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Data Sources and Methods:

Soil and Water Quality Indicators for Agriculture

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Canada

1. Introduction

The Soil and Water Quality Indicators for Agriculture are a part of the Canadian Environmental Sustainability Indicators (CESI) program, which provides data and information to track Canada's performance on key environmental sustainability issues.

Agriculture and Agri-Food Canada's (AAFC's) *Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series, Report #3*, presents indicators measuring the agriculture and agri-food sector's environmental performance for soil, water and air quality, farm land management, and resource use efficiency in the food and beverage industries. Results from multiple agri-environmental indicators related to soil, water, and air quality have been incorporated into agri-environmental performance indices to simplify the presentation of overall environmental performance. The indices are presented to draw broad, national-level observations on the status and trends of the agri-environmental sustainability of the agriculture and agri-food sector. Regional variation is explicitly discussed within the report's chapters.

For more information about AAFC's report on the Environmental Sustainability of Canadian Agriculture, visit Agri-Environmental Indicator Report Series, Report #3.

2. Description and rationale of the Soil and Water Quality indicators for Agriculture

2.1 Description

The Soil and Water Quality Agri-Environmental Performance Indices aggregate multiple indicators related to soil and water quality. They are derived from models and formulae that integrate data for soil, climate and landscape with data about crops, land use and land management.

The agri-environmental soil quality performance index comprises performance indicators for risk of soil erosion by wind, water and tillage; soil organic carbon change; risk of soil salinization; and contamination by trace elements:

- The *Soil Erosion Risk Indicator* presents the combined risk of water, wind and tillage erosion when climate, soil, topography and farming practices are considered.
- The *Soil Organic Carbon Change Indicator* assesses how organic carbon levels in soils are changing over time as a result of land use and management changes.
- The *Risk of Soil Salinization Indicator* estimates the risk of soil salinization associated with changes to land use and management practices.
- The *Risk of Soil Contamination by Trace Elements Indicator* considers the risk associated with arsenic, cadmium, copper, lead, selenium and zinc inputs to soil if the current use of fertilizers, manures and municipal biosolids continued for 100 years. Projected trace element concentrations, corrected for loss by leaching, crop removal and volatilization, are compared to the guideline for the health of soil organisms or human health, to estimate risk.

The agri-environmental water quality performance index components are performance indicators for the risk of water contamination by nitrogen (N), phosphorus (P), coliform bacteria and pesticides:

- The *Indicator of the Risk of Water Contamination by N* links the amount of excess N expected to be in the soil after harvest to climatic conditions and soil characteristics to assess the risk of N leaching to surface water and groundwater.

- The *Indicator of the Risk of Water Contamination by Phosphorus* estimates the relative risk of agricultural P reaching surface water bodies in Canadian watersheds. It is based on estimates of source levels of P and the likelihood of P transport.

- The *Indicator of the Risk of Water Contamination by Coliforms* assesses the relative risk of enteric micro-organisms from agricultural sources contaminating surface water bodies using coliform bacteria as a marker.

- The *Indicator of the Risk of Water Contamination by Pesticides* estimates the relative risk of pesticides reaching surface- and groundwater in agricultural areas as a result of agricultural management practices, taking into account the physical-chemical properties of the pesticides.

Calculated for agricultural land in Canada, the indicators use a five-class rating system, which ranges from very low to very high risk. The soil organic carbon change indicator is classified based on magnitude and direction of change in organic soil carbon content, with large increases being preferred over large decreases. A performance index is calculated for each reporting year, based on a weighted share of land in each indicator class. Multi-indicator aggregations result in unit-less agri-environmental performance indices ranging from undesirable performance (index value 0-20) to desired performance (index values of 81 or greater). The classification system and index scale are detailed in AAFC's Agri-Environmental Indicator Report Series, Report #3.

2.2 Rationale

The AAFC agri-environmental indicators are designed to be used as a report card of agri-environmental performance for producers, consumers and the international community and can be used to highlight areas where further efforts are required. They can also provide valuable information decision makers can draw upon when developing and evaluating agricultural policy. AAFC has set a goal to reduce risks to soil and water quality from farming to achieve the "desired" category in these two indices by 2030.

3. Data

3.1 Data source

The Soil and Water Quality Agri-Environmental Performance Indices are drawn from AAFC's Agri-Environmental Indicator Report Series, Report #3.

3.2 Spatial coverage

The Soil and Water Quality Agri-Environmental Performance Indices are national indices.

The underlying data for the indices originate from the Soil Landscapes of Canada (Available from: http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1227014964079&lang=eng) map, the Census of Agriculture), provincial agencies, the private sector and remote sensing data sources.

All indicators are calculated at a national scale except for the *Risk of Soil Salinization Indicator,* which is only calculated for the three prairie provinces where salinization is a major issue.

3.3 Temporal coverage

Because some indicator data are drawn from the Census of Agriculture, the Soil and Water Quality Agri-Environmental Performance Indices are only calculated for census years.

3.4 Data timeliness

The Soil and Water Quality Agri-Environmental Performance Indices are calculated and published once the Census of Agriculture data are available.

3.5 Methods

A complete description of how each agri-environmental performance index is calculated is available in AAFC's Agri-Environmental Indicator Report Series, Report #3.

4. Caveats and limitations

A full description of limitations associated with individual indicators is available in AAFC's Agri-Environmental Indicator Report Series, Report #3. The limitations applying directly to the soil and water quality indices include:

- The indicator for soil contamination by trace elements was only calculated for 1981 and 2006. For years in between, an interpolated value was included in the index calculation.

- The national indices are calculated using indicator models developed at a local level. These results are scaled-up to the national scale, which can result in the loss of the ability to determine actual physical causes of problems in specific locations.

5. References

Eilers W., R. MacKay, L. Graham and A. Lefebvre (eds.) (2010) Environmental Sustainability of Canadian Agriculture, Agri-Environmental Indicator Report Series, Report #3. Agriculture and Agri-Food Canada. Retrieved on 15 April, 2011. (Available from: http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1288198675224&lang=eng).