# Table of Contents

1: PURPOSE OF THIS DOCUMENT .................................................................................. 3

2: AGRICULTURAL AND RURAL POLICY ..................................................................... 3
   2.1 DEFINITION AND SCOPE OF THE THEME ......................................................... 3
   2.3 AGRICULTURAL POLICY RESEARCH PRIORITIES ........................................... 4
   2.4 RURAL POLICY RESEARCH PRIORITIES ....................................................... 9

3: BIOECONOMY - INDUSTRIAL USES ........................................................................ 13
   3.1 DEFINITION AND SCOPE OF THE THEME ..................................................... 13
   3.2 BIOECONOMY – INDUSTRIAL USES RESEARCH PRIORITIES ....................... 13

4: EMERGENCY MANAGEMENT .................................................................................... 18
   4.1 DEFINITION AND SCOPE OF THE THEME ..................................................... 18
   4.2 EMERGENCY MANAGEMENT RESEARCH PRIORITIES ................................. 19

5: ENVIRONMENTAL SUSTAINABILITY ..................................................................... 24
   5.1 DEFINITION AND SCOPE OF THE THEME ..................................................... 24
   5.2 ENVIRONMENTAL SUSTAINABILITY RESEARCH PRIORITIES ...................... 24

6: FOOD FOR HEALTH .................................................................................................. 28
   6.1 DEFINITION AND SCOPE OF THE THEME ..................................................... 28
   6.2 FOOD FOR HEALTH RESEARCH PRIORITIES ............................................... 28

7: PRODUCTS AND VALUE CHAINS .......................................................................... 30
   7.1 DEFINITION AND SCOPE OF THE THEME ..................................................... 30
   7.2 PRODUCTS AND VALUE CHAINS RESEARCH PRIORITIES ............................ 31

8: PRODUCTION SYSTEMS ............................................................................................ 33
   8.1 DEFINITION AND SCOPE OF THE THEME ..................................................... 33
   8.2 PLANT PRODUCTION SYSTEMS RESEARCH PRIORITIES ............................. 34
   8.3 ANIMAL PRODUCTION SYSTEMS RESEARCH PRIORITIES ........................... 38
1: Purpose of this Document

The 2015 Research Priorities document is the consolidated outcome of the Theme Advisory Groups (TAGs) under the OMAFRA Research Advisory Network (ORAN) for each of OMAFRA’s seven research theme areas. The main objective of this document is to communicate annual updated research priorities in order to inform calls for proposals.

2: Agricultural and Rural Policy

2.1 Definition and Scope of the Theme

Ontario’s agri-food sector is a significant contributor to regional economies and to the province. A key policy concern for OMAFRA is how to facilitate the sustainable development and long-term success of this sector while ensuring that the public interest is served. Similarly, understanding the growth and sustainability of regional and rural economies, including being able to measure their performance, is important to achieving the ministry’s rural mandate.

The strongest proposals will be collaborative, drawing on the combined strengths of more than one researcher at the University of Guelph in order to respond to the relevant policy questions. By extension, the ministry is also interested in proposals that link with relevant research capacity and expertise with other universities and research institutions. In such cases, successful proposals may feature cross-institutional collaborations in which the primary investigator is at the University of Guelph but related research activities in other institutions are funded under the same proposal.

In addition, under the Agricultural and Rural Policy research theme, there is an interest in fostering a stronger linkage between the Policy Division at OMAFRA and the economic analysis capacity at the University of Guelph. In order to address many policy questions, a better suite of data, analytical tools and resources will be needed than is currently available.

Through its priorities under this theme, the ministry is identifying some core research activities focused on enhancing the economic analytical tools, resources and expertise for its internal use. In some cases work to provide analytical tools that can become building blocks to a more comprehensive suite has already progressed. In others, new research and development will be required. Research to develop a full suite of analytical tools and resources is expected to be phased over a number of research calls. Maintenance of the data, tools and resources are also expected to be incorporated into future research priorities.

As the ministry continues to support the agri-food industry to deliver on the Premier’s Growth Challenge to double its annual growth rate and create 120,000 jobs by 2020, efforts are also in motion to develop a robust performance measurement system for the agri-food sector, which will also help inform the ministry’s policy and program development in the future. OMAFRA, therefore, is interested in the development of performance measures that are related to the core areas below to contribute to the Agri-Food Growth Challenge performance measurement system. This desire is reflected in the outcomes of each policy research question.
Similarly, for rural Ontario, OMAFRA is seeking economic tools to effectively assist in assessing and monitoring the health of rural communities and economies. This effort will contribute to ensuring that rural Ontario communities and economies are sustainable.

In the longer-term there are three core areas of effort are needed to help build capacity and support future policy work, to support the sustainable development of the sector. They are outlined below:

1. **ECONOMIC GROWTH**
   This theme will examine what are the economic development opportunities for the agriculture and agri-food sectors, as well as rural communities. Specific areas of focus are:
   - Sustainable Rural Communities
   - Agri-Food Growth Measurement and Sector Development
   - Trade
   - Regulated Markets
   - Business Risk Management

2. **STEWARDSHIP**
   For this theme, research will explore what data, tools and analysis are required:
   - To inform the development of policies to better manage and conserve resources and address climate change
   - To ensure agri-business sustainability
   Issues for research in this core theme also include farmland protection, resource and energy conservation, soil health, and water management.

3. **PROTECTION/ASSURANCE**
   Under this theme, the research is expected to provide an understanding of what is the role of industry, the government and others in enhancing public trust in all aspects of production practices in Ontario’s agri-food sector. There are no specific questions associated with this theme for the 2015-16 call.

### 2.2 Agricultural Policy Research Priorities

For each of the Agricultural Policy research priorities below, policy issue statements and questions are provided. These questions are intended to provide context and guide researchers in the development of appropriate approaches to achieve the expected outcomes to support the overarching policy objective.
**ECONOMIC GROWTH**

1. **Business Risk Management (BRM) Payments and Producer Investments**

   **Policy Objective:** Ontario’s suite of BRM programs effectively and efficiently contribute to the long-run sustainability of the agri-food system.

   **Policy Issue Statement and Questions:**

   In order to ensure that BRM programs are achieving multiple desired outcomes, these outcomes need to be better defined and more relevant performance indicators determined and developed for the specific outcomes.

   How do government Business Risk Management (BRM) programs affect producers’ behaviour? (E.g. investments for economic growth, environmental stewardship, involvement/enrolment in private or public risk management strategies)

   **Expected Outcome:**

   - Determine performance indicators for the impacts of BRM programs.
   - Develop a performance measurement system to assess BRM programs as a government investment.
   - Identify the most efficient and effective BRM tools/ways for supporting farmers in order to achieve policy objectives.

2. **Local Food**

   **Policy Objective:** Increase the use of local food within the food system of Ontario. The focus should be on food produced in Ontario from Ontario ingredients but could also include sub-regional definitions such as food produced within a county or 100 kilometres as there is a lack of consensus on the definition of local food by Ontario consumers.

   **Policy Issue Statement and Questions:**

   The Ontario government has long been a champion of local food investing in:

   - Consumer marketing and promotion initiatives (e.g. Foodland Ontario),
   - Grant programs (e.g. Ontario Market Investment Fund, Local Food Fund, & Greenbelt Fund),
   - Legislation (i.e. Local Food Act, 2013),
   - Research (e.g. under the University of Guelph partnership) along with other initiatives.

   Currently the government does not have the necessary data sources to determine the impact of their initiatives on the local food sector or the level of consumption of local food within Ontario. There are challenges in acquiring even some of the baseline data such as:

   - How much of Ontario food consumption is being met by local food?
   - Is the sale of local food growing in Ontario? In what markets are local food sales increasing in Ontario?
   - Are consumers willing to pay a premium for local food? (i.e. food produced in Ontario...
from Ontario ingredients)? What factors influence consumers’ food choices with respect to purchases of local food?

- What are the appropriate indicators/measures to monitor the use and consumption of local food within Ontario?
- What are the appropriate models to determine the actual or forecasted impact of government policies on local food consumption within Ontario?

**Expected Outcome:**

- The research will provide indicators to measure and monitor progress in local food consumption within Ontario.
- Develop policy intervention models to show the effect of specific government local food policies (implemented or considered) on the increase in local food use and consumption.

3. **Regulated Marketing**

   a) **Competitiveness in the Dairy Sector**

   **Policy Objective:** Ensure that the Ontario regulated marketing sector continue to adjust to emerging market trends for long-term competitiveness.

   **Policy Issue Statement and Questions:**

   Ontario supports supply management. Supply management has helped enhance returns to dairy and poultry farmers and stabilized these sectors. There is a need to look to the future and the long-term sustainability of these sectors.

   For example, in the dairy market, there is a shrinking demand for local products for various reasons such as decreased per capita consumption of fluid milk due to demographic changes and increased/anticipated increased imports for milk components or dairy products imports due to trade agreements and technological advances. These trends directly impact two important pillars of supply management: supply and import controls.

   OMAFRA is interested in identifying mechanisms within the current system (e.g. optimal pricing mechanism) to encourage / improve competitiveness within the supply management system for long-term sustainability for the dairy sector.

   **Expected Outcome:**

   The research will provide advice on the mechanisms as well as performance indicators for long-term competitiveness and sustainability.

   b) **Responsiveness of supply-managed commodities to consumer tastes and preferences.**

   **Policy Objective:** Optimize the responsiveness of supply-managed commodities to adapt to changing consumer tastes and preferences for long-term competitiveness.

   **Policy Issue Statement and Questions:**

   Critics of supply management contend that processors and retailers are unable to meet specialty markets demand as often times they are not economically viable
markets. OMAFRA is interested in understanding the factors affecting the decisions to cater for specific markets in the supply-managed industries as well as options for increasing the responsiveness of the market to specialized demands.

**Expected Outcome:**

The research will provide an analysis of the determinants of entry into specialized market as well as indicators to measure the responsiveness of the supply-managed system to specialized market demand.

---

**STEWARDSHIP**

1. **Sustainable Agriculture and Food System**

   **Policy Objective:** Optimize the sustainability of our agriculture and food system to preserve and enhance Ontario’s capacity to produce food, and to ensure access to healthy, affordable food for present and future generations.

   **Policy Issue Statement and Questions:**

   Optimizing the sustainability of Ontario’s agriculture and food system is essential to maintaining the province’s long-term capacity to produce food, and ensuring that access to healthy food is convenient and affordable for current and future generations of Ontarians. Sustainability is a challenging issue because it involves complex economic, environmental and social inter-relationships. Further, there is no common understanding between government and stakeholders about how to define or achieve sustainability. Recognizing that development of a clear definition of sustainability may not be feasible, and that sustainability is an evolution rather than a goal, there is a need to better understand:

   - The characteristics of a sustainable agriculture and food system for Ontario,
   - How our policies, programs and practices are positioned in that context, and
   - Where gaps exist, how best to implement improvements.

   What are the characteristics of a sustainable agriculture and food system in Ontario? How (economically, environmentally and socially) sustainable is Ontario’s agriculture and food system, in consideration of those characteristics? What are the factors affecting the rate of adoption of more sustainable practices in the agriculture and food production system? What are the barriers to the adoption of more sustainable practices? How can the government facilitate sustainable agriculture and food production systems in the context of global business and consumer trends / demands? What policies would be most effective and efficient in supporting a shift to a more sustainable food production system?

   What policy changes are needed to support the long-term sustainability and productive capacity of Ontario’s farmland (e.g. soil health, water availability, climate change impacts, etc.)? How economically, environmentally and socially sustainable are Ontario’s farm practices? Are these practices increasing or decreasing in prevalence in Ontario? How can they be optimized? What policy instruments could be applied to achieve the greatest impact (highest number of farmers implementing best management practices)?
What performance measurement framework should be established to measure the effectiveness of policies and programs in supporting sustainability objectives in Ontario’s agriculture and food system?

**Expected Outcome:**

- An assessment of the sustainability of Ontario’s agriculture and food system, including identification of risks, gaps and opportunities.

- An assessment of how Ontario’s current government policies and programs may be influencing the adoption of more sustainable practices in Ontario’s agriculture and food system, and the greatest opportunities for improvement.

- Establishment of a performance measurement framework to measure progress on the adaptation of sustainable practices in Ontario’s agriculture and food system.

2. **Climate Change Mitigation and Adaptation**

   a) **Climate Change Mitigation**

   **Policy Objective:** Minimize agriculture and food’s contribution to climate change.

   **Policy Issue Statement and Questions:**

   Ontario has committed to reduce greenhouse gas emissions by 37% below 1990 levels by 2030, and by 80% by 2050. To achieve these targets, the government (led by MOECC) is developing an ambitious climate change strategy and action plan, taking a sector-by-sector approach to analyzing opportunities. Meanwhile, the market is pressuring all businesses to reduce their environmental footprint. All ministries and sectors are expected to contribute to the solutions. There is limited data regarding Ontario’s agriculture and food sector emission sources and sinks, and therefore a need to gather this data to identify the areas of greatest opportunity for greenhouse gas reduction.

   What is the most cost-effective way to achieve carbon neutrality in the agricultural sector?

   What is the most cost-effective way to maximize emission reductions in each phase of Ontario’s food system value chain?

   **Expected Outcome:**

   An assessment of greenhouse gas emission sources and sinks in Ontario’s food production system (beyond the National Inventory Report categories of agricultural soils, manure management and enteric fermentation). This assessment will support benchmarking and determine which areas have the greatest emission reduction/carbon sequestration potential.

   - Evidence to support re-orienting ministry policies and programs toward the advancement of climate smart agriculture and food i.e.:
     
     - Reduce our sectors’ contribution to climate change,
     
     - Strengthen their resilience to climate change, and
     
     - Sustainably increase productivity and income.
• Support for agriculture and agri-food businesses to respond to market demands and opportunities (e.g. by supporting participation in assurance and certification programs and future carbon offset programs).

• Establishment of a performance measurement framework to measure progress.

b) Climate Change Adaptation

Policy Objective: Ensure that Ontario’s agriculture and food sectors as well as rural communities are resilient to climate change for long-term sustainability.

Policy Issue Statement and Questions:

Agricultural productivity is particularly sensitive to the effects of climate change. The latest Intergovernmental Panel on Climate Change report concludes that dramatic global environmental changes are already affecting food production, health and ecosystems, and that the world is ill-prepared for future risks. There is a need to assess the broad economic risks and opportunities for Ontario’s agriculture and food processing sectors, including the impacts on competing jurisdictions.

What are the key economic risks and opportunities for Ontario’s food production system over the next 20 years, resulting from the predicted impacts of climate change in Ontario and on the global food system? What methodology should be used to update this analysis over time, as new information becomes available?

Expected Outcome:

• Information to help identify opportunities for improvements to ministry policies and programs to minimize risk and maximize opportunities in our sectors in a changing climate.

• Identification of options to support agriculture and food businesses in responding to emerging and future market risks and opportunities – domestic and beyond.

• Establishment of a performance measurement framework to measure progress.

2.3 Rural Policy Research Priorities

For each of the Rural Policy research priorities below, policy issue statements and questions are provided. These questions are intended to provide context and guide researchers in the development of appropriate approaches to achieve the expected outcomes to reach the overarching policy objective.

1. Sustainable Rural Communities and Economies

Policy Objective: Develop a clear understanding of the nature of rural community and economic sustainability and how to apply and measure the key factors that make a rural community or regional economies sustainable.
Policy Issue / Problem Statement:

Rural community and economic sustainability is a broad concept. It essentially refers to the ability of a community to meet the needs of its people, the economy, and the environment in the present-day without compromising the future.

While there has been ample research on rural sustainability over the years and in other jurisdictions, there is a need to better understand what will help make Ontario's rural communities and economies sustainable in the 21st century context and beyond.

Policy Questions:

Research projects (which may use a case-study approach of communities and jurisdictions directly applicable to the rural Ontario context) should be largely quantitative and address one or more of the following:

a) What are the key drivers and components of ‘sustainability’ (e.g. environmental, economic, demographic, social, etc.)? The research should include a summary of current literature and jurisdictional approaches to defining and measuring rural sustainability.

b) How can rural economic sustainability be measured in the Ontario context?
   - What are the key indicators and performance measures?
   - What is already being done?
   - Where are the gaps?
   - What are the strengths and considerations that need to be taken into account for each of these measures?

One of the challenges facing rural development policy is the variation in economic and demographic trends across rural communities throughout the province. For example, some communities, typically those in closer proximity to larger urban centres, confront problems related to increasing demand on environmental resources and competing land uses. Others, typically in more remote locations, may face challenges from depopulation and from youth out-migration. Finding sustainable rural development strategies that are robust to these variations in local and regional conditions is a challenge. There may be a need to develop regionally differentiated approaches. The research should include performance measures which are realistic and possible within the Ontario context. The research could also look at the strengths and weaknesses of current approaches (e.g. community report cards such as Vital Signs do not look at long term future impacts)

c) How can the information learned from the research inform policy and program design?
   - What are the key opportunities and challenges in addressing rural sustainability in Ontario? The research should include an analysis of current policies and practices that are already supporting rural sustainability and consider how effective these policies and practices are in supporting a range of activities (e.g. do they encourage municipal investment or interventions, do they encourage increased collaboration between entities, do they support rural service delivery, do they mitigate the effects of rural economic transition)?
Expected Outcome:

The research will identify the conditions/parameters/metrics for assessing economic sustainability. The research will provide information and indicators that can be considered in rural policy and program design, delivery, and evaluation. The information learned from this research will be holistic and broad reaching and would benefit from using an ‘economic development’ lens (but not be limited to economic development and could include other factors such as environmental and social sustainability).

2. Changing Rural Economies

Policy Objective: Develop an understanding of the nature and scope of economic transition in rural communities to support their growth and competitiveness

Policy Issue Problem Statement:

The rural economy in Ontario is changing. Demographic, labour force and economic sector-specific transition is occurring (e.g. aging population, decline of traditional manufacturing, changing workforce structure resulting in precarious employment). These changes are integral to a highly interactive and dynamic economic system which poses both challenges and opportunities for rural communities and regions. Government policy makers and rural communities would benefit from a clear understanding of how some of these trends and changes are impacting rural communities and regions in Ontario, and examples of how these changes can be leveraged for community and economic success.

Policy Questions:

Research projects (which may use a case-study approach of communities and jurisdictions directly applicable to the rural Ontario context) should be quantitative where possible and address one or more of the following:

a) Using economic analysis, what are the implications for rural manufacturers in Ontario as result of recent and future trade agreements e.g. the Canada-European Union Comprehensive Economic and Trade Agreement (CETA)? Research could focus on one or more sectors and use case studies to illustrate the impacts.

b) What are the current trends and opportunities for manufacturing in rural Ontario?
   i. What is the appropriate role of government to support the future of rural manufacturing industry?
   ii. What opportunities exist for rural municipalities and regions to support the future of manufacturing?

c) What opportunities are there for diversification of rural economies and to help rural communities adapt to the changing nature of the global, national and provincial economies?

d) What is the nature and extent of precarious employment (i.e. not permanent or full-time) in rural Ontario? What are the implications of precarious employment in the short, medium, and long term for rural economies? What opportunities exist for rural communities and regions to address precarious employment in rural Ontario? What policy interventions are proving to be effective in addressing the issue in a rural-specific
context?

e) Given that the rural population is aging and that many rural communities face youth out-migration, is there a role for government to support the transition of existing businesses to new entrepreneurs or business leaders?

i. What best practices exist for succession planning at the firm and municipal level?

ii. What tools and supports do rural businesses and communities need to support succession planning?

iii. As a result of this demographic shift, what are the economic and community opportunities for new entrepreneurs in rural areas?

Expected Outcome:

Identify the appropriate role(s) for communities, regional organisations, orders of government and other partners to support rural communities and regions to support Ontario's communities during economic transition.

The research will provide important contextual information to policy and program makers that will clarify the current rural Ontario landscape in terms of precarious employment, succession planning and economic transition, including changes in the manufacturing sector. While research has been done on these topics generally, policy-makers would benefit from understanding in more detail the rural Ontario context. This research will help policy-makers to consider / evaluate relevant policy and program interventions.

Note to Researchers: Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- Climate change is also a consideration under the Environmental Sustainability and Production Systems research themes.

- Priorities specific to local food are described within the Food for Health research theme.

- The Agricultural and Rural Policy ‘Regulated Marketing’ priority has linkages to the ‘product diversification’ priority under the Animal Production Systems research theme.
3: Bioeconomy - Industrial Uses

3.1 Definition and Scope of the Theme

The Bioeconomy-Industrial Uses theme encompasses three major areas of focus, all of which involve use of agriculturally-derived biomass to produce some type of bioproduct. The three major product categories considered are:

Biomaterials - includes bioplastics, biobased blends, natural fibre composites, biobased nanocomposites, biofoams, biorubber, biobased paints and coatings, bioadhesives and bioinks, and natural fibres, as well as the resulting end products (e.g. textiles, carpets, mats), rigid components (e.g. tiles, panels, beams and posts, tubes/pipes, casings, or other formed products), or granulated products (e.g. chips, pellets, dust).

Biochemicals – includes industrial chemicals (e.g. cleaners, lubricants, sealants, solvents, ), intermediate biochemicals (e.g. ethylene), chemical inputs/feeds for production of other products (e.g. oils, phenols, resins) and biotech products where at least part of the product is a biological organism or a component thereof (e.g. enzymes, molecular probes, microbes, yeast, bacteria). Biopharmaceuticals and cosmetics are considered in the Bioeconomy-Industrial Uses research theme whereas nutraceuticals and functional foods are excluded as they are considered under the Food for Health theme.

Bioenergy – includes energy feedstocks (e.g. ethanol, methanol, butanol, biodiesel, bio-oil, biogas, pellets, hog fuel) as well as the end products (e.g. electricity, thermal energy).

3.2 Bioeconomy – Industrial Uses Research Priorities

1. FEEDSTOCK RELATED RESEARCH

Feedstock-Related Research is defined as research to create unique, sustainable, and/or more robust bio-based/organic feedstocks with the aim of long-term market viability and societal benefit. This includes research on organic waste streams and research into logistics/delivery of feedstocks, farm gate processing, storage, and transportation.

Priority areas for research are:

a) Utilization of low value agricultural based residue and byproduct streams as value-added bioproducts: residue and byproduct streams include crop residues, and low or negative value byproducts (e.g. glycerol and lignin from biofuel industries), Distillers’ Dried Grains with solubles (DDGS) from corn ethanol industries, soy meal and canola meal (from soy/canola oil industries), CO₂, and food processing waste streams. For example: Research into the economic utilization of residue and byproduct streams at the site where
residue is generated will be considered. Such research should also include aspects of environmental sustainability;

b) Development of new or improved crops beyond traditional or existing commodity crops. Examples include:

i. Agronomy (yield and agro-climatic suitability), selection or breeding of crops or unimproved plants with identity preserved traits for specific industrial chemicals/products/applications, stress tolerance, value-added feedstock for advanced manufacturing like biopharmaceuticals;

ii. New crops or cultivars of existing crops for biofuel and other industrial applications, such as paints, coatings, lubricants and solvents applications;

iii. Algae and agroforestry (e.g., use in bioproducts/processes linking benefit to agri-food sector and rural communities).

c) Feedstock development, quality development, production optimization, storage and supply chain logistics of biobased feedstocks for biomaterials, biochemicals, and bioenergy.

d) Biotechnology for improved agronomics and quality of raw materials for industrial uses.

2. PROCESSING TECHNOLOGIES RESEARCH

Processing Technologies Research is defined as research into methods and processes for converting/refining feedstocks to enable cost-competitive products for a variety of industrial uses. This type of research should work towards an integrated approach. Processing technologies that lead to novel or more efficient uses of biobased feedstock are desirable. The ultimate outcome of this type of research is increased value, either of a single component, or across products. This type of research includes development of processing technologies that are scalable to meet local needs as well as the needs of larger facilities. OMAFRA in particular needs research outcomes focused on the agri-technology side of this component.

Priority areas for research are:

a) Biological, thermal, chemical and/or mechanical (on and off farm) processing (of the optimized plant biomass to yield bioproducts and enhancement of processes for economic and environmental benefits. For example: cost effective methods and efficient processes for conversion of agricultural feedstock and development of enhanced quality parameters

b) Synthetic biology approach, genomic and proteomic research to enhance input/output traits for desired product streams encompassing total use (crops, microbial); this could span all areas of bioenergy, biofibre / biocomposites, or biochemicals;

c) Integration of biobased inputs with existing manufacturing industries (e.g., understanding of fossil-based processes and other biobased replacement opportunities); computer based models in bioproduct processing for input/output costs (gas, waste heat, feedstock preprocess to end products); processing technologies for use of biobased feedstock that are responsive to manufacturing issues);

d) Nanotechnology-based approaches for purification of biological molecules and aptamers (binding molecules); development of standards for nanotechnology in the bioeconomy,
nanotechnology application to biogas; scalable nano-fibre to nanomaterials manufacturing technologies;

e) Total utilization and integrated production of food/feed/specialty crops and high value/added value co-products (e.g. biorefinery, processing strategies for reuse of biobased industrial residues; fractionation of processed food/feed/specialty crops to capture high value co-products which remain after processing and conversion technologies have been utilized).

3. BIOPRODUCT DEVELOPMENT RESEARCH

Bioproduct Development Research is defined as scientific research undertaken with the objective of incorporating the results (if successful) into particular product applications. The product may be entirely bio-based, an ingredient substitution, or biomass used in combination with fossil fuels. This includes products made from Ontario woodlots, but not boreal forests. Forest products/residuals may be a component or part of a blend, but a product which is 100 per cent from the boreal forest is not included in this definition. OMAFRA would benefit from collaborative research with other ministries and universities in Ontario which are recognized leaders in this research area.

Priority areas for research are:

a) Value added bioproducts (e.g. plastics, complex chemicals, high-end bio-materials, enzymes, veterinarian/pharmaceutical drugs, latex, biopesticides, enabling biotechnology such as microbial tools/products for bioremediation and to drive bioprocesses), particularly those that have Canadian feedstock inputs, immediate processing opportunities and market applications. Examples include:

- Next generation biofuels, higher-chain alcohols, and bioalcohol from ligno-cellulosics;
- Development of biochemicals and biomaterials from corn, soybeans, algae, other crops, and agricultural residue streams, as equal or superior (e.g. performance, environmental and health benefits) substitutes for petrochemicals;
- High performance micro-fibres, nano-fibres, nanoparticles and carbon fibres for lightweight, structural composite applications;
- Bio fillers, composite reinforcement fibres, and biochemicals from agricultural residues and biofuel co-products streams.

4. BIOECONOMY – INDUSTRIAL USES POLICY RESEARCH

Bioeconomy policy research is defined as research undertaken to help inform government decision making. Research can include both economic and environmental impacts of the bioproducts sector, as well as identify areas where government initiatives or other tools may help stimulate further development of the sector to enable a successful bioeconomy in Ontario.

Over the last several years, OMAFRA and the Ontario government have made substantial investments in the bioeconomy. As the ministry continues to support the agri-food industry to
deliver on the Premier’s Growth Challenge to double its annual growth rate and create 120,000 jobs by 2020, efforts are also afoot to develop a robust performance measurement system for the agri-food sector, which will also help inform the ministry’s policy and program development in the future. OMAFRA, therefore, is also interested in the development of performance measures that are related to bioproducts production in the province, including the use of agricultural feedstock for the production of bioproducts. Specific priorities for this year include research that focuses on:

- A time series of the quantity of Ontario agricultural feedstock that goes towards the production of bioproducts domestically and internationally;
- A time series of the rate of adoption of emerging crops use for bioproducts production in Ontario; and
- The competitiveness of Ontario’s current agricultural feedstock for bioproducts production

Other areas of interest for Bioeconomy policy research include:

a) Economic research on bioproducts (e.g. biochemicals/biomaterials/ Bioenergy). Specific examples include:

i. Feasibility of transitioning from conventional manufacturing to biobased or hybrid production using agricultural sources;

ii. Economic viability of the development of bioproducts (biochemicals, biomaterials, bioenergy) including the biorefinery concept, full utilization concept, or implications of public policy;

iii. Barriers to scaling up of biochemical/biomaterial industries;

iv. Economic and other related impacts (e.g. impacts to other sectors, improved health, land use changes) of biochemical/biomaterial value chain development, including economic returns to primary producers;

v. Identification of gaps (economic, technology and infrastructure) in bioproduct value chains;

vi. Economics and barriers of using waste stream materials and other feedstock;

vii. Scan and inventory of regulatory requirements for any bioproducts or process to reach commercial viability.

b) Research into sustainability and life cycle impacts, which can be integrated into planning stages of research projects. This research would consider the short and long-term implications of biochemical/biomaterial development with a view to enhancing their competitiveness. Specific examples include:

i. Life cycle analysis of bioproducts versus conventional petroleum-based products (e.g. quantifying the environmental impacts, including assessment of GHG emissions reductions) and economic benefits associated with different feedstocks, processing technologies, processes and products);

ii. Development of standards and performance indicators for bioproducts (quality standards of feedstocks and bioproducts to meet industry requirements, as well as environmental, human health and food safety standards).
c) Identification of incentives and disincentives that are or are not working in North America or other jurisdictions, related to the adoption and utilization of feedstocks for biochemicals and biomaterials. Specific examples include: research on risk mitigation to be an early adopter; risk management for new crops; procurement; and the role of financial sectors/structures.

d) Study on consumer awareness/ perceptions/demand on bioproducts (e.g. retail market trends and demand for bioproducts).

**Note to Researchers**: Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- The **Products and Value Chains** research theme has priorities related to **product and value chain development and assessment** that may be relevant to bioeconomy projects.

- The **Plant Production System** theme also has priorities related to the development of new bioproducts (e.g. **product diversification** priority).
4: Emergency Management

4.1 Definition and Scope of the Theme

The Emergency Management research theme has an emphasis on ‘One Health’ (an approach recognizing connections among eco-system health, animal health and human health) and encompasses issues relating to zoonoses and public health, foreign animal disease, plant pests, food safety, plant and animal disease epidemiology and surveillance, risk management, and related emerging issues.

Research conducted under this theme will support the ‘core components’ of emergency management as they relate to agri-food emergencies:

**Pre-Event:**
- Prevention – actions taken to prevent an emergency
- Preparedness – actions taken prior to an emergency to ensure an effective response

**Event:**
- Mitigation – actions taken to reduce the effects of an emergency or disaster
- Response – actions taken to respond to an emergency

**Post Event:**
- Recovery and restoration – actions taken to recover from an emergency

The focus of the theme will be on disease agents and pests whose sudden emergence or re-emergence in Ontario requires an immediate and comprehensive response for containment, or on endemic agents that are known to give rise to exigent circumstances (e.g. foodborne pathogens). In general, emergencies are events that cannot be handled with typical resources, and require an urgent, significant and coordinated response.

Funding allocated under this theme will support emergency management research across the following subject matter areas (of which more than one may be present within the research priorities described in Section 4.2):

1. **Animal Health and Welfare:** Includes surveillance and emergency management issues relating to infectious diseases of animals and direct and foodborne zoonoses. Animal welfare as it relates to emergencies is in scope. Animal welfare as it relates to production (e.g. housing practices, pain control), as well as research relating to production limiting diseases (e.g. pneumonia and mastitis) is out of scope and will be addressed in the Production Systems research theme. Diseases of wildlife and companion animals are in scope as they relate to zoonoses of significance to livestock and human health. Purely basic research (e.g. disease mechanisms/bacteria pathogenesis) while important and necessary, is out of scope for this research theme.
2. **Plant Health:** The focus will be on emergency management issues relating to plant pests. Plant pests include insects, other invertebrates, bacteria, viruses, nematodes, fungi, weeds and other invasive species that affect the health of agricultural plant commodities. Plant pests and invasive species generally pose limited direct risk to humans or animals. Mycotoxins produced by certain fungi are an important exception, and some invasive plants are noxious and can present a public health hazard. Research relating to innovation in pest management will be addressed under the Production Systems research theme.

3. **Food Safety:** Food safety research needs and issues, including analytical methods, risk assessment and risk management are within the scope of this theme. Food safety research related to this theme will be primarily addressed and resourced under the existing competitive OMAFRA Food Safety Research Program.

4. **Related Public Health:** The research theme relates to public health as it pertains to human-animal interaction, zoonoses and food safety research.

### 4.2 Emergency Management Research Priorities

The Emergency Management Theme Advisory Group has identified five priority areas for research conducted under Emergency Management Research Theme. These are:

1. Economic Analysis
2. Threat Identification and Prioritization
3. Detection and Surveillance
4. Pathway Analysis
5. Prevention and Control of Disease.

To be successful, research proposals must clearly demonstrate how the proposed research addresses at least one priority area.

In addition, the Theme Advisory Group has identified specific gaps in the research funded to date across the five research priority areas. The research topics listed below, and reflected in the following descriptions of each priority area, represent areas of specific need and will be given priority consideration in the current Call for Proposals and review process:

- Analysis of the economic impact of emerging threats and intervention activities, especially related to plant health.
- Application / integration of economic analysis into disease transmission models;
- Impacts relating to the loss of effective antimicrobial drugs as a result of antimicrobial resistance;
- Impacts of climate change on emerging and existing animal diseases and plant pests;
- Implications of demographic changes on disease spread;
- Spread of zoonotic diseases from wildlife, elk, and deer;
- Systematic review of emergency response issues such as mass carcass disposal;
- Research into the sociological and socioeconomic aspects of provincial agriculture and food emergencies (e.g. 2014 PEDv outbreak)
- Research into the value and application of traceability to an effective emergency management system.
1. ECONOMIC ANALYSIS

Failure to plan for emergency situations, and the lack of clear plans for emergency response, puts considerable resources at risk. Information regarding the economic impact of possible adverse events is needed for both industry and the general public in order to assess the value of avoided losses (benefits) against the costs of investing in emergency management. Emergency management initiatives and policies need to achieve their intended benefits, be cost effective for the agri-food industry, and allow the sector to maintain its competitiveness globally.

Priority areas for research are:

a) Develop or identify best tools for comparative economic analysis of resource attribution to emergency management activities in all phases, including recovery.

b) Estimate the potential economic impact of adverse events and evaluate the costs and benefits of potential risk-reducing interventions in order to prioritize risk management options and support science-based decision and policy development with respect to emergency management activities.

c) Identify emergency management planning best practices, analyses of emergency situations world-wide, and gap analysis to assess the effectiveness of emergency management practices and quantify costs (with focus on animal health, plant health, food safety and public health).

d) Supply management impacts. Research is needed to understand and address the impacts that changes to supply management may have on emergency management systems in Ontario as they relate to animal and product security, biosecurity, traceability and movement.

2. THREAT IDENTIFICATION AND PRIORITIZATION

There is a need to identify and prioritize threats to plants, animals, food safety and human health within the Ontario context. This will optimize the application of limited resources so as to strategically manage risk to acceptable levels of likelihood, and impact. Risk assessments ask three questions: 1) What can go wrong? 2) How likely is the event to occur? 3) If the event happens, what is the magnitude of harm? The identification and characterization of potential hazards requires an evaluation and understanding of global trends in zoonotic and animal diseases and invasive alien species. Given that risk is a function of both likelihood and impact, uncertainties in our understanding of the factors that influence these two components for a given hazard compromises our ability to rank risks and prioritize surveillance, detection and risk management activities. Assessments of potential adverse events should take into
account health, economic, trade, ecological, social and political impacts, public perception, feasibility of control, as well as the variability and uncertainties inherent in the data.

For any research project proposed, consider costs and benefits (direct and indirect) as appropriate.

**Priority areas for research are:**

a) Identify and/or collect baseline data as required for specific plant and animal diseases in all species in order to prioritize risks.

b) Identify threats using different methodologies (scans, multi-criteria decision analysis (MCDA), simulation models, conjoint analysis, etc.) in different commodities, for different types of threats (foreign plant/animal diseases, zoonoses, microbial, natural and man-made hazards) from other jurisdictions with high risk of entry in Ontario. Analysis could include an inventory of emerging threats world-wide (e.g. with trading partners) to ensure potential hazards are on Ontario’s radar screen, biological impacts such as geographic location and wildlife interaction, and economic impacts (direct and indirect).

c) Identify and prioritize the emerging environmental impacts on agriculture across the sectors in reference to health and disease vectors (climate change, water, and insects). Identify and describe the effect of changing policy, production and management practices on emergency management issues.

d) Quantify the risks to agriculture from global movement of people (urban and rural) and agricultural commodities (animal and plant). Research is needed to identify and quantify potential health risks to plant, animal and the general public due to people migration from one place to another (from country-to-country or from less populated to densely populated areas and vice-versa).

e) Urban agriculture – Identify and prioritize the risks associated with the increase in the production of food in urban areas (such as backyard flocks and crop gardening). Issues such as disease spread (both in animals and crops), new pests and soil quality (from both emergency management and food safety aspects) need to be researched.

3. **DETECTION AND SURVEILLANCE**

Surveillance is important to support the safe trade of plants, livestock, and animal and food products. Food and animal health surveillance is also important to public health. Being able to detect hazards and conduct surveillance to understand their normal frequency and distribution, and detect important changes early, helps to facilitate timely response so as to mitigate impacts. The data required to help evaluate the effectiveness of food safety interventions and other initiatives is currently limited.

For any research project proposed, consider costs and benefits (direct and indirect) as appropriate.

**Priority areas for research are:**

a) Identify, evaluate and where appropriate merge existing data sources from multiple sources (e.g. agriculture and livestock sources, veterinarians, non-government organizations, etc.) that could be used to support emergency management in order to
better predict, identify and understand potential short and long term threats to the agricultural sector.

b) Identify efficient and effective risk–based detection and surveillance methods and technologies including strategies for better use of humans in surveillance for identifying potential risks across all sectors including aquaculture and with focus on vector-borne diseases resulting from the migration northward of disease agents and pests.

c) Detection and surveillance for antimicrobial resistance and pesticide resistance.

4. PATHWAY ANALYSIS

The increasing diversity and volume of trade and travel presents a challenge through the complex movement of people, food, animals, and plants across and within borders. Once introduced, pests and disease agents can spread provincially or nationally. Pathway analysis is a systematic assessment of the pathways along which a disease agent or pest might enter or move within and between Ontario farms and establish an outbreak of disease in plants, animals or humans. Understanding pathways of invasion and spread is important in order to identify the vulnerabilities and the weakest links from an Ontario perspective, resulting in the identification of critical control points throughout the agri-food system so we know where to best target interventions.

For any research project proposed, consider costs and benefits (direct and indirect) as appropriate.

Priority areas for research are:

a) Identify and model factors that contribute to the emergence, transmission and persistence of infectious animal diseases, zoonotic agents, food hazards, plant diseases and invasive species/pests with a focus on the hazards that pose the greatest threat to Ontario.

b) Review and assess pathway analysis methods. Which ones work well with plant, animal and food systems?

c) Conduct pathway analyses for priority diseases.

d) Identify and describe significant transport pathways that facilitate the spread of hazards (e.g. water, birds).

e) Apply HACCP-like principles to important pathways to determine where best to intervene.

5. PREVENTION AND CONTROL OF DISEASE

Preventing the introduction of a pest or disease agent is the most effective means to avoid or minimize risk, and can be considered the most cost-effective approach to emergency management. Effective prevention and control strategies are required that are affordable, predictable and can be broadly implemented. Research is required to support the development of best management practices. The design of emergency management systems that pay for themselves through improved business efficiency during non-emergencies, but that can be scaled up for use in emergencies has the best chance of adoption and success.
For any research project proposed, consider costs and benefits (direct and indirect) as appropriate.

**Priority areas for research are:**

a) Develop effective control measures (bio-security plans and best management practices (BMP)) for emerging and new pests (e.g. small hive beetle, Nosema ceranae).

b) Assess producer buy-in to disease prevention and control methods. Identify and understand barriers / facilitators to adoption, value added and benefit / cost. What options are available for information management, from a policy and/or technological perspective, which would provide the appropriate level of security?

c) Emergency management response. Research needs include:
   i. Identify appropriate strategies for communicating emergency messaging.
   ii. Research into the understanding of human behaviour in emergency situations and mechanisms for better coordination of resources and response which may include effective emergency management in a response phase that reduces uncertainty among government and non-government participants.
   iii. Research and development of new products to support emergency response.

d) Management of plant and animal populations in an emergency. Research needs include:
   i. Comparative analysis (including economic analysis) of emergency management policies and approaches (e.g. vaccination versus cull; surveillance zones versus compartmentalization).
   ii. Humane methods for the mass destruction and disposal of livestock during a foreign animal disease outbreak which minimize environmental impacts (i.e. contamination of waterways).

e) Assessment of existing traceability systems that have been developed worldwide. Analyses could focus on:
   i. Database/system structure, architecture and functionality.
   ii. System resource requirements and maintenance costs.
   iii. Value added.
   iv. Economic analysis
   v. Use in simulation modeling.

**Note to Researchers:** Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- Please refer to the Production Systems priorities for research needs relating to animal health and plant protection.
5: Environmental Sustainability

5.1 Definition and Scope of the Theme

The Environmental Sustainability (ES) research theme focuses on maintaining the ability of natural resources (soil, air, water and biodiversity) to support and strengthen agriculture, food and bioproduct sectors and rural communities by evaluating environmental, economic, and social perspectives. In order to support long-term sustainability of the agri-food sector (agro-ecosystem and food system) and address the concerns of society, OMAFRA invests in this research theme to:

- Understand the agriculture and food sectors potential risks and benefits to soil, water, air and biodiversity resources;
- Provide science for the development of credible and evidence-based government policies, programs and initiatives;
- Assess the effect of environmental policies on the agri-environment, agri-food sector’s economics and rural society; and
- Identify opportunities for agriculture, food, and bioproducts sectors, and rural communities to provide solutions for societal environmental challenges.

5.2 Environmental Sustainability Research Priorities

The Environmental Sustainability research theme for 2015-16 is focused on three main priority areas as given below.

1. Understanding the drivers and stressors influencing the agri-food system’s interaction with the natural environment
2. Managing effects of the agri-food system using best management practices (BMPs) that consider economic, environmental and social implications
3. Measuring performance of and defining optimum agri-food system management practices

The above three priorities are built on a systems approach to address ES research needs that support a sustainable agri-food system. Figure 1 describes the ES research continuum, linkages between research priority areas and desired outcomes of research to achieve the overall goal of the sustainable agri-food system.
The three research priority areas are described below with key deliverables. Research proposals should clearly describe how they address one or more of the following priorities.

1. **UNDERSTANDING THE DRIVERS AND STRESSORS INFLUENCING THE AGRI-FOOD SYSTEM’S INTERACTION WITH THE NATURAL ENVIRONMENT**

   A solid understanding of basic science that influences processes and resiliency of the agri-food system is necessary for environmental sustainability. Data/information that relate, describe and quantify environmental, economic and societal/behavioural changes of the agri-system to different causes can inform policy, program and management decisions. The agri-food system is both influenced by and influences the natural environment (climate, soil, water, air and biodiversity) and therefore understanding in detail this relationship allows more effective management strategies. The role of various land use and agri-food practices on the quantity, fate and pathway of contaminants needs to be understood and quantified. Concerns for water quantity and quality span many scales from farm to municipality to watershed to the Great Lakes basin. The implications of climate change for water management and other elements of agri-food production in Ontario need to be anticipated and understood. This research area seeks to provide science to assist with proactive response options by the agri-food system due to different drivers and stressors in the context of the environment.
Key deliverables from this research are:

a) Explanation and quantification of various biophysical processes of the agri-food production system affected by changes in drivers (e.g. changing production practices, land use, high land prices, climate change, energy, drainage, farm enterprise composition, increased market competition, species diversity legislation, Great Lakes water quality - particularly as it relates to phosphorus) while maintaining the productivity of the agro-ecosystem

b) Quantifiable list of the impacts (benefits and risks) of agri-food production practices on soil (e.g. soil health and ecology, erosion/soil loss, carbon sequestration, effect of agricultural land use intensification), water (e.g. quality, quantity, use efficiency, pathway of contaminants, ground water recharge), air (e.g. odour, GHG, particulate matter, emission inventories) and biodiversity (wild pollinators are of particular interest)

c) Cost effective and efficient methods measure the impacts of changes due to drivers and stressors on the agro-ecosystem. Life cycle studies describe and quantify soil health, air emissions, water use and water quality and rate of behavioural adaptation.

2. MANAGING EFFECTS OF THE AGRI-FOOD SYSTEM USING BEST MANAGEMENT PRACTICES (BMPS) THAT CONSIDER ECONOMIC, ENVIRONMENTAL AND SOCIAL IMPLICATIONS

This applied research area supports the development of scientifically credible and cost-effective BMPS including recommendations for their transferability, prioritization and placement. This research supports policy/program development and regulations as appropriate. Evaluation and validation projects are desirable even though a practice may not be considered "new or innovative". There is a need to confirm that environmental improvements expected through BMP adoption are being achieved at different scales and in different combinations. On-farm or model farm research should be used as much as possible to assess practicality, define antagonism/synergy between BMPS and improve the adoption of BMPS that are validated. Integrated systems analysis should be used to put the biophysical, economic and behavioural considerations together. Investigation of the link between field scale and watershed scale effectiveness of BMPS is required to assess water quality benefits. Continued development, evaluation and validation of BMPS are important to quantify trade-offs between soil/water/air/biodiversity impacts and environmental/economic/social/behavioural aspects of a practice.

Key deliverables from this research are:

a) New methods, farm level decision support tools, systems and technologies to reduce environmental risks and capture opportunities (including food safety) within economically sustainable agri-food production

b) Innovations in monitoring, evaluation and validation of systems/technologies/ BMPS to cost-effectively reduce potential adverse effect of agri-food production on soil, air and water and biodiversity and development of tools to support prioritized BMP implementation.
c) Analysis of producer behaviour and willingness to adopt BMPs with implications for policy, program development and KTT (Knowledge Translation and Transfer).

d) Assessment of the impact of various environmental policies, practice and technologies in Ontario for agricultural production and food processing.

3. MEASURING PERFORMANCE OF AND DEFINING OPTIMUM AGRI-FOOD SYSTEM MANAGEMENT PRACTICES

Once we understand and quantify the underlying biophysical processes and adopt best practices to manage the agri-food system it is important to measure the performance of agri-food production system to know if the science/practice is making a difference. Research is needed to define agri-environmental targets and develop indicators/ metrics of the required range of air, biodiversity, soil and water quality for agriculture and food production; then the additional value or consequences for practices outside this range can be determined.

This research area focuses on demonstration and valuation of the public benefits which the management of the agro-ecosystem provides in addition to the goods resulting from agricultural biodiversity (e.g. food and fibre production) which are already well recognized by society and have monetary value established through existing markets. The public values environmental benefits such as habitat, species protection, groundwater recharge and wetland filtering, and benefits to the producer such as agro-ecosystem resiliency and productivity which result from some adopted systems and practices. Quantification of the benefits and risks of sustainable agri-ecosystems is an objective of this research area.

Key deliverables from this research are:

a) Indicators/metrics to measure environmental, economic, social and biodiversity benefits/consequences of agri-food system management;

b) Methods and tools that quantify and qualify agri-environmental benefits/risks from agriculture landscapes;

c) Mechanisms by which producers and the public may achieve mutual benefit;

d) Targets for soil, air, water and biodiversity quality to support sustainable agri-food production

Note to Researchers: Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- Climate change is also a consideration under the Agricultural and Rural Policy research theme and the Plant and Animal Production Systems research theme.
6: Food for Health

6.1 Definition and Scope of the Theme

The Food for Health research theme focuses on enabling:

- improved health for Ontarians through healthy agri-food products, and/or
- increased competitiveness of the Ontario agri-food sector through identifying market opportunities for healthy agri-food products.

Collaborations with industry, grower groups and other researchers are strongly encouraged. An established audience for the outcomes from the research proposal is encouraged to show the research is demand-driven. Clear indication of benefits to Ontario is key in any research proposal. Benefits (economic, social, competitiveness etc.) must be specific and if possible targeted to an identified audience.

6.2 Food for Health Research Priorities

1. POLICY, REGULATIONS, INVESTMENT, AND THE ECONOMY

An examination of Ontario’s unique Food for Health market opportunities and strengths is the focus of this priority. Research in this priority area of the Food for Health theme needs to inform OMAFRA policy and program staff of the emerging opportunities and challenges for healthy agri-food products in Ontario.

As part of the evaluation process additional consideration will be given to proposals that focus on the following:

- What emerging market opportunities exist for Ontario-produced healthy agri-food products in Canada and abroad? How are Ontario’s strengths in production, processing, geography and other areas best suited to optimize these emerging opportunities? Are there significant regulatory or market barriers that would need to be addressed?

2. CONSUMERS AND HEALTHY CHOICES

This priority seeks to examine the opportunities and challenges facing consumers when choosing and utilizing healthful foods. A strong focus on food literacy and food skills* to support a healthier Ontario is the key focus of this priority area. Additionally, an understanding of the level of food skills held by Ontarians is needed to assess the opportunities and challenges to improve the ability of Ontarians to select and utilize healthy food products.

As part of the evaluation process additional consideration will be given to proposals that focus on one or all of the following:
a) Methods and best practices to increase consumption of local Ontario food.

b) Appropriate indicators/measures to monitor Ontarians food skills.

c) Appropriate models to determine the actual or estimated number of Ontarians preparing meals using local food ingredients.

* At an individual and household level, *food skills* are a complex, inter-related, person-centred, set of skills that are necessary to provide and prepare safe, nutritious, and culturally acceptable meals for all members of one’s household.”

Reference - Vanderkooy, P. Food skills of Waterloo Region adults. Fireside Chat Presentation. 1-20-2010. Online: [www.chnet-works.ca](http://www.chnet-works.ca)

**Note to Researchers:** Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- Priorities specific to local food are described within the **Agricultural and Rural Policy** research theme.
7: Products and Value Chains

7.1 Definition and Scope of the Theme

This research theme focuses on product and value chain development that anticipates market opportunities in Ontario’s agri-food and rural sectors to create a strong and resilient regional economy and support the Premier’s Agri-Food Growth Challenge by encouraging innovation. New products and value chains in these sectors face challenges during their initial start-up phase while enhanced products and value chains find difficulty at the scale-up phase; this theme hopes to address these issues.

Within this theme “product” encompasses:

- physical products or technologies in the marketplace (i.e. food products, enhanced agricultural commodities);
- services, on their own or as a part of a physical product or technology; and
- organizational processes, or collaborative initiatives.

A value chain in this theme is defined as a strategic partnership among inter-dependent businesses and potentially other organizations that collaborate to create value resulting in improved competitive advantage for all members in the value chain. The result is market-focused collaboration.

The definition of value in this theme includes:

- market value, derived from the sale of products, services and technology solutions;
- competitive advantage that benefits businesses through the value created by improving efficiency, reliability, quality, customer responsiveness and innovation;
- improved economic performance of Ontario’s agriculture, food and rural sectors; and
- socio-economic value including improved environmental sustainability, enhanced corporate social responsibility and regional economic development.

The strongest proposals will be collaborative, drawing on the combined strengths of more than one researcher at the University of Guelph using a multi-disciplinary approach. Successful projects will demonstrate that appropriate links have been made between the laboratory and the market place. Effective product and value chain research within this theme requires that researchers connect early in the process to align research with industry.

Demonstrating viability of research outcomes through business, value, market and network analyses is critical to market success in product or value chain development. Before any research begins in this theme, researchers must demonstrate that a Business Viability Assessment has been conducted. The strongest proposals will have completed this step at the time of submitting a full proposal. However, in some cases, depending on the type of project, it may be suitable to conduct the Business Viability Assessment as a project milestone. Many tools exist to assist in the completion of the required components of the Business Viability Assessment. An assessment includes the following four components:
1. **Business case.** This includes standard elements of a business case and other elements which will strengthen the case such as assessments of sustainability, social responsibility and regional economic development. You can develop your own business case format or you may benefit from adapting one of the many guides and templates that are available online at government, bank, university and consultant’s website.

2. **Market value proposition.** Who will pay for the product, service or technology that you plan to develop? What end users within the Ontario agriculture, food or rural sectors will benefit from the value you create? Do they want the value in the first place?

3. **General value proposition.** How is your project idea going to contribute value to Ontario’s agriculture, food or rural sectors? What type of value will it create and how will you measure it?

4. **Partnership and network development.** What external/internal partners would be interested in creating value with you?

Whether you are submitting your project to the (1) Product Development and Assessment or the (2) Value Chain Development and Assessment priority, the Business Viability Assessment is a requirement that applies to both.

### 7.2 Products and Value Chains Research Priorities

#### 1. PRODUCT DEVELOPMENT AND ASSESSMENT

Product development and assessment projects can include research done on any aspect of product development from initial concept to prototype development to scale-up manufacturing and marketing, or inbound and outbound logistics and services that might be added to create value at any point in the value chain.

The following areas of emphasis are encouraged within this priority:

1. An in-depth analysis outlining the economic feasibility and benefits for Ontario agriculture, food and rural sectors (above and beyond those conducted in the Business Viability Assessment).
2. Intellectual property analysis
3. Prototype development and assessment
4. Technical feasibility study
5. Scale-up plan

If you have other ideas that seem consistent with priority but are unsure as to fit, please contact the Research Program Director, Dr. Erna van Duren evandure@uoguelph.ca.

#### 2. VALUE CHAIN DEVELOPMENT AND ASSESSMENT

The value chain development and assessment priority focuses on the effective development of specialized value chains for Ontario based entrepreneurs (SMEs small and medium sized enterprises). Value chains can be developed to develop and market new product, improve
competitive advantage and enhanced to create other socio-economic or regional development benefits. Research should provide results that will help guide SMEs and/or other organizations to viable, value added opportunities.

Answering the following types of questions is encouraged within this priority:

a) Import replacement - Ontario imports a large quantity and variety of foods that can be produced within the province. Identify an import substitution opportunity and investigate how Ontario’s agri-food sector could successfully realize on this opportunity through Ontario produced and/or processed foods using Ontario ingredients. Also, identify any regulatory challenges at the municipal, provincial, and federal level along with potential solutions to realizing on this opportunity. Solutions may include opportunities for businesses to meet regulations by accessing existing resources, partnering with other businesses and/or government action to address their challenges.

b) Consumer Research - Ontario’s food market place is becoming less homogeneous with a greater diversity of products being demanded by consumers with specific product attributes (e.g. organic, local, no added hormones, no antibiotics, etc.). More research is required to determine the market premiums associated with specific product attributes or bundle of attributes within a market along with which product attributes are critical to success in that market. Furthermore, we are interested in methodologies for determining how the market premium could be allocated between members of the value chain.

c) Value Chains - In other jurisdictions (e.g. USA, UK, Australia and others) there are stronger more integrated food value chains. Ontario has not had a great deal of success in developing similar value chains. Investigate the reasons why closely aligned value chains fail or/and succeed in Ontario. A case study approach would be an expected component. Also, identify appropriate resources to increase the probability of a value chain succeeding.

d) Good communication between members of a value chain has been identified as a key success factor in previous research. Investigate methods to determine the best practices in building trust and information flow across the entire value chain.

e) Regional Economic Development – Economic development strategies require effective collaboration between myriad stakeholders in the private and public sector including multiple levels of government, regional organizations, NGO’s, individual businesses and industry associations. How could research that supports the application of value chains principles and practices to the development of regional economic development strategies result in improved economic outcomes for rural Ontario.

If you have other ideas that seem consistent with priority but are unsure as to fit, please contact the Research Program Director, Dr. Erna van Duren evandure@uoguelph.ca.

Note to Researchers: Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- Animal and Plant Production Systems theme (e.g. product diversification and product quality improvement research priorities).
- Bioeconomy theme (e.g. bioproduct development research priority)
8: Production Systems

8.1 Definition and Scope of the Theme

One approach to identifying what is in-scope for this theme is to pose the following questions, the answers to which would direct where Production Systems research resources should be applied. The first two questions are hypothetically posed to farmers and the third to the research community.

For farmers:

How can I enhance my farm productivity and profitability? (economic, stability and new challenges/opportunities)

How can I adapt to societal or external pressures and variables? (links to other themes)

For researchers:

What do we need to do to answer these questions for farmers? (This approach is termed “reverse engineering”. When the market or society provides the direction, Production Systems research engages to provide the solution.)

Definition and Scope of the Theme

First and foremost, Production Systems research must focus on production research and profitable agriculture. Secondly, the Production Systems research capacity can be employed to incorporate the needs of other themes into profitable systems.

The Production Systems Theme encompasses the development of agricultural production systems that will enhance profitability of agricultural production, while incorporating issues, opportunities and advances arising from related research areas that address the greater societal environment within which production agriculture operates, including environmental sustainability, emergency preparedness, end product expectations with regard to food (healthy eating) and non-food (industrial) uses, value chain opportunities and agriculture and economic development policy directions.

Production Systems – Key Research Areas

Plant Protection – Research in this area includes improving Integrated Pest Management (IPM), understanding the biology, ecology and management of current and invasive pests. This includes identification, tracking and monitoring, identifying biosecurity practices and protocols (especially related to maintenance of trade) and improving diagnostics and surveillance techniques to improve pest management and manage pathogen resistance.

Animal Health and Welfare – Research in this area includes production limiting diseases (including detection methods – e.g. prions), zoonotic diseases related to production, animal welfare/behaviour, antimicrobial resistance and the use of non-antibiotic therapeutics, emerging and foreign animal diseases, biosecurity and traceability, diagnostic techniques and disease surveillance methods.
Production Efficiency – Research in this area includes profit enhancement and improved efficiencies, reductions in labour, energy saving technologies and processes, reduced input costs, more efficient use of land, labour, energy, etc., waste stream reduction and reuse, alternate livestock feeds.

Environmental/Ecosystem Impact – Research in this area includes resource use, including water management, environmental impacts on natural and man-made environments, alternate pollinators, alternate energy generation, climate change induced challenges and opportunities, reduction of harmful emissions, maintain biodiversity.

Product Quality Improvement – Research in this area includes studies focusing on the introduction of traits for human health (e.g. omega 3, lycopene, Vitamin E), the introduction of traits to enhance value – (higher oil content), new markets or new products, storability and post harvest extension/shelf life.

Product Diversification – Research in this area includes new product development and associated production systems, climate change response (e.g. different crops), or different production strategies, or expansion of crop production to different land, market research to determine market demand and/or consume preferences for new products and/or uses.

Genetic Technologies and Reproductive Technologies – This research area focuses on genetic and reproductive technologies necessary to develop research in new products and specialty crops, enhance the marketability of existing products, improve productivity in pest management, environmental and end-use quality traits and to maintain our gene pool.

These descriptions of the broad key research areas above will be used to evaluate Tier II proposals for the Plant and Animal Production Systems theme for 2015-2016.

8.2 Plant Production Systems Research Priorities

NOTE TO RESEARCHERS: Proposals must clearly identify how they address the following specific priority needs described within each area below. Proposals that do not specifically address these specific priority areas will not be eligible for Tier I funding. Projects that address the broader Production Systems research areas located above under the definition and scope of the theme are eligible for Tier II funding.

All research areas apply to both conventional and organic production systems

1. PRODUCT QUALITY IMPROVEMENT (High Priority)

- Edible Horticulture:
  - Enhance initial product quality of processing vegetables
  - Improve product quality and shelf life of asparagus and berries (i.e. crop management, postharvest management, packing, storage, etc.)
  - Assess the impacts, including tree growth and syrup quality, of the use of TreeAzin for Asian Longhorn Beetle control in maple syrup production
  - Identify factors that lead to pesticide residues and investigate remediation techniques to reduce residues in Ginseng production
• Ornamental Horticulture:
  o Improve root growth for greater outplant survival. Understand and improve root growth and/or prevent root circling in container nursery production and compacted soils.

• Field crops:
  o Identify and characterize quality and functional parameters and identify production practices that improve barley, corn, oat, soy and wheat quality for specific end uses leading to value added markets.

2. PLANT PROTECTION (High Priority)

• Edible Horticulture:
  o Develop integrated pest management strategies for horticultural production systems that incorporate pesticides, alternative control measures, host resistance and/or take a systems approach to controlling pests, disease and weeds.
  o Develop clean plant material that is virus negative for the grape and wine sector.

• Ornamental Horticulture:
  o Improve control of insects, weeds and disease in ornamental plant production. In greenhouse floriculture the primary focus should be on biocontrol strategies.

• Field crops:
  o Resistance identification and management strategies for fungicides in corn soybeans and cereals. Effective management of Fusarium pathogens, soybean cyst nematode, soybean sudden death syndrome, foliar diseases, oat crown rust, seedling diseases and root rots. Develop integrated weed management strategies that consider management of herbicide resistance, and/or biology and ecology of specific weed species for corn soybean and cereals.
  o Agronomic influences on forage nutrient quality and yield in harvested forage and pasture - weed control, diseases, insect pests, fertility, establishment, etc.
  o Insect resistance, root and leaf disease management for edible beans
  o Swede midge and flea beetle control and effectiveness of boron in mitigating damage from extreme temperatures in canola.

• All Crops:
  o Develop alternative (non-neonic) management strategies for insect pests and/or define early-season soil insect pest thresholds.

• Pollinator Health:
  o Development of best management practices including integrated pest management strategies for field and horticulture crops to minimize risk of impact of production systems to pollinators.

3. PRODUCTION EFFICIENCY (High Priority)

• Edible Horticulture:
  o Develop strategies for 12 month production in greenhouse vegetables.
  o Evaluate automation systems that reduce labour costs in mushroom production.
o Develop agronomic practices and efficiencies for new and speciality crops.
o Develop cultural management strategies for optimum yield and marketability for apples.

- Ornamental Horticulture:
o Utilize water more efficiently in ornamental plant production and improve water quality in storage and recirculation systems e.g. by optimizing growth media, irrigation systems and/or recirculation systems.
o Develop strategies to optimize the use of nutrients in plant production in order to reduce input costs, promote plant health and manage contamination of water runoff.
o Early-stage research to characterize labour use and to identify issues and opportunities for driving down labour costs in the sector.
o Improve energy efficiency in greenhouse production. Strategies to reduce heat, electrical, energy and fuel use that are economically viable and commercially practical.
o Strategies to improve the production potential of supplemental lighting in greenhouse floriculture.

- Field crops:
o Optimize plant use efficiency of nutrients in field crops, particularly nitrogen, phosphorus and potassium.
o Investigate harvest and storage technology for forages to reduce losses, improve quality and marketability.

- All Crops:
o Validate precision agriculture technologies for use as agronomy research tools that improve efficiency and accuracy of data generation to better address experimental variables.

4. ENVIRONMENTAL ECOSYSTEM IMPACT (High Priority)

- Edible Horticulture:
o Evaluate the entire water management process for field vegetables, identify ways to conserve and reduce water use in all areas of production (e.g. irrigation and fertigation efficiencies) and evaluate new processes to minimize or replace the use of water in wash tank operations while maintaining a food safety focus

- Field crops:
o Identify soil health parameters and practices affecting crop resilience under various stresses; effectively integrate cover crops into field crop cropping systems (including identifying crop, soil, and/or environmental benefits).
o Management of climate related risks for harvested forage and pasture, with focus on drought and winterkill; value of environmental goods and services provided by forage, pasture and crops grown as biomass/biofuels.
o Research and field testing to evaluate sustainable and cost efficient tillage systems in edible beans.

- Pollinator Health:
o Development of best management practices including integrated pest management strategies for field and horticulture crops to minimize risk of impact of production systems to pollinators.
5. PRODUCT DIVERSIFICATION (Medium Priority)

- Edible Horticulture:
  - New variety acquisition and development of higher value tender fruit and fresh grape varieties suited to Ontario growing conditions and marketplace needs; and/or disease resistance especially to fireblight, black knot and bacterial spot.

- Ornamental Horticulture:
  - Understand market trends, quantify environmental benefits, identify what plants to grow, when to supply them, and how to present and market them.
  - Identify low maintenance, high performing, environmentally beneficial and/or consumer preferred plant cultivars through trials and/or breeding.

- Field crops:
  - Develop new bioproducts and new food uses for barley, corn, oat, soybean and wheat that are connected to existing and emerging market opportunities.

6. GENETIC TECHNOLOGIES

- Edible Horticulture:
  - Develop potato varieties with disease resistance, focusing heavily on common scab, low N, P, K requirements and drought tolerance as priority traits.

- Field crops:
  - Develop high-yielding, high-quality barley, corn, oat, soybean, and winter & spring wheat varieties adapted to Ontario, with genetic resistance to important pathogens including Fusarium in wheat and barley, Gibberella in corn, foliar pathogens, soybean cyst nematode, soybean sudden death syndrome (SDS), oat rust, and seedling diseases.
  - Forage varietal effects on management factors, such as NDF and fibre digestibility (milk/beef/acre), Roundup Ready alfalfa, manure tolerance and yield response, intensive cutting schedules, and other parameters. Forage variety performance testing.
  - High yielding edible bean varieties and varieties with resistance to the most important diseases; improved quality traits (seed size, seed coat integrity, seed coat colour)
  - High yielding canola varieties with disease/insect resistance and reduced free fatty acids

Note to Researchers: Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- Please refer to the Animal Production Systems research theme for priorities related to specific honey bee health issues in managed production systems and the Environmental Sustainability theme for priorities related to wild pollinators.

- The Production Systems ‘Product Diversification’ priority has potential linkages to priorities under the Products and Value Chains research theme.
8.3 Animal Production Systems Research Priorities

All research areas apply to both conventional and organic production systems

1. ANIMAL WELFARE (High Priority)

   Research is needed to:

   a) Develop, validate, and apply housing and management practices that meet animal health and welfare needs, align with market demands, and are economically viable.

   b) Develop, validate, and apply strategies to prevent and mitigate pain associated with disease or management practices (e.g. de-horning, castration). Research is also needed to better understand barriers to adoption of best practices.

   c) Reduce stress, pain or injuries during transportation, at livestock markets and at slaughter. Specifically, research to support Standard Operating Procedures (SOP’s) for proper management of animals transported to and managed at slaughter houses and at community sales barns.

   d) Establish management practices for effective, efficient and humane practices for on-farm euthanasia.

   e) Develop and validate tools for measuring and improving animal welfare, including application of precision technologies.

   f) Examine consumer and retailer perceptions and priorities for animal welfare practices.

2. ANIMAL HEALTH (High Priority)

   Research is needed to:

   a) Develop, validate and apply methods (especially nutritional, management, or genetic selection methods) that effectively and economically increase health or reduce the risk of disease.

   b) Develop, validate and apply methods to reduce the development of antimicrobial resistance from food animals or animal production systems.

   c) Improve animal immune function and regulation so as to reduce the incidence and impact of infectious or metabolic disease.

   d) Define factors that predispose animals to metabolic diseases. Research is needed to develop, validate and apply tools (in particular, precision technologies) for monitoring and early detection of disease.

   e) Improve prevention of disease transmission between animals and people (or among animal populations).

   f) Understand the effects of metabolic, nutritional, and environmental exposure during fetal development and early life on health and productivity at the animal and genome level.

3. PRODUCTION EFFICIENCY (High Priority)

   Research is needed to:

   a) Maximize profits, specifically minimizing economic or environmental cost per unit of output. Factors impacting feed efficiency that need to be explored include nutritional
programs with by-products or non-human-consumable feed ingredients, and feeding methods or treatments that improve feed efficiency.

b) Evaluate practical systems of information feedback and data capture from the animal production system such as precision management technologies and integrated management systems that allow cost effective production.

c) Develop and assess alternative livestock/aquaculture production systems and management decision-making tools and programs.

d) Develop, validate and apply genetic or reproductive management methods to maximize production efficiency.

e) Assess and benchmark production costs to identify ways of improving profits.

4. PRODUCT QUALITY IMPROVEMENT (High Priority)

Research is needed to:

a) Improve our understanding of consumer demands, market trends and changing demographics in order to enhance the demand for animal products or to better align product attributes with market demands.

b) Develop or apply technologies or production methods for milk, meat, eggs or fish that improve product quality.

5. ENVIRONMENTAL/ECOSYSTEM IMPACT (Medium Priority)

Research is needed to:

a) Develop and apply methods to measure and reduce the environmental (air, water and soil) and societal impacts of animal production (e.g. greenhouse gases (GHG), air quality, carbon footprint and energy efficiencies).

b) Measure the impact of climate change on animal production systems in Ontario and develop methods to mitigate expected effects of climate change on animal welfare, health, and productivity.

c) Investigate water use efficiency in livestock production from the perspective of water availability, quality and cost to the producer.

d) Investigate the effect of barn environment (e.g., air quality) and farm practices on worker and animal health and safety.

6. PRODUCT DIVERSIFICATION (Medium Priority)

Research is needed to:

a) Identify value-added animal products from livestock and the means to produce these products in Ontario.

b) Investigate non-food uses/alternatives for livestock by-products (e.g. manure for biogas), and waste products of livestock agriculture (e.g. specified risk materials, feathers, shells, hides, wool).
7. APICULTURE RESEARCH PRIORITIES

Research is needed to:

a) Further develop effective Integrated Pest Management, best management practices and food safety programs for controlling varroa mites, tracheal mites, small hive beetles, Nosema, waxmoth, honey bee viruses and other infectious disease of honey bees, including treatment-resistant pests and diseases (e.g. pest and disease resistant bee stocks, use of field and/or genomic methods of breeding selection, biological control methods, organic compounds, conventional treatments, management practices).

b) Assess and improve queen quality, genetics and management in Ontario.

c) Apply newly developed genomic technology for detecting Africanized honey bees (e.g. SNP technology).

d) Investigate the effects of agrochemicals and agrochemical residues, including synergistic effects, on bee health, reproduction and habitat, and on ecosystems.

e) Investigate methods to improve hive health, including management and nutrition treatments.

f) Investigate methods to improve bee immunity to pests and disease.

Note to Researchers: Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- Please refer to the Plant Production Systems Research Theme for priorities relating to pollinator health in managed production systems (environmental ecosystem impact priority) and the Environmental Sustainability theme for priorities relating to wild pollinators.

- Please refer to the Agricultural and Rural Policy priorities for research needs relating to regulated marketing, including ‘Dairy sector competitiveness’, and ‘Responsiveness of supply managed commodities to consumer tastes and preferences’.

- Climate change is also a consideration under the Environmental Sustainability and Agricultural and Rural Policy research themes.

- The Production Systems ‘Product Diversification’ priority has potential linkages to priorities under the Products and Value Chains research theme.