



Food Science
Department

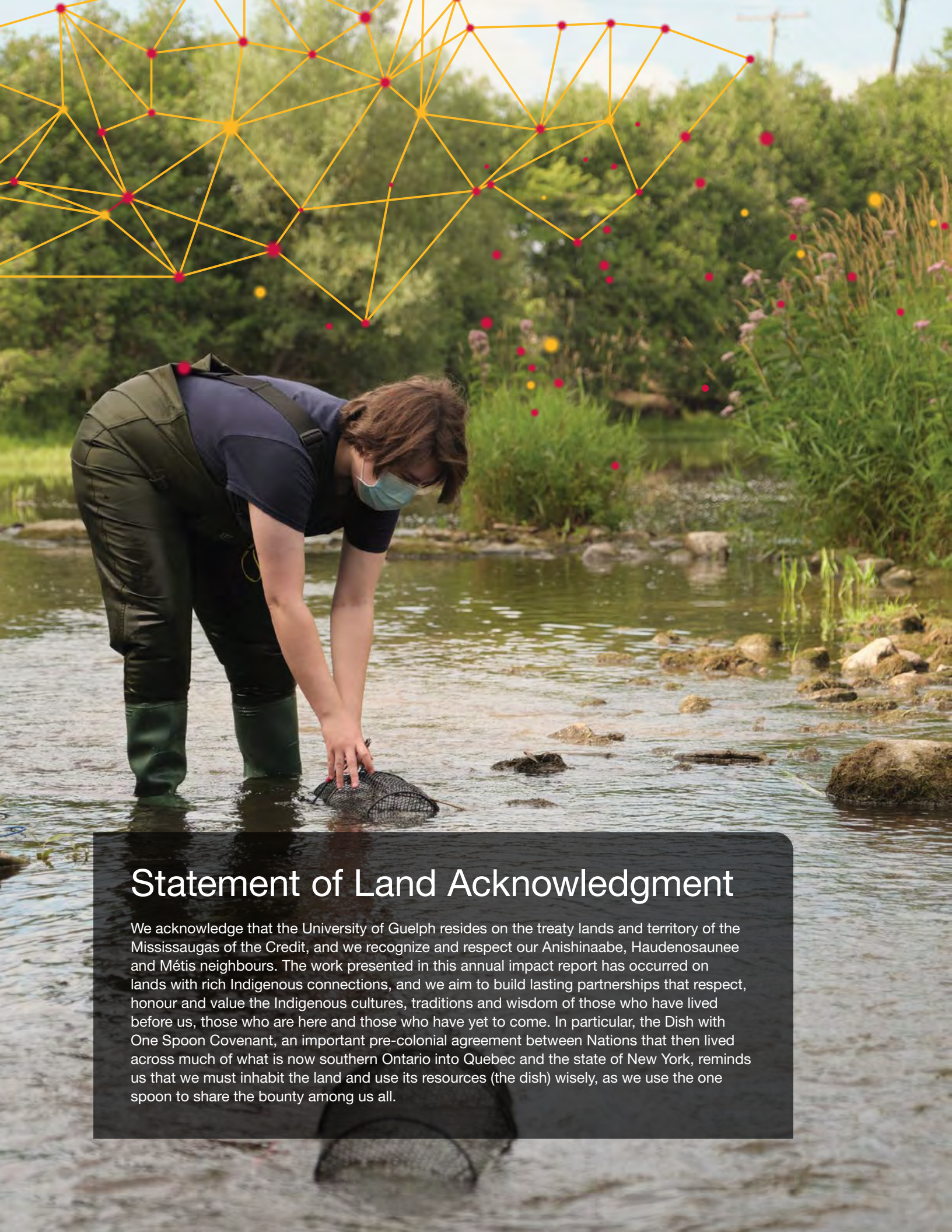
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AGRICULTURAL SYSTEMS FOR A HEALTHY PLANET

2022 – 23 IMPACT REPORT

UNIVERSITY
of GUELPH

FOOD FROM THOUGHT



Statement of Land Acknowledgment

We acknowledge that the University of Guelph resides on the treaty lands and territory of the Mississaugas of the Credit, and we recognize and respect our Anishinaabe, Haudenosaunee and Métis neighbours. The work presented in this annual impact report has occurred on lands with rich Indigenous connections, and we aim to build lasting partnerships that respect, honour and value the Indigenous cultures, traditions and wisdom of those who have lived before us, those who are here and those who have yet to come. In particular, the Dish with One Spoon Covenant, an important pre-colonial agreement between Nations that then lived across much of what is now southern Ontario into Quebec and the state of New York, reminds us that we must inhabit the land and use its resources (the dish) wisely, as we use the one spoon to share the bounty among us all.

Table of Contents

Joint Message from Vice-President (Research) and Scientific Director	2	Environmental Impact	21
Our Vision and Mission	3	Transforming Farming for a Sustainable Future: A Natural Capital Program’s Impact on Ecosystem Services and Engagement	22
Our 2022-23 Impact in Numbers	4	Transforming Ontario’s Grain Production Through Precision Agronomy and Data Integration	23
Impact on Agricultural Practices	6	Plumbing the Depths of Marine Biodiversity	24
Breeding Livestock for Climate Resilience	7	Unveiling Climate Change’s Impact on Canadian Agriculture	25
Enhancing Antimicrobial Stewardship in Dairy Farming	8	Advancing Indigenization, Equity, Diversity and Inclusion in Research: A Year in Review	26
Improving Disease and Feed Management Practices in Dairy Farming	9	Agri-Food Data Canada’s Progress Update: Empowering Agri-food Research with FAIR Data Principles	27
Enhancing Poultry Welfare and Efficiency	10	Ensuring a Pipeline of Highly Skilled Agri-food Experts	28
Enhancing Agricultural Sustainability Through Test Strips and Adviser Education	11	Where Are They Now Spotlights	28
Transforming Sow and Gilt Selection in the Pork Industry	12	2022-23 Conference Bursaries	30
Accelerating Economic Recovery and Ecosystem Sustainability in the Great Lakes Basin	13	Conference Bursaries Testimonials.....	31
Improving Weaning Strategies in Livestock	14	Food From Thought Bursary Profiles.....	32
Influence on Policy and Regulation	15	Accelerating the Global, National and Local Impacts of Our Work	35
Securing Smart Farms: A Cybersecurity Breakthrough in Agriculture.....	16	Policy Fellowship Program Update.....	35
Contributing to Greenhouse Gas Metrics and Reduction in Agriculture	17	Core Faculty	36
Advancing Bee Health and Policy Through Microbiome Research.....	18	Discover Our Leading-Edge Research	40
Leading-Edge Research on Land Use, Diet and Sustainability.....	19	Partners	44
Balancing Profits and the Planet: Precision Agriculture’s Impact on Crop Production Sustainability	20	Team	45



Joint Message from Vice-President (Research) and Scientific Director

We are thrilled to introduce this year's Food from Thought annual report, showcasing the impact of our research program in agriculture. This report is a testament to the University of Guelph's achievements, driven by the \$76.6-million Canada First Research Excellence Fund.

In 2017, the University of Guelph received the largest single federal research grant in its history, supporting the Food from Thought initiative. This monumental award has empowered more than 100 research leaders who collectively form an intellectual powerhouse driving technological advancements, social innovation and sustainable food systems.

Our ongoing projects are forging new research and innovation pathways, such as using remote sensing technology to create a data-driven approach to detecting early warning signs of drought, enabling farmers and policy-makers to react to and lessen the severity of these occurrences. As another example, the Canadian Bee Gut Project is helping to ensure sustainable honeybee populations in Canada by developing a novel approach to understanding the role of microbial communities associated with honeybee health and disease. These research projects position the University of Guelph as a leading force nationally and globally, underscoring our role as "Canada's Food University."

Within the pages of this report, embark on a journey through the multi-faceted aspects of the Food from Thought research portfolio. From investigating technologies that shape farming practices to formulating industry policies and regulations, and from enhancing the well-being of our farming communities to preserving our environment, these U of G research projects have profoundly impacted the agricultural sector.

Central to our success is our unwavering commitment to collaboration and implementation of our research results in the real world. This report showcases our influential partnerships with esteemed academic institutions, industry leaders, government organizations and community groups. One standout example is the work of Dr. Kevin McCann, who is currently engaging with Indigenous communities in a "slow the watershed" movement to restore riparian zones and coastal wetlands. His work is building relationships with

Indigenous communities, recognizing the necessity of trust-building and mutual collaborations that drive our continuous innovation.

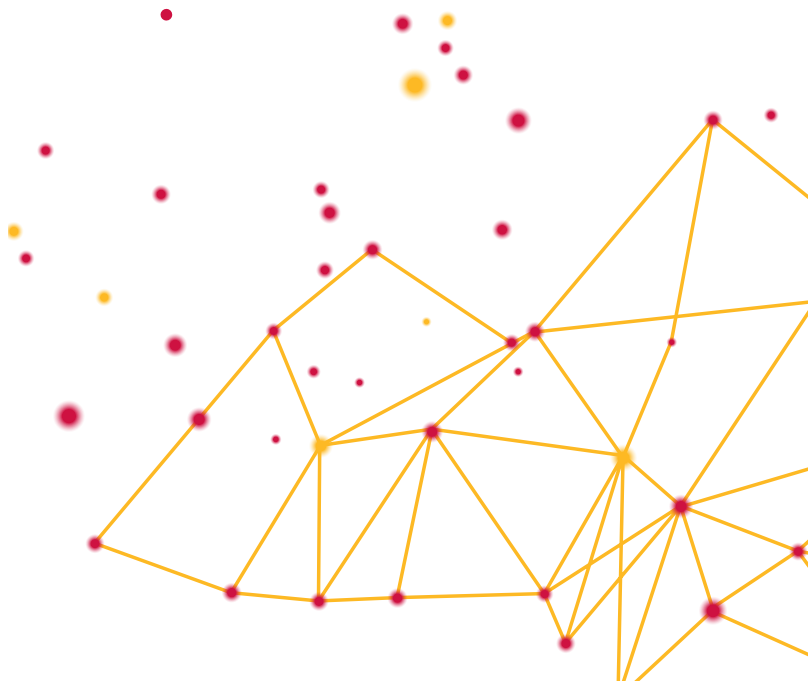
We invite you to join us in celebrating the tangible outcomes of these research efforts at the University of Guelph. Together, we are reshaping the future of agriculture and sowing the seeds of progress for a more sustainable, prosperous and resilient agricultural sector. ■



Rene Van Acker
Vice-President (Research)



Evan Fraser
Scientific Director





FOOD FROM THOUGHT: AGRICULTURAL SYSTEMS FOR A HEALTHY PLANET

is a research program led by the University of Guelph, supported in part by a \$76.6-million grant from the Canada First Research Excellence Fund.

Our Vision

Our vision is to transform our understanding of the ecosystems we depend on for food at scales that range from planetary to micro-scale. The goal is to increase the capacity, sustainability and safety of food production systems without undermining environmental health, ecosystem services or livestock health and welfare.

Food from Thought will create and implement next-generation information management systems, decision

support tools and digital applications that intelligently collect, analyze and apply massive amounts of data from crops, livestock and the environment. This new cutting edge research program will provide solutions to identify food fraud, reduce food safety risks, refine pesticide and fertilizer use, monitor soil and crop health, control pathogens and track emerging infectious disease threats. ■

Our Mission



Research Dollars Distributed

	2022-2023	Project to Date
Biodiversity	\$2,500,000	\$15,300,000
Commercialization Grants	\$155,460	\$520,460
Digital Agriculture Research Fund	The program ended in 2021.	\$2,169,000
Gryphon's LAAIR	The program ended in 2018.	\$105,000
Partner Universities	\$289,425	\$2,118,953
Thematic Research Fund	\$2,785,935	\$19,653,519
Total	\$5,730,820	\$39,866,932





193 | NUMBER OF Participating Faculty

63
FFT PROJECTS*

153
PARTNERS

247
KNOWLEDGE
USERS

46
PRINCIPAL
INVESTIGATORS

164
COLLABORATORS

17
POLICY
FELLOWSHIPS
AWARDED

215
MEDIA INTERVIEWS
WITH FFT
INVESTIGATORS

**MORE THAN
850,000**
YOUTUBE VIEWS
FOR CORE TEAM†

**MORE THAN
17 MILLION**
WEBSITE HITS
FOR CORE TEAM§

**ALMOST
45,000**
GOOGLE SCHOLAR
CITATIONS

* This does not include commercialization grants.

† This number is cumulative since the start of the grant.

§ Website hits saw a huge increase due to increased traffic on boldsystems.org (Centre for Biodiversity Genomics).



543 | NUMBER OF Participants

87
UNDERGRADUATE
STUDENTS

131
MASTER'S
STUDENTS

167
DOCTORAL
STUDENTS

64
POST-DOCTORAL
FELLOWS

36
RESEARCH
ASSOCIATES

58
TECHNICIANS

467
OUTREACH
EVENTS AND
WORKSHOPS



IMPACT ON Agricultural Practices



IN AGRICULTURE, INNOVATION AND technology are the driving forces behind progress. This section delves into research projects funded by Food from Thought that have far-reaching implications for agricultural practices. These projects have enriched our understanding of farming methods and yielded groundbreaking innovations and technologies. From optimizing crop yields to enhancing resource efficiency and promoting sustainability, our research initiatives are steering the agricultural sector toward a brighter, more productive future.



Breeding Livestock for Climate Resilience

Dr. Bonnie Mallard and her team are at the forefront of improving the climate resilience of livestock. Their project focuses on developing and disseminating technology for dairy producers that enhances immune response and disease resistance in livestock.



Bonnie Mallard
Department of
Pathobiology

One significant outcome of this initiative has been the widespread adoption of Dr. Mallard's High Immune Response (HIR®) technology, extending its reach to more than 80 countries worldwide through the Immunity+ program operating under the Semex Alliance. Animals identified as HIR® using this technology not only have improved resistance to infectious diseases but also exhibit heightened resilience to heat stress, an increasingly crucial trait in the face of climate change.

Unlocking Sheep's Potential Amid Funding Challenges

Despite these successes, challenges persist, especially a relative lack of funding for sheep research. Dr. Niel Karrow and his lab have worked to secure funding for research on sheep, which serve as an excellent model for ruminant animals. International interest in sheep production has surged, emphasizing the importance of further research in this field.

Collaborative Partnerships

The work of this research team, consisting of Dr. Mallard, Dr. Karrow and Dr. Angela Cánovas, extends beyond their laboratories. They effectively collaborate not only with each other but also with organizations such as Beef Farmers of Ontario, Mitacs, the Beef Cluster, the Canadian and American Angus Association, the Ontario Sheep Federation and the Semex Alliance. Through these partnerships, the U of G researchers engage industry stakeholders and promote genetic testing for immunity as a vital component of livestock improvement.

Fostering a Resilient Future

Research by Dr. Mallard's team on enhancing livestock for climate resilience transcends boundaries, benefiting dairy and beef producers as well as sparking interest in other livestock sectors. As climate challenges continue to loom, the team's work points toward a more resilient and sustainable future in agriculture. ■

Enhancing Antimicrobial Stewardship in Dairy Farming



Stephen LeBlanc
Department of
Population Medicine

Dr. Stephen LeBlanc's research addresses the critical issue of antimicrobial resistance (AMR) through stewardship in the dairy industry. Antimicrobial stewardship refines the use of antibiotics to enhance potential AMR while maintaining animal health. By studying dairy farmers' decision-making processes, he has gained invaluable insights that will help shape future practices.

Examining Antibiotic Usage

Dr. Claudia Cobo, a post-doctoral researcher, spearheaded a series of projects about dairy farmers' perceptions of and responses to antibiotic use and resistance. Despite the fact that farmers generally do not perceive antibiotic overuse on their own farms, Dr. LeBlanc and his team devised an intervention package. This package aimed to offer farmers targeted knowledge translation and transfer (KTT) regarding AMR. Through benchmarking against peers, some farmers gained valuable insights, while others identified opportunities for improved disease prevention. The research underscores the importance of tailoring KTT messages to individual farmers' specific circumstances.

Addressing Farmer Concerns

Farmers expressed two key concerns: their duty of care to animals, and the perception that major facility improvements would be required to reduce the need for some antibiotic therapy. This research identified opportunities for best management practices, such as optimizing vaccination programs and fostering quick and easy communication between farmers and veterinarians. Simple tools placed in farmers' hands can empower them to make informed decisions regarding antibiotic use.

Building Collaborative Bridges

Recognizing the importance of collaboration, the research team engaged with veterinarians through focus groups and presentations at continuing education meetings. They discovered a substantial opportunity to strengthen the connection between veterinarians and farmers, enhancing the responsible use of antibiotics.

Effective Knowledge Dissemination

Dairy at Guelph launched a podcast to disseminate research findings from this and other projects to farmers, veterinarians and industry stakeholders. The podcast serves as a valuable platform for knowledge mobilization, facilitating the adoption of AMR stewardship practices.



**LISTEN TO THE DAIRY
AT GUELPH PODCAST:**
dairyatguelph.ca/news/podcast

Leveraging Technology for Sustainable Practices

Dr. LeBlanc highlighted the potential of plain language summaries, short educational videos and technology automation in disease detection and antibiotic treatment decisions. Leveraging data from commercially available sensors on dairy farms, he and colleagues are conducting controlled trials on early detection of illness and non-antibiotic therapies. They aim to transform how diseases are managed on dairy farms, ultimately reducing antibiotic use.

Driving Positive Change

Dr. LeBlanc's research is improving AMR stewardship in the dairy industry. His work sheds light on farmers' and veterinarians' decision-making processes and offers concrete solutions to augment antimicrobial stewardship. The research team's work enhances dairy farming practices by fostering collaboration, disseminating knowledge and harnessing technology, ultimately benefiting the industry and public health. ■



Improving Disease and Feed Management Practices in Dairy Farming

Dr. Eduardo Ribeiro's research has significantly impacted on-farm practices in dairy production. This research project is intended to improve best management practices used by dairy producers, nutritionists, veterinarians and extension agents.



Eduardo Ribeiro
Department of
Animal Biosciences

Long-Term Effects of Disease on Dairy Cows and Economic Implications

This research explores the long-term effects of disease on milk production and reproduction in dairy cows, including economic impacts. Dr. Ribeiro's research has highlighted opportunities for strategic investments during the transitional period, which can yield significant returns, as demonstrated through rigorous calculations. Moreover, the study has delved into the role of inflammation in exacerbating the long-term effects of these conditions, opening possibilities for interventions such as using anti-inflammatory drugs to treat affected animals or improving nutritional strategies.

Digital Agriculture and Transitional Cow Health

Dr. Ribeiro's research at the Ontario Dairy Research Centre, a state-of-the-art research facility, underscores the importance of prepartum feed intake for transitioning cows' health and future productivity. This insight has paved the way for exploring sensor technologies that measure rumination and physical activity. By classifying cows in commercial herds as high or low risk for health and performance issues during this critical phase, the technology enables more targeted and effective management strategies.

Inclusive Research Environment and Mentorship

Beyond its scientific contributions, Dr. Ribeiro's research environment stands out for its inclusivity and commitment to mentorship. Everyone is encouraged to contribute their thoughts on specific questions in the lab, fostering a collaborative atmosphere. Notably, the involvement of highly qualified personnel in decision-making processes ensures that projects are carried out to benefit both students and the research objectives. Moreover, Dr. Ribeiro's lab provides essential support for students, recognizing their dedication by offering opportunities to present their research at international conferences.

Leveraging Knowledge and Collaborative Partnerships

The impact of this research extends beyond its primary findings. This study leverages existing knowledge and builds upon previous projects, promoting the expansion of research ideas and providing valuable training opportunities for students. For example, Dr. Leluo Guan at the University of Alberta and Dr. Fabio Lima at the University of California, Davis, are providing their microbiome expertise to investigate the contributions of rumen microbes to health and feed efficiency of dairy cows. Collaboration with experts from these academic institutions further enhances the reach and scope of the U of G research, facilitating interdisciplinary cooperation and knowledge dissemination. ■

The photo above shows Eduardo Ribeiro's research team at the 2023 American Dairy Science Association annual meeting in Ottawa. The team gave 12 presentations of original research performed in Guelph. From left to right: Bryn Van Winters (M.Sc. student), Matheus Santos (M.Sc. student), Bruna Mion (former PhD student), Dr. Eduardo Ribeiro (principal investigator), Ivan Avalos-Rosario (PhD student), Mika Schwartz (undergraduate research assistant), Chantel Van Dorp (undergraduate research assistant) and Guilherme Madureira (PhD candidate).

Enhancing Poultry Welfare and Efficiency



Grégory Bédécarrats
Department of
Animal Biosciences

Dr. Grégory Bédécarrats, alongside collaborators Dr. Alexandra Harlander and Dr. Elijah Kiarie, has made significant contributions to poultry farming by investigating how birds' behaviour and housing conditions affect their well-being and productivity. Their research findings have far-reaching implications for various stakeholders, including farmers, policy-makers and consumers.

Behavioural Adaptations in Birds with Damaged Wing Feathers

This research involved the use of wing feather clipping, a method to reduce wing area and to sculpt wing shape in birds. This study simulates commercial conditions, given that birds across various housing systems commonly suffer from poor feather and plumage conditions.

Dr. Bédécarrats and his team discovered a significant influence of feather loss on poultry behaviour. When birds lose their flight feathers, they adapt their behaviour by utilizing housing structures differently to safeguard their bodies from injury. This understanding is crucial for developing poultry housing that reduces stress and injury, thereby enhancing animal welfare.

Tailoring Housing Conditions for Different Poultry Strains

Their research highlights the importance of tailoring housing conditions to the specific strain of poultry. Brown-feathered birds, for instance, do not utilize tier systems effectively, leading to overcrowding and discomfort. The research recommends adjustments in housing to accommodate different strains, emphasizing the need for education and awareness among farmers and policy-makers.

Optimizing Pullet Development for Robust Poultry Production

Dr. Bédécarrats also emphasizes the significance of raising robust pullets (young chickens). Pullets

represent a crucial investment in the poultry industry, as they are the foundation for future egg production. Farmers can reduce mortality, lower injury rates and maximize resource utilization by optimizing pullet development and growth trajectories. This approach not only enhances animal welfare but also boosts efficiency and profitability.

Empowering Informed Consumers

For consumers, Dr. Bédécarrats and his collaborators stress the importance of dispelling myths about poultry farming and animal welfare. Their research sheds light on the conditions in which poultry are raised, empowering consumers to make informed choices and support ethical practices.

Enhancing Farming Practices for Improved Efficiency

Farmers are another critical audience that benefits from this research. Work by Dr. Bédécarrats and his team underscores the need for increased attention to the development and training of pullets. By raising pullets in environments that mimic their later stages of life, farmers can enhance the well-being and performance of their flocks, resulting in lower costs and higher productivity.

This research has substantially contributed to poultry farming by addressing critical issues related to animal welfare, housing and efficiency. The project informs and empowers various stakeholders, from farmers and policy-makers to consumers, ensuring a more sustainable and ethical poultry industry while promoting better practices and economic viability. ■

Mohammad Bahry, an international PhD student from Afghanistan in the Bédécarrats laboratory, uses state-of-the-art technology (nanoString nCounter™) recently acquired by the Department of Animal Biosciences for multiplex gene analyses.

Enhancing Agricultural Sustainability Through Test Strips and Adviser Education



Dr. John Sulik's research focuses on the promotion and utilization of test strips—a vital tool in modern agriculture. Test strips, often small sections or plots within a field, serve as essential components for evaluating the efficacy of various agricultural practices, including fertilization, pesticide application and crop management techniques. These strips enable farmers and agricultural researchers to monitor and assess the impact of specific treatments or interventions on crop growth and yield.

Empowering Crop Advisers and Farmers

Dr. Sulik's project involves collaborating with Caleb Niemeyer, a PhD student in the Department of Plant Agriculture, on developing computer code tailored to assist crop advisers and farmers in analyzing strip trial data.

One of the primary challenges faced in the agricultural community is farmers' hesitancy to embrace test strips, particularly for validating application rates for inputs such as nitrogen. Farmers typically rely on the guidance of crop advisers, who do not always advocate for using test strips. Dr. Sulik's research emphasizes the importance of test strips in modern farming practices.

Analyzing Strip Trial Data

This computer code project targets a key objective: to offer valid statistical insights into yield variability within on-farm strip trials. Currently, when strip trials are subdivided into smaller sections, they often ignore spatial autocorrelation in the data. Consider two strips located side by side: one a test strip, the other receiving a treatment. If the strips are subdivided into plots, current approaches fail to account for how plot size impacts statistical significance, so the plot replications are pseudo-replications. This makes it difficult to determine when a treatment effect is statistically significant.

The novel code under development by Dr. Sulik's team accounts for spatial autocorrelation, enabling the analysis of these trials. It empowers seed companies, crop advisers and farmers to determine whether strip treatments yield significantly different results or if the

observed yield differences reflect random chance. This research enhances decision-making for various agronomic practices like fertilizer application and tillage.

Unique Features and Innovation

While other farm management software may provide some analysis, these systems often lack statistical rigour, potentially leading to incorrect conclusions. This innovative code project fills a crucial gap by addressing spatial autocorrelation, a feature lacking from other tools.

Enhancing Sustainability and Efficiency

The use of this code in agriculture could significantly improve the sustainability and efficiency of crop production practices. By enabling producers to analyze and draw meaningful insights from strip trial data, the code enhances resource management, reduces unnecessary costs and minimizes environmental impact. With this tool, farmers and crop advisers can make data-driven decisions about treatment effectiveness, ensuring that the conclusions are accurate and that resources are utilized optimally and harmoniously with environmental preservation.

Community Impact and Integration

Dr. Sulik's research has increased collaboration and integration within the agricultural community. He has connected with other researchers across the University of Guelph campus, fostering a multidisciplinary approach to sustainable farming practices. In addition, he collaborates with growers and crop advisers to conduct on-farm research. This collaborative spirit has led to more funding opportunities and facilitated access to on-farm trials, which hold tremendous promise for sustainable agriculture. ■



John Sulik
Department of
Plant Agriculture

Kaelyn Lupyrpa, a summer student, collects data for a strip trial evaluating the effect of plant growth regulators on wheat growing in different soil types.



Transforming Sow and Gilt Selection in the Pork Industry



Julang Li
Department of
Animal Biosciences

Dr. Julang Li's research, conducted in collaboration with the Canadian Centre for Swine Improvement, is impacting the pork industry by introducing new measurements for the selection of pigs. Dr. Li's ongoing project aims to improve the efficiency and sustainability of pig farming by increasing the accuracy of sow and gilt selection for reproductive potential.

Improving Genetic Selection

One of the primary goals of Dr. Li's research is to improve sow selection in the pork industry. By identifying and leveraging biomarkers integral to female pig reproduction, the project seeks to optimize breeding strategies, leading to more productive swine populations.

Promising Biomarker Discoveries

Although the project is ongoing, Dr. Li and the research team have made significant strides. They have identified biomarkers that appear to be critical for pig fertility. These biomarkers reflect the reproductive condition of the sows, including their metabolism and gene expression. These findings will help enhance the precision and effectiveness of breeding programs in the pork industry. Once these biomarkers are defined, they can be measured in sow and gilt populations to determine which pigs should be selected or used to produce the most optimal breeding outcomes. ■

Accelerating Economic Recovery and Ecosystem Sustainability in the Great Lakes Basin



Kevin McCann
Department of
Integrative Biology

Dr. Kevin McCann’s research contributes to ecological science and economic sustainability in the Great Lakes Basin. His work is driven by a commitment to understanding and mitigating the complex challenges facing this critical ecosystem.

Through his collaborations and initiatives, he is helping to shape policies and practices that drive accelerated economic recovery while ensuring environmental sustainability.

Establishing the Centre for Ecosystem Management

Dr. McCann was pivotal in the creation of the Centre for Ecosystem Management at the University of Guelph, linked with agencies such as the Department of Fisheries and Oceans, the Ontario Ministry of Natural Resources and Forestry, and Environment and Climate Change Canada. This centre is instrumental in addressing critical issues such as fishery sustainability and water quality that will help achieve the long-term goal of sustainable food production in the Great Lakes Basin.

Balancing Ecological Understanding with Policy Implications

One of Dr. McCann’s key insights is comprehending the big picture and understanding trade-offs in policy management. His research is not limited to ecological theory but extends to practical applications, offering

valuable guidance for policy-makers and resource managers. The research has shown, for example, that the presence of local riparian zones can mitigate the impacts of regional landscape modification for the functioning of stream food webs. Similarly, Dr. McCann’s team is now working on management and policy decisions involving altered landscape-scale nutrient remediation for the production and resilience of Great Lakes fisheries through collaboration with the Great Lakes Fisheries Commission.

Building Trust and Collaboration with Indigenous Communities

Dr. McCann is actively nurturing relationships with Indigenous communities, recognizing the necessity of trust-building and mutual collaboration. He is currently engaging with Indigenous communities in a “slow the watershed” movement to restore riparian zones and coastal wetlands. This engagement will ensure maintenance of a holistic perspective of Indigenous two-eyed seeing, while also restoring key fish and biodiversity hot spots.

Dr. McCann also seeks funding opportunities that benefit these communities, aligning research objectives with their needs. This approach reflects a commitment to inclusivity and recognizes that Indigenous perspectives are invaluable in shaping ecosystem management policies. ■



Insect sampling on farms close to streams in the Lake Erie watershed



Stream sampling of emerging insects, algae, benthic invertebrates and fish in the Lake Erie watershed



Michael Steele
Department of
Animal Biosciences

Improving Weaning Strategies in Livestock

Dr. Michael Steele is a globally recognized researcher whose work in weaning strategies has left an indelible mark on the agricultural industry.

With a laser focus on improving feed efficiency and animal health, he has authored more than 100 influential papers in this field.

His dedication extends far beyond academia, as he actively collaborates with producers by conducting weekly meetings that have yielded remarkable success.

Collaborative Improvements to Calf Feeding Management

One of Dr. Steele's most notable accomplishments has been his work to improve colostrum feeding management, significantly reducing the incidence of diarrhea in young calves. He has partnered with Trouw Nutrition to develop new, highly effective formulations. This collaboration has led to astounding results, with market share soaring from zero to more than one million units sold. Dr. Steele's work underscores the critical importance of early-life calf management, as it profoundly impacts animal health and productivity.

Equity, Diversity and Inclusion in Academia

Dr. Steele is committed to fostering equity, diversity and inclusion within his lab. He employs non-biased recruitment strategies, ensuring talent is identified and nurtured across various platforms. He works diligently to help provide more opportunities for international students, recognizing the challenges they face, including higher tuition fees. He advocates for expanded scholarship opportunities to support students' academic pursuits.

The Transformative Power of Support

Dr. Steele attributes a significant portion of his success to the support he received through the Food from Thought program. This funding was instrumental in establishing his laboratory and provided him with the resources to differentiate his research. ■



INFLUENCE ON Policy and Regulation



IN THIS SECTION, WE ILLUMINATE

the transformative power of Food from Thought research projects in shaping agricultural policies and regulations. Our researchers have been at the forefront of driving change and providing invaluable recommendations to policy-makers. As we delve into the outcomes of these projects, you will discover their profound impact on shaping policies that govern agriculture, ensuring a resilient and prosperous industry.



Ali Dehghantanha
School of
Computer Science

Securing Smart Farms

A Cybersecurity Breakthrough in Agriculture

Dr. Ali Dehghantanha’s research bolsters the cybersecurity defences of the agriculture and food industry.

The project seeks to address the critical lack of cybersecurity standards in this sector and has the potential to protect farmers and the Canadian supply chain from devastating cyberattacks.

Key highlights from this research update include:

- Formation of a Cybersecurity Committee:** Dr. Dehghantanha’s research aims to safeguard producers from attacks and mitigate risks to Canada’s supply chains. As a testament to their expertise, Dr. Dehghantanha and Dr. Evan Fraser were invited to join the newly formed Agriculture and Agri-Food Canada task force on cybersecurity. The task force involves collaborative work with policy-makers and the public sector to address this topic and will be pivotal in shaping agriculture and food industry cybersecurity initiatives.
- Development of a User-Friendly Platform:** The research team has built a user-friendly platform and created training materials, including instructional videos. The platform is designed for voluntary use by farmers.
- Impact on Farmers:** The platform has the potential to assist more than 30 farmers in recovering from and understanding the impact of cybersecurity attacks on their operations.
- Training Program for Students:** The team is developing a comprehensive training program on cybersecurity in agri-food that aims to instruct 180 students over six years.
- Collaboration with Industry Networks:** The project has engaged with the Canadian Food Innovation Network and the Canadian Agri-food Automation

- Intelligence Network for potential partnerships and knowledge sharing.
- Financial Support for Cybersecurity Infrastructure:** Funding is being sought to build essential cybersecurity infrastructure to protect the agricultural and food sectors.
- Message to Producers:** Farmers are made aware that cyber attackers target profitable organizations. By identifying potential threats early, this project aims to protect businesses and the Canadian supply chain from significant damage.
- User-centric System:** The developed cybersecurity system is recognized for its user-friendliness and human-first approach. An interdisciplinary team was pivotal in designing the tool with the end users in mind.
- Filling the Cybersecurity Gap:** Before this project, cybersecurity was not well known or applied in the agri-food sector. This research positions the University of Guelph as a centre for cybersecurity excellence in agriculture.

Dr. Dehghantanha’s research is addressing the cybersecurity challenges faced by the agriculture and food industry. By creating a user-friendly platform, establishing collaborations and raising awareness, this research will revolutionize how cybersecurity is approached in the agri-food sector. ■



MORE INFORMATION ON THE PLATFORM CAN BE FOUND HERE:

cybersciencelab.com/services/security-of-critical-infrastructure-2



Dr. Dehghantanha’s research team working in the lab



Contributing to Greenhouse Gas Metrics and Reduction in Agriculture

Dr. Claudia Wagner-Riddle's research is making a positive impact on agriculture and climate change mitigation. Collaborating with Environment and Climate Change Canada as well as Agriculture and Agri-Food Canada, her team has crafted tools to bolster climate change mitigation in agriculture. These tools have been instrumental in enhancing the accuracy of national inventory reports, particularly in tracking greenhouse gas emissions.



Claudia Wagner-Riddle
School of
Environmental Sciences

Pioneering National-Scale Approaches

By comparing emissions data with a new methodology proposed for the national inventory report, the project has validated this strategy and influenced its adoption on a national scale. This shift promises to enhance the accuracy of emissions tracking across the country, a crucial step in addressing climate change.

Benefiting Diverse Stakeholders

Dr. Wagner-Riddle's research addresses a wide-ranging audience, including policy-makers, farmers and industry organizations at all levels of agriculture. The research findings have already informed discussions with farmer groups, particularly concerning national emissions targets set in previous years.

Empowering Farmers Through Nitrogen Management

The study reveals that significant reductions in emissions are attainable through improved nitrogen management. Conscientious farmers who carefully

manage their nitrogen use can meet and even exceed emission targets. While there is inherent variability, farmers can save money using nitrogen strip tests to optimize their nitrogen application rates, although this might initially impact yields.

Inclusive Research Practices

Dr. Wagner-Riddle emphasizes the importance of inclusive research practices. From the hiring phase, the project has prioritized diversity and a broad range of experiences beyond the research area. The team promotes inclusivity by engaging in open dialogue and individual meetings with students to align their interests with research opportunities, ensuring everyone has a voice in the research program.

Dr. Wagner-Riddle's work is expanding the horizons of soil health and ecosystem services. Her project showcases how technology, collaboration and inclusive research practices can reshape agriculture, mitigate climate change and benefit diverse stakeholders. ■

Advancing Bee Health and Policy through Microbiome Research



Emma Allen-Vercoe
Department of Molecular
and Cellular Biology

Drs. Emma Allen-Vercoe and Brendan Daisley have impacted bee health beyond their laboratory. Their research has deepened our understanding of bee microbiomes and has the potential to influence crucial policy changes and increase global awareness of the implications on our ecosystem.

The American Gut Project and Bee Health

Dr. Allen-Vercoe's work draws inspiration from the American Gut Project, a crowdsourced initiative that successfully mapped the human microbiome. By applying similar principles to bees, Allen-Vercoe is starting to uncover the intricate world of bee microbiomes, shedding light on the silent threat of disease-causing pathogens. These pathogens can remain undetected due to their asymptomatic nature within beehives, making them particularly elusive and dangerous.

Influence on Policy

One of the central questions stemming from this research is how to harness data to influence policy, especially within beekeeping regulations. The data provided by this study can serve as an important foundation for altering policies related to antibiotic use in beekeeping, ensuring that antibiotics are administered judiciously to prevent the development of antibiotic resistance and other unintended consequences.

Disease Transmission and Wildlife Extinction

This research aims to understand the factors behind disease transmission in bee populations, uncovering why specific pathogens remain dormant while others ravage bee colonies. Such insights are vital for beekeepers, policy-makers and the general public, as disruptions in bee populations can lead to wildlife extinction, affecting the entire ecosystem. Additionally, uncovering threats to managed bee colonies provides a window to understanding similar risks to native insect pollinators, since they share the same foraging areas.

Audience and Precedent

This research appeals to a broad audience encompassing beekeepers, policy-makers, the general public and affiliated research groups. By establishing a comprehensive database and setting a precedent for integrating microbiome-based data into beekeeping policies, this research is catalyzing a positive shift in beekeeping practices worldwide.

Diversity and Collaborative Perspective

The team's focus on diverse hiring practices and a multi-faceted research program demonstrates the broader societal impact of their work. Their lab is characterized by inclusivity and international collaboration, fostering a global perspective on bee health research. The research team coordinates with beekeepers from other countries, such as the U.S., Nigeria and Cuba, to collect samples throughout the year. The goal is to compare the microbiomes of bees from these different areas when analyzing data derived from the Canadian Bee Gut Project. This perspective is indispensable for understanding regional variations in bee health and for building a comprehensive understanding of the challenges bees face worldwide. ■



Students from the Allen-Vercoe lab inspect frames of a beehive: Dylan Brettingham (left) and Ailish Moore.



Leading-Edge Research on Land Use, Diet and Sustainability

Dr. Madhur Anand's research has made significant contributions to various fields, particularly in land use, diet and environmental sustainability. This impact summary highlights key aspects of her work, showcasing its relevance and implications for policy, conservation and agriculture.



Madhur Anand
School of
Environmental Sciences

Land Use Insights for Conservation and Policy

Dr. Anand's collaboration with the Credit Valley Conservation Authority has yielded valuable insights into regional land use interactions. Her research has informed policy decisions and planning efforts, emphasizing the importance of maintaining landscape diversity, particularly relevant to greenbelt preservation policies.

Dietary Guidelines and Food Sustainability

Amid evolving dietary guidelines, Dr. Anand's research underscores the potential changes needed to address global food challenges. She advocates for dietary modifications as a sustainable solution to feeding a growing population. This research has been shared extensively with policy-makers via the *Hill Times*, resulting in a shift in perspective toward dietary guideline revisions.

Global Implications of Land Use and Diet

Dr. Anand's research on land use and diet has garnered substantial media attention and global implications. Her findings have revealed that following U.S. dietary guidelines worldwide would necessitate an additional area for agriculture equivalent to Canada's land mass. This revelation has sparked discussions and op-eds in reputable publications, raising awareness of the urgent need for dietary guideline adjustments.

Innovative Approaches to Conservation in Agriculture

One of the standout achievements of Dr. Anand's research is her work on precision conservation in agriculture. Collaborating with Dr. Clarence Swanton, she identified economically unviable agricultural areas that could be repurposed to promote sustainable land use practices. This innovative research has been widely disseminated among farmer groups and businesses and is helping to create transformative changes in agricultural practices.

Predicting Tipping Points for Environmental Sustainability

Dr. Anand's work in developing methodological tools for predicting tipping points has profound implications, especially in drought prediction and understanding its impacts on agricultural production. These tools interact with existing vegetation, enabling the development of early drought warning systems that safeguard ecosystems and agricultural livelihoods.

Dr. Anand's body of research has sparked new projects, ideas and questions, reinforcing its lasting impact on these critical areas of study. ■



Balancing Profits and the Planet

Precision Agriculture's Impact on Crop Production Sustainability



Alfons Weersink
Department of Food,
Agricultural and
Resource Economics

Dr. Alfons Weersink studies the intricate world of precision agriculture to assess its financial and sustainability implications in crop production. His work explores the critical trade-offs between various farming systems and their environmental impacts, pointing toward a more sustainable and climate-resilient agricultural industry.

Farmers for Climate Solutions

One of the key summary highlights of this research is the “Farmers for Climate Solutions” initiative, which seeks to identify cost-effective practices for reducing nitrous oxide, methane and net carbon dioxide emissions in agriculture, including precision agriculture.

Cost-Effective Emission Reduction

Dr. Weersink's work was instrumental in establishing a framework for measuring the potential impact of climate-focused beneficial management practices, including precision agriculture, on reducing greenhouse gas emissions. Led by research associate Aaron De Laporte along with biophysical scientists from across the country, the project estimated that a variety of agricultural practice innovations could result in a 10-megatonne reduction in emissions that would cost \$270 million.

Impact on National Budget

This initiative, driven by a collaboration of policy-makers and producers, caught the attention of the federal

minister of agriculture, who incorporated its recommendations into the national budget with the creation of the On-Farm Climate Action Fund.

On-Farm Climate Action Planning

Dr. Weersink's research underscores the importance of continuing national and provincial on-farm climate action plans, highlighting the necessity of a multi-faceted approach that combines innovative policy measures with practical solutions implemented by farmers.

His research showcases how climate-focused beneficial management practices, including precision agriculture, coupled with collaborative efforts between policy-makers and producers can lead the way in achieving climate goals while considering economic viability.

This work informs policy decisions and empowers farmers to take meaningful steps toward a greener and more prosperous future. ■



Environmental IMPACT



AGRICULTURE FACES A DUAL challenge in an era of heightened environmental consciousness: to feed the world sustainably while safeguarding the planet. This section discusses Food from Thought research projects contributing to this monumental task. From conserving biodiversity to mitigating climate change and reducing environmental pollution linked to agriculture, these initiatives represent our commitment to fostering a harmonious relationship between farming and nature.



Andrew MacDougall
Department of
Integrative Biology

Transforming Farming for a Sustainable Future

A Natural Capital Program's Impact on Ecosystem Services and Engagement

Dr. Andrew MacDougall studies the interplay between food production, environmental preservation and global change. His research impacts ecosystem services and community engagement, pointing the way to a sustainable future for agriculture and the environment.

Global Insights: Balancing Act in Agriculture

Dr. MacDougall's team found that between 1986 and today, regions worldwide have experienced widely divergent shifts in climate and rangeland productivity. These findings emphasize the localized nature of climate change impacts on agriculture, necessitating region-specific strategies for sustainability.

Local Success: Ecosystem Services and Collaboration

At the local level, graduate students and faculty from various fields have collaborated to demonstrate the potential of marginal cropland retirement for generating ecosystem services on conventional farms. This research underscores three essential pillars of ecosystem services: biodiversity, nutrient retention and the storage of soil organic carbon. By partnering with farmers in southwestern Ontario through Alternative Land Use Services (ALUS) Canada, the project has created habitat on retired lands, leading to immediate increases in biodiversity across trophic levels and emphasizing the importance of land diversification in enhancing ecosystems. Nutrient retention by retired buffers has mitigated nitrogen and phosphorus losses during the growing season. Additionally, the research indicates significant shifts in soil biota diversity and root biomass, offering promising prospects for long-term soil health improvement.

Government and Corporate Engagement

A key driver of the project's success has been the active participation of local farming communities facilitated by ALUS Canada, along with close ties with major Canadian food companies and banks and all levels

of government. This collaboration between academia and these stakeholders is vital for influencing policy and promoting sustainable food production.

Engaging Farmers and Bridging the Information Gap

Farmers actively participate in the initiative, seeking outcomes that balance agricultural productivity and environmental sustainability. Precision agriculture and farm redesign are emerging as potential solutions, bridging the information gap and fostering more sustainable farming practices.

Unexpected Ecological Benefits

The research highlights the fact that farm landscapes can host diverse native biodiversity. Habitat reconstruction has demonstrated rapid and substantial positive responses from various plant and animal communities, revealing that by creating suitable habitats, many species can thrive on farm landscapes. Even small areas have witnessed notable increases in native pollinator diversity and abundance, while restored wetlands have provided a haven for numerous bird species, including those at risk.

Transformative Impact on Students and the Future Workforce

The program's impact transcends academia. It has reshaped students' perspectives on the value of their research, encouraging them to explore broader horizons. Collaborations across campus and connections with organizations like ALUS have inspired students to enter government roles, fostering positive change on a larger scale. ■



Transforming Ontario's Grain Production Through Precision Agronomy and Data Integration

Dr. Asim Biswas is transforming the agricultural landscape with a tool for farmers that will optimize nitrogen application by considering farm area and various time frames. This innovation aims to reduce the number of tractor passes, ultimately increasing resource efficiency.

As well, satellite images are employed to accurately identify crop types, enhancing the existing methods used by Agriculture and Agri-Food Canada. Dr. Biswas's team is working on an improved model for identifying field boundaries, which promises higher accuracy.

Beyond Agronomy: Economic Implications and Collaborations

The implications of this research extend beyond agronomy. Dr. Biswas's work also explores the impact on insurance markets, particularly in the corn sector, and examines the economic repercussions at a national level. Dr. Biswas continues to advance this research through collaborations with the Research Innovation Office at the University of Guelph and through a successful proposal to the Advancing Research Impact Fund.

Secure Data Integration and Maximizing Research Investment

The project encompasses the development of a data model, published in *Nature*, that enhances data movement and encrypts data using a "soil print" concept. This soil print is a unique fingerprint for soil data, ensuring its security. The approach involves

a federated system for sharing data, with outreach to tech companies to incentivize data sharing through rewards, maximizing research investment.

Fostering Inclusivity and Respect

Dr. Biswas actively fosters an inclusive and respectful environment in the lab, addressing equity, diversity and inclusion. This includes using gender-neutral language, hiring students and post-docs through non-traditional media channels, and incorporating modelling aspects into projects to make them more inclusive and accommodating for differently abled individuals.

Global Impact and Sustainable Agriculture

Dr. Biswas's research program advances precision agronomy and seeks to benefit marginal farmers worldwide, especially in developing countries. The development of sensors and methodologies for large-scale production, along with the ongoing scaling up of research initiatives, highlights the potential for transformative changes in the agriculture industry. ■



Asim Biswas
School of
Environmental Sciences

Plumbing the Depths of Marine Biodiversity



Diana Varela
Department of Biology,
University of Victoria

Dr. Diana Varela and her research team are studying the response of marine ecosystems to climate change. She aims to learn how marine biodiversity varies in response to changing environmental conditions.

Her research emphasizes the pivotal role of diversity of primary producers across ecosystems, focusing on the intricate relationships within the marine food web.

A Holistic Approach to Fisheries Management

One of the key takeaways from her research is the critical impact of biodiversity at the base of marine food webs on ecosystem modelling. By considering the broader spectrum of species, from bacteria to phytoplankton and beyond, Dr. Varela challenges the conventional approach to fisheries management, advocating for a holistic perspective that encompasses the entire food chain.

Shaping Marine Policies Through Research Integration

Dr. Varela collaborates closely with the Department of Fisheries and Oceans. Her research has the potential to influence marine policies indirectly, as it reshapes our understanding of how different components and regions of the oceans are interconnected. Her synthesis papers offer a blueprint for more comprehensive, ecosystem-based policies that reflect the complexities of marine life.

Championing Equity, Diversity and Inclusion

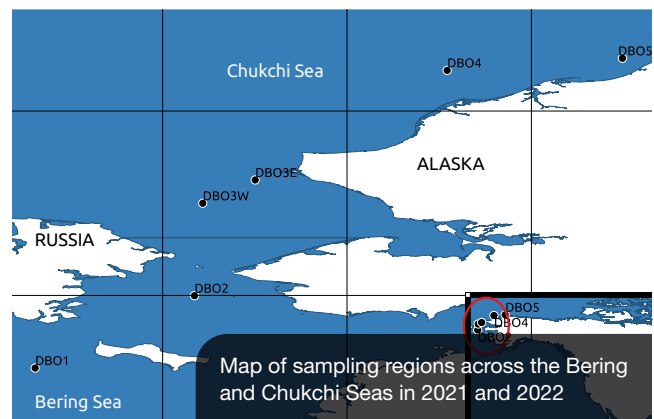
Beyond her scientific endeavours, Dr. Varela is a champion of equity, diversity and inclusion in marine biology. Drawing on her experience as an immigrant from Argentina, she highlights young scientists' financial and mobility challenges. She is a strong advocate for providing financial support and ensuring accessibility for underrepresented groups in both laboratories and conference settings. She also supports students with family and personal responsibilities in innovative ways.

Pushing the Boundaries of Marine Biology

As a scientist dedicated to women's empowerment and EDI, Dr. Varela's work transforms our understanding of the biodiversity of primary producers within marine ecosystems. Her ongoing research explores the exciting frontier of genetics versus ecophysiology, promising further discoveries that will shape the future of marine biology and conservation efforts. ■



Diatoms collected from the Chukchi Sea in 2021, samples prepared by Rebecca Crawford and photos taken by Shea Wyatt



Map of sampling regions across the Bering and Chukchi Seas in 2021 and 2022

DID YOU KNOW? Diatoms are tiny, single-celled organisms that live in ponds, rivers and oceans. They make their food using sunlight and carbon dioxide, just like plants. They also play a significant role in our environment by producing oxygen and serving as food for other aquatic creatures. These organisms may be tiny, but they significantly impact the world's ecosystems.



Unveiling Climate Change's Impact on Canadian Agriculture

Dr. Khurram Nadeem's research explores how shifting climate patterns could influence crop yield and agricultural productivity, particularly in Canada. By addressing these critical questions, his work provides valuable insights into adapting farming practices to changing environmental conditions.



Khurram Nadeem
Department of
Mathematics and
Statistics

Bioinformatics: Empowering Agricultural Research

Dr. Nadeem's commitment to advancing agricultural research extends to his active participation in the bioinformatics program. Leveraging cutting-edge computational techniques, he analyzes complex data sets related to climate change and agriculture. This interdisciplinary approach enables him to uncover hidden patterns and trends, contributing to more informed decision-making in the agricultural sector.

The Northward Shift: Adapting to Climate Change

Dr. Nadeem examines how emerging climate change patterns will impact farming in Canada. His investigations explore the feasibility of moving agricultural operations northward to adapt to changing climate conditions. This research is pivotal in ensuring sustainable Canadian agriculture under climate challenges.

Collaboration for a Sustainable Future

Dr. Nadeem's collaborative efforts with post-doctoral researchers are critical in addressing the complex challenges of climate change in agriculture.

Together, they identify regions of significant biodiversity value and notable carbon emitters. By pinpointing these areas, the team aims to determine whether it makes economic sense for farmers to expand their operations sustainably.

Publication in *Nature Scientific Reports*: A Testament to Quality

Dr. Nadeem's research has gained recognition through publication in *Nature Scientific Reports*, a testament to the significance and quality of his work. He is dedicated to sharing valuable findings with the broader scientific community, ensuring his research has a far-reaching impact.

Dr. Nadeem's research advances our understanding of the potential agricultural impacts of climate change and offers practical solutions for sustainable farming practices. As the world grapples with the consequences of a changing climate, Nadeem's research guides the future of agriculture in Canada and beyond. ■

Advancing Indigenization, Equity, Diversity and Inclusion in Research: A Year in Review



Joanne Garcia-Moores
Indigenization and EDI
Adviser in Research

Empowering U of G Researchers Through Enhanced Support

In the 2022-23 fiscal year, the University of Guelph worked diligently to bolster its commitment to Indigenization, equity, diversity and inclusion

(IEDI) within research. This initiative saw the allocation of additional resources and the infusion of pertinent expertise into U of G research.

IEDI Adviser Equips Researchers with Essential Resources

Joanne Garcia-Moores joined U of G's Research Services Office (RSO) and the Ontario Agri-Food Innovation Alliance in the new position of Indigenization and EDI adviser in research in April 2022. Guided by the advice of the EDI in Research Advisory Committee, Garcia-Moores works closely with Dr. Cara Wehkamp, assistant vice-president (Indigenous initiatives), to help achieve the research-related goals in the Indigenous Initiatives Strategy.

The RSO launched a dedicated web page, offering invaluable guidance and resources to help researchers meet EDI requirements in grant applications. Along with Meg Ecclestone from the University library, Garcia-Moores created an educational resource to enhance understanding of the barriers encountered by equity-deserving groups in STEM disciplines.

Empowering Faculty Through Training Workshops

Garcia-Moores co-developed and presented two EDI in research training sessions to help faculty in the College of Engineering and Physical Sciences (CEPS) and the Ontario Veterinary College to prepare for NSERC Discovery grant applications. A third session was offered through RSO's faculty information exchange series with presentations by Dr. Graham Taylor from CEPS and Dr. Leanne Son Hing from the College of Social and Applied Human Sciences.

These workshops helped to empower faculty members looking to integrate IEDI considerations into their research strategies, preparing them for forthcoming grant competitions.

Aiding Indigenous Research Ethics

Through a \$50,000 grant from the Canada Research Chairs program, the RSO developed a project to enhance understanding of Indigenous research ethics through support for researchers and Research Ethics Board members. This funding was invested in a project to enhance the understanding of Indigenous research ethics, with results slated to become accessible in 2023-24, offering support to researchers and Research Ethics Board members.

U of G's Ongoing Commitment

The Government of Ontario and U of G have renewed their collaboration known as the Ontario Agri-Food Innovation Alliance, with the province committing more than \$343 million over the next five years. This agreement now includes new EDI and Reconciliation and Indigenization statements drafted with advice from Garcia-Moores and Indira Naidoo-Harris, associate vice-president (diversity and human rights). The statements provide a framework to steer action plans and decision-making for Alliance operations over the next five years. ■



AGRI-FOOD DATA CANADA'S PROGRESS UPDATE

Empowering Agri-food Research with FAIR Data Principles

The Agri-Food Data Canada (ADC) initiative, nurtured within the Food from Thought research program and the Ontario Agri-Food Innovation Alliance, has achieved remarkable progress during the 2022-23 fiscal year. ADC's primary focus has been on elevating the value of research data by advocating for and implementing data principles that are findable, accessible, interoperable and reusable (FAIR).

Here are some highlights of ADC achievements in 2022-23:

Research Centre Data Portals: Facilitating Access and Collaboration

Collaborating with the Alliance, ADC successfully launched the next-generation Ontario Dairy Research Centre Data Portal in April. This cutting-edge dairy data portal, designed and developed by the ADC team, features enhanced data integrity and integration as well as improved features for researchers. The dairy portal is part of a broader initiative to create a suite of data access portals that will revolutionize data capture, storage, integration, access and security at Ontario's agri-food research centres.

Semantic Engine: Making Data FAIR for All

ADC introduced the semantic engine (<https://www.semanticengine.org/>) as a powerful tool to promote FAIR data principles in data documentation. The user-friendly SemanticEngine.org platform helps users to make data more understandable for humans and machines, ultimately enhancing data accuracy, integration and preparedness for machine learning under crucial automation.

Empowering Researchers with Tools and Education

ADC has provided workshops and training to agri-food researchers. The agri-food research data workshops held in spring 2023 covered topics such as research data management, data management plans, GitHub, methods to document data and the new Ontario Dairy Research Centre Data Portal. ADC also hosted a "Reusable Research Data Made Shiny" workshop, funded by Compute Ontario, to enhance the reusability of research data.

ADC Consultation Services

ADC now offers consultation services to assist in accessing data from Ontario's agri-food research centres and in creating comprehensive data documentation using the semantic engine. ADC representatives meet with researchers one-on-one, either in-person or online, to assist with data access or to help create a data schema.

Learn more about ADC at <https://agrifooddatacanada.ca>. For questions about Agri-food Data Canada, please email adc@uoguelph.ca. ■

The Ontario Dairy Research Centre is owned by the Agricultural Research Institute of Ontario and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance, a collaboration between the Ontario government and U of G.



**AGRI-FOOD DATA
CANADA**

AT THE UNIVERSITY OF GUELPH

Ensuring a Pipeline of Highly Skilled Agri-food Experts

In this year's annual report, we take great pride in showcasing the profound impact of the Food from Thought program on ensuring a pipeline of highly skilled experts poised to transform the agri-food sector through innovation and sustainability. Since its inception, Food from Thought has been committed to empowering the next generation of professionals, and our "Where Are They Now" section highlights the remarkable journeys of some of our past highly qualified personnel scholarship recipients and graduate students who have been involved in Food from Thought-funded research.



Dr. Jared Stoochnoff
exploration scientist,
Canadian Space Agency

Graduate Research Assistantship, 2018-19

"Food from Thought provided the opportunity to attend a wide variety of training programs that bolstered my knowledge and experience... These training courses have been immensely helpful with my work at the Canadian Space Agency."

Jared completed a PhD on lighting strategies for high-density protein crop production in controlled environment systems while also leading the finalist team Canada GOOSE* in the Canadian Space Agency's Deep Space Food Challenge. Stoochnoff now manages a collaborative project with the German Aerospace Center to study, design and build an advanced ground test demonstrator to trial controlled environment agriculture technologies and operations for future space missions. Innovative food production technologies resulting from the project will inform developments in the Canadian North and the first lunar agricultural module.

*prior to joining the Canadian Space Agency



Leah Blechschmidt
corporate engagement adviser for agriculture, Nature United

Graduate Research Assistantship, 2017-18

"Team building and communication were major outcomes of my participation in the FFT program...[it] also helped me define my ambition for working in the agri-food sector and my ability to communicate this to prospective employers."

Blechschmidt completed an M.Sc. on the impact of landscape and farm practices on wild bees in apple orchards. She has worked to advance agricultural sustainability in international non-profits and as an independent consultant. Blechschmidt has provided support and strategic direction to a wide range of projects, including promoting human rights for seasonal workers in Turkey, achieving sustainability goals with producers in Argentina and communicating the farmer perspective on how companies can more effectively support producers.



Dr. Cameron Fioret
policy analyst, Natural Resources Canada; visiting research fellow, United Nations University

Graduate Research Assistantship, 2017-18

"I gained important skills in qualitative research and interdisciplinary work from my time with Food from Thought, which help me in my daily work in communicating projects, research and goals across federal governmental branches."

Fioret completed a PhD on the ownership, commodification and distributive justice of natural resources, culminating in the publication of a book, *The Ethics of Water*. As a policy analyst for Environment and Climate Change Canada, he supported the creation of a new national freshwater governance agency. Currently, Fioret explores water governance as a visiting fellow at the United Nations University Institute on Comparative Regional Integration Studies and serves as a policy analyst in the energy systems sector of Natural Resources Canada.



Dr. Yunfei Jiang
 assistant professor in agronomy and crop physiology, Centre of Sustainable Soil Management, Dalhousie University

Post-doctoral fellow on Food from Thought-funded research, 2017-18

“I gained research experience in nutrient management, plant-microbe interaction and RNA sequencing while working on the project funded by Food from Thought.”

Jiang completed a PhD on the effects of heat stress on pollen development and seed set in field peas, followed by a post-doctoral fellowship investigating the effects of nitrate on nitrogen fixation in the common bean. She now leads research at Dalhousie’s Centre of Sustainable Soil Management to improve field crop production and enhance crop resilience to climate change through sustainable agronomic practices on the Atlantic coast. Through this research, Jiang harnesses her passion for improving field crop production in environmentally and economically sustainable ways.



Emily Sousa
 planner, County of Brant

Highly Qualified Personnel Scholarship, 2019-21

“Interdisciplinary communication and analysis is the most valuable skill... I learned to recognize and view problems in agriculture from all sorts of lenses: economic, social, political... The opportunities in the Food from

Thought program were key to building this skill set.”

Sousa completed an M.Sc. on best practices for on-farm diversification in Ontario and won first place in the Ontario Agricultural College Impact Case Competition for reducing packaging waste. She now specializes in agricultural systems planning, farm property issues and on-farm diversification in the municipal sector. She supports the permitting and construction of agri-food businesses, ensuring that they can complement Ontario’s thriving agricultural sector while simultaneously protecting our valuable farmland. Sousa also contributes to the creation of plans and policies that support the development of rural communities.



Amanda Hutter
 CEO and founder, Green Feet Ecosystem Services

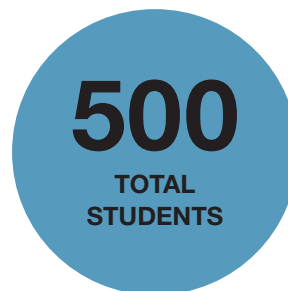
Master’s student on Food from Thought-funded research, 2018-20

“Food from Thought introduced us to a broad range of guests that, together, provided an accurate picture of where the cutting edge of the agriculture industry lies, and the chance to dive into a very under-explored realm of drone services and remote sensing technology.”

Hutter completed an M.Sc. examining processes for better communication about ecosystem services using drones. She founded Green Feet Ecosystem Services, where she applies the Drones, Data and Deep Communications (D3) process for provincial and national food-related strategies, particularly to communicate the unique value of carbon. Hutter has led training on the use of the D3 process for First Nations and agricultural organizations, helping to build capacity in the use of drone

technology to better understand both groups’ relationships with ecosystem services. ■

Number of HQP Graduates from FFT:



THE FOOD FROM THOUGHT CONFERENCE BURSARY PROGRAM is vital to our commitment to fostering the next generation of research innovators.

By facilitating students' participation in both in-person and virtual conferences, we empower them to refine their presentation and communication skills while sharing the outcomes of their research projects that align with Food from Thought's overarching objectives.

This section offers a snapshot of the program's impact, showcasing the invaluable experiences and learning opportunities it has provided to University of Guelph graduate students.



Locations Attended by Conference Bursary Recipients:

CANADA

- Granby, QC
- Halifax, NS
- Montreal, QC
- Ottawa, ON
- Toronto, ON
- Truro, NS
- Vancouver, BC
- Whistler, BC
- Winnipeg, MB
- Yellowknife, NT

UNITED STATES

- Albuquerque, NM
- Baltimore, MD
- Chicago, IL
- Cold Spring Harbor, NY
- Kansas City, MO
- Louisville, KY
- Manchester, NH
- Minneapolis-St. Paul, MN
- New Orleans, LA
- Oklahoma City, OK
- Pittsburgh, PA

- Portal, AZ
- Portland, OR
- San Diego, CA
- St. Louis, MO

EUROPE

- Berlin, Germany
- Dublin, Ireland
- Ferrara, Italy
- Galway, Ireland
- Geneva, Switzerland
- Glasgow, Scotland
- Granada, Spain

- Orléans, France
- Rennes, France
- Saint-Malo, France

INDIA

- Bangalore

RWANDA

- Kigali



Deus Mugabe
PhD candidate,
Department of
Plant Agriculture

“In one of the many lectures I attended at the conference, I learned about what enables innovation to impact society. The presenter urged us to learn about factors outside of research, such as policy and public acceptance.”

Mugabe attended the 2023 Plant and Animal Genome Conference in San Diego. He learned from and connected with globally renowned experts in agriculture and genomics.



Dr. Sabrina Rondeau
PhD graduate,
School of
Environmental
Sciences

“I learned about new methods of studying exposure of wild bees to pesticide residues in soil. These methods inspired many new ideas for future research projects.”

Rondeau attended the Entomological Societies of America and Canada joint annual meeting in Vancouver. She participated in sessions on diversity and Indigenous knowledge, which conveyed the importance of equity and inclusion in science.



Dr. Ginna Carolina Reyes Rodriguez
PhD graduate,
Department
of Animal
Biosciences

“Through talking to senior professionals in my field, I determined the next round of proteins I will use in my ongoing Western blot analysis.”

Rodriguez attended the International Symposium on Energy and Protein Metabolism and Nutrition in Granada, Spain. This career opportunity allowed her to receive advice from experts.



Emily Croft
M.Sc. student,
Department
of Animal
Biosciences

“I connected with researchers from the University of Missouri. This connection will contribute to greater collaboration between universities on beef cow nutrition, fetal programming and milk production.”

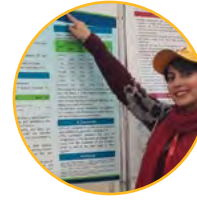
Croft attended the American Society of Animal Science and Canadian Society of Animal Science annual meeting in Oklahoma City, Oklahoma, where she learned about beef research.



Brooke McNeil
M.Sc. student,
Department
of Animal
Biosciences

“At this meeting, I met and spoke with others who are doing research with dairy calves. It reassured me that there are positions available in the field that I am looking for.”

McNeil attended the American Dairy Science Association annual meeting in Kansas City, Missouri, where she learned about novel calf research.



Dr. Solmaz Fatholouloumi
post-doctoral
fellow, School of
Environmental
Sciences

“This meeting was an excellent opportunity to exchange knowledge and technical advances. I heard about the latest research in my field and got to take advantage of networking opportunities to advance my career.”

Fatholouloumi shared her research at the Canadian Society of Soil Science annual meeting in Edmonton and gained critical feedback from experts.



Dakota Cherry
M.Sc. student,
Department of
Family Relations
and Applied
Nutrition

“At this conference, I learned about the term ‘survivance,’ which characterizes the struggles of colonized Indigenous communities. I plan to integrate a deeper understanding of this term into my research.”

Cherry attended the Native American and Indigenous Studies Association Conference in Toronto, where she learned about the importance of incorporating Indigenous perspectives in research. ■



Researcher Amanda Reside during a sampling trip on Lake Erie

THIS SECTION HIGHLIGHTS THE OUTSTANDING ACHIEVEMENTS

of two conference bursary recipients, Amanda Reside and Dakota Cherry. Their research projects exemplify their dedication and passion for creating innovative solutions for sustainable agri-food systems. Read their research stories to explore the fascinating discoveries and contributions that have emerged from their work.

U of G Study Explores the Effects of Neurotoxins in Aquatic Ecosystems

BY VANESSA VIRGO

Harmful algal blooms, which are increasing in frequency worldwide, have been known to release the neurotoxin beta methylamino-L-alanine (BMAA) into aquatic environments. Now, researchers at the University of Guelph are investigating the compound's presence in aquatic ecosystems and its impact on fish behaviour.

The study is conducted by Amanda Reside, an M.Sc. student in the Department of Integrative Biology, and is co-advised by Drs. Frédéric Laberge and Nicholas Bernier.

“Climate change is expected to increase the amount of harmful algal blooms across the globe, which is why we need to study the impact of BMAA on organisms in these ecosystems,” said Reside.



Four Petri dishes are filled with egg water medium and used to raise zebrafish embryos from fertilization to five days old. The egg water medium in three of the Petri dishes was spiked with different concentrations of BMAA.



A sampling trip in Lake Erie to study BMAA effects on fish and aquatic ecosystems

BMAA has been widely recognized as a neurotoxin associated with neurodegenerative disorders in humans, such as ALS and Parkinson’s disease. Yet, despite the growing occurrence of harmful algal blooms, the effects of BMAA on wildlife are not well understood.

In the first segment of her two-part study, recently published in *Toxicological Sciences*, Reside examined BMAA exposure in a laboratory setting.

“Our goal with the lab experiments was to simulate exposure to BMAA to understand its impact on fish behaviour and brain development.”

Using zebrafish, the team conducted a series of tests that analyzed BMAA’s neurotoxic effects on motor behaviours and brain size.

Zebrafish were exposed to varying water-borne BMAA concentrations, ranging from zero micrograms per litre to 100 micrograms per litre.

“Using a light-dark stimulus test, we concluded that there was a limited light-dependent effect on locomotion, suggesting targeted neurotoxicity to the visual system,” said Reside.

This study contributes to a growing body of toxicological research on BMAA, providing a basis for future studies to focus on behaviours governed by the visual system.

In the second half of the project, which is not yet published, the team examined the presence of the neurotoxin in the Lake Erie food web—an ecosystem in which the effects of BMAA on its organisms have not yet been studied.

The team took samples from various species, ranging from zooplankton to bivalves to predatory fish such as walleye and perch. They collected liver, heart, gonad, kidney, muscle, scale, gill and brain tissue from each fish specimen and analyzed the samples for BMAA’s presence.

The research is ongoing, but analysis results may explain how fish metabolize and accumulate BMAA in their tissues.

“Understanding BMAA and its presence in the Lake Erie ecosystem is important as the lake is home to large Canadian fisheries and is subject to severe harmful algal blooms,” said Reside.

“This study will help us understand the impact of algal blooms on wildlife in Lake Erie and could inform fish consumption guidelines.”

This research was supported by the Food from Thought program, funded by the Canada First Research Excellence Fund. ■



A young walleye caught in the western basin of Lake Erie during field research



U of G Researchers Support Indigenous Food Security and Sovereignty Through ‘Braiding Food Systems’

BY VANESSA VIRGO

Dakota Cherry, an Arrell Scholar and M.Sc. student in the Department of Family Relations and Applied Nutrition (FRAN), is collaborating with a team of interdisciplinary experts at the University of Guelph to help advance knowledge of Indigenous food sovereignty and security. The team, led by Dr. Silvia Sarapura, professor in the School of Environmental Design and Rural Development (SEDRD), is working to understand food insecurity and growing experiences in several First Nations communities across Northern Ontario.

The project, entitled Braiding Food Systems: Co-Constructing Indigenous Seed Systems in Northern Ontario for Food Sovereignty, Security and Climate Adaptation, began in May 2023 and will continue for the next three years.

“This project will support food systems in First Nations and reduce reliance on imported foods,” said Cherry.

“Food security is a primary goal for these communities, and food sovereignty is the ability of communities to determine the quantity and quality of the food they consume by controlling how their food is produced and distributed.”

The study will take a One Health approach to integrate people, plants, animals and shared environments, providing access to high-quality, biodiverse food sources for community growers.

The Braiding Seeds team from left to right: Paul Benalcazar, PhD student; Dr. Silvia Sarapura, SEDRD professor; Pris Henriquez, PhD student; Dakota Cherry, M.Sc. student in FRAN; and Justina Walker Mohamed, PhD student. Missing from photo: Charlotte Potter, PhD candidate; Mohammad Danial Salari, M.Sc. student; and Firoze Alam, PhD student.

The team will work with a Haudenosaunee Seed Keeper and community garden stewards to introduce Indigenous food crops from southern regions into the remote communities in Northern Ontario.

Participating community members will come together to envision and determine which seeds they want based on what they want to grow, what will benefit them the most and what they want to eat.

“This collaboration will help to ensure these communities continue to be fed culturally and nutritionally,” Cherry said.

“We hope to support the re-establishment of Indigenous food systems, which have been historically destroyed by the colonial imposition of agricultural systems that prioritize capital gain over human health.”

According to Cherry and her team, introducing the seeds will help to foster mutual learning between researchers and the communities, enhance food sovereignty and existing food systems, and reduce dependency on nutrient-deficient foods across communities.

In addition to exploring the viability of adapting seeds to local conditions, Cherry and the team will work to establish baseline health profiles in each community.

Using a questionnaire, the team hopes to gain insight into experiences and perceptions of food security and sovereignty rooted in locally specific contexts and draw from the experiences of children and families.

Using a horizontal and community-driven approach, the team hopes this research will provide evidence to inform policy and address each community’s unique and specific concerns in their pursuit of sovereignty and self-determination.

“We align our approach with the community’s definition of research, and we hope to create a research project that effectively and equitably braids different forms of research and knowledge to answer questions and address key concerns of communities holistically.”

This research is funded by the Ontario Agri-Food Innovation Alliance, a collaboration between the Government of Ontario and the University of Guelph. It is conducted in collaboration with researchers from Laurentian University and First Nations communities and leaders. ■

A Year of Innovation and Collaboration

We are pleased to share the latest developments in the University of Guelph Policy Fellowship Program in Agriculture, Food and Biodiversity. This year, we embraced a new approach by implementing a themed cohort model, allowing us to foster a stronger sense of community and facilitate more in-depth learning and networking opportunities for our Fellows.

The program, funded by Food from Thought and administered by the Research Innovation Office, continues to offer a unique platform for policy-makers to engage with the agricultural community and tap into the expertise of agri-food professionals from the University of Guelph. By bringing together these two vital sectors, we aim to drive evidence-informed decisions, bridge the gap between policy and academia, and contribute to advancing agriculture, food and biodiversity.

Here's a glimpse of the experiences and cohorts from this year:

Circular Economy Cohort

Our circular economy cohort had the unique opportunity to join the students participating in the Implementation Science Summer School, facilitated by the SMART Training Platform. This immersive learning experience included real-world problem-solving activities, guided tours of the Elora research centres and intensive training in the foundations of implementation science with a particular emphasis on circular economy issues.



With facilitation from Dr. Steven Clarke in the School of Environmental Design and Rural Development, Policy Fellows in the Circular Economy cohort collaborate to identify sustainable solutions to help local organizations.

Environmental Sustainability in Agri-Food Cohort

The environmental sustainability in agri-food cohort took place virtually and consisted of two days of group lectures by faculty. The lectures focused on critical research areas, such as the impacts of fertilizers, soil health, regenerative agriculture and livestock genomics. Fellows were invited to a day of Elora research station tours, enhancing their understanding of practical applications in the field.

These enriching experiences have contributed to the Policy Fellowship Program's ongoing success. This year, we welcomed 17 new Fellows—14 from the environmental sustainability cohort and three from the circular economy cohort—resulting in a total of 72 Fellows who have taken part in the program.

We appreciate the continued support of our partners and the dedication of our Fellows, and we look forward to furthering our mission of fostering meaningful connections, driving informed decisions, and making a lasting impact in agriculture, food and biodiversity. ■



Rebecca Dunn, research centre outreach coordinator at the Ontario Agri-Food Innovation Alliance, leads a tour of the Ontario Dairy Research Centre at the Elora Research Station for the Sustainable Agriculture cohort.

Core Faculty

Improving Life Through Unparalleled Creativity and Solutions-Oriented Discovery

The Food from Thought research program provides a robust vision for innovation and leadership in agri-food research. Our core faculty comprise professors from across all seven colleges at the University of Guelph who are ranked among the world's leading researchers in food and agriculture.

These faculty members lead globally recognized research in collaboration with industry, government and non-profit organizations, using evidence-based, multidisciplinary approaches to tackle complex agri-food problems. They improve life through unparalleled creativity and solutions-oriented discovery that will address problems in the wider agri-food system and feed our growing planet.



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Data Strategy Research Projects

The Canadian bee gut project

Emma Allen-Vercoe and co-investigators: Graham Thompson, Brendan Daisley, Andrew Pitek, Anna Chernyshova, Amira Bouchema, Elizabeth Mallory

Closing the digital decision-making loop in precision cattle management

Jennifer Ellis and co-investigators: Trevor DeVries, John Cant, Katie Wood, Vern Osborne, Dan Tulpan, Jan Dijkstra, David Innes, Jihao You, Carolina Reyes, Patty Kedzierski, Maureen Sahar

Big data analytics (BDA) using artificial intelligence (AI) to reduce food safety risks in Canada

Manick Annamalai

Integrating data to model food production and ecosystem services at multiple scales

Evan Fraser

Multidisciplinary approaches to a prediction model for gilt fertility

Julang Li and co-investigators: Dan Tulpan, Mohsen Jafarikia, Yashu Song, Brian Sullivan, Lauren Fletcher

A natural capital program for farm ecosystem services

Andrew MacDougall and co-investigators: Genevieve Ali, Asim Biswas, Neil Rooney, Andrew Young, Ryan Prosser, Kevin McCann, John Fryxell, Hafiz Maherali, Amy Newman, Bob Hanner, Joey Bernhardt, Jana Levison, Dirk Steinke, Jeremy DeWaard, Katherine Balpataky, ALUS Canada

Improving livestock for climate resilience

Bonnie Mallard

Coordinating antimicrobial resistance reporting in the Agri-Food Canada database

Nicole Ricker and co-investigators: Dan Tulpan, Zvonimir Poljak, Andrew McArthur, Durda Slavic

A hybrid cloud ecosystem for management, analysis and storage of large-scale agri-food data sets:

A Food from Thought legacy Scott Ryan and co-investigators: Cezar Khursigara, Jeff Gross, Dyanne Brewer, Jairo Melo, Elie El-Zammar

A WebGIS platform for identifying agri-environmental hot spots in the Lake Erie basin at a field scale

Wanhong Yang and co-investigators: Eric Nost, Diana Lewis, Hui Shao, Laura Hopkins, Rodrigo Miranda, Marjan Asgari, Jubril Bello

Digital Agriculture Research Projects

Enhancing Ontario's grain production using smart farming techniques

Asim Biswas and co-investigators:
William Deen, John Sulik,
Adam Gillespie, Prasad Daggupati

Scaling up precision agronomic management practices to enhance Ontario's grain production

Asim Biswas and co-investigators:
Solmaz Fatholouloumi, Hitesh Kumar
Bhogilal Vasava, Adam Gillespie,
Aaron Berg, Prasad Daggupati,
Joshua Nasielski, John Sulik,
Caleb Niemeyer, Tony Bulkwill,
Cameron Ogilvie, Daniel Saurette

Accounting for soil organic carbon in profitability maps

John Lindsay and co-investigators:
Adam Gillespie, Madhur Anand,
Eric Nost, Ahmed Laamrani,
Clarence Swanton, Paul Voroney,
Wanhong Yang

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

Medhat Moussa and co-investigators:
Katherine Wood, Dan Tulpan

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

Dave Renaud and co-investigators:
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 and co-investigators: Kari Dunfield,
Aaron Berg, Jon Warland,
Hadis Karimipour, Evan Fraser

A cybersecurity monitoring and threat hunting system for protecting smart farming

Ali Dehghantanha and co-investigator:
Andrew MacDougall

Enhancing the impact of agri-environmental research with repeat digital imaging

Claudia Wagner-Riddle and co-investigator: Aaron Berg

Applying wearable sensors and machine learning to improve dairy cow health and production

Eduardo Ribeiro and co-investigator:
Dan Tulpan

Using deep learning as an analysis and decision-support tool to assess biodiversity gain from habitat restoration in the agri-food sector

John Fryxell and co-investigator:
Graham Taylor

Informatics for single-specimen ecosystems

Paul Hebert

Development of near-real time analysis and reporting tool for important livestock pathogens

Zvonimir Poljak and co-investigator:
Maria Spinato

Rapid assessments of farmland functional biodiversity and specific ecosystem functions

Dirk Steinke

Ecosystem Services Research Projects

Eco-evolutionary dynamics and aquatic ecosystem services

John Fryxell and co-investigators:
Andreas Heyland, Teresa Crease,
Robert Hanner, Wanhong Yang

Genomic indicators of agro-ecosystem services

John Fryxell and co-investigators:
Dirk Steinke, Robert Hanner,
Elizabeth Mandeville, Paul Hebert

Food security and the maintenance of aquatic ecosystem services

Kevin McCann and co-investigators:
Robert Hanner, Neil Rooney,
Karl Cottenie, Fred Laberge,
Nicholas Bernier, Ryan Prosser,
Elizabeth Mandeville, Tyler Zemlak

Bioinformatics strategies for prediction of biodiversity and ecosystem services

Sarah Adamowicz and co-investigators: Elizabeth Mandeville,
Khurram Nadeem, Nicole Ricker,
Ayesha Ali, Dirk Steinke, Dan Tulpan,
Karl Cottenie, Robert Hanner,
Zeny Feng, Stefan Kremer,
Jacqueline May, Matthew Orton,
Jessica Castellanos Labarcena,
Helga Sonnenberg

Oceans of biodiversity: Energy flow and food resources in the twilight zone

Kim Juniper and co-investigators:
Catherine Stevens, John Dower,
Diana Varela, Emily Friczka, Monique
Boulanger. Fisheries and Oceans
Canada partners/collaborators:
Stéphane Gauthier, Akash Sastri,
Marie Robert, Moira Galbraith

Ecological and evolutionary impact of agricultural stressors

Melania Critescu and co-investigators: Gregor Fussmann,
Andy Gonzalez, Graham Bell,
Rowan Barrett, Kevin McCann,
John Fryxell, Andrew MacDougall,
Paul Hebert, Sarah Adamowicz,
Dirk Steinke, Takahiro Maruki,
Robert Hechler, Julien Beaulieu,
Wendy Gamero Morgado,
Kaushar Kagzi, Elizabeth Weller,
Michelle Gross, Patricia Humer,
Christopher Hempel

Terrestrial ecosystem services

Andrew MacDougall and co-investigators: Jana Levison,
Kari Dunfield, Hafiz Maherali,
Amy Newman, Brian Husband

Crops Research Projects

Modelling and monitoring agro-ecological mosaic ecosystems for optimizing human-environment sustainability
Madhur Anand

Combining deep learning and the theory of tipping points to better predict droughts
Madhur Anand and co-investigators: Rozita Dara, Chris Bauch, Daniel Dylewski

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

Development of a protocol and pilot study for nitrogen x water on-farm research
Bill Deen and co-investigators: John Sulik, Joshua Nasielski

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

Assessing and enhancing wild pollinator biodiversity
Nigel Raine

Microbes to microeconomics: Integration of data sets for sustainable agriculture
Kari Dunfield and co-investigators: Tongzhe Li, Claudia Wagner-Riddle, Alfons Weersink, Adam Gillespie, Mica Tosi, Kira Borden, Andrew Hector, Olivia Blumenthal, Evan Mayer, Heather White

A One Health approach to regenerative grazing
Kari Dunfield and co-investigators: Heather Murphy, Nicole Ricker, Claire Jardine, Charlotte Winder, Dasiel Obregon Alvarez, Sarah Fox, Heather White, Henry Ngo, Ilya Law

Enhancing biodiversity of the agro-ecosystem by enhancing adoption of cover crops
Elizabeth Lee and co-investigators: Bill Deen, Dave Hooker, Nigel Raine, Kari Dunfield

Strategies for achieving simultaneous increases in bean crop agro-ecosystem diversity and productivity
Peter Pauls

Improved approaches for management zone creation
John Sulik and co-investigator: Bill Deen

Enhancement of stress tolerance to weeds and cover crops
Clarence Swanton

Financial and sustainability assessment of precision agriculture in crop production
Alfons Weersink and co-investigator: John Sulik

RNA interference strategies for disrupting chitin biosynthesis and controlling fungal pathogens of crops
Melanie Kalischuk and co-investigators: Francois Tardif, Shirin Seifbargheii, Brooke Thompson, Priya Padmanabhan, Vighnesh Sukhu, Malavika Nair, Jason Deveau, Sean Thompson

Development of an N management decision support system
John Sulik and co-investigators: Ken Janovicek, Bill Deen, Josh Nasielski, Chad Anderson, Ben Rosser, Dale Cowan, Tony Balkwill, Greg Hannam

Livestock Research Projects

Precision poultry management: Combined approaches for enhancing layer health and welfare in the context of sustainable high egg production
Grégory Bédécarrats and co-investigators: Elijah Kiarie, Tina Widowski, Alexandra Harlander

Development of novel biomarkers for stress, boar taint and reproductive performance in pigs
Renée Bergeron and co-investigators: James Squires, Julang Li, Lee-Anne Huber

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

Precision cattle management
John Cant and co-investigators: Katie Wood, Trevor DeVries, Michael Steele, Vern Osborne, Eduardo Ribeiro, Dave Renaud

A comparison of key methodologies used to quantify protein quality of insect protein, black soldier fly larvae, for humans and farm animals
Kate Shoveller and co-investigators: Lee-Anne Huber, Elijah Kiarie, Michael Rogers

A comprehensive assessment of slow-growing chickens: Tackling sustainability issues for chicken strains of tomorrow
Tina Widowski and co-investigators: Elijah Kiarie, Ira Mandell, Niel Karrow, Dan Tulpan, Shai Barbut

Improving livestock for climate resilience
Bonnie Mallard and co-investigators: Niel Karrow, Angela Cánovas, Dan Tulpan, Christine Baes, Victoria Asselstine, Samla Cunha, Lauri Wagter-Lesperance, Shannon Cartwright, Carissa White, Kristen Lamers, Danielle Naylor, Nicole Moran, Olivia Willoughby

Development of targeted solutions for boar taint
Jim Squires and co-investigators: Renée Bergeron, Lee-Anne Huber, Dan Tulpan, Flavio Schenkel, Christine Bone, Jennifer Ronholm, Mohsen Jafarikia, Brent Devries, Dave VandenBroek

Pathogens and Food Safety Research Projects

Improving antimicrobial stewardship in food animals by identifying the determinants of use of antimicrobials by veterinarians and dairy farmers
Stephen LeBlanc and co-investigators: David Kelton, Dan Tulpan, Jan Sargeant

The use of big data to predict the emergence of food-borne outbreaks
Lawrence Goodridge and co-investigators: Jeff Farber, Rozita Dara, Amy Greer

Is it possible to control transmission of avian influenza virus?
Shayan Sharif and co-investigators: Zvonimir Poljak, Rozita Dara, Amy Greer

Building a surveillance and monitoring tool for avian influenza outbreaks in Canada
Shayan Sharif and co-investigators: Rozita Dara, Lauren Grant, Zvonimir Poljak, Fatemeh Haghighi

Control of food-borne pathogens
Lawrence Goodridge and co-investigators: Jeff Farber, Gisèle LaPointe, Nicole Ricker

Identification of factors contributing to *Streptococcus suis* disease in pigs: Big data approach
Zvonimir Poljak and co-investigators: Amy Greer, Brandon Lillie, Vahab Farzan, Nicole Ricker, Robert Friendship, Davor Ojkic

Large-scale AMR surveillance in a One Health context using DARTE-QM

Nicole Ricker and co-investigators: Dan Tulpan, Brandon Lillie, Heather Murphy, Adina Howe, Zvonimir Poljak, Andrew McArthur, Michael Mulvey, Richard Reid-Smith, Anne Deckert, Claire Jardine, Kari Dunfield, Gabhan Chalmers, Jutta Hammermueller

Biodiversity Research Projects

Tracking the response of arthropod communities to changing environments (TRACE)
Paul Hebert and co-investigators: Dirk Steinke, Sujeevan Ratnasingham, Jeremy deWaard, Evgeny Zakharov

Centre for Biodiversity Genomics (CBG) platform
Paul Hebert and co-investigators: Dirk Steinke, Sujeevan Ratnasingham, Jeremy deWaard, Evgeny Zakharov

Oceans of biodiversity: Sub-project synthesis and research integration
Diana Varela and co-investigators: Catherine Stevens, Sheryl Murdock, Shea Wyatt, Rebecca Crawford

Integrated Food Systems Research Projects

Exploring novel agricultural frontiers
Evan Fraser and co-investigators: Aaron Berg, Kevin McCann, Khurram Nadeem, Krishna KC

Human dimensions of the digital agricultural revolution
Evan Fraser and co-investigators: Dan Gillis, Rozita Dara, Alfons Weersink, Shoshanah Jacobs, Eric Nost, Rebecca Hallett, Krishna KC

Partners

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