



Cross Sector Livestock Research Priorities

Livestock Research and Innovation Corporation

February 2023

Table of Contents

HIGH LEVEL CONSIDERATIONS:	3
START WITH THE END IN MIND	3
RESEARCH INITIATIVES ARE PART OF AN INNOVATION SYSTEM	3
MOVING THE MARKERS WITH GRIP	3
INTEGRATED RESEARCH IS NEEDED	3
A NEW (A2B) APPROACH	4
CALL FOR PROPOSALS SHOULD INSPIRE CREATIVITY	4
REGULATORY RIGOUR	4
DEADSTOCK AND HIDES REMAIN CHALLENGES REQUIRING RESEARCH AND INNOVATION	4
KNOWING THE WHOLE STORY	4
LRIC CONTINUES TO WORK WITH MEMBERS TO ENSURE THAT THEY HAVE CURRENT RESEARCH PRIORITIES	5
<i>Poultry</i>	5
<i>Goats</i>	5
<i>Pork</i>	5
THE TOP THREE ISSUES	5
CLIMATE CHANGE.....	5
ADAPTING TO A WORLD WITH REDUCED USE OF ANTIMICROBIALS	6
EMERGENCY PREPAREDNESS.....	6
CROSS SECTOR OPPORTUNITIES:	6
CLIMATE CHANGE AND SUSTAINABILITY.....	6
ANTIMICROBIAL USE	6
EMERGENCY PREPAREDNESS.....	7
SECTOR SPECIFIC RESEARCH QUESTIONS:	7
APPENDIX 1: PRIORITY AREAS BY SECTOR	8
TABLE 1: PRIORITY AREAS BY SECTOR (CHANGES FROM 2022 HIGHLIGHTED).....	8
TABLE 2 – HEALTH	9
TABLE 3 – ENVIRONMENT	9
TABLE 4 – NUTRITION.....	10
TABLE 5 – WELFARE	11
TABLE 6 – PRODUCTION SYSTEMS	11
TABLE 7 – GENETICS AND REPRODUCTION	11
TABLE 8– FORAGE	12
TABLE 9 – PRODUCT QUALITY AND DEVELOPMENT	12
TABLE 10 – DATA	12
TABLE 11 – ECONOMICS	12
TABLE 12 – FOOD SAFETY	13
TABLE 13 – MARKETING	13
APPENDIX 2: SECTOR-SPECIFIC DOCUMENTS	14

High level considerations:

Start with the end in mind

The goal of livestock research in Ontario should be the innovation and sustainable growth of the livestock sector as a key pillar in Ontario's economy, environment and food security.

Research initiatives are part of an innovation system

LRIC's International Research Advisory Committee recently reviewed Ontario's livestock innovation system and made several recommendations:

<https://www.livestockresearch.ca/uploads/assets/files/Final%20IRAC%20report%20Feb%2028%202022.pdf>. Key improvements would see research priorities being set much more collaboratively (industry, faculty, OMAFRA) and a new and improved system of getting research into practice (GRIP). KTT is a required element of all Alliance funded projects, however, KTT is only one part of effective GRIP.

Moving the markers with GRIP

Several recent initiatives have created a moment in time to significantly move the markers in GRIP. The funding limits of past KTT calls should be increased to provide sufficient funds to broader coalitions with large initiatives. The program would be better named as GRIP rather than KTT to align with the change in approach that is being suggested.

Integrated research is needed

Industry needs comprehensive research to capture the many aspects of a problem or opportunity under study. Research should, whenever possible, be conducted with a team of expertise across colleges at the University involving any end users from the start. For example, 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

A new (A2B) approach

To effectively develop and prioritize research priorities, one must know where you are (A) and where you need to go (B) relative to the big things facing the sector. How to make that move is “2” and can include research, innovation, policy, access to products, etc. Taking this A2B approach better aligns research priorities with the strategic plan of an organization and/or the sector. Industry, faculty and OMAFRA should use this process to look at the big issues facing each sector (e.g. adapting to climate change, reducing climate impact, reducing use of antimicrobials, etc).

Call for proposals should inspire creativity

While there should be some specific research questions posed for each sector, and across sectors, there should be an “Other” option through which a researcher can propose new and creative means of achieving the stated objective. In addition, there should be additional funding allocations that ensure that great research ideas find a funding source.

Regulatory rigour

There is growing industry frustration related to the apparent lack of research results in place to back up new regulations that have a direct cost to producers. Examples include: access to products, particularly those that assist with a transition away from antimicrobials; proposed changes to the national and provincial building codes appear to lack the research results to warrant them.

Deadstock and hides remain challenges requiring research and innovation

On industry request, LRIC signed a separate TPA with OMAFRA to explore the issue of deadstock and hides produced by small and medium size processing plants. Findings and recommendations, including possible resView the recent LRIC webinar with Dr. Rogers at each, will be available in March and it is highly likely that research questions will be identified.

Knowing the whole story

Recent work by Dr. Michael Rogers, Food Science, Ontario Agricultural College, demonstrates that comparisons to date of plant-based products with meat and milk have been ignoring the critical element of how these foods are digested and their impact on human health, including the gut microbiome. View LRIC’s recent webinar featuring Dr. Rogers at <https://www.youtube.com/watch?v=5xS9OhPNIFI>. Research is needed to fully contrast livestock products with these new products that are in fact ultra processed foods now being marketed as superior to livestock products.

LRIC continues to work with members to ensure that they have current research priorities

Poultry

- LRIC hosted a meeting in October modelling a collaborative approach (4 feather groups, faculty, OMAFRA, CPRC, PIC)
- Avian Influenza, of course, dominated much of the discussion
- There is concern that USDA may class Salmonella as an adulterant in poultry
- Robotics to count birds, identify diseased and dead birds would be valuable
- It was noted that there are those that are prepared to throw Agriculture, livestock in particular, under the bus. Concern was raised that some of these voices are coming from policy makers and regulators.
- It was noted that there is a need for more effective communication and extension to ensure that research results are applied on the farm.
- We should consider a livestock think tank, community of practice for Ontario
- What are the big ideas that will alter the poultry industry. Where does the poultry or livestock need to be in 10 years.
- There is no SWOT analysis of the livestock sector in Ontario... this would be useful. Include all commodities.

Goats

- Following discussions and background work, LRIC presented the need to include work on climate change and impact to the Ontario Goat Value Change Roundtable and this priority has been added.

Pork

- LRIC was invited to meet with Ontario Pork to present a new approach to determining research priorities (A2B approach)

The top three issues

Climate change

- There are two elements to this priority: adapting production to the climate changes we are already experiencing and reducing the environmental impact of livestock production per unit of production.
- The report from the Provincial Climate Change Impact Assessment was due fall 2022 but is late. LRIC was actively involved in the consultations and looks forward to that report as input to consider further livestock research in this area.
- 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.

Adapting to a world with reduced use of antimicrobials

- This will involve production practices, genetics, alternatives (e.g. probiotics), treatments (e.g. antivirals), etc and involves every livestock sector. Development of vaccines is critical.
- Access to products, particularly those that assist with a transition away from antimicrobials
 - The possible elimination of Zinc oxide from swine rations (the period immediately after weaning) would remove a tool used by swine producers as they adapt to a world with less use of antimicrobials

Emergency preparedness

- Major disease outbreaks such as AI are known to be highly costly and disruptive
- During 2022, the industry learned a great deal about a highly infectious disease (AI) and also that we need to take new approaches to keep pathogens out of the province, detect when they arrive and track movement, understand the specifics (e.g. genotype), enhance biosecurity, explore means other than the use of controls zone and culling, etc

Cross sector Opportunities:

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 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.

Sector 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 1: 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 (changes from 2022 highlighted)

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

Table 2 – Health

Sector	Areas of Research Need
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 Causes of Sow Mortality
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

Sector	Areas of Research Need
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.
Goats	Adapt to, and limit impact on, climate change
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

Sector	Areas of Research Need
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

Sector	Areas of Research Need
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

Sector	Areas of Research Need
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

Sector	Areas of Research Need
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

Sector	Areas of Research Need
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

Sector	Areas of Research Need
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

Sector	Areas of Research Need
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

Sector	Areas of Research Need
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.



Appendix 2: 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” Initial meeting with Ontario Pork to investigate a new approach to priorities, work to be completed in 2023
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. Output from LRIC hosted collaborative session October 2022.
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 2022.
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