AGRI-ENVIRONMENTAL INDICATOR PROJECT

Agriculture and Agri-Food Canada

Report NO. 27

SUMMARY OF ACTIVITIES IN FISCAL-YEAR 1997-1998

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of Agriculture and Agri-Food Canada

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SUMMARY

- Methods development and baseline calculations of agri-environmental indicators (AEIs) progressed in all indicator areas. The following progress and technical reports were distributed for indicators related to soil quality, water quality, farm input management, agricultural biodiversity, and agricultural greenhouse gases:

  - The nitrous oxide component of the agroecosystem greenhouse gas balance indicator (report 20).
  - The methane component of the agroecosystem greenhouse gas balance indicator (report 21).
  - The organic carbon component of the soil degradation risk indicator (report 22).
  - The soil compaction component of the soil degradation risk indicator (report 23).
  - The phosphorous component of the risk of water contamination indicator (report 24).
  - The wind and water erosion components of the risk of soil degradation indicator (report 25).
  - The habitat component of the agroecosystem biodiversity indicator (report 26).
  - The input management component of the farm resource management indicator.

  Other technical reports were prepared (but not published) for tillage erosion and use of gap analysis for assessing biodiversity.

- A new approach was adopted for calculating energy and nutrient use efficiency indicators.

- 1996 Census of Agriculture data obtained from Statistics Canada were re-assigned to Soil Landscape of Canada (SLC) polygons, and provided to lead investigators, to allow for updates of the indicators.

- The departmental AEI Project Team held several meetings throughout the course of the year, including a major workshop in November 1997, to take stock of the work, discuss technical issues and confirm work plans, deliverables, timelines and priority areas in need of further work.

- Work was initiated on the comprehensive AEI Report to be published in 1999, including: confirmation of a working outline of the report (Appendix 4), development of a template for reporting indicators (Appendix 5), confirmation of roles and responsibilities of contributors, establishment of a schedule for preparing and releasing the report, and preparation of draft chapters 1 (Introduction) and 2 (Understanding and Assessing Environmentally-Sustainable Agriculture).

- The AEI Advisory Committee met in June and November 1997. The Committee reviewed the progress of several indicators, provided recommendations on their further development and requested, to AAFC Senior Management, that the AEI Project be implemented in as comprehensive a manner as possible.

- Several external liaison activities were pursued, including:
  - continued input and participation in the OECD initiative on agri-environmental indicators;
  - domestic and international distribution of AAFC material on agri-environmental indicators;
  - presentation of the AAFC AEI Project (methods, preliminary results, etc) in several domestic and international fora;
  - technical input into the development of an indicator bulletin on agricultural soils for the Environment Canada - lead National Environmental Indicator Series.

- AAFC devoted about $266,000 and 11.05 person-years to the AEI Project in the 1997-1998 fiscal-year.

1.0 THE AGRI-ENVIRONMENTAL INDICATOR PROJECT-A BRIEF OVERVIEW.

The Agri-Environmental Indicator (AEI) Project was initiated in 1993 by Agriculture and Agri-Food Canada (AAFC) in response to recommendations made by several groups, including the Federal/Provincial Agriculture Committee on Environmental Sustainability, the Canadian Agri-Food Research Council and the Auditor General of Canada. All of these recognized a fundamental need to further develop the information base available to decision-makers on environmental conditions and trends in Canadian agriculture.

Through the AEI Project, six indicators and their associated components are being developed: risk of soil degradation; risk of water contamination; agroecosystem greenhouse gas balance; agroecosystem biodiversity; input use efficiency; and farm resources management. Each indicator is described generally in Appendix 1. The indicators are being developed to assess the degree to which key agri-environmental issues are being addressed and objectives met, to help identify areas and resources at risk, to support the design and targeting of strategies and actions, and to facilitate communication among stakeholders, and between stakeholders and policy-makers.

Implementation of the project is coordinated by an InterBranch Committee (the AEI Project Team) which reports to the Departmental Management Committee through the Policy Branch. Environment Canada, Statistics Canada, and the National Agriculture Environment Committee also participate. An Advisory Committee of key stakeholders (Appendix 3) provides independent advice to AAFC on the design and implementation of the AEI Project. Project outputs are released periodically in the form of progress reports and technical papers (Appendix 2).

In 1997-98, baseline calculations and methods development were completed for most indicators, and the project began its transition into a calculation and reporting phase. A comprehensive report to be released in mid-1999 will update and report the indicators using data from the 1996 Census of Agriculture and other sources.

This report summarizes the key activities, outputs and expenditures within the AEI Project in the period from April 1, 1997 to March 31, 1998.

2.0 PROJECT MANAGEMENT ACTIVITIES WITHIN AGRICULTURE AND AGRI-FOOD CANADA.

- The departmental AEI Project Team held several meetings throughout the course of the year, including a major workshop in November 1997 in Ottawa. Participants at the Ottawa workshop took stock of the work, discussed technical issues and, in particular, confirmed work plans, deliverables, timelines and priority areas of further work for the AEI Project Report to be published in 1999. Management activities at the individual indicator level are discussed in Section 4 of this report.

- The publication series for documents generated through the AEI Project was maintained and updated as new reports were completed.

3.0 EXTERNAL LIAISON AND CONSULTATION ACTIVITIES.

- The AEI Advisory Committee met in June and November 1997. The Committee reviewed the progress of several indicators, provided recommendations on their further development and requested, to AAFC Senior Management, that the AEI Project be implemented in as comprehensive a manner as possible.

- AAFC researchers provided input into an updated draft of the Environmental Indicator Bulletin for agriculture being coordinated by Environment Canada. Work on the draft bulletin continued beyond 31 March 1998.

- The department continued to provide input into the initiative of the Organization for Economic Co-operation and Development (OECD) to develop agri-environmental indicators. Indicator data was provided to the OECD and draft OECD publications were reviewed. The department also provided input into the meetings of the OECD Joint Working Party on Agriculture and the Environment, and suggestions on the scope and agenda of the OECD workshop on AEIs to be held in September 1998 in the U.K.

- AAFC responded to numerous domestic and international information requests by providing documentation on indicator development and copies of requested reports. Presentations on the AAFC approach to AEI development were made to the FAO/OECD/ECE Conference of Agricultural Statisticians in Geneva (July 1997), the OECD workshop on environmental indicators in Mexico City (Sept 1997) and the Canada/Mexico/Chile workshop on environmental indicators in Hull, Quebec (February 1998).

4.0 PROGRESS ON THE DEVELOPMENT OF INDIVIDUAL INDICATORS.

This section briefly outlines activities to develop individual indicators and their components, including outputs achieved, meetings held and future activities.

4.1 RISK OF SOIL DEGRADATION

- Activities:
  - A methodology for the soil compaction indicator was developed (under contract) and applied to Eastern Canada (excluding the soils in the St. Lawrence and Ottawa River valleys). Lands within each stress class, and areas with the potential for improvement/degradation, were identified.
  - Soil organic carbon change was calculated for Ontario using the Century model to include the effects of soil erosion.
  - Regional 1981 and 1991 baseline calculations for water and wind erosion were completed for the entire country and distributed in a report entitled *The Risk of Soil Erosion in Canada.*
  - Work progressed on the development of a methodology for tillage erosion.
  - The Soil Degradation Study Team met in March 1998 to review progress and refine methods on the indicator components and to plan contributions to the comprehensive AEI Project Report.

- Outputs:
  - **Report No. 22 - Soil Degradation Risk Indicator: Organic Carbon Component: Technical Report: Pilot Study Using the Century Model to Calculate Change in Soil Organic Carbon in Ontario Soils** (Appendix 2, Report 22), was prepared and distributed in September 1997. The objective of the study was to investigate and evaluate the performance of the Century model for developing a soil organic carbon (SOC) indicator for Eastern Canada.
  - **Report No. 23 - Soil Degradation Risk Indicator: Soil Compaction Component: Technical Report: Feasibility Study on the Development and Testing of Agri-Environmental Indicators of Soil Compaction Risk (Eastern Canada)** (Appendix 2, Report 23), was prepared and distributed in October 1997. This study developed and tested criteria for provincial level soil compaction risk assessment using the Soil Landscapes of Canada database.
  - **Report No. 25 - Indicator of Risk of Soil Degradation: Erosion Component: The Risk of Soil Erosion in Canada** (Appendix 2, Report 25), was prepared and distributed in February 1998. The report identified estimated rates of erosion risk at the national, provincial and ecoregion level across Canada as well as the changes in soil erosion risk from 1981 to 1991 at the different landscape levels.

- Future Activities:
  - Future work will focus on updating erosion and salinity risk calculations with 1996 data, on extending the soil organic matter indicator nationally, and on refining and updating the soil compaction indicator, for inclusion in the 1999 AEI Project Report.

Lead Investigators:

Water Erosion, Soil Organic Matter and Soil Compaction
G. Wall, Greenhouse and Processing Crops Research Centre (Harrow)
Wind Erosion and Tillage Erosion
G. Padbury, Semiarid Prairie Agricultural Research Centre (Swift Current)
Soil Salinization
R.G. Eilers, Brandon Research Centre

Contributors:

Rees (Fredericton), J.M. Cossette (Ste. Foy), D. Lobb (N.B. Dept. of Agr.), D. King, (Harrow), I. Shelton (Harrow), J. Tajek (Lethbridge), L. Van Vliet (Summerland), W. Smith (consultant), Ray McBride (consultant).

4.2 RISK OF WATER CONTAMINATION (IROWC)

- Activities:
  - A methodology for developing a phosphorous component of the indicator was developed and tested in Quebec. Data availability in other provinces was investigated to determine the feasibility of extending the indicator beyond Quebec.
  - The methodology for the IROWC-N was refined and baseline calculations for 1981 and 1991 were completed.
  - The nitrogen balance portion of the IROWC-N calculation was provided as a contribution to the Environmental Indicator Bulletin being prepared for agriculture.
  - The IROWC technical team met in September 1997 in Ste. Foy, Quebec to review progress on the IROWC-N and IROWC-P indicators and plan future work.

- Outputs:
  - **Report No. 24 - Indicator of Risk of Water Contamination: Methodology for the Phosphorus Component: Progress Report** (Appendix 2, Report 24), was prepared and distributed in February 1998.

- Future Activities:
  - IROWC-N will be updated using 1996 census of agriculture data and reported in the comprehensive AEI Project Report.
  - IROWC-P calculations will be refined for Quebec and also calculated for other parts of eastern Canada, and reported in the comprehensive AEI Project Report.

Lead Investigators:

B. MacDonald, Greenhouse and Processing Crops Research Centre (Harrow)
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Contributors:

M. Bolinder, Soils and Crops Research and Development Centre (Sainte-Foy)
B. Bowman, Southern Crop Protection and Food Research Centre (London)
C. Chang, Lethbridge Research Centre
P. Milburn, Potato Research Centre (Fredericton)
B. Zebarth, Potato Research Centre (Fredericton)

4.3 AGROECOSYSTEM GREENHOUSE GAS BALANCE

- Activities:
  - Baseline calculations for 1986 and 1991 for methane and nitrous oxide were completed and reported.
  - Nitrous oxide (N_2O) emissions were also calculated using the DNDC model and compared against results using the IPCC/OECD methodology.
  - The results of this indicator study were used, on an ongoing basis, to support departmental positions in the periods before and following the Kyoto Protocol to limit emissions of greenhouse gases.

- Outputs:
  - **Report No. 20 - Agroecosystem Greenhouse Gas Balance Indicator: Nitrous Oxide Component: Technical Report: Estimates of Nitrous Oxide Emissions from Agroecosystems in Canada for 1986 and 1991 Using the Revised 1996 IPCC/OECD Methodology** (Appendix 2, Report 20). This study estimated nitrous oxide emissions on a provincial and national basis using the 1996 IPCC/OECD methodology and the Census of Agriculture data for 1986 and 1991.
  - **Report No. 21 - Agroecosystem Greenhouse Gas Balance Indicator: Methane Component: Technical Report: Net Methane Emissions from Agroecosystems in Canada for the Years 1986 and 1991** (Appendix 2, Report 21). This study presented estimates of methane emissions from agroecosystems in Canada for 1986 and 1991.

- Future Activities:
  - The composite GHG balance and its sub-components will be updated using 1996 census of agriculture data and reported in the comprehensive AEI Project Report.
  - Work to refine the methods and calculations of the indicator is ongoing.

Lead Investigator:

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Contributors:

H. Janzen, Lethbridge Research Centre
E. Pattey, ECORC
P. Rochette, Soils and Crops Research and Development Centre (Sainte-Foy)
W. Smith, consultant

4.4 AGROECOSYSTEM BIODIVERSITY CHANGE

4.4.1 SPECIES COMPONENT

- Activities:
  - An approach for assessing biodiversity at the broad national level was suggested in a draft report (listed below) that was developed under contract.

- Outputs:
  - Draft report entitled "Mapping the Biodiversity of Canada: A Gap Analysis Approach fo Integrating Natural Heritage Protection with Resource and Land Use Management." As the scope of the report extends beyond agriculture, it has not been formally distributed through the AEI Project.

- Future Activities:
  - No formal activities have been identified for this indicator component.

Lead Investigators:

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Contributors:

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4.4.2 HABITAT COMPONENT

- Activities:
  - Consultants were hired early in 1997 to develop a background, concept paper for the Habitat Indicator, complete a literature review and investigate possible approaches for developing indicators of habitat availability in agroecosystems in Canada. This concept paper was published in March 1998.
  - The conceptual approach for developing this indicator was presented to, and endorsed by, the AEI Advisory Committee in June and November 1997.
  - A second contract was let in January 1998 to further progress the work. Matrices linking agricultural land cover types with wildlife species uses of these cover types are under development for seven agricultural ecozones. This work, and the calculation of habitat indicators, continued into the 1998-99 fiscal-year.
  - The approach being followed for this indicator was presented at several fora including a workshop hosted by PFRA in Regina, May 1997; a Prairie Habitat Joint Venture (NAWMP) Land Use Committee meeting, August 1997; and to the Office of the Auditor General of Canada, January 1998.

- Outputs:
  - **Report No. 26 -Agroecosystem Biodiversity Indicator: Habitat Component: Review and Assessment of Concepts and Indicators of Wildlife Habitat and Habitat Availability in the Agricultural Landscape: Concept Paper** (Appendix 2, Report 26). This report reviews concepts, definitions, assumptions, frameworks and methodologies; and recommends potential approaches, for developing habitat indicators.
  - **Review and Assessment of Concepts and Indicators of Wildlife Habitat and Habitat Availability in the Agricultural Landscape: Annotated Bibliography.** (Available on request to PFRA).
  - **Review and Assessment of Concepts and Indicators of Wildlife Habitat and Habitat Availability in the Agricultural Landscape: Personal Interview Notes.** (Available on request to PFRA).

- Future Activities:
  - Completion of the habitat/species matrices for the seven targeted ecozones.
  - Development of a methodology for calculating and expressing the indicator, and reporting the indicator in the comprehensive AEI Project report.

Lead Investigator:

T. Weins, PFRA

Contributors:

LP. Neave, Neave Resource Management
E. Neave, Neave Resource Management
D. Ackerman, GIS section - PFRA
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R. Antonowitsch, PFRA

4.5 INPUT USE EFFICIENCY

4.5.1 IRRIGATION BY APPLICATION SYSTEM EFFICIENCY (IBASE) COMPONENT

- Activities:
  - Alberta Environmental Protection has provided a database of the acres of irrigation by application system for the period since the mid-1960s. Included are the estimated efficiency values for each system. This will provide the bases for illustrating the application system efficiency changes over a thirty year period.

- Outputs:
  - There were no specific report outputs during this fiscal-year.

- Future Activities:
  - Analysis of irrigation data from each prairie province and calculation and reporting of the indicator in the comprehensive AEI Project Report.

Lead Investigator:

Mr. E. G. (Ted) O'Brien, PFRA

4.5.2 NUTRIENT/ENERGY COMPONENT

- Activities:
  - Following a recommendation of the AEI Advisory Committee, a decision was made to use an alternative to the expenditure index approach for calculating use efficiency for fertilizers, pesticides and energy. Instead, it was decided to pursue an approach using actual quantity data for nutrients and energy. Pesticide use efficiency will not be considered as national use data are unavailable.
  - Partial nitrogen balances were developed on an ecodistrict and provincial basis for all of Canada, and a phosphorous balance for Quebec. The nitrogen balance results were provided as input into the draft Environmental Indicator Bulletin for agriculture being prepared by Environment Canada.
  - The Canada Agricultural Energy End Use Data Analysis Centre (CAEEUDAC) was approached to undertake calculation of an energy budget indicator.

- Outputs:
  - There were no specific report outputs during this fiscal year.

- Future Activities:
  - The Agricultural Energy Use Data Analysis Centre in Saskatchewan will complete energy budget calculations for agriculture for 1981 to 1996, and results will be reported in the comprehensive AEI Project Report.
  - Nitrogen balance and phosphorous balance calculations will be updated for 1996 and reported in the comprehensive AEI Project Report.

Lead Investigators:

B. Junkins, Policy Branch (energy component)
B. MacDonald and R. Simard (nutrient component)

Contributors:

Canada Agricultural Energy End-Use Data Analysis Centre (energy component)

4.6 FARM RESOURCE MANAGEMENT

4.6.1 SOIL COVER/LAND MANAGEMENT COMPONENT

- Activities:
  - Methods and data compilations were completed to replace the previous broad soil residue cover calculation with a more precise, crop and ecoregion-specific cover index. Bare-Soil Days (BSD) tables for specific crops and regions were compiled to allow the calculation of the indicator based on historical crop type, tillage and crop area data.

- Outputs:
  - There were no specific report outputs for this fiscal year.

- Future Activities:
  - The bare soil day index will be refined and updated for 1996 and reported in the comprehensive AEI Project Report. Land use data will be summarized from the 1996 census data to extend this indicator as well.

Lead Investigator:

E.C. Huffman, ECORC

Contributors:

M. McGovern, ECORC
D. Coote (consultant)

4.6.2 INPUTS MANAGEMENT COMPONENT

- Activities:
  - Regional and commodity-specific data from the 1995 Farm Inputs Management Survey (FIMS) were compiled, analyzed and published in a report entitled "Manure, Fertilizer and Pesticide Management in Canada."

- Outputs:
  - Report entitled "Manure, Fertilizer and Pesticide Management in Canada" (Appendix 2).

- Future Activities:
  - FIMS data will be analyzed further, compiled by province, and combined with relevant Census of Agriculture data into a chapter for the comprehensive AEI Project Report.

Lead Investigators:

D. Culver, Policy Branch
R. Koroluk, Policy Branch

5.0 DEVELOPMENT OF THE COMPREHENSIVE AEI PROJECT REPORT.

- Work was initiated in 1997 on the design and development of the AEI Project Report, with both the AEI Advisory Committee and the full AEI Project Team providing input. The principal accomplishments were:

  - Development of a working outline ofthe report, and clarification of its objectives and targeted audiences (Appendix 4).
  - Development and testing of a draft template for reporting agri-environmental indicators in the AEI Project report (Appendix 5), and confirmation of the expected content, and spatial and temporal coverage of the indicators to be included in the report.
  - Confirmation of the schedule for preparing and publishing the report, and of roles and responsibilities of contributors.
  - Preparation of initial drafts of two report chapters: 1) Introduction, and 2) Understanding and Assessing Environmentally-Sustainable Agriculture.

6.0 EXPENDITURES.

The following resources were expended by AAFC on the AEI Project in 1997-1998. These estimates only include costs directly incurred on AEI development. The ongoing costs of maintaining databases that are being used to develop AEIs (and which also support other programs and activities) are not included.

ACTIVITY/INDICATOR	INDICATOR COMPONENT	DOLLARS (,000)	PERSON YEARS
Project Coordination, Consultation, and Reporting		40	1.05
Census data Processing		41	1.5
Risk of Soil Degradation	Wind and Water Erosion	20	2
	Salinity	2	0.05
	Organic Matter	10	0.2
	Compaction	13	0.2
Risk of Water Contamination	Nitrogen	7	0.4
	Phosphorus	5.5	0.2
Greenhouse Gas Balance	CO_2, N_2O & CH_4	100	2
Agroecosystem Biodiversity Change	Species component	0	0
	Habitat component	11.5	0.05
Input Use Efficiency	Irrigation by Application System Efficiency	1	0.05
	Energy Efficiency [1]	0	0.05
Farm Resource Management	Soil Cover and Land Management	20	0.2
	Farm Inputs Management	5	1.5
Total		266	11.05

[1] Nitrogen / phosphorous efficiency calculation costs allocated to risk of water contamination indicator

APPENDIX 1

SUMMARY DESCRIPTION OF AGRI-ENVIRONMENTAL INDICATORS

1. SOIL DEGRADATION RISK

- DESCRIPTION:
  - Indicator components report trends in the extent, severity, and vulnerability of agricultural lands to soil erosion, salinization, compaction, and change in soil organic matter levels. The indicator will identify areas of higher relative risk of degradation and measure progress in managing agricultural lands sustainability.
  - The soil erosion (water, wind) component of this indicator will be measured in tonnes/ha/yr expressed in 5 classes of risk (tolerable, low, moderate, high, severe). Soil salinization will be expressed in a dimensionless multiplicative index (1 to 40) divided into 3 classes of salinity risk (low, moderate, high). The soil organic matter component will be expressed as the annual rate of change of carbon in kg/ha, and change as a percent of total soil carbon. Options for expressing soil compaction are under consideration (area degrading/improving; area under different compaction risk classes).

- COVERAGE:
  - SPATIAL: Wind erosion addresses cultivated land in the prairies at the Soil Landscapes of Canada (SLC) polygon scale; water erosion addresses cultivated land in Canada at the SLC scale. Salinization covers agricultural areas of the prairies. Soil organic matter will cover agricultural land in Canada and soil compaction will cover agricultural land in central and eastern Canada save for the St. Lawrence valley.
  - TEMPORAL: 1981, 1991, 1996.

2. RISK OF WATER CONTAMINATION

- DESCRIPTION:
  - This indicator identifies trends in the risk of water contamination from nutrients (nitrogen and phosphorus). The indicator will track primary agriculture's success in minimizing water pollution risks and will identify areas at higher relative risk. The components of this indicator are nitrogen and phosphorus contamination risk.
  - The nitrogen indicator will be expressed as a potential concentration and compared to environmental standards (e.g. drinking water). The indicator will be expressed as a ratio of the potential contaminant concentration (mg/L) to the maximum allowable concentration (mg/L). The nitrogen component will be reported in risk classes and the phosphorous component in site vulnerability classes.

- COVERAGE:
  - SPATIAL: N- National coverage expressed on an SLC or ecodistrict basis; P - regional coverage in eastern Canada.
  - TEMPORAL: N - 1981, 1991, 1996. P - 1991, 1996.

3. AGROECOSYSTEM GREENHOUSE GAS (GHG) BALANCE

- DESCRIPTION:
  - This indicator tracks the accumulation and release of the principal greenhouse gases from the agricultural sector and reports the net integrated balance.
  - This indicator is measured in net emissions and/or uptake of each greenhouse gas and will be expressed in tonnes per year. The integrated GHG balance will be expressed in tonnes of CO_2-equivalent units.

- COVERAGE:
  - SPATIAL: National and provincial level. Some components can be expressed at more detailed levels.
  - TEMPORAL: 1981, 1986, 1991, 1996.

4. AGROECOSYSTEM BIODIVERSITY CHANGE

- DESCRIPTION:
  - The habitat indicator component will report on changes in the availability (area) of broad habitat types in agricultural areas across Canada (e.g. Fallow, Cropland, Seeded Pasture, Native Pasture). To support validation of this indicator, habitat-species suitability matrices are being developed for the seven ecozones in Canada which contain agricultural land. These matrices identify primary, secondary and tertiary uses of agricultural habitat types by mammals, birds, reptiles and amphibians (invertebrates will be investigated on a case study basis). Habitat values will be weighted using the concept of "Habitat Use Units." These units are a tally of a species use of agricultural habitat types in different ways (e.g. for breeding, feeding, cover, winter, staging). Potential approaches for expressing the indicator include pie charts and/or maps showing the number of habitat use units for which habitats have increased, decreased or remained stable over time.

- COVERAGE:
  - SPATIAL: National coverage for the seven Canadian ecozones in which agriculture is practiced.
  - TEMPORAL: 1981, 1991, 1996, with some reference to historical land use changes.

5. INPUT USE EFFICIENCY

- DESCRIPTION:
  - This indicator consists of two components: irrigation by application system efficiency and use efficiency for nutrients and energy. The irrigation by application system efficiency component tracks the use of application systems of various efficiencies and the land area upon which water is applied by each of these systems. The nutrient and energy use efficiency component reports input use efficiency by measuring trends in the ratio of inputs to outputs in agriculture.

- COVERAGE:
  - SPATIAL: Nitrogen and energy use efficiency are covered nationally by province and

major region. Phosphorous efficiency will initially be calculated for eastern Canada. Irrigation application system efficiency covers Western Canada, however the specific areas included will vary depending on the data records.

- TEMPORAL: For nutrients: N - 1981, 1991, 1996; P - 1991, 1996. For energy: 1981, 1991, 1996. The irrigation application system efficiency indicator will be measured from various base years.

6. FARM RESOURCE MANAGEMENT

- DESCRIPTION:
  - The soil cover & management component estimates trends in the number of bare soil days on a regional basis, and the adoption of selected soil conservation practices. Farm inputs management tracks the extent of adoption by farmers of selected best management practices for inputs (fertilizer, manure, and pesticides).
  - Soil cover & management is expressed as the number of bare soil days, and percent adoption of soil conservation practices. Farm inputs management will be expressed as the distribution and rate of use of the identified inputs management practices.

- COVERAGE:
  - SPATIAL: Soil cover & management: national coverage disaggregated by province and ecodistrict. Farm inputs management: national, provincial and ecozone.
  - TEMPORAL: Soil cover & management component: 1981, 1991, 1996. Farm inputs management has a baseline year which is 1995. Frequency of updates has not been determined.

APPENDIX 2

Agri-Environmental Indicator Publications List, April 1998

Environmental Indicator Working Group. 1993. Developing Environmental Indicators for Agriculture: Discussion Paper. Report No. 1. Environment Bureau, Policy Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

McRae, T., and N. Lombardi. 1994. Consultation Workshop on Environmental Indicators for Canadian Agriculture: Final Report. Report No. 2. Environment Bureau, Policy Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Environmental Indicator Working Group. 1994. Developing Agri-environmental Indicators for Canada: General Proposal. Report No. 3. Environment Bureau, Policy, Agriculture and Agri-Food Canada, Ottawa, Ontario.

McRae, T. 1995. Report of the Second National Consultation Workshop on Agri-environmental Indicators for Canadian Agriculture. Report No. 4. Environment Bureau, Policy Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

MacDonald, K.B., and H. Spaling. 1995. Indicator of Risk of Water Contamination: Concepts and Principles. Report No. 5. Ontario Land Resource Unit, Centre for Land and Biological Resources Research, Research Branch, Agriculture and Agri-Food Canada, Guelph, Ontario.

MacDonald, K.B., and H. Spaling. 1995. Indicator of Risk of Water Contamination: Methodological Development. Report No. 6. Ontario Land Resource Unit, Centre for Land and Biological Resourc Research, Research Branch, Agriculture and Agri-Food Canada, Guelph, Ontario.

McRae, T., N. Hillary, R.J. MacGregor, and C.A.S. Smith. 1995. Role and Nature of Environmental Indicators in Canadian Agricultural Policy Development. Report No. 7. Paper presented to the June 1995 Symposium of Environmental Indicators of the Resource Policy Consortium, Washington, D.C.

Hillary, N., M. Spearin, and D. Culver. 1995. Farm Resource Management Indicator: Inputs Management Component: Discussion paper on a survey of inputs management practices. Report No. 8. Policy Branch, Agriculture and Agri-Food Canada, Ottawa.

McRae, T., N. Hillary, R.J. MacGregor, and C.A.S. Smith. 1995. Design and Development of Environmental Indicators With Reference to Canadian Agriculture. Report No. 9. Paper presented to the North American Workshop on Monitoring for Ecological Assessment of Terrestrial and Aquatic Ecosystems, Mexico City, September 1995.

Environmental Indicator Working Group. 1995. Description of Indicators and Project Activities and Outputs to 1998. Report No. 10. Environment Bureau, Policy Branch, Agriculture and

Agri-Food Canada, Ottawa, Ontario.

Narayanan, S. 1995. Input Use Efficiency Indicator: Use Efficiency for Fertilizers, Pesticides, and Energy. Report No. 11. Farm Economics Division, Policy Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Smith, C.A.S. 1995. Research and Development Needs for Monitoring Agro-Ecosystems in Canada. Report No. 12. Paper presented to the North American Workshop on Monitoring for Ecological Assessment of Terrestrial and Aquatic Ecosystems, Mexico City, September 1995.

Smith, W.N., P. Rochette, C. Monreal, R.L. Desjardins, E. Pattey, and A. Jacques. 1995. Agroecosystem Greenhouse Gas Balance Indicator: Carbon Dioxide Component. Report No. 13. Centre for Land and Biological Resources Research, Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Banerjee, R. 1996. Summary of Activities in Fiscal-Year 1995-1996. Report No. 14. Environment Bureau, Policy Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Statistics Canada. 1996. Farm Inputs Management Survey, 1995: A survey of manure, commercial fertilizer and commercial pesticide management practices on Canadian farms. Catalogue No. 21F0009XPE. Ottawa, Ontario.

Environmental Indicator Working Group. 1996. Project Work Plan for 1996-1997. Report No. 15. Environment Bureau, Policy Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Eilers, R.G., W.D. Eilers, and M.M. Fitzgerald. 1996. Soil Degradation Risk Indicator: Soil Salinity Risk Component. Report No. 16. Manitoba Land Resource Unit, Research Branch, Agriculture and Agri-Food Canada, Winnipeg, Manitoba.

MacDonald, K.B. and D.B. Gleig. 1996. Indicator of Risk of Water Contamination: Nitrogen Component (Ontario). Report No. 17. Research Branch, Agriculture and Agri-Food Canada, Guelph, Ontario.

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Copies of these reports may be obtained by contacting:

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APPENDIX 3

AAFC Advisory Committee on Agri-Environmental Indicators
List of Members

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Fisheries & Food

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Denis Chartrand
Statistics Canada

Doug Chekay
Ducks Unlimited Canada

Ken Edie
Manitoba Pool Elevators

Jim Farrell (chair)
Canadian Fertilizer Institute

Gordon Hamblin
Canadian Organic Advisory Board

Anne Kerr
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Julia Langer
World Wildlife Fund of Canada

Mike Langman
N.S. Dept. of Agriculture & Marketing

David Lobb
Canadian Society of Soil Science
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Terence McRae (Secretary)
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Jamie Fortune
Wildlife Habitat Canada

Judy Shaw (past chair)
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Norman Storch
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Ted Weins
Agriculture and Agri-Food Canada

Sheila Forsyth
National Agriculture Environment Committee

Garth Sundeen
Canadian Federation of Agriculture

APPENDIX 4

Working Outline of 1999 AEI Project Report

Purpose of the Report

1. To assess agriculture's progress in achieving a more sustainable resource base and a healthier environment.

2. To identify agricultural areas and resources that remain at risk of degradation.

3. To inform the policy discourse surrounding agriculture and the environment.

4. To respond to 1) the recommendations of the Federal-Provincial Agriculture Committee on Environmental Sustainability, the Office of the Auditor General of Canada, the Canadian Agri-Food Research Council, and the Science Council of Canada and 2) a commitment in the department's *Strategy for Environmentally Sustainable Agriculture and Agri-Food Development in Canada.*

Target Readership

While being scientifically based and presenting the most recent data, information and interpretations on the subject, the report is not intended for a scientific audience. Information will be presented in a non-technical manner that will be accessible and useful to a broad group of readers that includes:

- decision-makers and policy-makers in industry and government
- educators and students
- non-government organizations and other interest groups
- media
- concerned Canadians

Content

A preliminary outline of the report is attached and a draft template to guide preparation of the substantive chapters of the report has been prepared. Each chapter will aim for a thorough and balanced coverage of a particular subject matter. As an overall approach, individual chapters might be developed to address the following questions:

- What is the issue and why is it important? (eg. What is water quality? Why is water quality important in agriculture?)
- What is the current problem or challenge concerning this issue? (eg. In what ways does agriculture affect water quality?)
- What is the current status or situation concerning this issue, what trends are apparent, and what areas remain at high risk? (this is where the actual indicator calculations and results will be presented).
- Why are the conditions and trends noted occurring, and what is their significance?
- What can/is being done in agriculture to improve the situation?

Draft Summary Outline

Foreword

Executive Summary

1. Introduction

2. Understanding and assessing environmentally sustainable agriculture.

3. Driving forces influencing environmental sustainability in agriculture.

4. Sustainable land management.
- Indicators of soil cover and land management.

5. Farm inputs management.
- Indicators of manure, fertilizer and pesticide management.

6. Agricultural soil health.
- Indicators of wind and water erosion risk
- Indicators of risk of salinization of soil
- Indicators of changes in soil organic matter
- Indicators of risk of compaction of soil

7. Agricultural water quality
- Indicators of risk of water contamination from nitrogen
- Indicators of risk of water contamination from phosphorous

8. Agricultural biodiversity
- Indicators of habitat availability in agroecosystems

9. Agricultural greenhouse gases
- Indicators of emissions and net balance of agricultural greenhouse gases

10. Input use efficiency
- Analysis of input use (nutrients and energy) in relation to agricultural output.
- Indicators of irrigation by application system efficiency

11. Integrated assessment
- Integrated regional analysis of selected indicators in relation to agricultural output (proposed regions are B.C., Prairies, Ontario, Quebec, Atlantic)

12. Conclusions

APPENDIX 4

Draft Template for Reporting Agri-Environmental Indicators in the 1999 AEI Project Report

This template is designed to provide guidance for reporting results of AEIs in the context of contributions to the AEI Project report to be published in fiscal-year 1998-99. It is proposed that the write-up for each individual indicator be structured as follows.

A. List Highlights - 5%

List in point form the (4 or 5) major highlights of the indicator analysis.

B. Describe the Issue Being Analysed - 10%

Describe the issue or concern which the indicator addresses, linkages to agriculture, agricultural factors which affect the issue, why it is important from agricultural and other perspectives (eg. ecosystem health, human health, economic sustainability, etc).

C. Describe the Indicator, Associated Performance Objective(s), & Method of Calculation -5%

Define and describe the indicator in terms of what it reports and how it was calculated, limitations, etc. Describe the desired direction of performance of this indicator, noting any policy objectives or reference thresholds (eg. desired risk classes) that will provide the reader with a context for understanding and interpreting the indicator.

D. Report Results - 30%

Report results obtained from the indicator calculations in terms of conditions, trends,and areas at risk.

Focus on the national and regional picture.

E. Explain the Results Noted - 15%

Identify and discuss the key factors which have influenced the direction of the indicator, beginning with an analysis of on-farm factors. These might include changes in input use, in technology or use of selected management practices, in crop and livestock production or some combination. Explain on-farm changes in relation to broader driving forces, such as changes in agricultural or environmental policies & programs, economic factors, industry efforts, education and awareness activities, R&D, etc.

F. Interpret the Significance of the Results Noted - 15%

Include narrative which places the trends and conditions noted in context. Describe whether the indicator denotes more or less environmentally-sustainable performance, whether or not reference thresholds are in danger of being exceeded, possible economic or ecological effects, etc.

G. Identify Appropriate Response Options - 10%

Identify/describe actions that would move the indicator toward the performance objectives identified in section C above, including on-farm actions.

H. List Main Conclusions and Outlook - 10%

List the major conclusions of the indicator analysis and provide a qualitative outlook of how the situation might evolve over the next five years.

I. Other Information

List:

- Lead and Contributing Authors
- Acknowledgements
- Tables, Charts and Maps to be Presented.
- References
- Sidebars (brief explanatory text which discusses information relevant to the issue)

NOTES:

1. Percentages listed after each section denote the approximate length of that section in relation to the full text on the indicator.

2. This template applies to the following indicators:
   - Soil Cover and Land Management (Huffman lead)
   - Manure Management (Culver / Koroluk lead)
   - Fertilizer Management (Culver / Koroluk lead)
   - Pest Management (Culver / Koroluk lead)
   - Soil Wind Erosion Risk (Wall lead)
   - Soil Water Erosion Risk (Wall lead)
   - Soil Organic Matter (Wall lead)
   - Soil Compaction (Wall lead)
   - Risk of Soil Salinization (Eilers lead)
   - Risk of Water Contamination - Nitrogen (MacDonald lead)
   - Risk of Water Contamination - Phosphorous (Simard / Bolinder lead)
   - Agricultural Species Biodiversity (Smith / Tomlin lead)
   - Agricultural Habitat Biodiversity (Weins lead)
   - Agricultural Greenhouse Gas Balance (Desjardins lead)
   - Nutrient Use Efficiency (MacDonald / Simard lead)
   - Energy Use Efficiency (Junkins lead)

3. Chapters 1 (Introduction), 2 (Understanding and Assessing Environmentally-Sustainable Agriculture), 3 (Driving Forces) and 12 (Conclusions) of the AEI Project Report will be developed using an approach specific to these chapters.

4. Chapter 11 (Regional Assessment) will focus on an integrated assessment of selected indicators in the following regions: B.C., Prairies, Ontario, Quebec, and Atlantic.

5. This template will be revised slightly to reflect advice provided by the AEI Advisory Committee.