FOOD FROM
THOUGHT

UNIVERSITY of GUELPH

AGRICULTURAL SYSTEMS FOR A **HEALTHY PLANET**

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LETTER FROM THE VICE-PRESIDENT, RESEARCH AND SCIENTIFIC DIRECTOR

In a time of unprecedented change on our planet – a growing population, climate change, rapid expansion of technological capabilities, and changes to what and how we eat – it is all the more pressing to contribute strong, evidence-based solutions to the great global challenges facing our generation and the ones that follow.

Now in its third year, Food from Thought has been doing just that: Leveraging data science, new digital tools, and novel approaches to support sustainable agriculture and food production. Most recently, we just announced a $20 million-dollar investment in over 30 new and expanded research projects under the Food from Thought banner for exceedingly innovative research teams.

Cohesive threads are already winding their way through early research findings. Ecosystem services not only strengthen and repair the environment, but they can be profitable for farmers and producers. Precision agriculture, driven by big data, can detect illnesses in livestock sooner, with more accuracy, and identify optimal livestock management practices. Pathogens are resilient, but livestock and crops can be resilient too. Climate change is altering food webs globally. Biodiversity is at risk, but can also be improved through agricultural practices. Taken together, these research results are confirming that it is possible to intensify production, be profitable, and protect the health and well-being of livestock and the natural environment.

Our research impact is bolstered through our investment in innovation, commercialization, knowledge mobilization, and training. Food from Thought-funded research commercialization programs began in January 2018, with the Accelerator Guelph incubator launching six start-up companies in the first year. In 2018, we launched our highly unique Policy Fellowship program, directly connecting senior policy makers with researchers to support science-informed agri-food policy. We also joined forces with the Ontario Agri-Food Innovation Alliance to deliver enhanced experiential graduate student training aimed at readying our graduates to not only succeed, but to lead in the rapidly changing agri-food sector.

Our continued progress towards sustainability is critically dependent on our partners and collaborators, and it is these groups whose needs and priorities we strive to meet. New partnerships and collaborations strengthen our ability to deliver impactful research, such as signing a memorandum of understanding with the University of Saskatchewan to leverage our respective strengths in agri-food.

With science and collaboration as key drivers, the future for sustainable agriculture on our planet is strong. We are thrilled to be a leader in this space, working alongside visionaries from around the world, and excited to see that the work accomplished through Food from Thought and the Canada First Research Excellence Fund is elevating Canada's reputation for truly innovative agri-food systems.

Malcolm Campbell
Vice-President, Research

Evan Fraser
Scientific Director

AGRICULTURAL SYSTEMS FOR A HEALTHY PLANET

In the face of a rapidly growing population and escalating climate change impacts, we are left with a complicated question: How can we feed a growing population while protecting our planet and its ecosystems?

Food from Thought, funded in part by the Canada First Research Excellence Fund, is tackling this global challenge by advancing our understanding of the complex interplay between farming practices and the environment. The program's goal is to increase the sustainability and productivity of global food production by leveraging the considered power of big data, agri-food, and biodiversity science.

Food from Thought is positioning Canada as a global leader to create agricultural systems for a healthy planet on global, landscape, and micro-scales through four key strategies: cutting-edge research; training the next generation of agri-food leaders; innovation, commercialization and knowledge mobilization; and increasing the University of Guelph's capacity for data science expertise through faculty hiring and catalyzing the development of an integrated data sharing and analytics platform.

NEARLY
$20 MILLION
IN RESEARCH DOLLARS
ANNOUNCED

430+
PUBLICATIONS

9
POLICY
FELLOWS

6 INCREDIBLE
EXPERTS HIRED
INTO FACULTY POSITIONS

22,000
GOOGLE SCHOLAR
CITATIONS

SUPPORTED **33**
COMMERCIALIZATION AND
DEVELOPMENT VENTURES

65+ PARTNERS
AND KNOWLEDGE USERS

28 OUTSTANDING
GRADUATE
RESEARCH ASSISTANTS

200+ **OUTSTANDING**
GRADUATE STUDENTS AND
POSTDOCTORAL FELLOWS

MORE THAN
1,000,000
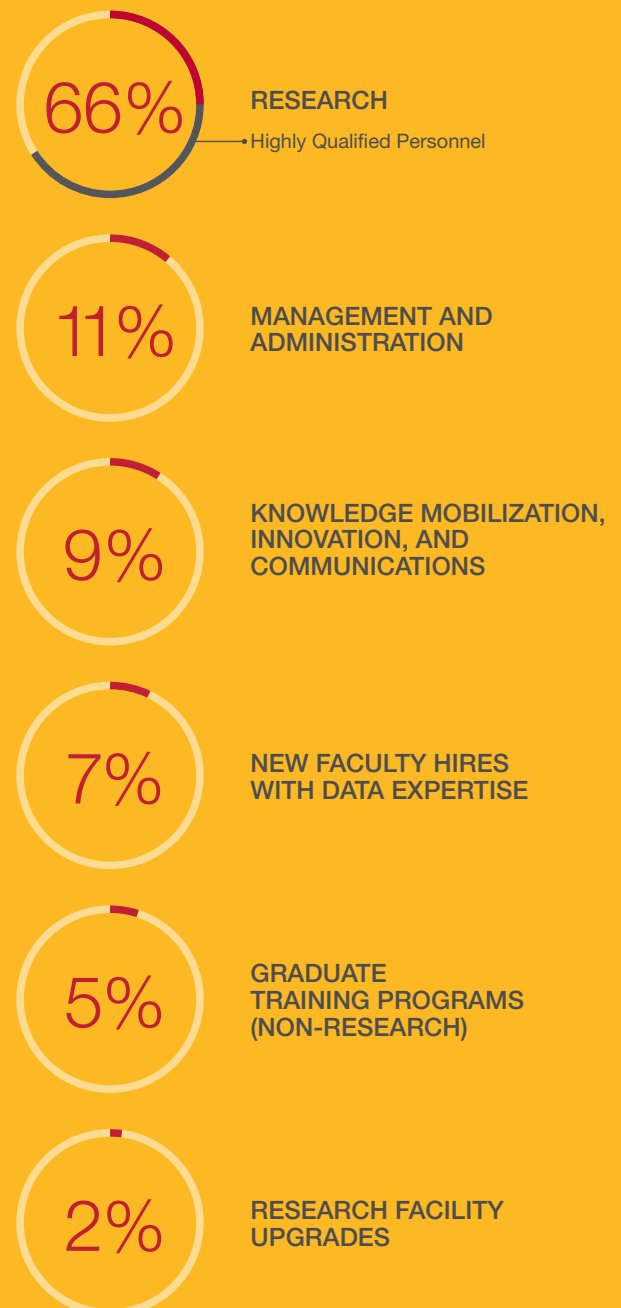**WEBSITE VISITS**

NEARLY
500,000
VIDEO VIEWS

100+
MEDIA
INTERVIEWS
WITH PRINCIPAL
INVESTIGATORS

250K+ IMPRESSIONS

FUNDING THAT HAS REAL IMPACT

Food from Thought is investing $76.6 million over seven years into groundbreaking research, and ensuring University of Guelph research is in the hands of policy makers and industry through knowledge mobilization and commercialization efforts. The grant is also expanding the University's capacity in data science through the addition of new faculty experts, training the next generation of agri-food leaders, and upgrading our research facilities.

RESEARCH

INCREASING CAPACITY

TRAINING

KNOWLEDGE MOBILIZATION AND INNOVATION

FUNDING ALLOCATION

66% RESEARCH
• Highly Qualified Personnel

11% MANAGEMENT AND ADMINISTRATION

9% KNOWLEDGE MOBILIZATION, INNOVATION, AND COMMUNICATIONS

7% NEW FACULTY HIRES WITH DATA EXPERTISE

5% GRADUATE TRAINING PROGRAMS (NON-RESEARCH)

2% RESEARCH FACILITY UPGRADES

NEW IDEAS IN DIGITAL AGRICULTURE

Food from Thought launched a $1,000,000 competitive research program in 2018 to support new research ideas in digital agriculture.

The competition resulted in five innovative research projects led by University of Guelph researchers, who began their research in April 2019. The priority areas for this new research program emphasize the development of novel digital, data-driven applications, analytics, and decision-support tools for the agri-food sector; advancements for the development of integrated research data platforms and databases that support progressive interdisciplinary research; and research on governance and management of agri-food research data.

NEW IDEAS IN DIGITAL AGRICULTURE
PROJECTS 2019

Enhancing Ontario's grain production using smart farming techniques

Asim Biswas

Bill Deen, John Sulik, Adam Gillespie, Prasad Daggupati

Accounting for soil organic carbon in profitability maps

John Lindsay

Madhur Anand, Aaron Berg, Evan Fraser, Adam Gillespie, Ahmed Laamrani, Eric Nost, Clarence Swanton, Paul Voroney, Wanhong Yang

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Livestock visualization project: Using visual and spectral images to determine calf growth and performance

Medhat Moussa

Katie Wood, Dan Tulpan, Megan Van Schaik, John Van de Vegte, Marlene Paibomesai

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Utilizing data from automated calf feeders: Identifying novel ways to identify disease to improve growth and performance of dairy calves

Dave Renaud, Charlotte Winder

Michael Steele

Expanding the value of soil health and soil ecosystem services research through development of an integrated data sharing platform

Claudia Wagner-Riddle

Kari Dunfield, Aaron Berg, Jon Warland, Myrna Simpson, Kate Congreves, Hugh Henry

ECOSYSTEM SERVICES RESEARCH

As new technologies and innovations have allowed the world to intensify agricultural production, we have created significant changes in natural ecosystems.

Some of this change is negative – such as biodiversity loss or decreased health of water and soils. And some of this change can be positive – such as improving ecosystem services locally on agricultural and impacted land through management practices, leading to regional and even global improvements. To address these changes, ecosystem services research spans local, national, and global scales to investigate the trade-offs between certain agriculture management practices and ecosystem health.

Scientists are working on leading-edge projects that advance our understanding of the relationship between food production and the sustainability of ecosystem services in both the harvested ecosystem (e.g. agro-ecosystems, great lakes fishery) and adjacent impacted ecosystems and associated biota (e.g., plants and animals of prairies, streams, forest). These projects are integrative, testing fundamental theory on a range of topics relating to the provision of ecosystem services by biological processes, but also applying those findings to farm management that combines principles of "precision agriculture" with "precision conservation".

The success of this research derives from close collaboration with farmers in southern Ontario. In many ways, the research is farmer-led through the efforts of Alternative Land Use Services (ALUS) Canada. This provides a rare opportunity to design integrative agroecosystem management informed by theory, which is carried out and tested in real-world settings. In addition to

Backus Heritage Conservation Area

farms, research will also take place in a highly controlled setting at an advanced University of Guelph research facility that enables large-scale, replicated aquatic experiments capable of testing organismal to whole ecosystem responses to environmental change such as climate change. It will also allow researchers to develop farm-based applications, such as user-friendly biomonitoring tools that support "greener" economic development.

The research program increases our understanding of stressors, responses, and implications of changes to terrestrial and aquatic biodiversity resulting from food production activities. This will help identify agricultural methods that are productive and support adjacent ecosystem function.

ECOSYSTEM SERVICES RESEARCH PROJECTS

Eco-evolutionary dynamics and aquatic ecosystem services

John Fryxell

Andreas Heyland, Robert Hanner, Teresa Crease

Genomic indicators of agro-ecosystem services

John Fryxell

Dirk Steinke, Robert Hanner, Elizabeth Mandeville, Paul Hebert, Amy Newman, Cynthia Scott-Dupree

Synergistic effects of climate change, nutrient loading, and pesticide accumulation

John Fryxell

Kevin McCann, Andreas Heyland, Robert Hanner, Karl Cottenie, Chris Caruso, Merritt Turetsky and Dirk Steinke

Terrestrial ecosystem services

Andrew MacDougall

Jana Levison, Kari Dunfield, Hafiz Maherali, Amy Newman, Brian Husband, Christina Caruso

Food security and the maintenance of aquatic ecosystem services

Kevin McCann

Nick Bernier, Fred Laberge, Neil Rooney, Merritt Turetsky, Robert Hanner, Karl Cottenie, Ryan Prosser

TERRESTRIAL ECOSYSTEM SERVICES

Andrew MacDougall

Jana Levison, Kari Dunfield, Hafiz Maherali, Amy Newman, Brian Husband, Christina Caruso

To be sustainable, farmers must balance production, profit and environmental impact. While they may be interested in the latter, farmers sometimes see environmental remediation and health as incompatible with production and profit. This project's goal is to increase environmental sustainability on high-production agricultural landscapes, while working collaboratively with producers to return marginal land to natural states. The team's work will leverage the data collected from 22 farms in Ontario, through a partnership with Alternative Land Use Services Canada (ALUS), to quantify ecosystem services, including measuring the impacts of farms on the environment, the effects of remediation efforts, and the socioeconomic impacts.

"**Our project focuses on quantifying ecosystem services on farms to increase environmental sustainability in agriculturally-intensive landscapes. The overarching goals are to measure farm impacts on environmental baselines, benefits of farm-based remediation, and advantages of ecosystem services to society and farmers.**"

– Andrew MacDougall

FOLLOW ANDREW **@AMACD_UGUELPH**

Ellen Esch (left), Mehra Balsara, and Kristin Doherty (Integrative Biology)

AGRICULTURAL SYSTEMS FOR A HEALTHY PLANET

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BIODIVERSITY RESEARCH

Humans share this planet with millions of species. Only a few of those are food sources, while most of the others lie at the margins of daily life but are central to the health of the planetary ecosystem. Human population growth and agricultural production create an escalating conflict with the natural world and have caused major declines in biodiversity.

The University of Guelph's Centre for Biodiversity Genomics is the global leader in advancing our understanding of human impacts on biodiversity by utilizing DNA barcoding, a technology that shifts traditional species identification systems based on morphology to DNA sequences. Such DNA-based identification systems can provide a more comprehensive understanding of biodiversity health on our planet. The Centre is advancing protocols for DNA barcoding and metabarcoding, and the instrumentation to reduce costs as well as maintaining and expanding its "Barcode of Life" data platform, BOLD, with the ultimate goal of providing immediate access to a multitude of species-specific life history traits. DNA barcoding will make it possible to complete the inventory of species on our planet and to track shifts in their abundance and distribution in response to global change.

This work will also allow agri-food and biodiversity science to expand our knowledge of the interplay between natural and agricultural systems in unprecedented detail. Ultimately, it will advance our understanding of human impacts on biodiversity, especially those linked to agricultural production.

Food from Thought's partnership with the Universities of Victoria and McGill has allowed us to expand our biodiversity research into new areas. The Oceans of Biodiversity project at the University of Victoria uses DNA barcoding and metabarcoding to characterize and monitor marine biodiversity of both plankton and benthic communities, which ultimately will contribute to improved management practices for commercial fisheries and aquaculture. McGill University's work on pesticides links farm management with the health of the aquatic environment.

BIODIVERISTY RESEARCH PROJECTS

Advancing environmental impact assessments

Paul Hebert

Dirk Steinke, Jeremy deWaard,
Sujeevan Ratnasingham, Evgeny Zakharov

Bio-surveillance for agriculture

Paul Hebert

Dirk Steinke, Jeremy deWaard,
Sujeevan Ratnasingham, Evgeny Zakharov

Oceans of biodiversity

Barbara Hawkins

John Dower, Kim Juniper, Diana Varela,
R. John Nelson

The ecological impacts of pesticides on aquatic ecosystems

Melania E. Cristescu

Gregor Fussmann, Andy Gonzalez,
Graham Bell, Rowan Barrett

The multiplex barcode research and visualization environment (mBRAVE)

Paul Hebert

Sujeevan Ratnasingham

Tracking the response of arthropod communities to changing environments (TRACE)

Paul Hebert

TRACKING THE RESPONSE OF ARTHROPOD COMMUNITIES TO CHANGING ENVIRONMENTS (TRACE)

Paul Hebert

"The University of Guelph's Centre for Biodiversity Genomics is leading BIOSCAN, a $180 million research program involving research organizations in 30 nations. TRACE will make a major contribution to BIOSCAN by laying the foundation for a global biomonitoring program. It's only possible for the Centre's research team to undertake this work because of our advanced capabilities in DNA barcoding and metabarcoding."

– *Paul Hebert*

The primary goal of TRACE lies in assessing arthropod diversity in three of Canada's most important ecoregions, two (Mixed Wood Plain, Prairies) that are intensely impacted by human activity and one that is less so (Boreal Shield). A standard methodological approach will be employed to facilitate comparisons of biodiversity patterns among these ecoregions as well as among the sites within each ecoregion. This will allow an unprecedented comparison of patterns in arthropod diversity and biomass between natural environments and those impacted by agriculture, forestry or urbanization. TRACE will not simply make it possible to employ organisms as indicators of environmental change; it will enable the development of a new branch of science – biotic forecasting. Through such action, the biodiversity science community will generate the information needed to formulate policies that will aid the protection of global biodiversity.

CROPS RESEARCH

Agricultural crops are a major component of the agriculture sector in Canada and around the world. As consumer preferences increase for more fruits, vegetables and plant-based protein food sources, the way we produce crops to feed a growing population will be increasingly important for our planet's health.

Food from Thought scientists are conducting cutting-edge research that enables the intensification of agricultural production, while protecting ecosystem services. Research in this area explores how to enhance plant, soil and landscape biodiversity to intensify agricultural productivity without reducing ecosystem services.

Crops research spans the micro level with cellular and genetic research; the field level with economics, soil health, cover crops, management zones, and nitrogen use efficiency; and the landscape level with landscape management, pollinator health, advanced applications, and satellite imagery.

Researchers are measuring the effects of modifying conventional production systems to increase diversity by understanding mechanisms of plant competition in order to enhance crop tolerance to weeds and cover crops. Projects are examining the impacts on yield of inter-seeding cover crops, identifying and fallowing unprofitable or low producing zones within fields, planting pollinator strips in field margins, planting crop variety mixtures, and increasing symbiotic associations between crops and plants in order to enhance nitrogen fixation. From a management perspective, our researchers are looking at how crop management influences ecosystem services, including pollination and soil health. Researchers are also developing and testing new approaches and applications for precision agriculture and precision conservation using high resolution and high temporal frequency data.

This work will ultimately provide farmers with evidence to make informed decisions on how to manage their fields and crops, including whether to set aside agricultural lands for ecosystem services, and how to increase yields on the most productive lands while ensuring the long-term health of soils.

K. Peter Pauls (Plant Agriculture) assesses soybeans

CROPS RESEARCH PROJECTS

Modelling and monitoring agroecological mosaic ecosystems for optimizing human-environment sustainability

Madhur Anand

Agricultural hydrology and modelling

Aaron Berg

Leveraging Canada's RADARSAT constellation mission for advances in precision agriculture and precision conservation

Aaron Berg

Development of a corn nitrogen (N) decision support system that incorporates soil moisture interactions

Bill Deen

David Hooker

Development of a protocol and pilot study for nitrogen x water on-farm research

Bill Deen

Josh Nasielsky

Investigating the soil microbiome to understand soil health and soil ecosystem services

Kari Dunfield

Enhancing biodiversity of the agro-ecosystem by enhancing adoption of cover crops

Elizabeth Lee

Bill Deen, David Hooker, Eric Lyons, Nigel Raine, Kari Dunfield

Cropping systems: White bean diversity and nitrogen efficiency

K. Peter Pauls

Strategies for achieving simultaneous increases in bean crop agroecosystem diversity and productivity

K. Peter Pauls

Assessing and enhancing wild pollinator biodiversity to support economically and environmentally sustainable crop pollination

Nigel Raine

Pollinator biodiversity monitoring and pollinator seed mix assessment

Nigel Raine

Improved approaches for management zone creation

John Sulik

Enhancement of crop stress tolerance to weeds and cover crops

Clarence Swanton

Financial and sustainability assessment of precision agriculture in crop production

Alfons Weersink

John Sulik

MODELLING AND MONITORING AGROECOLOGICAL MOSAIC ECOSYSTEMS FOR OPTIMIZING HUMAN-ENVIRONMENT SUSTAINABILITY

Madhur Anand

The main goal for prof. Madhur Anand's research team is to achieve win-win scenarios for agricultural production, profitability, and ecosystem health, and how these can impact human health and food security. The research uses field-based data collection and other large data sets to research the impacts and trade-offs of land-use for food production and functional diversity at local and global scales. A key objective of the research will be the development of next-generation profit mapping and other landscape optimization tools for land-use decision-making. An important component of the project incorporates social learning and network analyses to understand what drives the adoption of sustainable practices by farmers. Long-term outcomes aim to increase conservation opportunities and improve policy and management of natural and agricultural lands.

"In Southern Ontario, we live in mosaic landscapes, where not only agriculture but other competing interests on the land – conservation, recreation, urban development – exist. Although these systems interact naturally, we do not see much interaction in their management. We would like to see a major change in this kind of thinking and provide the science to help."

– Madhur Anand

FOLLOW MADHUR **@GLOBALECOCHANGE**

AGRICULTURAL SYSTEMS FOR A HEALTHY PLANET

LIVESTOCK RESEARCH

Increases in global livestock production will play a crucial role in meeting demands of a growing population for high-quality protein, however, there are questions around the sustainability of livestock production and growing consumer preferences for alternative sources of protein.

The way that livestock are managed, how they live, and related practices along the food supply chain can significantly influence the sustainability of these important food sources. Scientists at the University of Guelph are exploring these questions of sustainability by applying innovative, data-driven approaches to improve the competitiveness and sustainability of Canada's livestock industry.

The overarching goal of Food from Thought's livestock research is to support the development of highly individualized livestock management systems. Scientists are using the rapidly amassing data from the University's research facilities, including the state-of-the-art Elora Research Station, collected through technologies such as automated milking systems and sensors. They are leveraging this data, along with linking livestock genomics and metagenomics with phenotypic traits, to support improved livestock productivity, health, welfare and efficiency while reducing environmental impacts. The resulting data and findings are helping to address key challenges and opportunities in the livestock sector – including identifying genetic traits of cattle, sheep and goats that enable animals to be more resilient to disease, climate change, and other stressors.

This research not only improves the health and welfare of livestock, but also enables producers to reduce input costs and the environmental impact of livestock production.

LIVESTOCK RESEARCH PROJECTS

The animal database

Christine Baes

Bill Szkotnicki, Flavio Schenkel, David Kelton,
Jan Sargeant

Precision poultry management: Combined approaches for enhancing layers health and welfare in the context of sustainable high egg production

Grégoy Bédécarrates

Elijah Kiarie, Alexandra Harlander, Tina Widowski

Development of novel biomarkers for stress, boar taint and reproductive performance in pigs

Renée Bergeron

James Squires, Julang Li

Identifying genetic markers associated with low stress reaction in pigs

Renée Bergeron

Ray Lu, Kate-Shoveller

Precision cattle management

John Cant

Trevor DeVries, Katie Wood, Michael Steele

Roles of alkaline phosphatases in gut health and nutrient utilization in pigs health

Ming Z. Fan

Identification of metabolic markers for on-farm selection of gilts with high reproductive potential

Julang Li

Breeding livestock for climate resilience

Bonnie Mallard

Flavio Schenkel, Angela Cánovas, Niel Karrow,
Dan Tulpan

Mechanisms of long-term consequences of transition cow biology on production and reproduction traits

Eduardo de Souza Ribeiro

Breeding livestock for climate resilience: The capacity to maintain production and fitness

Flavio Schenkel

Christine Baes, Angela Cánovas, Niel Karrow,
Bonnie Mallard, Filippo Miglior

A comparison of key methodologies used to quantify protein quality of insect protein, black soldier fly larvae, for human and farm animals

Kate Shoveller

Lee-Anne Huber, Elijah Kiarie, Michael Rogers

A comprehensive assessment of slow growing chickens: tackling sustainability issues for chicken strains of tomorrow

Tina Widowski

Elijah Kiarie, Ira Mandell, Niel Karrow, Shai Barbut,
Dan Tulpan

Precision poultry management: Tackling sustainability issues of egg and chicken production

Grégoy Bédécarrats and Tina Widowski

BREEDING LIVESTOCK FOR CLIMATE RESILIENCE

Bonnie Mallard

Flavio Schenkel, Angela Cánovas, Niel Karrow, Dan Tulpan

Climate change impacts more than just our crops – it may also affect our livestock health and genetics. Preliminary data indicate substantial variation in the ability of both dairy and beef cattle to regulate their body temperature during summer heat waves in Ontario. This alters immunological and reproductive cell function. This research will result in a breeding program that uses data on individual animals and their environment, collected by automated, remote sensing systems, to produce resilient Canadian livestock. This enhanced resiliency will improve characteristics such as disease resistance and reproductive capabilities in the face of changing climate conditions.

> "While plants have been more extensively evaluated for their ability to withstand climate change, much less is known about animal genotypes able to adapt to climate change. Genetic selection plays a key role in breeding livestock that can better cope with climate change and, more particularly, tolerate extreme temperatures."
>
> – Bonnie Mallard

PATHOGENS IN FOOD AND LIVESTOCK RESEARCH

Sustainably intensifying production doesn't just mean growing more food, faster, and for more people – it also means protecting those food supplies to avoid major health risks to the public and economic loss for producers.

Diseases that devastate entire flocks of livestock, resistance to antibiotics resulting in death or illness, and increased pathogen outbreaks undermine our ability to feed the planet. Scientists are leveraging big data, such as advanced analytics and risk modelling, to identify and solve challenges in animal health, emerging infectious diseases and food safety.

Food from Thought's research on food safety is using big data approaches at the pathogen level to study microbial ecology and virulence through control strategies, discovery of new compounds and probiotics and molecular studies. Big data will also be used for food safety at the global level through predictive models, machine learning and artificial intelligence to predict the emergence of foodborne outbreaks. Together, based on these research results, new strategies and approaches are being developed to enhance the safety of Canadian and global food supplies.

Swine research explores how big data can inform animal health and disease management at the molecular level (genomic sequencing of pathogens), at the pathogen level (microbial/viral biomes as risk factors) and the animal level (with host genomes as a risk factor). Researchers are also examining mastitis in dairy
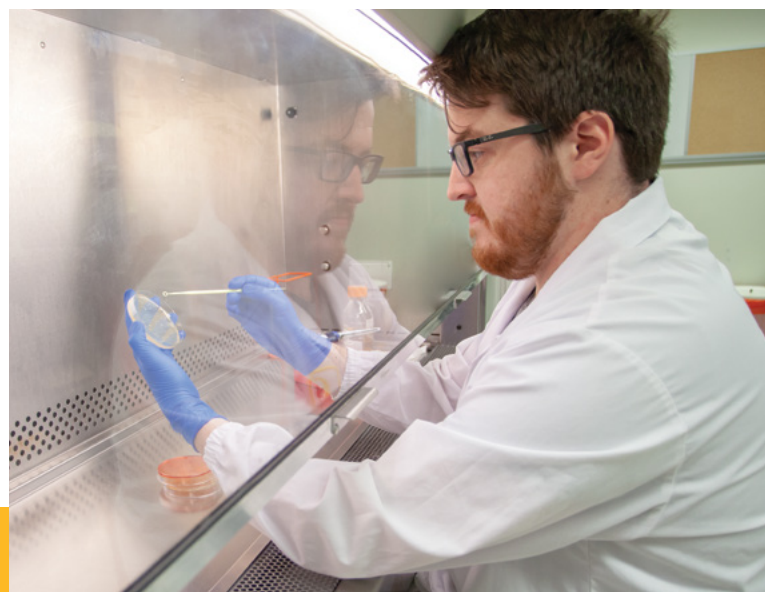
Matthew Dallner (Food Science)

cows using big data at the animal and industry level to create new tools for prudent antibiotics use to reduce emergence of antimicrobial resistance.

Research on emerging infectious diseases investigates the molecular and cellular mechanisms of host responses to influenza viruses and examines how commensal microbes, or friendly bacteria, of the host interact with these viruses. The research team is also harnessing outbreak data, animal movement and social media to create computational tools for predicting the emergence of influenza outbreaks around the world.

A modeling framework and use of big data to predict foodborne outbreaks

Jeff Farber

Rozita Dara, Amy Greer

Control of foodborne pathogens

Jeff Farber

Gisele LaPointe, Larry Goodridge,
Nicole Ricker

Improving antimicrobial stewardship in food animals by identifying the determinants of use of antimicrobials by veterinarians and dairy farmers

Jan Sargeant

Stephen Leblanc, David Kelton,
Dan Tulpan

Identification of factors contributing to Streptococcus suis disease in pigs: big data approach

Jan Sargeant

Vahab Farzan, Robert Friendship,
Brandon Lillie, Jan McInnes,
Amy Greer, Nicole Ricker, Davor Ojkic,
Zvonimir Poljak

Is it possible to control transmission of avian influenza virus?

Shayan Sharif

Zvonimir Poljak, Rozita Dara, Amy Greer

Bowornnan Chantapakul (Food Science)

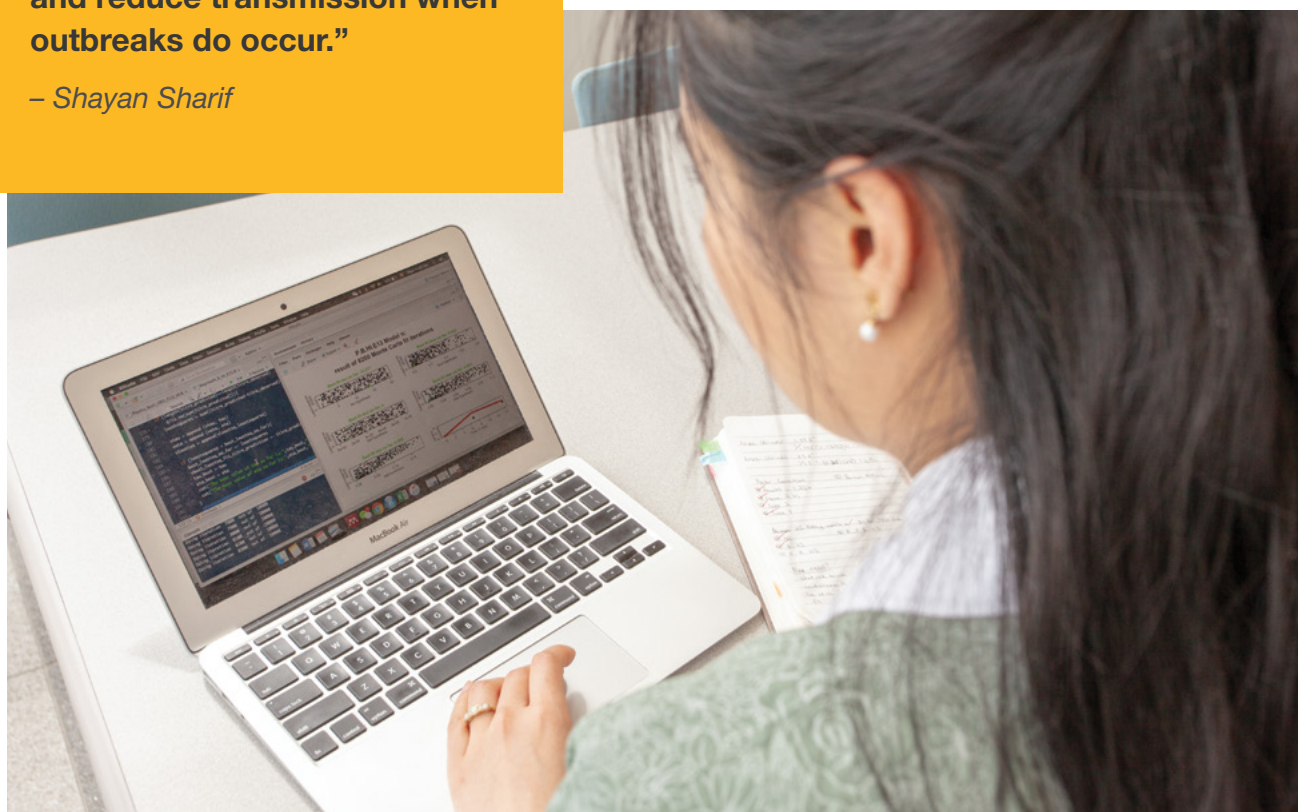# IS IT POSSIBLE TO CONTROL TRANSMISSION OF AVIAN INFLUENZA VIRUS?

"Avian Influenza, one of the most important emerging diseases of domestic animals, has caused significant implications for the industry. It has great economic consequences for the poultry industry, and poses threats to public health. Our goal is to prevent disease outbreaks and reduce transmission when outbreaks do occur."
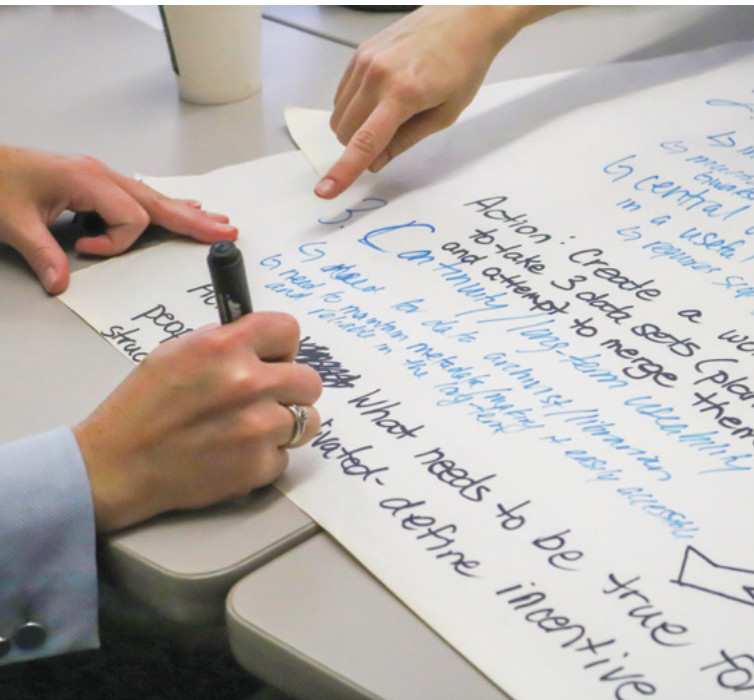
– Shayan Sharif

Shayan Sharif
Zvonimir Poljak, Rozita Dara, Amy Greer

Massive outbreaks of avian influenza across North America in recent years demonstrate that current measures to control outbreaks are inefficient, causing incredible loss to farmers. Prof. Shayan Sharif's team has found that vaccines with immune-enhancing compounds can reduce virus transmission. Aided by novel mathematical models, simulations, and data from across the poultry system, the next phase of their project focuses on developing and optimizing new ways to make chickens immune and reduce virus transmission among animals or from animals to humans. This research will ultimately reduce poultry loss, improve health and welfare, and support decision-making for chicken producers and policy makers.

INTEGRATED FOOD SYSTEMS RESEARCH

Food from Thought researchers are working to integrate results across the broad spectrum of the research program in order to better support policy priorities and shape industry practice.

In particular, the team's main research areas, exploring the human dimensions of digital agriculture and examining where agriculture may expand to new parts of Canada, are amassing insights from across the program.

The team's research on understanding the human dimensions of the digital agricultural revolution is exploring the challenges around access to digital technologies, data ownership and cybersecurity via a national agri-food data framework. In addition, the team is providing educational opportunities to ensure that we are effectively training the next generation of agri-food thought leaders in this critical area of study.

Research on the potential to expand agricultural crops into new parts of the country, such as northern Canada, is also shedding light on the potential drawbacks, such as soil erosion, and soil organic carbon and habitat loss. Understanding the impacts on existing land uses and the environment of developing new agricultural frontiers is helping to fill a major gap in climate change adaptation literature that currently speculates on how shifting weather patterns may open new areas up to cultivation and the potential for previously unproductive land to be farmed.

Agricultural shifts into new frontiers hold immense potential to feed a growing population, but also carry environmental concerns, and considerations about the social impacts of this expansion. By identifying both the potential opportunities for solutions to food insecurity and the social consequences of those advancements, these projects are advancing our understanding of policy options to manage these major shifts in agriculture.

INTEGRATED FOOD SYSTEMS RESEARCH PROJECTS

Exploring novel agricultural frontiers

Evan Fraser

Aaron Berg, Merritt Turetsky,
Kevin McCann, Khurram Nadeem,
Krishna KC

Human dimensions of the digital agricultural revolution

Evan Fraser

Daniel Gillis, Rozita Dara, Alfons Weersink,
Shoshanah Jacobs, Eric Nost,
Rebecca Hallett, Krishna KC

Collaborative big data workshop led by integrated food systems research team

EXPLORING NOVEL AGRICULTURAL FRONTIERS

Evan Fraser

Aaron Berg, Merritt Turetsky, Kevin McCann,
Khurram Nadeem, Krishna KC

Feeding the growing human population in a way that is equitable, sustainable, safe, and nutritious is one of the 21st century's "Grand Challenges." Research conducted by prof. Evan Fraser's research team is exploring possible new agricultural frontiers in Canada; that is, land that is not currently cultivated but may become suitable for agriculture due to climate change and new emerging technology. The team is also considering potential social and environmental consequences of expanding productive land in Canada, such as the effects of new technology adoption on rural communities and carbon loss.

"A combination of new technologies and climate change may create opportunities for food production in Northern Canada. However, developing these northern frontiers could have unintended ecological consequences, so this research project will explore the potential benefits and negative impacts."

– Evan Fraser

FOLLOW EVAN **@FEEDING9BILLION**

TRAINING AND EXPERTISE

Data science expertise

The University of Guelph is continuing to expand its research capacity and training by attracting faculty and students that can bridge disciplines across data science and agricultural systems. These include areas such as precision agriculture, deep learning, computer vision, bioinformatics, statistics, computational biology, mathematical modelling, and integrating advanced scientific technologies and agricultural production systems.

Training the next generation of agri-food leaders

Food from Thought is investing nearly $4 million in experiential graduate student training initiatives to support the next generation of agriculture specialists. In partnership with the Arrell Food Institute and the Ontario Agri-Food Innovation Alliance, Food from Thought supports up to 20 Research Assistants per academic year. In complement to their specific research interests, these students work with community partners on solutions to real problems related to agri-food sustainability through an interdisciplinary course and experiential learning opportunities.

Graduate students Kyra Lightburn (Department of Plant Agriculture and School of Environmental Sciences) and Sabrina Rondeau (School of Environmental Sciences)

INNOVATION, COMMERCIALIZATION, AND KNOWLEDGE MOBILIZATION

The University of Guelph created the Research Innovation Office (RIO) to increase the external impact of research teams' work. Food from Thought enabled RIO to extend the reach of their programming in 2018-19 into entrepreneurship through programs such as Accelerator Guelph and the science-policy interface.

Based on the award-winning model created by the Waterloo Accelerator Centre, Accelerator Guelph guides researchers to push their innovative ideas into commercialization. Since its launch in early 2018, the program has supported 12 incubator projects and launched six start-up companies. New teams will continue to participate in the program on a yearly basis to amplify U of G research's economic impact and foster entrepreneurship on campus.

Also launched in early 2018, the Policy Fellowship program brings senior policy makers to campus to participate in a three-day program that strives to answer their policy questions and engage with cutting-edge research. The only one of its kind in Canada, the Policy Fellowship program is helping to bridge the science-policy divide by directly linking policy makers with leading researchers. Seven policy leaders in agri-food from across Canada participated in 2018.

The RIO team spent 2018 developing more new programs which will launch this year.

RIO's new Advantage Workshops give researchers and students the tools they need to maximize the impact of their research and produce innovative tools and products. The workshops will include:

- Innovation Tool Kit
- Creating Persuasive Value Propositions
- Advanced Collaboration Techniques
- Knowledge Mobilization Strategy Tool Kit
- Intellectual Property Essentials

RIO will also launch two new Research Innovation grants to provide research teams with the skills and tools needed to commercialize their research. The Research Innovation Immersion Placement Grants support the cost of researchers, postdoctoral, and graduate students to learn new skills and strategies at innovative companies, that can be applied to their own work on campus. The Product Development Grants provide funds to validate concepts with external users, as well as to develop and test prototypes with commercial potential.

Food from Thought provides funding to the Research Innovation Office to further expand capacity for its knowledge mobilization, commercialization, and innovation activities.

Junelle Kirsten-Fisher engages with University of Guelph knowledge mobilization activities at the 2019 Gryphon's LAAIR Innovation Showcase and Pitch Competition.

PARTNERS

Canadian Postsecondary Institutions

McGill University

University of Victoria

Waterloo Institute for Complexity and Innovation

Other Canadian Research Groups

Beef Cattle Research Council

Canadian Centre for Swine Improvement Inc.

Livestock Research Innovation Corporation

Academic and Research Institutes Abroad

Hohenheim University (Germany)

Risk Sciences International

Smithsonian Institution (United States of America)

UK Global Food Security Program (United Kingdom)

University of Pennsylvania (United States of America)

University of Sao Paolo (Brazil)

Wageningen University (Netherlands)

Private Sector

Accelerator Centre

Bioenterprise Corporation

Canadian Dairy Network

EnviroFlight LLC

Food and Beverage, Ontario

Gay Lea Foods

IBM Canada

Innovation Guelph

Loblaw Companies Ltd.

Nutreco Canada Inc.

Maple Leaf Foods

Risk Sciences International

Semex Alliance

Southern Ontario Smart Computing Innovation Platform

Woodrill Ltd.

Public Sector

Agriculture and Agri-Food Canada

Canadian Food Inspection Agency

Christian Farmers Federation of Ontario

Credit Valley Conservation Authority

EMBRAPA

Environment and Climate Change Canada

Lloyd Longfield, Member of Parliament for Guelph

Ontario Ministry of Agriculture, Food and Rural Affairs

Ontario Ministry of Economic

Development and Growth

Ontario Ministry of Infrastructure

Ontario Ministry of Research, Innovation and Science

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Arrell Food Institute

Board of Directors, Biodiversity Institute of Ontario

Convention on Biological Diversity

Grain Farmers of Ontario

Great Lakes Fisheries Commission

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