CANADA
National Reporting to CSD-16/17
Thematic Profile: Drought and Desertification (Domestic)

Drought

1. Strategic planning frameworks for the protection and sustainable management of ecosystems in drought-prone areas.

In the years following European settlement of Western Canada, poor farming practices led to serious land degradation. Land damage was intensified during the extended and wide-spread drought of the 1930s. In response, Canada established the Prairie Farm Rehabilitation Administration (PFRA) to deliver programs in soils and water conservation, and to facilitate conversion of fragile lands back into grassland. Initial PRFA programs were successful in stopping and reversing the serious land degradation of the past. Subsequent research and programming has ensured that improvements in sustainable land management and soil quality continue to be made. Although these activities, which encourage good stewardship of land resources, are not specifically designed to manage drought or combat desertification, they do result in drought amelioration (adaptation to climate variability and long-term change) and reduced desertification; for these reasons, they are discussed in this report.

Canada's Agriculture Policy Framework (APF), implemented in 2003, forms the basis for federal, provincial and territorial governments to develop and deliver programs to inform and encourage farmers to adopt sustainable land management practices. Within the APF, several strategic efforts supporting sustainable use of natural resources have been initiated, including the development of a draft National Drought Action Plan. Agriculture and Agri-Food Canada (AAFC), with the PFRA, first drafted the Action Plan in 2004 to outline potential contributions to agricultural drought risk management and response in Canada. The draft document will form the basis for negotiations with provinces and other stakeholders in the development of a more detailed and comprehensive National Drought Action Plan. The Plan will clearly articulate Canada's role and contribution to agricultural drought risk management and response in collaboration with provincial/territorial partners, and will also be linked to the AAFC Water Strategy being developed for Canada.

2. Policies and practices to arrest land degradation and to restore land and soil productivity.

The Agriculture Policy Framework expires in 2008. In June 2007, Ministers of Agriculture from the Government of Canada, provinces and territories agreed in principle on a vision for its successor, entitled *Growing Forward*, which recognizes the interconnections between the three pillars of sustainable development. It identifies the importance of proactive risk management within the sector and that this includes enabling enterprises to adapt to risks posed by environmental factors (climate change, drought, etc.) and safeguard the future viability of the land and water resource base.

Environmental Farm Planning

The National Environmental Farm Planning (EFP) Initiative provides farmers across Canada with access to provincially/territorially delivered EFP programs, where farmers are encouraged to develop environmental farm plans, implement beneficial management practices (BMPs) and continuously evaluate the environmental performance of their farming operations with respect to soil, water, air and biodiversity resources.

An environmental farm plan is a voluntary and confidential process used by farmers to identify environmental risks to and benefits from their farming operations, and to develop an action plan to mitigate those risks. Once an environmental farm plan is completed and reviewed, farmers are eligible to apply for technical and financial assistance to implement BMPs on their farms through the National Farm Stewardship Program (NFSP) and Greencover Canada (see below).

Beneficial management practices (BMPs) are farm management practices that: minimize and mitigate impacts and risks to the environment, by maintaining or improving the quality of soil, water, air and biodiversity; ensure the long term health and sustainability of natural resources used for agricultural production; and support the long-term economic and environmental viability of the agriculture industry.

Environmental Farm Plans have been well received by farmers across Canada. By June 2007, over 67,000 producers have participated in the program (29% of total producers in Canada) and over 46,000 farms have a reviewed EFP.

Greencover Canada
The Greencover Canada Program is a federal initiative to help producers improve grassland-management practices, protect water quality, reduce greenhouse-gas emissions, and enhance biodiversity and wildlife habitat. It contains four components: land conversion - converting environmentally sensitive land to perennial cover; critical areas - improving management of agricultural land near water bodies; technical assistance- helping producers adopt beneficial management practices; and shelterbelts - planting trees on agricultural land. This program is the latest of a series of previous successful permanent cover and conservation cover programs that have focussed mainly on the conversion of sensitive crop lands to perennial cover. A total of 437,000 acres of land have been converted to perennial cover since 2003 across Canada.

National Farm Stewardship Program
The National Farm Stewardship Program provides producers who have a reviewed environmental farm plan (EFP) with technical assistance and financial cost shares to implement beneficial management practices (BMPs) on their farms, and address the agri-environmental risks identified in their EFP.

Recognizing that agricultural landscapes, farming practices and potential environmental risks vary across Canada, the Program has been designed to allow provinces the flexibility to support BMPs that address regional priorities. By ensuring that BMPs eligible under the program are nationally acceptable and regionally appropriate, the Program supports Canada's objective to be recognized as a leader in environmentally responsible agricultural production.

As of June,2006, over $76.7 Million in federal funding has been provided to implement over 19,000 BMPs across Canada. A 2007 NFSP review of the Program indicated that it has been successful.

3. National strategies and contingency arrangements for drought preparedness to deal with drought-related food and water deficiencies.

Drought varies in frequency, severity and impacts across Canada. Response to drought is a shared responsibility between federal and provincial/territorial governments. Strategies and programs generally involve cooperation between jurisdictions. Drought in Canada is usually limited to one or two regions; however, in recent years, drought was experienced across Canada, including in regions less accustomed to dealing with drought. These regions included parts of eastern Canada and the northern agricultural prairies. Drought is expected to become more frequent and widespread in future under climate change scenarios.

The National Drought Action Plan (described in Section 1) is expected to be finalized in early 2008. Within AAFC, the Action Plan will be linked to a Water Strategy and contribute to directions and outcomes of broader agriculture policy under the APF.

National Water Supply Expansion Program

The National Water Supply Expansion Program (NWSEP) focuses on assisting Canadian producers to develop and enhance long-term agricultural water supplies in order to help reduce the risk of future water shortages and to meet the everyday growing needs of a vibrant Canadian agricultural sector. NWSEP provides assistance for: on-farm water infrastructure (small-scale water development projects); large-scale infrastructure projects (such as tank loaders and regional water pipelines); and strategic initiatives (studies, planning activities, etc.).

The NWSEP has been delivered across Canada since 2002 and has constructed a total of 5196 on-farm water infrastructure projects, 242 large multi-user water infrastructure projects, and conducted studies or design activities for 309 strategic work projects for a total expenditure of over $80 million.

4. Drought-relief schemes and their integration into national and regional development planning

Drought Monitoring as input for drought relief programs

AAFC-PRFA leads the drought monitoring effort in Canada. Using internationally-recognized science-based indices, and the data supports drought mitigation programs, such as drought-induced tax deferral. It recognizes that there is a need to better integrate in a more formal manner, Federal and provincial drought activities to enhance and reduce the costs and impacts of drought. This will require the development of plans that integrate existing monitoring, reporting, adaptation, mitigation, and response activities more effectively. Examples of existing elements that could be more effectively integrated include:

- The North American Drought Monitor (NADM). AAFC is the author for Canadian drought conditions and rotational lead author for North American drought conditions. The importance of this effort is the ability to link drought monitoring in Canada to continental drought conditions and to utilize the knowledge and research to further refine programs and drought indicators.
- International Group on Earth Observation (GEO). Through the Canadian Group on Earth Observation (CGEO) there is a mechanism to link environmental monitoring to international conditions and standards. It also provides an opportunity for collaboration with the international community through data sharing and joint projects on environmental monitoring.

Crop Production Insurance

As a proactive measure to mitigate drought, the Government of Canada in collaboration with Provincial and Territorial Authorities provides funding to cover crop production losses due to drought and other weather related risks, as Crop Production Insurance often is not sufficient to cover losses. When droughts are severe, as in 2001 and 2002, other programs are established to mitigate the impacts.

Tax Deferral Program

The Tax Deferral Program for Drought-Induced Livestock Sales has been in place for two decades, and directly addresses the impact of drought on livestock. It provides producers with an option to defer income from part of their herd into the following tax year. Producers are eligible for the program if their municipality has been designated a drought-effected region. Drought regions are

designated on the advice of the Minister of Agriculture and Agri-Food to the Minister of Finance. Canada Revenue Agency requires that designated areas have recognized geo-political boundaries (e.g. municipalities or counties).

5. Afforestation and reforestation programmes using drought-resistant, fast-growing species

For over 100 years, the PFRA's Shelterbelt Centre has provided trees and shrub seedlings to prairie landowners for farm, field, wildlife and agro-forestry plantings. Technical assistance is provided to show how tree plantings can support sustainable agriculture by improving soil moisture and reducing soil erosion and energy requirements. The Shelterbelt Centre conducts research to develop new types of trees and uses for existing species. Over the last ten years the Prairie Shelterbelt Program has enabled the establishment of 7,539 km of field shelterbelts, protecting over 143,000 ha of agricultural soil from wind erosion.

The Canadian Forestry Service completed the Feasibility of Afforestation for Carbon Sequestration (FAACS) initiative in March 2005. It evaluated the feasibility of afforestation, collected information and land assessment research on privately owned lands, and contributed to Canada's carbon measurement and accounting infrastructure. Research focused on:

- Landowner Consultations
- Cost-Benefit Modelling
- Carbon Science Development
- Land Suitability Assessment

After FAACS ended, the Forest 2020 Plantation Demonstration and Assessment initiative was launched. This is a $20-million program to demonstrate that fast-growing tree plantations can act as sinks to absorb carbon dioxide. The Initiative established a network of fast-growing plantation demonstration sites across Canada, mainly on private lands, to test and improve our biological information and demonstrate the contribution from fast-growing trees to help offset greenhouse gas emissions.The demonstration portion of Forest 2020 included approximately 6000 hectares spread evenly across Canada

7. Use of climate and weather information, forecasts, monitoring and early warning to mitigate the effects of drought

The National Agroclimate Information Service (NAIS) was established by AAFC in 2001 to monitor and analyze agroclimate conditions in order to help the industry better prepare and cope with weather extremes. Monitoring has increased in scope from the Canadian Prairies to all the agricultural land of Canada. NAIS provides near-real-time updates on the extent, location and severity of drought and other weather extremes affecting agriculture in Canada through the Drought Watch Website Drought monitoring is also integrated between Canada, the United States and Mexico through the North American Drought Monitor. Agroclimate monitoring has been enhanced by an increased number of weather monitoring stations, better remote sensing products, improved foundational data products and models, and new initiatives to address adaptation to climate variability and climate change. As a result, response programs to mitigate the effects of drought are using monitoring to target areas for support, especially where livestock production was impacted. New initiatives in monitoring and modeling soil moisture and in integrating forecast information are expected to further improve early warnings of drought.

8. Use of Decision Support Tools for Risk Management.

The NAIS and Research Branch of AAFC developed a National Drought Model which derives science-based drought indices for the agricultural area of Canada. The model integrates climate, land use and soil information to identify active and encroaching drought conditions in Canada. It is also used by NAIS for their contribution to international drought activities such as the North American Drought Monitor.

The National Land and Water Information Service (NLWIS) is an Internet-based service being developed over four years to provide Canadian with on-line access to geospatial agri-environmental information. By providing geospatial information, decision-support tools and improvements in national data collection, analysis and reporting, NLWIS will support a number of environmental programs under the APF. Included in these programs are Environmental Farm Plans and Environmental Assessments, Greencover, National Farm Stewardship, National Water Supply Expansion and Water Quality Surveillance.This Service will benefit the agricultural sector and all Canadians by contributing to the development of better agri-environmental policies, increasing public awareness of the relationship between agriculture and the environment, and improving land-use decision making and risk management.

Development of the NLWIS will build on other efforts to reduce agricultural risks and better use Canada's land, soil, water and biodiversity resources. Among these efforts are initiatives to:

- Identify BMPs that protect land from wind and water erosion, improve water supply and quality, enhance biodiversity and increase carbon sequestration in the soil;
- Help producers adopt these BMPs for soil, nutrient and livestock management;
- Measure and track the environmental performance of Canadian agriculture.
- Estimate biomass and straw amounts on agricultural fields

NLWIS provides Web access to data, information and tools to support sound land-use decision making by Canadians. Content is provided by multiple levels of government as well as non-government organizations. NLWIS is also generating new information to fill critical gaps identified by user requirements. The NLWIS system and its associated data will meet international data sharing standards.

AAFC have several Earth Observation (EO) research and monitoring activities underway, including using remote sensing to assist in identifying drought, crop conditions, soil moisture and land use. AAFC is also an active participant in the Canadian Group on Earth Observation and International GEO committees. NLWIS and the Canadian research community continue to work collaboratively to develop the next generation of EO products, to meet ongoing and emerging user needs.

Desertification

6. Desertification and land degradation impact assessment

National Agri-environmental Health Analysis and Reporting Program

One of the goals of the APF is to position Canada as a global leader in environmentally responsible production while improving air, water and soil quality and conserving biodiversity. To help ensure that the agriculture industry is on the correct path to achieving this goal, and to help determine the impact policies and programs have on the environment, the Government of Canada established the National Agri-Environmental Health Analysis and Reporting Program (NAHARP).

More than ever, achieving environmental sustainability in agriculture has become a pressing and complex challenge. In some sectors, environmental concerns pose a direct constraint to growth, and could increasingly affect the agriculture industry's ability to serve existing international markets and to compete for new ones.

To manage these concerns effectively, it is important to first understand the pressures and opportunities that exist in terms of environmental sustainability. In 1993, in response to the need for agri-environmental information and to assess the impacts of agricultural policies on the environment, AAFC began developing a set of agri-environmental indicators (AEIs) to determine how environmental conditions within agriculture were changing over time, and how such changes could be explained.

Results of this work were published in February 2000 in a report called Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project (2000).

Further to this initial work, and in light of current and future needs for this kind of information, AAFC decided to strengthen its capacity to develop and continuously improve on AEIs, as well as the tools that use these indicators to develop policy and programs. AAFC is establishing this capacity through NAHARP.

Indicators of soil quality such as wind, water and tillage erosion, soil organic carbon and desertification are included in NAHARP and will be discussed below. Other indicators monitor environmental farm management, water quality, air quality, biodiversity and the food and beverage industry.

A subsequent report, Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series – Report #2, was published in 2005.

- **Erosion Indicators**
  Three separate indicators were developed to identify areas at risk to wind, water and tillage erosion and to assess how this risk is changing over time under prevailing agricultural management practices. The risk assessment is based on the application of models that estimate the annual amount of erosion per unit area. Areas at very low risk (less than 6 tonnes a hectare per year) and considered to be able to sustain long-term crop production and maintain agri-environmental health under current conditions are one of five classes of the risk assessment. The four remaining classes represent the risk of increasingly unsustainable conditions that call for soil conservation practices to support crop production and reduce impacts on water quality.

  The water erosion indicator shows that the Prairie Provinces experienced an increase in the very low risk class of croplands, from 83% in 1981 to 92% in 2001. This was mainly due to reduced tillage, reduced summer fallow, and removal of marginal land from production. The situation for wind erosion is similar, with an increase in the very low risk area for the prairies from 72% to 86% from 1981 to 2001. The risk of tillage erosion has, and still is, much higher than either wind or water erosion. It too showed an increase in share in the very low risk category from 40% in 1981 to 53% in 2001. Overall, risk of soil erosion is being reduced, and thus one of the major potential sources of land degradation is being addressed.

- **Soil Organic Carbon Indicator**
  Soil organic carbon, or soil organic matter, strongly influences many important aspects of soil quality and is a key component of good soil health. It helps hold soil particles together and stabilizes the soil structure, making the soil less prone to erosion and improving its ability to store and convey air and water. The improved structure helps the soil maintain an uncompacted state. Soil organic matter stores and supplies many nutrients needed for the growth of plants and soil organisms. It binds potentially harmful substances, such as heavy metals and pesticides. Because it enters the soil through the partial decomposition of dead plant material, it acts as storage for carbon dioxide captured from the atmosphere. Loss of soil organic matter ultimately leads to reduced yields and decreased sustainability of the soil resource.

  The soil organic carbon indicator utilizes the Century Model to simulate above- and below-ground production of plant material as a function of soil temperature as well as water and nutrient availability. This indicator is derived from the slope of a ten-year simulation of soil organic carbon. This identifies areas with increasing or decreasing soil organic matter. The share of cropland with stable/increasing soil carbon increased from 25% in 1981 to 72% in 2001, due again to changes in crop management associated with less tillage, reduced summer fallow and increased conversion of marginal cropland to forage.

- **Desertification Indicator**
  The NAHARP program contains a desertification indicator, which is still in development.

  It is challenging to develop a desertification indicator as desertification (land degradation) is not the result of a single process. An indicator must be developed to account for the major causal processes. Otherwise, some form of monitoring productivity as a proxy for landscape health will have to be used. This indicator must depend on the results from the other land quality indicators and requires development of new models. The proposed indicator will be based on: an integrated estimate of erosion that combines wind, water and tillage erosion and accounts for the interactions between them; an assessment of the sensitivity of different landscapes to erosion; and a rainfall efficiency index based on vegetation productivity measured by remote sensing.

  Although each of the erosion methods is currently treated independently in the indicator program, they do not act independently within the landscape. Simply summing the erosion rates for wind, water and tillage will not provide an adequate estimate of erosion risk. Further research is being conducted to develop a model that provides an improved method to estimate erosion rate due to the combined effects of wind, water and tillage.

  Landscapes not only differ in their rates of erosion, but also in the impact that erosion will have on productivity. A model simulating the impact of a range of erosion rates on crop productivity will be used to develop a better understanding of the sensitivity of different parts of the landscape to erosion. From a series of model results, the indicators will determine the sustainable erosion rate for each landscape. A simple comparison with the integrated erosion rates occurring under current management will identify the areas at risk to land degradation due to erosion (i.e., the areas where estimated current erosion rates exceed the sustainable erosion rate).

  Remote sensing can provide estimates of the productivity of vegetation. In dry areas, annual variation in water availability can mask trends in declining soil productivity. In order to develop an assessment of the productivity trend, an index that removes or accounts for the direct influence of precipitation is required. The simplest index, dividing the estimated

production by the rainfall, is currently being verified. This index has been termed ”the rainfall use efficiency,” as it shows the productivity per unit of precipitation. Higher values should occur in healthy landscapes.

When completed, the indicator will compare the identified level of risk of land degradation due to erosion with the remotely sensed productivity index, which monitors the previous 20 years of landscape change.