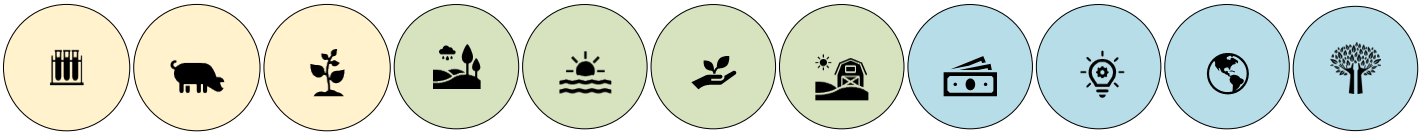
OMAFRA Priorities for the Ontario Agri-Food Innovation Alliance Research Program 2022-2023

Ontario Ministry of Agriculture, Food and Rural Affairs

August 2022

FINAL



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Introduction

Ontario Agri-Food Innovation Alliance

The Ontario Agri-Food Innovation Alliance (formerly the OMAFRA-UofG Partnership) is a collaboration between the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and the University of Guelph (UofG). Through the Alliance, OMAFRA and UofG work together to advance impactful research and innovation that contributes to the success of the province's agri-food sector and promotes rural economic development.

Alliance programming supports the intellectual capacity, infrastructure and networks that produce, synthesize, transfer, and invest in world-class research, innovation, laboratory testing and veterinary capacity.

The Ministry's desired outcomes for the Alliance programming are:

1. Transparency and public confidence in the agri-food sector through the protection of public, animal and plant health, the environment, and Ontario's economy.
2. The tools and ability to respond to emergencies quickly and effectively within its agri-food sector.
3. An effective research and innovation system to achieve assurance in food safety, to protect animal, plant and public health and the environment, to grow Ontario's capacity to produce food, and to support a globally and domestically competitive agri-food sector.
4. Development of future skilled capacity to be ready for employment opportunities offered by the agri-food sector and rural Ontario, including highly qualified veterinary capacity in place to meet Ontario's needs.
5. Growth of third-party investment in agri-food and rural research, innovation and development, and data focused initiatives.
6. Increased sharing and access to data to facilitate new agri-food and rural research and data analytics to inform government decision-making.

Beyond these overall outcomes for the Alliance, the ministry is also increasingly leveraging "One Health" principles to support a holistic and multi-disciplinary approach to protecting food safety, animal health and welfare, stewardship, and protection objectives. The broader benefits of multi-disciplinary collaborations with a wider range of partners and governments are important for addressing persistent and complex challenges within the agri-food sector.

The Research Program is a main component of the Ontario Agri-Food Innovation Alliance Agreement and provides funds for research projects that support the following strategic outcomes:

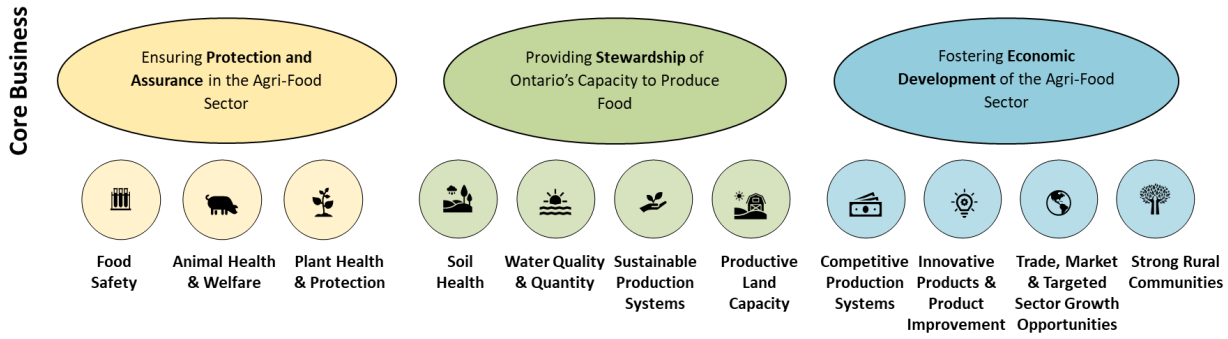
- Achieve assurance in food safety.
- Protect animal, plant and public health and the environment.
- Grow Ontario's capacity to produce food; and
- Support a globally and domestically competitive agri-food sector.

The University of Guelph administers the Alliance Research Program and makes recommendations on funding awards to OMAFRA.

Full details on the Alliance agreement can be found here.

Overview: OMAFRA Research Priorities

The purpose of this document is to outline OMAFRA's research priorities that will be used to evaluate proposals received through the Alliance Research Program's 2021-2022 call for proposals. Research priority setting aligns research priorities with the Ministry's core businesses and objectives: Protection and Assurance, Stewardship and Economic Development.



Each of these research priorities has a set of goals and research focus areas. Specific research questions under each focus area for the 2022-23 Alliance Research Program together with the research problem/information gap and desired outcomes of the research are identified in the Appendix to this document.

Program applicants must clearly demonstrate that their proposal is within scope of OMAFRA's research priorities and fits with **one** (1) of the research questions in the Appendix.

Proposals that involve the development of a product or service must include a Value Assessment Plan. Information about this will be included in the application. There are eleven (11) specific research questions identified in the Appendix require a Value Assessment Plan.

PROTECTION AND ASSURANCE

Ensuring Protection and Assurance in the Agri-Food Sector

Food Safety

Goals

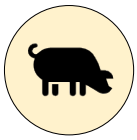
- Enhance public confidence in the sector to deliver on food safety, animal health, plant health, emergency management, and animal welfare expectations and demands.
- Anticipate, detect, mitigate and/or reduce food safety hazards along the supply chain.

Research Focus Area (refer to Appendix for detailed research questions)

Climate Change Resiliency: Understand risks and mitigation strategies to support an agriculture and food sector that is resilient and adaptive to climate change.

Detection and Surveillance: baseline data.

Prevention and Control: Verification and validation of prevention and control interventions



Animal Health and Welfare

Goals

- Enhance public confidence in the sector to deliver on food safety, animal health, plant health, emergency management, and animal welfare expectations and demands.

- Anticipate, detect, mitigate and/or reduce animal health hazards and antimicrobial use along the supply chain.

Research Focus Areas (refer to Appendix for detailed research questions)

Development of BMPs: Development of best management practices to improve farmed animal welfare (e.g., housing, equipment, pain management).

Emergency Management

Emerging Pathogens and Pests: Identification and understanding of new and emerging pathogens and pests in farmed animals.

Health, Welfare and Productivity of Young Animals: Reducing morbidity and mortality in young, farmed animals.

Prevention and Control of Pathogens: Development and integration of effective prevention, mitigation and control methods for production limiting, new and emerging diseases, and pest (e.g., antimicrobials or vaccines, biosecurity best management practices, carcass management).

Plant Health and Protection

Goals

- Enhance public confidence in the sector to deliver on food safety, animal health, plant health, emergency management, and animal welfare expectations and demands.
- Help strengthen the agri-food sector's sustainability and social license through increased utilization of integrated pest management (IPM) and other pest mitigation strategies.
- Anticipate, detect, mitigate and/or reduce plant hazards along the supply chain, and improve plant resilience and resistance.

Research Focus Areas (refer to Appendix for detailed research questions)

Biology of Current and Emerging Pests: Understanding of the biology, climate resilience, ecology and management of current and emerging pests, and resistance management. Includes identification, tracking, monitoring, biosecurity practices and protocols, diagnostics, and surveillance.

Innovative/Disruptive Technology Development: Identification verification, validation, demonstration and adoption of new, innovative, and disruptive technologies and practices to support a resilient and sustainable agriculture and food sector.

Integrated Pest Management: Improved integrated pest management strategies through efficacy studies; alternative control options; development of management strategies.

Pathway Analysis: Risks of new/expanding transmission pathways/distribution patterns of pathogens/pests.

STEWARDSHIP

Providing stewardship of Ontario's capacity to produce food

Soil Health

Goals

- Protect and enhance soil health and water quality, supporting improved public confidence in the sector to deliver on sustainability expectations.
- Improve soil health and conservation to support agricultural productivity.

Research Focus Areas (refer to Appendix for detailed research questions)

Baseline Soil Health Information: Baseline soil health information (i.e., relationship between physical, chemical, and biological components) and development of robust and measurable soil health indicators.

BMP Development: Develop, validate, and continuously improve practices and technologies to support water quality and quantity, soil health, and sustainable agri-food production and processing systems (environmental, economic, social).

Environmental Impacts of Management Practices: Environmental impacts of fertilizer use, nutrient management, and integrated pest management.

Water Quality and Quantity

Goals

- Protect and enhance soil health and water quality, supporting improved public confidence in the sector to deliver on sustainability expectations.
- Strengthen the agri-food sector's sustainability and social licence through improved water use and water quality.

Research Focus Areas (refer to Appendix for detailed research questions)

Analysis of BMP Adoption: Understand the behavioural, social, and economic barriers or incentives to BMP adoption by the agri-food sector.

BMP Development: Develop, validate, and continuously improve practices and technologies to support water quality and quantity, soil health, and sustainable agri-food production and processing systems (environmental, economic, social).

Climate Change Resiliency: Understand risks and mitigation strategies to support an agriculture and food sector that is resilient and adaptive to climate change.

Environmental Impact of Management Practices: Environmental impacts of fertilizer use, nutrient management, and integrated pest management.

Sustainable Production Systems

Goal

- Strengthen the sustainability of the agri-food sector through (1) Soil health and conservation, (2) Improved water quality (e.g., reduced phosphorus runoff and pesticides), (3) Increased water/waste/energy efficiency and reduced greenhouse gas (GHG) emissions, and (4) Increased utilization of 4Rs Nutrient Stewardship.

Research Focus Areas (refer to Appendix for detailed research questions)

Analysis of BMP Adoption: Understand the behavioural, social, and economic barriers or incentives to BMP adoption by the agri-food sector.

BMP Development: Develop, validate, and continuously improve practices and technologies to support water quality and quantity, soil health, and sustainable agri-food production and processing systems (environmental, economic, social).

Environmental Impact of Ag Production: Understand and quantify the impact of agricultural production systems on the environment (e.g., GHG emissions) to help mitigate environmental impacts.

Environmental Impacts of Management Practices: Environmental impacts of fertilizer use, nutrient management, and integrated pest management.

Impact of Changing Ecosystems on Ag: Understand the impact of changing ecosystems and biodiversity on agri-food production and processing systems to support an adaptive and resilient agri-food sector.

Innovative/Disruptive Technology Development: Identification verification, validation, demonstration and adoption of new, innovative, and disruptive technologies and practices to support a resilient and sustainable agriculture and food sector.

Productive Land Capacity

Goal

- Reduce the rate of loss of farmland through improved land use planning to support agricultural viability.

Research Focus Areas (refer to Appendix for detailed research questions)

Evidence to Support Land Use Policies: Evidence to inform land use policies to support policy and programs to protect farmland, support the viability of farmland operations and integrate land use with economic development.

ECONOMIC DEVELOPMENT

Fostering economic development of the agri-food sector and Rural Ontario

Competitive Production Systems

Goal

- Improve production efficiency, productivity, competitiveness and public trust efforts through technology adoption and innovation and technology development such a labour-saving technology or practices, automation, waste reduction, recycling, and increased water/waste/energy efficiency and reduced GHG emissions.

Research Focus Areas (refer to Appendix for detailed research questions)

Climate Change Resiliency: Understand risks and mitigation strategies to support an agriculture and food sector that is resilient and adaptive to climate change.

Emergency Management

Improved Management and Processes: Improved management and processes (e.g., crop and livestock productions systems that improve yields and quality through agronomy, production practices, genetic methods, efficient fertilizer use).

Innovative/Disruptive Technology Development: Identification verification, validation, demonstration and adoption of new, innovative, and disruptive technologies and practices to support a resilient and sustainable agriculture and food sector.

Input Use Efficiency: Input use efficiency (e.g., alternative feeds, feed efficiency, automation in horticulture; irrigation efficiency in greenhouse, reproductive performance, food processing resource efficiency).

Labour Access/Efficiencies: Research and evidence to support the development of strategies to ensure that the economic growth and sustainability of the agri-food sector is supported by adequate access to labour and/or labour efficiencies.

Performance Measurement: Measure performance through baseline information, trend and gap analysis, impact assessment, and BMP adoption to quantify and benchmark performance.

Innovative Products and Product Improvement

Goal

- Enhance competitiveness, profitability, and growth of the agri-food sector through new or improved products.

Research Focus Areas (refer to Appendix for detailed research questions)

Innovative/Disruptive Technology Development: Identification verification, validation, demonstration and adoption of new, innovative, and disruptive technologies and practices to support a resilient and sustainable agriculture and food sector.

New Product Development: Investigate new products (physical products, services, or processes) to improve marketability and profitability, meet consumer demands, and enhance productivity in the sector, from concept to prototype (e.g., alternative proteins, foods of the future, new crops, bioproducts).

Trade, Market and Targeted Sector Growth Opportunities

Goals

- Growth of the overall agri-food sector through expansion of existing and access to new domestic and international markets.
- Improve economic performance of identified priority sub-sectors and increased production of niche and/or value-add products.

Research Focus Area (refer to Appendix for detailed research questions)

Domestic Market Analysis: Research, data, and analysis to support Ontario's agri-food sector to remain competitive in domestic markets in response to change and challenges.

Global Market Analysis: Research, data, and analysis to support Ontario's agri-food sector to remain competitive in global markets in response to change and challenges.

Targeted Sector Growth: Identify (in partnership with industry stakeholders), investigate and research opportunities to address targeted sector growth opportunities that will remove key barriers and improve competitiveness of the sector in the areas of dairy goats, hazelnuts, aquaculture, greenhouse, maple syrup, processed vegetables, processed meats, baked goods, and cannabis/hemp.

Strong Rural Communities

Goal

- Enhance competitiveness, profitability, and growth of rural communities

Research Focus Area (refer to Appendix for detailed research questions)

Innovative/Disruptive Technology Development: Identification verification, validation, demonstration and adoption of new, innovative, and disruptive technologies and practices to support a resilient and sustainable agriculture and food sector.

Labour/Access Efficiencies: Research and evidence to support the development of strategies to ensure that the economic growth and sustainability of the agri-food sector is supported by adequate access to labour and/or labour efficiencies.

Multi-disciplinary collaborations to address complex needs: Research that includes multiple disciplines where goals are set under one thematic umbrella. Participatory, Interdisciplinary, and transdisciplinary research can be considered under this focus area.

Rural Community Development: Research that strengthens municipal and agri-food sector capacity to identify and successfully implement provincial and other initiatives that are economically sound, environmentally sustainable and support rural community development.

OMAFRA Research Priority Contacts

Priority Area	Research Analyst	Email
Plant Health and Protection	Anna Formusiak	Anna.Formusiak@ontario.ca
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Strong Rural Communities/ Productive Land Capacity	Robin Smart	Robin.Smart@ontario.ca
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Water Quality and Quantity	Chevonne Dayboll	Chevonne.Dayboll@ontario.ca
Sustainable Production Systems	Chevonne Dayboll	Chevonne.Dayboll@ontario.ca

APPENDIX: OMAFRA Research Questions

Food Safety

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Climate Change Resiliency	***Foodborne human pathogens and toxins are moving into areas where they were not previously an issue due to several factors including changing weather. What are the food safety risks associated with this, and how can these risks be mitigated?***	Changing weather is facilitating the movement of some types of pathogens (e.g., fungi) to new areas, and the production of toxins (such as mycotoxins) in areas where they have not previously been observed. Understanding which pathogens/risks are of most concern, and in which crops/ foods/feed etc. is an important knowledge gap.	This research would identify economically important crops with the highest risks associated with changing weather, allowing for targeted interventions that would reduce economic losses to the agriculture and food sector, and to the provincial economy.	2020.009
Detection & Surveillance	***What are the residual levels and data required to establish better usage guidelines and withdrawal times in livestock for drugs that have no current documented withdrawal period and no established maximum residual limit (MRL)?***	OMAFRA tests for the presence of veterinary drugs in food animals. Some of these drugs do not have an established maximum residual limit (MRL) against which to evaluate the residue level found. Moreover, there is a gap in data which would allow CgFARAD (Canadian Global Food Animal Residue Avoidance Databank) to determine the appropriate withdrawal times (based on residue level/depletion rate) for drugs administered to livestock. Knowing what the depletion rate is for different drugs in different species would be valuable information, to help Health Canada determine MRLs, and help CgFARAD determine appropriate withdrawal times.	Project results will help to establish the risk level of certain drugs administered to livestock that enter the Ontario market. The results may be used to inform changes to regulatory policy as well as veterinary care best practices. This work would provide some field guidance to vets/producers.	2019.066
Detection & Surveillance	***What is the pathogen burden in ground meat products prepared in small-scale, provincially licensed facilities?***	Ground meat is particularly at risk for the spread of pathogens due to the comminution process and has been linked to several E. coli outbreaks. Small-scale facilities may not have the rigorous mitigation procedures that large scale and/or federally licensed facilities must reduce this pathogen burden.	Project results will help provide needed data to establish the risk level of ground meat from small-scale, provincially licensed facilities.	2021.029

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Detection & Surveillance	***What is the pathogen burden in market-ready lamb, sheep, goat and/or pork in Ontario?***	The lamb, sheep, goat, and pork markets in Ontario are smaller than that of beef, therefore there is not as much information on the pathogen burden related to these markets. Research in this area will gather much needed data that will inform provincial operational protocols.	Project results will help establish the risk level of market products such as whole cuts and ground meats from these species, as well as help establish pathogen levels on the carcasses in slaughter plants.	2021.030
Prevention & Control	***What practical / feasible interventions or technological development at any point in the value chain are effective for reducing or mitigating pathogens on Ontario-produced minimally processed or ready-to-eat (RTE) fruits and vegetables, particularly for small scale producers and processors?***	Minimally processed or ready-to-eat fruits and vegetables become contaminated with pathogens and have been attributed to several recent outbreaks of foodborne illness. Although there is a considerable amount of research on effective interventions, there may be barriers to their adoption and implementation.	Project results would be used to promote effective risk management strategies that incorporate interventions to reduce or mitigate pathogen contamination and have a greater potential to be adopted and implemented. This will lead to a decrease in the number of reported cases of pathogens in food, the number of food recalls, and the incidence of food-related outbreaks and illnesses.	2019.061

Animal Health and Welfare

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Development of BMPs	***What are economically viable housing systems and management practices, which align with market and consumer demands and meet animal health and welfare needs? Examples of identified species-specific research gaps in this area include the impact of flooring surface in housing and transfer areas on dairy goat hoof health and lameness, as well as need for poultry and swine.***	There are several challenges with animal disease transfer, social interactions, mortality, environmental quality, management practices and labour efficiencies within different housing options. The diversity of housing systems brings this diversity of issues in need of addressing to develop BMPs for individual systems and management practices.	Outcomes will include knowledge regarding housing systems and management practices that support economical, sustainable, and efficient production, as well as optimized animal health and welfare.	2019.068

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Development of BMPs	***Are there new technologies or management practices that can eliminate/reduce known painful conditions such as lameness and the need to further alleviate and prevent the stress and pain of currently accepted practices/procedures? (i.e., debudding in goats, dehorning, castration, tail docking, teeth clipping, hoof trimming).***	There are currently few options available to reduce pain or stress during certain management procedures (i.e., dehorning, castration, tail docking, teeth clipping, hoof trimming) and these options often require significant labour and/or cost to a producer. More options are needed to reduce time and cost requirements while still ensuring pain/stress reduction. Pain management for goat disbudding is a priority research issue from updates to the Code of Practice for the Care and Handling of Goats.	New best practices associated with common animal procedures, or new technologies to reduce the need for these procedures.	2019.069
Development of BMPs	***How can stress, pain and injuries be reduced during transportation, at livestock markets and at slaughter facilities or other key handling points for livestock, poultry, and aquatic species?***	Transportation, market, and slaughter are crucial periods in animal production. Research is needed to better address sources of animal health and welfare concerns. Livestock codes of practice (transportation time) are in flux and need evidence to support their development.	Codes of practices are under development for some species; knowledge from research could be used to guide evidence-based decision making. Handling, tools and best practices for market and slaughter facilities will be improved to support animal health and welfare.	2019.070
Development of BMPs	***What tools and techniques can be used to drive behaviour changes throughout the farm to processing continuum that will support best practices for biosecurity and animal management within specific commodity sectors?***	Increasing the adoption of best practices related to labour (e.g., following public health guidelines), biosecurity and animal management is extremely important to ensure human and animal health and welfare. It is also important to determine and identify tools and techniques (education, policies, programs, legislation, etc.) that act as both barriers and incentives to the adoption of best practices and understand any associated economic and sustainability considerations.	Research will help provide an understanding of what motivates producers to adopt a best practice. The results would assist commodity associations and OMAFRA with modifying tech transfer approaches to get better uptake of best practices, which will reduce COVID-related impacts to farm businesses moving forward.	2019.075
Development of BMPs	***What new or emerging technologies or management practices can be utilized to ensure effective and humane stunning, slaughter and euthanasia of livestock and poultry at processing and on farm?***	Different jurisdictions continue to evaluate new practices for effective and humane euthanasia of animals. Evaluation of new technologies and/or techniques for euthanizing livestock and poultry domestically is needed, looking at large scale depopulation either for disease or market issues or emergency.	Determine best methods for euthanasia that will address animal health and welfare needs and improve Ontario's emergency response capability.	2020.014

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Development of BMPs	***To what extent does net pen aquaculture impact the benthic invertebrate community below net pens? What is the assimilative capacity of benthic invertebrates in response to aquaculture inputs (feces, waste feed, etc.)?***	Feed quota increases have been issued by the MNRF and will result in greater nutrient inputs at net pen sites over the next years. The resulting effects on the benthos and sedimentation below net pens requires scientific investigation to better understand the relationship between nutrient inputs and the assimilative capacity of the benthic community. Greater understanding of this relationship will inform regulators to determine production levels which are ecologically sustainable.	The research outcomes will provide insights to accurately identify the assimilative capacity of benthic invertebrates in response to aquaculture inputs. This information could be used to informed sustainable production levels for net pen aquaculture.	2020.020
Development of BMPs	***What best management practices can be employed in the livestock industries to mitigate the risk of zoonotic diseases or livestock diseases where animals are models for human disease, to improve animal welfare while also informing, or, minimizing the impact of disease on, the health of people working in those industries from a one health perspective? What are the potential risks or benefits of these BMPs to the immediate environment shared by both livestock and humans (e.g., barn, farm premises) and/or to the broader environment (including feed production, impacts on wildlife, etc.)?***	One health is a holistic approach which defines the health of humans, animals, and the environment as a coherent system. Livestock (including equine and aquatic species) have had an integral role in One Health through their close relationship with humans and their role in eco-diversity. For an example, horses have been a research model for human diseases for centuries and thus have had a pivotal role in comparative and translational medicine. The local environmental conditions from air quality in livestock barns to ground surfaces on which horses compete have a significant effect on both livestock and the people who interact with them. As well, climate change that affects vector dispersion, air quality and availability of different feeds impact both human and equine conditions. Understanding these interrelationships will further efforts to improve the entire one health system.	BMPs are used to mitigate livestock diseases. More translational research will inform human and environmental health and identify interventions that can improve the entire one health system.	2022.011

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Development of BMPs	***How can we promote the prudent use of medications or chemotherapeutics, including antibiotics, in food animal minor species (including aquatic species) through drug depletion studies to obtain appropriate milk and meat withdrawal information?***	There are few to no approved products for food animal minor species, therefore there is no withdrawal information available. Withdrawal information supports food safety, protects animal health and welfare, and encourages the prudent use of antibiotics and other medications. Minor species includes sheep, goats, honeybees, aquatic animals, rabbits, cervids, bison, and others.	Drug depletion and residue studies to validate timing and use concerns while ensuring food safety and animal health/welfare. Reduce off-label drug usage.	2022.012
Development of BMPs	***How can we improve preventative management practices and nutritional strategies to optimize health and performance in livestock (including equine and aquatic species)?***	Livestock of all species can suffer production-related diseases related to performance expectations. Understanding how to optimize this nutrition, as well as alternatives that can be used during feed shortages that may be caused by climate change, natural disaster, or supply chain issues, will support equine health and welfare. Development and adoption of management and nutritional strategies to address health issues (outside of conventional antimicrobial control measures) are necessary to improving cattle health, welfare, and performance. Results may also provide insight for other livestock species.	An understanding of how nutritional strategies can be used to support optimal equine health and performance. Results may provide insight for other species.	2022.015
Emergency Management	***How can we improve preventative management practices and nutritional strategies to optimize rumen health and performance of feedlot cattle?***	According to the 2016 Canadian Beef Quality Audit, the incidence of liver abscesses detected at slaughter as part of the study has increased over the last number of years. The presence of liver abscesses is associated with suboptimal rumen health conditions. Development and adoption of management and nutritional strategies to address rumen health issues (outside of conventional antimicrobial control measures) are necessary to improving cattle health, welfare, and performance.	Identification of existing and novel approaches to mitigate rumen health issues in feedlot cattle	2021.007

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Emerging Pathogens and Pests	***How can feed infected with mycotoxins be utilized for livestock without impacting animal health or performance? (Could include new testing technology.)***	With changing weather, mycotoxins are an increasing concern for animal feed; industries continue to struggle with mycotoxin loads.	Sectors that are predominantly grain fed will be provided with information and mechanisms to alleviate negative health and nutrition effects or concerns of feeding grain contaminated with mycotoxins.	2019.072
Emerging Pathogens and Pests	***How can the risk of new and expanding transmission and distribution pathways of pathogens and pests be identified (diagnosed), quantified and mitigated in a timely and cost-effective manner?***	Results of this research will contribute to the ministry's leading role in prevention of, response to and recovery from agricultural related emergencies, help fulfill the ministry's legislative responsibilities and fulfill commitments to our federal, provincial and industry partners in emergency management. Current gaps exist regarding zoonotic, tick borne and parasitic diseases that impact multiple species and humans. The growing change in climate also introduces new concerns.	Outcomes of research will support the ministry responding to agricultural emergencies; prevention and control of new and emerging risks to the agri-food sector.	2019.073
Health, Welfare and Productivity of Young Animals	***How do we improve the survivability of young, farmed animals?***	A prominent concern from multiple livestock sectors continues to be concern for reducing risk of disease and mortality in young livestock. Specific factors leading to disease and mortality are largely unknown for several species. Benchmarking number of losses and cause of losses is needed to determine best practices or development of treatments to mitigate.	Knowledge to support livestock sector to improve morbidity and mortality rates in those industries with specific concerns; new recommended management practices, disease prevalence rates to better inform producers, development of solutions or treatments for producers to adopt.	2019.071
Health, Welfare and Productivity of Young Animals	***What tools are available to improve and evaluate colostrum quality to mitigate the increasing issue of lamb and kid mortality?***	Sheep and goats are dependent on colostrum to protect them in early life from pathogens because little immunity passes through the placenta. Little is known about what factors in the diet influence and can be used to improve sheep and goat colostrum quality. Improved knowledge is also needed to accurately assess sheep colostrum quality as sheep colostrum is significantly different from goat or cow colostrum. Tools are urgently needed to reduce lamb and kid loss to deliver on public expectations of animal welfare.	Recommended nutrition best management practices to improve colostrum quality in sheep and goats producing multiple lambs/ kids. Producer tools to evaluate colostrum quality on farm. Improved colostrum quality in ewes/does with multiple lambs/kids would result in a reduction in mortality of young lambs/kids on Ontario farms.	2021.031

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Prevention & Control of Pathogens	***What are the therapeutic tools and alternatives or management programs that will improve the prudent use of or reduce the need for pharmaceutical interventions such as antimicrobials, anthelmintic or other treatments? What are the impacts of these alternatives on animal, public health, economic and environmental sustainability? Not limited to genetic improvement; may include management strategies.***	There continues to be a requirement to shift practices to those that support protection and assurance of the agri-food sector while adopting more prudent use of antimicrobials and medications in livestock agriculture/aquaculture. All sectors are looking for alternatives to antibiotics. There are also concerns highlighted by staff and industry regarding availability of pharmaceuticals for several species, i.e., small ruminants continue to face the issue of off-label use for most antimicrobials.	Alternative prebiotics, probiotics and vaccines, alternatives to pharmaceutical use, and management strategies that can reduce the need for use of these. Drug depletion and residue studies to validate timing and use concerns while ensuring food safety and animal health/welfare. Reduce off-label drug usage.	2019.067

Plant Health and Protection

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Biology of Current & Emerging Pests	***Are there commercial corn hybrids as well as wheat and barley varieties (either through development or identification) that are resistant and/or tolerant to DON (Deoxynivalenol) and more transparent information on DON risk of varieties/hybrids?***	Currently there are no corn hybrids or wheat and barley varieties with full resistance to DON available to Ontario corn and wheat growers. Development of resistant hybrids and varieties would give growers another tool to reduce their risk. It may also result in less dependency on fungicide applications which are not 100% effective. There is currently limited information on the DON risk of commercially available corn hybrids in Ontario.	Corn hybrids, wheat, and barley varieties with resistance to DON that are commercially available for Ontario growers. As well as more transparent information on the DON risk of current commercially available corn hybrids.	2020.087

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Biology of Current & Emerging Pests	***What are the biological, epidemiology, economic impacts and/or management options for new and emerging pests that threaten Ontario crops (including pests with expanding ranges, pesticide resistant pests, invasive pests)? How can this research improve the resiliency of crop sectors?***	New and emerging pests are constantly appearing. We require better ways to identify and understand their impact and develop ways to manage them before they become an issue. Risk management strategies to deal with emerging pests because of climate change and other factors are needed. With the loss of several pesticide tools, there is an increased reliance on crop protection products with a high risk for resistance development. Forecasting methods, predictive tools, economic thresholds are needed for various pests for Ontario specific conditions.	Research outcomes will improve the identification, tracking, monitoring and management of new and emerging pests threatening Ontario crops. Research on pesticide resistance will strengthen recommendations on pesticide use and develop BMPs to reduce the occurrence and spread of resistant pests.	2020.102
Biology of Current & Emerging Pests	***What are the mechanisms difficult to manage ginseng diseases and disorders (e.g., replant disease rusty root, skin disorders) and how can they be mitigated?***	Ginseng is prone to many diseases and disorders that are difficult to diagnose and may be caused by a combination of biotic and abiotic factors. The major issue affecting the future of the industry is ginseng replant disease. Although the fungal pathogen Ilyonectria mors-panacis is known to be involved, research is needed on co-factors of the disease (e.g., ginseng exudates and their metabolites, other pathogens, abiotic factors), testing protocols (e.g., replant risk testing), and improved management options. Skin disorders lead to significant reductions in root quality and marketability. There is a need to identify what factors lead to development of these disorders (weather conditions, rainfall, irrigation events, soil nutrient and pH status, and soil-borne pathogens) and determine how growers can reduce the incidence and severity of these issues.	Identification of the factors that lead to ginseng replant disease or superficial skin disorders of ginseng. Development of procedures to mitigate the occurrence of these diseases and disorders.	2021.046

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***Which new potato varieties can provide a 12-month supply of high-quality potatoes to the Ontario fresh and chip processing industries including important traits like early maturity, long term storage-ability and nutritional potential?***	Improved genetics are critical to ensuring Ontario's potato industry remains competitive and sustainable. New varieties are needed to fill market gaps such as early harvest and long-term storage. Resistance to common scab, late blight, early blight, and drought tolerance are also important considerations.	New potato varieties introduced into the Ontario market. Increased yields, increased marketability, increased pest, and disease resistance and more resilient to climate change impacts.	2022.010
Integrated Pest Management	***What are some integrated pest management (IPM) technologies or strategies that improve labour efficiencies, incorporate pesticides, alternative control measures, host resistance and/or take a systems approach to controlling pests? What are the economics of these technologies?***	Integrated pest management solutions are needed in all cropping systems. Overreliance on few strategies to manage a pest, especially chemical, is unsustainable for any pest/crop. It is important to consistently look for new and improved solutions.	Projects would improve scouting methods, detection, validation and improved thresholds, new pest control products (including biopesticides), and other management improvements for growers of field and horticultural crops.	2020.063
Integrated Pest Management	***How do we increase capacity to develop and access clean plant material or new pest-resistant cultivars for Ontario?***	Systemic diseases present in planting material and a lack of disease-tolerant cultivars is a major barrier to viable specialty crop production in Ontario. Systemic diseases lead to reduced yield and quality and necessitate intensive pest management, greatly increasing the cost of production (COP) of these crops.	Disease-free planting material and pest-resistant cultivars available for major specialty crops in Ontario.	2020.068

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Integrated Pest Management	***How can we develop an improved understanding of western bean cutworm (WBC) activity, crop preference, crop phenology, scouting methods and detection tools (including detection of pesticide and transgenic resistance), action thresholds, biocontrol's (e.g., nematodes), spray timing and application methods in Ontario corn and dry edible beans?***	WBC is a significant insect pest of corn and dry edible beans. The number of moths and geographic range they cover in Ontario increases each year and their habits in terms of where and when they choose to lay their eggs also seems to change each year. Very little research has been conducted on WBC in dry edible beans in Ontario, and they are very difficult to scout for in beans. Growers are applying insecticide to control WBC without clear evidence of the impact on yield or quality, or clear indicators on when to best apply insecticides. Improvements needed in understanding in season population dynamics, factors that influence infestation variability and prediction tool development (e.g., Growing Degree Day models)	Prediction tools to help determine potential infestations and spray timings, comprehensive integrated management plan and action threshold information is made available to dry bean producers. Detailed studies on WBC in Ontario clarify the activities of WBC, the factors that impact their egg laying timing and location choices, the impact of WBC on dry bean quality and yield, and how to effectively manage WBC in corn and dry edible beans.	2020.071
Integrated Pest Management	***How can robotic and artificial intelligence systems supplement existing agronomic practices such as planting of seeds or transplants (e.g., corn, soybeans, etc.), weeding of row crops (grain, oilseed, and horticulture), surveillance of pests/diseases, identification/rouging of male flowers (e.g., hemp/cannabis), pollination (e.g., hazelnut) and debudding/berry harvesting (e.g., ginseng)? How will new robotic technology in field work be integrated into current production systems? How can these systems help with effective sharing of pest and disease information among plant agriculture sector members/ partners? Projects must include cost benefit analyses and efficiency assessments.***	Many robotic and unmanned technologies are under development, and it is likely we will see a fundamental change in farm equipment. Robotic weeding systems are being tested and may offer new integrated pest management (IPM) strategies for herbicide resistant and hard to control weeds. Robotics may improve the ability to screen young seedlings (hemp/cannabis) to identify and remove male plants would be of tremendous benefit to these industries as the presence of male plants is detrimental to cannabinoid yields. Robotic seeders may offer opportunities to reduce soil compaction. There are many innovations on the horizon that may change the way these crops are farmed.	Development of robotic and AI systems would improve the efficiency of existing agronomic practices and reduce labour costs, thereby improving the competitiveness of Ontario farmers. Additional benefits may accrue such as reduced soil compaction, improved site-specific management across a field or of individual plants.	2020.074

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Integrated Pest Management	***Can we increase our understanding of the impact of viruses on Ontario specialty crops and conventional horticulture?***	Viruses are a significant pest issue for Ontario specialty crop growers. High levels of virus have been documented or are suspected in these crops; however, they cannot be controlled with pest control products. In addition to the development of sources of clean plants, growers need the ability to inexpensively test for these viruses, an increased understanding of their impact on yield and quality so they can determine when management is warranted, and the identification of potential management strategies for these pests.	Specialty crop growers can effectively detect viruses in their crops and make sound management decisions.	2021.048
Integrated Pest Management	***Can effective controls be identified for vertebrate pests in horticultural crops. For example: squirrels and jays, birds, deer, and voles.***	Vertebrate pests are major sources of crop loss in many horticultural crops. Vertebrate control requires a multi-pronged approach and there has been limited work to date on the most effective methods for managing these pests in Ontario.	Research outcomes will identify cost-effective methods for reducing damage due to vertebrates in Ontario specialty and other crops.	2021.049
Integrated Pest Management	***How can scouting/detection and prediction of two-spotted spider mites in soybeans and dry beans, and identification of pesticide resistance be improved. Can new pest management solutions including insecticides, biopesticides and biocontrol options for spider mites in soybeans be identified?***	There is only one insecticide active ingredient (dimethoate) registered for spider mite control in soybeans and dry beans and resistant populations have been identified in Ontario. Spider mites are very difficult to scout for (aside from observing crop damage) because they are extremely small so additional tools are required for detecting the presence of spider mites and identifying resistant populations. Spider mites spread very quickly and cause extensive damage when not identified and controlled promptly.	Improved scouting techniques will result in reduction of unnecessary insecticide applications. Alternative control mechanisms and/or insecticide options will mitigate development of resistant populations and improve crop protection.	2021.056
Integrated Pest Management	***What is the presence of alfalfa snout beetle in Ontario fields? What are the best management practices (BMPs) for effectively managing infestations, including development of resistant alfalfa varieties?***	Alfalfa snout beetle is a regulated pest in Canada that causes significant yield and stand losses in alfalfa. A 2008 survey determined the infestation covered 150 km2 in eastern Ontario. Insecticides are not effective on this pest, so other modes of management (e.g., cultural, biological) are required to prevent further spread of alfalfa snout beetle.	An updated understanding of the size of the infestation in Ontario. BMPs for alfalfa growers to minimize the damage caused by alfalfa snout beetle on their farms and prevent the spread of alfalfa snout beetle to new fields.	2021.057

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Integrated Pest Management	***Corn rootworm and Bt resistance: 1. What are new effective rootworm management tools to reduce risk of resistance development to Bt traits and soil applied insecticides? 2. What methods, tools and resources are needed to help influence behavioural change to encourage crop rotation options away from continuous corn? Why do these methods work? Determine the most sustainable approach to corn rootworm management in areas with Bt resistance. 3. How can predictive tools for key corn pests be improved and what influence and impact climate change will have on the phenology, impact, and management of corn rootworm?***	Corn is grown on approximately 2M acres in Ontario, and corn rootworm resistant to Bt traits has been confirmed. Bt traits are the key method by which corn rootworm has been managed in Ontario. Damage by corn rootworm causes lodging and high levels of yield loss. Livestock producers are reliant on corn silage and are most at risk of resistant corn rootworm as they have corn-heavy crop rotations. Insecticide seed treatments are facing increased restrictions or loss of use, and soil applied insecticides are difficult to fully adopt given equipment requirements. Other management tools and practices are required to limit risk of resistance development of remaining control options.	Integrated pest management (IPM) practices for corn Bt resistant corn rootworm are well understood, communicated, and implemented across Ontario. Expansion of Bt resistant corn rootworm across regions is mitigated, corn yield protected, and Bt technology remains viable in Ontario.	2021.058
Integrated Pest Management	***How do soil microbiomes influence above-ground pests (including insects and diseases) and beneficial species in cropping systems?***	Soil microbes such as mycorrhizal fungi are known to have a wide array of plant health benefits. There is little known about their impact on above ground pests, including insects and diseases, that might be reduced from the addition of these soil microbes into the cropping system. In addition, new research indicates insect microbiomes (pests and beneficials) depend on soil microbiomes, with the effects of plants on soil microbiomes being transmitted to aboveground insects feeding later other plants.	Research would demonstrate the direct and indirect benefits of soil microbes on pest and beneficial species in horticultural cropping systems.	2022.020

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Pathway Analysis	***How can new disinfection and sanitation technologies and/or processes minimize biosecurity risks from pests throughout the production cycle and through distribution channels?***	Better ways to identify and manage pests before they become an endemic issue are needed. Research is needed on risk management strategies to deal with emerging pests because of climate change and other factors. The effects and impact of sanitation on improving biosecurity should be a part of these studies. For example, biosecurity in field can also impact nearby crops (i.e., cull piles impacting nearby crops).	Research outcomes will improve the identification, tracking, monitoring and management of emerging and endemic pests that threaten Ontario production and protect the biosecurity of greenhouses, vertical farms, and field horticultural crops.	2019.084
Pathway Analysis	***How does mineral nutrition impact plant disease in ornamental and food crops?***	Mineral elements are applied on crops to increase yield and improve plant health. They are needed for improved production efficiency, but little is known about their impact on plant disease. For example, applications of iron sulphate have been shown to directly suppress dollar spot in turfgrass. Micronutrient deficiencies are known to increase susceptibility to disease, but little has been studied on a commercial level in soil and soilless media crops.	This research would contribute to a greater understanding of how plant health and nutrition impact plant disease and make advancements in reduction of pesticide use.	2022.017

Soil Health

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Baseline Soil Health Information	***How can producers assess soil health in different production systems? (e.g., Grain production vs. specialty crop production)***	Crop producers want to improve soil health and want to know how to accurately measure their progress.	An analysis of how soil health differs in field crops, horticultural crops, and specialty crops and tangible ways to assess soil health, either through soil tests, or combined with some other methods.	2019.003

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Baseline Soil Health Information	***What are best cost-effective indicators of biological soil health to assess soil functions? Functions include soil nutrient supply, carbon cycling and storage, soil structure and water dynamics, plant health and productivity.***	Biology is a critical part of soil health, but current measures are limited due to knowledge and cost limitations. A review of existing biological indicators of soil health would help to refine recommended measures in a way that is supported by science and minimizes cost. Examples of projects in this category: Comparing Potential Mineralizable Nitrogen (PMN) to Autoclaved Citrate Extractable (ACE) Protein Index for measuring soil Nitrogen (N) supply, and can permanganate oxidizable carbon (POxC) be used to infer future changes in Soil Organic Carbon (SOC)?	Research will inform improvements in measuring biological health through better indicators or more cost-effective methods for current indicators. Both outcomes would improve uptake of, and management decisions from, soil health tests.	2020.078
Baseline Soil Health Information	***How should soil health tests or indicators be evaluated for accuracy, saliency, and interpretability? What is the minimum dataset (MDS) required for soil health tests that are accurate, cost effective and interpretable? What are best cost-effective indicators of soil health to assess specific soil functions?***	Greater certainty is needed regarding what constitutes an effective and practical soil health test. Producers and their advisors require tests that are practical to perform, accurate in quantifying soil health status and that guide improved soil management in an economically feasible way.	Increased confidence in an economically viable soil health test would speed adoption of the methods and lead to more rapid improvement in soil health, thus reducing environmental impacts of crop production and enhancing economic performance.	2020.079
Baseline Soil Health Information	***How do the interactions between cover crops and other components of the crop production system (e.g., tillage, fertility, crop protection) influence the economic and environmental effects of including cover crops in the system? How would this contribute to furthering the understanding of the economic and environmental role of cover crops alone and in combination with tillage and other components of the overall crop production system.***	Two million acres of soybean grown in the province remain soil bare during the non-growing season, which has been shown to be the time of greatest erosion (wind, water, tillage) and nutrient loss. Cover crops and reduced tillage help to stabilize soils during the non-growing season and are known to improve soil health and environmental fitness in many ways, yet so many acres remain bare each winter.	Better understanding of cover crop management within production systems - with emphasis on reduced risk to cash crops and increased soil benefits - should lead to greater adoption of these practices. Greater adoption will reduce environmental consequences of crop production and over time enhance the economic performance of Ontario's crop production systems.	2021.059

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
BMP Development	***Since there is little to no research on high organic matter (muck) soil cover crop options, what are the cover crops that fit within a muck vegetable production system and increase soil health parameters while reducing soil-borne pathogens?***	Muck soils present a unique challenge for incorporating cover crops into the system due to their intensive high-value crop rotations and short planting windows. High-value crop production also leads to very short rotations and a build up of soil-borne disease issues. Muck soil is also very susceptible to soil erosion and subsidence, making cover crops even more important to preserve soil health and long-term sustainable production. No research on the suitability of cover crops for muck soils specifically has been done so there is great potential for increased grower adoption with customized recommendations.	Identify and develop appropriate cover crop BMPs for Ontario's muck vegetable production system.	2020.077
BMP Development	***What are the tools and methods (e.g., soil and plant tissue/sap testing, etc.) to develop and/or update soil fertility recommendations and plant tissue nutrition guidelines in horticultural crops (existing crops as well as newly introduced crops and cultivars) in Ontario?***	Several horticultural crops are grown in Ontario including some relatively new crops (e.g., hazelnut) for which we do not have Ontario-specific fertility recommendations available. For those crops, we are giving guidelines adapted from other agroecological regions. Also, growers have expressed their concerns about existing fertility recommendation for fruits and vegetable crops as outdated - this needs to be updated according to changing cropping systems and management practices (e.g., high density orcharding, high yielding varieties, etc.) thru field based applied research. Growers are generally left to figure out their crop's fertility demands on their own, and while this has been successful for some who have had previous crop experience, it has caused others to lose yields and quality due to under or over-fertilization. It is therefore essential to update Ontario-specific fertility recommendations for horticultural crops in the next few years for new as well as established orchards/farms in Ontario.	Growers will receive updated soil fertility and plant nutrition guidelines for tree fruits, tender fruits, and vegetable crops that will be discussed and approved by Ontario Soil Management Research Steering Committee in the next few years.	2022.019

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Environmental Impacts of Management Practices	***What are the economic costs and benefits of soil health in pasture and forage production systems (e.g., rotational grazing systems)?***	There has been a notable and recent historic shift from perennial to annual crops in Ontario. This is strongly correlated with decreased soil health metrics (i.e., decreased organic matter and aggregation, increased bulk densities, etc. due to increased tillage and field traffic.). A better understanding of the economics of soil degradation and the significance to the Ontario agriculture sector.	A better understanding of the economics of soil degradation and the significance to the Ontario agriculture sector.	2019.001
Environmental Impacts of Management Practices	***How do we determine the actual economic and environmental impact of soil compaction? Are there scientific methods and/or sensors already available or that can be developed and validated to measure i) the on-the-go stress applied by rolling equipment, ii) the ROI of compaction, and iii) the environmental impact of soil compaction across variable soils? What are the immediate and longer-term economic and environmental effects?***	Soil compaction is happening as springs and falls become wetter and farm equipment continues to get larger. The agricultural sector continues to be unable to measure the real impacts, either economically or environmentally. As equipment moves through a field the changing load and landscape makes the assessment of this very difficult.	By understanding the economic and environmental consequences of soil compaction with hard numbers, producers can have the required information for consideration of adoption of practices and technologies to reduce soil compaction. Without having hard verifiable numbers on the cost of soil compaction, the sector will continue to struggle to get people to invest in the management and technologies to address this issue.	2020.080

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Water Quality and Quantity

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Analysis of BMP Adoption	***What are the environmental and economic opportunities for farmers for planting switchgrass, miscanthus perennial biomass crops as filter media for capture of phosphorus and as farmable vegetative buffers from harvest sale?***	Adoption of planting vegetative buffers is limited by Ontario farmers, with challenges of losing the land and maintenance. Switchgrass has an advantage with deep root systems and biomass yield. To understand the economic benefits from planting switchgrass as vegetative buffers which requires a detailed evaluation on ideal width of the buffer based on field location and logistics for harvesting and costs and returns. The research could examine the potential use of bio crops as filter media. There is a lack of research information to support for farmers adoption.	Supports Ontario farmers adoption of agri. Environment best management practices for soil erosion control and phosphorus capture from runoff water from planting switchgrass and additional revenues from harvested biomass from sale to various end use markets. Outcomes can also include costs and benefits of preventing erosion, soil and nutrient loss, enhanced biodiversity, value of nutrients trapped in the buffer zone as fertilizers. estimating the potential economic returns of growing switchgrass and for developing new cost share incentive programs for farmable vegetative biomass crops buffers.	2021.064
BMP Development	***What opportunities exist to collect and manage stormwater on-farm? How can this water be improved for quality and quantity management? What are the benefits and costs to using stormwater in agricultural applications (e.g., irrigation, livestock water) or rural applications (e.g., drinking water, firefighting)?***	Farms have potential to collect and store large amounts of stormwater, which could be repurposed for other uses (e.g., irrigation, firefighting, livestock watering, drinking water). There is a potential opportunity to utilize this water to improve water infrastructure delivery in rural areas.	Evaluate the state of knowledge and research needs in similar jurisdictions that aligns with this research question. Prepare a state-of-the-practice synthesis document that identifies gaps, provides direction, and includes recommendations on preliminary project concepts for future policy and program development.	2019.045
BMP Development	***Considering recent synthesis research on buffer strips, how can riparian buffers be designed and managed to achieve better environmental results? How effective are new saturated buffer designs in trapping and reducing nutrient losses to surface water?***	Buffers are multifunctional yet have been dismissed as ineffective because they do not mitigate phosphorus loading unless properly designed to mitigate this issue.	Research that provides evidence for or against the promotion of vegetated or woody riparian buffer strips as a best management practice for Ontario agricultural producers would be helpful.	2020.007

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Climate Change Resiliency	***How can we better assess climate change storm event driven nutrient loadings from agriculture?***	We lack good data and evidence on non-point source nutrient loadings.	We need greater evidence to demonstrate that these large storm events are contributing to many of the loadings and if we can better deal with this on farm and in communities, we will improve environmental outcomes.	2019.009
Climate Change Resiliency	***What are the potential pathways that pesticides may be transported to surface water and what are the potential impacts to aquatic life? What are some cost-effective mitigation measures/management practices that growers can adopt to reduce the movement of pesticides to surface water from the agricultural application area?***	Neonicotinoid insecticides were found frequently in Ontario surface waters and are most agricultural uses are proposed for phase-out. It is important that we better understand the movement of pesticides from agricultural land to water sources and identify potential issues. If there are potential issues with movement of pesticides from agricultural land, mitigation measures need to be investigated that will reduce risk to the environment.	Better understanding of the potential movement of pesticides and environmental impacts. This information can be used in the Pest Management Regulatory Agency's pesticide risk assessments. Ontario is taking a proactive approach to protect the aquatic environment and help maintain/expand growers' pest management toolkit.	2020.084
Environmental Impact of Management Practices	***What are the differences in phosphorus losses in different cropping production systems? How are different forms of phosphorus transported from fields with highly erodible soils to rivers (e.g., dissolved phosphorus, vs. organically bound phosphorus vs. clay-bound phosphorous)?***	While there is research relating to soil bound particulate phosphorus from the last three years, there is still more to be understood regarding the issue of dissolved reactive phosphorus that results from excess and legacy phosphorus in sediment, streams, rivers, and lakes. A better understanding of phosphorus forms, pathways, and transport mechanisms in both wet and dry growing conditions is needed.	Comprehensive yet simplified schematics of phosphorus forms, pathways, and transport mechanisms in agricultural productions systems would be the research outcome.	2019.006

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Sustainable Production Systems

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Analysis of BMP Adoption	***What are the economic and environmental benefits, barriers, and management options for incorporating more perennial crops in Southern Ontario (i.e., forages, pastures, biomass crops, annual grasses) in corn and soybean rotations?***	Corn and soybean production in southern Ontario have been considered as limiting to improving soil health if other crops are not included in rotation. By examining evidence of barriers and options for including more crops in rotation, it may be possible to find ways to increase the practices. This research can inform pasture management and forage production best management practices to support the diverse Ontario agricultural sector and foster greater competition with other jurisdictions.	A report for corn and soybean producers that examines ways to incorporate more perennial crops in corn and soybean rotations while maintaining or increasing profitability and quality is the desired outcome from this research.	2019.014
Analysis of BMP Adoption	***Improve data on BMP adoption at the Provincial, Lake Erie Basin and sub-watershed scale. Collect baseline data and conduct ongoing monitoring to further understand BMP adoption ceilings, set adoption targets, monitor progress towards targets and provide data for input to models.***	Assessing where the Ministry has directed cost-share programs in the province and assessing the number and types of projects geospatially will serve two purposes. The first is to allow staff to report on past programming efforts more readily and accurately and the second is to design and target new programs at the sub watershed scale based on defined needs and priorities. A better understanding of the baseline of BMP adoption would help report on progress and design future programming.	A geospatial database of BMP adoption, with a focus on a Lake Erie Atlas project like the Lake Simcoe Atlas project. A stronger baseline of date, information, and knowledge that staff can use to assess performance of programs and improve and inform future work.	2019.016
BMP Development	***Improve understanding of water quality BMP effectiveness at the plot and field scale during typical and extreme weather events, over the course of the entire year and across various soil types to validate phosphorus reduction coefficients and make recommendations for BMP selection/targeting***	OMAFRA has provided cost-share to more than 30 categories of BMPs in the last 25 years. In that time, new knowledge has emerged and OMAFRA has always been committed to continuous improvement. With new science emerging on soils and phosphorus, this research question will help validate BMP effectiveness at different scales.	Stronger scientific evidence for how water quality BMPs are designed, promoted, adopted, and assessed.	2019.027

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
BMP Development	***How do Ontario crop fertility recommendations meet the needs of modern production practices and modern crop varieties, cultivars, hybrids of all crop types?***	Crop fertility recommendations developed in past decades may not address the needs of modern crops in both field crops and horticulture crops production systems. Other competitive jurisdictions (e.g., Quebec) have recently reviewed provincial crop recommendations. There is a need for Ontario to also review crop fertility recommendations to ensure both crop production and environmental stewardship goals are being addressed. There is also a need for fertigation recommendations in orchard systems. Important horticulture crops include but are not limited to: Potato, Ginseng, Asparagus, Hazelnut, tender fruit, grape, and high-density apple orchards.	The desired outcome is that Ontario fertility recommendations reflect the current state of production advancement.	2019.029

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
BMP Development	***How does nutrient stewardship practices (4R) apply to horticulture crop production?***	4R research is critical for horticulture crops because these crops, especially annual horticulture crops, typically require higher soil test levels of phosphorus and potassium than oilseeds and grain crops	4R research is critical for horticulture crops because these crops, especially annual horticulture crops, typically require higher soil test levels of phosphorus and potassium than oilseeds and grain crops for maximum economic production. There is a need for Ontario research that supports and validates nitrogen, phosphorus, or potassium fertilizer guidelines for new and current horticulture crops to mitigate under and over-fertilization, and related economic and environmental costs. Research is needed to improve crop nutrient use efficiency and minimize environmental losses (especially those crops in the Lake Erie watershed areas). There is also a need for Ontario research that supports and validates best timing and placement of fertilizers for horticulture crops in general, and for those destined for the certified organic market.	2019.030
BMP Development	***What metrics can be used to evaluate the environmental benefit of current environmental regulation (e.g., Nutrient Management) in the agricultural sector in Ontario? How do these metrics compare with other jurisdictions? Would stringent regulations produce a measurable improvement and impact to the environment? What are the economic costs and benefits to the agricultural sector of these regulations?***	Agriculture benefits from exemptions from strict environmental compliance requirements which other sectors are subject to (e.g., Environmental Compliance Approvals or ECAs). At the same time, agricultural land is in environmentally sensitive areas (e.g., Lake Erie watershed, greenbelt, etc.). If agricultural operations are required to obtain ECAs (e.g., for manure spreading) this could significantly increase costs and impact productivity for farmers. Increasing environmental regulations pertaining to agriculture needs to be balanced with an understanding of the economic impact on the agri-food sector.	Outcomes of this research would include a cost-vs-benefit analysis of environmental regulations pertaining to agriculture and an assessment of how the desired environmental outcomes would be affected by increase and or decrease in regulations, and an economic analysis of those regulations.	2020.004

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
BMP Development	***What novel crop management systems can be developed which enhance economic and environmental benefits in field crop production, for example, multi or relay cropping, including forages, canola, cover crops, and/or other fall seeded crops in rotation? How do these systems affect the economic, agronomic, and environmental impact of the whole cropping system?***	This research could help address the following questions. Could diverse multiple species of crops be grown in the same landscape at the same time and separated post-harvest? Would this lead to more diverse and resilient systems of production that would capture more economic and environmental value than current mono, annual crop approaches to crop production? For example, could Canola coffer additional benefits (i.e., offers soil health benefits and habitat for pollinators).	The desired outcomes include the analyses of new management practices which increase diversification of crop rotations, including on-farm economics, landscape-level impacts, environmental benefits.	2020.040
Climate Change Resiliency	***How best can integrating annuals into the annual grazing regime reduce or mitigate the impact of drought caused by summer drought period?***	Drought is no longer an unusual event but is now an annual event in Ontario which has significant impacts on pasture production and consequently leads to the feeding of forage saved for winter feed - this leads to a reduction in the carrying capacity, productivity, and increased cost of production on many Ontario beef farms. Integrating annuals into the grazing regime would reduce the impact of drought but little information is available on which annuals are best suited to use during these summer drought situations	Increased knowledge about which annuals are best suited for producers to grow to enable grazing to be provided during the summer drought period. In addition, how these annuals are integrated into a permanent pasture situation is critical for uptake by beef producers. Research could show that adopting annuals to provide summer grazing may significantly reduce the cost of production by avoiding the need to feed forages intended for winter feeding.	2021.013

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Climate Change Resiliency	***What are the effects of climate change on the yield, resilience, pest complex, biomass accumulation, and overall health of tree-based crops?***	Climate change is a threat that has wide-ranging impacts across all aspects of plant health. Most of these impacts are poorly understood, and research needs to be done to help growers adapt to farming under a shifting climatic regime. Climate change is an existential threat to several tree-based commodities. Even now, weather extremes are manifesting in early frost damage in tree fruits and tree nuts, and drought conditions that cause yield reductions. Another example is maple syrup, where crop yield is tied directly to temperatures during the spring thaw. The last few decades have seen volatile and shortened maple seasons which have reduced yield.	Information on a) how climate change has affected the growth and health of tree-based crops today compared to how trees performed in the past; b) how different future climate change scenarios will impact tree health and growth; c) potential mitigating actions that growers can take	2022.022
Environmental Impact of Ag Production	***How can economic benefits from cover crops (e.g., grazing, harvested as forage) be realized without compromising environmental benefits? i) Investigate various grazing/forage harvest strategies for cover crops and evaluate their profitability and impacts on environmental benefits ii) Determine site and/or operational characteristics that increase the probability of profitably utilizing cover crops while realizing environmental benefits.***	Cover crops provide long-term benefits to soil health and crop productivity, but short-term benefits are often not clearly apparent. Producers that rent land on short-term contracts represent a large and increasing acreage of Ontario farmlands. These producers are unlikely to implement cover crops; they would assume the costs, but unlikely to see the benefits. Research suggests there are opportunities to sustainably monetize cover crops within the year of implementation. Investigating these opportunities and providing guidance to producers would provide more incentive for adoption and could lead to increased cover crop acreage.	A report with recommendations on how to utilize cover crops (e.g., grazing strategies, forage harvest at certain conditions, etc.) so that economic and environmental benefits are realized. Report would consider operational and site-specific characteristics.	2019.020

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Environmental Impact of Ag Production	***What is quantitatively and qualitatively known about the economic value of maintaining and restoring wetlands, woodlands and other natural areas and enhancing biodiversity (which provide Ecological Goods and Services (EG&S)) on farms in Ontario? What are the best ways to measure the benefits of on-farm EG&S, including the economic value and other outcomes, such as improved resilience? How could information on the economic value of EG&S impact the adoption of on-farm practices?***	There is a lack of data to support decision making that considers the benefits and return on investment of conservation and sustainable management of on-farm eco-systems. Data is needed to support policy and program decision making to support biodiversity and healthy on-farm eco-systems.	Insights from this research will support evidence-based decision making that will help prioritize government programs and policies to improve environmental outcomes	2019.035

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Environmental Impact of Ag Production	***Can pH of organic amendments (e.g., digestate, Lystegro, hog manure, etc.) be managed to reduce nitrogen losses?***	General pH is not regularly tested in manure, but high pH (>7.7) increases nitrogen (N) volatilization in the first few hours of application. N supplied by the material is much lower than expected and often not supplemented with commercial sources. Research that could explore the pH level at which N losses occur more quickly. High pH is a constant in most anaerobic digestate and Lystegro, but not in manure. What leads to high pH (feed additives such as dried distiller grains?)? What strategies would be economic to keep pH near 7?	This research could provide improved: • prediction of available nitrogen from organic sources with high pH materials • understanding of role of pH in N volatilization, • understanding of whether additives (lime/N inhibitors) can economically reduce pH and N losses in storage and/or when field applied, • knowledge of feeds or feed additives or management practices that increase manure pH in specific operations (liquid hog, solid ruminant) • knowledge of predicted available nitrogen from organic sources with high pH materials. This research will also contribute to the understanding of: • At what pH level does N volatilization increase, • Are there any economic additives (lime/N inhibitors) that will reduce pH and N losses in storage and/or when field applied, and • Knowledge of feeds or feed additives or management practices that increase manure pH in some operations (i.e., liquid hog, solid ruminant).	2021.060
Environmental Impacts of Management Practices	***How could climate change, biodiversity loss and land conversion affect the potential for new and emerging animal pathogens including those which may have zoonotic potential, and how can those risks be mitigated?***	Knowledge is required to better understand and interpret the impacts of climate change on animal production systems to mitigate negative impacts or adapt to changes without compromising animal health, welfare, or production.	Research outcomes will inform producers and industry about issues to be aware of to take necessary steps to support risk mitigation.	2019.022

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Environmental Impacts of Management Practices	***How can additional food and agriculture waste processing capacity be incented in the province? Are there any barriers currently in place? How can additional processing capacity that not only diverts food and agriculture waste but also results in a beneficial end product be encouraged? Are there other opportunities to up-cycle organic waste materials currently being sent for composting or anaerobic digestion?***	The location of food and agriculture wastes are often located far from the farms needing soil amendments. In addition, such soil amendments are often not widely available or are available at prices too high for widespread use. There needs to be greater understanding of the organizational approaches that would enable efficient acquisition of organic amendments by individual farmers without high transaction costs.	Research outcomes will provide insights to assist in the ability to increase the amount of recovered food and agriculture waste.	2019.023
Environmental Impacts of Management Practices	***What are the barriers for municipalities and private processors to begin accepting and processing certified compostable products? What system changes would be required for organics processing facilities to accept and process compostables (as currently facilities are designed to primarily manage food waste and may need upgrades to process compostable products and packaging)?***	Additional research is needed to address the issue of compostable products and packaging such as cutlery, cups, take-out containers, and coffee pods not being accepted in municipal organic waste collection systems in Ontario.	The research will help support food processors and businesses invest in environmental solutions and may assist in the reduction of barriers to accepting compostables.	2019.024

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Environmental Impacts of Management Practices	***What compostable packaging options can the food and beverage processing sector rely on to successfully reduce waste? What are the barriers to ensuring certified compostable products and packaging are diverted from disposal and how can they be overcome? To what extent are consumers willing to pay a premium to acquire a compostable version of a product (or the packaging used for a product) versus a conventional one made from non-compostable materials?***	We have a lot of difficulty assessing and understanding whether compostable properly compost, or the cross-contamination with non-compostables, and the result of micro plastics contaminating compost or digestate and thus our agricultural fields	Better understanding of soil quality required for end products from compost and digestate.	2019.025
Environmental Impacts of Management Practices	***What is the extent, presence, and concentration of environmental chemicals (agrochemicals and agrochemical residues) in beehive products (honey, wax, pollen, propolis, etc.)? What are the adverse effects of these chemicals, including synergistic effects, on bee health, bee reproduction and the environment?***	There are ongoing concerns and risks of pesticides to the bee populations. Addressing these in a science-based approach will allow beekeepers and growers to focus on risks mitigation and well as refining integrated pest management.	This research will result in better knowledge of the potential exposures that impact honeybees, at which times of year and at what levels, provide better guidance to growers and beekeepers on strategies to reduce pesticide risks and help in identifying which pesticides and patterns of use are lower risk.	2021.069

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Environmental Impacts of Management Practices	***How do management practices (including inputs) impact the carbon sequestration potential of tree-based crops?***	There remains a dearth of empirical information on carbon sequestration in woodlots and in managed orchards, as most Ontario literature is published for agroforestry systems (tree-based intercropping, windrows, etc.). This results in a lack of good management practices with an end goal of carbon sequestration, as well as a lack of specific figures to use in carbon sequestration calculations, both from a tree biomass and inputs standpoint. There is growing pull among woodlot and sugarbush owners who are interested in taking part in the burgeoning carbon market. However, these producers lack the necessary tools to make the best management decisions to maximize carbon sequestration.	1) Best management practices to maximize carbon sequestration for trees in both woodlots and managed orchards, on topics including row spacing, silvicultural practices, inputs, pruning, soil management, etc. 2) Critical information for accurately measuring carbon sequestration efforts and comparing different methodologies (e.g., allometric equations for calculating woody biomass accumulation in trees under different growing conditions, direct and indirect emissions from the production and use of various inputs, etc.).	2022.023
Impacts of Changing Ecosystems in Ag	***How can production efficiencies at the whole farm level be improved using crop and livestock management systems?***	Producers often isolate production systems to make management decisions. Methods or strategies to evaluate the system at the whole farm level is needed to improve production efficiency and stewardship.	Research outcomes will identify methods for improving whole farm efficiency and best management practices that improve environmental stewardship on the farm.	2019.032
Innovative/Disruptive Technology Development	***How can we validate precision agriculture protocols and equipment for Ontario agricultural systems and identify opportunities for economic gain and environmental protection? An assessment of the differences between precision agriculture and precision conservation and how producers understand these terms is also needed.***	There are multiple methods and approaches to developing management zones and prescription maps for precision agriculture. The absolute and relative merits of different approaches are largely unknown, and specific methods are often used differently. Growers and advisors need guidance to evaluate options that are being marketed.	This result will provide vetted and accepted precision agricultural protocols to inform management decisions and agri-environmental programming. Best practices for specific tools (e.g., electrical conductivity (EC), electromagnetic induction (EM) mapping, digital elevation model derivatives)	2019.043

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***How effective are agricultural biologicals from plant and soil microbiomes for plant protection, for increasing crop productivity and for substitution of synthetic fertilizers and pesticides? What measures (e.g., environmental, economic, plant health) can be used to verify the effectiveness of these biologicals?***	Agricultural biologicals in the context of clean technologies as bioproducts include microbials, plant extracts, and other organics. This is a rapidly expanding area of research that utilizes indigenous microorganisms as an agricultural bioresource to improve crop productivity and provide environmental benefits. Plant & soil microbiome presents an opportunity to develop clean technologies for increasing the sustainability and productivity of agriculture in the face of climate change. The use of beneficial microorganisms for crop inoculants can improve nitrogen fixation, as well as promote growth and resistance to disease and stress (endophytes).	Outcomes will result in the development of bio stimulants, inoculants, biofertilizers, and microbials for enhanced crop performance, with effectiveness measured in terms of environmental, economic and plant health benefits.	2020.081
Innovative/Disruptive Technology Development	***Innovative growers, while often the spokespeople for new systems are also often at the "bleeding edge" of developing new crop and soil management systems; often making them ineligible for cost share or incentive programs. What is a fair way to support innovation?***	Innovative producers often take all the risk in adapting a new process, especially in terms of the BMPs that have often been supported through incentive programs. They are often ineligible. How do other regions of the world deal with this? What is working? What would work here as a proof of concept?	This science need if met would support greater innovation on farm particularly in BMPs for environmental benefit which in turn would support the positive influencing of the "moveable middle" and achieve more positive change in the landscape.	2020.082

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Productive Land Capacity

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Evidence to Support Land Use Policies	***How could environmental stewardship and food issues (i.e., food security, local food, and food supply) be integrated into Ontario's agricultural system approach? What land use policies and other implementation tools would help the agri-food sector become more sustainable and resilient over the long-term while addressing the public interest in a healthy environment and food systems?***	While we continue to promote implementation of the agricultural system approach, its current focus on farmland protection and economic development could be broadened to integrate other key priorities such as environmental stewardship and food issues. Expanding the agricultural system approach may help sector competitiveness, respond to climate change, build public trust, address the public interest in food issues, and the societal and economic need to have a robust agri-food supply chain. OMAFRA would benefit from multi-disciplinary research on this topic by land use planners, economists, food system planners, environmental specialists, etc. This research will help inform future policy and implementation of the agricultural system.	1. Analysis of current policies in municipal official plans (ON and other jurisdictions) that speak to stewardship and food issues (e.g., encouragement and requirement policies) 2. Analysis of other municipal practices/initiatives (ON and other jurisdictions) that also support these goals. 3. Identification of best practices in land use planning and complementary tools that advance stewardship objectives and strengthen the food system (e.g., food security, and local food supply). 4. Recommendations on potential changes to provincial agricultural system and other provincial land use policies that would increase environmental stewardship and support resilient food systems.	2020.001

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Competitive Production Systems

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Climate Change Resiliency	***How can a new cultivar of apple, tender fruit or grape cultivar be developed so that they are: 1) suitable for Ontario's climate, 2) fit current and emerging consumer preferences and 3) disease tolerant?***	Consumer preferences for different tree fruit and grape cultivars change over time which is influenced by a changing age demographic and immigration. Having a deep understanding of which traits (flavour, texture, sweetness) consumers prefer now or in the future can guide cultivar development in Ontario. At the same time, heavily marketed, new cultivars that are licensed to be exclusively grown and marketed by groups of growers are emerging in the market (i.e., Cosmic Crisp, SweeTango, Pink Lady) and can be hard to compete with. Ontario needs to be investing in new cultivar development suited to consumer preferences to be competitive with these emerging cultivars.	New cultivars bred and evaluated that are suitable for the Ontario climate and growing conditions, are resistant to pests and diseases, and meet consumer preferences.	2020.052
Climate Change Resiliency	***What is the impact that climate change has on livestock, poultry, and aquatic species production? What strategies can be developed to mitigate the impacts of climate change on livestock, poultry, and aquatic production systems?***	Climate change has had a large impact on livestock production. One specific example of this is the rising water temperature in the Great Lakes associated with global climate change, resulting in a loss of productivity and large-scale disease related mortality for aquaculture.	Outcomes include materials (2 pagers, decks, policy papers) that outline mitigation strategies that include but are not limited to breed improvements, development of new management systems, new technology, nutritional programs, movement of industry geographically and facility design. KTT outreach should include (but not be limited to) memberships of livestock and environmental organizations, relevant federal, provincial, and municipal levels of government, Indigenous communities, and PTOs etc.	2022.016

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Emergency Management	***The rapid rise of e-commerce resulting from shifting consumer preferences and demand for agri-food products (e.g., increased home cooking, reduced restaurant/food service demand, shift in meat consumption) has highlighted key supply chain weaknesses (e.g., retail vs wholesale distribution channels, bulk vs consumer packaging). How can consumer preferences be expected to continue to evolve post-pandemic? How can the agri-food supply chain become more resilient while also meeting consumer demand?***	The pandemic resulted in closures of many food service establishments and shifts to takeout/delivery only. Consumers moved to increased meals at home and home cooking, with reduced reliance on food service establishments. Products with high use in food service experienced significant sharp decrease in demand (e.g., bacon, potatoes). Supply chain challenges prevented some products from being redirected to the consumer supply chain due to packaging and distribution limitations (e.g., bulk packaging not suitable/practical for retail). Consumer preferences for certain products in home cooking may be different than in food service establishments. Increased flexibility in the agri-food production system and distribution supply chains to rapidly respond to shifting consumer preferences and market demands more effectively will contribute to a stronger and more secure food supply.	Evaluate the state of knowledge and research needs in similar jurisdictions that aligns with this research question. Prepare a state-of-the-practice synthesis document that identifies gaps, provides direction, and includes recommendations on preliminary project concepts for future policy and program development.	2020.097
Improved Management Processes	***What is the economic viability and environmental sustainability of small-scale land-based recirculating aquaculture systems (RAS) to produce market size Salmonids?***	Land-based RAS aquaculture for market size Salmonids is a new and emerging mode of aquaculture production with major worldwide development projects currently established or in development. The economic viability of RAS aquaculture producing market size Salmonids has not been demonstrated and a better understanding of the environmental sustainability is needed. Research supporting the economic viability and/or environmental sustainability of RAS aquaculture would initiate investment interest. RAS aquaculture can facilitate the diversification of fish production in Ontario, provide agricultural diversification opportunities for terrestrial agriculture and enhance the sustainability of Ontario aquaculture.	Applied research supporting the economic and environmental sustainability of RAS aquaculture producing market size Salmonids. Applied research supporting regulatory environmental guidelines and environmental assessment procedures for RAS aquaculture.	2020.019

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Improved Management Processes	***What alternative protein sources can effectively be used in commercial salmonid diets to reduce the reliance on fish meal without negatively impacting fish health or meat quality?***	Fishmeal comprises ~40% of most commercial salmonid diets and fish oils make-up another ~15%. Diets based on fishmeal are both expensive and bring into question sustainability of the industry. The aquaculture industry would benefit from salmonid diets based on alternative protein sources (e.g., insect larvae, black solider fly, algae, plant-based protein, yeasts, bacterial protein meal…) by reducing feed costs and improving the social license of the industry.	Identify alternative protein sources for salmonid feed diets which improve cost effectiveness, overall fish health performance, and decrease the need for fish meal as a primary protein source.	2020.021
Improved Management Processes	***How can production and post-harvest information for new or emerging crops (e.g., industrial crops, specialty fruit, specialty vegetables, specialty grains, tree nuts, culinary and medicinal herbs, hops, biomass crops) be evaluated and adapted for field production in Ontario (e.g., agronomy, cultivar evaluations, maximizing yield and quality under Ontario growing conditions, storage technology, packaging)?***	Information for new and specialty crop production from other jurisdictions needs to be evaluated and adapted for Ontario because it may not apply to our growing conditions. New knowledge is required in propagation and establishment, fertility and water requirements, season extension, harvesting methods and post-harvest handling and storage in new and speciality crops.	The development of agronomic information will allow Ontario growers to identify those specialty crops that represent the best diversification opportunities. Research outcomes will include best management practices in establishing new crops, pre- and post-harvest handling, fertility, and water requirements.	2020.033
Improved Management Processes	***What are potential techniques to increase post-harvest quality for tender fruit, apples, and fresh grapes (i.e., optimal harvest timing for new major cultivars, packing and cold chain management systems, and practices to increase quality and storage/shelf life)?***	Optimal harvest timing and post-harvest research helps to increase fruit quality and shelf life of fruit.	The research outcome will contribute to the development of best management practices for harvesting and storing fruit, that will optimize fruit quality.	2020.036

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Improved Management Processes	***How can Ontario livestock producers extend the grazing season through management techniques, alternative crops, and integrated crop/livestock systems?***	Livestock feed is the largest expense on livestock operations, and well-managed grazing is the cheapest source of feed for ruminant livestock. Extending the grazing season has a direct and positive impact on a farm's profit margins. Many grazing recommendations were developed in the prairies under different growing conditions and with different grass species, and do not translate well to Ontario conditions. Livestock operations are starting to graze cover crops, but it is unknown how the practice affects yields of grains and oilseeds in the rotation.	These results will be used to update best management practices (BMPs) for perennial pasture management that reflect the growing conditions of Ontario. These new BMPs for grazing in integrated crop and livestock systems will be based on grain and oilseed crop production data as well as the economics of grazing animals.	2020.039
Improved Management Processes	***Can new high yielding and high-quality crop varieties/hybrids/germplasm be developed through advanced crop breeding, new technologies and testing methods for field crops (e.g., corn, soybeans, dry beans, canola, winter wheat, spring wheat, oats, barley, forage crops)? This includes new varieties for value-added and identity preserved markets.*** ***Note: Proposals must include a Value Assessment Plan.***	Ontario requires new high yielding and high-quality grain and field crop varieties adapted to Ontario conditions through state-of-the-art breeding programs to ensure competitiveness against other jurisdictions. Crop variety genetic performance is only one important factor in selecting the best genetics. Understanding new variety performance in a wide range of environmental and management conditions will enhance selection and adoption of new varieties. Availabilities of such specialized varieties opens access to higher value markets for Ontario grains.	Varieties of grain and field crops that make Ontario farmers highly competitive in a local and global market to ensure continued access to markets and viability of the sector.	2020.047

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Improved Management Processes	***How can we grow a greater diversity of edible crops in Ontario greenhouses, warehouses, and vertical farms in a commercially sustainable manner?***	The COVID-19 pandemic exposed vulnerabilities in Ontario's food supply including heavy reliance on imports, and production of a narrow range of vegetables year-round. Peppers, cucumbers, and tomatoes are the primary vegetables grown in Ontario greenhouses, and leafy greens make up the bulk of what is grown in warehouses and vertical farms. Some strawberries, eggplants and lettuces are also grown in Ontario greenhouses in smaller quantities. Vertical farmers are also experimenting with fruits and vegetables, such as strawberries, beans, and mini vegetables. More research is needed to increase the diversity of crops grown in Ontario greenhouses, warehouses, and vertical farms year-round by understanding which crops can be grown in a commercially sustainable manner.	This research will contribute to the development of production systems for growing diverse edible crops in Ontario and across Canada in controlled environment agriculture systems year-round.	2020.092
Improved Management Processes	***What is the effect of weight at turn-out and body condition score on average daily gain at pasture from young beef cattle backgrounded in-doors over winter and subsequently on pasture?***	Research from other jurisdictions has shown that average daily gain at pasture is impacted by both weight at turn out and body condition score. There is no information available to Ontario beef producers on (a) what is an ideal body weight and body condition score at turnout under Ontario grazing conditions, (b) what is the ideal winter-feeding regime using available Ontario feeds to generate this ideal body weight and body condition score and, (c) the impact of the economic value of these cattle on the ideal wight and body condition score at turnout.	This research will contribute to providing evidence to demonstrate (a) the ideal weight at turnout that will maximise average daily gain at pasture, (b) the ideal body condition score that will maximise average daily gain at pasture and, (c) potential revenue return from optimising weight at turnout.	2021.009
Improved Management Processes	***How can livestock feed efficiency be improved through animal breeding or feeding strategies?***	Feeding and breeding strategies to improve feed efficiency have been identified by the Beef Cattle Research Council as a priority to improve sustainable beef production systems, reduce inputs, improve profitability, and reduce the carbon footprint of the beef sector.	The research outcomes will Identify breed traits that show improved feed efficiency and identify feed strategies to improve intake, average daily gain, and feed efficiency and carcass quality.	2021.012

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Improved Management Processes	***What are the optimal production practices for adzuki beans in Ontario and by soil type, e.g., practices could include reduced tillage, crop fertility management?***	Adzuki beans are one of the highest value field crops and are the highest value dry bean grown in Ontario. Acreage for adzuki beans has been steadily increasing. They are a different species than all other dry beans grown in Ontario and respond differently to management than other market classes. A comprehensive production guide for adzuki in Ontario and on different soil types is required to improve production and reduce crop insurance claims, including tillage types, plant populations, fertility requirements and placement, crop rotation, herbicide safety, bacterial disease control, white mould control and insect management.	A comprehensive adzuki bean management guide which is available for Ontario dry bean growers, resulting in improved yields and reduced crop insurance claims, and improving profitability.	2021.032
Improved Management Processes	***What are the best management practices for meat sheep mature body size?***	Animal agriculture farming needs to improve to meet public expectations of a small environmental footprint. Many factors must be balanced to ensure financial viability and reduced environmental impact. Mature body size affects feed intake, manure production and greenhouse gas (GHG) emissions.	The development of best management practices for mature body size and a measure or algorithm that balances mature size, lamb production, resource usage and environmental impact. The measure or algorithm will allow producers to adjust mature size as resources, production and environmental impacts change leading to a reduction in environmental impact per pound of lamb produced.	2021.033

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Improved Management Processes	***How can on-farm management practices, such as genetic selection, nutrition, out-of-season breeding, or extended lactations, be used to improve small ruminant (sheep and goat) milk composition (e.g., fat, protein, fatty acids, somatic cell count)? What is the economic impact of selection for favourable Alpha S1 Casein genotypes on milk processing and product quality in Ontario?***	Sheep and goat milk composition is a key component of a competitive production system. For both dairy goat and dairy sheep operations, milk composition and quality play an important role in economic success. Throughout the year protein, fat and milk quality fluctuate with higher components in the winter compared to summer months, but with reduced quality and yields. There is limited information at the individual animal or herd level of the impacts of genetic selection, nutrition, extended lactations, and out-of-season breeding on milk quality and milk composition. Research in this field would improve knowledge on how producers can achieve consistent milk supply throughout the year and its impact on economic viability. Alpha S1 Casein genotypes are associated with protein and fat yield, which are important to cheese processing, and associated with reduced human sensitivity to dairy products. Research is needed to determine the feasibility of Alpha S1 Casein genotype selection in the Ontario goat population.	This research will result in (1) an improved understanding of the impacts of protein and fat yield on economic viability of Ontario dairy goat and sheep operations and, 2) the development of best management practices (BMPs) to achieve ideal milk composition through on farm practices (e.g., genetic selection, nutrition, breeding management).	2021.034

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Improved Management Processes	***How can the prevalence of chronic infectious diseases (e.g., Johne's Disease, Caprine Arthritis Encephalitis, Maedi Visna and Caseous Lymphadenitis) in the Ontario small ruminant (sheep and goat) sectors be reduced through on-farm management practices such as genetic selection, vaccination, and replacement rearing procedures?***	Chronic infectious diseases such as Johne's Disease (JD) Caprine Arthritis Encephalitis (CAE), Maedi Visna (MV), and Caseous Lymphadenitis (CL) are profit-limiting, due to reduced production and increased involuntary culling, in Ontario small ruminant herds and flocks. The prevalence of CAE in Ontario dairy and meat goat herds was estimated to be 80.4% and 17.0%, respectively (Stonos et al., 2013). These diseases are challenging to detect and control as they are primarily adult-onset, and the infection may persist sub-clinically for months or years. Available control strategies and prevention are often highly expensive and have significant labour requirements (e.g., snatch and rear of replacement animals and colostrum replacement to prevent CAE transmission). The effectiveness of various management strategies such as colostrum replacement compared to heat-treated colostrum is not well-known. Research on cost-effective control programs (e.g., genetic selection, vaccination, replacement rearing procedures) for chronic infectious diseases were reported as a high research priority by the Ontario goat sectors.	1) Best management practices (BMPs) for the control of specific chronic infectious diseases for Ontario small ruminant flocks and herds. 2) Greater understanding of the impacts (e.g., economic, labour, animal welfare) of chronic infectious diseases and their control in the Ontario small ruminant sectors. 3) Novel cost-effective tools and strategies (e.g., genetic selection, vaccinations) to reduce the prevalence of these diseases.	2021.035
Improved Management Processes	***What are the origins of white striping/woody breast/deep muscle necrosis in broiler chickens?***	This is a genetic/metabolic issue because the birds are growing so fast that it causes striations in the muscle and sometimes, pockets of necrosis. It is being investigated in other jurisdictions, but processors here are trying to figure out causes and solutions in Ontario as it has different production/housing/feed than the southern US that leads to these unique challenges. Everything from production practices, feed, enrichment, ventilation, CO2/O2 levels in the barn etc., should be considered.	Evaluation of the causes and solutions in Ontario, accounting for Ontario production systems.	2021.038

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Improved Management Processes	***What are management methods and techniques that result in the production of sustainable, high quality (genetics and/or production) and high efficiency honeybees (queens and/or nucleus/colony production)?***	Ontario's honeybee economy lacks self-sustainability for locally produced queen bees, nucleus colonies and genetics. Queen breeding, production, viability, and marketing in Ontario needs to be improved, which can help reduce producer reliability on bee imports.	Refined techniques for wintering, production and breeding of honeybees available to Ontario beekeepers. In the future this could result in: - More production and availability of honeybees in Ontario to beekeepers, and growers. - More bees exported to growers and beekeepers outside of Ontario.	2021.067
Improved Management Processes	***Can automation of the labour-intensive management of compost bedding pack barns reduce carbon substrate use and achieve an investment payback period of less than 5 years?***	Compost bedding pack barns are well suited to Ontario's climate and size of our dairy farms. These facilities require daily repetitive labour to manage the pack. An automated system could improve performance of the compost pack, reduce labour, save material input costs, and improve milk quality. This work would also support animal health improvements from living in a better environment, which supports the One Health vision.	Validation of robotic technology for use in Ontario conditions, calculation of the return on investment; determine carbon material savings; measures of cow health and milk quality and animal behaviour around autonomous equipment.	2022.004

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***What opportunities and innovative technologies are available to reduce, recycle (including up-cycling for energy recovery and polymer regeneration), repurpose and/or replace used plastics from the agri-food sector including farms, orchards, greenhouses, nurseries, and food & beverage processing operations?*** ***Proposals must include the following:*** ***a. What are the economic costs and benefits of these opportunities and how do they compare to other jurisdictions?*** ***b. How could agricultural producers and processors be encouraged to increase transformation (i.e., energy recovery, reuse) and/or repurpose of used agricultural plastics?*** ***c. What incentives, policies or other supports would be needed to encourage the upscaling and transformation of used agricultural plastics?***	In Canada, plastics recycling has typically been conducted at offshore locations, but recent limitation on the shipping of used plastics has resulted in an increased cost to dispose of plastics and increased demand for new ways to recycle, repurpose and transform plastics within Canada. The development of plastic recycling or reuse capacity within Ontario could address the used agricultural plastics issue as well as create a new revenue stream from the sale of the recycled plastic feedstock. Potential areas of research include bioplastics, engineered fuel pellets, repurposing into alternative materials (e.g., pyrolysis and biogenic fuel conversion, including the BTU value of these resources for fuel conversion versus the cost of recycling). Proposals must consider practical, cost-based end-of-life options for alternative materials such as those described above. This research should include the assessment of the comparative cost of collection and sorting as well as the economic benefit of identified technologies.	To identify new ways for Ontario's agri-food sector (including prime production and food and beverage businesses) to verify and adopt new and innovative technologies and practices to support the recycling, reuse or replacement of plastic products generated by the sector. To support the development of new and disruptive technologies and services (including a new service sector) to support a more sustainable agriculture and food sector by reducing the agri-food sector's reliance on petroleum-based plastics. To satisfy objectives in the Made-in-Ontario Environment Plan on recycling and reducing used plastic materials.	2019.057

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***What are some labour-saving technologies (e.g., automatic, mechanic, chemical and/or precision tools) and management practices (e.g., canopy management and training systems, irrigation, water use efficiency, fertilizer) that can be used to improve labour and operational efficiencies in horticultural crops?***	The Ontario horticulture industry is very reliant on manual labour. The COVID outbreak has made it clear that growers must fine options for reducing their reliance on manual labour. Improved processes/systems/technologies that reduce the impacts of and/or costs of activities such as pruning, thinning (chemical thinners), harvesting and packing are needed. New technology including drones and robots are being developed to automate pest management and monitoring and production practices. These new technologies must be tested for their applicability to other production systems. Ultraviolet light (UVC) technology and robots for pest management and production practices, drones for monitoring and beneficial release, and robotic harvesters should be investigated. Technology that automates yield and fruit size data will help optimize labour and promote planning, marketability, and sales. An essential component in improving labour efficiency and mechanizing orchards is to have orchard/vineyard systems that are designed to accommodate new technologies.	Develop and validate new technology that will help reduce labour costs and improves efficiency.	2020.034
Innovative/Disruptive Technology Development	***How can the identification of new technologies and strategies to mitigate weather risks in apples, tender fruit, grapes, and berries help with climate change adaptation?***	Climate change is resulting in more irregular weather and increased risks of frost, winter injury, sun burn and drought. The fruit industries in Ontario are all vulnerable to weather risks and need access to tools (e.g., frost/hail prediction models, integrated weather stations, efficient irrigation systems, crop thinning models) to assist with climate change adaptation strategies.	Evaluate the state of knowledge and research needs in similar jurisdictions that aligns with this research question. Prepare a state-of-the-practice synthesis document that identifies gaps, provides direction, and includes recommendations on preliminary project concepts for future policy and program development.	2020.037

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***What new tools and techniques can be developed to improve production and reduce energy and labour requirements in specialty crops (e.g., a litmus test to detect maple buddy sap before it's made into syrup, sap testing for nitrogen nitrate content used to adjust in-season nitrogen rates (e.g., in hops), adding ash to calcium-deficient maple sugar bushes)?*** ***Note: Proposals must include a Value Assessment Plan.***	Specialty crops often have relatively few growers who lack the funds to invest in innovative technologies that could make or break their fledgling industries. However, there are occasional opportunities to develop these tools and techniques that growers require the means to take advantage of. For example, a significant amount of maple syrup is wasted annually due to a phenomenon called buddy syrup, made using end-of-season maple sap that only develops off-flavours after boiling. Researchers are on the cusp of developing litmus strips that can quickly and easily detect buddy sap. This tool could result in significant time, labour, and fuel savings for producers, or prevent them from stopping production too early.	Novel technologies and techniques that may significantly improve production and efficiency in various specialty crops.	2021.036
Innovative/Disruptive Technology Development	***What new tools and techniques (e.g., automated sensors) can be developed to improve nutrient decision making in horticultural crops? How can nutrient deficiency and/or excess in soil and plant tissues be determined?*** ***Note: Proposals must include a Value Assessment Plan.***	Fruit and vegetable sector needs faster and more reliable diagnostic tools to identify nutrient composition in soils and plant tissues. Portable techniques that rely on a near-infrared sensor have recently been developed. These technologies have great potential to increase the effectiveness of integrated plant nutrition management (IPNM) program and efficiency of external fertilizer inputs. Before they can be utilized widely, we need to evaluate if they will work in the Ontario context and where they fit within IPNM/BMP recommendations. The common barriers to existing tools include costs, accuracy, confidentiality, and the difficulty of interpreting results. This helps avoid over as well as under-application of external chemical fertilizers in tree fruits, tender fruits, and vegetables in mineral and organic soils across Ontario leading to healthy soils and the environment.	Portable handheld scanner and mobile apps that relies on a near-infrared sensor to determine the chemical composition of soils will be developed and tested across different soil textural classes in Ontario. Depending on the app we use, we can test the nutrients in a soil in real time. Also, the tool that measures chlorophyll per square meter of plant leaf area as an indicator of plant health and nitrogen availability in horticultural crops, will be tested and modelled in the Ontario context.	2022.018

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***How can the dependence on peat-based, soilless growing media be shifted to help support Ontario's ornamental sector going forward?***	Investigate, trial, and support the adoption of new soilless growing media options at a commercial scale. Ontario's ornamental sector, especially greenhouse floriculture and nurseries, are heavily reliant on peat-based growing media. with supply chain disruptions and concerns about the environmental impact of peat extraction, it is important to investigate alternatives. Alternatives will need to integrate with current production practices and allow for the simultaneous use of crop control products, fertilizers, and bio stimulants to support plant health.	BMPs on what to expect from new growing media options or mixes. Recommendations on alternatives for specific crops, best options for use with on-farm automation.	2022.024

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Input Use Efficiency	***Food and Organic Waste: What are the opportunities and barriers for Ontario's agri-food sector to reduce and/or divert food and/or organic waste to create alternate products, generate revenue from and establish markets for/from these materials?*** ***Preferred projects will address one or more elements of the following:*** ***a. What are the economic costs and benefits of these opportunities?*** ***b. Which waste sources are best suited for which revenue streams?***	There is a gap of knowledge on how best to manage mixed organic waste streams (including food and organic waste) in a cost effective and/or profitable way. Options could include converting culled fruit and vegetables to food products, including centralized de-packaging of food waste, solutions for rural municipalities, solutions for rural food processing businesses, achieving quality targets for contaminants, availability and cost of technologies, regulatory pathways, balance between feedstock volumes and end-use destinations. Potential materials include unsold crops (e.g., crop residuals, horticulture, nurseries, and greenhouses), cheese whey and skim milk. Potential cost savings could come from diverting imperfect produce to gleaning operations, where the reduced volume of residuals is diverted to other conversion processes other than landfill or composting. Potential revenue sources including conversion into food products, industrial acids, nutraceuticals, nutritional supplements, bio-resin extraction, Renewable Natural Gas (RNG) and use in biogenic digestion/reformation, biochar, animal feed, and other new products.	To identify and validate innovative technologies and practices to reduce the volume of edible, inedible and condemned products going to landfills. To satisfy objectives in the Made-in-Ontario Environment Plan on the reduction and diversion of food and organic waste from businesses. To inform Ministry policies supporting the development and expansion of the renewable natural gas (RNG) sector. To inform the adoption of Best Practices linked to Zero Carbon production and processing. To provide a rough order of magnitude and business case for the size of the resource, and its commercial value or economic cost where the cost of a practice does not generate sufficient revenue from its outputs to cover the cost of that practice (i.e., landfill, food rescue, municipal composting).	2019.058

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Input Use Efficiency	***How can we improve the quality and health of seedlings and/or cuttings produced in propagation greenhouses (ex. using supplemental lighting, and/or heating/cooling technologies, and/or IPM strategies)?***	There are only a few propagation greenhouses in Ontario that supply the majority of the vegetable, fruit, and ornamental seedlings and cuttings used in production greenhouses. The quality and health of the seedlings and cuttings that are transplanted into production greenhouses affect yield and quality of the vegetables, fruits, and ornamentals. There is a need in the greenhouse sector to improve the quality and health of seedlings and cuttings in order to maximize the yield and quality of crops in production greenhouses.	This research will provide propagation greenhouses with growing and/or IPM protocols to improve the quality and health of seedlings and/or cuttings for production greenhouses.	2019.088
Input Use Efficiency	***What new or improved technologies and strategies can be used to provide controlled environment agriculture (greenhouse, warehouse, and vertical farms) with alternative ways of meeting energy and natural resources needs (electricity, water, heating, supplemental carbon dioxide and natural gas)? (ex. improved electricity generation and storage, improved water collection/production techniques)***	Controlled environment agriculture (greenhouses, warehouses, and vertical farms) acreage has been increasing at annual rate of 5-7% per year for the past 10 years, and this pace of expansion for these production systems is on track to meet or exceed that in the next 10 years. The growth of the greenhouse sector has been concentrated in southwestern Ontario, and it has increased demand for electricity, water, and natural gas. This has put such a strain on municipal and provincial infrastructure in that region, such that Union Water implemented a water moratorium in 2021 on new greenhouse projects until updates to its aged unfractured were complete. New ways of reducing demand on the existing infrastructure for the controlled environment agriculture sector (electricity, water, and heating) are needed to sustain today's growth and to be competitive internationally in the future.	Technologies that will provide controlled environment agriculture with the resources it needs to grow, while reduce dependence on publicly/privately supplied (electricity grid, and water and natural gas supply).	2019.089

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Input Use Efficiency	***How do we maximize the economic return of growing industrial hemp for seed, fibre and/or flower (CBD extraction)? What genetic resources, agronomic, production and post-harvest practices are needed to optimize yield and product quality and maximize economic return.*** ***Note: Proposals must include a Value Assessment Plan.***	Industrial hemp can be legally grown in Canada for production of seed, fibre, and cannabinoids like CBD. CBD extraction offers a new economic opportunity for the industrial hemp sector which continues to drive the expansion of outdoor production. The lack of Health Canada registered elite germplasm and scientifically validated production, post-harvest handling and processing information is a major roadblock to sector growth. Research is needed to develop new germplasm, to understand the best way to cultivate hemp for seed, fibre, and flower (CBD), to harvest flower (for CDB) from large acreages and the logistics of supplying to licensed processors.	Research will provide validated information that OMAFRA staff can disseminate to internal and external stakeholders. UofG is developing capacity in cannabis/hemp research so this is an opportunity to leverage this capacity. Research will support help the sector to leverage this new economic opportunity for which Ontario has a first mover advantage. Currently the ability of Ontario hemp growers to produce flower competitively and economically are limited by a lack of Health Canada approved high CBD hemp cultivars. This research will allow development of these cultivars, thereby allowing Ontario growers to compete with other jurisdictions through the production of CBD rich oils and germplasm that can be sold globally.	2019.090
Input Use Efficiency	***What production practices and management recommendations can be developed to improve the yields, berry quality, season extension and competitiveness of strawberries and raspberries produced in soilless/substrate culture?***	New knowledge and information are required for these new production systems including research on protected culture, establishment, fertility, and water requirements, harvesting methods and post harvest handling and storage in soilless berry production.	Research outcomes will include best management practices in producing strawberries and raspberries in a soilless system including fertility, irrigation, substrate choice, and protected culture.	2020.035

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Input Use Efficiency	***What are the optimal 4R practices (right source, rate, time, and place) for application of nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) (from fertilizer or manure) to field crops to maximize economic crop response and minimize environmental losses? Top areas of interest include: - the likelihood (general risk, relative loss) of nitrogen loss for a given nitrogen application (product/timing/placement/use of inhibitors), soil type (texture, drainage), and the weather conditions since application? Where the nutrient is an organic amendment/manure, the product pH must be considered. - in-season loss risk estimates from volatilization, denitrification and/or leaching of pre-plant applications - optimal in-crop nutrient application practices (fertilizer or organic amendments)***	There is a lack of information on the effects of pre-plant and in-season nutrient (e.g., fertilizers, organic amendments) practices on N and P losses, N and P use efficiency and crop yields. Producers are encouraged to follow 4R practices, but more data is required to better understand and communicate these best management practices (BMPs).	Best nutrient application recommendations for Ontario producers to reduce off target movement/losses (runoff, leaching, volatilization, greenhouse gases) and improve nutrient use efficiencies.	2020.042

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Input Use Efficiency	***What are the best tillage practices to optimize crop production, profitability and sustainable soil functioning (e.g., soil structure stability, erosion resistance, water dynamics) while minimizing nutrient losses? - comparisons of modern (e.g., strip-till, high speed disk, vertical tillage, bio-strips) and traditional tillage equipment - considering tillage timing, intensity, tillage depth, equipment setup and speed -across soil types, soil conditions, and across the crop rotation/multiple years -including livestock operations with manure in the system***	There is a need to provide more specific recommendations that balance the objectives of soil warming, drying, residue management, soil health, water quality (runoff/leaching) and crop response to tillage. There is limited research on comparisons of tillage equipment as it pertains to response of specific crops various tillage practices, soil health impacts, and trade-offs of crop vigour or yield vs soil function.	Required amounts of tillage and nutrients are optimized for crop production, and opportunities to reduce tillage are identified where tillage would provide little benefit.	2020.043

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Labour Access/Efficiencies	***What are available cost-efficient manual labour-saving technologies (e.g., automation or other) for the agri-food sector which have been successful adopted or can be successfully adopted to reduce manual labour shortages (e.g., fruit and vegetable picking, processing of animals in meat facilities)? How does this technology currently compare to manual labour productivity? What is the cost/benefit of adopting such technology?***	Labour shortages are expected to be an ongoing issue in the agri-food sector for years to come. New technology is evolving to address agri-food manual labour shortages. There is a lack of Ontario data on what technologies are available/are being adopted, what the criteria are to purchase/adopt new technologies (e.g., concerns, risks, return on investment (ROI), technical staff needed, farmer/food processer socio-demographic characteristics) and what policies or programs will accelerate/expand the adoption of efficient manual labour-saving technologies in Ontario's agri-food sector.	Results from this research could: 1. Quantify the rate of adoption of labor-saving technologies in Ontario's agri-food sector (horticulture, meat processing, food processing) by North American Industry Classification System (NAICS) code. 2. Perform a comparative study of automation technology in the field crops (such as corn and soybean versus the horticultural sector to test the hypothesis that automation is more prevalent for these crops (corn and soybean) than any horticultural crop in Ontario and the conditions (e.g., Farm Implements Act, Grains Act) that induced this adoption over time. Do a similar such study for the meat processing/food processing sub-sector. 3. Socio-demographic characteristics of farmers/meat processors/food processors adopting technologies faster than others. 4. The ultimate objective would be to understand the root causes of technology adoption rates (horticulture, meat processing, food processing) so that OMAFRA and its partners are able to activate the proper policy and industry levers to affect the desired agreed upon change. 5. Identify which labour-saving technologies are the most suitable to encourage Ontario's agri-food sector to explore and consider for adoption.	2021.006

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Performance Measurement	***How can production efficiency, environmental sustainability and animal health and welfare in Ontario sheep, goat, beef, and aquatic animal industries be improved with genetic and genomic selection? How can "-omics" technologies (e.g., genomics, transcriptomics, metagenomics, proteomics) be leveraged to accelerate the rate of genetic improvement for difficult and/or expensive to measure traits?***	Genetic and genomic selection has been shown to rapidly accelerate genetic progress for countless traits in many livestock species, especially traits that are difficult and/or expensive to measure (e.g., meat quality, milk composition, feed efficiency, disease and parasite resistance, longevity, lameness). However, adoption of this technology remains limited in Ontario's sheep, goat, beef, and freshwater salmonids sectors. The successful implementation of genomic selection requires the availability of phenotypes for the traits of interest and development of genomic reference populations. Research is needed to determine the feasibility of genomic selection in these sectors for specific traits of economic, environmental, and/or animal health and welfare importance. Additionally, the existing barriers to phenotype recording and participation in genetic improvement programs should be explored for the benefit of the sectors. Traits including, meat quality, mortality, disease resistance, parasite resistance, milk quality and composition, and lameness were identified as key research areas by Ontario's small ruminant sectors. The Ontario aquaculture sector has identified fish health and climate change related health impacts as the sector's top research priority and is looking to genetic and genomic selection to breed a rainbow trout more tolerant to changing lake conditions. Genetic and genomic selection have been successfully applied to improve these traits in various livestock sectors around the world but need to be validated for use in Ontario.	This research could lead to 1) Implementation of genomic selection to accelerate genetic improvement for novel traits of economic, environmental, or animal health and welfare importance in Ontario livestock sectors (e.g., sheep, goat, beef). 2) Identification of the barriers to phenotype recording, participation in genetic improvement programs and genomic selection in Ontario's, sheep, goat or beef sectors and development of tools and strategies to reduce these barriers.	2021.010

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Performance Measurement	***What is the environmental footprint of Ontario's equine industry? How can best management practices or benchmarks be used to improve sustainability of the sector?***	Very little is known about the environmental impact of horse farms. Excluding nutrient management, there are few focused processes on farm to reduce, re-use, recycle. Environmental concerns are an important focus area particularly for certain generations (i.e. Millennials and Gen Zeds) who are the future of the industry.	We will understand the impact the equine industry, or sectors thereof, have on the environment. Measures can be evaluated to reduce these impacts.	2022.014

Innovative Products and Product Improvements

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***What new automation tools and techniques can be developed to improve production efficiency and reduce energy, labour, and pesticide use, and improve plant health decision-making and pest detection in greenhouse, warehouse, and vertical farm production of edibles (vegetables and fruits), ornamentals (flowers, landscape), and cannabis? (e.g., autonomous growing, sensor technology for climate and irrigation, packaging alternatives, vision systems and scouting software for integrated pest management (IPM), etc.)***	Greenhouse, warehouse, and vertical farm production is intensive, and often integrates tools and technology to make it more efficient. Technology that can improve production, energy or labour efficiency is needed to keep the sector competitive in domestic and international markets. On farm diagnostic tools and techniques are needed to improve the effectiveness of IPM programs. More efficient IPM will improve pest detection and control outcomes (e.g., finding pests at lower levels, using fewer biocontrol agents/pesticides due to earlier detection). The sector is a strong adapter to emerging technology, and options for greenhouses, warehouses and vertical farms of all crops and sizes continue to be in demand. Creating technology options in Ontario also has the added benefit of increasing the local support sector for Ontario producers.	Cost-effective and innovative technologies that improve labour, energy, production, and pesticide efficiency. Outcomes would include efficiency/savings reports highlighting improvements to pest detection and outcomes; reports of reduced pesticide use due to better management and planning of IPM programs through data analysis; best management practices (BMPs) on how automation best fits into a system wide IPM program. Technologies would have a commercialization potential to benefit the sector.	2020.050

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***With the adoption of smart farming technologies by a generation of predominantly older agricultural operators, what are the privacy and data-sharing vulnerabilities/challenges that cut across societal, business, and legal areas?***	A better understanding of the vulnerabilities of Ontario's farming operations because of data breaches or access to proprietary information will enable the stronger protection of our food system.	A stronger understanding and a quantification of risks of Ontario's farming operations due to vulnerabilities from data sharing arrangements or privacy breaches.	2021.024
New Product Development	***What are some options for low cost, in-field diagnostics for counting parasite eggs in feces?*** ***Note: Proposals must include a Value Assessment Plan.***	Research projects are underway to provide important selection tools to improve genetic resistance to parasites. These tools are dependent on sheep farmers collecting fecal egg counts from animals. The effectiveness of adoption is going to be dependent on cost and labour requirements of fecal egg count measurement. The current method used by laboratories is manual, time consuming, expensive and results aren't available when decisions need to be made on farm. A smartphone solution has recently been developed for horses.	A low cost, objective, diagnostic tool/technology that could be used on-farm by producers to estimate parasite load in individual animals. This would accelerate the adoption of tools currently being developed to select for parasite resistance in the Ontario sheep flock.	2021.008
New Product Development	***What are the processes to profitably develop value-added products for locally grown hops, including extracts for brewing and natural health products?*** ***Note: Proposals must include a Value Assessment Plan.***	International hop markets are variable for raw products (e.g., leaf hops and pelletized hops). In the last 10 years, hop extracts have captured over 15% of all hop use in Canada at the expense of pelletized hops. Currently there are no known hop extracts being produced in Canada from Canadian grown hops. This growing opportunity could provide Ontario hop growers with new market opportunities to produce extracts from their raw product making it more shelf stable and increase quality and longevity of their products. Additionally, some Ontario growers are investigating the opportunity for hops in other ways including as natural health products. Further understanding of the value of hops for health purposes and the development of products for end users is needed.	Development of cost-effective resin extract processing facilities and the development of high quality, novel packaging for Ontario produced hop resins for brewers. Develop a better understanding of health-related uses for hops and shelf ready products/packaging for the consumer market.	2021.039

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
New Product Development	***How can new feed ingredients for livestock (including aquatic animals) including alternative protein ingredients, pre and probiotics, by-products or other non-registered feedstuffs improve sustainability, animal health and welfare, and productivity?*** ***Note: Proposals must include a Value Assessment Plan.***	Nutrition makes up most of the input cost of all livestock production. Research into new, economically viable feed sources could reduce input cost for expensive constituents like energy and protein. There continues to be increased interest in insects as a potential ingredient as we see an increase of insect farming in North America. There is approval for some commodities to use specific insect-based feed in Canada, but it is not yet widespread.	New ingredients and feeding recommendations for novel ingredients. An economically viable source of feed for livestock.	2021.041
New Product Development	***How can adopting existing technologies, (i.e., handheld near infrared (NIR) devices, etc.), improve the uptake of forage testing? Is there potential for new technologies to improve forage testing?*** ***Note: Proposals must include a Value Assessment Plan.***	Maximizing the performance of livestock requires a knowledge of the quality of forage available to beef cattle. Knowledge of forage quality can only be achieved through forage testing. Forage testing rates in the Ontario beef sector remains stubbornly low, despite all the KTT provided regarding the productive and economic benefit of forage testing. Research is required to address the reasons behind low forage testing rates. The development of new technologies to make forage testing easier to undertake, results easier to understand and implement at farm level is critical to improve this situation.	The development of new technologies that have the capacity to improve the rate of forage testing by the Ontario beef sector, which in turn will lead to improvements in animal performance and farm economic performance.	2021.042
New Product Development	***What products can be developed or refined to expand the use of the dairy ingredient known as solids-not-fat (SNF)?*** ***Note: Proposals must include a Value Assessment Plan.***	One of the challenges in the sector is the disequilibrium in the marketplace for butterfat versus protein and other solids (SNF, for solids non-fat). Growth has been strong for dairy fat recently and that's outpaced growth for SNF. As a supply managed sector, there are export caps for what Canada can export in terms of skim milk powder etc., which has been an important outlet for SNF surpluses. That outlet shrunk with implementation of the latest CUSMA trade deal, so new uses for SNF would be a positive development.	The results of this research could provide new markets for SNF within Ontario and Canada.	2021.043

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
New Product Development	***How can biomass crops (miscanthus, switchgrass, big blue stem), hemp and other agricultural crop fibres be suitably used in the construction/ building materials and for potential carbon storage and GHG emission reduction?*** ***Note: Proposals must include a Value Assessment Plan.***	There is lack of information regarding the chemical composition of the fibres and their compatibility and behaviour with cement building materials and for insultation. Engineering properties are required to be determined as per Ontario building code standards materials. Quantification on carbon storage and GHG emission reductions from building materials.	The desired outcome is to better understand on use of biomass and other agriculture fibres suitability for use in sustainable building materials. The research outcomes can demonstrate for robust uptake of bio-sourced and innovative construction materials.	2022.007
New Product Development	***How can livestock (equine, poultry, swine, ruminant and aquatic species) manure be developed into usable products to support sustainability of the sector e.g., renewable energy source, medium for production of antimicrobial from fungus, compost for sale etc? What would be the economic feasibility and environmental impact of such products sold commercially? What are the potential barriers to market for products?*** ***Note: Proposals must include a Value Assessment Plan.***	Many facilities pay people to haul manure off the farm. Manure management is a large part of livestock production. For example, on average, a 1000 lb horse produces 50 lbs of manure/day. In other countries, horse manure has been used as a renewable energy source (horse manure bricks) and as a medium to grow fungus that produces an antimicrobial for use in food preservation (copsin). The feasibility of developing these or similar products in Canada have not been pursued for many species. There is potential for livestock producers/custodians to economically benefit from manure.	An understanding of how livestock manure can be developed into sustainable products and support the growth of rural communities.	2022.013

Trade, Market and Targeted Sector Growth Opportunities

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Domestic Market Analysis	***How can we gather and compile the data on existing supply and value chains and expand or create new market opportunities for specialty crops (e.g., ginseng, industrial crops, specialty fruit, specialty vegetables, specialty grains, tree nuts, herbs, hops) both domestically and internationally? (e.g., develop economic, trade, and marketing information).***	There is no or limited data for developing new supply chains, value-added products, and economies of scale for specialty crops. This information needs to be collected and/or adapted for use in creating new market opportunities for Ontario specialty crop products.	The collection and development of market and supply/value chain data and information will allow Ontario growers to identify those specialty crops that represent the best diversification opportunities.	2021.061
Domestic Market Analysis	***How can we increase market uptake and consumer education on how to use new and underutilized crops (e.g., haskap, ginseng, Jerusalem artichoke, pawpaw)?***	New and underutilized crops require consumer education and better recognition to develop markets and to sell products. Ideally this research would help better understand the supply chain, value-added opportunities, and how best to educate consumers on what the crop is, and how to incorporate it into regular use.	Develop and increase sustainable opportunities to market and sell new and underutilized crops and determine how to best educate consumers on name recognition, appropriate flavours, or other attributes, and use in various applications.	2021.063
Domestic Market Analysis	***What are the direct shipping lanes between Ontario and North American market areas, including the carriers for those markets by mode (truck or rail) and class (dry van, refrigerated or less than truckload)?***	Logistics capacity and driver availability in the USA has been constrained over the past year due to COVID, port backlogs and delays that absorb available logistics capacity, driver turnover rates as high as 100%, the growth of last mile logistics, reduced driver training and mandatory US substance abuse testing that is permanently removing 5% of US drivers per year. Logistics costs in the USA have increased significantly and shippers (exporters) are experiencing high rates of load rejection for long haul shipments. This makes new business difficult to establish and is a pressure on existing business.	Identify the leading logistics providers by lane (between Ontario and delivery points by market area) would provide a template for Ontario's exports to access markets based on proven and existing service providers. The project may support increased use of multimodal services within Canada which in turn would increase the cohort of Ontario-based drivers for US-bound shipments which cannot be as easily served by multimodal connections due to the lack of in-market border clearance facilities in Ontario for US and Mexico - bound shipments.	2021.065

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Domestic Market Analysis	***Equity deserving groups have been disproportionately impacted by food security and food sovereignty challenges both before and during the pandemic. What are the perceptions and expectations of consumers from equity deserving groups regarding ethically sourced/produced and processed food that addresses food sovereignty, food security, and social responsibility? Is the sector meeting those expectations? Is the food supply chain perceived as an inclusive, accessible sector? If not, how can those perceptions be addressed as the demographic profile of Ontario continues to become more diverse due to immigration? What inclusive practices in food production and processing can be integrated into the supply chain to address their expectations? How can OMAFRA support those practices?***	Maintaining and enhancing public trust in the food supply chain is important including the provision of transparent responses to increased public interest in sustainable, socially responsible, culturally relevant, and ethical food practices. Understanding consumer demands of equity deserving groups and how the agri-food sector can respond to their demands will inform business supports targeted to sector recovery, diversity, and resiliency. It will also impact OMAFRA's design and delivery of supports and programming for international and domestic agri-food workers.	An accurate, in-depth snapshot of consumer demands and food security challenges of equity deserving groups will support OMAFRA's policy and program development. The results will provide a snapshot of challenges on which OMAFRA can design effective and targeted strategies to increase the access by those groups to the agri-food supply chain whether they are food-preneurs, workers, and/or consumers. It will position OMAFRA as a vital partner in cultivating a diverse agri-food supply chain that includes all groups within Ontario's population.	2021.078

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Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Domestic Market Analysis	***What are the potential economic/market impacts and key market opportunities (for Ontario businesses) if red meat products processed by provincially licensed plants were able to be sold in other Canadian provinces? What is the interest of provincially licensed establishments in trading interprovincially, and the rationale behind their decision? What would be the economic, environmental, and social ramification of the interprovincial trade, including animal welfare, transportation costs, local economy, community development and improved services?***	Industry stakeholders have long advocated for reduced barriers to interprovincial trade. Corresponds to stated priority of FPT ministers in Guelph Statement (2021) Research in this area may contribute to breaking down long-standing structures and complexities around internal trade that have impeded progress in the past.	Enabling domestic trade may: • support market growth • increase processing capacity • build resiliency in agri-food systems • reduce wait times for slaughter/processing • reduce costs • support environmental footprint, and • support rural community economic development.	2022.027

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Global Market Analysis	***COVID 19 impacts, changing consumer preferences and shifting consumer trends will create new regional opportunities in the U.S. for Ontario exporters. Among the secondary group of Ontario's U.S. state trading partners, which ones (i.e., Missouri, Kentucky, Tennessee, Indiana, West Virginia, Virginia, North Carolina, South Carolina), present the best opportunities for Ontario's agri-food sector to seek realistic success in the next 2-5 years?*** ***Preferred proposals will include one or more of the following:*** ***a. Which subsectors of Ontario's agri-food sector might be most compatible with each market's needs?*** ***b. What are the potential barriers to overcome, particularly in terms of logistical and transportation challenges?*** ***i. How can these barriers be addressed?*** ***Proposals could consider regional demographics, purchasing power, head office locations, predilections to try new foods, private label-focused retailers, or proximity to major transportation hubs, or any combination of such factors.***	The long-term trend holds that the U.S. is the largest and most important export market for Ontario's agri-food sector: in 2021, 96% of Ontario's agri-food exports to the U.S. were value-added exports. Ontario's top U.S. trading partners are concentrated in the Northeast and Mid-Western regions of the country, in addition to Florida, Georgia, Texas and California. Highly integrated and well-established north-south supply chains facilitate this ongoing, mutually beneficial two-way trading relationship. While Ontario has much success in the U.S., the full potential of the market is far from being realized. In 2021, U.S. global agri-food imports totalled $212.9B USD ($266.7B CAD). With Ontario's -wide variety of agri- food exports to the U.S. totalling $15.6 billion CAD, the ON market share of the domestic U.S. agri-food market is less than 6%. Ontario food manufacturers have ample opportunity to work with retail and food service buyers beyond the Northeastern and Mid-West regions. Ontario could likely seek significant growth in the Southern states, to fill the gap between Ohio and Florida starting with the retail channel. Not enough is currently known about the opportunities that Ontario could maximize and the existing challenges to that success in the secondary U.S. states that Ontario trades with, beyond its top trading partners.	Obtain a better understanding of the challenges and growth opportunities for Ontario's agri-food sector beyond it's top trading partners to then inform a strategic approach to guide key agri-food sectors to take actively pursue growth in key channels in those markets. Ultimately, this research would help answer the question if this avenue of market diversification should be a priority for OMAFRA.	2019.080

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Global Market Analysis	***What are the international market opportunities (e.g., Asia) for specialty crops (e.g., ginseng) and what are the regulatory (e.g., CITES) and non-regulatory (e.g., pesticide residues) barriers/challenges with serving these markets?***	Direct access to large international markets for Ontario crops and animal products (e.g., ginseng market in China) is impeded by numerous barriers (e.g., DDT and other pesticide residues, medications, paperwork required for CITES for tourist markets). Analysis of current challenges and opportunities and identification of mitigation options could support the growth of new markets for Ontario agri-food products.	Better understanding and evidence to expose barriers / challenges to accessing targeted markets for Ontario's crops and animal products.	2019.092

APPENDIX: OMAFRA Research Questions

Global Market Analysis	***How has the COVID-19 pandemic affected consumer behaviour in Ontario's seven key international priority markets (i.e., the U.S., Mexico, Japan, China, U.K., Germany, the Netherlands) and how does that shift present opportunities for Ontario's agri-food exporters in the next 2-3 years?*** ***Preferred proposals should include one or more of the following:*** ***a. How has increased use of e-commerce impacted consumer purchasing?*** ***b. What are the evolving trends in e-commerce; and how are last mile, logistics and warehousing trends affecting e-commerce?*** ***c. What are the challenges and how can they be addressed?*** ***d. Proposals could focus on just one of the seven markets, or a combination of multiple markets among the seven.*** ***e. Proposals could consider regional demographics, purchasing power, packaging, and flavour preferences, etc. and should offer specific insights, strategies and information relating to identified platforms (e.g., practical approaches like e-commerce or curbside pick-up, etc.) that would help Ontario's value-added agri-food exporters***	COVID-19 has dramatically affected the global food supply chain and altered consumer behaviour and purchasing trends. Ontario's agri-food exporters would greatly benefit from timely and relevant insights on the new landscape of exporting - both in terms of challenges and opportunities. Comparisons to the circumstances before the pandemic could help companies better adapt and adjust to the changes in the agri-food supply chain, which would contribute to Ontario's economic performance.	Obtain timely information in the form of a report or reports on how Ontario's agri-food exporters can adapt and best recover from the impacts of COVID-19 to inform strategic thinking and support for continued agri-food export growth. This research would align with ongoing ministry efforts to support trade advocacy, market diversification and market access.	2020.029

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
	develop their own exporting plans. ***The focus of the synthesis/research should be on value-added agri-food goods since most Ontario's agri-food exports are value-added products.***			
Targeted Sector Growth	***What are the most promising economic end use market opportunities for biomass crops (switchgrass, miscanthus), hemp, crop and food processing residues and by-products and for potential industrial bioproducts manufacture and value chains in Ontario?***	There is increasing interest in transitioning away from petroleum-based products and processes. The demand for increased plant-based products is expected to drive new economic opportunities for purpose grown feedstocks and biomass, organic residues/food wastes and other bio-based by-products. For example, Michelin plans to reduce its industrial carbon footprint by 5% to 25 % and Lego launched a range of plant-based plastic toys in 2018. Other companies/retail stores in the value chain, such as IKEA, Lego, Danone, Walmart, and Nestlé are incorporating policies for reducing fossil-based products and processes with those that are bio-based. There is potential use of biomass and hemp in buildings and construction industry. Understanding these new market opportunities from using biomass crops, hemp and agricultural feedstocks is important as information is lacking.	This research results will provide evidence to support 1. growth of the agri-food sector in Ontario, 2. expansion of acreage of biomass crops and hemp in Ontario, 3. new market applications for biomass crops and hemp, 4. use of advanced materials and industrial bioproducts manufacture from biomass crop feedstocks and 5. new feedstock supply chains and integrated bioproduct value chains which best fits for Ontario.	2019.093

Strong Rural Communities

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Innovative/Disruptive Technology Development	***What types of northern fruit tree varieties (i.e., apples, pears), vegetables and cold climate nuts are available in western provinces (i.e., Manitoba) and elsewhere that can be adopted in Northern or near-northern Ontario regions? Where can seeds be sourced from?***	Meta-analysis of northern fruit, vegetables and nut varieties that can be adopted to Northern Ontario	A report back on northern fruit, vegetables and nut tree varieties that can be recommended for northern Ontario regions.	2022.025

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Labour Access/Efficiencies	***If pandemic responses, availability of international agri-food workers (IAWs) and possible accelerated increase of automated operations increase the need for skilled and technical workers due to the increased role technology plays in agri-food workplaces; what are the skills that will be required within the workforce (e.g., programmers, developers, data analysts, equipment technicians, and tech operators), to maximize technologies' potential to support the sector and increase productivity?*** ***Preferred proposals will include one or more elements of the following:*** ***a. Are these skills more in demand in certain sub-sectors and are they suitably prepared?*** ***b. If these skills are not available, what is the recommended approach for developing a workforce that has the required skillset?*** ***c. Are there any barriers/challenges for ensuring that the appropriate level of skill is available to utilize technology now and in the future?***	Technology is playing an ever-increasing role in agri-food. To ensure that its' potential to help the sector is realized, Ontario must ensure it has an appropriately skilled workforce to take full advantage of technology. Efficient adoption of technology in production and processing requires workers to possess specific technology-readiness skills, which may move international and domestic workers into higher wage levels. Understanding the job-specific skills and knowledge that workers must possess to utilize technology in the workplace will enable the ministry and the sector to develop a plan to fulfill those emerging jobs including funding programs for training, policy development and incentives.	The desired outcomes include - identification of agri-food subsectors where skills may be more in demand, recommended approaches to ensuring a skilled workforce is in place and the identification of barriers or challenges to developing this workforce. Job task analysis will provide information to more accurately assess the skill levels required for various agri-food occupations, which will positively impact job attraction and retention. The project results will inform future workforce and technology policy and program development. An appropriately skilled workforce is vital to increasing productivity and maintaining the stability of the food supply chain. Agri-food jobs are often labelled as no or low skilled. This project will investigate that claim by analyzing job tasks to develop informed job profiles, i.e., levels of skills and education required.	2020.026

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Labour Access/Efficiencies	***As unmet labour demands increase, the need to understand new labour motivations increases.*** ***What attracts equity deserving groups (e.g., BIPOC, PWD, women, low income, job precarious etc.) into the agri-food sector and supports their retention? And what are the barriers and risks that these populations face with respect to entering and advancing the in agri-food workforce (farm, food processing, distribution, and retail)?*** ***Preferred proposals will include one or more of the following:*** ***a. What best practices exist to address these risks and barriers?*** ***b. How are other jurisdictions approaching diversity and inclusion in their agri-food sectors?*** ***c. What are the key challenges for equity deserving groups to access, examples urban farming, rural communities, food entrepreneurship?*** ***d. How can succession planning be leveraged to increase access by equity deserving groups to the agri-food sector?***	Equity deserving groups could help address the labour gaps in the agri-food sector. The ministry needs to determine which government levers (policies and programs) currently exist that support the attraction and retention of these groups. Issues of appropriately skilled workers and adequate numbers of workers were pre-existing challenges that became more visible during the COVID-19 pandemic. Understanding the motivations and strategies to attract and retain equity deserving groups as well as the risks and barriers to their participation in agri-food will allow Ontario to better support the agri-food sector and ensure healthy and safe work environments. Projections of job vacancies by agri-food sector groups confirm that immediate and long-term strategies are necessary to maintain supply chain stability and enhance productivity.	A comprehensive report on risks, barriers, and motivations will support employers within agri-food that are in most need of workers. The research will positively contribute to increasing the capacity and production levels of agri-food businesses. Project results will inform ministry policy and program development. Research into models used in other similar jurisdictions will inform the ministry about successful, best practices. The report will include recommendations for programming, projects, and policy development. It will provide insights into engaging equity deserving groups into the agri-food labour pool.	2020.027

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Labour Access/Efficiencies	***How can the ministry support the development of a skilled pool of job seekers that will enable agri-food businesses to expand and produce?*** ***Preferred proposals will include some or all the following considerations:*** ***a. A skill-needs profile of the agri-food workforce in the short and long-term.*** ***b. What are the levels of education, skills and knowledge required for agri-food occupations that are most in need?*** ***c. Are jobs in agri-food actually "unskilled" or "low skilled" as is often the description of frontline agri-food occupations?*** ***d. What are the working conditions for frontline agri-food workers?*** ***e. Which incentives and remuneration support attraction, retention, and promotion of workers from job entry to skilled worker or supervisor?*** ***f. How has the COVID-19 pandemic impacted working conditions?***	A comprehensive report on labour engagement and utilization will support the sector to focus on effective strategies based on current sector intelligence. Identification of labour recruitment and training pathways will help businesses to meet immediate and future labour needs. Utilizing this research along with labour demand reports from the agri-food sector organizations including existing skills matrices, will enable a coordinated cycle of labour management to ensure food supply stability and decreased business risks due to lack of suitable workers.	A detailed, formal labour force research study, including job task analysis, key informant interviews, and documentation of working conditions conducted by an objective third-party, will provide detailed intelligence upon which the sector and the ministry can plan strategies. The report should identify workforce skill gaps and identify opportunities for new occupation-specific training programs. The research will identify agri-food subsectors where skills may be more in demand or where skill levels are increasing due to the integration of technology. The labour study report should provide baseline data and recommended measures that can be used to coordinate comprehensive labour force management over the long-term.	2021.075

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Labour Access/Efficiencies	***What pathways are currently available to funnel job seekers into the Agri-food and food processing sectors? What are the gaps in recruitment?*** ***Preferred proposals will include some or all the following considerations:*** ***a. How has COVID-19 impacted recruitment and retention?*** ***b. Are there effective pathways into the frontline jobs in agri-food? E.g., occupation specific recruitment such as harvesting workers, meat cutters, etc.*** ***c. How can employment, education, and training partners provide new multiple pathways into agri-food?*** ***d. How can we leverage stakeholder partnerships, other ministries, and levels of government to help the sector meet projected job vacancies?***	It is important to understand current pathways into the sector and how those can be expanded and strengthened to encourage larger numbers of workers to fill job gaps and to replace aging workforce. By identifying new employment and training partners, they can assist the sector to provide more recruitment pathways through short-term, job-specific micro-credential programs. The proposed research will directly benefit agri-food businesses as well as job seekers who may not have considered the sector as a career path. It will document effective strategies and potential partnerships between training institutions and employers. It will provide information to leverage other government programs such as MLTSD Employment Ontario programs that support employers with worker recruitment, job placements and employer incentives.	An assessment of pathways (existing and potential ones) to funnel job seekers into the Agri-food and processing sectors will help to target funding and supports to employers within agri-food that are in most need of workers. The desired outcomes will include materials and activities that increase understanding with respect to the role of existing programs and supports and will identify gaps and opportunities for new pathways. At an individual job seeker level, the project will include elements that will increase efficiency of training and recruitment pathways to access long-term employment in the sector as well as potential internal promotions. Results will inform further policy and future program development within OMAFRA.	2021.076
Labour Access/Efficiencies	***What are the areas in which innovation and technology cannot replace human labour in the agri-food sector, including specific tasks and skills on the farm and in food processing plants, retail, and distribution? Which sectors will remain highly reliant on human capital? Which sectors will have human capital be replaced by automation?***	An understanding of the agri-food sectors in which labour disruption is not anticipated will help inform labour policy and program initiatives and business supports. Having accurate data about the current and projected technology disruptions across the agri-food sector will enable strategic planning and program investments to support businesses in a timely and effective manner.	Identification of agri-food subsectors where skills may be more in demand to support approaches to ensuring a skilled workforce is in place. Results would inform policy and program development and design respectively, to help support the development and/or maintaining of an appropriately skilled workforce.	2021.079

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Labour Access/Efficiencies	***As unmet labour demands increase, what are the labour motivations as well as business and management/business owner impacts resulting from changes in labour compensation?*** ***Preferred proposals will include a holistic assessment of the business and employer impact of significant increases in labour total compensation (this includes regionally competitive wages, health/dental benefits, pension/RRSP, etc.) and will include elements of the following:*** ***Business impacts to consider include, but are not limited to:*** ***a. Productivity*** ***b. Operating costs (labour)*** ***c. Turnover costs (training, recruitment, etc.)*** ***d. Opportunity capitalization*** ***Employer impacts:*** ***a. Mental health indicators – stress, etc.*** ***b. Physical health*** ***c. Work/life balance – business owner/manager ability to take time off, etc.***	It is well known that the agri-food sector (primary production and processing) is chronically plagued by labour challenges and shortages. A large focus towards addressing these challenges have recently focused on sector skills development as well as industry marketing efforts. It is also well known that the agri-food sector predominantly offers lower wages and struggles to compete with other sectors offering more attractive employee compensation – regionally and provincially. The ministry needs to understand to what effect/impact compensation (including wages, health/dental benefits, pension/RRSP, etc.) has on attracting, retaining, and motivating farm and processing labour. Comprehensive impacts on the business and business owner(s)/manager(s) needs to be understood, beyond the initial increased labour costs due to compensation increases.	The desired outcomes include the identification of business and business owner(s)/manager(s) impacts directly related to significant increases in labour compensation. Various KTT products could be developed and shared; including an extensive report (help inform government and industry/sector association policy) as well as a summarizing PowerPoint to be used in stakeholder as well as industry business communication. Results could inform policy and program development and design respectively, to help support the attracting, retention, and productivity of sector labour. Results should be disseminated to relevant sector participants and individual businesses. Future research/projects could involve implementing these changes, if results are positive, in case-studies (using key influential people/business owners, etc.). An outcome of this research could involve suggestions for research outcome industry adoption.	2022.001

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Labour Access/Efficiencies	***How prepared and what tools are available to support farmers in understanding the workplace accommodation needs of international agricultural workers as well as Indigenous, Black, and Racialized communities? As OMAFRA moves towards a zero-tolerance culture to racism and discriminations, how can the ministry support farmers and the agri-food sector with Equity, Diversity, and Inclusion, promote growth of the sector and retain international agricultural workers as well as Indigenous, Black, and Racialized communities?***	Staff have reported incidents of racism and harassments at regulated clients and partners work locations. There are potentials for international agricultural workers as well as Indigenous, Black, and Racialized communities are or will face similar issues. Part of OPS response to the Third-Party Review and OMAFRA's Anti-Racism Action Plan include applying Equity, Diversity and Inclusion lens to policies and programs.	An increased understanding of farmers preparedness in understanding accommodation needs of international workers. Determine the level of support required to assist farmers in fulfilling the ministry's zero tolerance culture to racism, discrimination, and harassment.	2022.006

Multi-disciplinary collaborations to address complex needs	***How can housing arrangements be improved to reflect the health and welfare needs of international agri-food workers (IAWs)?*** ***Preferred proposals will include some or all the following considerations:*** ***a. How can best practices from other jurisdictions be adapted for housing for international agri-food workers in Ontario?*** ***b. What are the most supportive approaches to helping farmers to ensure housing equity?*** ***c. How do housing arrangements affect IAWs' health, both physical and mental?*** ***d. IAWs are essential to the stability and potential growth of the agri-food supply chain, so how can we provide a housing framework that supports the workers and the employers?*** ***e. How has the pandemic impacted health & safety measures within housing structures?*** ***From a land use perspective, housing for IAWs must be consistent with provincial policy in the Provincial Policy Statement for prime agricultural areas. What are the best practices for on-farm and off-farm housing that fit with existing, or if necessary, potential future provincial policy?***	There are several challenges with biosecurity, social interactions, and environmental quality within different IAW housing options. The current availability and quality of housing options needs be assessed to develop a new framework that supports worker health and welfare and quality of life. Housing conditions should be consistent across the province. The pandemic highlighted pre-existing housing conditions that needed to be addressed from a health & safety perspective. Housing is one of the key factors of worker retention and safety, so the sector must be empowered to provide conducive environments. A housing framework will provide supportive strategies to the sector. Further, it will provide a foundation for future policy and programming targeted to housing policy and standards. Employers will benefit from consistent housing expectations and guidance on best practices from government. The stabilizing effect of quality housing on workers will support their health, safety, and retention.	Outcomes will include knowledge regarding current housing systems and management practices, options for improved housing arrangements that support optimal health and welfare conditions for IAWs.	2021.083

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Rural Community Development	***What is the cost benefit analysis of green infrastructure as an asset in rural and peri-urban water management systems? How would watershed management benefit from the incorporation of built green infrastructure as an asset within rural and peri-urban drainage infrastructure? What are the costs and benefits?***	Although significant research has been done in the urban context in the U.S. and some limited research has occurred in Canada, much less is known about green infrastructure in the rural context. Green infrastructure is considered an emerging practice that is believed to have the potential to improve water quality, manage water to prevent flooding downstream, provide storage for times of drought, increase biodiversity, and maintain agricultural productivity. The sector requires an understanding of the costs and benefits associated with incorporating green infrastructure into Ontario's rural/agricultural drainage systems. Further, there is a knowledge gap on how the Drainage Act can be leveraged in urban settings to support green infrastructure.	Regionally specific financial/economic analysis and case studies of rural and peri-urban drainage infrastructure that consider the impact of green infrastructure on agricultural productivity and flood protection. A clear business case is developed that identifies the costs and benefits of green infrastructure. In peri-urban, or non-farm contexts, this project would also assess the economic considerations for municipalities of utilizing the Drainage Act for implementing green infrastructure. The outcome would be research that that would inform decisions regarding the need for private and public investment and how any future policies and programs might be structured and implemented. An economic analysis is required to support commitments in the (draft) revised COA 2020 to promote eligible investments, including investments in green infrastructure, that support the reduction of excess nutrients from non-point sources such as urban and rural stormwater (including stormwater from agricultural landscapes), as priority considerations under applicable infrastructure and other funding programs as well as commitments to build infrastructure resiliency and avoid wetland loss in the Ontario Flooding Strategy 2020. Risk of not proceeding is failure to leverage green infrastructure funding for rural drainage and to support watershed scale flood management.	2020.090

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Rural Community Development	***What factors or barriers are hindering a stronger economic recovery in rural Ontario from the COVID-19 pandemic?***	The COVID-19 pandemic is having differing impacts on different industries and locations across Ontario. This research will help us better understand the economic recovery laggards including the potential barriers that may be limiting their recovery.	A better understanding of which industries and rural areas have been most impacted by the pandemic including potential reasons preventing a full economic recovery will be the outcome of this research.	2021.070
Rural Community Development	***COVID-19 has highlighted the ongoing food insecurity challenges faced by Indigenous communities. While barriers to overcoming food insecurity are well known, an integrated Indigenous food security strategy for Ontario is needed. What are the elements of an integrated Indigenous food security strategy that can be adopted, locally, regionally, and provincially?***	Food insecurity, lack of access to affordable healthy food and lack of food sovereignty in Indigenous communities, particularly in northern and remote communities, is a well-recognized issue of concern with multiple contributing factors that require collaborative problem-solving approaches. Interdisciplinary research focused on, but not limited to, infrastructure, economics, technology, agronomy, policy, and human health are needed to meaningfully address this chronic challenge facing Ontario's indigenous communities.	This research can provide insights into shaping an integrated indigenous food security strategy that have many benefits including proving access to healthy food in indigenous communities including improved health, increased economic development opportunities in food production, processing, niche market development and new transport technologies, community resilience and capacity.	2021.073
Rural Community Development	***What are the structural (infrastructure, transportation, policy, lack of investment, scalability, etc.) barriers, drivers, and opportunities that limiting or support the development and/or expansion of Indigenous participation the agri-food economy?***	Indigenous partners continue to indicate that multiple structural factors are preventing their participation in the agri-food economy thereby limiting their economic development and exacerbating food insecurity, especially in Northern and remote communities.	This research can contribute to improved understanding of the barriers to Indigenous agri-food economic development and the development of novel strategies and approaches to address them.	2021.074
Rural Community Development	***What are suitable business, funding and financing models for small and medium scale Indigenous agri-food farms, aquaculture, and businesses to support start-ups, improvements to existing businesses and expansions)?***	Indigenous participation in Ontario's agri-food economy faces historical and ongoing barriers due to the lack of scale-appropriate financial and business supports. As a result, Indigenous entry into the modern agri-food economy faces considerable barriers.	Micro- farms, micro-financing, collective purchasing, social enterprise, band and tribal council ownership, alternative forms of equity and private sector partnerships and community-based agriculture are among the models that could be applied to support increased indigenous participation in Ontario's agri-food economy.	2022.009

APPENDIX: OMAFRA Research Questions

Research Focus Areas	Question	Rationale for Research and Benefit	Outcomes and Deliverables	RIB ID
Rural Community Development	***What is the interest in access, by either producers or processors, in mobile abattoirs across Ontario, and in particular Northern Ontario? What challenges have other jurisdictions faced (e.g., Alberta, BC, US) when it comes to inspection and overall food safety that would be pertinent to Ontario?***	Currently in Ontario, livestock processed using mobile abattoirs can only be returned to the producer for personal consumption. Other jurisdictions (US, Alberta) have developed systems utilizing mobile abattoirs to bring slaughter services to the farm. Accessibility to processing services, particularly in remote and northern communities is a long-standing industry challenge. Therefore, developing an inspection model that can support mobile abattoirs would address service availability challenges.	Enabling mobile abattoirs may: • improve animal welfare by eliminating stress of transportation and minimize losses (e.g., dead on arrivals). • Reduce environmental footprint caused by long distance transportation Provide new and innovative market opportunities for producers, butchers, and meat processors to expand their business • Increase slaughter capacity and access to slaughter services – particularly for remote communities • Encourage local markets while supporting Ontario producers • Offer strong alignment with One Health objectives	2022.026