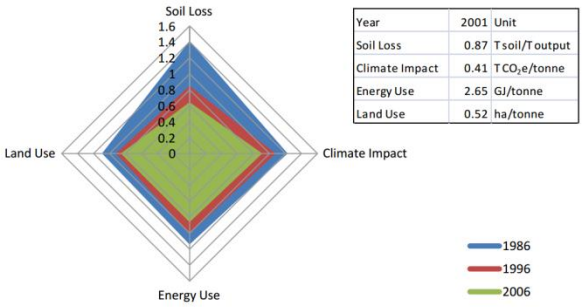
Canadian Field Print Calculator

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

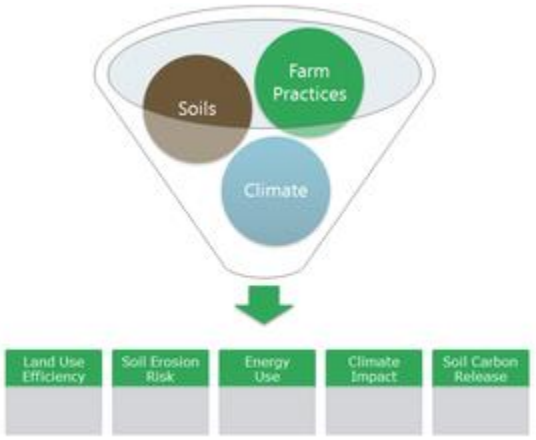
Help Your Industry by Trying the Tool

Pulse Canada and other industry partners are now working with Serecon to develop this Canadian Field Print 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

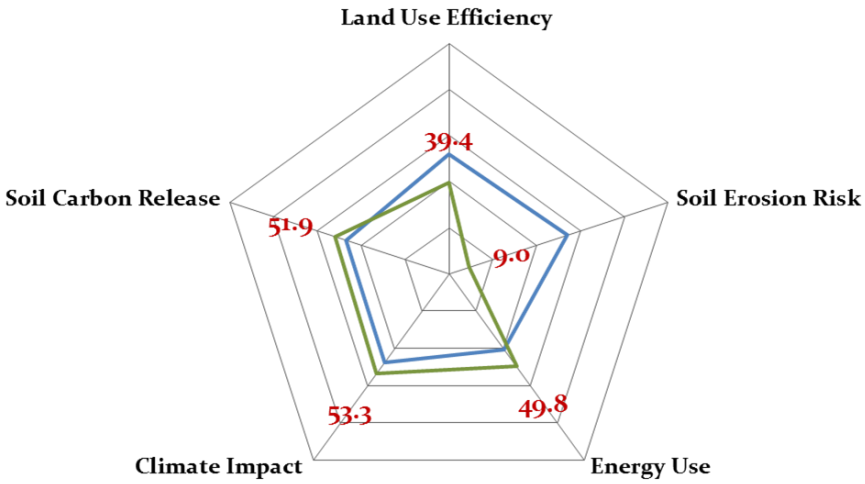
All that is required is basic farm and field operations data, as outlined in the three attached worksheets. They can be completed by hand and sent by fax to (780) 448-7445 or completed in Microsoft Excel and e-mailed to us. Either way, you will receive a detailed five-page sustainability report for each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



The Canadian Field Print 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 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.

Canadian Field Print Calculator

Sample Report for 2011 Peas

Sample Producer, Midwest, AB

Summary of Field Data

Field: Field 1 (SE-4-39-13-W4), 150 acres
The surface form of this field is undulating and the slope class is A = 0 - 0.5% slope. It is in the dark brown soil zone and has a clay loam texture. The centre of SE-4-39-13-W4 is in Ecodistrict 769 according to the National Ecological Framework.

History: In 2011 this field was seeded to peas and spring wheat was grown in 2010. Field 1 has been continuously cropped with annuals for at least 20 years. The practice on this field changed from fallowing to continuous cropping in 2001. The tillage regime changed from conventional to zero till in 2001.

Summary of 2011 operations:

No tillage passes were undertaken in this crop year. The seed drill was pulled by a 440 horsepower tractor and seeding of the peas took 6.0 hours to complete.

There were two sprayer passes for a total of 4.0 hours. In terms of fertilizer during the 2011 crop year, you applied 30.0 lbs of phosphorus, and 5.0 lbs of other nutrients per acre.

The crop of peas took 19.0 hours to combine and yielded 40.0 bu/ac (1.09 tonne per hectare). The crop did not need to be dried.

Sustainability Indicators

The field print 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.

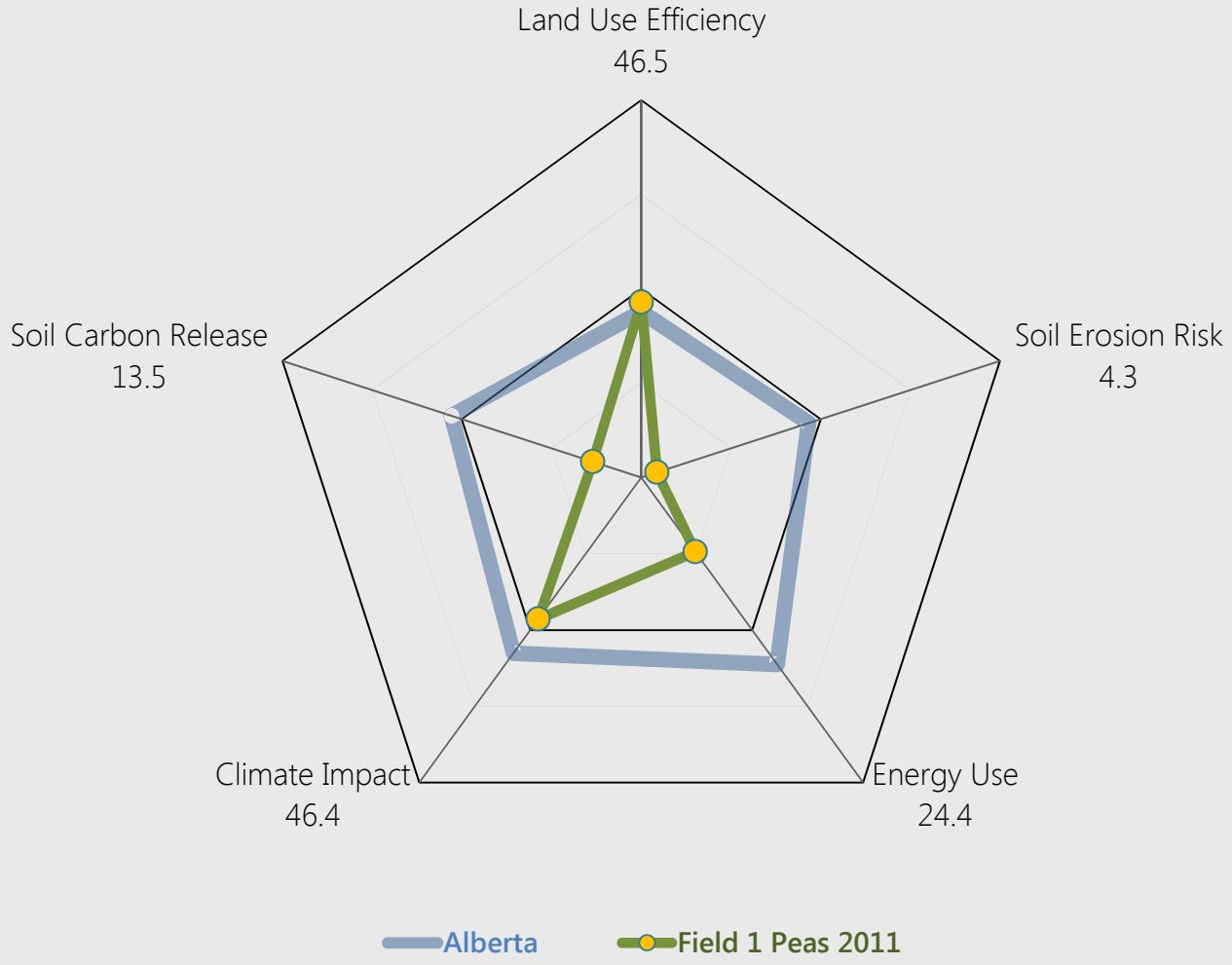
The field print values in the table below are relative indices on a scale of 1-100 that represent your resource use or impact per unit of output for each of the five indicators. In all cases, the index of 50 represents the average impact across Western Canada

Field Print Indicator	Western Canada	Alberta	Field 1 Peas 2011
Land Use Efficiency	50.0	43.9	46.5
Soil Erosion Risk	50.0	46.6	4.3
Energy Use	50.0	61.3	24.4
Climate Impact	50.0	57.6	46.4
Soil Carbon Release	50.0	52.9	13.5

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

Sustainability Spidergram

The field print indicators below were calculated based on the data provided for peas grown on Field 1 in 2011 and compared to estimated impact for 2011 peas in the province of Alberta. The indicators 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.



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

Field Print Indicator	Alberta	Field 1 Peas 2011
Land Use Efficiency	43.9	46.5
Soil Erosion Risk	46.6	4.3
Energy Use	61.3	24.4
Climate Impact	57.6	46.4
Soil Organic Carbon Release	52.9	13.5

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.

In order to more easily compare a specific farm or field's land-use, these absolute values were used to generate an index on the scale of 0 to 100, with 50 representing the average land-use efficiency across Western Canada for the same crop (peas), in the same year (2011). The following chart compares the yield and resulting land use efficiency indicators for Field 1 with provincial and western Canada averages:

	2009	2010	2011
Yields	*tonne/ha*	*tonne/ha*	*tonne/ha*
Your peas on Field 1			2.690
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 Field 1			0.372
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 Field 1			46.5
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	0.30	
Wind Erosion Risk	0.00	
Soil Erosion Risk Potential	0.33	Mg/ha/yr

Your potential soil erosion risk is 91.10% lower than the average of 3.75Mg/ha/yr for your ecoregion. Your estimated potential soil erosion risk of 0.33 Mg/ha/yr for Field 1 is lower than the Alberta average of 3.59 and lower than the Western Canada average of 3.85.

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.

Energy Use

Overall, the production of each kilogram of peas on Field 1 in 2011 used an estimated 1,303 kilojoule of energy, which is 50.4% lower than the Alberta average of 2,629 kilojoule and 42.9% lower than the Western Canadian average of 2,282 kilojoule/kilogram.

The field operations during the 2011 crop year used 648.2 kilojoule of energy per kilogram of peas, with the largest element (60.5%) 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	196.5	30.3%
Fertilizing	0.0	0.0%
Spraying	59.5	9.2%
Manure	0.0	0.0%
Harvest	392.2	60.5%
	648.2	

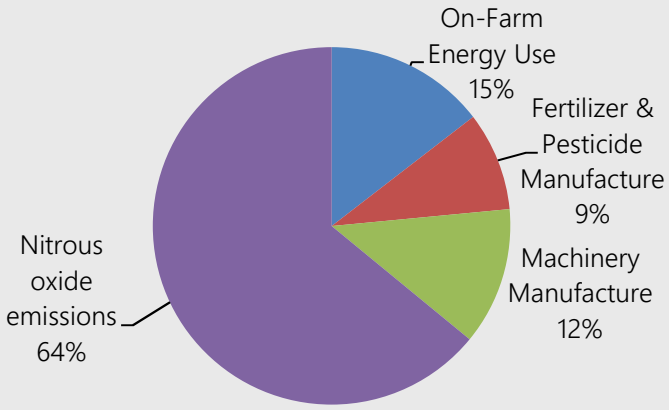
Other energy uses for your peas crop were 188 kJ/kg for the manufacture of fertilizers and 454 kJ/kg for machinery manufacture.

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). CO_2 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. N_2O emissions also result from tillage practices, water accumulation in low spots, leaching, runoff, and volatilization.

The production of each kilogram of peas on Field 1 in 2011 had an overall climate impact of approximately 314.3 gCO2 equivalent. This includes 45.7 g CO2 equivalent from fieldwork energy use, 201.3 g CO2 equivalent from nitrous oxide emissions, and 67.2 g from other energy use, including fertilizer and machinery manufacture.

Nitrous oxide emission	201.3
Machinery manufacture	39.1
Harvest	27.7
Fertilizer manufacture	26.3
Seeding	13.9
Spraying	4.2
Pesticide manufacture	1.8
Tillage	0.0
Fertilizer application	0.0
Manure application	0.0
Grain Drying	0.0
Total gCO2e/kg crop	**314.3**



Your overall estimated climate impact of 314.3 g CO2 equivalent per kg of crop is 31.5% lower than the Alberta average of 458.8 and 16% lower 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 Field 1 on your farm in 2011 was a net sequestration into the soil of approximately 388.5 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.

Removing fallow from the rotation on Field 1 in 2001 is resulting in a net sequestration of 300.2 kg of carbon per hectare in 2011. It is estimated that 88.3 kg carbon was sequestered per hectare in 2011 due to your change from conventional to zero till in 2001. 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 Carbon Release indicator.

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 from 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 Canadian Field Print Calculator supported by: