AGRICULTURAL SYSTEMS FOR A HEALTHY PLANET

2021 – 22 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.

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MESSAGE FROM VICE PRESIDENT, RESEARCH, AND SCIENTIFIC DIRECTOR

Our work to transform agricultural systems for a healthy planet continues.

In another year dominated by the COVID-19 pandemic, the Food from Thought program remained focused on supporting innovative research by leading University of Guelph agri-food scientists and collaborators. Their research projects deliver on our core mission to transform agriculture's impact on biodiversity, sustainably intensify food production, and enhance food and livestock health.

One highlight of 2021 was the call for proposals for Food from Thought's third and final Thematic Research Fund (Thematic III), which resulted in a total of $8.66 million in funding provided for projects up to three years in duration led by 23 researchers from U of G and partner universities.

This fund has been instrumental in bringing together interdisciplinary experts in climate change, pandemic recovery, food safety and animal health to create new solutions to improve food production, quality and sustainability.

Supporting equity, diversity and inclusion in research

Food from Thought principal investigators continue to rethink and reshape the way they conduct research by implementing equity, diversity and inclusion principles into their work. They have embraced an approach that promotes diversity in team composition and trainee recruitment, fostering an equitable, inclusive and accessible research work environment and highlighting diversity and equity in mentoring, training and access to development opportunities.

This focus on equity, diversity and inclusion is a part of Food from Thought's commitment to creating a more inclusive research process. We value the unique perspectives of diverse teams, and we believe that the benefits they bring to creating agri-food solutions for the global community are immeasurable.

Research contributing to sustainable food systems for Canada

As you will read in the following pages, we have made tremendous progress in our efforts to our efforts to position Canada as a global leader in developing innovative solutions that improve the sustainability and productivity of food systems at the global, landscape and micro-levels.

Malcolm Campbell
Vice-President (Research)

Evan Fraser
Scientific Director

Our research has led to new insights into making food systems more sustainable and productive while improving the resilience of those systems to climate change impacts. Partners and leaders who share our vision for a sustainable future have recognized Food from Thought research projects in academia, business and government. Our partnerships with industry stakeholders have expanded to include new countries and institutions.

The work of Food from Thought researchers has never been more important. The world's population is growing, climate change is worsening and food shortages are becoming more common. We need new ways to feed this planet—and we need them now.

Our dedication to improving food systems for all Canadians remains unwavering—but we know there's more work to be done! We look forward to continuing our mission into 2023 and beyond. ■

THE WORK OF FOOD FROM THOUGHT RESEARCHERS HAS NEVER BEEN MORE IMPORTANT. THE WORLD'S POPULATION IS GROWING, CLIMATE CHANGE IS WORSENING AND FOOD SHORTAGES ARE BECOMING MORE COMMON. WE NEED NEW WAYS TO FEED THIS PLANET—AND WE NEED THEM NOW.

OVERVIEW

GLOBAL IMPACT: AGRICULTURAL SYSTEMS FOR A HEALTHY PLANET

Food from Thought is tackling the challenge of how to feed a growing global population by advancing our understanding of the complex interplay between farming practices and the environment.

The program's goal is to increase the sustainability and productivity of global food production by leveraging the power of big data, agri-food and biodiversity science.

Food from Thought is positioning Canada as a global leader to create agricultural systems for a healthy planet on global, landscape and micro-scales through four key strategies:

- cutting-edge research
- training of the next generation of agri-food leaders
- innovation, commercialization and knowledge mobilization
- increasing the University of Guelph's capacity for data science expertise through faculty recruitment and by catalyzing the development of an integrated data-sharing and analytics platform.

Food from Thought: Agricultural Systems for a Healthy Planet is a research program led by the University of Guelph, funded 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 digital agricultural research platform 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

OVERVIEW

OUR 2021-22 IMPACT IN NUMBERS

RESEARCH DOLLARS DISTRIBUTED

	2021-2022	Cumulative to-date
Biodiversity	$0	$12,800,000
Commercialization Grants	$150,000	$405,000
Digital Agriculture Reseach	$306,600	$2,169,000
Gryphon's LAAIR	$0	$105,000
Partner Universities	$372,000	$1,829,528
Thematic Research Fund	$705,970	$16,867,594
Total	$1,534,570	$34,176,122

NUMBER OF PARTICIPATING FACULTY

40
Partners

62
Knowledge Users

159
Collaborators

24
Policy Fellowships Awarded

845,063
YouTube Views for Core Team

1,517,944
Website Hits for Core Team

128
Media Interviews with FfT Investigators

35,855
Google Scholar Citations

52
Students with FfT HQP Scholarships

NUMBER OF PARTICIPANTS

40 Undergraduate Students

121 Master's Students

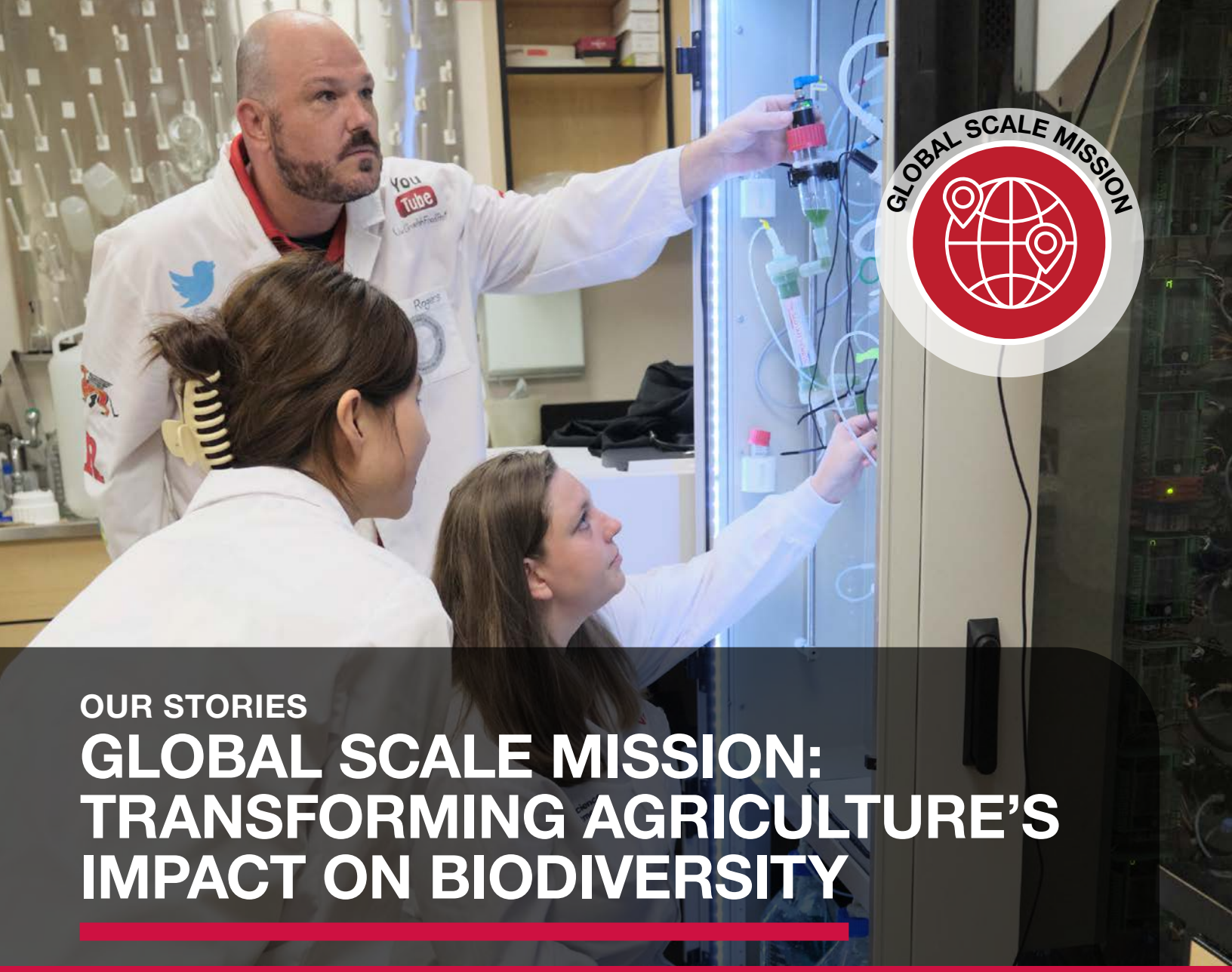
115 Doctoral Students

37 Post-doctoral Fellows

127 Research Associates

44 Technicians

410 Outreach Events and Workshops



OUR STORIES

GLOBAL SCALE MISSION: TRANSFORMING AGRICULTURE'S IMPACT ON BIODIVERSITY

Food from Thought research is pioneering new ways of producing food while safeguarding natural ecosystems. Food from Thought envisions a future where the study of food production systems is rooted in a comprehensive knowledge of the complex ecosystems that sustain them.

Through the Global Scale Mission, our research projects answer questions relevant to global food production and agri-food sustainability. Our work is creating a sustainable future for agriculture in the face of growing environmental challenges, including climate change and biodiversity loss.

The following research stories illustrate the powerful connections between scientific inquiry, societal needs and innovation.

Research stories written by Lois Harris of Wordswork Communications

Growing crops in northern Canada: What are the odds?

Khurram Nadeem
Department of Mathematics and Statistics

Learning more about growing crops in northern Canada under climate change is the goal of a Food from Thought research project at the University of Guelph.

The researchers are bringing big data analysis and machine learning to their studies of new northerly frontiers for farming, says Dr. Khurram Nadeem, a statistics professor in the College of Engineering and Physical Sciences.

"We are studying the yield and soil potential of Canadian lands, especially in the North, in the face of a changing climate," says Nadeem. "Our hypothesis is that northern Canada will become more suitable for agriculture."

A specialist in predictive modelling of ecological and environmental processes using big data analysis, he was hired in 2018 under the Food from Thought program to bring statistical expertise to this research.

He's extending work done by other U of G researchers, including Dr. Evan Fraser, director of the Arrell Food Institute, and Dr. Krishna Bahadur KC in the Department of Geography, Environment and Geomatics, on northern crops globally and here in Canada. (See related article.)

Refining research

Earlier studies incorporated information on parameters such as soil pH, temperature, precipitation and topography.

"Now, we're using data and machine learning, whereas earlier we were using expert opinion and formulae to map soil suitability," says Nadeem.

Based on Statistics Canada crop data from 2013 to 2020, the researchers developed statistical models and employed machine learning systems. Those methods can help in looking at potential crop yields even in northern Canada where crop inventories are lacking.

Leading this aspect of the project is Aman Bhullar, a PhD candidate in the Department of Mathematics and Statistics (profiled elsewhere in this report).

"His preliminary results show a significant yield decline in current southern agricultural areas," Nadeem says.

He says the team is using remote sensing data and global warming scenarios to see potential effects around the country.

The researchers also use Google's large data repository, Google Earth Engine, which holds crucial detailed geospatial information.

"Aman has a massive job because he is taking data from multiple sources at multiple scales," says Dr. Nadeem.

Now halfway through this project, Nadeem expects to complete the machine learning aspect this fall.

New discovery

Bhullar is further refining the data to look more closely at yield potential. Statistics Canada currently collects information but on scales that are too broad for the project.

The researchers are currently exploring vegetation indices – specifically the normalized difference vegetative index (NDVI) – based on satellite measurements of sunlight reflected from Earth.

"It's a great index for vegetation – it peaks in late July and early August," Nadeem says. "Aman has discovered that there is a strong correlation between the yield at harvest and the peak NDVI value for a farm."

Essentially, the NDVI data could be used as a proxy for yield data in areas where no crops currently grow.

"The other huge advantage is that NDVI is available at a much smaller scale – down to kilometre by kilometre," Nadeem says.

Although the researchers are using this technique for Canadian crops, they could apply it to other parts of the world.

Nadeem says the team is looking at scenarios 50 years and 100 years from now.

"When you consider that only 10 years ago, there was still a lot of skepticism in the public about the existence of climate change, now with heat waves and floods and wildfires and droughts, nearly everyone is convinced," he says. "Our modelling says that the changes we're predicting are only two generations away – which isn't that far." ■

Exploring the pros and cons of northern farming frontiers

As we look to feed a growing global population under climate change, farming is moving northward. That presents an economic opportunity for Canada, but what are the environmental and societal consequences?

Krishna KC
Department of Geography, Environment and Geomatics

Evan Fraser
Department of Geography, Environment and Geomatics

Food from Thought researchers at the University of Guelph hope to help improve Canadian, and potentially global, food production.

"Our role is to clearly show all the possibilities and pathways to help policy decision-makers proceed," says Dr. Krishna Bahadur KC in the Department of Geography, Environment and Geomatics within the College of Social and Applied Human Sciences.

He's leading the "Exploring Novel Agricultural Frontiers" project, a wide-ranging initiative examining potential economic opportunities, societal issues and environmental trade-offs required for agricultural sustainability in Canada.

"We must try to balance producing healthy, nutritious food for a growing population using novel technologies while minimizing environmental hazards as much as possible," he says, emphasizing that those decision-makers need to consider implications for Indigenous sovereignty and food preferences.

Early research

This research follows earlier published work by KC along Dr. Evan Fraser, director of the University of Guelph's Arrell Food Institute, and other scientists from around the world.

In one study, researchers modelled how growing 13 global crops farther north would affect water, biodiversity and carbon storage.

"We wanted to explore the extent to which climate change in the North provides a way to adapt to the loss of productivity in the south," says Fraser.

They found that an area equivalent to more than 30 per cent of current global farmland – or about 15 million square kilometres – could become suitable for farming, but at a price. Besides large losses of forests, biodiversity and habitat, cultivating that land could release 177 gigatonnes of carbon, or about a century's worth of current U.S. emissions.

Research refinements

In a 2021 paper in the journal *FACETs,* researchers led by KC determined how much of Canada's land could support four staple crops – potatoes, wheat, corn and soybeans – by 2080.

The team looked at climatic variables as well as soil parameters, topography and other components. One scenario limited the search for suitable land to within 10 kilometres of roads.

They found that about 4.79 billion square kilometres could be made available for agriculture. But replacing wetlands and forests would release about 15 gigatonnes of carbon into the atmosphere. Food production would also harm wildlife habitats, biodiversity and conservation lands, and involve serious implications for Indigenous land sovereignty.

Watch a video explainer of the project here: https://www.youtube.com/watch?v=L5rkNbmAWt4

"Exploring northern agricultural frontiers is a new thing. It's very complex and you need to include many parameters, develop models, validate them and then implement them to find what areas would be suitable," says KC.

Now refining the models, he says, "The long-term plan is to develop models for all the regions of the world."

A cautionary tale

Fraser says scientists 20 years ago foresaw some of the impacts of climate change and that efforts should have begun then to curb its effects.

Although many parts of Canada could become arable later in this century, he says, there's a cautionary example in the Amazon, where incremental deforestation for agriculture has devastated the region's ecology and ecosystem services.

"In the 1970s and '80s, no one thought that so much of the Amazon rainforest would be turned into soy cultivation."

Referring to the North, Fraser adds, "Without careful strategy, thought and planning, this process of land use change could happen without people being aware of it."

He hopes any discussions about adaptation to climate change and land use principles will involve consultations led by northern Indigenous communities. ■

Picture this: Technology developed to bolster climate change studies

University of Guelph researchers are studying the use of diversified crop rotations to reduce carbon emissions and help combat climate change. In the process, they've also come up with new, less expensive digital camera technology that could be used by agri-environmental scientists around the world.

"We've already accumulated a few years of carbon and water exchange data. Now we're doing an analysis of agri-ecosystems – about whether and when they're a carbon source or sink," says Dr. Claudia Wagner-Riddle, a professor in the Ontario Agricultural College who studies climate change mitigation.

The project is funded by Food from Thought, Fertilizer Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) through the Ontario Agri-Food Innovation Alliance.

In an ongoing experiment at U of G's research station in Elora, Ont., one field is managed conventionally with a corn-soybean-soybean rotation while another is managed with a corn-soy-wheat rotation using cover crops.

"It takes three years to get a complete cycle – we're evaluating the net carbon use and the water cycle," says Wagner-Riddle, a professor in the School of Environmental Sciences.

The team has completed two full years of its experiment.

The researchers added the sites to the PhenoCam Network, established in the U.S. in 2008 to track vegetation phenology (the progression of plants through the growing season) across North America and around the world. The network currently has more than 700 sites and contains 60 million images in its archive.

At Elora, a phenocamera at each site tracks the greenness of the crop canopy. The cameras take time-lapse photos throughout the year that the team analyzes to assess the crop's carbon exchange.

"In the future, people could use some of our data for more global analysis," says Wagner-Riddle.

Claudia Wagner-Riddle
School of Environmental Sciences

Advancing the technology

Each phenocamera typically costs about US$1,000. Dr. Shannon Brown, a post-doctoral researcher working with Wagner-Riddle, came up with the idea of using a less expensive model.

"The cameras that we're building are closer to $100 each," says Brown.

A photo showing two phenocameras. The camera on the left is the standard model, and the one on the right is the less expensive one that Dr. Wagner-Riddle and her research team are testing.

The newly developed equipment includes a Raspberry Pi Zero W computer with a camera board, a case and an SD (secure digital) card. Raspberry Pi is a low-cost computer about the size of a credit card that takes the images and uses wi-fi to give other devices access to the data through web interface.

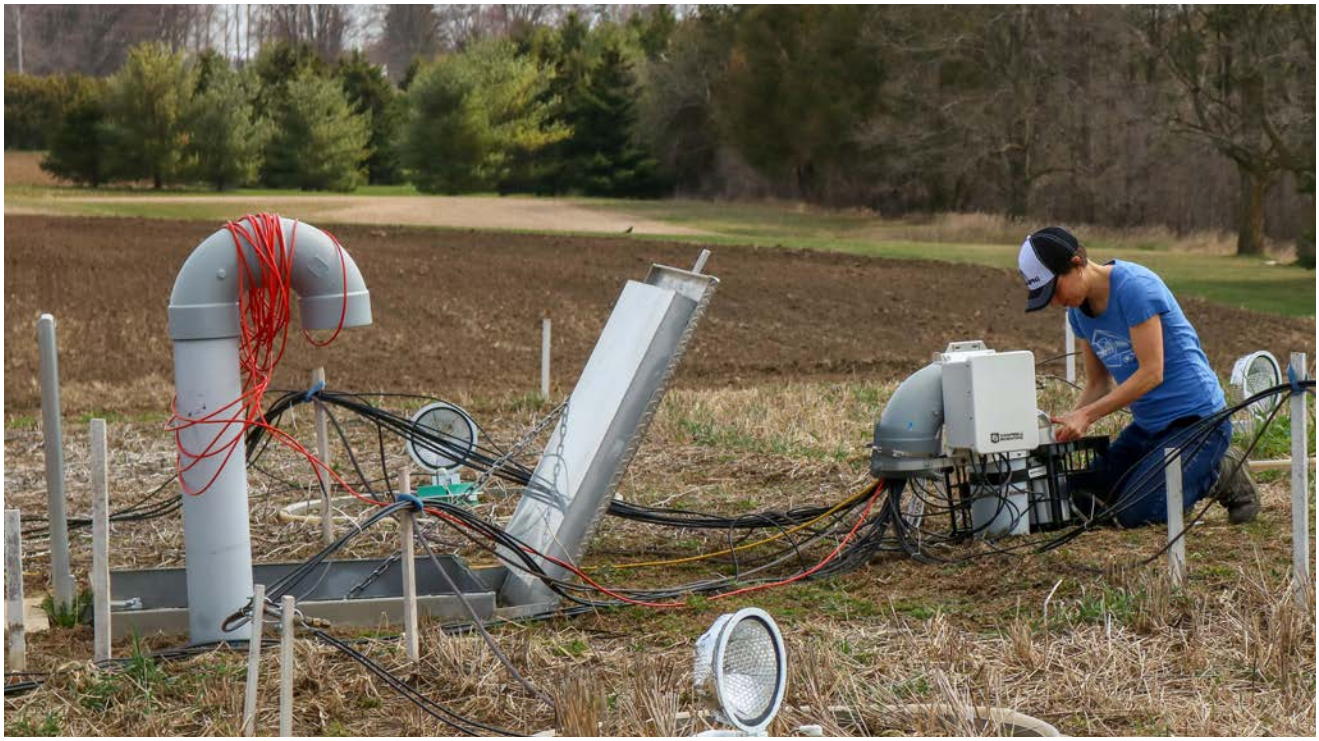
Early results from testing the cameras during a soybean growing season have been encouraging.

David Collins, a student working on the project from University College, Dublin, found that compared with the standard phenocam, the custom-built equipment yielded greenness chromatic coordinates (the degree of greenness in an image) that correlated slightly better with the net ecosystem exchange (how much carbon enters the atmosphere versus how much is removed).

After the researchers finish testing, they will install their cameras on each of the 18 lysimeters at Elora. Lysimeters are large underground cylinders encased in steel with sensors for monitoring soil water and nutrient budgets.

"While we're currently focused on carbon flux, the technology could be used to gather data on a number of different things, including the water cycle and nitrogen use," says Wagner-Riddle.

She says cheaper cameras used along with instructions posted on GitHub (an open-source repository for computer programmers) will help improve accessibility of data collection in agriculture and other sectors worldwide. ■



OUR STORIES

LANDSCAPE SCALE MISSION: SUSTAINABLY INTENSIFYING PRODUCTION

Food from Thought research addresses one of the biggest challenges facing human civilization in the 21st century: to devise systems capable of meeting the rising demand for food while sustaining healthy ecosystems, populations and economies.

Through the Landscape Scale Mission, Food from Thought research projects explore how all aspects of the agriculture and food system can be brought together by harnessing the power of bioinformatics, state-of-the-art simulation modelling and innovative new technologies to create a more sustainable and profitable food industry in Canada.

Collaboration between scientists and farmers is the key to meeting increasing demands for food. Learn about how the following research projects are helping to create a solid scientific foundation for sound decision-making so that Ontario's agriculture can thrive, grow and adapt to changing conditions.

Mixing beans helps growers and the environment

Peter Pauls
Department of
Plant Agriculture

Mixed beans can mean higher yields and reduced risk for farmers and also help the environment, say University of Guelph researchers.

Traditionally, bean farmers have planted only a single variety of bean throughout their fields, says Dr. Peter Pauls, a professor in the Department of Plant Agriculture within the Ontario Agricultural College.

Farmers have looked for ways to increase environmental diversity such as planting hedgerows around their fields, he says.

"But that doesn't really address the in-field issue. We thought, what about mixing pure bean lines? That would really increase the genetic diversity."

For the past five years, his team, including post-doc Yarmilla Reinprecht and technicians Thomas Smith and Lyndsay Schram, have combined varieties of navy beans, kidney beans and black beans. They have experimented with planting mixtures within rows and in alternate rows and compared the results with pure lines of beans.

Benefits to farmers

"At the end of it, we concluded there was no penalty in terms of yield for mixing varieties, and sometimes the average yields of the mixtures were better than the pure lines," says Pauls.

That's a new idea for many bean plant breeders, who rely mostly on developing and evaluating pure varieties. This Food from Thought project suggests mixing varieties with different architectures and traits may pay off.

To study risk mitigation in one trial, the team planted white and black beans in alternating rows. Flooding killed the black beans but not the white ones.

"Instead of having a total crop failure, the white beans can fill in the rows, producing a pretty decent crop at the end of the day," says Pauls. "For the farmer, it's like building in insurance because they don't know what the growing season will throw at them – it's essentially hedging their bets."

Environmental benefits

Greater crop diversity may also benefit the environment in various ways. Researchers are analyzing bean root samples to determine how mixtures affect beneficial soil microbes. Pauls says mixing purple-flowered black beans with white-flowered white beans may attract a wider variety of pollinators.

Increasing genetic diversity supports a broader mixture of organisms on the landscape, he says. "This is a pretty simple way to increase that genetic diversity right in the field."

Economic benefits

Environmental benefits may also help Canadian exports. Beyond the agronomic and environmental pluses of mixing beans, says Pauls, more markets including the European Commission are demanding that crops they grow and buy are environmentally sustainable.

"Eighty per cent of our beans are shipped overseas," he says.

Europe's farm to fork policy currently applies to domestic production, but its parameters – including genetic diversity – may apply to imports from other countries, including Canada.

Pauls has discussed this research with growers at industry conferences and has published the team's findings in a leading journal. ■

Learning the language of plants could improve crop yields

Learning more about how crop plants communicate – especially under competition from weeds – is the goal of University of Guelph research funded by Food from Thought.

Dr. Clarence Swanton, a weed scientist in the Department of Plant Agriculture within the Ontario Agricultural College, studies how corn and soybean plants interact and communicate.

More important, he's looking at how weeds affect that communication as well as the physiology and yield potential of crop plants. To compete with weeds, plants need to expend energy that they would normally use to grow and produce.

Photos showing experimental tests on the impact of neighbour weeds on corn physiology. The pot with no weeds is the control (the element that remains unchanged or unaffected by other variables) and the pot surrounded by grass is the weedy treatment.

"The detrimental changes to the plant – including the suppression of photosynthesis and the expression of free radicals and oxygen – are irreversible to the crop," Swanton says.

"Up to now, competition has meant for light, water, nutrients and space, but we asked, what if there's more to it than that?"

He and his team have discovered that the mere presence of a weed – even one that's not touching a corn plant – can affect how nitrogen is distributed in the plant.

The secret lies in light

Clarence Swanton
Department of Plant Agriculture

"It has to do with far-red light signals with which the plants detect their neighbours," he says.

To observe how plants interpret those light signals, the researchers placed potted crop plants and weeds near one another and gave them adequate space, light, water and nutrients. For comparison purposes, potted crop plants were grown in exactly the same way but had no weeds nearby.

The results were intriguing

During the research, the corn growing near weeds stopped mobilizing nitrogen.

"It's a very subtle form of communication in which a crop plant can detect a neighbour plant and determine whether it's a competitor and, if so, gets stressed and reduces its yield potential," he says.

These previously unreported mechanisms mark a new understanding of how plant communities are shaped, says Swanton. They also help explain why it's so important to control weeds in the field early.

He says researchers might ultimately design crop plants that are more tolerant of weeds. "If we could shift the yield loss curve so that it's slower and later, it would have a significant impact on agronomy," he says.

While crop plants may not become completely tolerant of weeds, this research "would definitely make a big difference in terms of sustainable crop production," he says.

He says the work may further enhance crop production in Canada and adds that it is garnering attention from researchers around the world.

The U of G plant scientist is ranked seventh in Canada by Research.com for his impact in plant science and agronomy. ■

Discovery may yield a natural way to control toxic algae

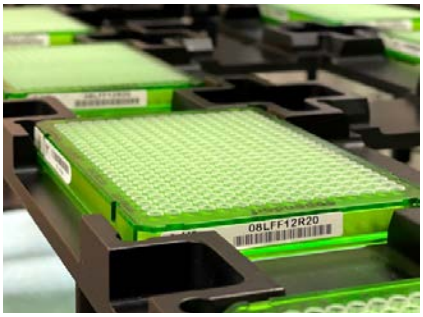
A tiny crustacean may hold the key to preventing toxic effects from outbreaks of algae in the Great Lakes and other freshwater bodies, according to University of Guelph biologists.

Blooms of cyanobacteria (blue-green algae) can taint drinking water and harm fish and wildlife. The blooms are caused mainly by excessive nutrients from fertilizer runoff from farm fields and warm water temperatures.

"We're looking to develop basically a biocontrol agent to mediate or suppress cyanobacteria outbreaks," says Dr. John Fryxell, a professor in the Department of Integrative Biology within the College of Biological Science. They may have found one in Daphnia, a minuscule crustacean commonly called a water flea.

Says Fryxell, "If we can encourage Daphnia as a biocontrol agent, it might be a beneficial way of naturally responding to these outbreaks."

His team included Dr. Seth Rudman, now a faculty member at Washington State University (WSU), and Dr. Rene Shahmohamadloo, now a Natural Sciences and Engineering Research Council and Liber Ero post-doctoral researcher with WSU and the University of Guelph.



This Food from Thought project aims to address a serious environmental and human health threat. For example, in summer 2014, the drinking water system in Toledo, Ohio, had to shut down for two days after a cyanobacteria outbreak.

The research

The U of G team worked with 20 clones of *Daphnia magna,* whose adults grow no bigger than five millimetres. The researchers studied the organism's sensitivity to both healthy green algae and cyanobacteria in different concentrations. They recorded the water flea's lifespan and growth and reproduction rates among other parameters. Daphnia can live for weeks in warm water and for several months in colder water.

"The results showed that there's quite a lot of variation in the sensitivities between clones," says Fryxell.

John Fryxell
Department of Integrative Biology

The researchers cultured Daphnia in Lake Erie water temperatures to see how they reacted over a typical growing season. Experiments with groups of single clones and with mixtures of clones took place at the Hagen Aqualab on the University of Guelph campus. The team is now analyzing the results.

Next steps

"We're interested in the interplay of differing concentrations of cyanobacteria and competition within the Daphnia population," Fryxell says.

To study that interplay, the team is developing a technique using DNA markers to distinguish variants of Daphnia. Using this DNA assay, the team hopes to better evaluate how well different strains of Daphnia cope with the cyanobacteria throughout the growing season.

"We're entering into the proof-of-concept phase," says Fryxell. "What makes this project different from other biocontrol projects is that these are strains within a species – not different species."

He says the team hopes to encourage existing genotypes that do the best job of suppressing cyanobacteria. They also hope to learn why cyanobacteria harm some organisms but not others.

This is discovery science, says Fryxell, meaning that developing biocontrols for real-world conditions can take years or decades.

"We're doing this to find out if there's a potential here – which we think there is – and we're determining what the constraints are." ■

OUR STORIES

MICRO-SCALE MISSION: ENHANCING FOOD SAFETY AND LIVESTOCK HEALTH

Food from Thought research is working to address the food safety and livestock health challenges that the agri-food industry faces.

Through the Micro-Scale Mission, Food from Thought research enhances food safety and livestock health by using big data analytics to study the smallest scale. These projects are creating new strategies to control pathogens in our food supply and animal and human populations.

Discover how the following research projects will profoundly impact global food safety, livestock health and zoonotic disease prevention, and transform how we protect our farms, our livestock and human health.

Promoting antimicrobial stewardship on dairy farms

Stephen LeBlanc
Department of Population Medicine

University of Guelph research aims to help farmers reduce antimicrobial use in dairy herds. The researchers hope their studies over the past three years will feed into programs and policies designed to help combat the serious global problem of antimicrobial resistance (AMR).

"We wanted to understand how dairy farmers and veterinarians make decisions around antimicrobial use," says Dr. Stephen LeBlanc, director of Dairy at Guelph – The Centre for Dairy Research and Innovation.

A professor in the Ontario Veterinary College's Department of Population Medicine, LeBlanc oversaw the Food from Thought projects, which were led by post-doctoral researcher Claudia Cobo-Angel.

AMR caused by use or overuse of antimicrobials threatens animal and human health. As bacteria evolve resistance to medications, farmers and veterinarians need new drugs to treat disease.

AMR in animals and humans is a complex relationship, but the researchers aim to reduce the use of antimicrobials to the minimum needed for animal health and welfare. The team worked with both farmers and veterinarians.

Farmers have a duty of care

Using online surveys and focus groups, the team found that farmers relied mostly upon their experience and assessment skills for treating their animals.

"The top of the list for farmers in making decisions is duty of care – a sense of responsibility for looking after the animal," says LeBlanc. "Interestingly, cost considerations and milk production were further down as priorities."

At the same time, farmers who are aware of AMR often fail to connect the worldwide human health problem with what they do on their farm.

"They're uncertain about their role in the global scheme of things," LeBlanc says. "They don't think they overuse antimicrobials – that they only use what's necessary and that the problem must be elsewhere."

That perception can change.

This U of G study included a pilot project with 30 farmers who learned about AMR and recorded their use of antibiotics over a year. Many who found they used more medication than they thought were able to cut their antibiotic use considerably.

It also helped to benchmark their antibiotic use against that of other farmers.

Veterinarians challenged by AMR

Like farmers, veterinarians were motivated by caring for one animal at a time. Veterinarians also knew about AMR, but it was a challenge for them to connect a single sick cow with a global problem.

Veterinarians voiced frustration over being pulled in different directions. Even amid general expectations to reduce antimicrobial use, some farmer clients just wanted to ensure their animal was treated.

In 2018, a new Canadian regulation required all medically important antimicrobials to be prescribed by a veterinarian. Previously, farmers could buy some antibiotics at the feed mill or the local co-operative.

Still, LeBlanc says in most Canadian provinces, antimicrobial use decisions are made by individual veterinarians and farmers.

What could work

He says two of the most important elements in encouraging optimal use – also considered as antimicrobial stewardship – are strong veterinarian-farmer relationships and quantifying use of products on the farm.

"While the regulation helped, we really need a push to bolster communications between farmers and veterinarians to apply the best information on balancing animal health and reducing antimicrobial use," he says. "The benchmarking data the farmers saw in our small-scale study really helped open their eyes and support changes in behaviour."

With a national funding proposal currently under review, the U of G team plans to look at more farms in Ontario and in other parts of Canada. ■

Research aims to solve postpartum health problems in dairy cows

The mysteries of debilitating and costly postpartum diseases in dairy cattle are being unlocked by Food from Thought research.

"During the time just after calving, cows are susceptible to health problems," says Dr. Eduardo Ribeiro, professor in the Department of Animal Biosciences at the University of Guelph. "In fact, about one in three dairy cows have at least one clinical disease in the first three weeks after calving."

He says most diseases like retained placenta, metritis (infection of the uterus) and mastitis (infection of the udder) are diagnosed and most animals recover. But his previous research showed serious long-term effects in cows contracting the disease in the first place.

"They produced less milk, were less likely to become pregnant and more likely to lose a pregnancy," Ribeiro says.

Cows that had clinical disease in the first three weeks postpartum were more likely to leave the herd – either by being sold or dying – by 300 days after calving than cows that did not have clinical disease in the first three weeks. Multiple diseases magnified the problem.

Postpartum health is a big issue in Canada, where in 2021, dairy farms generated nearly $7.4 billion in farm cash receipts and supplied a milk manufacturing sector worth $16.2 billion.

Costly consequences

For farmers, these problems lead to costly treatments, reduced milk production and the potential loss of income from having to cull cows. The U of G researchers also considered economic factors.

"While it varies depending on the production system, a single problem in a single cow can cost $600, and if there are multiple problems, it can reach $1,200," says Ribeiro.

The research

Eduardo Ribeiro
Department of Animal Biosciences

Until now, the biological mechanisms that affected lactation and reproductive performance over the long term were unknown. Ribeiro and his team wanted to unravel some of the mystery.

They suggested long-term effects on milk production could be linked to feeding behaviour, feed intake and the microbial population in the rumen. They also thought the long-term reproductive effects could result from changes in the uterus because of the early disease.

To investigate the first hypothesis, they studied 250 lactating dairy cows at the state-of-the-art Ontario Dairy Research Centre in Elora, Ont., collecting data on postpartum health, feeding behaviour and feed intake. They also took blood and ruminal fluid samples at three weeks (short-term) and 10 weeks (long-term) postpartum.

For the second hypothesis, they collected postpartum health information, blood samples and uterine flushings in 100 lactating cows.

The results

They found that, while the short-term effects of the diseases were serious, milk production suffered no long-term effects due to feeding behaviour, feed intake and rumen microbial populations. The team plans to focus instead on epithelial cells of the mammary gland and how they are affected by postpartum disease and inflammation.

On the reproductive side, the team found small but important changes in the concentration of metabolites in the uterine flushings in cows with different postpartum health issues. They'll now look at how these metabolites affect the cow's pregnancy and whether dietary changes can improve outcomes.

Ribeiro says good management practices and prudent investments, especially in areas like housing and nutrition, can prevent or reduce postpartum health problems.

"Making sure the cows are comfortable and fed properly are the two most important ways to avoid problems," he says. "We're looking at preventing problems in the first place, but when they do happen, we're looking to minimize the consequences." ■

ENRICHING OUR WORK THROUGH EQUITY, DIVERSITY AND INCLUSION

Food from Thought is committed to fostering a culture of equity, diversity and inclusion (EDI) within research. Our EDI Action Plan and University of Guelph institutional programs and initiatives aim to advance the practice of building inclusive environments and programs by:

- Incorporating EDI principles in recruitment and hiring
- Providing mentoring and career development opportunities for early career researchers and members of equity-deserving groups
- Working to identify and remove systemic barriers in policies, practices and procedures that impede the full participation of equity-deserving groups
- Offering on-demand and customized EDI training
- Nurturing culture change and institutional strategy that foster an inclusive community

New 2021-22 Food from Thought activities in support of the EDI Action Plan include:

- Changes to the competitive research funding programs to incorporate the review of submitted EDI research plans by the University of Guelph's Office of Diversity and Human Rights, accompanied by mentoring support for incomplete plans.
- Food from Thought convened a national conversation about Indigenous Food Sovereignty in research as part of developing the Sustainable Food Systems for Canada Network.
- The Food from Thought data strategy team completed The First Nations Principles of OCAP™ (ownership, control, access and possession) training.
- Food from Thought has launched a new email newsletter feature to educate and build awareness of best practices for EDI in research. The monthly feature will promote U of G and federal government EDI resources and include commentary from U of G's Indigenization, Equity, Diversity and Inclusion adviser in research. ■

AGRI-FOOD DATA CANADA AT U OF G

A Data Ecosystem Serving Agri-Food Sustainability

The Agri-food Data Canada (ADC) initiative that is currently being incubated within the Food from Thought research program and the Ontario Agri-Food Innovation Alliance made great strides in 2021-22.

The team, led by Michelle Edwards, director of agri-food data strategy, and Carly Huitema, manager, agri-food data strategy, is working to create a data ecosystem serving agri-food sustainability.

Agri-food Data Canada's vision is to be researcher-centered, providing reliable data management and analytics that fuel innovation and enable broad access to world-leading, curated research data that promotes opportunities for innovation and partnerships. In short, ADC's focus is to make agri-food data findable, accessible, interoperable, and reproducible (FAIR).

The team is creating tools and training to help researchers and data scientists write better data schemas for sharing research. These resources will improve how research data is shared throughout the University and with other researchers in Canada.

Michelle Edwards
Director of Agri-food Data Strategy

Carly Huitema
Manager, Agri-food Data Strategy,

Here are some 2021-22 ADC highlights:

U of G Partners with Human Colossus Foundation for Better Sharing of Agri-Food Research Data

The Human Colossus Foundation and Agri-food Data Canada have partnered to help agri-food researchers make their data more accessible. This is excellent news for Canadian researchers, as it means more collaboration opportunities, more impactful research and increased efficiency when working with large datasets.

The University of Guelph is now the only institution in Canada to collaborate with the Human Colossus Foundation to help agri-food researchers make the most of their data. The Human Colossus Foundation and Agri-food Data Canada will co-develop tools and training to help researchers better describe their data sets. The partnership will help the University of Guelph to build infrastructure for well-documented data in agri-food research.

The Agri-Food Data Canada team is collaborating with U of G researchers on various data management projects.

Dr. Maria Corradini, professor in the Department of Food Science, is leading a food informatics project team at U of G focused on obtaining additional information from the chemical fingerprint of food to determine shelf life and deterioration kinetics. The team is partnering with ADC to build databases for internal and public use, to develop a tool to report the remaining shelf life of a product in real time and to create a process for data analytics from the database.

Ontario Agri-Food Innovation Alliance and Ontario's Agri-Food Research Centres

ADC will work with data scientists to improve the collection, documentation and accessibility of the data collected at the Ontario Dairy Research Centre, the Ontario Beef Research Centre and other participating research centres. This collaboration will help promote agri-food discoveries, validate laboratory findings, stimulate further research and provide valuable information for Ontario's agri-food sector.

For more exciting developments on Agri-food Data Canada, learn more at:

AGRI-FOOD DATA CANADA
AT THE UNIVERSITY of GUELPH

https://agrifooddatacanada.ca/

For questions about Agri-food Data Canada, please email adc@uoguelph.ca. ■

PROGRAMS SUPPORTING FACULTY AND STUDENT SUCCESS

2021-22 HQP program

The Highly Qualified Personnel (HQP) program, jointly funded by Food from Thought and the Ontario Agri-Food Innovation Alliance, supports the development of skilled graduates to become future researchers, policymakers, business leaders and innovators. Highly Qualified Personnel scholarship recipients are forward-thinking future leaders in the agri-food and rural sectors poised to bring leadership to solving complex agri-food problems and contribute solutions to improve food production and sustainability.

2021 HQP scholars participated in UNIV *6050: Innovation and Entrepreneurship in Agri-Food Systems, an eight-month course that exposes students to a wide range of agri-food-related challenges and that provides foundational skills of project management, teamwork, plain language communication and conflict resolution.

Here are some 2021 HQP program highlights:

Students participated in field trips for the first time in almost two years, which included visits to Schuyler Farms, the home of Wooley's Lamb, and Norfolk Fruit Growers Association.

For many international students, it was the first visit to an Ontario farm, including the first opportunity to talk with a farmer about issues of importance in agriculture, such as labour, regenerative agriculture and the economics of small- and large-scale farming.

Farmers Brett Schuyler and Carrie Wooley shared with the students how they are working to solve food waste at the farm level by using a mechanical harvester to collect fallen fruit and use it for juice processing. They discussed the benefits of year-round grazing of their sheep in the apple orchards and the challenges of employment on their farm.

The course concluded with an in-person celebration with participating partners, students and faculty at the Arboretum Centre on campus.

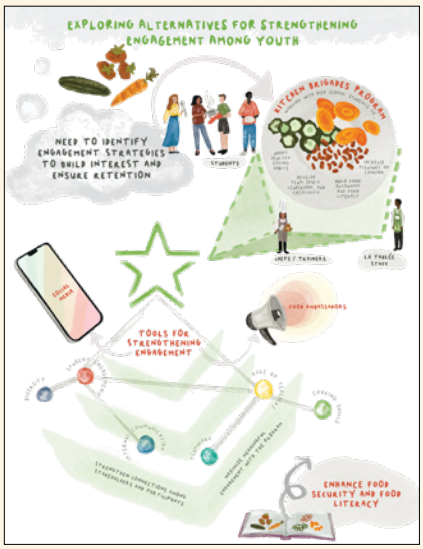
Students toured the Norfolk Fruit Growers Association, where they saw apples being processed, were introduced to robotic machinery being utilized in the plant and had a special treat from the Apple Place retail store, where local food is celebrated.

The UNIV *6050 course is delivered through a partnership between the Government of Ontario and the Gordon S. Lang School of Business and Economics and the Arrell Food Institute, both at the University of Guelph. ■

Community partner projects

As part of the UNIV*6050 course, HQP and Arrell Food Institute scholars are paired with an organization or business to build new skills through experiential learning. Together, these interdisciplinary groups draw on their skills and expertise to solve a problem for their partner, build industry relationships and gain valuable project management experience.

Here's a snapshot of the 2021-22 community partner projects:

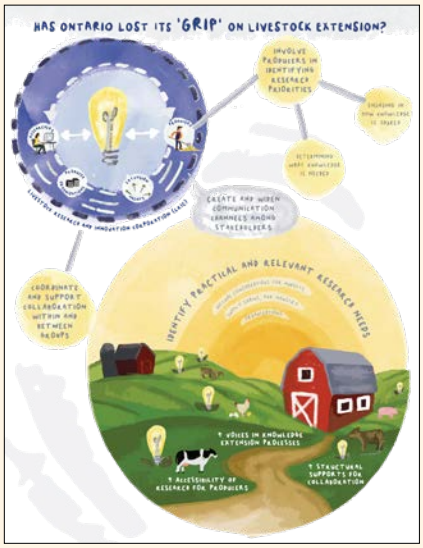


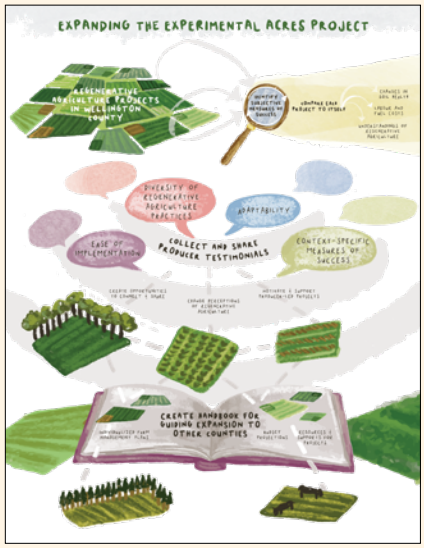
YOUTH FOOD LITERACY
La Tablée des Chefs is an organization whose Kitchen Brigades program teaches kitchen basics and healthy eating habits to young people. U of G students analyzed program data and worked with the organization to increase participation.

FOOD PACKAGING
De La Mer Fresh Fish Market is a Toronto-based premium fish retail chain. In this project, students looked at how to increase the sustainability of De La Mer's packaging materials.

VERTICAL FARMING
Vertical farms are important for our food future, especially if they use renewable energy. Students paired up with GoodLeaf Farms to study its environmental impact and look closer at how energy use impacts the sustainability of vertical farming.

Take a closer look at the community partners projects here:
https://arrellfoodinstitute.ca/community-partnership-projects-2021-2022/





LIVESTOCK

The Livestock Research and Innovation Corp. (LRIC) wants to create an effective knowledge transfer system among livestock producers in Ontario and act as a liaison between research and its end users. Along with LRIC, students recommended ways to develop a new, more effective knowledge transfer system to increase the uptake of research innovations on Ontario livestock farms.

REGENERATIVE AGRICULTURE

For local farmers to realize the benefits of regenerative agriculture, it would be optimal for them to see the results first-hand. Students worked with Our Food Future, an initiative to advance circularity in the food sector, to create Experimental Acres. This program provides support to local farmers interested in trying regenerative agriculture practices within their operations, to make local farming more sustainable.

Since 2016, more than

270 HQP HAVE RECEIVED $2.7 MILLION

in scholarship funding and were engaged in high-performing research teams and training to develop their strengths as the agri-food thought leaders of tomorrow.

2021-22 conference bursaries

The Food from Thought program provides conference bursaries to support students' participation in in-person and virtual conferences, enabling future research innovators to hone their presentation and communication skills and share the results of their research projects aligned with Food from Thought objectives.

The 2021-22 Food from Thought conference bursary recipients have been busy learning at conferences around the world. Here's what some had to say about their learning experiences:

Reza Khalidy

- PhD student in the College of Engineering and Physical Sciences
- **Conference Attended:** Goldschmidt 2021 Conference
- **Location:** Lyon, France (attended virtually)

"After my presentation at the conference, I received feedback from the audience that helped me enhance my methodology for the remaining part of my project. A professor suggested performing soil sampling in different seasons throughout the year to see if there is any fluctuation in organic carbon dynamics in the soil we are investigating. I attended several workshops on topics including confidence in public speaking and networking best practices in academic publishing. I gained knowledge on these topics that have helped me better perform my assignments during my PhD studies."

Janean Sharkey

- M.Sc. student in the School of Environmental Sciences
- **Conference Attended:** Southwestern Research Station
- **Location:** Portal, Arizona

"I attended the renowned bee course at the American Museum of Natural History's southwestern research station in Portal, Arizona, which was a once-in-a-lifetime opportunity. I was immersed in a 10-day field course and learned an immense amount about bee systematics, evolution and biology of North and Central American bees. It was a fantastic opportunity to meet other graduate students and network with established bee researchers and professors. I also used the opportunity to get expert verification of some bee specimens from my research, resulting in new species records for Canada."

Young researcher making a mark in Canadian agriculture

It's early in his research career, but Amanjot Bhullar is already mapping a path for himself and the country's food future.

A PhD candidate in the College of Engineering and Physical Sciences, Bhullar is working on a Food from Thought project on Canadian farming under climate change. He aims to assess the suitability of land for agriculture in both southern Canada and farther northward – as far north as Canada's territories.

The research draws upon his experience with various statistics and modelling tools.

Dr. Ayesha Ali, Amanjot Bhullar and Dr. Khurram Nadeem

"I've worked in a number of different areas – from border security to astrophysics to developing an algorithm that makes it possible to turn photos of people into a 3-D mesh that can be measured for custom tailoring in the fashion industry," says Bhullar, who completed physics studies at McMaster University.

He came to U of G for his master's degree with Dr. Ayesha Ali, a statistics professor in the Department of Mathematics and Statistics.

"He was a model graduate student," says Ali, who is the director of U of G's master of data science program. "He was curious, independent, good at writing and critical thinking, and he would come to meetings with a list of questions."

She helped Bhullar choose avenues to pursue and guided his methodology. She also suggested that he take on a Food from Thought project for his doctorate. Ali is now Bhullar's PhD co-supervisor along with Dr. Khurram Nadeem, also a statistics professor and a member of the Food from Thought project.

"I was interested in the whole question of how you figure out what's suitable and what's not suitable land for agriculture," Bhullar says.

He chose to pursue his graduate studies at the University of Guelph because the project was well-funded and allowed him to work with esteemed supervisors.

For his project, he's creating a detailed digital map of Canada's 60th Parallel, which runs along the southern borders of Yukon, Northwest Territories and Nunavut. The map will show the suitability of this area now and over the next 100 years under projected climate change.

This innovative project uses a fully data-driven approach that can be adjusted over time. Until now, explains Bhullar, land suitability work has been based on expert opinions.

"They can't really tell you how suitable that land is going to be," says Bhullar. "My modelling is more precise, which can translate into better policies because you can more accurately predict both the area's crop potential and its limitations."

Two years in, Bhullar's preliminary results suggest that northern Canada will receive more precipitation in future, making it better suited for agriculture.

At the same time, heat stress brought on by climate change, unsustainable practices and other human impacts will make current southern farmland less suitable. That means crops may need to be developed to withstand higher southern temperatures or that crop production will need to move northward.

Bhullar's research will help guide decision-makers in land management policies, agricultural zoning and climate adaptation. It will also help inform policies for future food security and economics as well as potential environmental problems caused by farming in Canada's North. ■

ACCELERATING THE GLOBAL, NATIONAL AND LOCAL IMPACT OF OUR WORK

Community engagement

TWITTER

1,824
Total followers in 2021-22

305
Tweets

381,664
Tweet impressions

38,016
Profile visits

283
Mentions

526
New followers

NEWSLETTER

782
Total subscribers in 2021-22

51%
Open rate

10.9%
Click rate

18
Newsletters sent

YOUTUBE

1,900
Views

5,200
Impressions

80.4 hrs.
Watch time

56
Total subscribers

FOOD FROM THOUGHT WEBSITE

35,651
Total website page views

Top 3
most viewed pages

- Recognizing HQP Scholars
- Mission and Team
- Research

Policy Fellowship

The University of Guelph Policy Fellowship Program in Agriculture, Food and Biodiversity, funded by Food from Thought and administered by the Research Innovation Office, offers a unique opportunity for policymakers to engage with the agriculture community and receive the guidance of agri-food experts from the University of Guelph.

The program connects decision-makers from government, industry and non-governmental organizations (NGOs) with University of Guelph researchers for focused conversation about issues in agriculture, food and biodiversity – supporting evidence-informed decisions and building connections between policy or practice and academia.

Since 2018, the Policy Fellowship Program has engaged more than 55 decision-makers from five federal departments, six provinces and numerous non-governmental and industry organizations. A 2021 evaluation of program impact showed that **94 per cent of participants used information** from the program to inform their work, and **61 per cent leveraged connections** made for future initiatives.

As of the start of 2022, the program continues to see increased demand, leading to an additional annual cohort and a shift to a thematic cohort mode.

Upcoming cohorts for 2022-23

Fall 2022 – Environmental Sustainability in Agri-Food

Winter 2023 – Digital Agriculture

Spring 2023 – One Health

Summer 2023 – Food Security

Would you like to become a University of Guelph Policy Fellow? Please email policyfellows@uoguelph.ca or visit uoguel.ph/policyfellowship. Applications are accepted throughout the year. ■

TESTIMONIAL:

"I thoroughly enjoyed every minute of my time in the University of Guelph Policy Fellowship program. Meeting with faculty to ask for their insights on my policy questions was a valuable and unique opportunity that I would highly encourage others to pursue. It was particularly interesting to meet faculty from outside my normal circles and share insights and questions with the other Policy Fellows in my cohort."

Crystal MacKay, founding CEO of Farm & Food Care, the Canadian Centre for Food Integrity, and Loft32

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 across all seven colleges at the University of Guelph who are ranked among the world's leading researchers in food and agriculture.

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

Sarah Adamowicz
Deparment of Integrative Biology

Emma Allen-Vercoe
Department of Molecular and Cellular Biology

Madhur Anand
School of Environmental Sciences

Manick Annamalai
School of Environmental Sciences

Christine Baes
Department of Animal Biosciences

Rowan Barrett
Department of Biology, McGill University

Grégoy Bédécarrats
Department of Animal Biosciences

Aaron Berg
Department of Geography, Environment and Geomatics

Renée Bergeron
Department of Animal Biosciences

Nicholas Bernier
Department of Integrative Biology

Asim Biswas
School of Environmental Sciences

Dominique Bureau
Department of Animal Biosciences

Angela Cánovas
Department of Animal Biosciences

John Cant
Department of Animal Biosciences

Christina Caruso
Department of Integrative Biology

Kate Congreves
College of Agriculture and Bioresources, University of Saskatchewan

Karl Cottenie
Department of Integrative Biology

Teresa Crease
Department of Integrative Biology

Melania Cristescu
Department of Biology, McGill University

Prasad Daggupati
School of Engineering

Rozita Dara
School of Computer Science

William Deen
Department of Plant Agriculture

Ali Dehghantanha
School of Computer Science

Trevor DeVries
Department of Animal Biosciences

Jeremy DeWaard
Department of Integrative Biology

John Dower
Department of Biology, University of Victoria

Kari Dunfield
School of Environmental Sciences

Jennifer Ellis
School of Environmental Sciences

Ming Fan
Department of Animal Biosciences

Jeff Farber
Department of Food Science

Vahab Farzan
Department of Population Medicine

Evan Fraser
Department of Geography, Environment and Geomatics

Robert Friendship
Department of Population Medicine

John Fryxell
Department of Integrative Biology

Gregor Fussmann
Department of Biology, McGill University

Adam Gillespie
School of Environmental Sciences

Dan Gillis
School of Computer Science

Andy Gonzalez
Department of Biology, McGill University

Amy Greer
Department of Population Medicine

Rebecca Hallett
School of Environmental Sciences

Robert Hanner
Department of Integrative Biology

Barbara Hawkins
Centre for Forest Biology, University of Victoria

Paul Hebert
Department of Integrative Biology

Andrew Hendry
Department of Biology, McGill University

Hugh Henry
Department of Biology, Western University

Andreas Heyland
Department of Integrative Biology

Dave Hooker
Department of Plant Agriculture (Ridgetown)

Lee-Anne Huber
Department of Animal Biosciences

Brian Husband
Department of Integrative Biology

Shoshanah Jacobs
Department of Integrative Biology

Kim Juniper
Department of Biology, University of Victoria

Niel Karrow
Department of Animal Biosciences

Krishna KC
Department of Geography, Environment and Geomatics

David Kelton
Department of Population Medicine

Elijah Kiarie
Department of Animal Biosciences

Fred Laberge
Department of Integrative Biology

Stephen LeBlanc
Department of Population Medicine

Elizabeth Lee
Department of Plant Agriculture

Jana Levison
School of Engineering

Julang Li
Department of Animal Biosciences

Brandon Lillie
Department of Pathobiology

John Lindsay
Department of Geography, Environment and Geomatics

Ray Lu
Department of Molecular and Cellular Biology

Eric Lyons
Department of Plant Agriculture

Andrew MacDougall
Department of Integrative Biology

Janet MacInnes
Department of Pathobiology

Hafiz Maherali
Department of Integrative Biology

Bonnie Mallard
Department of Pathobiology

Ira Mandell
Department of Animal Biosciences

Elizabeth Mandeville
Department of Integrative Biology

Kevin McCann
Department of Integrative Biology

Filippo Miglior
Department of Animal Biosciences

Medhat Moussa
School of Engineering

Khurram Nadeem
Department of Mathematics and Statistics

Joshua Nasielski
Department of Plant Agriculture

Amy Newman
Department of Integrative Biology

Eric Nost
Department of Geography, Environment and Geomatics

Davor Ojkic
Department of Veterinary Pathology, University of Saskatchewan

Gopinadhan Paliyath
Department of Plant Agriculture

Peter Pauls
Department of Plant Agriculture

Zvonimir Poljak
Department of Population Medicine

Ryan Prosser
School of Environmental Sciences

Nigel Raine
School of Environmental Sciences

Sujeevan Ratnasingham
Department of Integrative Biology

Dave Renaud
Department of Population Medicine

Eduardo Ribeiro
Department of Animal Biosciences

Nicole Ricker
Department of Pathobiology

Michael Rogers
Department of Food Science

Neil Rooney
School of Environmental Sciences

Scott Ryan
School of Environmental Sciences

Jan Sargeant
Department of Population Medicine

Flavio Schenkel
Department of Animal Biosciences

Cynthia Scott-Dupree
School of Environmental Sciences

Shayan Sharif
Department of Pathobiology

Anna-Kate Shoveller
Department of Animal Biosciences

Michael Steele
Department of Animal Biosciences

Dirk Steinke
Department of Integrative Biology

John Sulik
Department of Plant Agriculture

Jim Squires
Department of Chemistry, University of Toronto

Clarence Swanton
Department of Plant Agriculture

Dan Tulpan
Department of Animal Biosciences

Verena Tunnicliffe
Department of Biology, University of Victoria

Diana Varela
Department of Biology, University of Victoria

Claudia Wagner-Riddle
School of Environmental Sciences

Jon Warland
School of Environmental Sciences

Alfons Weersink
Department of Food, Agricultural and Resource Economics

Tina Widowski
Department of Animal Biosciences

Charlotte Winder
Department of Population Medicine

Katherine Wood
Department of Animal Biosciences

Wanhong Yang
Department of Animal Biosciences

Evgeny Zakharov
Department of Integrative Biology

DISCOVER OUR LEADING-EDGE RESEARCH

Research inventory

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, Lana 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 datasets: 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 Fathololoumi, 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

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

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 Fricska, 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 Gozalez, Graham Bell, Rowan Barrett, Kevin McCann, John Fryxell, Andrew MacDougall, Paul Hebert, Sarah Adamowicz, Dirk Steinke, Takahiro Maruki, Robert Hechler, Christopher Hempel, Julien Beaulieu, Wendy Gamero Morgado, Kaushar Kagzi, Elizabeth Weller, Michelle Gross, Patricia Humer

Crops Research Projects

Modelling and monitoring agroecological 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 Dylewsky

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

Microbes to microeconomics: integration of datasets 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

Assessing and enhancing wild pollinator biodiversity
Nigel Raine

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
Gopinadhan Paliyath and co-investigators: Francois Tardif, Shirin Seifbargheii, Priya Padmanabhan, Vighnesh Sukhu, Malavika Nair, Jason Deveau, Sean Thompson, Brooke 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
Grégoy 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

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

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

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

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

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

Development of Targeted Solutions for Boar Taint

Jim Squires and co-investigators: Renee 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 is 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

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The funding provided to Food from Thought from the Canada First Research Excellence Fund has enabled researchers at the University of Guelph to strengthen existing partnerships and attract new supporters and collaborators, multiplying the resources available to achieve our mission. More than 100 partners have contributed more than $55M cash and $115M in-kind support for Food from Thought research to date. Key partners include:

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CANADA FIRST RESEARCH EXCELLENCE FUND

This research was undertaken thanks in part to funding from the Canada First Research Excellence Fund.