2016-17 OMAFRA Research Themes: Consolidated Priorities

OMAFRA Research Advisory Network

Ontario Ministry of Agriculture, Food and Rural Affairs

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1: Purpose of this Document

The 2016 OMAFRA Research Themes-Consolidated Priorities document is the consolidated outcome (updated priorities) recommended by the Theme Advisory Groups (TAGs) of the OMAFRA Research Advisory Network (ORAN) for each of OMAFRA’s seven research themes. The main objective of this document is to communicate annual updated research priorities to inform calls for proposals under OMAFRA-funded research programs.

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 build a measurement culture and appropriate metrics within the agri-food sector, which will also help inform the ministry’s policy and program development in the future. This desire is reflected in the outcomes of each policy research question.
Similarly, for rural Ontario, OMAFRA is seeking additional economic tools to 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 needed to help build capacity and support future policy work and support the sustainable development of the sector. They are outlined below:

**A. 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
- Business Risk Management

**B. 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.

**C. PROTECTION/ASSURANCE**

Under this theme, research is expected to provide an understanding of what is the role of industry, government and others in enhancing public trust in all aspects of Ontario’s agri-food sector production practices.

### 2.2 Agricultural Policy Research Priorities

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

**A. ECONOMIC GROWTH**

2.2.1. Trade and Competitiveness

**Policy Objective:**

Ensure that Ontario’s agri- businesses remain competitive in response to increased foreign competition resulting from recently concluded and future trade agreements.
Policy Issue Statement and Questions:

It is difficult for Canada and Ontario to compete on price in global markets against larger players such as the United States of America (U.S.), European Union (E.U.), China and Brazil that operate on a much larger scale and have trade agreements with regions that were established earlier. Pork is an example of a commodity that stands to benefit from new market access opportunities in Japan, a key market for Canada and Ontario within the Trans-Pacific Partnership (TPP) zone. However, some TPP members including Mexico, Chile and Australia have existing market access agreements for pork with Japan, affording them preferential pricing and already established supply chains for pork.

Beyond TPP, the Canada-Korea Free Trade Agreement (CKFTA) was of critical importance to the Canadian pork sector for two reasons: 1) South Korea’s longstanding recognition of the quality of Canadian pork and 2) CKFTA allows the pork industry the possibility of being on an equal footing with key competitors – U.S., EU and Chile – who previously benefitted from tariff rate advantages as a result of already having FTAs with South Korea in place. One focus for Ontario agri-food businesses could thus be on catering to niche markets and on product differentiation – in other words, selling the Canadian brand, which is considered synonymous with high-quality in many markets. In the case of pork, this would mean catering to the demand amongst Japanese consumers for premium, high-quality pork such as pork cuts.

- What are the options for Ontario’s agri-food sector to remain competitive in the global market place?
- Can Ontario’s agri-food sector be competitive in the global market place by differentiating its products? How? Where can Ontario’s agri-food sector be most competitive? What are the appropriate target markets? Which commodities are likely to be competitive? How can less competitive commodity groups adapt to improve their competitiveness?
- What resources are available to the sector to encourage product differentiation and export development? What support is the Ministry in a position to provide? What can the Ministry do to encourage Ontario agri-food investment to promote competitiveness and take advantage of new market access opportunities?

Expected Outcome:

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

2.2.2. New Entrants

Policy Objective:

Ensure Ontario’s approach to sector concentration and renewal of Ontario’s agri- businesses results in a competitive and innovative sector.

Policy Issue Statement and Questions:

There is a perception that in Ontario there are insufficient new entrants to the business of agriculture programming among some agricultural stakeholders. The 2011 Census of Agriculture reports that 8.19 per cent of Ontario farmers are less than 35 years of age, 42.53 per cent are between 35 to 54 years of age, and 49.28 per cent are more than 55 years old. However, structurally, the scale of commercial farms in Ontario is small with 62 per cent of farms under 200 acres in size (Census of Agriculture 2011). Financially, it has never been cheaper to borrow money, and a specialized lending company exists to ensure there is no gap in lending (Farm Credit Canada).
The research should focus their efforts on assessing the extent to which there is a need for a new entrant policy or program(s) for agriculture in Ontario. The research should, at a minimum, seek to address the following:

- How are the demographics of current farmers changing in Ontario? How does it compare to other jurisdictions like other Canadian provinces and the United States?
- What gaps exist that would warrant a new entrant policy or program(s) for agriculture in Ontario?
- What is the “profile” of new entrants to Ontario’s agri-food sector over the past 5 years?
- Identify the broad types of new entrants in agriculture in Ontario.
- Identify opportunities that a new entrant could fulfill that are not being addressed by the existing sector?
- Provide an assessment of how financial institutions (Farm Credit Canada, national banks) approach lending with regards to new opportunities.
- Identify if there are agriculture and/or business management training needs that limit new entrants.
- Identify if there are regulatory barriers that are limiting new entrants.
- Gather evidence related to the rate of failure of each type of new entrant identified.
- Provide a comparison to this rate of failure with other sectors of the economy.

**Expected Outcome:**

Assess the need for a new entrant policy for agriculture in today’s circumstances, and what policy options need to be explored to meet that need.

### 2.2.3. Food and Beverage Processing – Barriers to Growth, Firm-level Investment, Research Capacity

**Policy Objective:**

Build on recent research findings and leverage related ongoing research to develop a better understanding of the uniqueness of Ontario’s food and beverage processing (FBP) sector, and challenges that hinder growth in the sector or sub-sectors.

**Policy Issue Statement and Questions:**

Challenges in Ontario’s (FBP) sector are generally similar to other Ontario manufacturing sectors, including lagging productivity and innovation, regulatory burden, need for skilled labour and high input costs (e.g. energy and labor). Investment in research and development (R&D) and capital is the key to productivity growth. However, the food and beverage processing sector continues to have under-investment in capital, low R&D spending, and unique cost drivers surrounding supply management, food safety and perishability.¹

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Growth and Competitiveness Challenges:
- Are there barriers to growth of Ontario’s FBP sector or specific sub-sectors?
- Where can growth be expected in the sector over the next 2-5 years?
- Are there areas within the sector where shrinkage may occur?
- What are the sector’s competitive advantages that can be built upon?
- What are the key factors influencing investment by small to medium food and beverage processing enterprises to significantly grow sales?
- What are the key factors influencing location by small to medium food and beverage processing enterprises?

Research and Development Capacity:
- What is the capacity of R&D at the firm-level for various FBP business sizes? What types of R&D activities are undertaken and how is R&D defined?
- Does / could firm-level R&D support productivity improvements in Ontario’s FBP firms?
- What is the relation between investment in R&D and the presence of R&D staff at the firm-level?
- What models are used internationally to bridge the gap between firm level R&D and academic research (e.g., Wageningen (Netherlands); Ontario’s UofG partnership) that requires business partners? What model could be used / replicated in Ontario?

Expected Outcome:
Evidence-based identification of:
- Ontario’s FBP sector / sub-sector competitive advantage.
- Barriers to Ontario’s FBP growth, particularly productivity growth.
- The factors shaping firm-level decision-making related to R&D investments.
- The factors shaping the growth of firms based on size (Large: more than 500 employee; Medium: 100 - 500 employee; and Small: less than 100 employee).

2.2.4. Essential Regional-scale Agri-food Linkages

Policy Objective:
To strengthen agri-food value chain linkages through increased provincial-municipal-industry collaboration within the Greater Golden Horseshoe (GGH).

Policy Issue Statement and Questions:
Collaboration is needed between provincial and municipal governments and industry to better understand and strengthen agri-food value chain linkages in the GGH region. Economic development and land use planning are two key areas of government involvement that could be further integrated to support essential agri-food value chain linkages at a regional scale. This direction has been strengthened in the proposed provincial plans for the Greenbelt and the Growth Plan for the GGH. This research would build upon previous research by the Golden Horseshoe Food and Farming Alliance that has produced Agri-food Asset Mapping and data sets. (The report will be made available to researchers.) Municipalities and the agri-food sector are looking for specific actions they could take to understand and support the economic viability of agriculture in terms of the services, infrastructure and human capacity that agriculture depends
upon. While this research would focus on the GGH region, it would continue to develop a model for municipal-provincial collaboration that may be applicable to other areas of Ontario.

**Researchers will address the following items:**

- Identify the key decision makers, value-chain leaders and organizations that influence available services, infrastructure and human capacity for agriculture in the GGH.
- Determine the essential linkages between primary agriculture, support services and infrastructure at a regional scale in the GGH, building upon previous research such as the Agri-Food Asset Mapping project.
- What are the constraints or obstacles for regional-scale agri-food linkages?
- Identify the best combinations of tools to assess and actions to strengthen these linkages (e.g., economic development, land use planning)?

**Expected Outcome:**

Outline options and recommended actions for municipal planning and economic development decisions that have the greatest positive impacts on agriculture. For example, the results may be used in developing Regional Agri-Food Strategies or in evaluating the impacts of a new development on the agricultural support network.

Further build upon and advance the findings of existing agri-food asset mapping research to develop easy-to-use tools for municipalities to understand what services and infrastructure are available to agriculture in the region (for example, web-based mapping tools and data sharing).

The research will provide additional information to assist municipalities in implementing and conforming to the GGH Agriculture System by 2021.

**2.2.5. Growth Measurement:**

**Policy Objective:**

Provide the Ontario agri-food industry with the metrics needed to measure growth and benchmark competitiveness across their respective value chain.

**Policy Issue Statement and Questions:**

In 2013, Premier Wynne issued the Agri-Food Growth Challenge (Challenge) to the Agri-Food sector to double growth (GDP) and add 120,000 jobs by 2020. Following on the Challenge, in October 2015, the Agri-Food Growth Steering Committee provided Minister Leal with seven recommendations. One of the recommendations included building sub-sector measurement systems and creating indicators that measure progress towards increasing the competitiveness of a sector relative to competitive and comparable jurisdictions. To support tracking progress toward this goal, the Growth Measurement System (GMS) was developed. The Growth Measurement System is a framework that supports a culture of measurement and evidence-

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2 [http://www.omafra.gov.on.ca/english/about/agrifoodgrowthsc-advice.htm](http://www.omafra.gov.on.ca/english/about/agrifoodgrowthsc-advice.htm)

3 Contact Strategic Policy Branch at OMAFRA for more details.
based comparisons including the collection of sub-sector data. Research should address at least two of the following:

- What are three critical indicators that can be identified and measured to benchmark and assess the competitiveness of selected agri-food sub-sectors that have high growth potential and limited data (e.g. physical, production, price, financial, resource management indicators for dairy sheep, dairy goat, aquaculture and world crops, among others)? What data sets, specific to the sub-sectors under investigation will help in developing an understanding of their growth potential and supply chains?
  - From the above analysis, what are the emerging gaps that reduce the sub-sector’s competitiveness?
  - What are the options for government to support efforts to improve sub-sector level competitiveness?

- What are the drivers of growth opportunities in these sub-sectors under investigation, along the supply chain in Ontario?

- One key part of this GMS is the development of the supply-disposition tables for commodities, particularly where data are currently not available. There is a need to build a provincial level supply and disposition tables for the agri-food sector, especially for commodities that have limited data and understanding of market details. Provide data that would be helpful for developing a supply-disposition table for the sub-sectors under investigation.

**Expected Outcome:**
Development of key performance measurements, tools, indicators and methods for various agri-food sectors and protocols around measuring progress and benchmarking. The information generated will then help the industry to strategically allocate resources to maximize industry growth and profitability.

The measurements and database created will be maintained and regularly updated as part of an ongoing long-term measurement system, including a provincial level supply and disposition tables for commodities with limited data (as mentioned above).

### 2.2.6. Business Risk Management (BRM) Payments and Producer Investments

**Policy Objective:**

Provide the appropriate risk management programs that are comprehensive in scope and effective in helping to manage the impacts of production losses, severe market volatility, extreme events and disasters. The intent is to give producers confidence to invest in their farm businesses to manage risks that are less severe and contribute to making the sector competitive, innovative and adaptable.

**Policy Issue Statement and Questions:**

One intended benefit of BRM programs is to encourage investment in Ontario’s farm operations to innovate and increase competitiveness within a highly volatile sector that is significantly impacted by weather and world markets.

- Do Ontario’s BRM programs provide a suitable business climate of confidence to invest?
- How would one assess the optimal level of assurance that provides producers with the confidence to make long-term investments in their operations?
How effective are BRM programs in encouraging agricultural producers to make long-term investments impacting productivity or profitability in their operations?

Assess the effectiveness of BRM programs in encouraging agricultural producers to make investments in public goods in their operations, such as environmentally sustainable management practices?

**Expected Outcome:**
Provide evidence to show the impact of BRM programs and long-term investment tendencies of producers.

**B. STEWARDSHIP**

**B1. Climate Change Mitigation**
Where possible, climate change related research will build on and/or link with relevant work completed or underway by other ministries, primarily the Ministry of the Environment and Climate Change (MOECC). OMAFRA will facilitate inter-ministerial linkages as appropriate.

**2.2.7. Food Waste in Agri-Food**

**Policy Objective:**
Minimize agriculture and food’s contribution to climate change and support industry compliance with Bill 151, the Waste-Free Ontario Act.

**Policy Issue Statement and Questions:**
Ontario’s food and beverage processing sector (FBP) is the 2nd largest manufacturing industry in the province, contributing $11.7 billion in GDP (2014) and employing 95,457 people (2015). The sector has strong potential to further enhance its competitiveness and significantly reduce greenhouse gas (GHG) emissions if it takes steps to reduce waste and improve energy/water-use efficiency. In Canada, a significant amount of organic/food waste produced by FBP businesses ends up in landfill, contributing to GHG emissions. Of the total waste produced by the agri-food value chain, almost 18 per cent\(^4\) is contributed by FBP sector.

Ontario has recently adopted two key policy measures to move towards a low-carbon (Climate Change Action Plan) and waste-free economy (Waste-Free Ontario Act, 2016). These policy developments present an excellent opportunity for Ontario’s FBP sector to reduce its organic food waste footprint, thereby reducing its contribution to GHG emissions and improve waste management.

- How much organic waste is produced annually by Ontario’s FBP businesses?
- What is the proportion of avoidable and unavoidable waste of the total organic waste produced annually by the sector?
  - How does it compare to competitor sectors in other jurisdictions?
- What efforts are underway within the sector to reduce/recycle/re-use waste?

What are competitors doing in other jurisdictions? How could some of the best-in-class organic waste reduction/recycling/re-use practices, policies, technologies be adopted by the sector in Ontario?

**Expected Outcome:**

Fill a critical data gap related to food waste and its impact on climate change.

### 2.2.8. Opportunities for the Agriculture and Food Sector to Transition to a Low-carbon Future

**Policy Objective:**

Identify opportunities to target incentives for greenhouse gas (GHG) reduction initiatives in agriculture and food, which support the objectives of the Climate Change Action Plan. The research will be used to inform development of future programs, and provide analysis to guide sector investments, help reduce GHG emissions, and support their ability to compete and thrive in a low-carbon economy.

**Policy Issue Statement:**

Ontario has committed to reduce greenhouse gas emissions by 37 per cent below 1990 levels by 2030, and by 80 per cent by 2050. Ontario’s Climate Change Action Plan has identified some early actions for agriculture to achieve GHG reduction towards the 2020 reduction target. To achieve these targets, government has developed an ambitious Climate Change Strategy and Action Plan which takes a sector-by-sector approach. To support government’s commitments, revenues generated under the cap and trade program will be reinvested across the economy to support innovation and low-carbon technology adoption. Meanwhile, the market is increasingly pressuring all businesses to demonstrate their products are sustainably produced.

There are limited data regarding Ontario’s agriculture and food sector emission sources and sinks. There is a need to gather data to identify areas of greatest opportunity for the agri-food sector and rural communities to be part of the solution. More data are required to understand where the greatest opportunities are to focus investments in the agri-food sector, achieve GHG emission reductions, and benchmark against a ‘business as usual’ approach and measure future progress.

The key challenge for the sector in the coming decades will be achieving continued economic growth and increasing food production at the current rate of energy, resource and land use (input versus output efficiency). To remain productive and competitive while growing, the sector will need to transition to reduce agriculture’s carbon footprint.

**Policy Questions:**

Research projects should address one or more of the following:

- What is the relative potential for GHG emission reduction from on farm practices (e.g. conservation tillage, cover cropping) by type of production system- in isolation, and as a suite of complementary activities as part of a systems approach?
o What are the most cost-effective GHG reduction measures (technology or practice) with the greatest number of co-benefits (economic, social, environmental) – by commodity and/or production system and/or product? Are there opportunities to tailor solutions at the regional or landscape level?
o Where can the government have the greatest impact in fostering the solutions, and how?
o What are the key obstacles to behaviour change, and how can government help industry overcome them? Based on current best practices and available technology, how much could Ontario’s agriculture and food sector emissions be minimized by 2020, 2030, and 2050, while achieving Ontario’s agri-food economic growth targets?
o Which types of agriculture and food production will have an advantage and which will have a disadvantage in a low carbon future?
o How can Ontario optimize what mix of food (e.g. livestock versus alternative protein sources)/bio-products it produces and how (e.g. field crop versus greenhouses or other indoor system) – for the best economic, social (with a focus on food security) and environmental outcomes?

Expected Outcome:
o Comprehensive evidence to demonstrate and measure the performance of OMAFRA’s contributions to the Climate Change Strategy and Action Plan, and to support prioritization of focus areas and policy tools.
o Comprehensive evidence to be used in the Soils Strategy to guide recommendations and actions.
o Food will be produced with fewer fossil-inputs (lower emissions intensity), and biological emissions will be reduced through increased uptake of best practices and technology.

B2. Climate Change Adaptation

2.2.9. Food and Beverage Processing & Bio-economy

Policy Objective:
Ontario’s food and beverage processing sector (FBP) and the Bio-economy are predominantly composed of small-to-medium-sized enterprises (SMEs) – almost 99 per cent of the businesses. Both these sectors are important economic drivers for the agri-food value chain. The recent shift in Ontario’s policy environment with the introduction of the Climate Change Strategy (including the Climate Change Action Plan and the cap and trade system) presents potential challenges as well as opportunities for these businesses in terms of their competitiveness. However, the ministry currently does not have access to data to assess the competitiveness challenges and/or opportunities in terms of business size. Research is needed to fill this information/data gap, and to enable the ministry to develop evidence-based policy and programs to enhance sector competitiveness as they transition to a low-carbon business model.

Policy Issue Statement and Questions:
o How does GHG emissions reduction and affiliated process/technology innovation impact firm level competitiveness by size (small, medium and large) in the short, medium and long term?
What do experiences of firms (by size) in other jurisdictions (e.g., British Columbia, Québec and California) tell us in this regard?

- How do changes to environmental or other policies (e.g. labour) affect a firm's bottom line and its decision to further invest, consolidate or move production to another jurisdiction?
- Do the factors that influence decision-making change depending on the size of the firm?

Notes:

- Researchers are expected to consider the above noted changes within the broader policy environment (e.g. the cumulative impact of the Ontario minimum wage, Waste-free Ontario Act and electricity prices relative to other jurisdictions).
- Researchers are expected to acquire firm-level data using collection tools (e.g. surveys), develop firm specific case studies and a firm-level database that can be updated over time.
- Researchers should recognize that access to firm-level data would enable researchers to investigate other questions (e.g. R&D could be connected to innovation in recycling, improved productivity and reduced GHGs).

Expected Outcome:

Fill a critical data/information gap related to a low-carbon shift in FBP and Bio-economy sectors to inform future policy and program initiatives, including through waste management.

2.2.10. Resilience in the Food Production System:

Policy Objective:

Increase our understanding of food security risks and opportunities over time, to guide policies that will build food system resilience to climate change impacts, in order to support food security for future generations.

Policy Issue Statement

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.

Climate change is impacting food production in Ontario and globally. While putting a price on carbon will help mitigate the impacts of climate change, it could also directly and indirectly impact all sectors of the economy, and will have the most impact on those who are more fossil energy dependent.

Policy Questions:

Research projects should address one or more of the following:

- How will global climate change affect food security in Ontario, and how can the government help ensure food security for future generations in light of those changes?
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, under Ontario’s cap and trade program?

What are the impacts at the regional or landscape level and are there opportunities to tailor solutions? For example, by including considerations for vulnerable populations such as remote and/or indigenous communities in the Northern Ontario.

What measures should be applied and what methods should be used to update this analysis over time, as new information becomes available?

**Expected Outcome:**

- Evidence to support delivery of OMAFRA’s climate change adaptation action plan commitments and the Climate Change Strategy.
- New information for stakeholders that will guide their decisions in adopting new technology and practices.

### 2.2.11. 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:**

**a) Agricultural Soil**

OMAFRA is working with industry stakeholders to develop an Agricultural Soil Health and Conservation strategy in response to increasing concerns over declining soil health through loss of organic matter and loss of soil structure leading to erosion risk. Long-term reduction in forages and pasture, simplification of crop rotations, increases in fall tillage and other factors are thought to be the causes of this change. Reversing these trends poses economic, social, technological, environmental and scientific challenges. A new systems approach to cropping to build soil health can be challenging to current approaches. On-farm learning systems, experimentation and advice appear to be important factors in stimulating change and supporting the longer-term implementation of the soils strategy.

- What has research revealed to date about the state of soil health in the range of Ontario soils (e.g. soil organic matter, fertility, soil structure)?
- What are the trends in cropping practices affecting soil health, including changing types of crop rotation, changing crop types, fall and spring tillage?
- What are the long and short-term economics associated with adoption of a system of practices benefiting soil health, evidence from elsewhere and from Canada and Ontario?
- What is the return on investment in terms of time and money for farm managers adopting soil health practices (e.g. impact of implementing conservation tillage, cover cropping, soil amendments, improving soil ecology etc. on productivity and inputs required, carbon sequestration and GHG emissions, and water quality etc.)?
- What are the factors that influence a farmer’s management choices in cropping and soil management? (e.g. short or long term economics, social factors, family and social
relationships, management experience etc.) What types of learning approaches and knowledge transfer best suit adoption of systems of practices to benefit soil health (social science, marketing research, adult education)?

- How do current business risk management programs like crop insurance affect adoption of new practices to benefit soil health? Would change in program parameters foster change?
- What types of tools, incentives or strategies would be the most effective in encouraging farmers to make changes to their management practices with the intent to improve/maintain soil health?

Expected Outcome:

Effective evidence to be used in the development of policies to support Great Lakes water quality, improvements to soil health as well as all policy/program work related to the effective implementation of on-farm best management practices.

It is expected that researchers will compare current evidence with past studies.

**b) Environment**

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 while minimizing environmental impacts of agricultural production.

Lake Erie is the smallest in volume and shallowest of the Great Lakes, and has the closest proximity to agricultural production, placing it under a high degree of stress. As a result it is the warmest and most biologically productive, creating ideal conditions for algal growth.

For more than a decade, the occurrence of toxic and nuisance algae blooms in Lake Erie has been increasing. The increased occurrence of algal blooms in Lake Erie is influenced by many factors including excess nutrients, climate change and invasive species. Phosphorus is the primary nutrient driving increased algal blooms in the Lake and comes from multiple sources, including both urban and rural.

All sectors will have a role to play in improving the health of Lake Erie. In terms of the land base, agricultural land uses make up more than 75% of the land area delivering non-point sources of Phosphorus to Lake Erie. The agriculture sector will need to address this challenge.

Policy Questions:

- What are the most effective tools (e.g., education and outreach, incentives, disincentives, legislation etc.) to improve Great Lakes water quality and reduce loss of nutrients from agriculture land (e.g. nutrient management, soil management, water management/drainage, etc.)?
- How effective is a voluntary approach to adopting best management practices in achieving long-term change in behaviour?
- What policies and strategies are most effective in helping the agriculture sector capture multiple benefits related to climate change, water quality and soil health?

Expected Outcome:
Best available science will be used in the development and assessment of policies and programs to support Great Lakes water quality, and reduction in phosphorus loss.

C. PROTECTION ASSURANCE

2.2.12. Anti-Microbial Resistance

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

Policy Issue Statement and Questions:
- What changes in current husbandry/management practices along with the minimal use of antimicrobials would be required for specific commodities to raise poultry and livestock?
- What are the costs and benefits of alternative husbandry/management practices related to minimal use of antimicrobials?
- What policy tools (e.g., education, incentives, and legislation) would be most effective from a cost and sustainability perspective to help the agriculture sector adapt to instituting these changes?

Expected Outcome:
Prioritize risk management options, provide information and support for evidence-based decisions and food safety and animal health policy development.

2.3 Sustainable Rural Communities and Economies

2.3.1. Climate Change and Rural Communities

Policy Objective:
In the context of a changing climate, develop a better understanding of rural community resiliency and vulnerability and identify challenges and opportunities for Ontario’s rural communities to be active participants in a low-carbon economy.

Policy Issue Statement:
Dealing with climate change impacts over the long term has become a focus for governments at all levels in Canada. Ontario has committed to reduce greenhouse gas emissions by 37 per cent below 1990 levels by 2030, and by 80 per cent by 2050. To achieve these targets, the government (led by the Ministry of Environment and Climate Change) has released a climate change strategy and action plan. Meanwhile, businesses, communities and residents will need to leverage constructive solutions to reduce their carbon footprint. All levels of government and sectors are expected to contribute to the solutions.

Rural areas of the province may face unique challenges including limited capacity (financial, technical and human resources) to not only plan for and mitigate climate change impacts (e.g.
innovations to reduce emissions) at the local level, but there may also be greater vulnerability and limited ability to respond and adjust to economic or physical shocks (e.g. extreme weather events, higher energy costs) resulting from climate change. There may be opportunities for urban Ontario to leverage the assets of rural Ontario (e.g. offsets) for GHG reduction. Identifying programs and initiatives that foster these carbon reduction activities can help to ensure that rural Ontario communities are active participants and beneficiaries of Ontario’s drive towards a low-carbon economy.

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:

- What are the key factors and components of rural community ‘resiliency’ and ‘vulnerability’ (e.g. environmental, economic, demographic, social, organizational, etc.)? The research should include a summary of current literature and jurisdictional approaches to defining and measuring these concepts, including an examination of key indicators and performance measures and their strengths/weaknesses, what is already being done, and where the gaps are.
- Can the provincial government play a role to enhance resiliency and decrease vulnerability?
- What are the implications of a low carbon future for rural communities, and what are the greatest opportunities, strategies, initiatives or activities for rural communities to lower their emission intensity while achieving economic and social objectives?

Expected Outcome:

The research will identify the conditions/parameters/metrics for assessing vulnerability and resilience in rural communities in the Ontario context. Research will also identify strategic opportunities for rural Ontario communities to be active participants in Ontario’s low-carbon economy. 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).

2.3.2. Economic Sustainability of Rural Communities

Policy Objective:

To better understand what success in Ontario’s rural communities will look like in the future, how we can measure that success against a commonly understood baseline, and what opportunities exist for targeted and effective government support and intervention to enable rural community growth going forward.

Policy Issue Statement:

Policy makers are tasked with developing policies, programs and services that help to enable community and economic success. However, it can be difficult for decision makers to know exactly what levels of intervention are needed to help communities to succeed, especially in a rapidly changing environment. How do we know if we are moving the bar forward? Furthermore, it can be difficult to know what the key drivers are for community success and how to measure that success over time.
Communities and regions possess their own strengths and vulnerabilities that enable them to thrive or not thrive. Further information is needed beyond the available data and statistics that can tell us if communities are successful, what the future state of rural Ontario could look like, and how government can best support communities to be successful in the future.

**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:

- How do other jurisdictions define their objectives for rural development?
  - How can jurisdictions work together on common issues?
  - Are these other jurisdictions demonstrating success?
- What is the baseline for growth/success in rural Ontario? Is this information available at the community level? What impacts are current Provincial supports and funding having at the community level? How can we better measure these outcomes?
- Identify the drivers of change in rural communities of Ontario.
- What can we learn from the methods used in past policies and programs in order to create future economic opportunities for rural Ontario? i.e. which method was most effective? How should communities be targeted for policies and programs to support success/growth?

**Expected Outcome:**

The research will provide essential information to OMAFRA and the Province about how to better target support to rural communities to enable their success.

### 2.3.3. Rural Community/Agricultural System Interdependencies

**Policy Objective:**

To better understand the interplay and interdependencies between rural communities and the agricultural system and how this relationship can be leveraged for mutual success in Ontario.

**Policy Issue Statement:**

An agricultural system is a group of inter-connected elements that collectively create a viable, thriving agricultural sector. An agricultural system includes areas of productive and protected farmland as well as an agricultural support network that includes supportive infrastructure and vibrant, agriculture-supportive rural communities.

Research is required to better understand the role of rural communities in supporting the viability of the agricultural system, and vice versa. For example, rural communities may provide the agricultural sector with services, skilled workers, agriculture-supportive infrastructure such as transportation systems, retail opportunities, and agri-food related businesses that support the overall success of the sector. In turn, agricultural areas provide rural communities with customers, jobs, and farm products/feedstock. There is a need to account for and measure these interdependencies to enable government support in areas where there will be positive impact on the agriculture system and rural communities as a whole.
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:

- What information/data could be analyzed to characterize the interplay between rural communities and agriculture? What economic model would quantify this interdependency?
- What approaches have other jurisdictions taken to measure this relationship, and what actions have been undertaken as a result? How successful have these actions been?
- What are some current examples of rural communities that effectively support or attract a vibrant agricultural industry/community? What makes these communities successful in this role? Conversely, are there examples we could draw on where opportunities were missed? What has been the impact of government policy/investments (or lack thereof)?
- What are the critical requirements for a supportive socio-economic business environment?

Expected Outcome:

The research will provide essential information to OMAFRA and the Province about how to better target support to agricultural systems in Ontario.

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

- Climate change has been identified as a priority for other research themes as well.
- Researchers seeking help in identifying potential priorities and collaborators may contact University of Guelph’s Research Program Director or OMAFRA Theme Research Analyst.

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/feedstocks 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

#### 3.2.1. 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:

- 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;

- Development of new or improved crops beyond traditional or existing commodity crops. Examples include:
  - 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;
  - New crops or cultivars of existing crops for biofuel and other industrial applications, such as paints, coatings, lubricants and solvents applications;
  - Algae and agroforestry (e.g., use in bioproducts/processes linking benefit to agri-food sector and rural communities).
• Feedstock development, quality development, production optimization, storage and supply chain logistics of biobased feedstocks for biomaterials, biochemicals, and bioenergy.
• Biotechnology for improved agronomics and quality of raw materials for industrial uses.

3.2.2. 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:

• 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
• 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;
• 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);
• 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;
• 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).

3.2.3. 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:

- 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.

3.2.4. 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:

- Economic research on bioproducts (e.g. biochemicals/biomaterials/ Bioenergy). Specific examples include:
  - Feasibility of transitioning from conventional manufacturing to biobased or hybrid production using agricultural sources;
  - Economic viability of the development of bioproducts (biochemicals, biomaterials, bioenergy) including the biorefinery concept, full utilization concept, or implications of public policy;
  - Barriers to scaling up of biochemical/biomaterial industries;
  - 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;
  - Identification of gaps (economic, technology and infrastructure) in bioproduct value chains;
  - Economics and barriers of using waste stream materials and other feedstock;
  - Scan and inventory of regulatory requirements for any bioproducts or process to reach commercial viability.

- 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:
  - 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);
  - 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).

- 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.

- 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).
- Researchers seeking help in identifying potential priorities and collaborators may contact UofGuelph’s Research Program Director or OMAFRA Theme Research Analyst.
4: Emergency Management

4.1 Definition and Scope of the Theme

The Emergency Management research theme focuses on emerging, re-emerging or endemic pathogens and pests in livestock and crops that require (or may require) an immediate and comprehensive response for containment that cannot be handled with typical resources. The theme is rooted in “One Health” at the interface of livestock, ecosystem and human health. The Emergency Management research theme has an emphasis on evaluating and mitigating the impact of emergencies on Ontario’s agricultural sector and related public health through the lens of the core components of emergency management: prevention, preparedness, mitigation, response and recovery.

Note: Research related to food safety is funded outside of the OMAFRA/UofG Partnership, through the OMAFRA Food Safety Research Program. Applicants interested in applying for funding for food safety projects should apply to that program. The next call for proposals is anticipated in spring 2017.

4.2 Emergency Management Research Priorities

The research priority areas for the Emergency Management Research Theme are:

- Economic Analysis
- Threat Identification and Prioritization
- Detection and Surveillance
- Pathway Analysis
- Prevention and Control of Pathogens and Pests.

Successful research proposals will align strongly with at least one of the specific research needs identified in the following priority areas.

4.2.1. ECONOMIC ANALYSIS

Emergency management initiatives and policies need to achieve their intended benefits while being cost effective for the agricultural sector. Information regarding the economic impact of emergencies is needed to weigh the costs and benefits of investing in emergency management to support the agricultural sector and protect public health.

Specific research needs:

- Quantify the costs and evaluate the effectiveness of emergency management best practices through analysis of emergency situations world-wide to identify and/or develop appropriate economic tools to guide emergency management resource allocation.
• Estimate the potential economic impact of emergencies 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.

• Evaluate the economic impact of changes in animal management practices that may result from trade negotiations as they relate to animal and product security, biosecurity, traceability and movement. (e.g. What impact would changes to supply management have on the cost of managing an emergency?)

4.2.2. THREAT IDENTIFICATION AND PRIORITIZATION

There is a need to identify and prioritize emerging, re-emerging or endemic pathogens and pests that require (or may require) an immediate and comprehensive response for containment that cannot be handled with typical resources. It is also important to understand the conditions under which these pathogens and pests may become a threat (e.g. due to changes in the environment). Results of this research will guide and facilitate optimization of resources to strategically manage risk to commercial agriculture and public health.

Specific research needs:

• Identify and prioritize the impact of changing environmental factors (including climate change) on the distribution and spread of pathogens and pests.

• Identify and describe the effect of policy decisions, production and management practices on threats to agriculture and related public health within the scope of this theme (see 4.1).

• Identify and quantify the risks of new or expanding transmission pathways or distribution patterns of pathogens and pests.

• Define and quantify the risk of pests and pathogens to agriculture and/or public health associated with the increase in the production of food in urban areas.

4.2.3. DETECTION AND SURVEILLANCE

Surveillance is important to animal, plant and public health and essential to ensuring the safe trade of plants, livestock, and animal and food products. Detection and surveillance of pathogens and pests helps to facilitate a timely response to changes in frequency and distribution.

Specific research needs:

o Define and collect baseline data about pathogens and pests within the definition and scope of this theme (see 4.1).

o Identify, evaluate and where appropriate merge existing data sources (e.g. agriculture and livestock sources, veterinarians, non-government organizations) 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.

o Identify and evaluate efficient and effective risk–based detection and surveillance methods and technologies.
• Detection and surveillance for antimicrobial resistance and pesticide resistance within the scope of this theme (see 4.1).

4.2.4. PATHWAY ANALYSIS

Pathway analysis is a systematic assessment of the pathways along which a pathogen or pest might enter or move within and between Ontario farms resulting in an outbreak in plants, animals or humans.

Specific research needs:

• Identify and model transmission factors for pathogens and pests that pose a threat to Ontario agriculture and public health within the definition and scope of this theme (see 4.1).

• Identify and describe transmission or distribution pathways that facilitate the spread of pathogens and pests within the definition and scope of this theme (see 4.1 - above).

4.2.5. PREVENTION AND CONTROL OF PATHOGENS AND PESTS

Preventing the introduction of a pathogen or pest 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 that are affordable and can be broadly implemented are required. Research is required to support the development of new products, new approaches and best management practices.

Specific research needs:

• Develop effective prevention and control measures for pathogens and pests within the definition and scope of this theme (see 4.1 - above).

• Assess barriers/facilitators to the adoption of prevention and control methods within the scope of this theme (see 4.1). Example includes (but is not limited to) the impact of data confidentiality during an emergency.

• Emergency management response. Research needs include:
  • Identify and evaluate best practices for emergency management communications that considers the diverse stakeholders involved in the emergencies.
  • Research and development of efficacious strategies to support emergency response. Examples include (but are not limited to) development diagnostic tests and vaccines.
  • Evaluation and comparative analysis of emergency control measures.
  • Development and evaluation of humane methods for the mass destruction and disposal of livestock which minimize environmental impact.

• Assess the efficacy of existing traceability systems.
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 is focused on three main priority areas as given below.

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

The above three priorities are built on a continuous improvement 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.

![Environmental Sustainability Research Continuum](image)

**Figure 7.1: Environmental Sustainability Research Continuum**

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.

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

An understanding of science that influences biophysical processes and resiliency of the agri-food system is necessary for environmental sustainability. Data and information that relate, describe and quantify environmental, economic and societal/behavioural changes of the agri-food system due to different drivers and stressors 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). Therefore, a detailed understanding of these relationships allows more effective management strategies. The role of various land use and agri-food practices on the quantity, fate and pathway of contaminants, and soil health needs to be understood and
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, such as opportunities for expanding agriculture to the north, carbon sequestration and soil health, 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. Research projects need to consider linkages and collection of holistic and integrated datasets for soil, air, water, biodiversity, land management and economics, facilitating understanding of cumulative effects.

This research area will:

- Explain and quantify how drivers and stressors affect various biophysical processes of the agri-food production system. The examples of drivers and stressors include:
  - changing production practices,
  - land use,
  - climate change,
  - energy,
  - drainage,
  - farm enterprise composition and ownership,
  - increased market competition,
  - end-consumer influence,
  - technologies like precision technology, biotechnology,
  - species diversity legislation,
  - Great Lakes water quality - particularly as it relates to phosphorus.

- Quantify the impacts (benefits and risks) of agri-food production practices on soil, water, air and biodiversity. The topics of research include:
  - impacts on soil health,
  - soil degradation and loss,
  - soil carbon sequestration,
  - water quality and quantity,
  - odour, particulate matter and GHG emission, and
  - wild pollinators.

- Deliver cost-effective and efficient methods to measure the changes in the biophysical processes 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.

5.2.2. MANAGING EFFECTS OF THE AGRI-FOOD SYSTEM USING BEST MANAGEMENT PRACTICES (BMP) THAT MEASURE ECONOMIC, ENVIRONMENTAL AND SOCIAL IMPLICATIONS

This research area supports the development of scientifically credible and cost-effective BMPs including recommendations for their transferability, prioritization and placement. The goal is to thereby reduce adverse effects or accrue benefits of agri-food production. Evaluation and
validation projects are desirable even though a practice may not be considered “new or innovative”. 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 or other benefits.

This research area also 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.

Continued development, evaluation and validation of BMPs are important to quantify trade-offs between soil/water/air/biodiversity impacts and environmental/economic/social/behavioral aspects of a practice.

This research area will:

- Develop new (or improve existing) methods, practice, farm level decision support tools, and technologies to reduce environmental risks and capture opportunities (including food safety, carbon sequestration) from economically sustainable agri-food production.
- Identify indicators or metrics to measure environmental, economic, social and biodiversity benefits or consequences of agri-food system management.
- Evaluate potential impacts of multiple BMPs and market opportunities of environmental stewardship facilitating greater use of BMPs.
- Analyze producer behaviour and willingness to adopt BMPs for policy, program development and KTT (Knowledge Translation and Transfer) leading to greater adoption of best practices.
- Assess the impact of various environmental policies, practice and technologies in Ontario for agricultural production and food processing.
- Understand the impact of BMPs/changes on the whole farm system including economics, practices, biodiversity, market opportunities, social license etc.
- Analyze and provide foresight on market opportunities for agricultural production that pertains specifically to environmental stewardship and sustainability.

5.2.3. MEASURING PROVINCIAL IMPACT AND DEFINING OPTIMUM AGRI-FOOD PRODUCTION SYSTEMS

Once we understand and quantify the underlying biophysical processes and adopt best practices to manage the agri-food system, it is important to measure agriculture and food’s ability to effect changes that meets social, economic and environmental goals. There is a need to confirm that environmental improvements expected through BMP adoption are being achieved at different scales and in different combinations. This research uses risk/benefit assessment to define realistic options and develop what level of BMP adoption is required. It answers the questions “So what” by defining agri-environmental targets and the additional value or consequences for
practices outside this range. 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 that considers foresight or scenario development, and beyond the farm to sector to provincial scale.

This research area will:

- Forecast what level of BMP adoption is necessary to achieve desired environmental outcomes considering critical areas, critical mass for change and benchmarking for potential to effect change.
- Define the targets, confidence level and limitations for achieving soil, air, water and biodiversity quality to support sustainable agri-food production.
- Develop accountability to support provincial targets for environmental benefits. If we are not seeing a change why not?
- Create realistic options that support provincial scale BMP adoption by answering how and what is needed from farmers, food producers and land managers.

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

- **Climate change** research priority is addressed by all the other research themes.
- Researchers seeking help in identifying potential priorities and collaborators may contact UofGuelph’s Research Program Director or OMAFRA Theme Research Analyst.
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 agri-food products, and/or
- increased competitiveness of Ontario’s agriculture and food sectors through food for health

Research into food production, processing, distribution, retailing, access, and skills needs to be undertaken to improve Ontarians’ health, help reduce health care costs associated with diet, and improve market opportunities for Ontario growers, manufacturers and related businesses.

Projects should demonstrate:

1. Collaborations with industry, grower groups, other researchers and/or Ontario food for health initiatives;
2. An established audience for the outcomes from the research proposal to show the research is demand driven;
3. Benefits to Ontario are in each research proposal. Benefits (economic, social, environmental, competitiveness etc.) must be specific and targeted to an identified audience.

Note:

Any projects under the Food for Health research theme developing a product (product, technology or service) are asked to include an analysis of the market opportunity for the product to create value for Ontario, called a Value Assessment Plan (VAP). The VAP includes components such as the stakeholder or group anticipated to benefit, the potential path to market, etc. that need to be considered in the early stages of the product development process. See the Products and Value Chains research theme section of this document for more detail about preparing a VAP. Researchers may also wish to review the Products and Value Chains research theme priorities to consider an application to or in part to that theme.

6.2 Food for Health Research Priorities

6.2.1. POLICY, REGULATIONS, INVESTMENT, AND THE ECONOMY

This priority focuses on research that increases competitiveness for Ontario’s agriculture and food sectors related to food for health, and/or improves Ontarians’ health through food. A key audience for this research is OMAFRA program and policy staff.

Proposals should focus on one or more of the following:
- Evaluate the benefit to Ontario of serving freshly-prepared meals made from fresh, locally available foods, in hospitals.
  - Consideration should be given to multiple end points, such as but not limited to seasonality, cost of fresh locally available food, institutional budgets for food, patient health outcomes, patient satisfaction, patient supplementation, reducing food waste and environmental footprint.
- What opportunities exist to create jobs in Ontario that relate to food for health?
- How do climate change and/or sustainable food production interact with food for health and access to healthful food in Ontario? For example: soil health.
- Examine how to improve Ontarians’ health using behaviour change theories related to food (i.e. nudge based approach to reduce obesity; social license and public trust).
- How does technology (QR Codes; smart phones and websites, etc) influence information sharing and inform consumer choice?
  - Does smart phone technology, additional information and logos on packages reduce awareness of mandatory on-label health messages (i.e. allergen warnings, nutrition facts table, health claims)?
  - Are third-party endorsement systems that address consumer values and perceptions (i.e. fair trade; animal welfare; GMO free; halal; vegan, etc.) perceived as trustworthy and credible as other types of information on food packages.
- Identify, scan and analyze a model or models from other jurisdictions (i.e. Food Valley) that could be adapted to Ontario to improve Ontarians’ health through food and/or increase competitiveness for Ontario’s agriculture and food sectors related to food for health.

6.2.3. CONSUMERS AND HEALTHY CHOICES

This priority seeks to examine the opportunities and challenges facing consumers when choosing and utilizing healthful foods.

Proposals should focus on one or more of the following:

- Creation of tools to measure attributes of food literacy* and food skills** within the local food and public health context in order to reach consensus about the level of food literacy and food skills held by Ontarians. Consumer motivation to apply food literacy and food skills should also be a consideration.
- Appropriate models to determine the actual or estimated number of Ontarians who prepare meals with local food for family and friends, and/or make local food more available through food service providers.
- How to encourage healthy eating behaviours (i.e. nudge based behavior change, specific food skills).
- Apply the above sub-priorities (a), (b), and/or (c)) to Indigenous communities’ traditional foods in Northern Ontario. For example, traditional food literacy and food skills and their
relationship to healthful eating and development of local/regional food systems; the role that traditional and local foods could play in addressing health outcomes – including mental health.

* **Food literacy** is the ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan in order to navigate, engage, and participate within a complex food system. It’s the ability to make decisions to support the achievement of personal health and a sustainable food system considering environmental, social, economic, cultural and political components. *Reference – Cullen, T. et al. Food Literacy: Definition and Framework for Action. Canadian Journal of Dietetic Practice and Research, 2015, 76(3): 140-145. http://dcjournal.ca/doi/abs/10.3148/cjdpr-2015-010*

** "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)**

### 6.2.4. UNDERSTANDING LINKAGES BETWEEN FOOD AND HEALTH

This priority represents research projects that build on or evaluate existing programs, policies or projects to benefit Ontarians’ health and/or Ontario’s agri-food sector competitiveness related to food for health.

Research applications under this priority area must make a strong, specific case for the research outcomes’ benefits to Ontario and for the relevance to the previously-funded initiative.

Proposals should focus on a food for health aspect of one or more of the following:

- Demonstrate direct linkage and relevance to an existing Ontario program or policy in food and/or health, such as but not limited to: the Healthy Kids’ Strategy; Healthy Kids’ Community Challenge; Ontario School Food and Beverage Policy; Student Nutrition Program; First Nations Student Nutrition Program; Northern Fruit and Vegetable Program; Making Healthier Choices Act (menu labelling); Local Food Act; Growth Plan for Northern Ontario; and Ontario’s Climate Change Action Plan; or
- Build on one or multiple projects previously funded by the Greenbelt Fund, the Local Food Fund, Growing Forward II or the Ontario Trillium Foundation.

In preparing your proposal for this research priority area, consider:

- Collaboration and/or partnership is required (i.e. with the previously-funded initiative, with a stakeholder who could benefit from the research)*
- Clinical trials or other relevant research models that can assess or build on the impact to Ontarians’ health of the previously-funded initiative linked to your project, fit under this priority area.
- A letter of support from a relevant government ministry or third party agency administering a grant program or project (i.e. Greenbelt Fund, Ontario Trillium Foundation Grant Recipient) is encouraged with the application to indicate the value of the proposed research.

* Depending on the nature of the research, care should be taken to ensure third-party relationship(s) in the case of an evaluation of a program, policy or project.
**Note to Researchers**: Please note the following linkages to priorities described in other themes to identify potential synergies and opportunities:

- **Climate change priorities** are also addressed in all the other research themes.
- *Researchers seeking help in identifying potential priorities and collaborators may contact UofGuelph’s Research Program Director or OMAFRA Theme Research Analyst.*
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 for 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 more developed 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/for the marketplace (i.e. food products, enhanced agricultural commodities, retail technologies, processing technologies, robotics, etc.);
- 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, using a multi-disciplinary approach, and engaging early with any collaborators who can increase the likelihood of the product and/or value chain entering the marketplace and/or being valuable to Ontario industry. Successful projects will demonstrate that appropriate links have been made between the laboratory and the market place.

Research projects funded under this theme have to address an opportunity or solve a problem in a manner that creates value.

Proposals must include a Value Assessment Plan (VAP). The goal of the VAP is to demonstrate the value (as defined above), of your proposed project and to identify and communicate the thinking and planning required for product or value chain development success. Please see below how to complete a Value Assessment Plan.
**HOW TO COMPLETE A VALUE ASSESSMENT PLAN:**

<table>
<thead>
<tr>
<th>Value Assessment Plan ELEMENT 1 – to be completed as a part of the Letter of Intent</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIE assessment – How will the proposed research affect Productivity, Innovation and Exports/Domestic Market (PIE)? All Letters of Intent (and full proposals), should include a PIE assessment in the rationale and/or benefits section of the letter of intent and full proposal:</td>
</tr>
<tr>
<td>a) <strong>Productivity</strong>: Will a business be able to sell more, reduce costs or use resources more efficiently or effectively as a result of the project? Will the project support a highly-skilled workforce or the development of leading edge technology?</td>
</tr>
<tr>
<td>b) <strong>Innovation</strong>: Does the project provide something new or different than what is available in the market, thus creating more consumer or business choice? Does it foster collaboration between partners?</td>
</tr>
<tr>
<td>c) <strong>Exports/Domestic Market</strong>: Does the project increase the revenue or market share of Ontario companies abroad? Does it foster international and interprovincial trade? Or allow for expanded domestic markets?</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Value Assessment Plan ELEMENT 2 – include with the Letter of Intent or, if not ready at that time, incorporate it into the project (i.e. as milestones)</th>
</tr>
</thead>
<tbody>
<tr>
<td>How will the proposed research project address an opportunity or solve a problem in a manner that creates value?</td>
</tr>
<tr>
<td>a) Ideally, this can be answered as part of the Letter of Intent if the applicant has already considered the four questions listed under b), below. It should be presented as a Value Assessment Plan document uploaded with the proposal or as a detailed support letter from a stakeholder. It could be a business plan or a competitiveness plan previously conducted for this project.</td>
</tr>
<tr>
<td>b) If not ready at the Letter of Intent stage, then the Letter of Intent should include how and when the components listed below, that are relevant to your research, will be included in your project. (i.e. general value proposition will be completed by The Centre for Business and Student Enterprise (CBaSE) at the University of Guelph in year 1, Market Value Proposition will be completed by …in year 2, a business case will be completed in year 3, etc.). This should be written into your proposal across relevant sections of the application (i.e. Benefits, Milestone, Methods, Team Members, etc.)</td>
</tr>
<tr>
<td>1. <strong>General value proposition.</strong> How is your project idea going to contribute value to Ontario’s agriculture, food and/or rural sectors? What type of value will it create and how will you measure it?</td>
</tr>
</tbody>
</table>
| 2. **Market value proposition.** Who will pay for the product, service or technology that you
**Value Assessment Plan ELEMENT 2** – include with the Letter of Intent or, if not ready at that time, incorporate it into the project (i.e. as milestones)

- 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. **What is the opportunity analysis (‘business case’) for the proposed research?**

   i) Do you have a vision for the product or value chain being researched?

   ii) What are your strategic goals to achieve the development and assessment of the product or value chain being researched?

   iii) Which products and markets are relevant to the product or value chain you are developing?

   iv) What type of competition exists for your proposed product or value chain? If none, ask yourself “why not?”

   v) How will other organizations in the value chain be affected?

   vi) Do organizations in Ontario have the ability and interest to produce the product or implement the value chain, following the completion of the research project?

   vii) What other research and development may be needed for the proposed product or value chain to continue to be successful after this project is completed? (I.e. what equipment/technology is required for the product and/or processing? Is it commonly used in the industry? If not, is R&D required for manufacture?)

   viii) Are there human resources considerations such as the skill level of staff that will be required to contribute to the impact of this project’s outcomes? If job creation is expected from this project, please indicate that as well.

   ix) What financing is required for this research project to go from idea to impact for Ontario, including this research project and what can be forecasted beyond it? Also, include general or specific details of product pricing considerations if they can be made at this time.

   x) What regulatory conditions will be important for this product or value chain research to result in an impact for Ontario?

   xi) What governance and structure will be used for the partnerships formed to complete this project and afterwards?

   xii) Are there considerations required regarding health and safety programs for this product or value chain?

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

You can develop your own Value Assessment Plan format to include the items from b) or, depending on your project, you may benefit from adapting one of the many guides and templates that are available online at government, bank, university and consultant’s websites for creating a business plan (i.e. [http://www.canadabusiness.ca/eng/page/2752/](http://www.canadabusiness.ca/eng/page/2752/))
**Value Assessment Plan ELEMENT 3** - include with the Letter of Intent or, if not ready at that time, incorporate it into the project (i.e. team members)

1. Who can you partner with outside of your project team to conduct the assessments from b) above that are relevant to your project during year 1, 2 or 3 or is there a member of your team who can conduct these assessments? And when during year 1, 2 or 3 will these assessments occur? (Include in relevant sections of the application i.e. team members table, methods).

   Some local organizations that may be able to assist you in your opportunity analysis or the larger Value Assessment Plan are BioEnterprise Corporation, NSF-GFTC, CBaSE at the University of Guelph and the Catalyst Centre at the University of Guelph.

Whether submitting your project to the 1. Product Development and Assessment or the 2. Value Chain Development and Assessment priority, the **Value Assessment Plan** is a requirement that applies to both. The request for a **Value Assessment Plan** to accompany your research is for you or a partner of your research project to communicate how far into the future you can predict the outcomes of your research, how long you anticipate until impact for Ontario from this project, and what impact you expect for Ontario, in as much detail as is available to you. A few resources to assist you in preparing your **Value Assessment Plan** are: CBase at the University of Guelph, Catalyst Centre at the University of Guelph, BioEnterprise Corporation and NSF-GFTC.

**7.2 Products and Value Chains Research Priorities**

**7.2.1. 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. Make connections/partnerships to increase the potential for your research to have a beneficial impact for Ontario.

Proposals should focus on one or more of the following:

- An in-depth research analysis of a product or value chain outlining the economic feasibility and benefits for Ontario agriculture, food and rural sectors (above and beyond those conducted in the Value Assessment Plan). Aspects of your work might include: Intellectual property analysis; product development process analysis; analysis of opportunities for improvements related to climate change; technical feasibility study on ingredient supply (commercial) and availability, equipment, process, packaging, shelf-life etc; and scale-up analysis for Ontario agri-foods.

- Develop a prototype that is ready to be commercialized.

- Investigate climate change/sustainability related to a product or value chain. For example, product development of clean technologies for agriculture and food processing that reduce
energy and/or water usage; improve waste water management, greenhouse gases, etc.; opportunities to use low value products (also known as waste)?

7.2.2. 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 built to develop and market a new product, improve competitive advantage, create other socio-economic or regional development benefits. Research should provide results that will help the development of a new value chain for Ontario and/or guide SMEs and/or other organizations to viable, value added opportunities.

Proposals should focus on one or more of the following:

- **Increase Domestic Market Access** –
  - Ontario’s domestic marketplace demands a large quantity and variety of foods that can be produced within the province. This sub-priority seeks to identify one or more increased domestic market access opportunities, how Ontario’s agri-food sector could successfully realize this opportunity with Ontario-produced and/or -processed foods using Ontario ingredients, and if possible, through collaboration and partnership, implement opportunities identified. Areas of research might include regulatory challenges at the municipal, provincial, and federal level and potential solutions to realizing this opportunity by accessing existing resources, partnering with business and/or government to address challenges.

- **Do Consumer Research** –
  - Ontario's marketplace and export food marketplaces are 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, gluten-free etc.). These markets offer opportunities for Ontario firms and products. More research is required to determine market premiums across the value chain associated with specific product attributes or bundle of attributes within a market along with which product attributes are critical to success in that market.
  - Social license can drive market trends. Research how to optimize the value of social license for members of a value chain (i.e. acceptance of practices by consumers; requests by retail for free-from, organic, local, gluten-free, etc.).

- **Make a Value Chain work** –
  - Investigate how to apply, and the impact of applying, a strong and integrated food value chain model from another jurisdiction (i.e. Netherlands, Israel, UK, Australia, others) in Ontario. Could investigate resources and tools used by these jurisdictions (i.e. communication, trust-building, engaging SMEs along the value chain, value chain resources). See Appendix A: Framework to Guide Establishment of Sustainable Value Chain Initiatives.

- **Regional Economic Development** –
Economic development strategies require effective collaboration between a myriad of stakeholders in the private and public sector including multiple levels of government, regional organizations, non-government organizations, individual businesses and industry associations. This sub-priority is focused on value chain research to improve economic outcomes for rural Ontario. For example, develop and assess a value chain to build capacity in rural Ontario beyond infrastructure needs; research the true cost of monoculture and the value chain economics of diversification in agriculture.

- Investigate how lenders view farms that practice “sustainable agriculture” vs traditional.

- Evaluate sustainable opportunities and engage with partners to move agriculture and food value chains north, particularly in view of a changing climate. Some key opportunity areas are cereals, beef, aquaculture, new food processing.

• Climate Change

- Develop a value chain to reduce agri-food and related waste in Ontario. For example, agriculture and/or food products into animal feed and/or packaging, decrease need for water, improve process inefficiencies.

- Investigate opportunities to establish metrics / standards for sustainability along the agricultural supply chain.

- Determine opportunities and challenges of urban agri-food value chains for climate change, and economic benefit to Ontario.

**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)
- **Food for Health** theme
- Researchers seeking help in identifying potential priorities and collaborators from OMAFRA and other organizations may contact UofGuelph’s Research Program Director or OMAFRA Theme Research Analyst.
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

#### 8.2.1. 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 Understand and improve plant establishment and survival in challenging environments, especially with regards to root growth in container nursery production and compacted soils.

Field crops:
  o Identify production practices that improve barley (malting barley), oat (beta glucan), soy (protein quality, sugar levels (for soy milk, dessert tofu, etc.), and isoflavones), wheat (protein levels and health benefits) and edible bean quality for specific end uses leading to value-added markets.
  o Investigate conditions causing brown seed and increased free fatty acids in canola, including genetic- environment (GxE) interactions to improve quality and marketability.
  o Investigate harvest and storage technology for forages to reduce losses, improve quality and marketability.

8.2.2. 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, effective management of Fusarium pathogens and associated mycotoxin accumulation, ergot, soybean cyst nematode (SCN), soybean sudden death syndrome (SDS), foliar diseases, oat crown rust, seedling diseases and root rots (issues are in order of priority).
  o Chemical and biological control options for pests of canola, as well as control thresholds, reproductive biology, scouting practices, and agronomic practices that mitigate damage by pests including: swede midge, striped flea beetle, crucifer flea beetle, alternaria and sclerotinia (issues are in order of priority).
  o Develop effective management strategies that consider resistance identification, and root and leaf disease management for pests and pathogens in edible bean production.
  o Develop integrated weed management strategies that consider management of herbicide resistance, and/or biology and ecology of specific weed species.
  o Develop early-season soil insect pest thresholds and management strategies. Develop alternative (non-pesticide or biopesticide) management strategies for insect pests and/or define early-season soil insect thresholds.
8.2.3. PRODUCTION EFFICIENCY (High Priority)

- Edible Horticulture:
  - Develop strategies for 12 month production in greenhouse vegetables.
  - Evaluate automation systems that reduce labour costs in mushroom production.
  - Develop agronomic practices and efficiencies for new and specialty crops, including existing crops moving into controlled environmental systems. Develop cultural management strategies for optimum yield and marketability for apples.

- Ornamental Horticulture:
  - 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.
  - Early-stage research to characterize labour use and to identify issues and opportunities for driving down labour costs in the sector.
  - Strategies to improve the production potential of supplemental lighting in greenhouse floriculture.

- Field crops:
  - Develop strategies to optimize the use of nutrients in field crops, particularly nitrogen, phosphorus, potassium and sulphur (specifically around developing a test for sulphur).
  - Validate precision agriculture technologies for use as agronomy research tools that improve efficiency and accuracy of data generation to better address experimental variables and offer opportunities for economic gain.

8.2.4. ENVIRONMENTAL ECOSYSTEM IMPACT (High Priority)

- Edible Horticulture:
  - 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.

- Ornamental Horticulture:
  - 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.
  - Improve energy efficiency in greenhouse production. Strategies to reduce heat, electrical, energy and fuel use that are economically viable and commercially practical.

- Field crops:
  - Effectively integrate cover crops into field crop cropping systems (including identifying crop, soil, and/or environment benefits & detriments).
  - Identify soil health parameters including soil ecology and practices affecting crop resilience under various stresses.
  - Identify the impacts of various tillage systems and major soil types on phosphorous and nitrogen best management practices that would ensure productive crops and mitigate nutrient losses.
Identify and validate best management practices and risk assessment tools for phosphorus in terms of both crop productivity and potential for phosphorus loss (in soluble and particulate forms) throughout a year, including consideration of soil type and weather (i.e. risk assessment tool).

Investigate production practices for their efficiency and effectiveness at sequestering carbon, along with the practicality and profitability of these practices.

- Pollinator Health:
  - 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.

8.2.5. 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 fire blight, 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 bioproducts and new food uses that are connected to existing and emerging market opportunities.

8.2.6. GENETIC TECHNOLOGIES

- Edible Horticulture:
  - Identify new potato lines that can help to provide a 12 month supply of high quality potatoes to the Ontario fresh and chip processing industries through value added traits such as early maturity, long term storage ability and nutritional potential, any of which would serve to enhance the competitiveness and profitability of the Ontario potato industry.

- 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, ergot, foliar pathogens, soybean cyst nematode (SCN), soybean sudden death syndrome (SDS), oat rust, 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)

- Development of high yielding spring and winter canola varieties adapted to Ontario conditions expressing resistance/tolerance to insects and diseases, improved stand-ability for direct harvest, low pod shatter, tolerance to frost, and specialty oil profiles.

**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 and Bioeconomy research themes.

- Researchers seeking help in identifying potential priorities and collaborators may contact UofGuelph’s Research Program Director or OMAFRA Theme Research Analyst.

### 8.3 Animal Production Systems Research Priorities

All research areas apply to both conventional and organic production systems

#### 8.3.1. ANIMAL WELFARE

Research is needed to:

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

- 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.

- Reduce stress, pain or injuries during transportation, at livestock markets and at slaughter.

- Establish euthanasia management practices/technologies to ensure effective, efficient and humane practices are available for use on farm.

- Develop and validate tools for measuring and improving animal welfare.

- Investigate producer barriers to adoption of best practices for animal welfare.

#### 8.3.2. ANIMAL HEALTH

Research is needed to:
• Investigate alternative antimicrobial treatments (natural or manufactured) and management programs/tools (genetics, nutrition, welfare, biosecurity and environmental management) to reduce the use of traditional antimicrobials.

• Investigate strategies for controlling parasites which reduce reliance on and build-up of resistance to chemical amendments.

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

• Improve animal immune function and regulation to reduce the incidence and impact of infectious or metabolic disease.

• Define factors that predispose animals to production limiting diseases. Research is needed to develop, validate and apply tools (e.g. precision technology) for monitoring and early detection of metabolic or endemic infectious diseases.

• Understand the causes and prevention of death in neonatal or young livestock.

8.3.3. PRODUCTION EFFICIENCY

Research is needed to:

• Sustainably maximize profits, specifically minimizing economic or environmental cost per unit of output.

• Identify factors impacting feed efficiency including nutritional programs which utilize by-products or non-human-consumable feed ingredients, and feeding methods or treatments that improve feed efficiency.

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

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

• Assess and benchmark production costs and identify means of sustainably increasing profitability and farm business resiliency.

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

8.3.4. PRODUCT QUALITY IMPROVEMENT

Research is needed to:

• 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.

8.3.5. ENVIRONMENTAL/ECOSYSTEM IMPACT

Research is needed to:

- 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).

- 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.

- Identify opportunities and means to develop animal agriculture in northern Ontario.

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

8.3.6. APICULTURE RESEARCH PRIORITIES

Research is needed to:

- Examine pest and pathogens and/or environmental stressors with treatment and mitigated options to develop and improve Integrated Pest Management strategies for apiculture.

- Investigate methods to improve queen health management, genetics and production practices.

**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 Emergency Management theme when dealing with new or emerging diseases.

- **Climate change** is also a consideration in other theme, particularly Environmental Sustainability and Agricultural and Rural Policy research themes.

- Researchers seeking help in identifying potential priorities and collaborators may contact UofGuelph’s Research Program Director or OMAFRA Theme Research Analyst.