Developing agri-environmental indicators for Canada : general proposal

DEVELOPING AGRI-ENVIRONMENTAL INDICATORS FOR CANADA

GENERAL PROPOSAL

MARCH 1994

(description of proposed water quality indicator modified in June 1994)

ENVIRONMENTAL INDICATOR WORKING GROUP
AGRICULTURE & AGRI-FOOD CANADA

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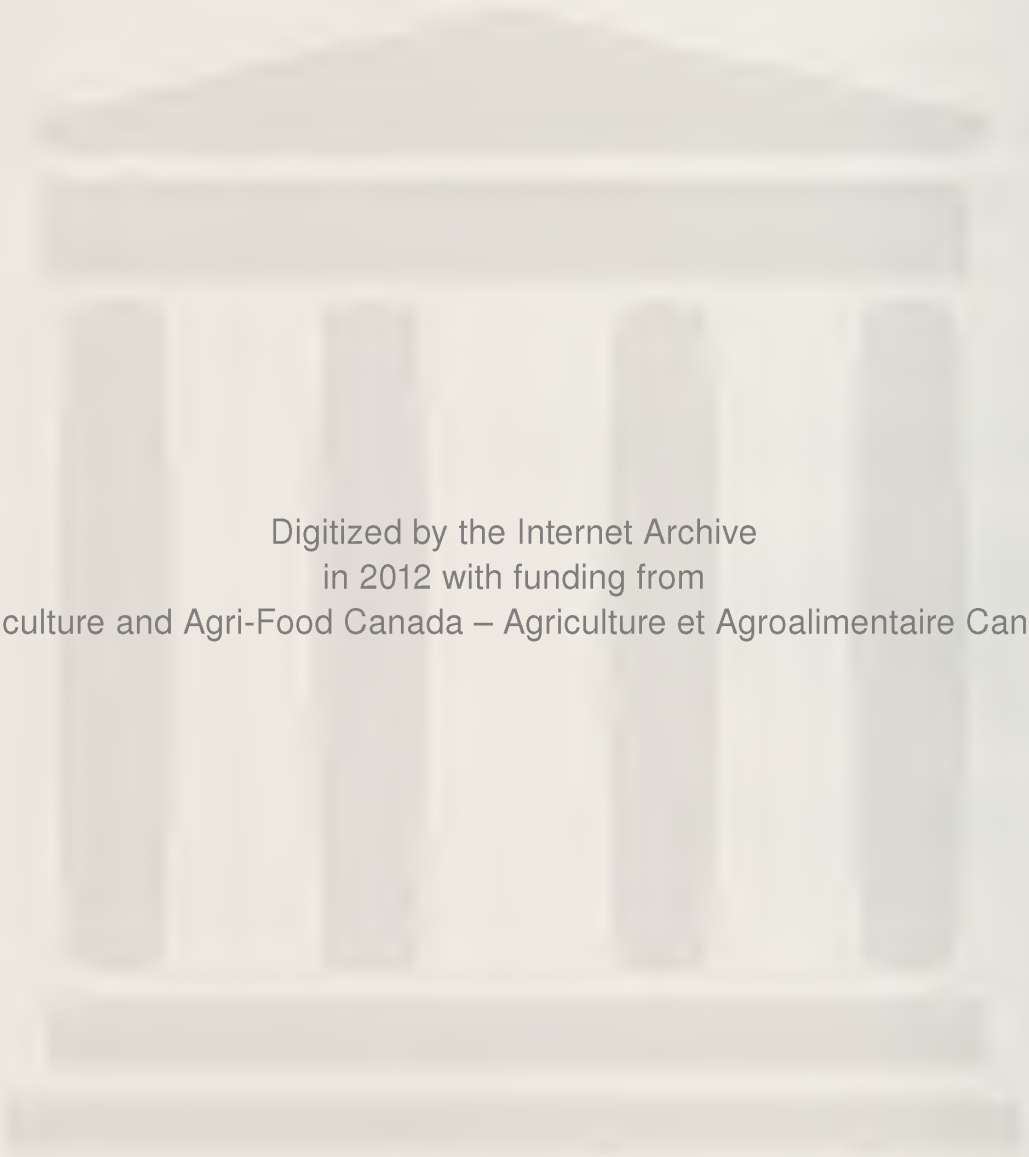

1.0 INTRODUCTION.

This paper presents the direction being considered by Agriculture and Agri-food Canada (AAFC) for developing a core set of agri-environmental indicators for Canadian agriculture.

The paper begins with an overview of the objectives, context and achievements to date of AAFC's agri-environmental indicator project (sections 2, 3 and 4 respectively). Section 5 presents the agri-environmental framework being used to group the indicators and section 6 identifies the core set of indicators proposed for development. Section 7 discusses proposed future directions for the project. Information of interest is also included in the attachments to the paper.

2.0 PROJECT OBJECTIVE.

The objective of the agri-environmental indicator development project is to ***develop a core set of agri-environmental indicators*** which will:

* provide a capability for evaluating the environmental sustainability of the agricultural sector, in particular from a national perspective.

* provide agri-food decision-makers and stakeholders with succinct information on key trends in the sector in relation to environmental sustainability.

* through the provision of relevant information, facilitate the integration of environmental considerations into the sector's policy-making, programming and planning processes.

3.0 PROJECT CONTEXT.

The importance of environmental information in general, and the need to develop environmental indicators in particular, has been recognized both nationally and internationally, as well as within the Canadian agri-food sector. For example:

- At the 1989 G-7 Economic Summit, member countries agreed on the priority of environmental indicators and tasked the Organization for Economic Cooperation and Development (OECD) with development of an international set of environmental indicators. Research by the OECD is underway in this area, including within the OECD Food, Agriculture & Fisheries Directorate.

- The federal Green Plan (1990) identified environmental information as being key to sound decision-making and committed the federal government to developing and releasing, on a periodic basis, a comprehensive set of indicators that measure Canada's progress in achieving its environmental goals. Work to develop environmental indicators

is ongoing at the federal level, both at Environment Canada and in several resource departments.

- In 1990, the Federal-Provincial Agriculture Committee on Environmental Sustainability reported to the federal and provincial Ministers of Agriculture. Recommendation 11 of the Committee's report, which was endorsed by all Ministers, called for the development of "indicators to monitor and assess the state of natural resources and environmental quality in relation to agriculture".

- The Science Council of Canada, in recommendation 15 of its 1992 report "Sustainable Agriculture: The Research Challenge", called for the development of physical and biological indicators against which alternative agricultural practices can be assessed.

- In 1992, the Canadian Agricultural Services Coordinating Committee recommended that increased efforts be made within the sector to develop a set of environmental indicators that would adequately reflect the state or sustainability of the agricultural environment.

- In recommendation 19 of its 1992 report "The Path to Sustainable Agriculture", the House of Commons Standing Committee on Agriculture recognized the importance of monitoring Canadian agriculture's progress towards sustainability .

- In its 1993 audit of the environmental sustainability project of AAFC, the Office of the Auditor General of Canada identified the development of agri-environmental indicators as a key priority for the department.

The agri-environmental indicator project is, in part, a response to such initiatives and recommendations. The project also reflects a basic need within the department and sector for more concise and accessible environmental information on which to base and evaluate policies and facilitate program design and analysis.

The project seeks to build on and integrate past and ongoing work in such areas as land management evaluation, biological resources research and other areas. Over the years, for example, AAFC has gathered detailed data related to the condition and use of agricultural soil resources and land management practices. Statistics Canada collects information on environmental aspects of agriculture and added, in 1991, a land management module to the Census of Agriculture. Environment Canada collects data related to water quality, habitat availability and other variables related to agriculture. Provincial departments of both agriculture and environment, and industry, also collect and use information on such variables as land use, cropping practices and inputs. Despite these efforts, however, significant limitations in availability of required data exist that can only be overcome through inter-agency collaboration and focused efforts to collect, standardize and/or manipulate data.

4.0 ACHIEVEMENTS TO DATE.

The Agri-Environmental Indicator Project was initiated in early 1993. The principle accomplishments to date are:

- Within AAFC, a project management and implementation structure was established. This is composed of a Steering Committee (Environmental Indicator Working Group) and seven Indicator Development Teams composed largely of specialists from within AAFC.

- A policy framework paper was prepared in June 1993 which identified seven key environmental issues [1], project objectives, policy assessment questions and indicator selection criteria.

- Through the Indicator Development Teams, potential environmental indicators were identified and described for each of the seven targeted issues.

- A national consultation workshop was held in December 1993 to review the project framework and the seven environmental issues identified, evaluate the potential indicators and advise on their development and on overall implementation of the project. A report on the results of this workshop is in preparation.

- A departmental proposal on agri-environmental indicator development is being prepared. The proposal is to be reviewed by selected stakeholders and considered by senior management of AAFC.

In addition, AAFC provided international leadership on environmental indicator development through its role as a key sponsor to the International Workshop on Sustainable Land Management, held in June 1993 in Lethbridge, Alberta. Participants at this workshop identified potential indicators of sustainable land management. The department also commented on the selection of a core set of environmental indicators to guide OECD environmental performance reviews of member countries. There are important linkages between these initiatives and the Agri-Environmental Indicator Development Project.

5.0 AGRI-ENVIRONMENTAL ASSESSMENT FRAMEWORK.

At the December 1993 consultation workshop on agri-environmental indicators, participants were asked to consider the issue-by-issue approach that had been used to organize and link the indicators and provide suggestions on how this approach might be improved. Several suggestions were offered, in particular that:

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[1] *The agri-environmental issues are: Agricultural Land Resources, Surface & Ground Water Quality, Genetic Diversity, Wildlife Habitat, Agricultural Inputs, Air & Climate and Water Quantity.*

- The indicators selected should relate to the broad environmental and resource stewardship objectives Canadians have for agriculture.

- A more comprehensive framework to organize and link the indicators be developed. The American and Australian agri-environmental frameworks [2] were identified as two examples that may be relevant for Canada, given similarities in geography, landscape and the extensive nature of agriculture in all three countries.

- The issues of genetic diversity and wildlife habitat be combined as biodiversity.

- Where feasible and appropriate, the farm unit should be used as the basic unit for collecting data, with data aggregation scaled to the particular needs of users using ecological units such as watersheds and agro-ecological resource areas.

- Consideration be given to including indicators of selected production and management practices deemed environmentally sustainable.

In response, the following changes to the project framework are proposed:

- Integration of the issue approach with a more comprehensive agri-environmental assessment framework (see Table 1);

- Greater consistency with the approaches being pursued by the United States and Australia in their agri-environmental indicator development programs, to the extent that it is appropriate to do so.

- Use of the farm unit and appropriate ecologically-based spatial units for collecting, organizing and reporting data.

The proposed new framework, outlined in Table 1, addresses the following general statement about national objectives for agriculture:

> An agri-food sector that is productive, that conserves and enhances the natural resources used and shared by agriculture and that is compatible with other environmental resources that are affected by agriculture, through the use of environmentally-sound production and management practices [3].

The three categories in the framework relate to the statement of objectives above and

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[2] *The U.S. framework includes three categories of indicators: productivity, environmental quality (air, water & soil) and biodiversity. The Australian framework identified in 1991 focuses on productivity, management and condition of the resource base.*

[3] *Modified from the 1990 Report of the Federal-Provincial Agriculture Committee on Environmental Sustainability.*

are, to a degree, similar to the organizing frameworks being pursued in the U.S. and Australia. Elements of the issue-by-issue approach can be integrated into the framework, which also incorporates economic aspects of agricultural production as they relate to environmental sustainability.

Through the framework, broad relationships, processes and linkages between the indicators can be identified. At the most basic level, production and management practices can affect environmental and resource conditions which can, in turn, affect productivity. Productivity can also affect the ability of producers to manage environmental and other resources.

TABLE 1: AGRI-ENVIRONMENTAL ASSESSMENT FRAMEWORK

INDICATOR GROUP	DESCRIPTION
PRODUCTIVITY	Indicators track trends in efficiency of production (input / output ratios), actual versus potential crop yield and yield variability. Production efficiency will give some indication of environmental sustainability; Increased yield variability can signal poor land management, soil degradation, climate change or socio-economic factors.
ENVIRONMENTAL & RESOURCE CONDITIONS (Quality & Quantity)	Indicators provide a measure of the condition, or potential change to the condition, of environmental resources used and shared by agriculture and of the impact (beneficial or adverse) of agriculture on such resources. Focus is on soil, water and biological resources.
PRODUCTION AND MANAGEMENT PRACTICES.	Indicators track the adoption / use of various production & management practices associated with stewardship and environmental maintenance, or are proxy measures for such practices.

6.0 AGRI-ENVIRONMENTAL INDICATORS PROPOSED FOR DEVELOPMENT.

At the December 1993 consultation workshop, some fifty potential indicators were evaluated for their suitability and relevance. These were ranked within each of the seven

issues and, in some cases, combined into broader composite indicators. Given resource limitations, it is important that those indicators considered the most relevant be selected for development.

In the development phase of the project, AAFC proposes to pursue development of the indicators listed in Table 2. This list may change once feasibility (current capabilities, data limitations, etc) has been examined in more detail. Partnerships with other stakeholders will be required for successful development of many of the indicators.

TABLE 2: PROPOSED AGRI-ENVIRONMENTAL INDICATORS

FRAMEWORK CATEGORY	PROPOSED INDICATOR
PRODUCTIVITY	* Crop Yield & Variability
	* Input Use Efficiency
ENVIRONMENTAL & RESOURCE CONDITIONS	* Soil Degradation Risk
	* Water Contaminantion Risk
	* Agro-Ecosystem Habitat Availability
	* Agro-Ecosystem Biodiversity
PRODUCTION & MANAGEMENT PRACTICES	* Soil Cover & Management
	* Nutrient Balance
	* Input Management
	* Pesticide Risk
	* Greenhouse Gas Balance
	* Irrigation System Efficiency

The indicators were selected based on:

- The ranking given to each at the December 1993 workshop.
- Their fit with the indicator selection criteria (see attachment 1).

A decision was taken to focus, at least at this stage, on those indicators which track the sector's impact on the condition of the environment and its progress in reducing adverse impacts and in sustaining resources (i.e. indicators of environmental impacts on the sector caused by factors external to agriculture were dropped).

The indicators in Table 2 have been grouped by framework category but there are important linkages between the categories and indicators, as depicted in Attachment 4. Linkages between the indicators and various agri-environmental issues are identified in Attachment 3. Each of the indicators identified in Table 2 is discussed generally below.

Indicator: Crop Yield & Variability.

- Indicator reports long-term trends in yields of selected major cultivated crops (to be determined) in relation to both total potential yield and actual historical yield.
- The indicator will provide a measure of sustainability as decreased yields and increased yield variability can indicate inappropriate land management, soil degradation, climate change or socio-economic factors.
- Development is feasible within 1-2 years as a number of studies have already provided preliminary data and have developed some of the protocols required for further development. Data are available from long-term experiments, long-term yield records from crop insurance programs and from yield simulations using crop growth models.
- Development will be led by the Land Resources Division of the Centre for Land & Biological Resources, Research Branch.

Indicator: Input Use Efficiency.

- Indicator provides a signal of production efficiency by measuring long-term trends in the amounts of selected inputs (such as energy, nutrients & other inputs) used per unit of production output. The initial focus will be on measuring fertilizer use efficiency.
- Efficiency of production will give some indication of environmental sustainability as more efficient production systems will likely exert less pressure on ecosystems than less efficient production systems.

- At an aggregate level, development is foreseen within 1-2 years. Refinement of the indicator (by commodity and region) will require more precise estimates of fertilizer applications by crop & region than are currently available.

- Development will be led by the Industry Performance & Analysis Directorate, Policy Branch, in collaboration with other stakeholders such as the fertilizer industry.

Indicator: Soil Degradation Risk

- Indicator reports trends in the extent and severity of, and vulnerability of agricultural lands to, soil erosion and change in soil organic matter and salinity levels.

- The indicator provides a measure of the vulnerability of the soil resource base to degradation induced by land management and production practices and is a proxy for more direct measurements of soil quality parameters, which are technically difficult and expensive to monitor.

- Development is foreseen in 1-2 years as water erosion maps have already been prepared for all of Canada and wind erosion and salinity maps for the prairie provinces. Development of the indicator will require that these be integrated or combined with soil cover and crop management data, possibly using models, to provide for current assessments.

- Development will be led by the Land Resources Division of the Centre for Land & Biological Resources Research, Research Branch.

Indicator: Water Contamination Risk.

- Indicator identifies areas at risk of water contamination by agri-chemicals and trends in degree of risk of contamination for selected water bodies and / or aquifers.

- Development is foreseen in the medium to longer-term. To develop this indicator, it will be necessary to identify priority contaminants (eg. pesticides & nutrients), required data and to develop a methodology for estimating and reporting risks. The indicator will combine information on land management, input use and soil characteristics related to erosion and leaching potential in order to estimate degree of risk to water quality. The initial focus of development work could be done on a pilot project basis.

- Development work will be lead by the Research Branch of AAFC with input from the Environment Bureau and interested external stakeholders.,

Indicator: Agro-Ecosystem Habitat Availability

- Indicator measures change in the availability and fragmentation of selected wildlife habitats in agricultural landscapes, such as wetlands, woodlands and grasslands.

- The indicator will measure agriculture's impact on wildlife habitat in agroecosystems and thus provide a signal of sustainability. There is an important linkage to efforts to evaluate the environmental impacts of various farm support policies on wildlife habitat in general and on wetlands in particular.

- For development, some data are already available on various types of land cover and habitat amenable to wildlife, such as wetlands, woodlands and grasslands, thus aspects of this indicator can be developed in the short to medium-term. However, there are also significant data limitations that will need to be addressed, such as change to total wetland cover (net balance of additions and losses) and measurement of habitat fragmentation.

- AAFC is willing to collaborate with other agencies which possess the required data and expertise. Development work within AAFC will be led by the Prairie Farm Rehabilitation Administration. Collaboration with the Centre for Land & Biological Resources Research of the Research Branch, Environment Canada and other partners (eg. habitat conservation groups) will be essential.

Indicator: Agro-Ecosystem Biodiversity.

- Indicator measures change in the diversity of non-domesticated species residing in agro-ecosystems. This would be based on a sub-set of diverse taxonomic groups selected to represent biological resources important for agriculture, providers of key ecological services, bio-indicators of soil & water quality and wildlife shared with other ecosystems in agricultural landscapes. The indicator would be designed to apply to a set of selected sites representing agricultural landscapes across Canada.

- The indicator will measure agriculture's impact on biodiversity in agroecosystems and thus provide a signal of sustainability. There is a direct linkage to the recommendations of the Canadian Biodiversity Strategy being prepared by Environment Canada and the approach is complementary to that of the Agro-Ecosystem Health component of the U.S. Environmental Monitoring and Assessment Program to develop agro-ecosystem health indicators of biodiversity.

- Development will require considerable conceptual and technical work. The indicator could be developed conceptually and tested through a pilot project within 3-5 years using expertise and information available within the Research Branch of AAFC and possibly within other agencies, such as Environment Canada.

- Development will be led by the Biological Resources Division of the Centre for Land & Biological Resources Research, Research Branch. Collaboration with Environment Canada, other Research Branch Stations and possibly other partners will be essential.

Indicator: Soil Cover & Management

- Indicator reports trends in area of agricultural land having sufficient cover to reduce the extent and degree of soil degradation to a level that does not impair current or future crop production and adoption rates of selected sustainable land management practices. Reporting can include such parameters as:

  - area of fallow (winter & summer) as a percent of total cultivated or total seeded land area;
  - area of land sown to a winter cover crop;
  - area of monoculture cropping as a percent of total cultivated land area;
  - area of agricultural land in which crops are seeded directly into standing stubble as a percent of total land area;
  - area of forage crops in rotation as a percentage of total cultivated land area;
  - area of marginal agricultural cultivated lands returned to permanent cover as a percent of total cultivated marginal lands in an area;
  - kilometres of field shelterbelts planted annually;
  - area of agricultural land intentionally burned each year as a percent of total cultivated land area.
  - adoption rates of selected sustainable land management practices.

- The indicator tracks various aspects of land use & management and is a proxy for soil degradation as it relates to crop production, the regulation and partitioning of water flow and the role of soil in serving as an environmental buffer. It thus provides an important measure of sustainable land management, which also has implications for other issues such as water quality.

- Development is feasible in the short term from Census of Agriculture and other data.

- Development will be led by the Land Resources Division of the Centre for Land & Biological Resources Research, Research Branch.

Indicator: Nutrient Balance.

- Indicator tracks trends in the amount of nitrogen and phosphorus put into and taken out of soils and reports whether applications are in balance, deficit or surplus.

- Over-application of nutrients can increase the risks of water contamination while under-application can lead to mining of soil nutrients, thus the indicator will provide an

important signal of sustainability of nutrient input use.

- The indicator can be developed in the medium-term at the regional scale. Current capabilities allow for development of an aggregated balance based on estimates of nutrient applications and removals. The accuracy of the indicator will be enhanced if detailed data on fertilizer uses can be obtained at a more localized scale.

- Development will be led by the Land Division of the Centre for Land & Biological Resources Research, Research Branch. Collaboration with industry will be sought.

Indicator: Inputs Management

- Indicator tracks the extent of adoption by farmers of selected sustainable management practices (SMPs) for inputs, in particular nutrients and pesticides.

- An indication of the extent of adoption by farmers of SMPs will provide an indication of environmental stewardship, success of extension efforts and thus of environmental sustainability.

- Development will be over the medium term. A first step will be to identify and secure agreement on a set of appropriate and measurable SMPs for nutrients and pesticides, followed by identification of relevant data.

- Development will be led by the Industry Performance and Analysis Directorate, Policy Branch. Cooperation with the fertilizer and pesticides industries will be sought.

Indicator: Pesticide Risk

- Indicator tracks trends in the use of various pesticide active ingredients classified into groupings based on their potential environmental risk.

- The indicator will measure increases or decreases in potential environmental risks resulting from pesticide use and will thus provide a measure of environmental sustainability. There is a direct linkage to the risk reduction strategy being developed for the Canadian pesticide registration system.

- The indicator can be developed in the medium-term. A first step will be to develop an environmental risk classification system for pesticides. More detailed data on pesticide use in Canada than is currently available will enhance the utility of the indicator.

- The lead unit within AAFC for development of this indicator has not yet been determined. Partnerships with other federal departments (Environment, Natural Resources, Health), industry, the provinces and other stakeholders will be essential.

Indicator: Agricultural Greenhouse Gas Balance

- Indicator tracks the total accumulation and release of greenhouse gases from the agricultural sector and reports the net balance. Components of the indicator track releases of various greenhouse gases from fertilizer use, ruminants, waste storage sites, etc and carbon accumulation in soils, crop biomass, etc.

- The indicator tracks the sector's contribution (beneficial or adverse) to climate change and thus provides an important signal of sustainability. There is also a direct relationship to Canada's reporting commitments for the global Framework Convention on Climate Change.

- Development of some of the individual components of the balance is underway. Completion of a comprehensive greenhouse gas balance is foreseen for the medium to long-term as additional research and methodological work is required.

- Development will be led by the Land Resources Division of the Centre for Land & Biological Resources Research, in collaboration with other Research Branch stations involved with relevant research. Collaboration with Environment Canada and Natural Resources Canada will be sought.

Indicator: Irrigation System Efficiency.

- Indicator tracks the relative irrigated area by irrigation system efficiency.

- An assessment of trends in irrigated acreage efficiency is relevant to the promotion of water use efficiency. An increase in the percentage of land irrigated by efficient irrigation systems would signal a trend towards more efficient use of the water resource, thus increased environmental sustainability.

- Development is envisaged in the medium term as data available from provincial governments and irrigation districts will have to be accessed and integrated.

- Development will be led by the Prairie Farm Re-habilitation Administration. Collaboration with provincial governments will be sought.

7.0 FUTURE DIRECTIONS.

Proposed next steps for the agri-environmental indicator project are described below and outlined in attachment 2. These are discussed in the context of four areas: indicator selection, partnerships and development, consultations and reporting. These steps or phases of the project will involve numerous specialists and agencies both within and external to AAFC. The Environment Bureau of AAFC will continue leading implementation of the project

by coordinating consultations, formation of partnerships, preparing progress reports and bulletins, etc.

In general, the period leading up to the 1996 Census of Agriculture can be described as a selection and development phase. Greater emphasis on reporting of results will begin following the 1996 Census of Agriculture, although some indicators will available prior to 1996.

Indicator Selection.

The first step will involve completing the current indicator selection phase. Comments on the directions proposed in this paper, and in particular on the indicators proposed for development, are therefore invited from stakeholders. Following receipt of comments, an indicator development proposal will be prepared for consideration by AAFC. The indicators endorsed by the department will be pursued in the development phase of the project. This process is to be completed in the second quarter of 1994.

Partnerships & Indicator Development.

Following selection of a core set of indicators, development teams will be established for each indicator or group of related indicators. A Team Leader will coordinate the establishment and the work of each team. Participation will be open to specialists outside of AAFC, such as from industry, other federal departments, provincial governments, etc. who have an interest in the development of specific indicators. The Leader of each Team will sit on the project steering committee -- the Environmental Indicator Working Group.

The role of the Teams will be to develop the indicators. This will involve a process of further conceptual development of the indicators, scientific validation, methodological work, and collection, analysis, tabulation and interpretation of relevant data.

The teams will be the principal mechanism through which partnerships are formed to develop the indicators. As a first step, it is proposed that each Team develop a work plan for its assigned indicator(s). Development work on the targeted indicators will commence in 1994 and will be ongoing.

Consultations.

Consultations with stakeholders and partners will be ongoing. These can occur through presentations by AAFC to stakeholder groups and at conferences, meetings, etc (i.e. on an ad hoc basis). In addition, a series of more focused meetings is proposed, in the form of seminars, to provide stakeholders with an opportunity to review the progress that has been achieved and to discuss the direction of the project. These seminars will be on a smaller scale

than the December 1993 Consultation Workshop.

The first such seminar is proposed for the fourth quarter of 1994, with another to take place in the fourth quarter of 1995. Interim or progress reports will be developed for each seminar to focus discussions.

Reporting.

The environmental information generated by the project will be reported in a number of ways. In the first instance, prior to 1996 the progress reports prepared for each of the consultation seminars will include the results obtained through the project at the time of the seminar. It may also be possible, for some indicators, to report results through periodic special bulletins.

In the period following the 1996 Census of Agriculture, AAFC proposes to prepare a comprehensive report on the results of the project. This report will analyze environmental conditions and trends in the sector using the indicators that have been developed. Periodic reporting of the indicators will then be ongoing, perhaps following the cycle of the Census of Agriculture.

ATTACHMENT 1: INDICATOR SELECTION CRITERIA

POLICY RELEVANCE: Indicators should provide information which is relevant to the policy-making process, by:

- informing of movement toward or away from general or specific policy objectives or scientific thresholds;
- signalling trends in, or changes to, critical aspects of environmental sustainability in agriculture.

SCIENTIFICALLY SOUND: Indicator should be technically sound and scientifically defensible. A reasonable consensus should exist about the scientific merit and accuracy of the indicator.

UNDERSTANDABLE & UNAMBIGUOUSLY INTERPRETABLE: The meaning of the indicator and, in particular, its environmental significance, should be readily apparent to users.

MEASURE ENVIRONMENTAL SUSTAINABILITY OF SECTOR: Indicator focus should be on tracking environmental conditions & trends affected by agriculture, and on progress made in reducing impacts & sustaining resources. Indicators of environmental impacts on agriculture caused by sectors and activities external to agriculture are to be excluded at this time.

INTEGRATIVE ACROSS ISSUES: Indicator should integrate or link to as many issues/concerns as possible.

IDENTIFY SPATIAL & TEMPORAL CHANGE: Indicator should be referenced in time and space to allow for temporal and spatial analysis.

FEASIBLE TO DEVELOP: In addition to being relevant, the indicator should be feasible to develop within a reasonable time period (2-3 years). Data and expertise should be largely available, cost should not be prohibitive.

REGIONALLY RESPONSIVE: Indicators should be regionally sensitive where appropriate.

ATTACHMENT 2: GENERAL PROJECT SCHEDULE

ACTIVITY	1994	1995	1996	1997
FINALIZE SELECTION OF INDICATORS	2nd Quarter 1994			
ESTABLISH INDICATOR DEVELOPMENT TEAMS	2nd Quarter 1994			
PURSUE DEVELOPMENT WORK	→ Ongoing			
PROJECT CONSULTATION SEMINAR NO. 1	4th Quarter 1994			
PROJECT PROGRESS REPORTS	4th Quarter 1994	4th Quarter 1995		
PROJECT CONSULTATION SEMINAR NO. 2		4th Quarter 1995		
COMPREHENSIVE INDICATOR REPORT			Following 1996 Census of Agriculture	

ATTACHMENT 3: LINKAGES BETWEEN INDICATORS & AGRI-ENVIRONMENTAL ISSUES

Indicator	Land Resources	Water Quality	Water Quantity	Biodiversity	Inputs	Air & Climate
Crop Yield Variability	√	√	√	√	√	√
Input Use Efficiency	√	■			◙	√
Soil Degradation Risk	◙	√				√
Water Contaminantion Risk	√	◙		√	√	
Agro-Ecosystem Habitat Availability	√	√		◙		
Agro-Ecosystem Biodiversity	√	√		◙		
il Cover & Management	◙	√	√	√		
Nutrient Balance	◙	◙			◙	
Input Management	√	√			◙	
Pesticide Risk		√		√	◙	
Agricultural Greenhouse Gas Balance	√		√			◙
Irrigation System Efficiency		√	◙			

◙ denotes primary linkage.

√ denotes secondary linkage.

ATTACHMENT 4: LINKAGES BETWEEN INDICATORS & FRAMEWORK CATEGORIES

INDICATOR	PRODUCTIVITY	ENVIRONMENTAL & RESOURCE CONDITIONS	PRODUCTION & MANAGEMENT PRACTICES
Crop Yield Variability	■	√	√
Input Use Efficiency	■	√	√
Soil Degradation Risk	√	■	√
Water ContaminantionRisk	√	■	√
Agro-Ecosystem Habitat Availability		■	√
Agro-Ecosystem Biodiversity	■	■	√
Soil Cover & Management	√	√	■
Nutrient Balance	√	√	■
Input Management	√	√	■
Pesticide Risk		√	■
Agricultural Greenhouse Gas Balance		√	■
Irrigation System Efficiency		√	■

■ denotes primary linkage.

√ denotes secondary linkage.


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