

MAINSTREAMING CLIMATE CHANGE INTEGRATED LANDSCAPE ASSESSMENT, DECISION-SUPPORT & TOOL KIT

Briefing document | Lessons from Southeastern Ontario

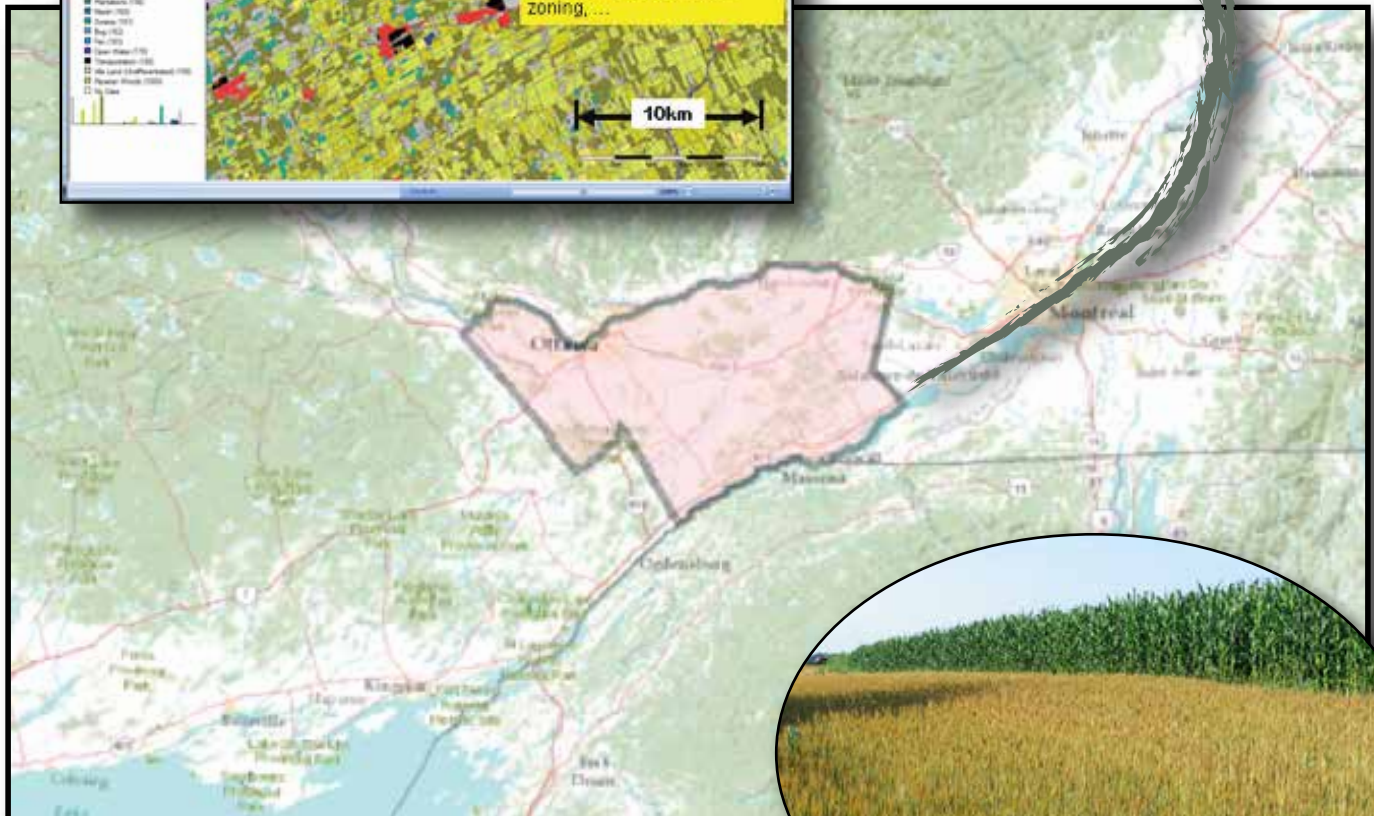
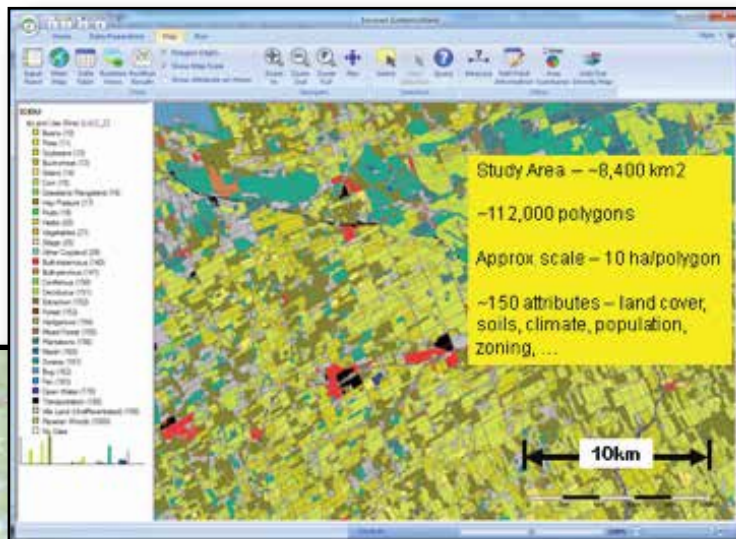


Photo courtesy: Pierre Mineau

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PROJECT TEAM

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INTRODUCTION

This briefing paper provides an overview of the activities and key outcomes of the collaborative project *From Farms to Regions: Development and Testing of an Integrated Landscape Assessment and Decision-Support Process and Tool Kit for Mainstreaming Adaptation into Regional Planning* led by Agriculture and Agri-Food Canada (AAFC) implemented in collaboration with a number of key partners, consultants and local stakeholders.

Addressing climate change at the level of strategic planning, policy design and implementation across sectors and jurisdictions is becoming integral to policy and planning processes. Key to this is adaptation, defined as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, in order to reduce harm or take advantage of opportunities. Some examples include raising river or coastal dikes, promoting more temperature-shock resistant plants to replace sensitive ones, or improving the effectiveness of pest-management practices (Intergovernmental Panel on Climate Change [IPCC], 2007). However, responding to climate change adaptation is not just a stand-alone activity presented by developing specific climate change adaptation strategies and plans. Rather, a crucial part of adaptation planning is making sure that needed adaptation actions and policies are integrated into sectoral and other strategies to ensure their resilience. Building on these insights, the importance of a coordinated adaptation planning process at the regional, sectoral and program/project levels is increasingly being emphasized as crucial for successful integration and implementation of adaptation measures and actions.

In Canada, as elsewhere in the world, agricultural activities differ regionally. This requires that adaptation planning be regionally tailored to consider future growing and economic conditions, including local and international influences. To facilitate such planning, we set out to develop and test an approach to support local and regional adaptation planning using a collaborative framework. In our principle project area—southeastern Ontario (SEO)—the agricultural landscape is a complex mosaic of multisectoral land use, production, and economically diversified communities uniquely defined by various biophysical, social, cultural, and economic conditions. Agriculture, like all sectoral activities, is affected by a range of extrinsic factors, including demographic changes, economic trends, and ecological functions. To understand potential pathways of change at the landscape level, and their implications for water, air, soil, and biodiversity, a participatory process combined both qualitative and quantitative approaches assessment to aid in integration of adaptation needs with sectoral priorities.

Specific aims of the project can be listed as follows:

- **Identify socioeconomic pathways for a region that formally consider the role and future of regional agriculture (including management plans and actions) by 2035; and**
- **Identify and explore regional adaptation and management options, including strategies to mainstream climate change planning into regional decision-making processes**

METHODOLOGICAL APPROACH

The approach applied in this project aimed at identifying and mainstreaming adaptation actions for both policy and practice. This targets developing regional and local capacity and brings together tools that allow the impacts and interactions of policy and management choices on socio-ecological systems to be quantified within agricultural regions (Table 1). The methodological approach was guided by a structure that aimed to:

- Provide a shared framework to allow practitioners and stakeholders representing different interests and governing structures¹ to engage in the collaborative planning processes.
- Enable synergies and identify trade-offs between different sectors and within sectoral activities to increase adaptive capacities.
- Create an iterative process that would allow integration of both qualitative and quantitative data when assessing adaptive capacities and needed adaptations and their mainstreaming when planning for future actions.²

The framework is operationalized through collaborations with two major groups and their interaction within and between a team of analysts and modellers and the various stakeholders and decision-makers. These two groups are engaged in parallel activities: (i) acquiring data and regional models and modelling expertise to develop a dynamic assessment tool and (ii) providing inputs and advice on alternative future scenarios, potential adaptations, their relevance and needed policies. The two tasks, while technically different, require ongoing coordination and alignment. The overall project is orchestrated by a core working group comprising a subgroup with technical expertise in the necessary sciences, including the use of climate change model projections, and geographic systems to populate the dynamic system platform, and a second subgroup of risk and/or policy experts who engage the stakeholders in order to characterize and define the current and future trajectories of change.

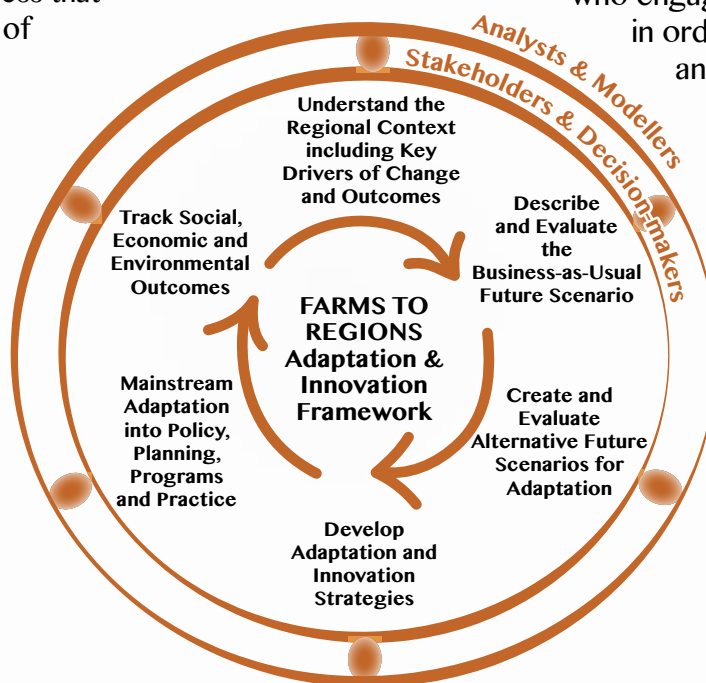


Figure 1. Framework for mainstreaming adaptation to climate change at the landscape level

1. This extended agricultural regional planning beyond just the agricultural sector, to include Conservation Authorities and other sectoral organizations both governmental and non-governmental (including industry).
 2. This also allows the process to be revisited with new information and objectives in the future.

STAKEHOLDERS & DECISION-MAKING

Key for the implementation of the mainstreaming initiative at the landscape level was forming a project team. This team was responsible for ensuring the implementation of the project as well as communicating with stakeholders and planning and implementing workshops. A series of workshops were used to guide the projects at each step and these included:

- Setting context to project and identifying key stakeholders and drivers of change in EO (Workshop 1, November 2011).
- Developing a business-as-usual (or baseline) scenario and reviewing available data sets for the area (Workshop 2, March 2012).
- Developing a series of alternative (future) scenarios (Workshop 3, November 2012).
- Reviewing modelled scenarios and identifying policy recommendations (March, 2014).

Stakeholder mapping

In order to identify regional drivers of change, stakeholder mapping was conducted to identify a diverse group interested in participating in order to represent a wide

range of the aspects of the region in the projects' focus (during Workshop 1; Table 1). The selection was carefully considered and, based on this insight, we would like to suggest the following basic criteria:

- Representativeness (stakeholders with expertise covering important sectors e.g., water, soils, production, municipal planning, forestry, agricultural sector representatives, etc.).
- Influence on policy (stakeholders involve responsible authorities from relevant jurisdictions involved in setting or realizing policy and planning objectives).
- Knowledge of relevant science (subject matter experts in key scientific disciplines, researchers from biology, agriculture, engineering/planning, etc.).
- Availability (experts with available time and interest to engage for the duration of the scenario process and/or some redundancy in expertise is represented in group as a whole).

Table 1. Stakeholders' map for Eastern Ontario developed during Workshop 1

Climate Change Adaptation	Water	Chemicals	Biodiversity	Integrated assessment and planning	Monitoring
Mississippi Valley cc Modelling and studies	EC Water quality	EC Pesticides and chemicals research and management	Biosphere Reserve Biodiversity and community development	OMAFRA Land use	EC Monitoring and reporting
U Ottawa Rural cc impact and adaptation	South nation permitting; flood mgt; water quality	Fisheries	CFS Species at risk	Ont Soil / Crop prod Env farm plans	AAFC Land suitability rating system
AAFC Global/national cc adaptation policies	Mississippi valley Source water protection and cc; IWRM plans	South Nation Fisheries	Ottawa Green space	CFS Ecosystem integrity	AAFC NAHARP Indicators and use in planning
CFS Climate change adaptation: knowledge, tools and guidelines	Air	Energy	EC Habitat; biodiversity conservation	AAFC BMP eval; WEBS	EC Weather forecasting
AAFC Farming systems and flexibility	CFS Carbon mgt	U Ottawa Rural energy	EC Species and wildlife	OMAFRA Knowledge mgt; BMPs	Ottawa Env indicator report card
AAFC Foresight National cc impacts and science/policy	South nation ghg mgt	U Guelph bioenergy	Wellbeing	CFS Cost benefit analysis of land mgt strategies	AAFC Land and soil information and mgt (sic); WEBS
City of Ottawa Resiliency and sustainability plan	Dairy farmers of CDN cc mitigation	Food security	Ottawa Natural heritage	AAFC Integrated water basin modelling	AAFC Earth observation; remote sensing tools
OCCIAR cc science, impacts and adaptation	EC Air Quality	Dairy farmers of CDN Food quality	Ont. Soil / Crop prod Farm livelihoods	Ottawa Growth forecasting and planning	CFS cc adaptation indicators
AAFC Adaptation from place-based perspective	Forests	Policy instruments for ecosystem mgt	OMFRA Socio-economic and env sustainability	Partnerships	
	South Nation Forest management	AAFC Econ. instruments and Growing Forward Plan	Ottawa City planning and urban boundaries	EC partnerships	
	U Ottawa Forest management	Biosphere reserve Conservation trusts	Ottawa Quality of life and env sustainability	Gateway Info sharing	
	CFS Model forests			CFS Cross-pollination of ideas	

REGIONAL CONTEXT, KEY DRIVERS & OUTCOMES

To better understand future challenges and choices that regions must make to address available (and/or future) resource considerations, the major drivers of change must be identified in specific areas. These drivers can be at the local and regional level and include things like available resources and infrastructure, population growth, types of governance systems and global changes in market prices, trade agreements and changes in resource development in other countries.



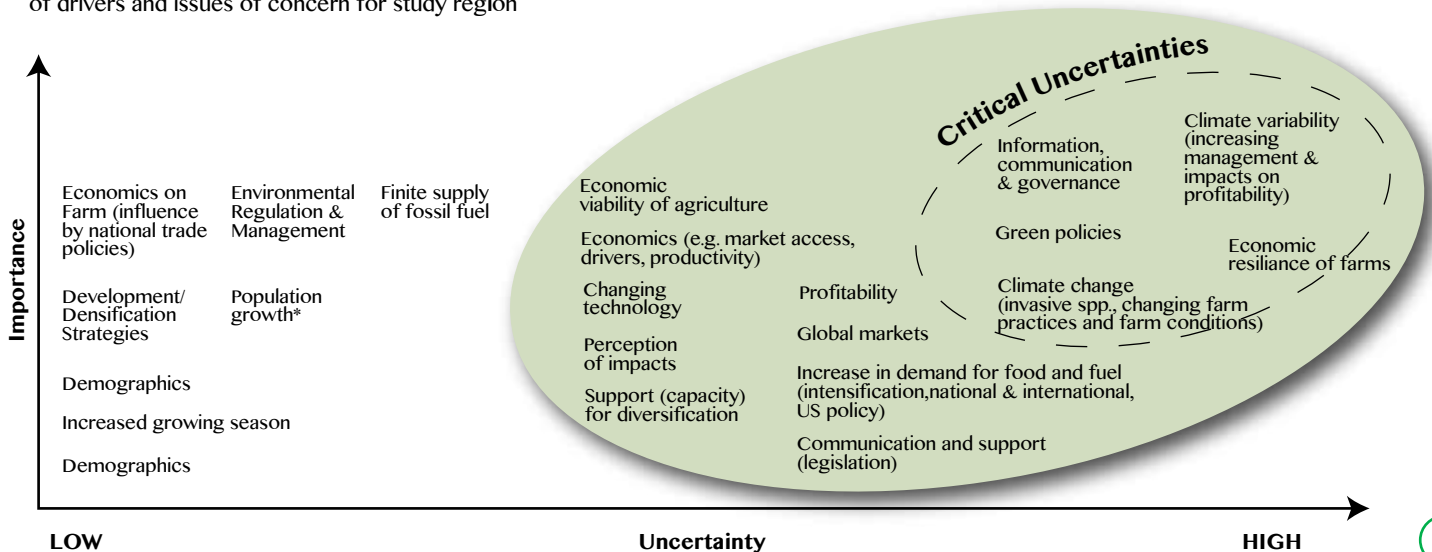
Figure 2. Southeastern Ontario project area (SEO ~ 31,297 km²)

In SEO, the key drivers were identified in Workshop 1 by asking regional stakeholders:

1. What are the key drivers that affect achievement of the regional goals?
2. How important and uncertain are these drivers going forward?

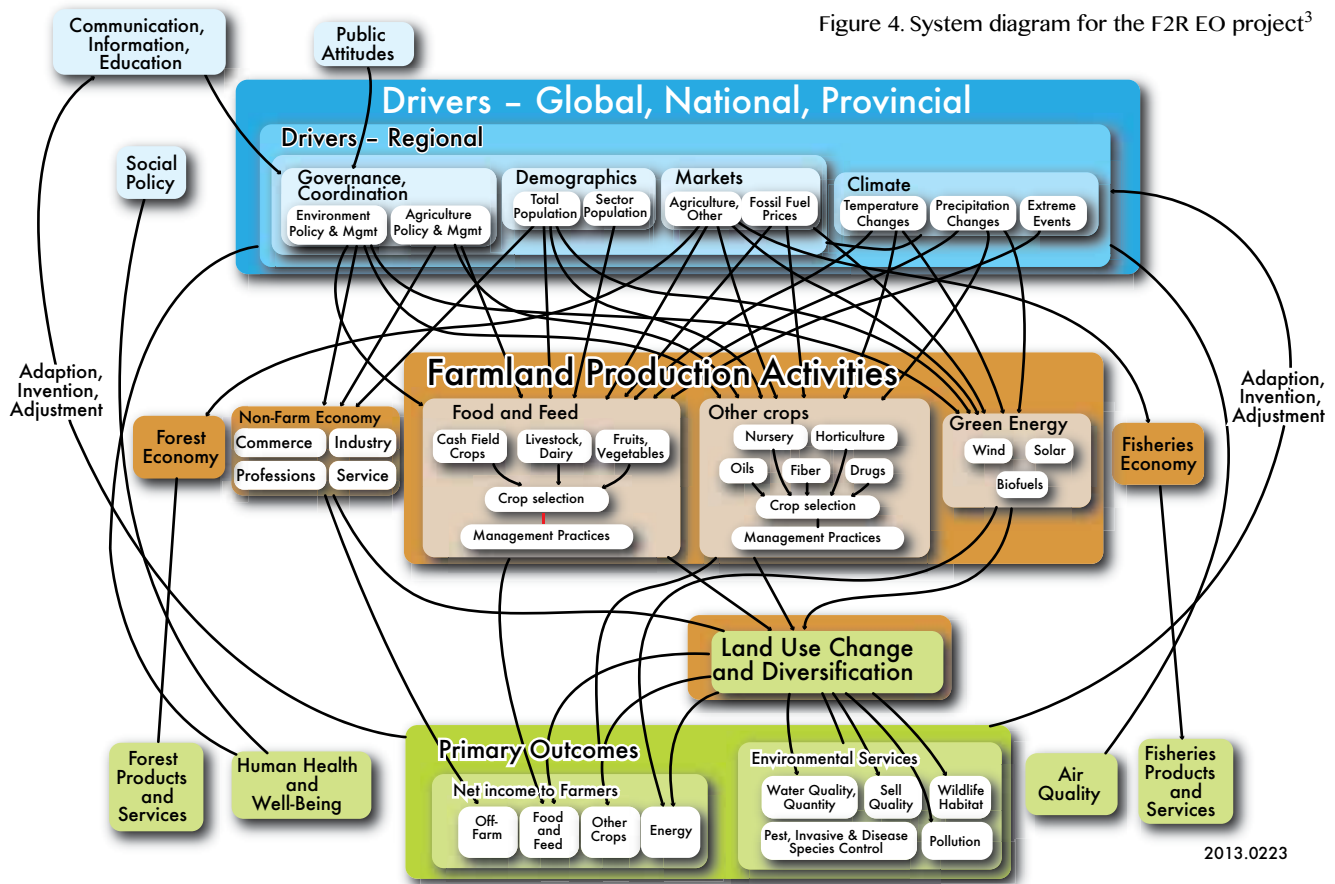
Although many drivers and factors were raised and discussed, those identified by all as being the most important and most uncertain naturally fell together under three headings: climate change, markets and the economy, and governance and policy (Figure 3). Climate change was placed as an overarching driver because it had implications for all the others. From all the identified drivers, “critical uncertainties” have key importance in understanding change, and they are also highly uncertain with respect to the future, and thus provide the framework’s alternative scenarios.

Figure 3. Graph of importance and uncertainty of drivers and issues of concern for study region



SYSTEM DIAGRAM & ALTERNATIVE FUTURES

Building on stakeholder feedback about the drivers, a system diagram was prepared to provide a visual representation of how drivers interact and their impacts within a region. It shows three main levels—from global to provincial, on the farmland production and on primary outcomes impacting farm economics and environmental services (Figure 4).



The project team expanded each aspect of (and interaction within) the system diagram, and identified responsive indicators to monitor the outcomes of the potential future changes in the system. To allow regional changes to be examined in light of different policy and management options (adaptations), a dynamic geospatial platform was used to link scenarios, participation and integrated modelling (Envision⁴). Envision is a “framework for constructing alternative future scenario applications” and consists of a dynamic GIS-based spatial engine for representing landscape characteristics that allows the system to operate evaluative and process models, visual analysis modules used for data processing and model generation. Since Envision has been applied in a wide range of land-use planning processes and geographic areas to address a variety of policy and planning needs, we needed to adapt it for the Canadian landscape. This project also represents its first expansion to factor in climate change.

3. The system diagram were prepared using the open source concept mapping software VUE available from Tufts University (vue.tufts.edu).

4. The Envision modelling framework, developed by Dr. John Bolte of Oregon State University (OSU), was selected as a candidate system for this project—see <http://envision.bioe.orst.edu>.



To put together the data, available datasets were collected and catalogued. Sources of data ranged from local municipalities to conservation authorities to provincial and federal departments to national databases, including those available to the general public and the ones whose use is restricted to Agriculture and Agri-Food Canada employees (e.g., NGIS). Data from the general census and the Census of Agriculture⁵ were also integrated in a geodatabase.

Table 2. SEO: Geodatabase feature classes and key datasets

	Data integrated into Envision
Land cover / Land use	Southern Ontario Land Resource Information System (SOLRIS); Agri-Environment Services Branch (AESB) 2011; Cadastral Zoning
Soil / terrain	Soil Landscapes of Canada (SLC); Detailed Soil Survey (DSS)
Census	Population counts by Dissemination Block; Ag Census variables by Census Consolidated Subdivision; National Agricultural Profiling Project (NAPP) variables by Dissemination Area
NAHARP	Indicator of Risk of Water Contamination by Phosphorus (IROWC-P); Indicator of the Risk of Water Contamination by Nitrogen (IROWC-N)
Climate	Projected daily data, baseline daily data and 2011 daily data on minimum and maximum temperature and precipitation; the model considers climate impacts as weather trends (averages) ⁶

Envision works as a platform that integrates diverse sectoral models to allow cross-sectoral assessment of landscape changes. The models prepared for the Envision SEO include three adapted models developed by the Government of Canada within the National Agri-Environmental Health Analysis and Reporting Program (NAHARP)⁷, and The National Agri-Environmental Standards Initiative (NAESI)⁸ for biodiversity standards models, in addition to models developed by academic and U.S. government.

In Envision, decisions are made at the level of an integrated decision-making unit (IDU). The criteria for the size and boundaries of IDU consisted of balancing the size as well various geographical aspects of the output indicators of the project. It is important to have small enough spatial units to resolve features of interest, but also to have large enough units that the total number of units would allow a reasonable response time when conducting real-time modelling.

Box 1 | Defining the integrated decision-making unit (IDU)

The data that were chosen to be combined for IDU data composition included: for crops, the AAFC AESB crop and vegetation (Land Cover) dataset representing crop conditions as of 2011 in 78,306 polygons in the study area; for soils, the Detail Soil Survey dataset representing soils conditions as of 2009 in 9,021 polygons; for land use and land cover, the SOLRIS dataset representing the landscape as of 2006 in 111,566 polygons; and for land parcels, the Ontario cadastral representing ownership as of 2007 in 10,328 polygons. To develop the IDU geometry, three input datasets included the 2007 AAFC Cadastral Data, 2011 AAFC-AESB Land Cover (2011) and the 2009 Detailed Soil Survey dataset.

5. www.statcan.gc.ca/ca-ra2011/index-eng.htm?fpv=920

6. Our next phase of work will integrate the extreme events into the model, so we can run a sensitivity analysis of how production, environmental and economic measures respond to particular extreme weather events.

7. www.agr.gc.ca/NAHARP

8. Neave, E., D. Baldwin, and C. Nielsen. 2009. Tier 2 and 3 Standards – Developing Landscape-specific, Habitat-based Standards Using Multiple Lines of Evidence. National Agri-Environmental Standards Initiative Synthesis Report No. 4. Environment Canada. Gatineau, Quebec. 138 p.

BAU & FUTURE SCENARIOS AT LANDSCAPE LEVEL

The scenario development was done in two steps: first the stakeholders focused on developing a business-as-usual scenario and then a series of alternative scenarios till 2035.

Within the BAU scenario, stakeholders identify the key directions of drivers, especially for environmental and agricultural policies and then extrapolate their impacts on agricultural production, types of farming systems and non-farm activities following the categories of the system diagram. The specific purpose of the alternative scenarios in this project is to make assumptions about the critical uncertainties facing the region to allow regional planners to identify the scope of adaptation that may be necessary.

We focused on drafting a set of scenarios based on the key drivers identified in the first workshop and then using the following steps:

- Linking global scenarios with regional decision making by looking at projected changes in global population, fuel prices, trends in economic growth and food prices.
- Identifying the implications of scenarios and foresight products developed in Canada to single out priorities that will likely shape the future of the Eastern Ontario region.
- Consulting with key experts and the broader stakeholders group of potential future trends relevant for the region and creating a set of scenario narratives.

Box 2 | BAU and the alternative scenario narratives

- **BAU:** Builds around the importance of increasing demand for high-end products and increasing competition for cheaper products which will require balancing growing concerns about food and water insecurity. It is expected that inputs costs will increase (e.g., costs of fertilizers, energy) due to environmental regulation but also due to limited resources and higher demand. Agricultural policy will also focus on greening the food supply and using certification programs for products currently driven by industry response to consumer demand. Environmental policy will focus on balancing economics with environmental protection which will differ by sub-sectors/regions.
- **Targeting foreign markets:** Agricultural producers are interested in targeting growing global market opportunities. Large and specialized farms dominate the production of goods, especially for foreign markets. Federal and provincial governments cooperate with industry in setting market-based incentives to enable meeting market needs both domestically and internationally.
- **Promoting the bioeconomy:** The region will aim to explore opportunities from the bioeconomy including those found in energy production, pharmaceuticals, fabrics, cosmetics, and plastics. The region aims to become a leader in the bioeconomy, building on the opportunities in the area and exploring leadership development with local and provincial governments.
- **Moving towards greener agriculture:** Because of increasing pressures on natural resources, the impact of severe weather events (and combined with increasing interest in promoting food security regionally, nationally and globally) there will be a stronger focus on improving the environmental performance of agricultural production by different levels of governments. For agriculture, this will mean balancing efficiency and environmental impacts. Agricultural outputs will be targeted mostly to local and North American markets.
- **Living locally:** Smaller farms and farm partnerships dominate the producers' group and create a diversified "agri-landscape." They successfully explore niche markets (mostly regionally) and they cooperate with local governments (municipal and watershed) on market incentives and rules and regulation. Some large farms remain, though on a relatively small proportion of the landscape.

ALTERNATIVE FUTURE SCENARIOS FOR ADAPTATION

In the SEO application, we used a three-step approach to translate qualitative scenarios into quantitative measures and indices values:

- In the first step, we worked with stakeholders to describe the scenarios in detail, using broad categories based on the key drivers of the system diagram—such as trends in markets and different sectoral policies. The categories included: types of climate impacts relevant for the scenario; environmental stewardship (environmental policy, landscape character, agricultural policy, types of agriculture markets and character of the leading enterprise, technology, ecosystem services); and industry (energy, other industry).
- The second step was specifying those categories that could directly inform modelling, often described as changes compared to current trends. Crop production [crop mix (annual and perennial, including new crops);

crop rotation (two major types of rotation); livestock feed supply], livestock production (types of livestock, intensive/extensive livestock operation); field management (irrigation, tillage; existing and tile drainage; surface-water management); agriculture inputs [chemical, (green/livestock) manure; pest and disease management]; energy farms (size and planted crops); environmental stewardship (riparian/wetland buffers, freshwater quality and groundwater protection; wildlife habitat and air quality and GHGs).

- The third step was led by the project team that took and further quantified this information using the same categories as was provided to the stakeholders and integrated it into the Envision model.

After iterating among outcomes, models, and data, the structure of Envision modelling can be illustrated in a process diagram.

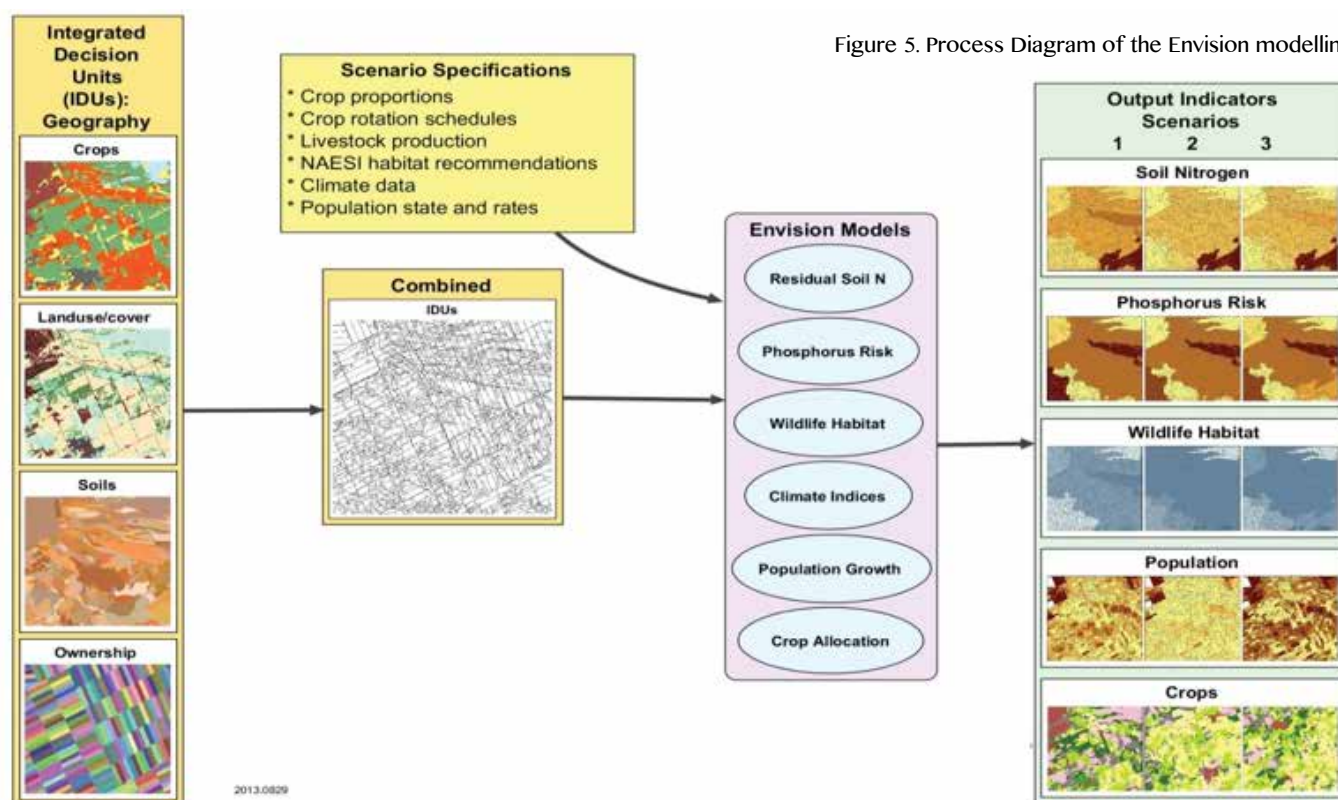


Figure 5. Process Diagram of the Envision modelling



We used the model outcomes to evaluate the scenarios by identifying outcomes and consequences that are relevant and desired for the future landscape at SEO, including the impacts on key indicators such as level of phosphorous and nitrogen, habitat and biodiversity (Figure 6; Table 3). Future climate change was considered independently and as an interactive factor on crop yield, using regionally relevant climate model projections to represent variance.

Figure 6. Examples of visual outputs for key scenario features

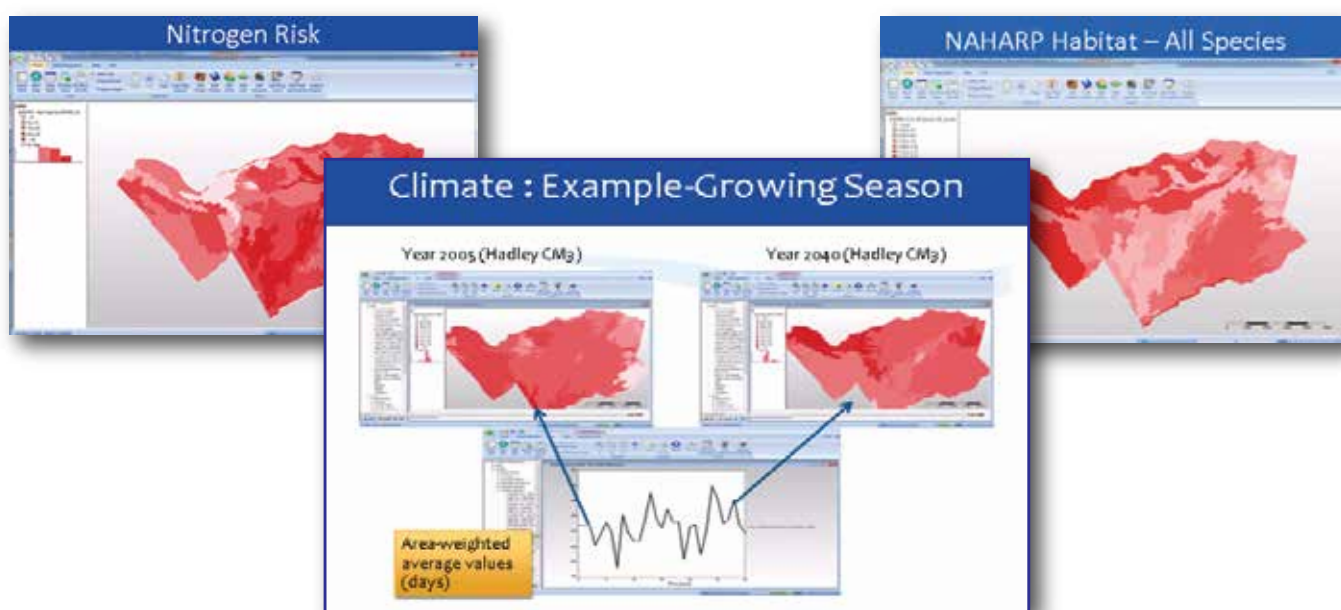
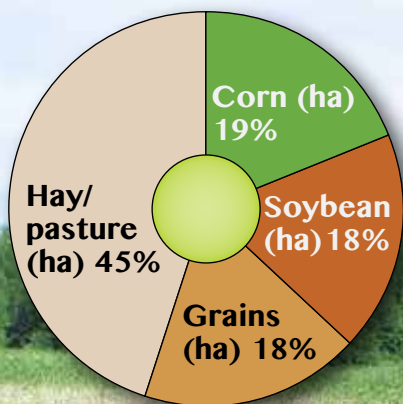
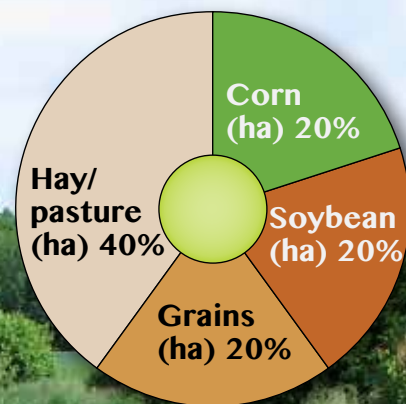


Table 3. Overview of the impacts of the scenarios on primary outcomes indicators

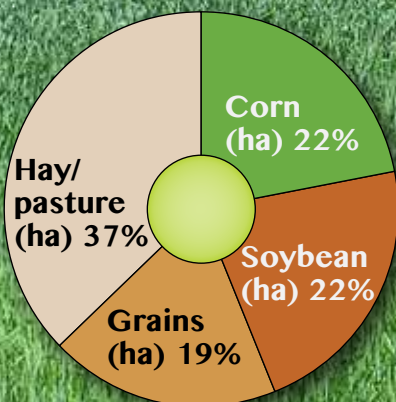
	Targeting global markets	Promoting bioeconomy	Greening agriculture	Living locally
Land use	Less forested area	Less hay and pasture	Less hay and pasture	Smaller farms close to urban markets
N	Overall increase on the landscape	Drop in N at landscape level	Moderate reduction of N loadings	Greatest drop in N loadings
P	Highest risks loads across the scenarios	Medium levels	Low risks to P loads	Lowest risks to P loads across the scenarios
Wildlife	Negative impacts on habitat and thus provides low support for species	Less intensive production (perennials) with positive impact on habitat; medium support for wide range of species	Landscape restoration esp. to wetlands medium support for wide range of species	High support for wide variety of species



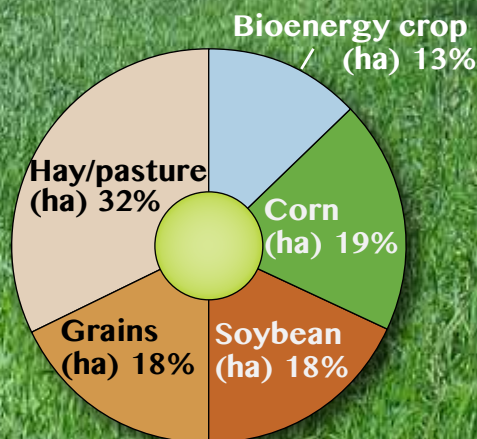
Crop Allocation in 2010



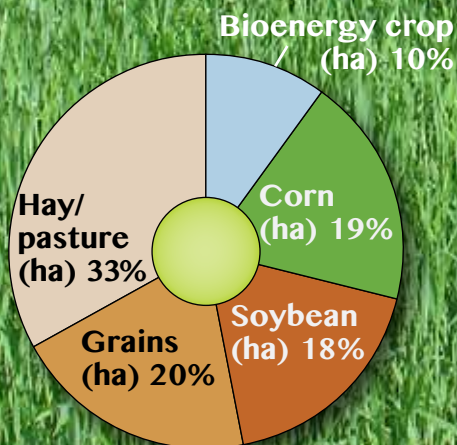
Business as Usual 2040



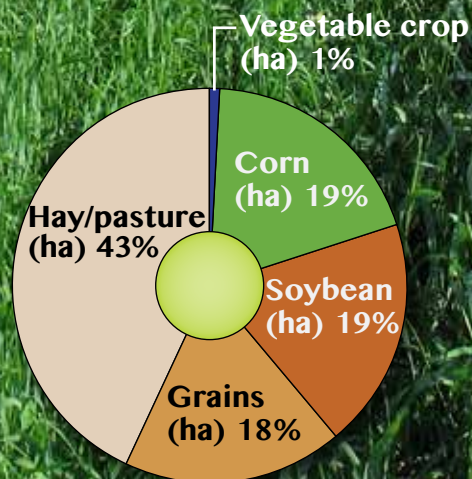
Global Markets 2040



Bioeconomy 2040



Greening Agriculture 2040



Living Locally 2040

Photo courtesy: Pierre Mineau

ADAPTATION & INNOVATION STRATEGIES

The developed scenarios served as a basis to identify specific adaptation options as well as discuss the changes in strategic development of the region in general (and agricultural practice in particular). In terms of agricultural change, key trends on the adaptation needs and strengths were identified (Table 4). The specific adaptation needs and actions of more than 50 types of adaptation actions were identified and grouped into five clusters.

Table 4. Overview of potential innovations and policy changes on agriculture and adaptations.

Targeting global markets	Promoting bioeconomy	Greening agriculture	Living locally
Large farms have higher adaptive capacity (e.g., access to insurance). It would require strong financial instrument coordination with policy to prioritize other types of measures (public infrastructure, data, natural resource management).	Highly resilient scenarios, but it includes also high level of public and private investments, which needs to be structured in a way that promotes adaptive capacity, environmental protection and business development.	This scenario indicated that significant changes (both at the level of practices and policy) are required to make the agriculture system resilient.	At the small scale, the scenario provides benefits for communities, natural environment and adaptation. It requires a maintained continuous policy support to sustain small-scale production, at least close to urban areas.

Overview of the clusters of adaptation actions identified by stakeholders:

- **Farm-level** action in response to identified vulnerabilities in their production and location is the responsibility of the farmers and producers. They may, for example, choose to adjust livestock herd size or composition and/or acreage dedicated to livestock, change crop type or rotation (no new equipment necessary or minor alterations), or shift to different varieties, and modify pest-management practices. Ultimately, the actions taken by producers will build on the research, development and transfer work by industry and government researchers to identify shifts or adjustments in management practices (e.g., tillage, pest control, irrigation).
- **New actions**, such as new forms of crop insurance to allow farmers to manage risks presented by climate change. Given the high uncertainty, these would serve as a cushion to bridge gaps and mitigate surprises, especially those related to extreme climate change, such as changes in insurance premiums to consider vulnerability of flood risk zones, or even farm size and crop diversity.
- Support for maintaining **ecosystem goods & services** to reduce vulnerability at the farm and regional levels to ensure that natural systems act as buffers to reduce the vulnerability of the agricultural and human systems; this includes policy support and incentives to encourage actions such as changing river set-back areas and stronger regulation on riverbank protection, changes in land use that increase run-off.
- **Providing tools and information** to farmers, farmers' groups and regional and local policy-makers to help them understand vulnerability, identify risks and plan for adaptation by using GIS data and tools, and access relevant weather prediction and seasonal forecasting tools. This will require improving data availability (and timeliness) and sharing between the communities and local policy-makers
- **Awareness raising and education** for the public and key stakeholders to create support for acceptance adaptation measures in agriculture, encouraging cultural shifts both in the farming community and between policy-makers, including emphasizing the importance of mainstreaming adaptation into sectoral policy-making.

MAINSTREAMING ADAPTATION INTO POLICY & TRACKING OUTCOMES

The scenarios and the identified adaptation needs indicated that adapting to climate change is a multi-scale and multisectoral challenge that requires coordination between agricultural policy and other sectoral approaches. These sectors include municipal, provincial and federal agencies which should be considering measures ranging from support to ecological goods and services, different types of insurance mechanisms, addressing infrastructure challenges and ensuring that agriculture also provides societal and natural benefits. This approach has implications for monitoring to ensure that mainstreaming efforts (as well as the actual change in agriculture at the landscape level) are tracked and recorded.

Indicators and performance measures

- At the strategic planning level, agriculture would need to be considered for its role in shaping rural landscapes, maintaining environmental quality, and supporting economic viability and communities in the region, thus contributing to adaptive capacity.
- Performance measures/indicators focusing on the agricultural sector specifically need to be placed into the context of wider economic and social issues.
- Monitoring of mainstreaming efforts to make sure that adaptation planning and implementation of adaptation actions is occurring across sectors as part of their day-to-day planning and implementation efforts. Monitoring should also serve to document related cross sectoral co-benefits of individual and strategic level adaptation actions.

Table 5. Example of indicators to monitor mainstreaming and performance

Strategic planning
<ul style="list-style-type: none"> • Extent of cross-sectoral and cross-jurisdictional participation in strategic planning • Assessment of trade-offs and synergies between sectoral priorities • Types and frequency of cross-sectoral committee meetings • Types and sources of data accessed for analytical planning or assessment (e.g., risk assessment, cumulative effects) • Number of generations considered into future during strategic planning • Consideration of uncertainty in analysis (e.g., climate change, economic market shifts)
Agricultural sectors
<ul style="list-style-type: none"> • Development and adoption frequency of beneficial management actions (adaptation) • Requests for/use of climate projection data maps and information products by planners • Shift in crop varieties and/or rotations • Financial resources needed/increase in resources needed to implement adaptations • IPM and pest management, chemical application management changes (type and nature)
Mainstreaming
<ul style="list-style-type: none"> • Number of municipal plans with adaptation actions included • Number and frequency of cross-sectoral consultations between different agencies and departments to identify best ways of integration • Amount of resources (human, financial etc.) allocated to adaptation projects • Number and types of expenditures and activities that use climate change data in their planning • Types of monitoring schemes that include climate vulnerabilities, impacts and adaptation efforts



NEXT STEPS

- Our next phase of work under the Climate Change Crop Sensitivity Project will integrate extreme events into the model, so we can run a sensitivity analysis of how production, environmental and economic measures respond to particular extreme weather events.
- Analysis of trajectories of risk and productions will be published and released for eastern Ontario.
- Test secondary application of scenario modelling platform—Prince Edward Island—with a focus on potatoes and water (collaboration with Fisheries and Oceans, Atlantic).
- Expanded evaluation of the use of downscaled climate data, and its limitations.
- Continued analysis and characterization of climate model projections of extremes (by crop and risk factor).
- Defining of risk indices for communities (e.g., water, human health, pests and disease).
- Graduate student support (two MSc, one PhD) for continued climate extreme modelling (Dalhousie, Carleton, Toronto).
- Three year OMAF funding (2014-2017) will expand water modelling of risk—eastern Ontario project and expansion into Greater Toronto area (Peel region).
- Joint DFO and DC discussion on development of PEI risk-modelling project.
- Preparation of collaborative submission to Call for Proposals: Quebec–Ontario Cooperation for Agri-Food Research Competition.

REFERENCE

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