



## **Cross Sector Livestock Research Priorities**

**Livestock Research and Innovation Corporation**

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## Overview

Livestock Research and Innovation Corporation (LRIC) annually documents sector specific and cross sector livestock research priorities. This document is vital input for OMAFRA's Alliance research priority setting process. Along with working closely with industry organizations, we also keep an eye to the future so as to identify research needed to address emerging issues and opportunities. This report is formatted in a way that presents:

- high level (Top 3) issues and research needs;
- cross sector opportunities;
- priority areas by sector;
- areas needing to be addressed in the Alliance call;
- timely and sector-specific questions.

Input was gathered from a number of sources including our International Research Advisory Committee (IRAC), our member's own research priority documents, LRIC reconnaissance, a meeting of LRIC member research staff as well as from three key livestock research faculty at the University of Guelph.

Including faculty in our process follows a recommendation from our IRAC.

1. Research priorities should be established using a collaborative approach of industry, government and faculty to ensure they reflect both industry and government needs. More focus should be placed on cross sector opportunities and, where possible, take more of a systems approach.

Our meeting of member research staff focused on the questions below. The intention was to capture "in the moment" and more specific issues and opportunities than one finds in research documents.

1. Considering last years LRIC cross sector priorities document, are there any priorities that can be eliminated, are there any that need to be added?
2. What are the top three issues facing your sector that need research as part of the solution?
3. If you had \$1 Million to invest in research, what would you spend it on?
4. What cross sector priorities do you want to see in the Alliance call for proposals?
5. What are your thoughts on the current state of Getting Research Into Practice (GRIP)?

This final LRIC document, as per usual process, was circulated to LRIC members for comment.

## Top Three

Having LRIC member research staff identify the top three research issues highlighted the top concerns of the livestock sector. Top issues include: climate change, antimicrobial use and emergency preparedness.

**Climate change** includes reduction of livestock impacts as well as helping the sector adapt to existing and increasing climate change challenges. For example there are new disease challenges in sheep and weather fluctuation impacts aquaculture. The growing negative impacts of climate change on livestock production will require research and innovative solutions. Further, the livestock sector is now being unduly blamed for its own impact on climate change through greenhouse gas (GHG) emissions, often with worldwide data that is not reflective of the Ontario industry. Research is needed to document an accurate baseline of livestock impacts and also to

find and make available products and management techniques that reduce GHG emissions from livestock production. Of note, livestock production can have positive impacts on soil health and biodiversity and these need to be documented and more broadly recognized. While not a research issue per se, it was noted that our regulatory approval system is a limiting factor in getting new products (feed additives, vaccines, etc) into commercial use at the farm level.

The livestock sector is adapting to a world of **reduced antimicrobial use**. Producers need alternatives including vaccines, genetic selection for health, management techniques and feed additives, such as probiotics. Sustainable production and animal welfare are depending on research and innovation in this area.

Diseases such as African Swine Fever, Avian Influenza and Foot and Mouth Disease pose ongoing economic and environmental threat. **Emergency preparedness** involves industry and multiple levels of government planning and working together to prevent and eradicate any incidence of these diseases. Examples of research include biosecurity systems, vaccine development, prevalence detection and modelling and deadstock disposal.

## Cross sector Opportunities:

The high level research priority areas noted above lend themselves to cross sector research initiatives with specific areas of research noted below.

- **Climate change and sustainability**
  - Document the livestock sector impact on climate change and design a report card to be used to show progress;
  - Identify most appropriate measure of GHG emissions, for example GHG per unit of product is vastly different than GHG per amount of product required to provide a set contribution to daily protein and vitamin requirements;
  - With particular emphasis on the rumen, develop feed additives that can be used to reduce GHG emissions while maintaining high productivity;
  - Identify additional means of improving feed efficiency as a way of reducing GHG and improving production efficiency;
  - Management and innovations to help the livestock sector adapt to and mitigate the impacts of climate change;
  - Quantify the positive impacts of livestock on soil health.
- **Antimicrobial use**
  - Develop vaccines for common diseases in livestock.
  - Identify, develop and commercialize feed additives and management strategies that stimulate animals immune system and reduce disease incidence and severity;
  - Identify management techniques to lower stress and morbidity associated with transportation and other stressful occurrences.
- **Emergency preparedness**
  - Improved surveillance techniques;
  - Effective systems to monitor movement of disease, including via fomites;
  - Effective depopulation and disposal.

## Priority areas by sector

Using all of the sector specific priority 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 1: Priority areas by sector*

	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	H	H		H	H		H	16
<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>Genetics and Reproduction</b>	M	H	M		H	M			M	M	10
<b>Production systems</b>		H	M	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	M			M			M	5
<b>Economics</b>		H	M	M							5
<b>Food Safety</b>	H		H	H							6
<b>Marketing</b>		M								M	2



**Table 2 – Health**

<b>Sector</b>	<b>Areas of Research Need</b>
All	AMU and alternative management and products Emerging disease resulting from climate change Emergency preparedness
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 diarrhoea, pneumonia 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.
Broilers	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
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
Hatcheries	Understanding metabolic disorders in developing chicks
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.
Equine	Real time assessment of impacts of physiological stress Rapid stall-side testing (e.g. respiratory)

**Table 3 – Environment**

<b>Sector</b>	<b>Areas of Research Need</b>
All	Documentation of impacts (positive and negative) of livestock production Identification of ways to reduce environmental impact Identification and ways to mitigate emerging threats resulting from climate change
Beef	Need for documented, comprehensive role/impact of beef production Specific priority to capture information on GHG emission and carbon sequestration in Ontario grasslands Quantify the positive impact of livestock on soil health Facility design and management adapted to changing climates



Pork	Improving ecological footprint Environmental sustainability Disposal procedures after mass depopulation Facility design and management adapted to changing climates
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 Facility design and management adapted to changing climates
Broilers	Improved housing environment for workers and birds (all poultry) Facility design and management adapted to changing climates
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. Facility design and management adapted to changing climates
Sheep	Need for documented, comprehensive role/impact of sheep production, particularly wool as a replacement for synthetic fibers Quantify the positive impact of livestock on soil health.
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.
Aquaculture	Development of scalable recirculating aquaculture systems Development of benthos and sediment monitoring systems Facility design and management adapted to changing climates
Equine	Documentation of the environmental footprint of the industry

**Table 4 – Nutrition**

<b>Sector</b>	<b>Areas of Research Need</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
Broilers	Improving feed efficiency
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.
Equine	Effect of high protein diet on acid/base balance Effect of dietary antioxidants on post-exercise inflammation resolution

**Table 5 – Welfare**

<b>Sector</b>	<b>Areas of Research Need</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	Advance science regarding welfare requests from a consumer perspective (e.g. natural lighting)
Eggs	Improved welfare outcomes 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 6 – Production systems**

<b>Sector</b>	<b>Areas of Research Need</b>
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 Identification of fertile eggs on farm to avoid infertile eggs being shipped to hatcheries
Turkey	Improved litter management to avoid breast blisters
Hatcheries	Identify factors affecting hatchability, substandard chick quality and livability Determination of chick gender prehatch
Goat	Housing and handling equipment
Veal	Investigate breeding strategies and engage the dairy sector to determine those that can benefit dairy and veal producers

**Table 7 – Genetics and Reproduction**

<b>Sector</b>	<b>Areas of Research Need</b>
Beef	Genetics that provide high fertility and high feed efficiency
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



**Table 8– Forage**

<b>Sector</b>	<b>Areas of Research Need</b>
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 9 – Product Quality and Development**

<b>Sector</b>	<b>Areas of Research Need</b>
Beef	Improved grading system
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.
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

**Table 10 – Data**

<b>Sector</b>	<b>Areas of Research Need</b>
Beef	Functional traceability that benefits all along the supply chain
Dairy	Big data: systematic analysis of trends and associations of data to improve profitability
Broilers	Data for benchmarking regarding sustainability
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

**Table 11 – Economics**

<b>Sector</b>	<b>Areas of Research Need</b>
Dairy	Farm economic performance & impact of trade: risks and opportunities
All (not Broilers)	Cost of production for various production (e.g. housing) systems

**Table 12 – Food Safety**

Sector	Areas of Research Need
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)
Broilers	Feed additives / probiotics as alternatives to antibiotics and importation considerations
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

**Table 13 – Marketing**

Sector	Areas of Research Need
Pork	Marketing and consumer trends
Bees	Conduct market research and product development for honey and hive products.

## Areas needing to be addressed in the Alliance priorities document:

The Alliance call for proposals should address industry ongoing needs, specific and timely questions and also allow for **highly innovative proposals** that do not fit neatly into an identified question. Researchers are continually exposed to novel ideas and so there should be an opportunity to bring those ideas forward. This opportunity should not be seen as abandonment of priorities but rather as a means of bringing the most current ideas and options forward... those that may not yet be known as possibilities by those in industry.

There are several issues at the farm level that could have an **Engineering** solution. LRIC is working closely with the University of Guelph School of Engineering to bring them closer to the livestock sector. We have identified several areas of research and development including:

- Geofencing to enable grazing of what are now unfenced croplands
- Develop an affordable, high retention alternative to the RFID tags used in livestock
- Easy data capture systems for grazed animals
- Elimination of stray voltage
- Identification of fertile eggs on farm to avoid infertile eggs being shipped to hatcheries
- Develop a robot to pick up floor eggs
- Precision feeding systems taking weight, stage of production and body condition into account
- Imaging to provide accurate bird counts in aviary housing systems

These Engineering opportunities should be reflected in the Alliance priorities document.



While the future of livestock production will be more data driven, the reality of today is one where those who want to “digitize” farming and those actually farming are separated by a chasm of language and understanding. The solution to this challenge will be having industry clearly identify issues and opportunities which will create an “industry pull” for solutions. All data-focused proposals should be required to have a clear industry issue/opportunity statement, along with industry support.

All Alliance projects are required to have a Knowledge Translation and Transfer (KTT) plan. KTT, and **Getting Research Into Practice (GRIP)**, which involves more stakeholders in the space between research result and implementation on farm, is an area needing improvement. That is the assessment of several parties.

LRIC members, Grain Farmers of Ontario and Ontario Fruit and Vegetable Growers Association recently prepared a position paper “Defining Success: Industry position on Alliance renewal”. A key point in that paper focused on GRIP.

*“Start over with approach to GRIP (Getting Research Into Practice). This will include a reset on the current approach to KTT and may involve having extension identified as a core part of the applied faculty roles as well as funding for industry organizations to take on greater roles.”*

Additional comments on GRIP from the recent LRIC members research priority meeting:

- *“We need dedicated people working closely with researchers to get information out faster and in the right format/language.”*
- *“Many researchers have taken on a global approach which can mean that results are not applicable to Ontario.”*
- *“Small commodities often get ignored.”*

## Specific research questions:

While high level research priority areas do not change significantly over a short time, the industry does have more timely and specific research questions that they need answered. From the meeting with LRIC member research staff, these are the specific questions that the industry wants to have included in the Alliance priorities document.

1. How can the sheep industry capitalize on the potential uses for wool?
2. How can the broiler industry minimize and manage E.coli?
3. How do grazed livestock contribute to healthy soil?
4. What species and varieties of forage will provide increased yield, nutrition and longevity?
5. What are new effective means of deadstock disposal? Are there uses for the biowaste generated?
6. What feed additives can be used to reduce the GHG emissions from ruminant livestock while not impeding production?
7. What management practices and facility modifications will enable livestock producers to maintain highly efficient production in the face of changing climate?
8. What are control strategies for reovirus? This can include the development of live and inactivated vaccines for reovirus.
9. How can we control, reduce and eradicate Salmonella Dublin on farms?
10. What are new treatment options for Varroa mites?
11. How can barn design and ventilation be improved to the benefit of animal and human health?
12. Can meat tenderness be determined automatically using camera systems?

13. How can feed efficiency be improved as a means of improving sustainability and lowering GHG impacts?
14. What alternative materials can producers use to reduce their plastic wastes?
15. What practices are needed to optimize carbon sequestration?

## Appendix: Sector-specific documents

Sector	Documents
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 Updated by industry in 2021.
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

