2013 required an estimated 8.5 Gigajoule of energy, which is 24.3% lower than the Alberta average of 8.9 GJ/tonne. The relative contributions of the modelled energy use categories (in GJ/tonne of crop) on this field in

Fertilizer Manufacture	5.14 GJ/tonne
Harvest	0.47
Machinery Manufacture	0.39
Pesticide Manufacture	0.36
Seeding	0.06
Sprayer	0.02

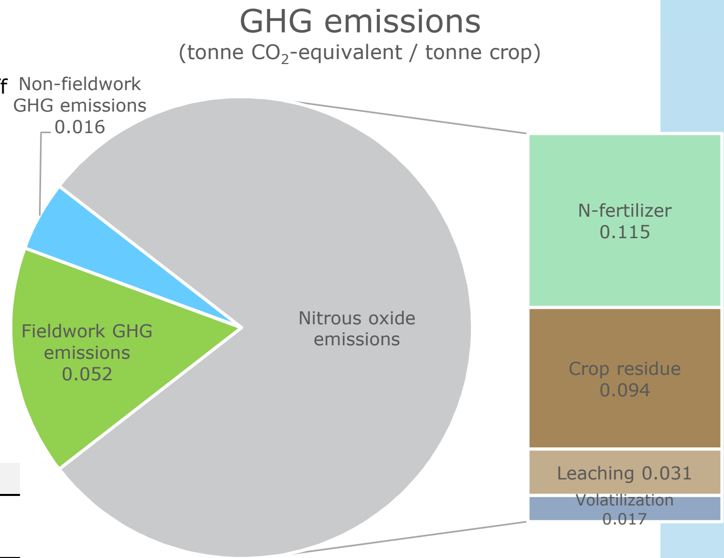


Climate Impact Indicator

Canadian agriculture contributes to Canada's greenhouse gas emissions. In turn, agriculture is susceptible to the impacts of climate change resulting from these emissions. For these reasons, the effect of changes in management practices on overall farm sustainability is informative for the industry and for a farm manager.

The climate impact indicator estimates the emissions of two greenhouse gases associated with crop production: carbon dioxide (CO_2) and nitrous oxide (N_2O). Carbon dioxide is produced when fuel is burned for fieldwork or in the production of inputs such as fertilizer or machinery. Nitrous oxide emissions from agricultural soils result largely from fertilizers, manure, crop residues and mineralization of native soil organic matter. They also result from tillage practices, water accumulation in low spots, leaching, runoff, and volatilization.

The Calculator models both direct nitrous oxide emissions (from chemical and organic nitrogen fertilizer application, from nitrogen that becomes available after crop residue decomposition, and from the additional of soil organic carbon), as well as indirect nitrous oxide emissions (from leaching/runoff and from volatilization).
The nitrous oxide emissions are then expressed as tonnes of CO2-equivalent GHG emissions per tonne of crop.
The energy use for fieldwork (0.6 GJ/tonne canola) equates to 0.052 tonne of carbon-dioxide emissions per tonne of crop. Likewise, the non-fieldwork elements including manufacture of machinery, fertilizer, and pesticides (2.1 GJ/tonne) equate to 0.016 tonne CO2 emissions. The nitrous oxide emissions (expressed as tonne of CO2-equivalent emissions) are estimated as follows for this field in 2013:



Emissions (tonne CO2-equiv / tonne canola)

Emission Source	Field 1 Canola	Average 2013	Difference
N-fertilizer	0.115	0.143	-19.2%
Crop residue	0.094	0.081	15.1%
Leaching	0.031	0.032	-2.6%
Volatilization	0.017	0.017	5.1%
Total N_2O	0.257	0.272	-5.5%
Total GHG	0.326	0.514	-36.6%
Soil C Change	0.432		
Net GHG	-0.106	*(net sequestration of -0.106 tonne CO2-equiv greenhouse gas per tonne canola)*	

More information: Both the greenhouse gas emissions and the soil carbon change estimates are based largely on modelling algorithms used by Agriculture and Agrifood Canada in their Holos modelling software. Users can select scenarios and farm management practices (including both crops and livestock) and then adjust these practices to see the effect on emissions.

Holos

Soil Carbon Change

Losses of soil organic carbon can be slowed (or the sequestration of soil organic carbon can be increased) by the following practices: decreasing soil erosion, reducing tillage intensity, reducing summerfallow, using cover crops, or periodically producing forages and crops that leave large quantities of residue. Over the past few decades, Western Canadian farmers have generally significantly reduced both the amount of tillage and the amount of summerfallow in rotations. For that reason, there has generally been a net sequestration of carbon in Western Canada.

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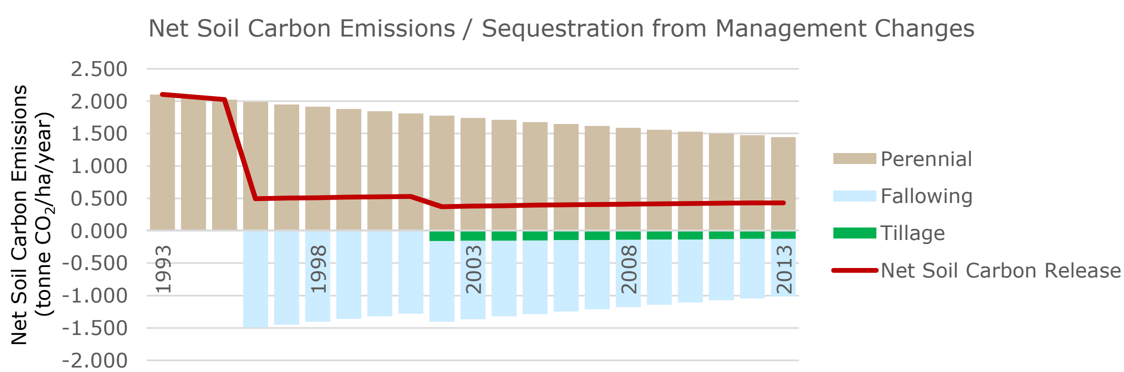
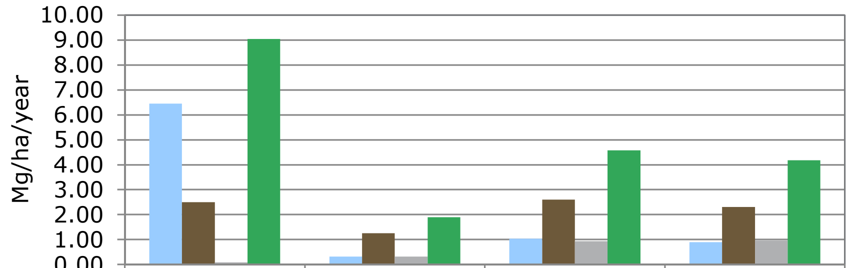


Soil Erosion Risk Indicator

Rainfall-runoff, and tillage are both significant drivers of soil erosion in Western Canada. This soil erosion risk indicator estimates probable soil loss due to water erosion and tillage erosion. Wind erosion does not significantly contribute to total soil erosion risk potential in Western Canada. The indicator is based on soil, topography, land use and climate data, as well as previous and current crop type, from which tillage and water erosion are calculated. Note that, on Western Canada's prairies, most soil erosion is strictly a down-slope movement of soil, with the great majority remaining on the field. For this reason, erosion in Western Canada is calculated based on the landscape segment with the highest erosion potential (i.e., the upper-slope position for tillage erosion and the middle-slope position for water erosion).

It is also important to note that total soil erosion risk is not simply the sum of tillage and water erosion. As water erosion moves soil generally from mid-slope segments, some of the soil eroded from the upper-slope via tillage erosion is deposited on the mid-slope. Therefore, the integrated soil erosion value is normally less than the sum of water, tillage, and wind erosion.



	Field 1	Ecodistrict	Ecoregion	Alberta
Water	6.44	0.32	1.04	0.90
Tillage	2.50	1.25	2.60	2.31
Wind	0.09	0.32	0.94	0.97
Total	9.04	1.90	4.57	4.17

Unlike both your ecoregion and Alberta, the greatest risk of soil erosion on Field 1 comes from water, with an estimated soil erosion potential of 6.44 Mg/ha/year. The diagram above shows the relative risks on this field in comparison to modelled estimates for the ecodistrict 727, ecoregion 156, and the province of Alberta.

Canadian Field Print Iniatiative Funders

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Canadian Canola Growers Association
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