ROUNDTABLE PROCEEDINGS:

Carbon in Agriculture.

FOOD, AGRICULTURE, RESEARCH & POLICY.

THE SIMPSON CENTRE. THOUGHT FOR FOOD.

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CARBON IN AGRICULTURE:

AGRICULTURE + GHG EMISSIONS + POLICY.

Roundtable Report.

Event date: February 16, 2023.

Location: Fairmont Hotel Macdonald, Edmonton, AB.

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Executive Summary

Canada is a major global food exporter, but the projected increase of 1.7 billion in the world's population by 2050, accompanied by a corresponding increase in food demand, poses a challenge to the country. Its federal policy targets a 30 percent reduction in Nitrous Oxide (N_2O) emissions from 2020 levels by 2030, with the ultimate goal of achieving net zero emissions by 2050. Achieving these goals will impact the cost and competitiveness of Canadian agri-food products in the global market. This raises the question of whether feeding Canadians and the growing world population is more important than meeting emission reduction targets, or if both objectives can be achieved simultaneously.

The Simpson Centre, School of Public Policy, University of Calgary hosted a roundtable conference, in Edmonton on February 16, 2023, on reducing greenhouse gas (GHG) emissions from Canada's agriculture sector. The event garnered attendance from a diverse group of individuals including government officials, representatives from financial institutions, academicians, reputable researchers, agriculture suppliers and primary producers. The discussions revolved around the challenges, opportunities, and practical solutions for sustainable agriculture in Canada.

Despite stakeholders' appreciation of the objective to decrease global greenhouse gas emissions from agricultural production, challenges and barriers must be addressed to accomplish the targets. Carbon offsets alone prove inadequate to compensate for the expenses of reducing emissions at the farmgate level. Barriers exist at the economic, behavioural, and policy levels, and producers need proper technology, measurement tools, education and financial support. Canada has the potential to retain its global market position while achieving emission reduction targets; however, this would require the provision of funding, low-cost incentives, or tax credits to encourage producers to adopt new sustainable technologies and processes.

The roundtable discussions centered on fostering climate-friendly practices in agriculture by eliminating obstacles to the adoption of novel knowledge and technologies. The discourse encompassed diverse topics, including cooperation and synchronization between government and industry, financial backing for the agricultural industry, remedying technology impediments, accessibility to precise data collection and reporting tools and innovation ecosystem support. The attendees emphasized the significance of mentorship, data availability, consumer education and robust communication and collaboration among stakeholders to expedite the assimilation of optimal management practices and novel AgTech to curtail emissions while maintaining the sustainability of the Canadian agri-food sector.

The roundtable culminated in a set of recommendations, indicating the need for government involvement in the innovation ecosystem to incentivize capital markets and encourage investment in agriculture. This would involve the use of financial levers, tax incentives, tax credits and responsive regulations. Producers, apart from fiscal incentives, should be incentivized by increasing their participation in policy creation, promoting investment in agriculture with private partnerships, reducing bureaucracy and red tape, addressing poor rural internet access, developing new components for farm equipment, and increasing investment in research and development.

Experts from various sectors emphasized the importance of elevating Canada's status as an agricultural nation to improve its visibility and attract potential investors. To achieve this, continuity in direction and support is necessary. Canada must build on its talent, experience and knowledge base and improve collaboration among all players involved in the innovation ecosystem. The focus should be on demand-driven innovation and better communication to meet its climate goals without compromising the long-term sustainability of its agriculture sector.

Objectives and Introduction

The purpose of this conference was to bring perspectives from wide-ranging stakeholders — researchers, policymakers, producers, and industry leaders to the discussion on agricultural sustainability and emission reductions. The objective of the event was to create practical recommendations through discussions and roundtable sessions, which included panellists such as government representatives, industry experts and researchers.

Guillaume Lhermie, Director of the Simpson Centre at the School of Public Policy, University of Calgary, presented an overview of the Simpson Centre's focus on policy acceleration and knowledge brokerage in relation to agriculture and food. He also introduced the Government of Alberta Carbon Program, led by the Simpson Centre, which aims to support provincial efforts towards sustainable agriculture and emissions reduction. The Simpson Centre has produced several papers that focus on understanding GHG-emission reporting methodologies, assessing the international comparison of emissions from Canadian crop and cattle production and identifying feasible technologies and applications to reduce emissions in Alberta and Western Canada. Notably, the Carbon Program has published several reports and hosted outreach webinars on the agriculture sector's emissions.

The event was comprised a keynote speech by Jason Hale, Deputy Minister of Agriculture and Irrigation, Government of Alberta, followed by two panel presentations and roundtable discussions. The focus of the event was on reducing GHG emissions in agriculture, with panellists consisting of government representatives, industry leaders and researchers.

Panel Discussion 1	**Panel Discussion 2**
What Could Incentivize Adoption of Climate-Friendly Policies without Harm to Producer Economics?	An Innovation Ecosystem for Reducing GHG Emissions in the Food System
Panellists: 1. Josh Bourassa: Research associate with the Simpson Centre and lead researcher in Carbon Program 2. Melissa Downing: Director of Regulatory and Sustainability, Alberta Cattle Feeders' Association. 3. Dan Heaney: Senior consultant, Random Cross Consulting. 4. John Conrad: Assistant Deputy Minister Primary Agriculture, Alberta Ministry of Agriculture, and Irrigation at Government of Alberta	**Panellists:** 1. Paul Thiel: Thought leader, Olds College. 2. Jim Jenkins: Senior Manager, Product Risk and Sustainability, Nutrien. 3. Alison Sunstrum: Founding Partner, CDL-Rockies; Founder, CEO CNSRVX-Inc.
03 Roundtable Discussions	**03 Roundtable Discussions**
Identification of barriers to adoption of climate-friendly practices on the farms and potential solutions	The role of Canada's innovation ecosystem in AgTech adoption and meeting sustainability challenges to the Agri-food sector

After the panel presentations and Q&A sessions, the participants were divided into smaller roundtable groups to delve deeper into specific questions related to the topics discussed and the associated challenges and recommendations. Following this, the groups regrouped to present and summarize the diverse perspectives and points of view of the various stakeholders.

Participation

The Carbon in Agriculture event was attended by a total of fifty-six individuals hailing from academia, the provincial and federal governments, and the private sector, including the agriculture and fertilizer industry, finance, and the non-government sector. Distinguished panellists from Alberta and Saskatchewan and prominent academic institutions such as the University of Calgary, Olds College and Red Deer Polytechnic shared their insights on diverse topics. Also present were participants from businesses associated with the agricultural industry, including Nutrien, Alberta and National Cattle Feeders' Association, Random Cross Consulting and

Conserve X (CNSRV-X) Inc. Attendees were deliberately selected to ensure a diverse and well-rounded representation of industry, government and research sectors.

The participants, who were experts in their fields, provided valuable insights into various areas including agricultural research, federal and provincial policy, financial solutions, perspectives and attitudes.

Keynote Address:

JASON HALE: DEPUTY MINISTER OF AGRICULTURE AND IRRIGATION, GOVERNMENT OF ALBERTA.

The event commenced with opening statements from the Deputy Minister, Jason Hale, followed by panellists sharing their insights on the subject matter.

In his opening address, Mr. Hale expressed appreciation for the Simpson Centre's Carbon Program and provided an update on the government's efforts to support sustainable agriculture in Alberta. The world's agriculture industry is facing the challenge of feeding a population of 10 billion people by 2050 while remaining responsible stewards of the land and environment. Sustainable agriculture is therefore important, and Alberta's farmers and ranchers are known for their dedication, leadership and initiative as stewards of the natural land. Mr. Hale acknowledged that farmers are impacted by climate change with challenges such as shorter growing seasons, unpredictable weather including severe storms and droughts and transportation issues. Alberta Farmers and industry have made significant advances in lowering emissions by participating in Alberta's carbon program and improving production efficiencies through nutrient stewardship, legumes rotation and innovative four best practices. Farmers have implemented these best practices in soil health, water management, fertilizer use and biodiversity because they make economic sense. Western Canada accounts for almost all the production under the 4R management program in Canada. The agricultural industry's ability to communicate positive actions and successes will gain trust while affecting environmental policies.

He gave an example of a recent survey in Alberta which found that only 14 percent of people had positive feelings towards gene editing, but after learning about its benefits for sustainable agriculture, more than 50 percent had improved perceptions. The agriculture sector has an opportunity to communicate their positive actions to build public trust. Alberta producers have been implementing regenerative practices for a long time, including improving soil health, water management, fertilizer use, and biodiversity. Water quality management has the highest adoption rate at 76 percent, followed by biodiversity at 60 percent, soil health at 46 percent, and air at 37 percent. Alberta's crop sector has also reduced emissions and increased carbon sinks by adopting reduced tillage practices. These are the stories that need to be told.

Government of Alberta is focusing on advancing sustainable agriculture by addressing climate risks, creating conditions for industry to succeed and compete globally, and adopting environmentally sustainable and regenerative practices. Alberta's crop sector has a strong record of accomplishment on reducing emissions and increasing carbon sinks, and practices that support managing water quality have the highest adoption rate. The future of agriculture depends on finding the right balance between economic profitability and environmental stewardship, which is even more important given Alberta's farmers' reputation for innovation in sustainable agriculture. The Alberta government is advocating for Alberta's farmers at the federal level to ensure future environmental policies are thoughtful, balanced, and farmer led.

"Alberta's government is consistently advocating on behalf of Alberta producers to make sure policies for emission reduction and sustainability do not turn into regulations that do more harm to our industry than good."

Alberta government is also taking measures to promote sustainable agriculture practices, such as supporting research on soil health and promoting adoption of beneficial soil-health management practices through programs and initiatives including the $200 million On-Farm Climate Action Fund (OFCAF) and the new sustainable Canadian Agricultural Partnership (Sustainable-CAP) to assist farmers fight climate change. The new Sustainable CAP framework that took effect in April (and was 1.5 months away at the time of the roundtable) supports innovation, growth and prosperity in the agriculture sector. There is a $500 million increase to the cost-shared portion; half of that funding is for development and implementation of the resilient agriculture landscape program to support carbon sequestration adaption and other environmental co-benefits.

The Federal Solutions Program has living labs; three are already funded in Alberta. The government is also investing in technology and innovation such as the circular economy challenge, which aims to reduce emissions and create jobs through recycling and sustainable design projects. These efforts aim to support the agricultural sector's economic growth while protecting the environment and ensuring long-term sustainability. Alberta's food production sector contributes $9 billion to the economic output, and organizations like the Simpson Centre continue to support and assist in growth for generations to come.

Stuart Cullum, President, Red Deer Polytechnic Olds College.

Stuart Cullum moderated the first panel discussion. He highlighted that one of the common themes in discussion around agricultural is environmental sustainability and how it is addressed while maintaining economic viability. Producers live in a world of risk and reward, fraught with variables that can turn a promising season into a wreck. Climate friendly policy is another variable to manage in our agriculture sector, especially when policy does not line up with economic value. He opened the panel discussion to present what is happening and needs to happen to incentivize best management practices (BMPs).

Panel Discussion 1: What could Incentivize the Adoption of Climate-Friendly Policies without Hurting Producer Economics?

Panellists — Josh Bourassa, Melissa Downing, Dan Heaney, John Conrad

JOSH BOURASSA, RESEARCH ASSOCIATE, SIMPSON CENTRE

Bourassa presented findings of his research conducted at the Simpson Centre for the Alberta-Government-funded Carbon Program. The study analyzed the potential and economics of Nitrous Oxide (N_2O) emission reduction in Alberta using nitrification inhibitors (NI), an enhanced-efficiency fertilizer. He also presented policy options for incentivizing BMP adoption. The key points of the presentation were:

- NI has a low adoption rate in Western Canada, of 10 percent of acres. However, the fertilizer offers very high mitigation potential of between 30 and 40 percent reductions in N_2O emissions, and it also appears to be fairly effective at increasing yields or at least protecting against yield loss. NI adoption does not require changes in the production system, it impacts farm revenues and reduces N_2O emissions.
- The study estimated N_2O emissions and their impact on adoption rates and farm revenues at the provincial level using Canada's national GHG inventory methodology. The methodology was modified to include NI and estimate its effects on N_2O emissions and farm revenues by considering multiple variables including environmental characteristics, soil texture, fertilizer, application rate, precipitation and potential of application integration.
- We found a large degree of variation in N_2O emissions across the province, driven by differences in rainfall, soil texture and crop productivity. However, emissions are low across the province.
- The average emissions in the province are currently 210 kilograms of carbon dioxide equivalent per hectare, which could be reduced to about 130 with the adoption of NI. This results in a relative reduction of about 36 percent, but per unit reductions will be low, making it difficult to incentivize based solely on emission reductions. To address this, potential solutions include subsidies, emission pricing or carbon pricing, with subsidies being the most straightforward approach for incentivizing NI adoption.
- Subsidies are the most straightforward approach for incentivizing AI adoption, but are expensive, costing around $475 per ton reduced on average. Other options include emission pricing and passing on the price of adoption to producers or consumers.
- Carbon pricing strategies alone would not be enough to cover the offset cost of adoption. At a carbon price of $95/tonne of CO_2 eq., on average, an offset of $7/tonne would be generated from emission reductions with NI adoption. That would entail a substantial reduction in net revenue, of $29 per acre.

- Low emission production certification would more than offset the cost of adoption and could increase adoption rates in the long run. Fully offsetting the increased cost of production with NI adoption and remaining revenue neutral would require an increase of approximately 2 to 3 percent in the price of wheat. At a 10 percent price premium for production with NI, there would be a rather substantial increase in net revenue: $110/ hector across the province.

To summarize, subsidies are the quickest approach for increasing adoption rates, but they are expensive and may not be sustainable once removed. Carbon pricing is theoretically efficient but requires a higher carbon price (around $300 to $400 per ton) to fully offset adoption costs. Low emission production certification is consumer-driven and can potentially offset costs if consumers are willing to pay more, but there is a risk of low demand and logistical challenges. Incentivization is important and further conversation is needed to determine the best approach.

MELISSA DOWNING, DIRECTOR REGULATORY AND SUSTAINABILITY ALBERTA CATTLE FEEDERS' ASSOCIATION

Downing shared an example of a half-mile of land located north of her own farm in east-central Alberta, which was put up for sale at a high price. The land was sandy, and locals could not make it pencil out. An outsider bought the land and tried to farm it, but he realized it was not suitable for farming and put it back up for sale two months later. In the process, 600 acres of native grassland were lost, and the carbon stored in it was all gone. This example highlighted the importance of economics in maintaining land use. Prices are driving the conversion of grassland, and the province is losing native grassland every year. If these practices were not profitable, farmers might choose not to implement them, potentially leading to the land being used for other purposes that do not prioritize environmental concerns. Similarly, policies like the fertilizer policy affect costs of production. They have small margins where even small costs can have huge impact. Economics is the major factor in BMP adoption, and farmers have always responded to incentives provided by the market and policies. Emission reduction is also associated with favourable returns on farms. The economic aspect is an important part of sustainability in the industry.

"The soil carbon has increased over the last fifty years. It's not because of carbon policies; it's because we saw benefits to zero till, and how that can help improve the soil."

Despite the policies that are focused on reducing nitrogen emissions and capturing carbon, the industry is confronted with a major challenge, which is the lack of a clear baseline to measure the current level of emissions and track the progress towards reduction goals. Downing also noted that lack of on-farm carbon measurement tools makes it difficult for producers to accurately measure carbon on their farms. "As producers, we have small margins. And eating into that even just a little bit is a big deal. And the prices driving conversion of grassland is a huge issue. We are losing native grassland every year." Millions of pounds of carbon stored in grasslands are being lost due to factors such as deforestation, overgrazing and land-use changes. Working collaboratively with conservation groups is important to improving management practices that may benefit ecosystems. Ducks Unlimited works with producers. The industry needs more of that collaboration, not prescriptions and policies.

DAN HEANEY, PLANT NUTRITION CANADA; SENIOR CONSULTANT, RANDOM CROSS CONSULTING

Heaney presented the GHG footprint of agriculture in Canada, highlighting the upward trend in agriculture soil emissions in the last two decades. He noted that about half of the N_2O emissions charged against the agricultural sector are due to fertilizer use, which has been increasing because of changes in technology and a drive for higher yield goals. Also, the cropland emissions have been trending downwards, representing carbon sequestration, due to reduced tillage and zero tillage practices. Agriculture does not receive credit for this sequestration in the National Inventory Report (NIR) system, as these are reported in the different category of "land and land-use change."

There is a large range in emissions per hectare across Alberta, driven by both climate and regions with higher yield potential using more fertilizer. Emissions are higher in humid climates such as Ontario and Quebec, but this is balanced out by the large acres in Western Canada. Lana Awada from University of Saskatchewan showed in her research that when you start to actually do the accounting, adding up the emissions from crop-based agriculture and subtracting the sequestration, the crop-based agriculture in Western Canada is a lot closer to net zero, but this is not given credit in reporting. (Awada 2021)

The N_2O Emissions Reduction Protocol (NERP) is a voluntary program that provides farmers with tools and strategies to reduce N_2O emissions. This program has been successful in reducing emissions, but that uptake has been slow due to barriers such as cost, lack of knowledge and the time required to implement changes. A government-led policy could help overcome these barriers and encourage more farmers to participate in the program. Combining model predictions with field measurements could improve accuracy and provide a more complete picture of N_2O emissions.

In Alberta, there has been a significant increase in fertilizer use, driven by the desire for high-yield goals and the conversion of forage land to crop land. Looking at the national picture, emissions per hectare vary across the country due to factors such as climate and regions with higher yield potential using more fertilizer. There are higher N_2O emissions in the east due to higher emission intensity. Spending $1 on a nitrification inhibitor in Ontario will lead to a bigger reduction than in Alberta. In wetter, higher emission zones, the reduction will be greater than in drier zones.

"As nitrogen-use efficiency goes up, nitrous oxide emissions tend to go down, and there's a whole bunch of different ways to do nitrogen-use efficiency."

Canada's nitrogen-use efficiency is at about 65 percent, which is higher than the global average of 50–55 percent. Western Canada is even better than the national average due to conversion from broadcast to banding and spring application of fertilizer. Canada has been doing well in terms of nitrogen-use efficiency and N_2O emissions due to nutrient stewardship and regionally appropriate BMPs. However, the NIR used by the government does not account for BMPs and the progress made towards N_2O emission reduction can't be measured. Furthermore, better farm activity data is needed to accurately measure progress towards lower emissions.

One commissioned research study utilized a series of scenarios for major Canadian cropping systems across Canada and builds out a path forward to 2030 based on broader implementation of selected 4R practices. This study modelled the impact of BMP adoption and N_2O emissions from fertilizer for major cropping systems in five regions and compares the effects of different 4R BMP adoption rates on the regional crop production economy and N_2O emissions from fertilizer. The study found that a 30 percent absolute emission reduction is not realistically achievable even when flattening yields. Canada can raise production levels with aggressive but realistic adoption rates of 4R management practices and reduce fertilizer N2O emissions by 14 percent. This emission reduction can be helped by growth in production of key grains and oilseeds, maintenance or improvement of the crop-based economy and reduction in carbon intensity.

Canada does not want to lose global supply. Built on 4Rs, NIR needs to fix the tools and sustainable incentives that will work over long term. If it does not pay economically, then the incentives are gone, and farmers will go back to what they were doing before.

JOHN CONRAD, ASSISTANT DEPUTY MINISTER OF PRIMARY AGRICULTURE

Conrad discussed the role of public service and public participation in facilitating and assisting the implementation of policies to address climate change. He is enthusiastic about the issue of stewardship and climate change. The problem can be attributed to public policy, and there is a need to reshape the narrative surrounding Alberta and its producers nationwide.

"The inches we need are right there, the gaps that we need to close are right within our grasp, but we seem to be struggling with connecting the dots."

Alberta producers have long known about no-till and soil health and have become expert in the practice, which is why some of the earliest protocols in the carbon market were created in the province. The narrative about Alberta's emissions intensity has been unfairly negative, and must be changed, to focus on how many emissions we produce per ton of crop production and how much fertilizer we put into the soil — a positive story.

According to Conrad, the NIR may not be the best tool for reporting on methane emissions because it is based on statistical models, which offer a limited possibility of understanding net reductions in GHG emissions tied to specific practices.

He talked about the different colours of money flowing from the Agricultural Climate Solutions Program in Alberta. The program has three living labs, one of which is shared with British Columbia, and OFCAF money is in play. There are various ways that a producer

can make an application through RDAR, the Canola Council, and the Canadian Forage and Grassland Association. Conrad emphasized the need to deconflict different programs to make them more effective. After the first of April, GoA will be contacting different stakeholders and organizations like Simpson Centre, to have a conversation about how best to mobilize knowledge and bring in industry and post secondary institutions in the discussion. Government still has a role a facilitating role, but one that is not as dominant as it was in the past, certainly prior to 2020.

Roundtable Discussion I — What are Potential Barriers to the Adoption of Climate-Friendly Practices on Farms?

The participants broke out into three roundtable discussions to discuss specific barriers to adopting AgTech and BMPs on farms and recommendations to overcome these barriers. A summary of the discussion is presented below:

I. GRIEVANCES WITH POLICIES

The attendees engaged in a thoughtful discussion regarding the dearth of producer involvement in shaping agricultural policies and their practical implications. Without the valuable input of farmers, it becomes difficult to ascertain the economic impact of these policies. It is imperative to establish a stronger sense of harmony and cooperation between government policymakers and the industry, fostering a more inclusive and collaborative approach towards policy formulation.

II. ACCESS TO ACCURATE DATA COLLECTION AND REPORTING TOOLS

The agricultural industry must prioritize capturing accurate emission numbers, backed by comprehensive comparisons of acres and emissions to ensure the dissemination of precise information. It is crucial for producers to have access to reliable and purpose-built tools that facilitate accurate comparisons, enabling them to assess their starting points and current progress. While the NIR method of estimating emissions relies on a model, the emphasis should shift towards deploying tools that can effectively monitor, predict, mitigate, and optimize emissions.

Farmers have been actively engaged in carbon sequestration for years, even across multiple generations, yet they remain unaware of their progress and have not received due recognition for their efforts. Introducing new processes must demonstrate clear benefits, with any additional costs being covered. Offering benefits such as carbon credits or increased production can incentivize producers to adopt these practices as a long-term commitment.

Information sharing among producers plays a pivotal role in driving improved practices. It fosters a culture of knowledge exchange, empowering farmers to learn from each other's experiences and successes. Providing assurances against yield losses and offering insights into the factors contributing to yield increases are vital for producers to make informed decisions and take necessary steps towards sustainable agriculture.

III. THE 30 PERCENT EMISSION REDUCTION TARGET FOR FERTILIZER

Efforts are needed to reward proficient producers who excel in maximizing production, grassland management and carbon storage. Unfortunately, existing programs that encourage cropland conversion to pasture fail to benefit these deserving individuals. Finding ways to recognize their achievements, such as through tax incentives or carbon credits, requires further exploration. Discussions should also address whether government oversight, particularly regarding manure storage in the livestock industry, is necessary. While some farms making strides towards net-zero outcomes have witnessed positive results from best management practices economically and environmentally, widespread adoption faces economic challenges. Quantifying the added economic value of smart agricultural practices is crucial in driving their implementation.

IV. FINANCIAL SUPPORT FOR THE AGRICULTURAL INDUSTRY

The cost of changing farm practices or incorporating new components into equipment presents a significant barrier to the adoption of agricultural technology (agtech). One suggestion is to explore the possibility of cost-and-risk-sharing between the private and public sectors. Determining who bears the strategic costs and how to create an ecosystem that facilitates such collaboration is crucial, as it currently does not exist.

Financial institutions, such as banks, can play a role in incentivizing agtech adoption by offering low-cost incentives and financial support to the agriculture industry. Encouraging collaboration among these institutions could yield favourable outcomes. To ensure widespread acceptance, new farm products must be affordable, garnering buy-in from farmers.

Positive incentives that drive adoption could encompass various measures, such as reducing farm interest rates, crop insurance rates, providing government subsidies like farm tax credits, or offering incentives for farm insurance. The objective of the OFCAF fund is to assist farmers in embracing BMPs that store carbon, reduce GHG emissions and specifically target nitrogen management, cover cropping and rotational grazing. These practices not only contribute to carbon reduction but also enhance biodiversity and soil health. Increasing exposure of OFCAF to producers is essential to facilitate its effectiveness.

V. TECHNOLOGY BARRIERS

Inadequate rural internet access hampers data availability and sharing, posing a challenge to the adoption of new technologies. For instance, when it comes to incorporating new components that complement existing farm equipment, limited or poor internet connectivity restricts software downloads and hampers the accessibility of these new components. Also, there is a lag between innovation and technology development. Moreover, there are prolonged delays in protocol development in Canada, partly attributed to insufficient research funding and bureaucratic hurdles. In contrast, other countries can expedite approval processes within weeks, while in Canada it often takes months or even years.

VI. ISSUES WITH TRUST

Farmers generate substantial amounts of data on their farms; however, there is often hesitancy among producers to share this valuable information due to concerns about data security. It is imperative to establish a secure methodology for sharing farm experiences and BMPs to enhance adoption among all producers. Creating a trusted platform or framework that ensures data privacy and confidentiality would alleviate the reservations of farmers, enabling them to contribute their experiences and knowledge.

In addition, there is a general hesitancy to share data in research, primarily driven by fears of information theft. Addressing these concerns and implementing robust data-protection measures can help foster a culture of data sharing for research purposes, benefiting the industry as a whole.

VII. CARBON OFFSETS VS. CARBON INSETS

The key difference between carbon insets and offsets is the way an entity invests to reduce its carbon footprint. Carbon in-setting involves investing in projects that are related to a company's products; carbon offsetting involves projects that are not related to a firm's products.

Panel Discussion: Innovation Ecosystem for Reduction of GHG Emissions in the Food System

Panellists — Paul Thiel, Jim Jenkins, Alison Sunstrum

> ***"I believe that we don't always have the thoughts, but we can reach out to people and gather ideas from them."* — Paul Thiel, thought leader, Olds College**

Thiel shared some thoughts on the barriers to adoption and where we stand today in achieving net zero GHG emissions by 2050, with production agriculture contributing to 11 percent. However, the understanding of these words can differ, making it hard to move forward together.

Olds College has committed to becoming the smartest Ag institution in Canada by embedding technology in their strategy. For instance, John Deere's new technology, including planting, fertilizing and pesticide control, is a significant advancement towards reducing waste, better water management and improving crop yields. To communicate these technologies to stakeholders, including consumers, we need to quantify and convey its benefits.

The challenges in agricultural technology evolution in the discussion around carbon and agriculture are many. Growers are inundated with potential solutions that may not be applicable to them, making it hard to make decisions using data collection. The

evolution of taking things and scaling them up requires lifting everyone up with the right expertise and transferring knowledge that growers can use to reach their goals.

A McKinsey Global study states that 78 percent of North American growers have no intention of doing anything about carbon on the farm, with 11 percent claiming to have already taken steps. We must focus on educating growers about the benefits of implementing carbon farming practices and technology that will assist them in reaching their goals.

Canada's goal is net-zero GHG emission by 2050 and reduction of contribution from agriculture production to 11 percent. Olds College is committed to becoming a smart agricultural institution in Canada. Agriculture continues to advance, and technology is part of the solution moving forward, but it needs to be communicated across the industry. Challenges in agricultural technology evolution translate into communication around carbon and agriculture. Technological advancements are being made in other industries and applied to agriculture. There is a market and a business opportunity for these companies.

Growers are inundated with so much data and must now use that data to make better management decisions. The challenge is to get the right expertise for industry concerns, and to scale knowledge to a meaningful level, so producers become users instead of beta testers.

From a McKinsey & Company study, the numbers surveyed are small, but 78 percent of North American growers have no intention of doing anything around carbon. Eleven percent said they had never even heard of it. Some claim the information was not offered to them. For instance, let's consider the implementation of agricultural practices that are economically beneficial for growers, such as the No-till farming policy. In this case, growers took the lead, and subsequent research validated its economic viability, prompting many growers to adopt it.

JIM JENKINS, SENIOR MANAGER PRODUCT RISK AND STEWARDSHIP, NUTRIEN

Jenkins asked his audience if the innovation ecosystem is delivering enough, and if we are moving fast enough to address the significant challenge of mitigating the planetary missions from food production — which account for 26 percent of total GHG emissions, with crop production alone accounting for one-third of that these emissions.

He suggested that changing mindsets is necessary to accelerate progress in this direction. This shift in mindset should start with engaging people at a personal level and requires a high level of value-chain collaboration and coordination. He stressed the need for clarity on BMPs, support for producers, and shared risk in the value chain. He also emphasized the relevance of data, which is often not seen as a crucial component of the value chain.

"And for us to win, everybody has to get some value out of that value chain."

From his experience in the fertilizer sector, he presented three mindset shifts in motion in the fertilizer production value chain. The first shift is from the traditional model of big plants and central fertilizer production to a balance between local and central production, which disrupts production, shipping and growing. This makes the role of collaboration and coordination more important, because if Nutrient makes a big shift in its product offering and does not work with the value chain further down the system, something is going to go wrong. A small disruption in value chain will have to managed at every level.

The second shift involves shifting focus from promoting increased fertilizer usage to achieving greater efficiency in fertilizer utilization. This necessitates innovation in agricultural inputs and the establishment of new protocols. Whatever steps are taken at the initial stages of the value chain to introduce a new product, its value must extend throughout the entire chain to contribute to stabilizing or enhancing production.

The third shift involves broadening the perspective beyond fertilizer alone and exploring the incorporation of bio-stimulants or other additives that enhance efficiency and promote sustainability in food production. The ecosystem encompasses not only the plants but also the soil, soil biome, and biodiversity. Each of these components of the ecosystem can be influenced by our products, ultimately affecting best management practices (BMP), growers, and the food processing sector.

Decarbonizing nutrients holds enormous potential and would require a large technology and infrastructure shift. Plants would need to work differently, and major fertilizer producers in North America are starting to take that action. Jenkins provided examples of innovation in fertilizer production, including the development of products that use nanotechnology to improve nutrient uptake and reduce fertilizer application rates.

The biostimulant sector has the second highest potential and is new in Canada and the US but established in Europe. Biostimulant enhances fertilizer efficiency and emission benefits, but the emissions effect has not been quantified well enough. Enhanced efficiency fertilizers, on the other hand, are fairly established in terms of efficiency and emission benefits. However, there is a need for continuous technological advancements to further reduce costs associated with these fertilizers. Aptamers, which are signals that can be used in the soil to release fertilizer, comprise another useful technology. The use of the 4R (right source, rate, time, and place) approach has increased production by 14 percent and reduced potential environmental damage. However, only 9.6 million acres of land have been verified to use this approach, with 25 million acres remaining unverified or self-assessed. The goal is to collaborate with the owners of these acres to ascertain the program's value. There are encouraging changes, but transformational change is needed to increase engagement, collaboration, and coordination.

Only a collaborative and coordinated approach to innovation in the fertilizer production value chain can address the challenges facing food production and GHG missions. Changing mindsets, prioritizing data, and embracing innovative technologies is critical to accelerating progress in this area.

ALISON SUNSTRUM, CEO, CNSRV-X INC.

Sunstrum related a personal story about successfully developing CNSRV-X Inc., a data acquisition and analytics platform for livestock, which led to collaborations with sixty universities, employment for over 1,500 STEM professionals and the creation of over 2,400 publications. From Canada, that technology went global. Sunstrum faced were two important challenges — despite her company's success, she faced lack of access to both capital and mentorship for entrepreneurs. She observed that building a science-based business in Canada can be challenging. Agriculture is a significant contributor to climate change, and climate change affects productivity.

Agriculture has the potential to be part of the solution to this problem if disruptive innovation can be implemented. Agriculture, globally, comprises an eight trillion-dollar opportunity. With a growing global population, it will become a twelve trillion-dollar opportunity in the next few years (Nieuwkeep 2019). Canada needs to produce more with less, sustainably, through disruptive innovation. Agricultural exports sit Canada as the number five producer of agricultural commodities and the number eight creator of value-added businesses. Canada has a huge opportunity.

The Commerce Board of Canada issues an Innovation Report Card every year. Canada is in the bottom 50 percent among peer countries. When it comes to patents, Canada is in last place. The challenge is how to get innovation out of universities and to deploy it — how to mentor entrepreneurs to succeed.

The University of Calgary's CDL Rockies program does not need government funding to survive. It is funded by philanthropists and corporations. It has had $2.3 billion in equity creation since 2017 and more than one thousand jobs created. The program has partner support from Nutrien, the Canadian military, Osler and Farm Credit Canada. Its mentors for entrepreneurs include experts in law, the sciences, and technology.

"To reach net-zero transition is going to require more capital. We cannot rely on the government. but they can provide the ignition to the capital."

People have to be highly creative and innovative to access capital for this agricultural transition. It cannot come from farmers alone. Canada's investment in research and development for the private sector sits at $86 million. In contrast, the US invests $19 billion.

As for the innovation ecosystem in Canada, all areas of the complex ecosystem are working in silos — governments, universities and even different branches of agriculture. Innovation is not demand driven, so it does not consider what farmers and industry need. It provides only the carbon targets, so it does not resonate with farmers and their economy.

Government and academia must speed up to match the speed of industry and business. Components of the ecosystem need to collaborate, so that information flows between all components of the ecosystem. The primary focus of innovation should be productivity and the secondary focus on climate environment. Innovation needs to address the industry and farmers.

Bureaucracy and excessive regulations lead to significant delays, particularly in the agricultural sector where processes that take only a week in other jurisdictions can take up to two years. Furthermore, technology transfer in agriculture lags behind by ten years due to the establishment of national labs with corporate research agreements, while universities and government entities operate on outdated models. Sunstrum emphasized the importance of establishing a comprehensive resource directory to facilitate researchers in finding business partners and help businesspeople connect with researchers.

Roundtable Discussion II — Does Canada have an Innovation Ecosystem? Is it Working?

After the second panel discussion and Q&A session, the participants broke out into three roundtable discussions to discuss specific questions about the Canadian innovation ecosystem and how it could be strengthened to help accelerate innovation and AgTech adoption.

I. GOVERNMENT INVOLVEMENT IN THE INNOVATION ECOSYSTEM

The government plays a crucial role in incentivizing capital markets and promoting investment in agriculture. Leveraging financial tools such as tax incentives, tax credits and business expenditure on research and development can further bolster this effort. Additionally, regulatory frameworks should be updated to foster innovation and facilitate communication of emerging technologies across all industry sectors, including Environment, GHG emissions, energy and water, which can be streamlined under one umbrella for greater effectiveness.

Despite being a key contributor to the economy, the agriculture portfolio is often viewed as a secondary sector. By elevating its importance and giving it parity with Finance or Industry Canada, Canada can enhance its visibility and attract potential investors.

It is concerning that the 3-Nitrooxypropanol (3-NOP) supplement, a methane emission reduction measure, has been approved in forty-four countries, but not yet in Canada. This is indicative of a larger issue such that innovation lacks support and is often brought in from the US, resulting in regulatory hurdles to adoption. Overall, Canada needs policies that are more conducive to doing business and that encourage innovation.

II. RESEARCH AND DEVELOPMENT

To improve the innovation ecosystem in Canada and foster growth in the agriculture sector, challenges must be addressed. One key challenge is the regulatory pathway, which can function as an impediment to innovation. Canada tends to prioritize the protection of existing industries and can be hesitant to embrace new ones, resulting in regulatory barriers. Additionally, the patent process can prevent innovative technologies from reaching the market.

Canada's research institutions perform well, but commercialization of innovative technologies is often lacking, due to insufficient collaboration between industry and applied research institutions. This lack of collaboration, along with a non-supportive innovation ecosystem, poses significant challenges for agriculture, including insufficient funding for research and development in areas where expertise is needed. To overcome these challenges, Canada should prioritize collaboration and innovation, streamline the regulatory process, and provide greater support for research and development in the agriculture sector.

III. THE INNOVATION PROCESS

Innovation in the agriculture sector is occurring through various channels; however, it is not demand-driven and does not fully consider the needs of the farming industry. Better communication is necessary to prepare both consumers and farmers for innovative technologies. This may require establishing producer-public-private partnerships to create more competitive pressure and bring all components of the ecosystem together to facilitate information flow.

Although Canada has the necessary infrastructure, the innovation process in agriculture can take years. To foster innovation, it is critical to involve all players in the ecosystem, including farmers, processors, researchers, finance, NGOs, and government. Insufficient information about the Return on Investment (ROI) of technologies is also a challenge to technology adoption.

Overall, Canada's non-supportive innovation ecosystem has implications for agriculture, such as inadequate funding for research and development where expertise is needed. Collaboration between industry and applied research institutions needs to be strengthened to address commercialization challenges.

IV. WHAT'S WORKING AND NOT WORKING IN THE ECOSYSTEM

Canada possesses abundant talent in agriculture; however, it lacks efficient communication channels to connect this talent with industry. While Canada has achieved notable successes in no-till agriculture and improving Canola production, farmers' voices often go unheard. Collaboration between all stakeholders involved in agriculture needs to be enhanced to achieve better outcomes. There is a gap in the alignment of research timelines with market access, and the direction of research often overlooks agriculture. Hence, continuity in research direction and support is necessary for the agriculture industry's advancement.

Recommendations and Next Steps

The participants discussed the suggestions on how to encourage climate-friendly practices on the farms by removing the barriers to adoption of new knowledge and technologies. They also discussed the strengths and weaknesses for the Canadian innovation ecosystem and how it can be leveraged to support the transition to a sustainable agriculture. The following recommendations from the roundtable discussions were presented before the larger audience of the event.

COLLABORATION AND ALIGNMENT BETWEEN GOVERNMENT AND INDUSTRY

- Increase farmer involvement in the creation of agricultural policies to better understand how policies will affect them economically.
- Create channels for dialogue and collaboration between government policy makers and the industry to ensure policies align with the needs of farmers and support their adoption of climate-friendly practices. Consult with producers and build trust by ensuring their interests are considered in research and policy development.
- Efforts should be made to reduce bureaucracy and red tape in the agriculture industry. This will help to speed up innovation and technology transfer, bringing innovative ideas to market more quickly.
- Grain support programs and supply management disrupt the supply chain and discourage efficiency improvement. Policies should be designed to push for innovation and efficiency.

FINANCIAL SUPPORT FOR THE AGRICULTURAL INDUSTRY

- Government should incentivize capital markets and investment in agriculture and create more responsive regulations to encourage innovation and communicate innovative technologies. The agriculture portfolio should be given greater importance to attract potential investors.
- Share the cost and risk of changing farm practices or adding new components to equipment between the private and public sectors. determining how the costs of certain initiatives or strategies are split between financial and public sectors.
- Encourage financial institutions to work together and incentivize them to provide low-cost incentives and financial support for the agriculture industry.
- Provide positive incentives to encourage adoption, such as a reduction in farm interest rates, crop insurance rates, and government subsidies. Find ways to reward farmers who are already doing a decent job in managing their farms sustainably.
- Explore tax or carbon credits as incentives to encourage farmers to adopt climate-friendly practices. Consider regulation in the livestock industry, such as manure storage, to achieve the 30 percent emission reduction target for fertilizer. Quantify the added economic value of smart agricultural practices to encourage adoption.

ADDRESSING TECHNOLOGY BARRIERS

- Address poor rural internet access to increase data availability and sharing.
- Develop new components that complement existing farm equipment and make them accessible to farmers with limited internet access.

- Reduce delays in protocol development and approvals to accelerate innovation and technology development.

ACCESS TO ACCURATE DATA COLLECTION AND REPORTING TOOLS

- Develop fit-for-purpose tools that can monitor, predict, mitigate and optimize emissions on farms.
- Provide farmers with accurate and transparent data on their emissions to identify areas where they can improve.
- Consider providing incentives such as carbon credits or production benefits to encourage farmers to adopt climate-friendly practices as a long-term strategy. Develop a secure methodology for sharing farm data to increase adoption of BMPs among all producers.

INNOVATION ECOSYSTEM SUPPORT

- Canada needs to invest more in research and development to keep up with other countries in the area of innovation. Efforts should be made to increase investment in R&D, particularly for the private sector.
- Funding for research and development should be increased and collaboration between industry and applied research institutions should be strengthened.
- Innovation in agriculture should be demand-driven to meet the needs of farmers and industry. Collaboration between government, universities and industry should be improved to create a more cohesive ecosystem, in which information flows between all components.
- All components of the ecosystem should be brought together to enable information flow. A directory of resources should be created to help researchers and businesspeople find the assistance they need. This will help to connect entrepreneurs with the resources they need to succeed in the agriculture industry.
- Lack of access to capital and mentorship is a major challenge for entrepreneurs, particularly those in the agriculture sector. Efforts should be made to improve access to funding and mentorship opportunities for entrepreneurs in the agriculture industry.
- Producer-public-private partnerships should be created, and communication should be improved to prepare all stakeholders for innovative technologies.
- The regulatory pathway should be streamlined to enable commercialization of innovative technologies.
- There is a need for improvement in collaboration between all players involved, and producers should be heard.

The way forward would involve a collaborative effort between all stakeholders in the innovation ecosystem, including farmers, processors, researchers, finance, publics, NGOs and government. Policies should be designed to encourage investment in agriculture and streamline the regulatory pathway for commercialization of innovative technologies. Communication should be improved, and producer-public-private partnerships should be created. All stakeholders should work together to increase competitive pressure to push for innovation, and there should be continuity in direction and support for research and development.

Concluding Remarks

JACKIE SIEPPERT, DIRECTOR OF SCHOOL PUBLIC POLICY, UNIVERSITY OF CALGARY.

The event concluded with a vote of thanks by Dr. Jackie Sieppert, Director of the School of Public Policy at the University of Calgary. He highlighted that agriculture is connected to conservation, which in turn connects it to areas of policy being researched by the Simpson Centre, allowing for components of the research to be put into practice. The Simpson Centre also has a role as a convener and connector for conversations that come out of meetings such as the GHG emissions conference. The discussions during the conference reinforced that the agriculture sector has been missed in policy conversations in this country, particularly around sustainability, carbon management and emissions. The event identified the challenges that the sector faces in this area and the pressure that producers are under.

Producers face massive challenges regarding carbon management and sustainability and how they connect to the agriculture industry. There are foundational aspects that are often overlooked and not acknowledged, which could serve as a basis for collaborative efforts with the Simpson Centre. Solutions require engagement and involvement from everyone to change the narrative and find solutions together. The event brought together multiple voices from government, partners, academic researchers, colleagues, and industry representatives. Producers work hard and have challenging lives, and their successes are critical to share with the people of Canada. It is up to all the stakeholders to tell those stories in compelling ways so that people understand why this conversation is important and why the agriculture sector needs support as it moves ahead.

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