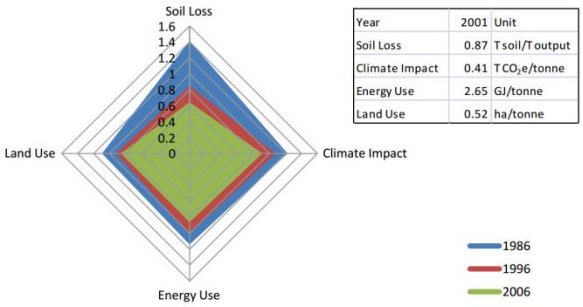
On-Farm Sustainability Calculator

Production of crops in Western Canada has become considerably more sustainable over past decades, as a result of improvements in many areas, including especially:

- Higher yield
- Reduced tillage
- Improved nutrient management
- Changes in crop rotations

Consumers and retail food supply chains are now demanding more sustainability information. In response, an industry-led initiative has developed sustainability metrics for Western Canadian crop production. Indicators were developed for Land Use, Soil Loss, Energy Use and Climate Impact across the crop-producing area of Western Canada. These macro-level metrics were developed for wheat (spring, winter, durum), canola, oats, peas, flax and lentils.

On the right is a sample of the findings for Canadian peas for the time period 1986 to 2006. The indicators show estimates of environmental impact per tonne of crop output. Just like this diagram for peas, sustainability improvements were seen for every one of the indicators, for every one of the eight crops studied.



Year	2001	Unit
Soil Loss	0.87	T soil/T output
Climate Impact	0.41	T CO_2e/tonne
Energy Use	2.65	GJ/tonne
Land Use	0.52	ha/tonne

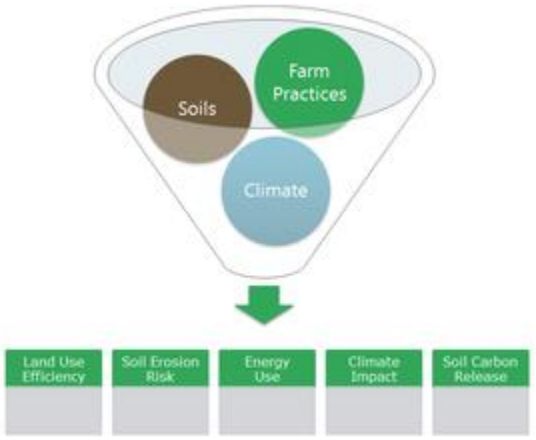
Help Your Industry by Trying the Tool

Pulse Canada and other industry partners are now working with Serecon to develop this On-Farm Sustainability Calculator. They are looking for help collecting real field-level data to build regional sustainability indicators.

You can help the crop industry show the sustainability of Canada's production. And during this pilot project, you can also help us fine-tune the calculator itself. If you are interested in participating in the pilot project, you can get more details at:

www.serecon.ca/calculator

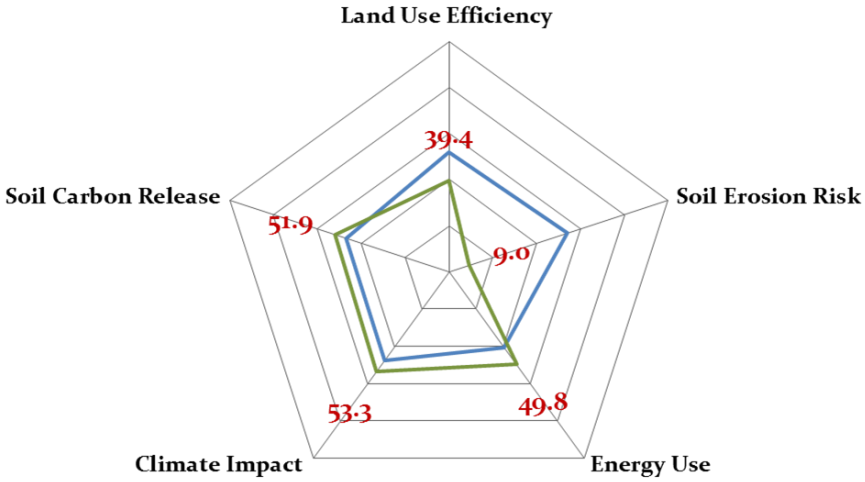
All that is required is basic farm and field operations data, as outlined in the three attached worksheets. They can be completed by hand and sent by fax to (780) 448-7445 or completed in Microsoft Excel and e-mailed to us. Either way, you will receive a detailed five-page sustainability report for each field & crop-year you submit.



The On-Farm Sustainability Calculator lets individual growers document that their production practices are appropriate and sustainable.

The diagram to the left gives an overview of how simple the calculator is at its core. Basic information on farming practices, soils, and climate are used to model an individual crop's estimated sustainability on the five indicators.

The On-Farm Sustainability Calculator is an easy-to-use Microsoft Excel-based tool that enables our industry to demonstrate its sustainability improvements. It also allows participating farmers to compare alternative management scenarios on their own farms, monitor improvements over time, and compare their sustainability to regional averages.



Fieldprint Indicator	Western Canada	Province	Your Field
Land Use Efficiency	50.0	51.7	39.4
Soil Erosion Risk	50.0	54.1	9.0
Energy Use	50.0	40.7	49.8
Climate Impact	50.0	47.6	53.3
Soil Carbon Release	50.0	47.1	51.9

The sample output from the calculator above shows both graphically and in detailed tables how the sustainability of production on a specific field compares to provincial averages. Through the participation of farmers contributing their data, we hope to also build regional comparisons for better insight and continued improvement in the sustainability of our farming practices.

On-Farm Sustainability Calculator

Farm-Level Data Input Sheet

Farm ID	★	
Muncipality	★	
Province	★	

Equipment used in Field Operations

Tractors

Equipment Name	Horsepower	acres/hr

Swathers

Equipment Name	Horsepower	acres/hr

Combines

Equipment Name	Horsepower	acres/hr

Sprayers

Equipment Name	Horsepower	acres/hr

Notes

Difficulties with the calculator? Please call Markus or Angela at Serecon at (780)448-7440 if you have any questions during this pilot project.

On-Farm Sustainability Calculator

Field-Level Data Input Sheet

Field Name			
Legal Land Location	Quarter		
	Section	★	
	Township	★	
	Range	★	
	Meridian	★	
Field size		★	acres

Soil Information -- *NOTE: If you make no selection, legal land location will be used to estimate soil values.*

Surface Form	☐	I = Inclined & Dissected
	☐	H = Hummocky, Knoll & Kettle
	☐	L = Level
	☐	R = Rolling
	☐	U = Undulating
Slope Class (% slope)	☐	A = 0 - 0.5 % slope
	☐	B = 0.5 - 2.0
	☐	C = 2.0 - 5.0
	☐	D = 5.0 - 9.0
	☐	E = 9.0 - 15.0
	☐	F = 15.0 - 30.0
Observed Wind Erosion	☐	None
	☐	Very Slight
	☐	Slight
	☐	Moderate
	☐	Severe
Soil Type	☐	Brown
	☐	Dark Brown
	☐	Black
Surface Soil Texture	☐	Clay
	☐	Clay Loam
	☐	Loam
	☐	Loamy Sand
	☐	Sand
	☐	Sandy Clay Loam
	☐	Sandy Loam
	☐	Sandy Loam
	☐	Silt Loam
	☐	Silty Clay
	☐	Silty Clay Loam

Tillage Practices

		Current Practice		Previous Practice	Year of Change
Pre-plant tillage system ★	☐	Conventional	☐	Conventional	
	☐	Minimum Till	☐	Minimum Till	
	☐	Zero Till	☐	Zero Till	
Fallowing practice ★	☐	Fallow in rotation	☐	Fallow in rotation	
	☐	Continuous cropping	☐	Continuous cropping	
Last perennial crop	☐	Grassland			
	☐	Other Perennial			
	☐	Annual >20 years			

Wetland Drainage

Acres typically not seeded until June 15		acres
Acres drained		acres
Acres drained last 5 years		acres

On-Farm Sustainability Calculator

Individual Crop Data Input Sheet

Crop-Year Information

Field Name ★

Crop Year ★ *(indicators available for 2008-2013)*

Crop this year ★ *(indicators for several other crops still under development)*

- ☐ Canola
- ☐ Oats
- ☐ Peas
- ☐ Spring Wheat

Frequency of this crop in rotation ★

Yield ★ bu/ac

Crop prior year ★

Field Operations

			Hours for operations	
Cultivation	Cultivation #1	(tractor used)		hours
	Cultivation #2			hours
	Cultivation #3			hours
	Cultivation #4			hours
	Seeding tractor used ★	(tractor used)		hours

Fertilizer Application		Tractor used	Fertilizer Application Rates (lbs nutrient/acre) Nitrogen (N)	Phosphorus (P)	Potassium (K)	Macronutrients	Hours
	Pre-Seed						
	With Seed						
	Post Seeding						

Manure — Application method

- ☐ no manure applied
- ☐ Broadcast - Solid
- ☐ Injected - Liquid

Manure type

- ☐ Beef
- ☐ Dairy
- ☐ Hog
- ☐ Poultry

Application rate lbs manure/acre

	Spreader/injector	(tractor used)		hours
	Loader tractor	(tractor used)		hours
Pesticide	Application #1	(sprayer used)		hours
	Application #2			hours
	Application #3			hours
	Application #4			hours
	Application #5			hours

Harvest

Swather used			hours
Combine used ★			hours

Average speed miles/hr

Crop drying -- type

- ☐ Batch-in-Bin
- ☐ High Temperature with Air
- ☐ High Temperature without Air
- ☐ Low Temperature
- ☐ Natural Air

Crop drying -- fuel

- ☐ Natural Gas
- ☐ Propane

Moisture content before drying %

Moisture content after drying %

On-Farm Sustainability Report

2011 East Field Peas

Sample Farm, Albertatown, AB

Sustainability Indicators

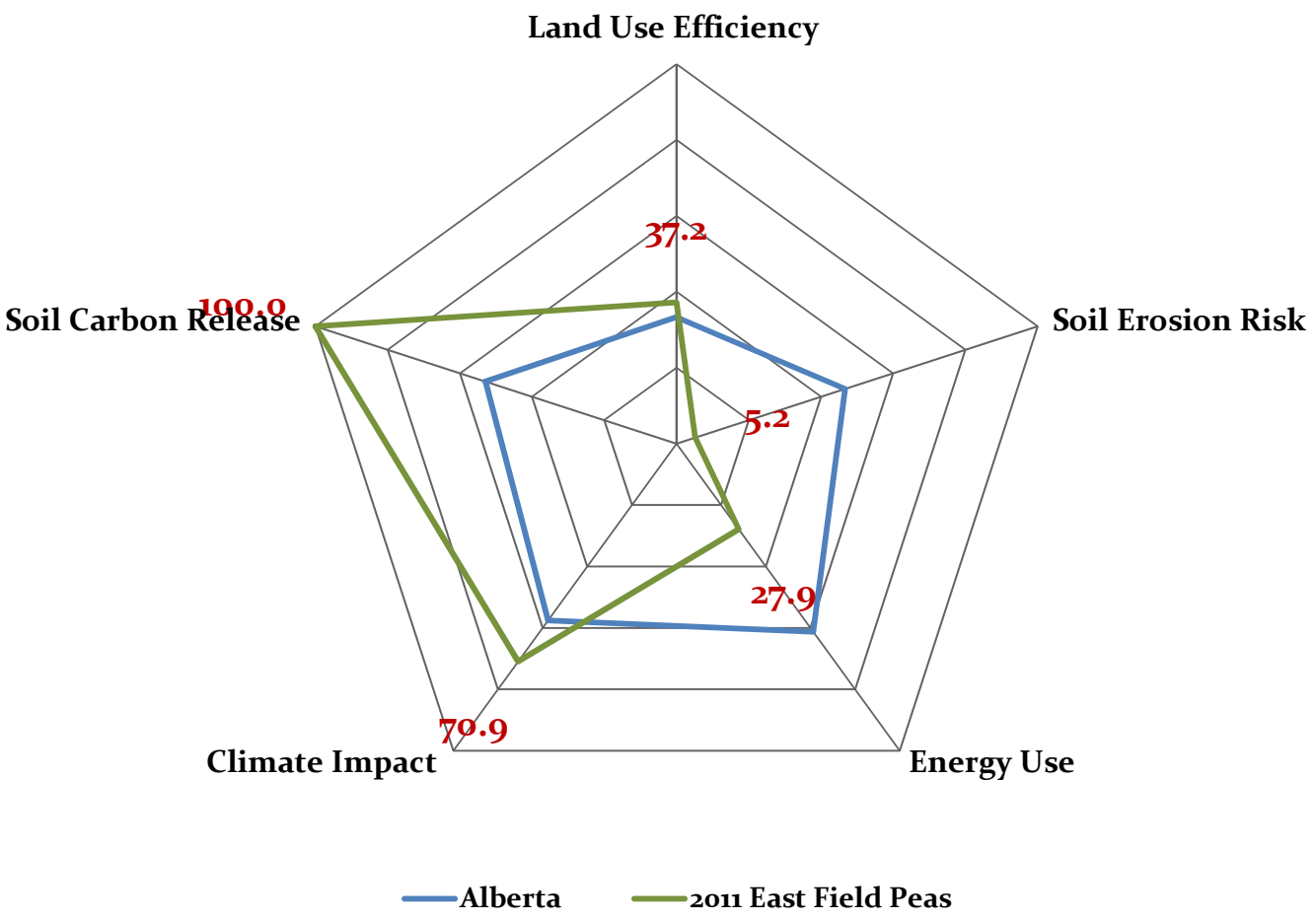
The fieldprint indicators below were calculated based on the data you entered in the Input Form and compared to estimated average impact for Western Canada and the province of Alberta.

The fieldprint values in the table below are relative indices on a scale of 1-100 that represent your resource use or impact per unit of output for each of the five indicators. In all cases, the index of 50 represents the average impact across Western Canada.

Fieldprint Indicator	Western Canada	Alberta	2011 East Field Peas
Land Use Efficiency	50.0	33.3	37.2
Soil Erosion Risk	50.0	46.6	5.2
Energy Use	50.0	61.3	27.9
Climate Impact	50.0	57.6	70.9
Soil Carbon Release	50.0	52.9	100.0

A smaller number indicates a lower estimated impact. An index of 50 is the Western Canadian average.

Sustainability Spidergram



An index of 50 represents the average impact across Western Canada. The closer your farm's fieldprint indicators are to the center of the diagram, the lower the relative impact and the higher the sustainability of production.

Fieldprint Indicator	Alberta	2011 East Field Peas
Land Use Efficiency	33.3	37.2
Soil Erosion Risk	46.6	5.2
Energy Use	61.3	27.9
Climate Impact	57.6	70.9
Soil Organic Carbon Release	52.9	100.0

Land Use Efficiency

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.

	2009	2010	2011
Yields	*tonne/ha*	*tonne/ha*	*tonne/ha*
Your peas on East Field			3.363
Average Alberta yield	2.200	2.600	2.700
Average Western Canada yield	2.300	2.200	2.500

Land Use Efficiency	*ha/tonne*	*ha/tonne*	*ha/tonne*
Your peas on East Field			0.297
Alberta	0.455	0.385	0.370
Western Canada	0.435	0.455	0.400

Land Use Efficiency Indicator			*Index 0-100 (Western Canada average = 50)*
Your peas on East Field			37.2
Alberta	52.3	42.3	46.3
Western Canada	50.0	50.0	50.0

Soil Erosion Risk

Rainfall-runoff, wind and tillage are all significant drivers of soil erosion in Western Canada. This soil erosion risk indicator estimates probable soil loss due to water erosion, wind erosion and tillage erosion. The indicator is based on soil, topography, land use and climate data, as well as crop type, from which water, wind and tillage 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.

The Soil Erosion Risk Indicator was used to estimate the risk of erosion for the most eroding portion of the landscape (i.e., the upper and mid-slope positions) for the three elements:

Tillage Erosion Risk	0.04	
Water Erosion Risk	0.36	
Wind Erosion Risk	0.00	
Soil Erosion Risk Potential	0.40	Mg/ha/yr

For more information on the soil erosion risk indicator, please see "The impacts of land use on the risk of soil erosion on agricultural land in Canada", Sheng Li, David A. Lobb, and Brian G. McConkey, 2010 19th World Congress of Soil Science. (http://www.iuss.org/19th%20WCSS/Symposium/pdf/0068.pdf)

Energy Use

Overall, the production of each kilogram of peas on East Field in 2011 used an estimated 1,489 kilojoule of energy, which is 43.4% lower than the Alberta average of 2,629 kilojoule and 34.8% lower than the Western Canadian average of 2,282 kilojoule/kilogram.
The field operations during the 2011 crop year used 727.0 kilojoule of energy per kilogram of peas, with the largest element (47.7%) being for harvest and the remainder as outlined in the table below:

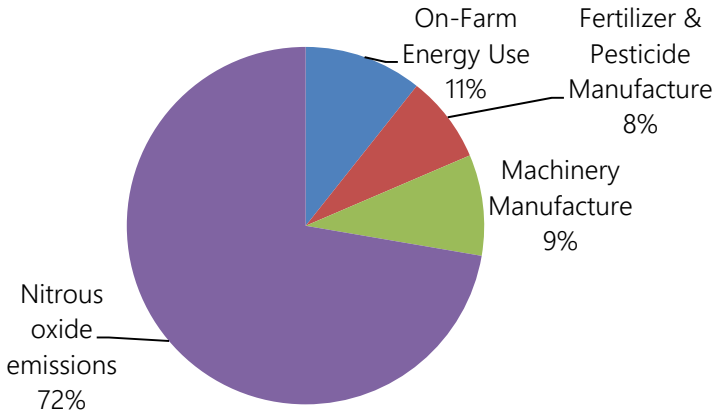
	Energy Use for Fieldwork	
	Energy Use kJ/kg crop	% of fieldwork energy use
Tillage	0.0	0.0%
Seeding	282.3	38.8%
Fertilizing	0.0	0.0%
Spraying	98.1	13.5%
Manure	0.0	0.0%
Harvest	346.7	47.7%
	727.0	

Other energy uses for your peas crop were 229 kJ/kg for the manufacture of fertilizers and 509 kJ/kg for machinery manufacture.

Climate Impact

The climate impact indicator estimates the emissions of two greenhouse gases associated with crop production: carbon dioxide (CO_2) and nitrous oxide (N_2O). CO2 is produced when fuel is burned for fieldwork or in the production of inputs such as fertilizer or machinery. N_2O emissions from agricultural soils result largely from fertilizers, manure, crop residues and mineralization of native soil organic matter. N2O emissions also result from tillage practices, water accumulation in low spots, leaching, runoff, and volatilization.
The production of each kilogram of peas on East Field in 2011 had an overall climate impact of approximately 480.1 gCO2 equivalent. This includes 51.3 g CO2 equivalent from fieldwork energy use, 347.1 g CO2 equivalent from nitrous oxide emissions, and 81.7 g for other energy use.

Nitrous oxide emission	347.1
Machinery manufacture	43.9
Fertilizer manufacture	34.3
Harvest	24.5
Seeding	19.9
Spraying	6.9
Pesticide manufacture	3.6
Tillage	0.0
Fertilizer application	0.0
Manure application	0.0
Grain Drying	0.0
Total gCO2e/kg peas	**480.1**



Your overall estimated climate impact of 480.1 g CO2 equivalent per kg of crop is 4.6% higher than the Alberta average of 458.8 and 28.3% higher than the Western Canada average of 374.2g CO2 equivalent per kg of peas.

Soil Carbon Release

The soil carbon indicator estimates how soil organic carbon levels are changing over time. The change in soil organic carbon is a useful indicator of long-term trends in overall soil health. At the same time, this indicator estimates how much carbon dioxide is removed from the atmosphere by plants and stored (sequestered) as soil organic carbon. Thus, the soil carbon indicator shows changes in soil health, as well as reductions in atmospheric carbon dioxide.

The soil carbon indicator accounts for soil carbon changes due to three farm management activities: changes in tillage practices, changes in use of fallow, and change from perennial cropping or grassland to annual crop production. Soil carbon improves in response to tillage reduction and to fallow reduction, but deteriorates in response to changing from perennial cropping or grassland to annual cropping.

Overall, it is estimated that the change in soil organic carbon for East Field on your farm in 2011 was a net release of approximately 532.2 kg of carbon per hectare per year. By comparison, the Alberta average is a net sequestration of 62 kg C/ha/year and the Western Canadian average is a sequestration of 86 kg C/ha/year.

It is estimated that 532.2kg of carbon per hectare was released in 2011 due to your having broken grassland in 2011. The biggest increase in carbon sequestration is during the first few years after adopting conservation tillage or reduced fallowing, since the system reaches a new equilibrium after about 20 years. This should be kept in mind when interpreting the Soil Release indicator.

You have entered some data on wetland drainage which is useful and relevant, but this indicator does not yet account for that wetland data in this version of the Fieldprint Calculator.

The provincial and prairie averages are based on 2006 estimates, as outlined in "Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series, Report #3", Agriculture and Agri-Food Canada, 2010. For more information on the soil organic carbon indicator, please see http://publications.gc.ca/collections/collection_2011/agr/A22-201-2010-eng.pdf.

Notes

This report contains actual results for a central Alberta farm.
Only the identifiers have been changed -- the field and crop-level data is based on actual farm results.

Development of the Western Canada Fieldprint Calculator supported by:

Pulse Canada
Ducks Unlimited Canada
Conserving Canada's Wetlands
GENERAL MILLS
CANADIAN CANOLA GROWERS ASSOCIATION
CropLife CANADA