

CANN₂ONET
QUARTERLY NEWSLETTER

THE N FACTOR

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Introducing CanN₂ONet

Due to the increasing demand for agricultural products to support the growing world population, synthetic nitrogen fertilizer is an essential input for agricultural crops, driving yield gains and subsequently supporting global food security. Inefficient fertilizer use exacerbates nitrogen losses through multiple channels, including as the greenhouse gas nitrous oxide (N₂O), and represents a significant economic cost to agricultural producers as inputs are not effectively translated into agricultural products. To address this, we introduce CanN₂ONet. Led by Dr. Claudia Wagner Riddle (*University of Guelph*), CanN₂ONet is an NSERC-funded collaborative network between leading experts from post secondary institutions across Canada with partners spanning industry, government, and producer organizations.

Kick Off Meeting Success

The CanN₂ONet kick-off meeting was held on October 23, 2024, in Guelph, Ontario with attendees from across North America. The meeting featured over 20 expert speakers, including project lead Claudia Wagner-Riddle, who provided a project overview and reviewed the planned and ongoing actions for the benchmark studies component. Other attendees from academia who presented on behalf of their respective teams included David Burton (*Dalhousie University*), Kate Congreves (*University of Saskatchewan*), Henrique Carvalho (*University of Manitoba*), Mario Tenuta (*University of Manitoba*), Aaron De Laporte (*University of Guelph*), Tristan Skolrud (*University of Saskatchewan*), Graham MacDonald (*McGill University*), and Tongzhe Li (*University of Guelph*).

Speakers from Agriculture and Agri-Food Canada included Research Scientists David Pelster, Ward Smith, and Roland Kroebel, and Senior Agricultural Scientist Arumugam Thiagarajan presented on behalf of Environment and Climate Change Canada. On the policy side, attendees also heard from Mary Jane Roberts, Deputy Director for Agriculture and Agri-Food Canada. Representatives from the private sector also presented on industry initiatives and perspectives including Carlos Romero (*Nutrien*), Espartaco Gonzalez Orteaga (*Field to Market Canada*), and Brian McConkey (*Viresco Solutions*).

To draw on the expertise of other national and international initiatives, our kick off meeting also included talks from Ligia Souza (*Colorado State University*) on the Soil Carbon Solutions Center, Wendy Yang (*University of Illinois Urbana-Champaign*) on the N Onet Design Workshop, Xin Yang (*University of Maryland*) on the Global Nitrogen Innovation Center for Clean Energy and the Environment (NICCEE) and University of Guelph's Jordan Minigan who shared her experiences as the CREATE Climate-Smart Soils Program Coordinator. Presentations and video recordings of each speaker can be found [here](#).

The infographic features a central tree-like structure with three main levels: C1. BENCHMARK STUDIES (sub-points: C1.1 FIELD TOWERS, C1.2 SOIL PROCESSES, C1.3 BEHAVIORAL EXPERIMENTS), C2. METRICS (sub-points: C2.1 REGIONAL TOWER, C2.2 DATABASE, C2.3 MODELS), and C3. ROADMAP (sub-points: C3.1 TRADE-OFFS, C3.2 REGIONAL SCALING, C3.3 POLICY ACTIONS). The top of the tree is labeled 'CANN₂ONET CANADIAN NITROUS OXIDE NETWORK'. Surrounding the central structure are logos of partner organizations: Grain Growers of Canada, Les Producteurs de grains du Canada, FERTILIZER CANADA, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, FARMERS FOR CLIMATE SOLUTIONS, Nutrien, Field to Market Canada, PULSE CANADA, Iresco Solutions, Plant Nutrition Canada, OLDS COLLEGE OF AGRICULTURE & TECHNOLOGY, UNIVERSITY OF GUELPH, McGill University, University of Manitoba, DALHOUSIE UNIVERSITY, UNIVERSITY OF SASKATCHEWAN, LETHBRIDGE POLYTECHNIC, and THE UNIVERSITY OF BRITISH COLUMBIA.

What We Heard ...

At our kick-off meeting, we asked participants to provide feedback on the following:

1. Internal Communication Strategy

What communication strategies should we implement to keep all team members and stakeholders informed and engaged?

2. Data Management

What aspects are critical for a robust data management plan to ensure data quality, accessibility, and security throughout the project?

3. Evaluation and Impact

How will we measure the success of the project, and what metrics can we use to evaluate its impact during and upon project completion?

4. Policy Action

What strategies can be employed to effectively communicate research findings to policymakers and facilitate their translation into actionable policies?

5. Collaboration and Team Dynamics

How can we foster an inclusive, collaborative environment that encourages diverse input and teamwork?



Internal Communication Strategy	Data Management	Evaluation and Impact	Policy Action	Collaboration and Team Dynamics
<p>Regular meetings and progress reports are needed within and between groups</p> <p>Bi-annual “all-hands” meetings to provide updates on deliverables</p> <p>Agendas set for meetings and meeting minutes posted to a shared location</p> <p>Platforms for regular communication within groups such as Microsoft teams</p>	<p>Consistent sample and data collection, management, labelling, and documentation through standard operating documents</p> <p>Traning workshops to teach protocols and achieve standardization</p> <p>Collaboration with different data initiatives</p> <p>Interoperability across data platforms</p>	<p>CanN ONet is a shared knowledge hub that facilitates networking, collaboration, mentorship, scientific publications, and outreach articles between academia, industry, government, and producer groups</p> <p>Data generated is being successfully used in models</p> <p>Consistency in research methodologies is achieved</p> <p>Communications with policy makers is ongoing</p>	<p>Incorporate what policy makers need from the project at the onset</p> <p>Schedule regular communications with and provide updates to policy makers</p> <p>Provide plain-language summaries of findings to policy makers including economic and social considerations</p>	<p>Encourage open and frequent communication</p> <p>Provide opportunities for everyone to share their work and perspectives</p> <p>Inclusion of diverse stakeholders at meetings</p> <p>Maintain and promote diversity in hiring practices</p> <p>Form an equity, diversity, and inclusion committee</p>

Policy Action Panel

Our kick off meeting also featured a policy action panel with representatives from industry and government to provide their perspectives on how CanN₂O_{Net} can best serve their needs, and to identify areas for collaboration. Thank you to our panelists: Carlos Romero (*Nutrien*), Brian McConkey (*Viresco Solutions*), Curtis Rempel (*Canola Council of Canada*), Tom Bruulsema (*Plant Nutrition Canada*), and Mary Jane Roberts (*Agriculture and Agri-Food Canada*).

Data access, management, and usage was a common theme among panelists, which paralleled what was heard by Roberts as co-chair of the Government of Canada's Fertilizer Working Group. Representatives from industry such as Rempel, stressed the need for open and transparent data management strategies with consideration given to farmers' rights and privacy concerns. To this end, Romero highlighted the benefits of building trust with producers, generating a value proposition for emission-reducing management practices, and communicating this effectively by working with trusted agronomists.

When asked, "*How can CanN₂O_{Net} best address the need for N₂O offset protocols for agricultural activities and what are your most pressing data needs?*" McConkey responded that there is a need for reliability and consistency with accounting methodologies based on the best available science. According to Bruulsema, the best available science is science that considers the N balance of the whole agroecosystem and is not solely focused on N₂O.

In discussions about how to pursue and maintain a long-term positive impact through CanN₂O_{Net}, Bruulsema asked project participants to consider the larger goal of producing food with low greenhouse gas emissions as well as other goals with a wider range of environmental outcomes, such as biodiversity, suggesting that CanN₂O_{Net} is an excellent opportunity to begin collaborations with international partners to pursue continued research and act as a blueprint for future projects.



We would like to extend a thank you to those who participated as panelists. These conversations allow researchers to understand what is needed at the onset of a project and how best to translate results into tangible benefits. Fostering collaboration between academia, industry, and government is essential to the success of CanN₂O_{Net}, and we will continue to pursue opportunities for collaboration amongst a diverse group of stakeholders.

Project Updates

Each newsletter will feature some of the latest updates on our field activities, bringing you closer to the work we're doing on the ground. These updates are designed to keep you informed and engaged with our ongoing efforts. As part of the Benchmark Studies component, we will be developing a field tower network for the measurement of N₂O emissions. Detailed soil sampling will take place at these Benchmark Sites.

Field Towers

CanN₂Onet builds upon the four-field tower-based flux gradient approach, which enables year-round measurements of N₂O and CO₂ fluxes with high temporal and spatial resolution in agricultural fields. Currently, there are six functioning sites (three in Ontario, two in Manitoba, one in Saskatchewan) and two new sites will be installed in Alberta, which collectively make up the project's benchmark sites. At each of these sites, suites of regionally-suited agricultural management practices will be applied to fields and towers will capture emission data for contrasting management practices at scales representative of farmers' fields. While the sites in Ontario, Manitoba, and Saskatchewan are already capturing data, the new sites in Alberta are currently taking the first steps to organize and install necessary infrastructure before winter hits in the west.

Baseline Soil Sampling

Baseline soil sampling at the benchmark sites is underway. These soil samples will ship to research labs across Canada, where they will be used to study soil nitrogen mineralization, create isotopomer maps that distinguish between the main microbial processes leading to N₂O production, and conduct microbial community analysis and pathway identification to track the sources and pathways of nitrogen transformation in soil and subsequent N₂O emissions. These results will be interpreted in conjunction with the high-frequency, year-round emissions measurements from the benchmark site field towers to understand overall soil nitrogen dynamics that drive N₂O emissions.

GET TO KNOW CANN₂ONET

In each newsletter, we'll spotlight some CanN₂O Net members, giving you an inside look at the people who are driving the project forward! Through these profiles, you'll learn about their unique backgrounds, roles, and motivations, as well as the skills and experiences they bring to our team.



Henrique Da Ros Carvalho

Assistant Professor
University of Manitoba

Henrique grew up in the State of São Paulo in Brazil where he received his B.Sc. from the University of São Paulo. He then moved to Texas where he obtained his M.Sc. and Ph.D. degrees from Texas A&M University. Before joining the University of Manitoba, he was a Postdoctoral Research Scholar at North Carolina State University.

Henrique is an expert in agricultural meteorology, through which he seeks to understand how the physical environment influences the growth and development of plants and animals. At the University of Manitoba, his research program will study how different cropping systems use the natural resources available to them and the efficiency with which they do that. The goal is to find out which practices are most efficient. With this research he also seeks to understand the mechanisms that drive these responses so that we can design cropping systems that are more productive, efficient, and sustainable.

In his spare time, Henrique likes to listen to music, play acoustic guitar, and tinker with sensors, dataloggers, and electronics and even installed a weather station on his family's multi-generational coffee farm in Brazil! When asked if he has any pets, Henrique recalls his childhood dog, Milu (which is Portuguese for "Snowy"), named for *The Adventures of TinTin*.

As a member of the Benchmark Studies and Metrics teams, Henrique will act as the component lead for all the field tower activities of CanN₂O Net as well as the regional tower activities, lending his expertise to a regional monitoring effort that is currently lacking in Canada.

Nirmani grew up in a family with agricultural background in Sri Lanka, where she was surrounded by small-scale corn and paddy fields. Later, she earned her Bachelor of Science degree in Agricultural Technology and Management, specializing in Soil Science, from University of Peradeniya (Sri Lanka). She then moved to Ghent, Belgium, where she obtained her Master of Science in Physical Land Resources (majoring in soil science) from the University of Ghent. In her master's research, she measured vulnerability to drought-induced cavitation: assessment of the hydraulic method in *Malus domestica* Borkh. She got a joint Ph.D. degree in Bioscience Engineering from the University of Ghent and Université Catholique de Louvain, Belgium, in 2022.

Through her Ph.D. research, she worked with soil process-based models to examine soil-plant-climate interactions under climate change. This led her to a position working in Dr. Wagner-Riddle's lab, where she is investigating soil processes and greenhouse gas emissions to identify climate-smart soil management practices using biogeochemical models. With the use of process models, her research can contribute to scaling up large datasets on soil processes to greenhouse gas emission reduction for agroecosystems and sustainable crop production under changing climate conditions.

When not contributing to research, soil-enthusiast and process-based model expert Nirmani loves traveling and taking photographs of nature, cuddling cats, and eating lots of pasta! Her favorite quote is "*Follow your passion, be prepared to work hard and sacrifice, and above all, don't let anyone limit your dreams*" (Donovan Bailey, Jamaican-Canadian sprinter).

Nirmani will play an integral role to in the Metrics team of CanN₂O_{Net} as a member of the modelling component, primarily working with the process-based model DNDC.

Nirmani Ranathunga

Arachchi

Post Doctoral Researcher
University of Guelph



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