



## **Cross Sector Livestock Research Priorities**

**Livestock Research and Innovation Corporation**

**December 2020**

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## Overview

Livestock Research and Innovation Corporation (LRIC) is responsible for the annual identification of cross sector livestock research priorities. These priorities are used as input for the OMAFRA research priority setting process that leads to a call for proposals through Alliance funding. LRIC works with all livestock sectors, bringing forth research priorities by area and, where possible, specific research questions as well as identifying research areas of cross sector benefit. In addition, LRIC identifies emerging areas of research that will be important to the Ontario livestock industries.

This year, LRIC began working with member organizations to identify specific research questions so that industry input better meshes with the evolving OMAFRA process. It is critical that livestock organizations see their priorities in the Alliance call for proposals or they will lose enthusiasm for providing input to the system and the needed strong link with industry will be broken. Several input documents were used to identify priorities and evaluate cross sector opportunities (table 1).

**Table 1 – Documents used to determine research objectives**

Sector	
Beef	Report from the LRIC-facilitated meeting of Beef Farmers of Ontario (BFO) Research Committee Oct 2019 (reviewed fall 2020), also drew on Beef Cattle Research Council (BCRC) document
Pork	Pork Research Call Document (2019) which has an overall focus on: “Testing potential improvements to swine industry practices”
Poultry	Poultry Research Strategy 2014-2020; the Canadian Poultry Research Council (CPRC) research priorities document; 2020 EFO priorities; and the Canadian Hatching Egg Producers research document.
Dairy	Priorities approved by the DFO Board in fall 2020
Sheep	Report from the LRIC-facilitated session on behalf of Ontario Sheep Farmers (OSF) in 2018
Goat	Report from LRIC-facilitated session of the Goat Value Chain Roundtable Dec 2019 Confirmation via December 16 meeting of the Goat Value Chain Roundtable
Veal	2020 Veal Farmers of Ontario (VFO) research priorities
Aquaculture	Report from LRIC-facilitated session on behalf of the Ontario Aquaculture Association (OAA) in Feb 2019
Forage	Report from LRIC-facilitated session for Ontario Forage Council (OFC) in Oct 2019: BFO, Dairy Farmers of Ontario (DFO) and OSF participated
Equine	Report from LRIC-facilitated industry session in 2018, Equine Research Priorities 2019-2024 plus results of a survey of Ontario Equine Veterinarians.
Apiculture	Research priorities document from the Ontario Beekeepers Association

## Overarching, Cross-Sector concerns:

There remains the previously identified (2019) concern regarding effective “**innovation**” where innovation is defined as the process of driving change based on research results. Knowledge Translation and Transfer (KTT) is an important step in a successful innovation system but it must work effectively with other elements (facilities, HQP, etc). **While all Alliance funded proposals must include a KTT plan, research results are not making it to the farm level for consideration and adoption.**

As noted by industry during a session of the LRIC Mentorship program for early-stage faculty, having a positive relationship with industry is critical to the ability to design and implement an effective KTT plan. A key element of successful innovation is the **economic analysis** of implementing research results on farm. At minimum, an initial economic analysis should be part of all KTT plans. The Agri-Food Innovation Council noted in a recent report:

- 1. There is a need for further financial resources for infrastructure and staffing to address research dissemination, knowledge transfer and intellectual property issues.*
- 2. Research and extension should be participatory, engaging end-users and stakeholders throughout the research process.*

Industry recognizes the importance of having both **modern facilities and the appropriate Highly Qualified Personnel**. The renewal of research facilities is well underway and needs to be completed. This is not just an Ontario need. The Canadian Poultry Research Council notes in their priorities document the need for a **modern poultry research facility** in Ontario. Failure to complete the planned rebuild of all sector facilities threatens the critical research needed in the poultry sector.

Several sector-specific webinars, co-hosted by LRIC were used to identify challenges, learnings and opportunities arising from our experience with COVID-19. The already important areas of concern, and in need of research and innovation, are **labour and automation** within the livestock supply chains.

Feed represents a large portion of the costs on all livestock farms. There is always interest in identifying **alternative feed sources** that improve performance or product quality and/or reduce cost of production. In fact alternate feeds may become more necessary given shifts in cropping patterns due to disease threats.

An area in need of increased focus is **One Health**, through which livestock health and associated challenges (e.g. antimicrobial use) are viewed in a much larger picture that takes into account human and animal health and environmental factors. COVID-19 has demonstrated the need for ongoing surveillance as well as rapid and effective elimination of disease. The Ontario livestock sector must have a practised plan ready to implement in the event of an epidemic.

An emerging topic is **regenerative agriculture** which may present both challenges and (more likely) opportunities for Ontario livestock producers. As “regenerative” becomes more clearly defined, it will be critical that research and innovation understand the foundation of land ownership and individual business decision making that is Ontario agriculture. Failure to do so

will yield interesting but impractical results.

A final area of concern that arose in the past year with an LRIC member involves how to fund critical research without opening the researcher and the results up to the perception of bias. The proposal in question would have investigated the full human health impact of meat versus a highly processed, plant-based alternative. While this is a very important and timely research topic, the livestock group felt the research results could be perceived as biased if their organization contributed funding. In cases such as this, the **Alliance should provide full funding** to ensure that such important research proceeds.

## Common high priority specific areas of research:

High priority research areas include:

1. Development of a comprehensive **net impact analysis of livestock production**. This is needed to inform a concerted effort to communicate facts showing that livestock production is, by far, net beneficial to the environment and society. Of particular note, the net impact of including forage in farming systems must be documented and promoted. This approach can be inclusive of One Health and regenerative agriculture perspectives.
2. Means that can be employed by the livestock industry to contribute to the effort to avoid **antimicrobial resistance** while maintaining or improving productivity and profitability. This includes research to ensure knowledge of appropriate drug use withdrawal times and true efficacy of products with claims to reduce AMU.
3. Effective means of on-farm **euthanasia**.

## Emerging areas worthy of consideration:

**Artificial Intelligence (AI)** remains set to revolutionize many aspects of life, livestock production included. It will “remain set” to do so until data capture is automatic (some sectors are far ahead of others in this regard) and until an industry-led structure is developed through which data sharing and value capture is obvious and trusted.

There is a clear need for **360-degree research/analysis**. The livestock sector is under threat, often by people using one small part of the whole picture (e.g. GHG emission) while ignoring other critical considerations (e.g. soil health). This also ties well with new focus on One Health and regenerative agriculture.

The LRIC Emerging Issues Committee has identified the need for a **Trusted Food Supply** as the emerging issue of greatest concern. This is due in large part to witnessing consumer reactions as a result of COVID-19. Key considerations that constitute a trusted food supply include:

### 1. Available

- a. Though the livestock supply chains did a good job in flexing to meet changes in product demands as a result of COVID-19, there are opportunities to improve the elasticity/flexibility of our systems.

## 2. Authentic

- a. The problem of food fraud continues to grow and is a threat to the entire system.

## 3. Accountable

- a. Producers and regulatory agencies must create, fully resource and effectively communicate programs that demonstrate accountability through the supply chain.

There will be many research and innovation opportunities that will help to address availability, authenticity and accountability toward the trusted food supply that consumers demand.

## Determining priority areas across sectors:

Using all of the available sector priority ranking documents, each area by sector was scored as high priority (H) or medium priority (M). Using a scoring method of 2 per H ranking and 1 per M ranking, the table below shows the resulting relative ranking of priorities across all livestock sectors. A case could be made for weighting individual sector scores by industry size; however, a test of that approach showed no change in rankings.

*Table 2 – Priorities across sectors*

	Beef	Pork	Dairy	Poultry	Sheep	Goat	Veal	Aqua-culture	Equine	Bees	Score
<b>Health</b>	H	H	H	H	H	H	H		H	H	18
<b>Environment</b>	H	H	H	M	H		H	H		H	15
<b>Nutrition</b>	M	H	M	H	H	H	H		H		14
<b>Welfare</b>	H	H	H	H		H	M	M	M		13
<b>Production systems</b>		H	M	H		H	M			H	10
<b>Genetics and Reproduction</b>	M	H	M					H	M	H	9
<b>Forage</b>	H		M		H	M			M	M	8
<b>Product quality/development</b>	M	H	H	M	M					M	8
<b>Data</b>	M		M	H			M			M	6
<b>Economics</b>		H	M	M							5
<b>Food Safety</b>	H		H	M							4
<b>Marketing</b>		M								M	2

**Table 3 – Health**

Sector	Areas of Research Need	Specific Research Questions
Beef	Antimicrobial Resistance/Antimicrobial Use (AMR/AMU): benchmarking and alternatives Improving gut health Chute-side test for vaccination immunity Better understanding/prevention of Bovine Respiratory Disease (BRD) and lameness	
Pork	AMR/AMU and alternatives Herd health	
Dairy	Strategies to mitigate targeted infectious diseases and new emerging diseases: mastitis, paratuberculosis, salmonellosis, leucosis, bovine viral, diarrhea Lameness and injuries prevention, management and treatment Dairy cow transition period related health and welfare issues Pain mitigation and euthanasia BMPs and science-based decision-making tools Sustainably reduce the use of antimicrobials while maintaining farm biosecurity, dairy cattle health and welfare.	How can we control, reduce and eradicate Salmonella Dublin on dairy farms?  What alternative products to antimicrobials can we use on the farm while maintaining farm biosecurity, dairy cattle health and welfare?
Broilers	Understanding and response to on farm practices affecting AMR (all poultry) Development of vaccines (all poultry)	
Eggs	Bronchitis is the significant issues with layers Re-emerging pathogens as birds are housed on litter Air quality in barns	What third-party validations of antibiotic replacement additives are available to ensure efficacy?
Turkey	Production systems that enable a reduction in AMR Better ways to implement biosecurity on farms Investigate the epidemiology of reoviruses, and the emergence of novel reovirus strains	What are control strategies for reovirus? Development of live and inactivated vaccines for REO virus
Hatcheries	Understanding metabolic disorders in developing chicks	How can we better control/eliminate REO virus?
Sheep	Withdrawal times for off label products AMR/AMU and alternatives Ewe vaccinations to reduce mortality and morbidity of lambs Effective determinants of parasite loads	
Goat	Improved control of Caprine Arthritis Encephalitis (CAE) Withdrawal times for off label products Kid health	
Veal	Establish the benefit of all producers receiving calf health and age records. Mitigating the effects and transmission of S. Dublin and bovine respiratory syncytial virus. Identifying diseases and ways to identify alternative treatments and management programs will improve the health and welfare of the calves while reducing antibiotic use.	What is the prevalence of Salmonella Dublin in the male dairy calf population and what treatments are available to reduce antibiotic usage?

Equine	Real time assessment of impacts of physiological stress Rapid stall-side testing (e.g. respiratory)	<p>Can stem cells be used to effectively to treat osteoarthritis?</p> <p>How does manipulation of the microbiome affect equine health and performance?</p> <p>Does the response to furosemide (Lasix) differ between horses racing with Lasix compared to those who aren't in terms of racing performance?</p> <p>Does the location of the racetrack (urban vs. rural racetracks) make a difference in terms of the amount of Lasix required for the horse and hence impact performance?</p>
Bees		<p>What are new treatment options for Varroa mites?</p> <p>What are methods to improve bee immunity to pests and diseases?</p>

**Table 4 – Environment**

Sector	Areas of Research Need	Specific Research Questions
Beef	Need for documented, comprehensive role/impact of beef production Specific priority to capture information on Green House Gas (GHG) emission and carbon sequestration in Ontario grasslands	
Pork	Improving ecological footprint Environmental sustainability Disposal procedures after mass depopulation	
Dairy	Reduced environmental footprint including GHG (enteric methane), energy, wastes and water Soil quality and retention Understanding the role of biodiversity on dairy farms to complement or enhance farm management practices	<p>What alternative materials can producers use to reduce their plastic wastes?</p> <p>What nutrition additives can producers use to reduce their GHG?</p> <p>What practices are needed to optimize carbon sequestration?</p>
Broilers	Improved housing environment for workers and birds (all poultry)	How can barn ventilation be improved to the benefit of animal and human health as well as litter management?
Eggs	Lighting types (energy efficient) for layers/pullets: colour, flicker, effects of delayed lighting, delayed calcium under spring & fall conditions with present barns & under ideal light tight systems.	
Sheep	Need for documented, comprehensive role/impact of sheep production, particularly wool as a replacement for synthetic fibers	
Veal	Ventilation systems have changed over the years and veal producers would like to know ways they can improve the health and welfare of veal cattle by understanding how to improve ventilation.	What is the optimal ventilation system for veal cattle at different stages of production?





Aquaculture	Development of scalable recirculating aquaculture systems Development of benthos and sediment monitoring systems	
Equine	Documentation of the environmental footprint of the industry	
Bees		What are the adverse effects (including synergistic effects) of agrochemicals & agrochemical residues on bee health, bee reproduction and the environment?

**Table 5 – Nutrition**

<b>Sector</b>	<b>Areas of Research Need</b>	<b>Specific Research Questions</b>
Beef	Improving feed efficiency and the nutritive value of alternative feeds (different by-products, grains, and forages). Improving calf feeding systems.	
Pork	Feed costs Precision feeding Slowing pig growth (in the case of market disruption)	
Eggs	To enhance performance & shell quality in all housing systems Pullet nutrition & management as it relates to False Layer	
Turkey	More precisely defined nutritional requirements for various life phases	
Sheep	Impact of grazing winter wheat or rye Strategies to optimize ewe body condition score in accelerated rearing systems	
Goat	Need updated, meat and dairy goat-specific ration formulations Better understanding of nutrition related diseases (e.g. pregnancy toxemia)	
Veal	In the Code of Practice for the Care and Handling of Veal Cattle one of the requirements is the inclusion of fiber and producers would like to know more about the benefits of including fiber in a ration. Determine feeding practices that reduce number of days on feed, specifically the appropriate corn to supplement ratio.	What aspects of the inclusion of fiber in a grain-fed veal feeding program are important to rumen health including ways to improve average dairy gain and reduce days on feed?
Equine	Effect of high protein diet on acid/base balance Effect of dietary antioxidants on post-exercise inflammation resolution	

**Table 6 – Welfare**

<b>Sector</b>	<b>Areas of Research Need</b>	<b>Specific Research Questions</b>
Beef	Effective pain control Welfare during transport (need for rest stops, impact on behaviour and physiology) Impact of housing and ventilation on welfare	
Pork	On-farm euthanasia techniques, barriers to euthanasia, transportation, behaviour vices, space allowance	



Dairy	Improve the health and welfare of calves and cows and optimize productivity and longevity by understanding the behavioural, social and economic barriers or incentives to BMP adoption Understanding the social licence for dairy cattle health and welfare for existing management practices and alternatives.	
Broilers	Effective and humane euthanasia (all poultry)	
Eggs	Improved welfare outcomes in various housing systems	What are the perch requirements in various housing systems?
Turkey	Improved transportation	
Goat	Effective pain management Euthanasia	
Veal	Reducing disease transfer in co-mingled calves in various production systems Improving welfare of male dairy calves throughout the supply chain	
Aquaculture	Best practices for culture, euthanasia, shipping and slaughter	

**Table 7 – Production systems**

Sector	Areas of Research Need	Specific Research Questions
Pork	Improving barn environment (temperature, ventilation, light cycle)	
Dairy	Sustainable barn design for conventional and alternative dairy cattle housing systems (new national/provincial building & electrical codes, social impact)	
Eggs	Create a facility in which new and evolving systems can be evaluated and compared	What management techniques for aviaries and furnished cages will mitigate common problems such as not going to the nest, aggression, and smothering?
Turkey	Improved litter management to avoid breast blisters	
Hatcheries	Identify factors affecting hatchability, substandard chick quality and livability Determination of chick gender pre-hatch	
Goat	Housing and handling equipment	
Veal	Investigate breeding strategies and engage the dairy sector to determine those that can benefit dairy and veal producers	
Bees		Best management practices need to be developed for a) the culling, disinfection, re-use and disposal of frames of comb and b) bee colonies moved for pollination.

**Table 8 – Genetics and Reproduction**

Sector	Areas of Research Need	Specific Research Questions
Beef	Genetics that provide high fertility and high feed efficiency	Can facial recognition be used to match calves and dams for parentage?
Pork	Hyperprolific sows and related issues (runt pigs, lactation, etc) Improving longevity of breeding stock	
Dairy	Dairy cattle genetic improvement (fertility, productivity, feed efficiency)	



	Dairy cow reproduction (including alternative tools and practices to reproductive hormones use)	
Broilers	Selection for improved immunity (all poultry)	
Eggs	Selection for hens that retain shell and egg white quality later in life	
Turkey	Solutions for leg problems, roundheart	
Sheep	Genetics that have lower lamb mortality and morbidity	
Equine	Genetics of muscle disorders	
Goat	Genetic evaluations for meat and dairy	
Veal	Evaluate the relationship between high immune responding cows and calf health	
Aquaculture	Develop a formal breeding program for Ontario Rainbow trout	
Bees		How can we improve queen viability and survival, early queen production and overwintering of queens?

**Table 9– Forage**

Sector	Areas of Research Need	Specific Research Questions
Beef	New species and better genetics Comprehensive systems approach to pasture management	
Dairy	Forage breeding and management for improved yield, resistance, conservation, quality and digestibility	
Sheep	Pasture management to reduce parasite loads	
Equine	Forage quality and respiratory conditions	
Bees	Investigate methods to increase pollinator forage and habitat in order to offset land use that has negative effects on pollinator populations.	
All	Need for documented, comprehensive role/impact of including forage into livestock production systems, including soil health and biodiversity Fertilizer recommendations that match today’s genetics Methods to accurately and effectively measure on farm forage yields Identify yield of comparable options to alfalfa Extending the grazing season through crop selection, genetics and management	

**Table 10 – Product Quality and Development**

Sector	Areas of Research Need	Specific Research Questions
Beef	Improved grading system	Can meat tenderness be determined automatically using camera systems?
Pork	Meat quality and safety	
Dairy	Effect of farm practises (feed, equipment...) on the quality, shelf life and processing of milk Identify the methods to naturally modulate the composition of milk and improve its quality and value, potentially enabling new dairy product development.	How can we reduce Free Fatty Acids in milk and prevent non-frothing of milk?  What new technology is needed to better implement rapid milk sample testing?
Eggs	Prolonged shelf life	



Sheep	Impact of dietary ingredients on meat quality	
Goat	Organisms affecting milk quality	
Veal	Determine factors that will improve meat quality	
Bees		What are the health and medical benefits of honey and other hive products?

**Table 11 – Data**

<b>Sector</b>	<b>Areas of Research Need</b>	<b>Specific Research Questions</b>
Beef	Functional traceability that benefits all along the supply chain	Can data be collected automatically (e.g. weight using animal photos)?
Dairy	Big data: systematic analysis of trends and associations of data to improve profitability	
Broilers	Data as an input to smart agriculture (all poultry)	
Eggs	Benchmark data needed to plot progress in environmental impact	
Sheep	Need for benchmark industry data	
Goat	Need for benchmark industry data	
Veal	Benchmark production practices and correlate with health outcomes	
Equine	Effective traceability Baseline of disease trends	How can data be gathered to determine and monitor equine herd health and disease?

**Table 12 – Economics**

<b>Sector</b>	<b>Areas of Research Need</b>	<b>Specific Research Questions</b>
Dairy	Farm economic performance & impact of trade: risks and opportunities	
All	Cost of production for various production (e.g. housing) systems	

**Table 13 – Food Safety**

<b>Sector</b>	<b>Areas of Research Need</b>	<b>Specific Research Questions</b>
Beef	Avoiding and quickly addressing food safety issues Rapid and cost effective in-plant detection of microbial agents	
Dairy	Microbiology – better understanding of the impact of microbes on milk and dairy products composition and quality as well as human health Chemical, physical and biological hazards and indicators (including addressing relevant risk management strategies for hygienic practices in milk and dairy production and processing)	
Veal	Develop best practices for sharing of information between dairy and veal producers through tools such as traceability Drug Labelling & Approvals/Depletion Studies that take into consideration the metabolism of calves and veal cattle	
Small ruminants		What are the allowable dosage levels for important off label pharmaceuticals?

**Table 14 – Marketing**

<b>Sector</b>	<b>Areas of Research Need</b>	<b>Specific Research Questions</b>
Pork	Marketing and consumer trends	
Bees	Conduct market research and product development for honey and hive products.	

### Summary:

The Ontario livestock industry is highly appreciative of the commitment to research by both the Ministry of Agriculture, Food and Rural Affairs and the University of Guelph. While there are many research needs across Ontario’s livestock sectors, cross sector priority areas have been identified along with three overarching concerns and several emerging new areas of research that warrant investment.

There is a clear need for all parties to work more collaboratively to define and improve our **innovation system** to ensure that research results are implemented on Ontario livestock farms and beyond through the various supply chains. The innovation system encompasses facilities; HQP; appropriate research priorities; effective research management; effective KTT/extension/advisory services; etc. LRIC looks forward to working with OMAFRA, the University of Guelph and industry to define a common view of this system and identify initiatives, supported by all parties, to make improvements.

