

Seeds of Change

Shifting Diets & Soil Carbon Sequestration Markets: How Climate Change is Driving New Opportunities and Risks in Agriculture

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Executive Summary

Climate Change is driving change on Canadian farms and ranches at an increasingly rapid pace, introducing new opportunities and risks that were unanticipated just a few years ago. Traditional forecasting methods fail when the future looks nothing like the past. How best then, to manage risk when faced with this kind of uncertainty? Farm Management Canada's *Roots to Success* project responded to this challenge by undertaking a foresight exercise focused on farms and ranches.

Weak signals or seeds of change are defined in foresight analysis as the first indicators of change that may become significant in the future.¹ Members of Farm Management Canada's National Risk Management Roundtable participated in a horizon scan exercise that identified 8 weak signals driven by climate change. Two of these signals were identified as priorities by Roundtable members:

- Canadians are shifting their diet to include more fruit, vegetables and non-animal protein alternatives (for both health and environmental reasons); and
- Soil carbon sequestration markets will become an opportunity for the agriculture sector.

Each of the priority signals were then used to build future scenarios that indicate potential outcomes should the signal become the norm. Resulting opportunities and risks to farmers and ranchers were then identified, along with recommendations for support strategies that Farm Management Canada and government can provide.

Plant-Based Diets

It is clear Canadians (and Americans) are shifting their diets to include more plant-based food at an everincreasing pace. Should the majority of Canadian's significantly shift their diets in this direction, resulting impacts are consequential and far-reaching for farmers, ranchers, governments, and other food industry stakeholders. A key driver of this shift in behavior is the consumer's concern for the environment, and more specifically climate change. Yet, the scenario mapping exercise indicated that adopting a more plant-based diet does not necessarily result in lower GHG emissions. There are a range of opposing impacts and opportunities that will need to be managed to ensure climate-friendly outcomes.

For instance, vertical farms and greenhouses will need to be powered by renewable energy and located close to, or within cities, if transport/logistic related emissions are to be reduced. However, there are still provinces and territories in Canada where traditional fuels are used to power the grid. There are also examples of large greenhouse operations located remotely from major urban centers. Consumer demand for fresh fruit and vegetables in a country that experiences winter for half the year will drive imports even further. Promoting local production and ensuring refrigerants used in "cold chains"¹ are managed to minimize GHG emissions are some of the counter measures required. While farmers may be interested in increasing the production of high value fruits, vegetables and pulses, current regulations may not ensure the optimal allocation of horticultural land. These are a few examples of the challenges identified in this report.

¹ Definition: A cold chain is a low temperature-controlled supply chain. See <u>here</u> for more information.

Interestingly, the plant-based diet scenario does not spell doom and gloom for the livestock industry. Canadians are unlikely to eliminate meat from their diets. They are, however, more likely to become increasingly discerning consumers. This means buying less meat, but of a higher quality and raised more sustainably. There will also be an increased focus on exporting livestock and meat, requiring further investments in logistics, transportation, and international marketing of high-quality Canadian products.

Scenarios developed for plant-based diets suggest that government and other key stakeholders will need to take this trend very seriously. It will be important to identify and prioritize which response measures need to be taken soon for Canadian agriculture to manage the new risks and capitalize on the opportunities associated with this shift in behaviour.

Soil Sequestration Markets

Soil sequestration markets face a number of challenges on the road to becoming established. However, there is good reason to believe that they will emerge as part of a broader set of sequestration/GHG emission reduction opportunities for farmers and ranchers. Interestingly, this scenario demonstrated the link between establishing these markets, the need to establish 5G networks in rural areas, and how data will play an ever-increasing role in farm and ranch management. Not only will soil carbon sequestration improve soil health and productivity; it will also demonstrate that reforesting marginal lands can bring alternative sources of revenue and benefits.

Government will need to play a central role in minimizing the risk to farmers and ranchers of entering these emerging markets. This will include supporting transparency measures related to pricing, identification of credible third-party regulators, and providing insurance to cover instances where carbon sequestration is lost. Taking early action on these points will encourage early entrants and help to avoid failures from poor implementation.

The Link Between Both Scenarios

Both scenarios show that regenerative agriculture practices will likely increase as these seeds of change become established norms. This will drive shifts in how farming is practiced in Canada and require further support by government agencies and Farm Management Canada. There is a real need to provide guidance to different types of farm/ranch operations on what measures can be taken, associated risks to be managed, and potential returns. Regenerative agriculture practices will also promote connections between farms and other local businesses, driving circular economic practices. Sunk costs in expensive farming equipment represent a potential obstacle and opportunity for some farmers interested in changing operations. It also represents an opportunity for entrepreneurs to find innovative ways to retrofit machinery for other uses. Policy makers and Farm Management Canada are well placed to help farmers and ranchers understand and adopt these practices.

Key Recommendations

While this report provides a detailed, extensive list of recommendations for both government and Farm Management Canada, the following recommendations have been highlighted as key factors in contributing to meeting Canada's climate change goals.

Government

The shift towards more plant-based diets will challenge Canada's ability to meet its GHG commitments. Recommendations for government agencies include ensuring policy, regulations, infrastructure, support and/or incentive programs are developed to:

- Phase out the use of Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and other substances used in refrigeration, air conditioners and fire suppressants responsible for direct fugitive emissions. These are associated with "cold chains" transporting fruit and vegetables.²
- Limit GHG emissions associated with transport/logistics resulting from cross-border imports. This can help reduce waiting time at borders, etc.
- Power greenhouses and vertical farms from non-GHG emitting power sources.
- Target new farmers entering the greenhouse/vertical farming space. These individuals tend to come from highly technical backgrounds (engineering, IT, biotech disciplines) and will likely not be reached through traditional channels.
- Support watershed management and precision irrigation in areas where competition for water from competing land uses is high.
- Ensure regulations are updated to support the optimal allocation of horticultural land.
- Support GHG emissions monitoring, reporting and transparency along supply chains

The scenario developed for soil carbon sequestration markets underscores the reality that this shift will require ensuring 5G connectivity in rural areas thereby enabling precision agriculture and big data applications on farms.³ Key recommendations for government include ensuring policy, regulations, infrastructure and incentive programs are developed to:

- Reach remote rural areas with robust 5G coverage to support data collection, analysis, reporting and verification.
- Provide timely, accurate, readily available information to farmers and ranchers regarding market prices and aggregators for soil carbon credits.
- Provide insurance schemes for instances when soil carbon sequestration fails (this could include situations where land is bought from farmers and converted to other uses, or when natural disasters greatly affect soil profiles).
- Protect the digital privacy of farmers and ranchers.

Regenerative farming plays a key role in both scenarios. Government agencies will need to work with farmers to provide the research, incentives and guidelines that will help different farm and ranch systems convert operations while keeping new initiatives and processes accessible and efficient.

² Source: <u>https://www.epa.gov/sites/default/files/2015-07/documents/fugitiveemissions.pdf</u>

³ Source: <u>https://www.newswire.ca/news-releases/5g-has-positive-impacts-for-canadians-in-rural-and-urban-communities-848033601.html</u>

Farm Management Canada

The shift towards plant-based diets and the rise of carbon sequestration markets reveals opportunities for Farm Management Canada to develop and deliver programs and services, and conduct research, that provide Canada's farmers and ranchers with the knowledge, resources, and tools to manage change and seize the new opportunities that these two signals could provide for the agricultural sector. Key recommendations for Farm Management Canada include:

- Lead work on climate change risk management and business opportunities for farmers and ranchers.
- Continue to promote and support a comprehensive approach to managing risk in agriculture that acknowledges the connections between Canada's climate change goals and the risks and opportunities for farmers and ranchers.
- Continue to explore the connection between farm business management and climate change to identify existing and emerging risks and business opportunities for Canada's farmers and ranchers
- Expand on foresight techniques piloted in this report as a means of identifying potential risks and opportunities for farmers and ranchers.
- Help farmers and ranchers assess and apply regenerative farming practices to improve soil health and tap into soil carbon sequestration markets.
- Raise awareness amongst farmers and ranchers regarding the risks and opportunities that the shift to a plant-based diet may bring and provide relevant training on marketing opportunities that arise from these trends.
- Help farmers and ranchers explore and capitalize on the opportunities brought by 5G networks in rural areas to improve the business of farming and risk management. From improved forms of e-commerce to real time data collection and analysis, remote medical support,⁴ online training and mobile apps that farmers can use to support their work.
- Vertical farms and greenhouses are ushering in a new type of farmer. They come from biotech, engineering and IT backgrounds, and may not even consider themselves farmers in the traditional sense. It will be important for Farm Management Canada to develop new networks, supported by cutting edge IT applications if they are to engage this group. Engaging with this new group of farmers may also require hiring staff with new skill sets to support these operations.

One of the more revealing outcomes of the Seeds of Change exercise has been that there needs to be a shift in thinking and attitudes towards climate change in the agricultural sector. What is currently viewed as a risk or obligation that causes extra work or imposes costs for farmers and ranchers can also be an important opportunity. Shifts in climate drive extreme weather events and introduce new pests along with a suite of other risks for farms. However, agriculture will also benefit as new techniques and technologies improve productivity and efficiencies. Canadian agriculture can lead sustainability efforts, while benefitting economically from the programs that are being put in place to counter climate change. Farm Management Canada will need to work proactively in this space with its members to ensure the future of our farms and our country is bright.

⁴ Source: <u>https://www.theglobeandmail.com/featured-reports/article-how-5g-is-helping-to-connect-rural-communities/</u>

Report Structure

This Seeds of Change report is structured as follows:

- i. <u>Introduction</u>: The report starts by introducing the rationale for undertaking this foresight exercise, and provides background on the Roots to Success project, the National Risk Management Roundtable and the results of the first phase the horizon scan exercise.
- ii. <u>Approach</u>: Describes how interviews were conducted and wheels of change diagrams developed.
- <u>Wheels of Change</u>: The core of the report focuses on presenting the resulting scenarios associated with each of the prioritized seeds of change. First, second and third order impacts and consequences are presented and visually represented through wheel of change diagrams. Analysis and recommendations are included for government and Farm Management Canada support.
- iv. <u>Conclusions</u>: Final conclusions and recommendations.
- v. <u>Annexes</u>: A list National Risk Management Roundtable members and the interview form used to gather insight to develop the wheels of change. Also included are research results from phase 1 that focus on the two prioritized signals.

Introduction

Climate Change is introducing new opportunities and risks to agriculture that were unanticipated a few years ago. The challenge is how best to identify and manage these risks, while maximizing associated opportunities? Traditionally, approaches to risk management have relied on projections using past data to identify potential future conditions. However, this approach is of little use during times of profound change where the future bears little resemblance to the past. Instead, alternative techniques like foresight are now being used that apply more creative approaches to support decision-making.

Farm Management Canada's *Roots to Success* project was used to undertake a horizon scan exercise. The project started by identifying 8 weak signals or seeds of change associated with climate change with the potential to impact Canadian agriculture. National Risk Management Roundtable members where then asked to prioritize two weak signals deemed the most consequential for farmers and ranchers. The two priority signals selected were:

- The shift in diet to more fruit, vegetables and non-animal protein alternatives that Canadians are making (for both health and environmental reasons); and
- Emerging soil carbon sequestration markets

These two signals were then used to develop future scenarios where the assumption is made that these weak signals have now become established norms. For each scenario a set of first, second and third order impacts were identified. These, in turn, were used to target opportunities and risks that farmers and ranchers, industry and government agencies will need to manage should these future scenarios become a reality.

The value of this foresight exercise is two-fold. First, it identifies indicators that should be monitored that will alert decision-makers on whether these scenarios are becoming a reality. Secondly, they provide an indication of the consequences that can be anticipated and managed accordingly. This will prove cost effective for farmers and ranchers, government and other stakeholders in a context where the speed of change is only increasing and requires proactive planning and responsiveness in order to manage risk and seize opportunity.

Background Information

Roots to Success Project

Farm Management Canada's *Roots to Success* project was initiated in 2019. Its goal is to improve risk management for the agriculture and agri-food sector by investing in education and training that promotes a comprehensive approach to managing risk. The project also is working to establish industry benchmarks using baseline data to identify opportunities for policy and program improvement to meet the risk management needs of Canada's farmers.

National Risk Management Roundtable

As part of the *Roots to Success* project, the National Risk Management Roundtable was established with 15 key stakeholders from across Canada's agriculture sector representing a diversity of views and a demonstrated interest in supporting a more comprehensive approach to risk management. As advisors to the *Roots to Success* project, Roundtable member roles include:

- Providing insight regarding the state of risk management in their sector/area of activity/region
- Providing guidance and feedback to the project team to meet diverse industry needs
- Sharing and identifying the best approaches to implementing a national comprehensive risk management strategy and ensure its continuity
- Identifying gaps in current policy and programming to meet specific risk management needs
- Identifying the best way to establish linkages between associated industry initiatives including government BRM programs and compliance mechanisms

Phase 1 Horizon Scan Results

In Phase 1 of this exercise, a Horizon Scan was undertaken to identify emerging climate change issues that have the potential to impact farmers, ranchers, and their supply chains over the next 10-15 years. Eight weak signals or seeds of change were identified along with an initial list of potential risks and opportunities for farmers and ranchers. They were:

- 1. Shift in Canadian diets to include more fruit and vegetables and non-animal protein.
- 2. Removal of oil subsidies.
- 3. Increased investment in resilient supply chain infrastructure including diversifying transport options.
- 4. Increased use of big data for disclosure and transparency in farm operations and their supply chains.
- 5. Increased investment in water management infrastructure.
- 6. Issues of freshwater availability (reliability, quality and quantity) and competing uses from other sectors.
- 7. Emergence of carbon trading and soil carbon sequestration markets.
- 8. A more variable growing season in terms of temperature and moisture fluctuations.

From this list, two weak signals identified as priorities by Roundtable members. A shift toward more plant-based diets was ranked as the top priority. The second signal was further refined to focus specifically on soil carbon sequestration markets as the second priority. Table 1 below summarizes the risks and opportunities identified in Phase 1 for both signals. Phase 2 work expanded on these results by building on potential impacts for each signal and identifying opportunities for support strategies from government and Farm Management Canada.

| Weak Signal | Dicks | Opportunities |
|------------------------|----------------------|---|
| weak Signal | RISKS | opportunities |
| Shift in diets to more | Decreased sales for | Increased market size for fruit and vegetable producers |
| fruit, vegetables and | meat and meat | and protein alternatives. |
| non-animal protein | products in parts of | |
| | Canada. | Opportunity to differentiate Canadian meat production |
| | | based upon ecological conditions nationally (different |
| | | from Global context). |

Table 1: Phase One Prioritized Weak Signals, Risks & Opportunities

| Established market for | Farmers that ignore | Carbon sequestration programs designed by the private |
|------------------------|--------------------------|---|
| carbon sequestration | carbon markets will | sector that pay farmers for using low/no-till techniques, |
| in soils | miss revenue | and potentially extra for using cover crops. 5 |
| | opportunities. | |
| | | Governments may also recognize and reward carbon |
| | Farmers may not be | sequestration and storage efforts by farmers. |
| | able to avoid carbon | |
| | pricing fees, penalties, | Adopting regenerative agriculture practices can improved |
| | etc. | soil health, improve productivity and lower input costs. |
| | | |
| | There will be | Improving soil health promote water retention in soil. |
| | increased costs | |
| | associated with inputs | Diversification of species and adaptive grazing |
| | and supplies for farms. | techniques promote climate resilience.° |
| | | |
| | | Carbon credits could be used to offset additional costs |
| | | with fertilizer, fuel, transportation that will pass on the |
| | | costs of carbon taxes. |

 ⁵ Source: <u>https://www.ontariosoilcrop.org/carbon-sequestration-a-new-farm-revenue-source/</u>
 ⁶ Source: <u>https://understandingag.com/growing-resilience-through-regenerative-agriculture/</u>

Approach

To fully understand the consequences of each prioritized weak signal, a Wheel of Change exercise was undertaken. This approach is used to map out possible future scenarios around the assumption that each weak signal is now fully realized. Primary, secondary and potentially tertiary consequences are identified.

Figure 1 provides the initial example shown to Roundtable members to illustrate this process. Undertaking this work allows one to better understand the full scope of potential opportunities and risks or challenges that need to be managed.





The following activities were undertaken:

- 1. <u>Research</u>: Research was undertaken to identify potential consequences of the selected weak signals becoming fully realized. Results were used to:
 - a. Develop initial wheels of change for both signals including first, second, and occasionally third order impacts.
 - b. Document assumptions used to develop these impacts.

- 2. <u>Interviews</u>: As with Phase 1, individual interviews were conducted with Roundtable members to review/update impacts and assumptions, as well as identify what types of:
 - a. Investments and activities farmers and ranchers could be making
 - b. Support Farm Management Canada could be providing
 - c. Policies and support programs governments could be developing
- 3. <u>March Workshop</u>: Results were jointly reviewed and updated as a group during the March workshop. At the workshop, Roundtable members were divided into two groups based on their particular areas of interest and given the task of reviewing a specific wheel of change. An appointed representative was then asked to summarize and present their findings to the group including updates required and recommendations for Farm Management Canada and government to support the opportunities and challenges associated with identified impacts. Particular attention was given to identifying systemic patterns and risks that need to be managed as a result of converging risks/impacts.

Roundtable members were also asked to.

- a. Summarize what the experience of developing the wheels of change did to change their perspective on how change will have unintended consequences
- b. Identify what new challenges and opportunities emerged for their business or work
- c. Identify any unexpected insights or surprises.
- d. Identify one thing their business, Farm Management Canada and/or government could do differently to prepare for these impacts
- 4. <u>Finalize Results</u>: Based upon insights gathered in the workshop, final findings and recommendations were compiled and are presented in this report.

Shift In Diets



Introduction

There is little doubt that Canadians have started to increase their consumption of fruits and vegetables while reducing their consumption of meat and dairy. In 2018 Dalhousie University Study found that close to 10% of Canadians – approximately 2.3 million - considered themselves vegetarian or vegan.⁷ By 2020, Agri-Food Analytics lab had revised this number to 10.2 million. "Things are changing really fast, faster than ever really," stated Sylvain Charlebois, author of the original study.⁸

A shift to a *more* plant-based diet is also gaining traction among a wider segment of consumers. This shift is due in part to the newly updated Canada Food Guide, which emphasizes legumes, vegetables and lean proteins, and no longer features traditional dairy products.⁹ The guide may have widespread impact, since hospitals, schools, doctors and nutritionists, among others, often use the guide in preparing meal plans and/or guidance for healthier personal eating habits.¹⁰

At an individual level, however, Canada's Food Guide is unlikely to influence choice. Instead, climate change and environmental concerns have become important, potentially dominant drivers.^{11 12} An increasing number of people are worried about the carbon footprint of meat — and beef in particular. Consumer preferences are also influencing business decisions. In April 2021, Epicurious - a major U.S. food magazine and website took a public stand on the issue by announcing they were no longer publishing beef recipes, because of how carbon-intensive the protein is.¹³ Filling this void, are plant-based protein companies such as Beyond Meat, Impossible Foods and Just Foods, which are rapidly expanding their sales.¹⁴ AT Kearney estimates \$1bn has been invested in such vegan products, including companies like Cargill who dominate the conventional meat market.¹⁵

The UN's Food and Agriculture Organization estimates beef is responsible for <u>41 per cent</u> of all livestock emissions, far more than other meats.¹⁶ In 2018, scientists behind the most comprehensive analysis to date of the damage from farming to the planet found avoiding meat and dairy products was the <u>single</u> <u>biggest way to reduce individual environmental impacts on the planet</u>. The research showed that without meat and dairy consumption, global farmland use could be reduced by more than 75% – an area equivalent to the US, China, European Union and Australia combined – and still feed the world.¹⁷

Plant-Based Diets

While diets are shifting to incorporate more fruit and vegetables and less meat and dairy, how significant will this shift be? A study by AT Kearny suggests that up to 60 per cent of "meat" may come from non-

⁷ Source: <u>https://wedc.org/export/market-intelligence/posts/canadian-consumers-shift-to-plant-based-diets/</u>

 ⁸ Source: <u>https://www.nationalobserver.com/2020/02/18/news/young-canadians-are-becoming-vegetarian-or-vegan-fight-climate-change</u>
 ⁹ Source: <u>https://www.foodincanada.com/features/plant-based-foods-are-the-</u>

future/#:~:text=Plant%2Dbased%20diets%20traditionally%20were,longer%20features%20traditional%20dairy%20products.

¹⁰ Source: <u>https://wedc.org/export/market-intelligence/posts/canadian-consumers-shift-to-plant-based-diets/</u>

¹¹ Source: <u>https://www.vox.com/21562639/climate-change-plant-based-diets-science-meat-dairy</u>

¹² Source: <u>https://wedc.org/export/market-intelligence/posts/canadian-consumers-shift-to-plant-based-diets/</u>

¹³ Source: <u>https://www.cbc.ca/news/science/beef-climate-diet-grass-grain-1.6009471</u>

¹⁴ Source: <u>https://www.theguardian.com/environment/2019/jun/12/most-meat-in-2040-will-not-come-from-slaughtered-animals-report</u> ¹⁵ Source: <u>https://gfi.org/blog/cargill-invests-aleph-farms/</u>

¹⁵ Source: <u>https://gfl.org/blog/cargill-invests-alepn-farms/</u>

¹⁶ Source: <u>https://www.cbc.ca/news/science/beef-climate-diet-grass-grain-1.6009471</u>

¹⁷ Source: <u>https://www.theguardian.com/lifeandstyle/2021/apr/25/going-vegan-can-switching-to-a-plant-based-diet-really-save-the-planet</u>

animal sources by the year 2040.¹⁸ ¹⁹ However the rate of change to plant-based diets may be accelerating even faster due to a number of socio-economic factors including COVID-19 and rising food prices. According to Farm Credit Canada (FCC), "The recurring lockdowns and foodservice closures also curtailed meat consumption."²⁰ The report notes that meat consumption and demand are declining in Canada due to lower household incomes, soaring meat prices and the struggling restaurant industry.

The shift to plant-based diets has very likely already become a trend. For the purpose of this foresight exercise, the assumption has been made that in 10 years time the majority of the Canadian population will have made a significant shift to plant-based diets, either in whole (vegetarians) or in terms of a more balanced diet with a higher proportion of fruit, vegetable and plant-based proteins.

Wheel of Change Results for Shift in Diets to More Fruit, Vegetables and Non-Animal Protein

Figure 2 provides an overview of a future scenario where Canadians have shifted a significant portion of their diet from meat to fruit, vegetables and non-animal proteins. This was by far the most complex scenario developed amongst seeds of change.

A number of important assumptions were made to develop this scenario:

- (i) First and foremost, it was assumed that current emission levels associated with logistics and transport of food would not change. This meant any increase demand for transport of food would drive up GHG emission levels. While this might seem like an overly conservative position, considering the time horizon (10 -15 years), the number of countries involved in trade with Canada, and the various modes of transportation required, the assumption felt like a reasonable parameter to impose.
- (ii) It was also assumed that farmers and ranchers involved in raising livestock would not go out of business, or decide to close operations. There would continue to be national sales of meat in this scenario, and export of livestock and butchered meat would continue to grow in importance. This assumption is not without its own challenges. For instance, Canada currently exports 47% of its cattle and beef to the United States.²¹ Consumers in the United States are also shifting their diets to one that is more plant-based. This means that competition from local U.S. suppliers of beef and potentially other types of livestock would increase. Under this scenario the assumption is that Canada would start to more aggresively focus on other export markets including China.

¹⁸ Source: <u>https://www.theguardian.com/environment/2019/jun/12/most-meat-in-2040-will-not-come-from-slaughtered-animals-report</u>

¹⁹ Source: <u>https://retail-insider.com/retail-insider/2019/06/the-future-of-meat-in-canada-is-shifting-to-plant-based-products/</u>

²⁰ Source: <u>https://www.fcc-fac.ca/en/knowledge/economics/top-economic-trends-canadian-agriculture-food-2022.html</u>

²¹ Source: <u>https://www150.statcan.gc.ca/n1/pub/18-001-x/18-001-x2021002-eng.htm</u>

Figure 2: Wheel of Change for Plant-Based Diets Becoming the Norm



(iii) A final assumption was that migrant workers will continue to be essential to farm operations.
 Increased production of fruit and vegetables, regardless of whether on traditional farms or greenhouses will translate into an increased need for workers.

First order impacts associated with a shift in diet to plant-based food included:

- 1. Increased investments in greenhouses and vertical farms
- 2. More land devoted to plant crops
- 3. Increased levels of adopting regenerative agriculture practices
- 4. Growing new types of crops to meet consumer demand
- 5. Increased imports of fresh fruit and vegetables to meet consumer demand

- 6. Increased investment in plant protein meat alternatives and other products
- 7. Improved health associated with more balanced diets
- 8. Reduced domestic sales of Canadian meat
- 9. Increased exports of meat to other countries

Roundtable members paid particular attention to developing sub scenarios for (i) greenhouses, (ii) devoting more land to fruit, vegetable, grains and oil seeds, as well as (iii) regenerative agriculture. As a result, separate wheels were developed to support an exploration of these scenarios and their impacts. Also worth noting are linkages between this scenario and the emergence of soil carbon sequestration markets. In this scenario, farmers and ranchers interested in regenerative agriculture were also likely to explore sequestration markets and vice versa.

The following list presents first, second and third order impacts associated with a scenario where the majority of Canadians adopt some form of plant-based diet:

- 1. Increased investment in Greenhouses and Vertical Farms: This particular shift in the future scenario had so many unique primary, secondary and tertiary impacts that a separate wheel of change was developed to better represent the Committees' findings (see Figure 3). Resulting impacts include:
 - a. New business operators enter the market
 - Engineers and tech sector business operators have competitive advantage, including being able to mobilize venture capital from non-traditional agriculture sources
 - Existing farm programs and support will have to be updated approaches and outreach to accommodate non-traditional actors who do not necessarily view themselves as farmers
 - b. Greenhouse operations established in locations where energy costs are low. This includes colocation with gas pipelines, biogas and geothermal facilities. They could also harness bio thermic reactions from sewage.
 - Increased need for farmers to be able to develop partnerships with energy managers
 - c. Increased deployment of onsite renewable energy (RE) and battery storage to power operations and reduce costs
 - Increased skill levels of farmers for use of these technologies on site
 - Costs for operations increase as do barriers to entry
 - Increased need for technical experts for repairs and maintenance of this equipment
 - Potential need for increased access to Canadian production of technology and parts
 - d. Water use by greenhouses becomes an issue

Figure 3: Wheel of Change for Increased Number of Greenhouses and Vertical Farms



- Drip irrigation is favored over sprinkler systems
- Access to clean water becomes an important determinant of location
- e. Greenhouses locate close to communities to access local markets and logistic hubs
 - Increased number of old industrial sites and buildings retrofitted to become greenhouses
 - Cost and GHG emissions for transporting associated fruit and vegetables drops
 - Maintenance of transport infrastructure reduced in some rural areas
 - Increased complaints of light emissions from operations
- f. Use of robotics for harvest and data collection mainstreamed
 - Increased number of skilled workers required to operate greenhouses, especially with engineering and tech sector experience
 - Costs for operations increase as do barriers to entry
 - Increased need to have access to technical experts for repairs and maintenance of this equipment (rapid turnaround)
 - Increased Canadian production of parts and robotics equipment (just in time manufacturing using 3 D printing on site may be an option)
 - Increased need for universities and colleges to provide training for new experts and specialists
 - Increased need for subsidies, technical support and training programs from government and Farm Management Canada.
- g. Increased use of air conditioning to cool greenhouses in summer
 - Increased GHG emissions from air conditioners
 - Increased regulations, technical support and government subsidies required to promote appropriate AC technologies
- h. Anti-greenhouse movement gains momentum
 - Debates over GMO versus non-GMO foods increasingly in the public eye, as well as natural versus hot house vegetables
 - NIMBY (not in my backyard) movement arises around greenhouse operations and light pollution
 - Labelling to identify greenhouse versus "Open field" produce gains momentum
- i. Import and export levels of certain fruit and vegetables changes
 - Potentially impacts certain trade deals
- j. Specialized risk management and insurance schemes developed for greenhouses
- k. Increased need for migrant workers
- 2. Farmers and Ranchers devote more land to growing fruit, vegetables, grains and oilseeds: This

includes more focus on crops like peas and lentils, and potentially less production of crops like wheat. The Wheel of Change indicates anticipated impacts shown in Figure 4. Resulting impacts include:

- a. Increased soil carbon sequestration from larger land area devoted to orchards²²
- b. Increased irrigation needs and costs (some fruit grow better in drier climate):
 - Increased need to build reservoirs in places like the prairies,
 - Increased use of water management practices on farm (re-circulating water, etc.).

²² Source: <u>https://www.frontiersin.org/articles/10.3389/fenvs.2021.700768/full</u>

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Figure 4: Wheel of Change for More Land Devoted to Fruit, Vegetables and Plant Protein Crops



- c. Increased need to apply pesticides and herbicides
 - Increased use of precision agriculture to reduce costs
- d. Current rules and regulations fail to optimally allocate horticultural land
- e. Increased risk of relevant crop diseases
- f. Increased sales of plant crops to countries like Japan
 - Higher GHG emissions
- g. Increased transport and logistics requirements
 - Higher GHG emissions
- h. Plant waste from die back and harvest needs to be managed
 - Used for livestock bedding
 - Sold to turn into paper
 - Used to generate heating from a biodigester
- i. Production of feed crops decrease
 - Feed crop prices potentially increase
- j. Increased number of migrant workers to support production
- k. Increased number of food hubs established to service local produce
 - Food hubs divert fruit and vegetables to food banks to avoid waste
 - Food hubs set themselves up to market "ugly" fruit and vegetables²³
- I. Increased levels of direct marketing by farmers. This includes farm market shops, pick your own operations, community supported agriculture (CSA), agri-tourism and selling produce and goods at farmers markets.²⁴
 - Farmers require increased social media skills for online sales
 - Marketing of "ugly" vegetables and fruits gains in popularity
 - Farmers produce more processed goods like jams, chutneys, etc.
 - Agri-tourism increases
 - Pick your own operations gain in popularity
 - Increased local sales reduces transport and emission costs
- 3. Regenerative agriculture practices increase in response to climate change movement: In this scenario there is an assumption that consumers switching to a plant-based diet will do so both for health as well as climate change reasons. This in turn will drive the adoption of regenerative agricultural practices by farmers and ranchers to distinguish and market their products. Resulting impacts are significant and presented in Figure 5. Resulting impacts include:
 - a. Increased costs and knowledge required to apply regenerative agriculture practices
 - New equipment and tools are purchased by farmers
 - New businesses are established to retrofit/retool existing equipment
 - b. Land set aside for nature and pollinators
 - c. Decreased use of pesticides and herbicides through precision agriculture and other practices
 - Wild bee populations rebounds
 - Adjacent rivers and streams regain their health
 - d. Mixed farming operations make a come back

²³ See U.K. examples including <u>https://www.misfitsmarket.com/</u> and <u>https://www.imperfectfoods.com</u>

²⁴ Source: <u>http://www.omafra.gov.on.ca/english/busdev/facts/16-025.htm</u>

Figure 5: Wheel of Change for Regenerative Agriculture Becoming Mainstreamed



- e. Ranchers outsource herds to graze on adjacent farmlands to provide natural fertilizer to fields
- f. Increased application of manure in place of chemical fertilizers
- g. Industrial scale composting established
 - Food waste significantly reduced as it becomes valued in the market
- h. Increased consumer pressure to certify certain practices (similar to organic crops)
 - New or established certification bodies produce guidelines
 - Certification bodies require increased capacity
 - Training and education required by farmers to comply with certification requirements
 - New revenue opportunities for certified crops
- i. Increased levels of direct farm marketing to consumers by farmers. This includes farm market shops, pick your own operations, community supported agriculture (CSA), Agri-tourism and selling produce and goods at farmers markets.²⁵
 - Farmers require increased marketing including social media skills
 - Increased local sales reduces transport and emission costs
- j. Farmers start to grow alfalfa or other perennial crops to reintroduce phosphates as part of a new combination of crops that are rotated
- k. Livestock increasingly fed grass and "natural" feed
- I. Farmers become more interested in participating in soil/carbon sequestration markets. Many farmers in Canada already practice no-till, so they might consider alternative forms of crop rotation or planting trees as a means of increasing sequestrating carbon.
- m. Larger retail chains start marketing local produce to consumers to brand themselves as climatelocal friendly
- 4. Farmers grow new types of fruits, vegetable, grain and seed crops (enabled by plant genetics) to meet consumer demand for increased variety. Consumer demand is driving interest in an increased diversity of food crops. Whether it is a reflection of immigration, or celebrity chefs, people are developing an appetite for an increasingly broader range of fruits and vegetables. Farmers are responding, where they can, by growing increasingly diverse crops. The plant protein market is also driving new opportunities for crops. Resulting impacts include:
 - a. Farmers will start growing new crops like lentils, peas, legumes, soy associated with new plant protein industry
 - b. New types of plant disease potentially become a risk
 - c. New combinations of fertilizer, herbicides and pesticides needed to support production
 - d. Transport and logistics issues with shipping grains and other new products arise
- 5. Increased imports of certain fruits and vegetables to meet consumer demand: As Canadians embrace increased fruit and vegetables in their diet, this need will be met by both local and international production. Resulting impacts include:
 - a. Increased dependence on logistics, transport and associated costs to access imported foods
 - b. Increased GHG emissions associated with transportation
 - c. Less control of Canadian food security
- 6. Increased investment in plant protein meat alternatives and other products. Companies like Beyond Meat, Prairie Fava and others represent a growing and important market for Canadian

²⁵ Source: <u>http://www.omafra.gov.on.ca/english/busdev/facts/16-025.htm</u>

farmers. As an increasingly broad range of plant protein products are developed, farms will respond by growing soy, lentils, chickpeas, etc.²⁶ Resulting impacts include:

- a. Canadian start-ups enter development of new plant protein products
 - Drives demand for increased production of related crops from Canadian farmers
- b. Restaurants and other institutions provide more plant-based options on their menus
 - Drives demand for increased production of related crops
 - Generate waste that can potentially be used as an input to livestock production
- c. Establishment of quality control protocols and standards for the plant protein industry. This could potentially avoid cross boarder transport issues similar to what is experienced for meat inspection between Ontario and Quebec.
- 7. Improved health associated with balanced diet: The Canadian public, including farmers and ranchers may shift towards a more balanced diet. Reasons for this may be varied. It may reflect an increased awareness of the health benefits associated with eating a more balanced diet. Resulting impacts include:
 - a. Decreased hospitalizations associated with diabetes, cardiovascular diseases and some forms of cancer
 - b. Counter movement arises to promote meat as healthy component of diet
- 8. Reduced domestic sales of Canadian meat: A key assumption in this scenario is that farmers raising livestock will not reduce or cease production. Instead, they would shift their focus to either increasing exports or catering to more niche consumer preferences for higher quality, more "naturally" raised, low GHG products. If Canadian consumers buy less meat, resulting impacts include:
 - a. Reduced import of meats to meet local demand
 - Increased marketing to promote buying of local products
 - b. Increased sales of higher quality cuts of meat
 - Revitalization of local abattoir capacities
 - Increased number of boutique livestock operations
 - Increased cost of meat as consumers shift to smaller operators with decreased production efficiencies
 - c. Dietary supplements and feed alternatives used to reduce emissions and market to consumers. This is already being trialed in Australia where oils, fats, tannins, probiotics, nitrates, enzymes, marine algae and Australian native vegetation are used to reduce GHG emissions.²⁷
 - d. Replacement of meat with plant protein products
- **9.** Increased exports of meat to Asia and other parts of the world. Canada already exports significant amounts of meat to other parts of the world. As Asian economies continue to grow, so to have consumer incomes and the capacity and desire to eat more meat.²⁸ High quality pork is currently exported to between 145-150 countries. Efforts to maintain or increase export levels are expected under this scenario. Resulting impacts include:

²⁶ Source: <u>https://www.medicalnewstoday.com/articles/321474</u>

²⁷ Source: <u>https://www.agric.wa.gov.au/climate-change/reducing-livestock-greenhouse-gas-emissions</u>

²⁸ Source: <u>https://www.reuters.com/article/sponsored/china-appetite-still-growing</u>

- a. Increased promotional focus on quality of Canadian meat products in international markets (meat raised without antibiotics, progressive environmental policies for livestock production, etc.)
- b. Increased international investment in Canadian meat production
- c. Canadian producers would likely be more vulnerable to the volatility associated with international markets
- d. Increased use of air transport of livestock for butchering in Asia
 - Increases GHG emissions associated with meat production
- e. Shipping of butchered meat using deep freeze increases from Canadian ports
 - Increases GHG emissions associated with meat production

Analysis & Recommendations

A shift to plant-based diets will create a number of opportunities and challenges for Canadian farmers and ranchers. Government agencies will need to develop policy positions on which of the identified outcomes are desirable, and how best to support them should this scenario become a reality. The sections that follow flag high-level issues and suggest ways to support optimal outcomes. Where appropriate, opportunities for Farm Management Canada to support these efforts through its programs and services are also highlighted.

1. Increased investments in greenhouses and vertical farms:

a. Location of operations: Greenhouses and vertical farms do not have to be located on traditional agricultural land. In fact, they can be based right downtown in shopping malls as <u>Nokifarms</u> has demonstrated in Guelph. This flexibility can be used to address a potential suite of issues ranging from access to water and energy, to conserving arable land for other uses. However large-scale greenhouse operations have also been associated with light pollution. In Southern Ontario, the Leamington town council received nearly <u>1,300 comments on their proposed light abatement law</u>. Nearly all were in favor of limiting the nighttime light from local greenhouses.²⁹ While urban locations for vertical farms and greenhouses bring production directly to consumers, reducing transportation costs and reducing GHG emissions – it is clear there are a number of issues that need to be resolved to make this relationship a harmonious one.

Government Assistance

- Zoning laws and regulations need to be revised for urban and rural areas to address potential conflicts between residential neighbors and greenhouse operations associated with light, noise and other aspects of operations
- Government agencies should consider what regulatory measures and incentives could be rolled out to help actively support greenhouses and vertical farms

Farm Management Canada Assistance

²⁹ Source: <u>https://www.darksky.org/light-pollution-industrial-greenhouses/</u>

- Provide assessment tools and guides focused on risks and opportunities associated with location of operation – key considerations for those interested in starting greenhouses and vertical farms
- Provide training programs and tools for greenhouse and vertical farm operators to address potential issues and opportunities to build positive relations with urban and rural neighbours and communities
- **b. Powering operations**: Vertical farms and greenhouses use high amounts of energy to power their operations. Depending on which province or territory and/or how they are generating electricity, this can have significant implications for GHG emissions.

Government Assistance

- Governments will need to continue the transition to non-GHG power generation to assist vertical farms and greenhouses powered by the grid
- Streamline regulations for deploying onsite solar, wind, biogas and battery storage options should continue

Farm Management Canada Assistance

- Provide assessment tools and training programs to help operators assess power sources available to support greenhouse and vertical farm operations to maximize non-GHG power generation while remaining commercially viable
- c. **Future farmers**: Operators of vertical farms and greenhouses are often not traditional farmers. They come from business, engineering or biotechnology backgrounds. Not only will they bring new approaches and values to farming, but they are also unlikely to be part of any existing farming networks.

Government Assistance

 Government agencies will need to re-think how to reach out to engage and work with these new farmers. This could include working with tech incubators, research centers and universities to develop new networks and approaches for engaging these entrepreneurs.

Farm Management Canada Assistance

- Provide outreach/extension programs to reach and support this new group of farmers and help them integrate into the agricultural community.
- d. Increased GHG emissions: While vertical farms and greenhouse operations provide a range of opportunities to lower GHG emissions, they are also big energy users. As a result, increased deployment of these operations could drive up GHG emissions, especially in jurisdictions like Alberta, Saskatchewan, Nova Scotia, and Nunavut where the majority of electricity is generated from fossil

fuels (coal, natural gas, or petroleum).³⁰ A second potential source of GHG emissions comes from the use of air conditioning and refrigeration, both onsite and as part of associated "cold chains". Leakage of refrigerant can occur during operation of cooling equipment, as well as during assembly, repairs and end of life recycling/disposal.³¹ This leakage is responsible for 29.7% of total global GHG emissions in the cooling services sector and 30.7% of total GHG emissions in the space cooling sector.³²

Government Assistance

- Governments will need to phase out the use of Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and other substances used in refrigeration, air conditioners and fire suppressants responsible for direct fugitive emissions. These are associated with "cold chains" transporting fruit and vegetables.³³
- Governments will likely need to continue their efforts to transition to zero GHG power generation options
- Government agencies can develop guidance for onsite energy management and financial incentives for developing onsite renewable generation and power storage options
- Government can develop regulations around what types of refrigeration technologies are allowed, along with guidelines for maintenance and disposal of coolants, etc.

Farm Management Canada Assistance

- Provide assessment tools and training programs to help operators develop onsite renewable power generation and storage options while remaining commercially viable
- e. Technology sector growth: While the Netherlands have led these efforts to date, greenhouses and vertical farms have the potential to drive innovation in Canada's technology sectors. From increased use of robotics, bioengineering and big data to onsite renewable power generation and storage...all have exciting potential for scale-up if the appropriate incentives and scale-up ecosystems are there to support Canadian entrepreneurs.

Government Assistance

 Government can provide support for incubators, start-up and scale-up using approaches inspired by the IT sector. For instance, the Kitchener-Waterloo area is considered an IT hub for start-ups. In addition to having the University of Waterloo as a major research center, Google, Shopify and others have set up shop in the area. This in turn has attracted start-up schools, accelerators, etc. There are locations in Canada that have similar attributes that could be used to develop Agriculture IT Hubs. For example, the University of Guelph and associated private sector research

³⁰ Source: <u>https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles/canada.html#:~:text=Alberta%2C%20Saskatchewan%2C%20Nova%20Scotia%2C,%2C%20natural%20gas%2C%20or%20petroleum.
³¹ Source: <u>https://www.annualreviews.org/doi/full/10.1146/annurev-environ-012220-034103</u></u>

³² Source: Green Cool. Initiat. 2020. Global greenhouse gas emissions from the RAC sector. Green Cooling Initiative. <u>https://www.green-cooling-initiative.org/country-data#!total-emissions/all-sectors/absolute</u>

³³ Source: <u>https://www.epa.gov/sites/default/files/2015-07/documents/fugitiveemissions.pdf</u>

interests could be further developed as an Ag-IT hub. Similarly, the Pan-Canadian Smart Farm Network, led by Olds College and Telus' could act as Western Hub. Their work includes creating new opportunities to accelerate the development and adoption of technologies to support farming across Canada.

Farm Management Canada Assistance

 Provide training programs and tools to help operators identify and assess opportunities to integrate technology and innovation into greenhouse and vertical farm operations

2. Devoting more land to growing fruit, vegetable and protein crops:

Development and allocation of horticultural land: The amount of land devoted to grow fruit, vegetable, and other protein crops (soy, peas, etc.) will increase. However, it is not clear that current government regulations would result in the optimal allocation of existing horticultural land with competing demands for land.

Government Assistance

 Government agencies should consider undertaking research and consultations on existing zoning regulations to ensure that land-use decisions are made that result in optimal allocation of horticultural land

Farm Management Canada Assistance

 Provide knowledge resources on optimal growing conditions for fruit, vegetable and other protein crops to help producers identify and assess opportunities to convert existing land to these crops

3. Improved transport and logistics infrastructure:

Increased production in a wide range of locations will need to be supported by appropriate transportation and logistics infrastructure.

Government Assistance

- Develop more food hubs³⁴ to support small and medium-scale farms. This can be done through supporting grants, mapping their location and services,³⁵ etc.
- Increased investment and support in local farmers markets by governments. This could include measures that help ensure these markets are used to sell local produce rather than imports as has increasingly become the case with some vendors.

³⁴ Source: <u>https://foodsecurecanada.org/resources-news/news-media/fsc-news/understanding-regional-food-hubs</u>

³⁵ Source: <u>http://www.omafra.gov.on.ca/english/about/localfoodbpsgoal.htm</u>

- Provide training and support tools for food hub managers and employees
- Provide training and support tools for producers to assess potential risks and opportunities associated with transportation and logistics infrastructure for getting products to market

4. Growing new crops:

Consumer preference may drive demand for new crops like soy, quinoa, lentils, spirulina, chia seeds, etc. Farmers will want to respond, where possible, to consumer interests in new types of fruit, vegetable, grain and seed crops. This will require taking on new skills and knowledge, as well as potentially tools and equipment.

Government Assistance

- Develop regulations, guidelines and monitoring programs that backstop the rollout of new crops
- Develop best practice guidelines with industry for how to grow new crops, including appropriate mix of crops, etc.
- Support to encourage uptake of and transition to new crops by farmers
- Support research for new crops and methods
- Provide support for marketing new crops, including trade missions to new markets, etc.
- Ensure government programs are in place that provide guidance and help manage risks associated with growing new crops (ex. crop diseases, market fluctuations, etc.)
- Work proactively with transport, processing and logistic groups to support new production

Farm Management Canada Assistance

 Provide training and support tools for producers to assess potential risks and opportunities associated with growing, marketing and selling new crops

5. Increased need for migrant workers:

Barring significant breakthroughs in robotics or availability of domestic workers, migrant workers are likely to continue to play a vital role in harvesting fruit and vegetables on Canadian farms.

Government Assistance

 Government agencies will need to provide appropriate support to migrant workers. This includes access to visas, ensuring healthy working conditions, legal protection, streamlining immigration processes, etc.

Farm Management Canada Assistance

 Provide training and support tools to for producers to assess labour needs and managing migrant workers

6. Increased pesticide, herbicide and fertilizer use:

Increased production of crops will likely be accompanied by increased application of pesticides, herbicides and fertilizers and negative environmental impacts (associated with pollinators, fisheries and waterways) and economic impacts (increased input costs, supply chain risks).

Government Assistance

- Continue to evolve regulations around the use of certain chemicals, and promote best practices in terms of application
- Develop guidelines and incentives for the adoption of precision agriculture practices

Farm Management Canada Assistance

 Provide training and tools for farmers to assess risks associated with increased fertilizer use and alternative options to mitigate such risk

7. Improved water management:

Fruit and vegetable crops will require high amounts of water. This will put a focus on water management and conservation at the farm and watershed levels.

Government Assistance

- Governments will need to support watershed management and help mitigate conflict over water use and protection of riparian areas and related fisheries
- It some parts of Canada, it may be necessary to develop reservoirs
- Government agencies should also promote and support precision irrigation and other techniques that manage water use

Farm Management Canada Assistance

- Provide training on various forms of water management, including data management to assist farmers and ranchers
- Provide guidance and support on precision irrigation techniques

8. Management of plant waste:

Increased crop production will likely also be accompanied by increased levels of plant waste.

Government Assistance

- Government could provide regulations, support programs and incentives for recycling/upcycling plant waste
- Government could support research into developing crop varieties that reduce potential for waste, or alternatively promote different market uses for plant waste. For instance, some car companies are using soy in car seats and coconut husks in composite body parts. ³⁶

³⁶ Source: <u>https://www.extremetech.com/extreme/99249-ford-to-complement-soy-car-seats-with-coconut-composite-body-parts</u>

- Government could support guidance to farmers on how to use plant waste for composting, as well as selling to third parties for making biofuels
- Government could consider introducing regulations and public awareness campaigns to boost use of ugly fruit and vegetables. This could start by requiring public institutions like hospitals, prisons, etc. to use them in food production.

 Provide training and tools to farmers on how to reduce plant waste and/or use and market plant waste for composting and other recycle and upcycle schemes

9. Translating regenerative agriculture into practice:

While there is a lot of research into regenerative agricultural practices, it has not been mainstreamed in a way that the average farmer can see the connection between their farming practices and the opportunities these practices provide.

Government Assistance

- Support programs for industry to adapt/retrofit existing machinery and tools to enable their application to regenerative agricultural practices.
- Promote research and the value proposition of regenerative agriculture from a sales and risk perspective
- Expand existing subsidies and incentives that promote the adoption of regenerative farming/ranching practices³⁷

Farm Management Canada Assistance

 Provide training and tools for farmers and ranchers introducing them to what type of regenerative farming techniques are most appropriate for their land/type of farm operations and geography

10. Increased direct marketing to consumers:

Farmers growing fruit and vegetables will become more interested in direct marketing to consumers. There are a variety of ways of doing this, from roadside stands and agri-tourism to farmers markets and community supported agriculture (CSA) programs. These farmers will also be interested in developing secondary products like jams and preserves to capture higher value and avoid waste. Farmers and ranchers engaged in regenerative agriculture/rangeland management practices will wish to distinguish their products from those that do not.

Government Assistance

- Develop regulations that promote local number of farmers over resellers at farmers markets.
- Support industry in developing training and providing guidance to farmers for direct marketing and development of secondary products

³⁷ Source: <u>https://www.organiccouncil.ca/exploring-incentives-for-regenerative-practices/</u>

- Support Buy-Local campaigns
- Work with industry and not for profits to develop labelling standards and certification processes for regenerative agriculture.

 Develop training and tools for farmers for direct marketing and developing of secondary products including pricing, promotion, packaging, and positioning strategies

11. A focus on local and circular economic practices:

Adoption of regenerative agriculture practices are likely to put a greater emphasis on farmers who can work with other local businesses to reduce waste and promote circular economic practices. This may increase opportunities for composting, grazing, mixed farming, etc.

Government Assistance

- Governments can provide financial incentives that promote circular economic practices
- Support the development of markets, transport and logistic infrastructure that promote largescale composting using industrial food waste that is then used on farms or ranches.

Farm Management Canada Assistance

 Provide training and tools to help farmers and local businesses understand and become engaged in circular economic practices including risks and rewards

12. Carbon sequestration practices:

Farmers and ranchers engaged in regenerative agriculture will also likely be interested in entering carbon sequestration markets. Recommendations for government and Farm Management Canada are provided in the next section of this report focused on Carbon Markets.

13. Increased imports of fresh fruit and vegetables:

Canada will likely not be able to meet all its needs with increased local production. Consumers prefer fresh produce all year round, even in the middle of winter. Vertical farms and greenhouses are currently unable to grow many of the preferred fruits and vegetables people like to buy. As a result, it is very likely that imports will be used to meet the resulting deficit. Depending on where the fruit and vegetables originate, imports will increase GHG emissions associated with inputs, production, refrigeration, and transportation.

Government Assistance

 Increased focus on infrastructure, regulations and other capacities required to minimize GHG emissions associated with border crossings, "cold chain" imports of fruit and vegetables and ports³⁸

³⁸ Source: <u>https://www.epa.gov/sites/default/files/2015-07/documents/fugitiveemissions.pdf</u>

- Stablish requirements for improved reporting of GHG emissions along supply chains
- Increased investment in border as well as logistics infrastructure required
- Government will need to develop a national food security strategy that focuses on local production and trade with select partners
- Promotion of locally-produced frozen fruit and vegetables as healthy options during winter

 Provide training and tools to help farmers increase their capacity to grow, store and market local products, including during winter or off-season months

14. Increased investment in plant protein meat alternatives:

Start-ups and established food companies will continue to develop plant protein meat alternatives and other products. This has direct and indirect consequences for Canadian farmers. Not only will it drive the need for certain crops, but it will also provide opportunities for resulting waste to be used as inputs for livestock production.

Government Assistance

- Work with industry to establish quality control protocols, standards and guidelines for plant protein products
- Provide increasing support to Canadian start-ups developing new products, helping take them to scale, and linking them to local producers
- Promote buy-local campaigns to support Canadian farmers and plant protein product developers

Farm Management Canada Assistance

 Provide training and tools to farmers on risks and opportunities associated with supporting plant protein meat alternative markets and products including working with food companies

15. Improved public health:

In this scenario, society, including farmers, may enjoy improved health benefits associated with a balanced diet.

Government Assistance

- Ensure health improvements from plant-based diets are tracked, then shared. Provide relevant statistics on cardiovascular diseases, blood pressure, etc.
- Support research into what constitutes a healthy diet, focusing on the benefits of plant proteins, as well as increased levels of fruit and vegetables.

Farm Management Canada Assistance

 Provide training and tools to support farmers and promote the connection between diet and health and its importance to personal well-being to run the farm for farmers and employees

16. Reduced domestic sales of meat:

Reduced domestic sales of meat in Canada will increase competition among existing meat producers and may potentially suppress the entry of new domestic players. This will focus marketing efforts on selling local Canadian meat as high quality, environmentally friendly products.

Government Assistance

- Local production and sales of meat will be supported by reinvesting in locally owned and operated abattoirs. Governments can explore subsidies, tax breaks, development of infrastructure and regulatory reforms that assist in the re-establishment of these businesses.
- Support labelling/verification efforts for organic, free-range and grass-fed meat
- Support for research on dietary supplements like puffy pink seaweed and fish oils that reduce GHG emissions from livestock.³⁹

Farm Management Canada Assistance

 Provide training and tools for farmers and ranchers to assess risks and identify opportunities associated with producing and marketing Canadian meat for niche markets associated with premium and environmentally friendly products

17. Increased meat and livestock exports:

While Canada and the United States start to reduce consumption of meat in favor of a healthier diet, other parts of the world have been increasing their intake. Unless this trend changes, Canadian livestock producers will be well positioned to export products to these expanding markets.

Government Assistance

- Promote high-quality Canadian meat exports through labelling initiatives, marketing and trade missions
- Invest further in ports, airports and related facilities to support increased volume of meat exports
- Streamline regulatory requirements around exports and providing appropriate support at Customs.

Farm Management Canada Assistance

 Provide training and tools for farmers and ranchers to assess risks and identify opportunities associated with producing and marketing Canadian meat for export markets

³⁹ Source: <u>https://newatlas.com/environment/dietary-supplement-cuts-cow-methane-</u>

emissions/#:~:text=Tropical%20leaves%2C%20puffy%20pink%20seaweed,dent%20in%20bovine%20methane%20emissions

Carbon Markets

Introduction

Canadian agriculture is responsible for <u>10 per cent</u> of national greenhouse gas (GHG) emissions. On April 19 the 2021 federal budget earmarked \$270 million to support agriculture and climate-smart solutions, including regenerative farming to meet its climate change commitments.⁴⁰

One way to achieve these goals is through the establishment of carbon markets. These would allow farmers and ranchers to participate by either (i) reducing emissions or (ii) capturing and storing emissions (referred to as sequestration).

Reductions in emissions can be achieved by:

- Decreased manufacturing and application of synthetic nitrogen fertilizers
- Altered manure management
- Reduced fuel consumption
- Changes in feeding practices
- Switches to alternative fuels, such as from coal to natural gas or bioenergy
- Producing biofuels feedstock
- Implementing rotational grazing programs⁴¹

Carbon sequestration in agriculture refers to the capacity of agricultural lands and forests to remove carbon dioxide from the atmosphere.⁴² Carbon dioxide is absorbed by trees and plants through photosynthesis and stored as carbon in biomass and soils.⁴³ Soils are the largest terrestrial sink for carbon on the planet. Carbon sequestration can be achieved by:

- Conservation tillage and cover crops
- Rangeland management sequestration practices including reducing stocking rates and rotational grazing to allow forage regrowth and seasonal use as needed in eligible locations⁴⁴
- Organic cropping systems increasing soil organic matter through use of compost and eliminating emissions from the production and transport of synthetic fertilizers
- Land restoration and land use changes: Converting marginal cropland to trees or grass to maximize carbon storage on land that is less suitable for crops
- Irrigation and water management practices that reduce the amount of water and nitrogen applied to crop systems. This in turn reduces GHG emissions.
- Nitrogen use efficiency using techniques like precision agriculture to reduce nitrous oxide emissions, nitrogen fixing crop rotations, composting and integrated pest management
- Methane capture

⁴⁰ Source: <u>https://www.cbc.ca/news/canada/agriculture-emissions-reduction-strategy-1.5993201</u>

⁴¹ Luis A. Ribera and Bruce A. McCarl, N.D. Carbon Markets: A Potential Source of Income for Farmers and Ranchers. Texas A&M Agrilife Extension. Source.

⁴² Jeff Schahczenski and Holly Hill, 2009. Agriculture, Climate Change and Carbon Sequestration. National Sustainable Agriculture Information Service. <u>Source</u>

⁴³ United States EPA. 2008. Carbon Sequestration in Agriculture and Forestry.

⁴⁴ Ronald Follett and Debbie Reed, January 2010. Soil Carbon Sequestration in Grazing Lands: Societal Benefits and Policy Implications. In Rangeland Ecology and Management 63(1): 4-15 (2010)

At the 2015 Paris Climate Conference, an international initiative called the "<u>4 per 1000</u>," showed that increasing soil carbon by just 0.4% yearly on a global scale could <u>offset that year's new growth in carbon</u> <u>dioxide emissions from fossil fuel emissions</u>.

Soil Carbon Sequestration Markets

This foresight exercise has assumed that a market has been established for <u>soil carbon sequestration</u> in 10 to 15 years' time. This requires that a price be established that is sufficiently high to attract farmers and ranchers into this market. There are several other factors that would have to be overcome for this scenario to become a reality. For instance:

- i. Recent studies have shown that the International Panel on Climate Change (IPCC) estimates for the amount of carbon that can be captured through sequestration may be overvalued.⁴⁵
- ii. It is also unclear how permanent carbon capture is using soils. Scenarios where carbon can be released from soils include if a farmer decides to till the soil again, and if the land is sold and converted to other purposes where the soil will be disturbed.⁴⁶ Some carbon can also be released as soils warm.
- iii. Farmers that have practiced no till farming for years have also stated that they should be compensated for their historical efforts. This raises the challenge of being able to develop ways of measuring historical carbon capture, as well as whether or not markets would be willing to pay.

Despite these uncertainties, a compelling argument can be made for encouraging soil carbon sequestration. Improving soil health can also increase agricultural yields while reducing the need for synthetic fertilizers that contribute to nitrous oxide emissions (another potent GHG).⁴⁷⁴⁸ Soil carbon sequestration practices have also been shown to promote resilience to increasingly variable weather on farms and ranches.⁴⁹ For instance research has shown that soils with higher levels of organic matter are better at retaining water. This in turn mitigates yield loss from droughts.⁵⁰

Soil Carbon Sequestration

Soil carbon sequestration is a process in which CO2 is removed from the atmosphere and stored in the soil carbon pool. This process is primarily mediated by plants through photosynthesis, with carbon stored in the form of SOC. Improvements to soil health using regenerative agriculture practices have been shown to increase the sequestration of carbon in soils.

Farmers face a number of challenges adopting these practices:

1. It can take time for farmers to see the benefits of soil management

 ⁴⁵ Source: <u>https://www.csis.org/analysis/soil-carbon-sequestration-myths-realities-and-biden-administrations-proposals</u>
 ⁴⁶ Source: <u>https://thebreakthrough.org/issues/food/carbon-</u>

farming#:~:text=While%20soil%20carbon%20sequestration%20can,produce%20especially%20vulnerable%20carbon%20sequestration 47 Source: https://www.american.edu/sis/centers/carbon-removal/fact-sheet-soil-carbon-sequestration.cfm

⁴⁸ Source: <u>https://agriculture.canada.ca/en/international-trade/market-intelligence/soil-health-our-future-outcomes-report-eu-canada-agriculture-dialogue-workshops</u>

⁴⁹ Source: <u>https://theconversation.com/to-make-agriculture-more-climate-friendly-carbon-farming-needs-clear-rules-160243</u>

⁵⁰ Source: <u>https://iopscience.iop.org/article/10.1088/1748-9326/abe492</u>

- 2. Cover crops grown during the winter do not necessarily feed people or livestock, but they do help regenerate the soil
- 3. Research data quantifying the economic and environmental impacts of regenerative farming has been scarce to date (though more studies are now being undertaken in this area)
- 4. There are no regulatory bodies for regenerative agriculture

This foresight exercise assumes that these challenges have been overcome.

Wheel of Change Results for Soil Carbon Sequestration Markets

Figure 6 provides an overview of a future scenario where soil carbon sequestration markets are fully established. First order impacts identified include:

- 1. Rise of verification services for carbon credits
- 2. Increased farm revenue from soil carbon sequestration markets
- 3. Increased number of third-party aggregators
- 4. Sensors are used on farms to collect site specific carbon capture data
- 5. Increased used of satellite imagery to capture supporting data
- 6. Regenerative agriculture practices are mainstreamed
- 7. Afforestation and re-wilding of marginal land by farmers and ranchers
- Rise of verification services for soil carbon sequestration credits: This was viewed as a critical element of any established soil carbon sequestration market. Results of sequestration efforts would need to be scientifically defensible. The amount of carbon stored varies significantly across soil type, texture and climate.⁵¹ A combination of private sector and government services are envisioned in this scenario to ensure this market is sustainable. Resulting impacts include:
 - a. Agronomic mapping service companies start to sell verification services for carbon credits
 - Increased productivity will help sell other data driven agricultural practices
 - Verified carbon credits will attract more farmers and ranchers to the soil carbon sequestration market

⁵¹ Source: <u>https://www.nature.com/scitable/knowledge/library/soil-carbon-storage-</u>

^{84223790/#:~:}text=Soil%20carbon%20sequestration%20is%20a,in%20the%20form%20of%20SOC.

Seeds of Change

Figure 6: Wheel of Change for Soil Carbon Sequestration Markets Becoming Established



- 2. Increased farm revenue from soil carbon sequestration markets: While it was agreed that current income derived from early markets is insufficient to motivate large numbers of farmers and ranchers, this scenario assumes revenue streams have increased to motivate them. It was also recognized that once soils have sequestered carbon, there is no additional room to generate revenue. Soil carbon sequestration markets should be considered as a transitory fund that helps promote farmers to embrace other carbon neutral practices on the farm. Resulting impacts include:
 - a. Additional revenue reduces risks in farming, including changing economics and barriers to entry
 - b. Covers costs of collecting data and promoting other beneficial agronomic management practices (reduced tillage, controlled water usage, controlling plant populations)⁵²
 - c. Promotes development of compensation measures for other forms of ecosystem services (riparian zone protection, etc.)
- 3. Increased number of third-party aggregators: As this market matures, so too will the number of aggregators entering this space. This trend has already started in North America. Resulting impacts include:
 - a. Price of carbon credits stabilizes
 - b. Certification process established with quality controls
- 4. Sensors used on farms to collect site-specific carbon capture data: Farmers, aggregators and buyers, will all likely be interested in having access to site specific data on soil carbon sequestration. This will ensure that money spent on carbon credits is based upon scientifically verifiable data. For this reason, sensors will likely be established on all farms entering these markets. Resulting impacts include:
 - a. Robust rural 5G coverage will need to be established to support sensors and equipment
 - Increased deployment of data collection technologies on farms
 - Remote areas are now able to use a wider range of online data/IT services
 - b. Farmers will want to measure sequestration on their own farms acquiring new technical skills to track carbon sequestration
 - Third party technical support established for sensors (existing providers or new)
 - c. Third parties will provide sensors/tech for free in exchange for a portion of the revenue (example Carbon Asset Solutions)
 - d. Reference farms are used to established approximate sequestration values for farmers
 - e. Use of sensor data on farms will potentially change what crops are grown, where, etc. Crop rotations may shift as well depending on feedback from soil data.
 - f. Interoperability of sensors and equipment can become an issue where companies compete for market dominance This happened with USB cables in computing. There has been a slow convergence in standards. Similar issues could arise with this market.
 - g. There are a growing number of markets for a wide range of farm and ranch data collected
 - Insurance companies will have an interest in additional data points required by carbon markets as a further means of assessing on-farm risk

⁵² Source: <u>https://www.frankbayvillas.com/?p=132</u>

- 5. Increased use of satellite data to verify carbon sequestration data: The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) already uses satellite data to develop carbon sequestration estimates in Ontario. It is likely that this type of work will continue, and even intensify as a means of providing complimentary data sources to in-field sensors.
 - a. Sequestration data gathered by sensors will be verified by satellite data
- 6. Regenerative agriculture practices mainstreamed: Soil carbon sequestration markets would be a strong driver for mainstreaming regenerative agriculture practices. More specifically, they would help further define and refine practices on farms and ranches based upon types of soil, local climate, type of operations, etc. Crop diversification as well as cover crops, legumes and perennials returns more carbon to soil and sustain soil microbes that play key roles in carbon storage.⁵³ A wheel of change focusing specifically on regenerative agriculture impacts is shown under the Shifting Diets portion of this report.
- 7. Afforestation and re-wilding of marginal land: Potential revenue streams from soil carbon sequestration will also provide important incentives for farmers and ranchers to re-wild marginal lands. This will not only stabilize soils, but potentially result in further sequestration benefits that can be monetized.
 - a. Farmers derive secondary income from planting trees for maple syrup and timber
 - b. Farmers and ranchers graze livestock to reduce brush and wildfire risk
 - c. Increased wildlife habitat helping meet biodiversity commitments of government
 - Wild bee populations rebound

Analysis & Recommendations

Soil sequestration carbon markets will create several opportunities and challenges for Canadian farmers and ranchers. Government agencies will need to develop policy positions on which outcomes are desirable, and how best to support them should this scenario become a reality. In this section we review aggregate impacts identified through the wheel of change exercise and suggest options for government interventions and Farm Management Canada support.

1. Rise of verification services for soil carbon sequestration credits:

A critical element of any established soil carbon sequestration market will be the establishment of a system that verifies soil carbon sequestration credits.

Government Assistance

- Provide an online register of accredited companies selling verification services
- Support research that identifies soil sequestration levels expected in different soils, climates and crop systems. This work will help ensure carbon credits are awarded for actual capture.⁵⁴ For instance, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) uses a

⁵³ Source: <u>https://theconversation.com/to-make-agriculture-more-climate-friendly-carbon-farming-needs-clear-rules-160243</u>

⁵⁴ Source: <u>https://theconversation.com/to-make-agriculture-more-climate-friendly-carbon-farming-needs-clear-rules-160243</u>

combination of satellite imagery and lidar to survey soils and tree cover. The data is updated every 3 years.

Provide services for track credits sold and amounts of carbon sequestered.

Farm Management Canada Assistance

 Provide training and tools for farmers and ranchers to understand and implement verification measures and credit calculations for carbon sequestration

2. Increased farm revenue from soil carbon sequestration markets:

Farmers and ranchers will need to understand the economic risks and opportunities associated with soil carbon sequestration markets.

Government Assistance

- Provide tax-based incentives, subsidies and tools for farmers and ranchers to help reduce barriers for participating in soil carbon sequestration markets. This could include not taxing revenue derived from soil carbon sequestration efforts.
- Governments should lead in establishing rules and regulations around how soil carbon credits are verified and sold. There also needs to be some sort of insurance developed so that if conditions change or different crops are used that consequences/ liability is clear. This will reduce risk for all parties.
- Provide oversight and help develop private sector soil carbon sequestration markets⁵⁵
- Certification and verification programs can be established by governments to help reduce risks to farmers and provide assurances of financial returns
- Target young farmers: A significant demographic shift in the age of farmers will be taking place over the next 10 years. These farmers are going to be more tech savvy and looking for new ways to generate farm income. The government should target this demographic when developing the above strategies.
- Carbon sequestration opportunities are numerous, as are risks associated with undertaking these activities. Government can promote research into identifying when farmers should consider entering these markets.
- Governments can also help develop and promote other ecosystem markets with GHG and/or biodiversity benefits as soil carbon sequestration markets take off
- Governments might explore markets/incentives for long term payments to farmers that maintain soil carbon sequestration levels (rather than a one-off payment)

Farm Management Canada Assistance

- Providing training to farmers and ranchers to raise awareness and help manage risks associated with entering soil carbon sequestration markets. This could include developing case studies that run financial projections on costs and returns.
- Provide training to farmers and ranchers on how to calculate carbon sequestration levels and estimate potential returns from markets.

⁵⁵ Source: <u>https://agecon.ca.uky.edu/carbon-markets-101</u>

 Provide research and economic analysis to demonstrate the economic impact and opportunities associated with regenerative agricultural practices

3. Increased number of third-party aggregators:

Once carbon credits are generated, buyers can purchase those credits to help meet their GHG goals. These transactions occur through third-party aggregators that link sellers (farmers) with buyers.⁵⁶ Examples of these companies include <u>IndigoAg</u> and <u>Nori</u> in the U.S. and Farmers Edge in Manitoba which are already facilitating payments to farmers for carbon credits.^{57 58}

Government Assistance

- Government can provide transparency on the price of carbon credits by publishing available market information, tracking credits sold and amount of carbon sequestered.
- Support for connecting farmers and ranchers with aggregators
- Review the <u>Growing Climate Solutions Act of 2021</u> which authorizes the U.S. Department of Agriculture to help farmers, ranchers and private forest landowners participate in carbon markets

Farm Management Canada Assistance

 Provide training and information on entering the soil carbon sequestration market and working with third-party aggregators

4. Deployment of sensors on farms to collect site-specific carbon capture data:

Given the variability of soil carbon sequestration levels based upon local soils, climate and planting regimes, it is likely that farmers will deploy sensors on site to verify carbon capture. Doing so implies that support for IT infrastructure and skills be developed to support these activities.

Government Assistance

- ♦ Government supports the rollout of 5G networks in rural areas
- Government support for farmers to obtain measurement, sensors, data collection and analysis tools to verify carbon capture data
- Government will have a role in the protection of farm data privacy and ensuring that farmers have access to their own data. This includes ensuring an enabling framework that ensures data is used for the public good.

Farm Management Canada Assistance

 Provide training and tools for farmers and ranchers to deploy sensors to collect, analyze and verify carbon capture

5. Regenerative agriculture practices mainstreamed:

⁵⁶ Source: <u>https://agecon.ca.uky.edu/carbon-markets-101</u>

⁵⁷ Source: <u>https://theconversation.com/to-make-agriculture-more-climate-friendly-carbon-farming-needs-clear-rules-160243</u>

⁵⁸ Source: <u>https://www.agcanada.com/2021/07/big-ag-goes-headhunting-for-carbon-offsets</u>

Soil sequestration markets will help mainstream regenerative agriculture practices. However, there may be financial and other barriers that deter farmers from adopting these practices.

Government Assistance

- It will be important for farmers and ranchers to understand what carbon sequestration means in practical terms for their operations. Governments can work with Industry experts to provide knowledge, guidelines and tools that target specific types of farms and ranches and what sequestration opportunities are available to them.
- The cost of buying new equipment and tools for regenerative agriculture could be prohibitive.
 The government could consider:
 - Supporting retrofitting/retooling programs for existing equipment
 - Subsidies that offset costs for the purchase of new equipment
 - o Showing how existing equipment can be used differently
 - Running demonstration trials with certified agronomists to show benefits and reduce time/cost risks
 - Supporting training programs to promote use of new technologies and methods to support soil carbon capture and maintenance. These could be associated to eligibility to financial incentives for adopting regenerative agriculture practices.

Farm Management Canada Assistance

- Provide knowledge, training, guidelines and tools to help farmers and ranchers understand carbon sequestration in practical terms including associated challenges, risks and opportunities. This includes information on which plants contribute to soil carbon sequestration the best options for specific types of farms and ranches in various locations, including opportunities to diversify or change crops and farmland uses.
- Provide research and economic analysis to demonstrate the economic impact and opportunities associated with regenerative agricultural practices

6. Afforestation and re-wilding of marginal land:

Soil carbon sequestration could potentially generate enough revenue that farmers have an incentive to re-wild marginal land. This could help address important biodiversity goals and promote the resurgence of pollinators critical to crop health. However, ensuring that this is done properly will require guidance and support.

Government Assistance

- Government can develop maps that identify which lands could be converted to achieve afforestation, re-wilding and biodiversity goals
- Government can also support and/or develop satellite and ground surveys to measure progress towards afforestation, re-wilding, and biodiversity goals
- Establishing policies and guidelines will be important for government to ensure best practices are used to convert marginal land towards achieving afforestation, re-wilding, and biodiversity goals
- Establish government incentives and reward programs for farmers and ranchers who convert marginal land to support afforestation, re-wilding and biodiversity

 Resources including seedlings with desired species can be made available through government programs at low/no cost

Farm Management Canada Assistance

 Provide training and tools to help farmers and ranchers assess risks and opportunities associated with converting marginal land to support biodiversity

Conclusions

There is no doubt that climate change is driving shifts in weather and behaviour that are consequential to Canadian farms and ranches. And these changes are accelerating. Being able to understand the consequence of related impacts will better position farms and ranches to manage opportunities and risks. Foresight approaches provide new and exciting ways of achieving this goal. Farm Management Canada's *Roots of Success* project provided an opportunity for National Risk Management Roundtable members to undertake a horizon scan exercise. The scan was used to identify weak signals – or seeds of change – that have the potential for significant impacts should they become the norm.

Two seeds of change were identified by Roundtable members as potential priorities for consideration:

- The shift towards more plant-based diets in Canada, and
- The emergence of soil carbon sequestration markets

These seeds of change were used to develop wheels of change including primary, secondary and tertiary impacts associated with each change.

Key Findings

The complexity of scenarios developed by Roundtable members revealed a wide range of primary, secondary and tertiary impacts associated with each seed of change. Some of these impacts would not have been obvious without applying foresight techniques. For instance:

 The potential rise in GHG emissions associated with a shift towards more plant-based diets despite the fact that consumers are changing their diets in part due to their concerns over the impacts of livestock on GHG emissions.

or

• How the emergence of soil carbon sequestration markets will require the establishment of 5G networks and push the use of big data on farms and ranches.

There are also examples of impacts that push the system in opposing directions. For instance, the deployment of greenhouses and vertical farms in or close to cities will reduce GHG emissions associated with transportation and logistics. However, if those same operations are powered by fossil fuels, and do not manage refrigerants and coolants used, they can potentially increase associated emissions. This is a potential issue in regions that have not converted their grid to non-GHG emission power sources.

While Canada produces more than enough food to feed itself, we are in fact a country that relies heavily on imported fruits and vegetables to meet consumer demand for fresh produce during the winter. Unless this preference changes, a future scenario where the majority of Canadians are eating a plantbased diet will need to be met through significant increases in greenhouse production, as well as through imports. Increasing imports could dramatically increase GHG emissions and also bring new competition to Canadian producers. If Canada is to meet its GHG emission targets, it will need to make a concerted effort to promote local production and consumption, while addressing GHG emissions associated with transportation and logistics. A particular focus will need to be made on addressing related "cold chain" issues.

Interestingly the rise of soil carbon sequestration markets is likely to be strongly linked to the rollout of 5G networks, sensors, and data management in rural areas. This IT infrastructure will help drive improvements in productivity and encourage other markets for other ecosystem services (riparian zone protection, biodiversity measures, etc.) once farmers understand the benefits to their operations. The above will require considerable government support and investment by aggregating businesses interested in developing these markets. Complexities in the scenarios developed underscore the challenges facing policy makers, enforcers, service providers and farms when trying to meet emission targets and the opportunities that may arise from climate change impacts.

It is important to note here that these scenarios have limitations. They are attempts to understand possible futures but are certainly not definitive. They are intended to help decision makers by flagging trends and indicators of change that should be monitored over time. Should scenarios begin to manifest, stakeholders will be better placed to understand potential consequences along with associated risks and opportunities that need to be managed. Most foresight exercises are revisited and refined over time. This is something that Farm Management Canada can consider with seeds of change identified in this report, and others identified through future exercises.

Key Recommendations

While this report provides a detailed, extensive list of recommendations for both government and Farm Management Canada, the following recommendations have been highlighted as key factors in contributing to meeting Canada's climate change goals:

Government

The shift towards more plant-based diets will challenge Canada's ability to meet its GHG commitments. Recommendations for government agencies include ensuring policy, regulations, infrastructure, support and/or incentive programs are developed to:

- Phase out the use of Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and other substances used in refrigeration, air conditioners and fire suppressants responsible for direct fugitive emissions. These are associated with "cold chains" transporting fruit and vegetables.⁵⁹
- Limit GHG emissions associated with transport/logistics resulting from cross-border imports. This can help reduce waiting time at borders, etc.
- Power greenhouses and vertical farms from non-GHG emitting power sources.
- Target new farmers entering the greenhouse/vertical farming space. These individuals tend to come from highly technical backgrounds (engineering, IT, biotech disciplines) and will likely not be reached through traditional channels.
- Support watershed management and precision irrigation in areas where competition for water from competing land uses is high.
- Ensure regulations are updated to support the optimal allocation of horticultural land.

⁵⁹ Source: <u>https://www.epa.gov/sites/default/files/2015-07/documents/fugitiveemissions.pdf</u>

• Support GHG emissions monitoring, reporting and transparency along supply chains

The scenario developed for soil carbon sequestration markets underscores the reality that this shift will require ensuring 5G connectivity in rural areas thereby enabling precision agriculture and big data applications on farms.⁶⁰ Key recommendations for government include ensuring policy, regulations, infrastructure and incentive programs are developed to:

- Reach remote rural areas with robust 5G coverage to support data collection, analysis, reporting and verification.
- Provide timely, accurate, readily available information to farmers and ranchers regarding market prices and aggregators for soil carbon credits.
- Provide insurance schemes for instances when soil carbon sequestration fails (this could include situations where land is bought from farmers and converted to other uses, or when natural disasters greatly affect soil profiles).
- Protect the digital privacy of farmers and ranchers.

Regenerative farming plays a key role in both scenarios. Government agencies will need to work with farmers to provide the research, incentives and guidelines that will help different farm and ranch systems convert operations while keeping new initiatives and processes accessible and efficient.

Farm Management Canada

The shift towards plant-based diets and the rise of carbon sequestration markets reveals opportunities for Farm Management Canada to develop and deliver programs and services, and conduct research, that provide Canada's farmers and ranchers with the knowledge, resources, and tools to manage change and seize the new opportunities that these two signals could provide for the agricultural sector. Key recommendations for Farm Management Canada include:

- Lead work on climate change risk management and business opportunities for farmers and ranchers.
- Continue to promote and support a comprehensive approach to managing risk in agriculture that acknowledges the connections between Canada's climate change goals and the risks and opportunities for farmers and ranchers.
- Continue to explore the connection between farm business management and climate change to identify existing and emerging risks and business opportunities for Canada's farmers and ranchers
- Expand on foresight techniques piloted in this report as a means of identifying potential risks and opportunities for farmers and ranchers.
- Help farmers and ranchers assess and apply regenerative farming practices to improve soil health and tap into soil carbon sequestration markets.
- Raise awareness amongst farmers and ranchers regarding the risks and opportunities that the shift to a plant-based diet may bring and provide relevant training on marketing opportunities that arise from these trends.
- Help farmers and ranchers explore and capitalize on the opportunities brought by 5G networks in rural areas to improve the business of farming and risk management. From improved forms of e-

⁶⁰ Source: <u>https://www.newswire.ca/news-releases/5g-has-positive-impacts-for-canadians-in-rural-and-urban-communities-848033601.html</u>

commerce to real time data collection and analysis, remote medical support,⁶¹ online training and mobile apps that farmers can use to support their work.

• Vertical farms and greenhouses are ushering in a new type of farmer. They come from biotech, engineering and IT backgrounds, and may not even consider themselves farmers in the traditional sense. It will be important for Farm Management Canada to develop new networks, supported by cutting edge IT applications if they are to engage this group. Engaging with this new group of farmers may also require hiring staff with new skill sets to support these operations.

Climate change will continue introduce new risks and opportunities to Canada's agricultural sector. Farm Management Canada's National Risk Management Roundtable members were able to identify both threats and potential opportunities by engaging in this foresight exercise. Resulting future scenarios provide an indication of what will need to be managed if these trends are fully manifest.

One of the more revealing outcomes of the Seeds of Change exercise has been that there needs to be a shift in thinking and attitudes towards climate change in the agricultural sector. What is currently viewed as a risk or obligation that causes extra work or imposes costs for farmers and ranchers can also be an important opportunity. Shifts in climate drive extreme weather events nd introduce new pests along with a suite of other risks for farms. However, agriculture will also benefit as new techniques and technologies improve productivity and efficiencies. Canadian agriculture can lead sustainability efforts, while benefitting economically from the programs that are being put in place to counter climate change. Farm Management Canada will need to work proactively in this space with its members to ensure the future of our farms and our country is bright.

Farm Management Canada has an opportunity to support agriculture through ongoing research in this area, by developing new tools, and by engaging Canada's farmers and ranchers in knowledge dissemination activities and training. Taking a proactive approach to managing risks associated with climate change and seizing business opportunities will help ensure that Canadian agriculture continues to lead global efforts to feed the planet while nurturing it at the same time.

⁶¹ Source: <u>https://www.theglobeandmail.com/featured-reports/article-how-5g-is-helping-to-connect-rural-communities/</u>

Annex 1: Seeds of Change Participants

Members of Farm Management Canada's National Risk Management Roundtable that contributed to the Seeds of Change exercise include:

| Name | Position | Organization |
|-----------------|-------------------------------|---|
| Derek Brewin | Head of the Department | University of Manitoba |
| | Agribusiness and Agricultural | |
| | Economics | |
| Bob Burden | Director | Serecon |
| Amy Cronin | President | Cronin Farms |
| Craig Macfie | Co-CFO | Monette Farms |
| Stephen Duff | Chief Economist | Ontario Ministry of Agriculture, Food and Rural |
| | | Affairs (OMAFRA) |
| Steve Funk | Director Agriculture Risk | MNP |
| Trish Laugharne | Farm Business Specialist | BC Ministry of Agriculture, Food and Fisheries |
| Earl Pollock | Owner | Pollock's Tax Services |
| Scott Ross | Assistant Executive Director | Canadian Federation of Agriculture (CFA) |
| Mike Tisdall | Director, Knowledge & | Farm Credit Canada (FCC) |
| | Advisory Services | |
| Herman | Private Consultant | |
| Simmons | | |
| Brian Wittal | Private Consultant and | Pro Com Marketing Ltd |
| | Columnist | |

Annex 2: Interview Form

Seeds of Change Interview Questions & Guide

February 2022

Introduction

As a result of the Horizon Scan exercise in Phase 1, two weak signals were select as priorities by the National Risk Management Committee. They were:

- Shift in diets to more fruit and vegetables and non animal protein
- Established market for carbon sequestration in soils

In the next step, a wheel of change will be developed for each signal around the assumption that the signal is now real and pervasive. Undertaking this work allows one to better understand the full scope of potential positive and negative impacts that need to be managed.

Two objectives underpin this exercise:

The first is to identify primary and secondary impacts associated with each weak signal, and to flag any assumptions around those impacts. This helps develop a potential future scenario for that signal. Developing wheels of change assist in visualizing cause and effect. The drafts attached to this form are intended as starting points and totally open to change based upon Committee Members thoughts and ideas.

The second objective is to develop recommendations that help manage associated risk and maximize benefits. These recommendations should answer the following questions:

- What investments should farmers be making and what activities should they undertake?
- What support can Farm Management Canada provide?
- What policies and programs should governments develop?

Tables have been developed for each wheel of change that will assist in this exercise. Note that **Attachment 1** focuses on plant-based diets, while **Attachment 2** focuses on markets for carbon sequestration.

Seeds of Change

Attachment 1: Wheel of Change Plant-Based Diets



First order impacts associated with an increased plant-based diet include (but are not limited to):

- 1. Increased investment in Greenhouses
- 2. Regenerative agriculture practices increase in response to climate change movement
- 3. Increased investment in plant protein meat alternatives and other products
- 4. Farmers and Ranchers devote more land to growing vegetables
- 5. Increased number and size of orchards
- 6. Improved health associated with balanced diet
- 7. Increased exports of meat to Asia
- 8. Reduced Canadian sales of meat, but increased percent of sales for high-quality meat products
- 9. Farmers and ranchers enjoy improved health from better diet

Details on the assumptions and implications of these impacts for farmers, Farm Management Canada and the Government follow. So too does the extended analysis of secondary impacts and their implications

| Primary Impact | Assumptions | Farmers Response | FMC Response/Support | Proposed Government Response |
|---|---|--|--|---|
| Increased number of Greenhouse | Increased volume of fruit and vegetables will | New greenhouse operations may choose locations | What are the best technologies to invest in and why? | Grants/subsidies?? Technical support? |
| operations | attract investors in this space | close to cities, giving them a competitive advantage | Risks and opportunities to be managed by Greenhouse operators | |
| | | Existing farms and ranches may add greenhouses to their operations | Develop a guide to the most cost-effective crops. | |
| Secondary | Assumptions | Farmers | FMC | Proposed |
| Impacts | | Response | Response/Support | Government Response |
| Increased demand for onsite RE power generation and storage | Greenhouses have high energy requirements that will make it cost effective for farmers to deploy onside solutions | Farmers will increase number of solar panels, windmills and battery storage facilities onsite | What are the best technologies to invest in and why? Risks and opportunities to be managed on farm for RE production and storage | Provide subsidies for RE and battery installations in regions where provincial generation is not already 100 % RE |
| Reduced transport costs for vegetables | Location of greenhouse operations will be determined by access to transport hubs, rather than soil quality. | Lower GHG emissions may provide competitive advantage to local producers | None | Model GHG reductions achieved through localized production and transport? |

Sample Impact Table

| Need to import | All year | Note: Impacts | May have trade |
|-------------------|-------------------|-------------------|----------------|
| certain | production | distributors more | implications |
| vegetables (leafy | efficiencies and | than farmers. | |
| greens) may | price points will | | |
| disappear | make it pointless | | |
| altogether | to import certain | | |
| | vegetables. | | |

Seeds of Change

Attachment 2: Wheel of Change - Soil Carbon Sequestration Markets Established



Carbon sequestration of soils offers a range of potential benefits for farm systems which are detailed below. Governments are in a position to promote carbon sequestration in soils through a range of awareness, training and incentive programs. Farm Management Canada could also potentially provide training courses. First order impacts associated with established soil sequestration markets include:

- 1. Regenerative agriculture practices are mainstreamed
- 2. Rise of verification services for carbon credits
- 3. Increased farm revenue from soil carbon sequestration markets
- 4. Increased number of third-party aggregators
- 5. Sensors are used on farms to collect site specific carbon capture data
- 6. Increased used of satellite imagery to capture supporting data
- 7. Afforestation and re-wilding of marginal land by farmers and ranchers

| Primary Impact | Assumptions | Farmers Response | FMC Response | Proposed Government |
|--------------------|--------------------|-------------------------|--------------|------------------------|
| | | Response | | Response |
| Regenerative | This suite of | Will require new | | Government |
| agriculture | practices provides | skills | | promotes |
| practices increase | demonstrable | | | regenerative |
| | advantages for | | | agriculture |
| | sequestering | | | practices through |
| | carbon in soils. | | | training, awareness |
| | | | | raising and |
| | | | | compensation |
| | | | | packages. |
| Secondary | Assumptions | Farmers | FMC Response | Proposed |
| Impacts | | Response | | Government |
| | | | | Response |
| Improved soil | Rangeland | Reduces irrigation | | Government |
| water retention | management | needs and costs | | introduces policies |
| with watershed | sequestration | , , | | and incentives that |
| penerits | practices improve | increased raising | | protect and |
| | water retention. | of buffalo and | | expand natural |
| | | other native species | | grassiands. |
| | | | | Watershed |
| | | | | management |
| | | | | initiatives are used |
| | | | | to promote |
| | | | | rangeland |
| | | | | management |
| | | | | sequestration |
| | | | | practices |
| Decreased use of | Other drivers will | Savings from | | Governments may |
| chemical | include increased | avoided costs of | | already ban the |
| pesticides and | use of precision | apply pesticides | | use of certain |
| herbicides | agriculture | and fertilizers can | | harmful pesticides. |

Sample Impact Table

| | technologies and | be used to offset | | |
|------------------|---------------------|------------------------|------|---------------------|
| | bans of certain | other related | | Awareness raising |
| | chemicals. | investments. | | and training |
| | | | | programs can be |
| | | Farmers will | | used to promote (i) |
| | | require increased | | precision |
| | | knowledge and | | agriculture |
| | | skills | | practices that |
| | | | | reduce application |
| | | | | of pesticides and |
| | | | | herhicides (ii) |
| | | | | composting and |
| | | | | livestock practices |
| | | | | that reduce the |
| | | | | nood for |
| | | | | herbicides |
| Largo Scalo | Largar farm | Formars will pood | Nono | Circular aconomy |
| Large Scale | | to have | NOTE | |
| Composing | | compositing | | policies and |
| | require significant | facilities and tools | | |
| | | | | encourage the |
| | composting | to apply | | diversion of food |
| | material that will | la sus sus division of | | waste to |
| | be provided from | increased use of | | commercial |
| | large scale | manure from | | compost |
| | operations | livestock to | | operations |
| | | cultivate soils | | |
| New Equipment | Existing machinery | Farmers may wish | | Government could |
| and knowledge | for farms may be | to adopt low-cost | | promote retrofit |
| will be required | contributing to | regenerative | | programs that |
| | erosion of soil | solutions first. | | modify existing |
| | health. | | | tools and |
| | | New equipment | | equipment. |
| | | and tools are | | |
| | | developed to | | |
| | | support | | |
| | | regenerative | | |
| | | agriculture. | | |

Annex 3: Phase 1 Results from Changing Canadian Diets Research

1. What is an important weak signal associated with climate change that you consider consequential to farming operations and their supply chains?

Canadians increase their consumption of fruits and vegetables while reducing their consumption of meat and dairy over the next 10 years.

2. Please provide quotes and references that support your suggestion of the weak signal.

- A 2018 Dalhousie University Study found that close to 10% of Canadians now consider themselves vegetarian or vegan. That's approximately 2.3 million who identify as vegetarian, an increase from 900,000 reported in 2003, and another 850,000 labeling themselves as vegan.⁶²
- "In 2018 we estimated that 6.4 million Canadians already follow a diet that restricts meat
 partially or completely," notes the principal investigator of the study Sylvain Charlebois from the
 Agri-Food Analytics Lab. "But now [in 2020] we've already revised this number to 10.2 million.
 Things are changing really fast, faster than ever really."⁶³
- A shift to plant-based diets is gaining traction among a wider segment of consumers. This shift is due in part to the newly **updated** Canada Food Guide, which emphasizes legumes, vegetables and lean proteins, and no longer features traditional dairy products.⁶⁴ The guide may have widespread impact, since hospitals, schools, doctors and nutritionists, among others, often use the guide in preparing meal plans and/or guidance for healthier personal eating habits.⁶⁵

3. What are the key drivers for this weak signal?

- There is growing pressure to reduce climate impacts from agriculture by adopting plant rich diets.⁶⁶
- Consumers are shifting their diets away from meat-based diets for a variety of reasons including concern for animal welfare, the environment, sustainability and reducing environmental footprint, and concern for personal health.⁶⁷
- In 2018, scientists behind the most comprehensive analysis to date of the damage of farming to the planet found avoiding meat and dairy products was the <u>single biggest way to reduce your</u> <u>environmental impact on the planet</u>. The research showed that without meat and dairy consumption, global farmland use could be reduced by more than 75% – an area equivalent to the US, China, European Union and Australia combined – and still feed the world.⁶⁸

⁶² Source: <u>https://wedc.org/export/market-intelligence/posts/canadian-consumers-shift-to-plant-based-diets/</u>

⁶³ <u>https://www.nationalobserver.com/2020/02/18/news/young-canadians-are-becoming-vegetarian-or-vegan-fight-climate-change</u>

⁶⁴ Source: <u>https://www.foodincanada.com/features/plant-based-foods-are-the-</u>

future/#:~:text=Plant%2Dbased%20diets%20traditionally%20were,longer%20features%20traditional%20dairy%20products.

⁶⁵ Source: <u>https://wedc.org/export/market-intelligence/posts/canadian-consumers-shift-to-plant-based-diets/</u>

⁶⁶ Source: https://www.vox.com/21562639/climate-change-plant-based-diets-science-meat-dairy

⁶⁷ Source: <u>https://wedc.org/export/market-intelligence/posts/canadian-consumers-shift-to-plant-based-diets/</u>

 $^{^{68}\} https://www.theguardian.com/lifeandstyle/2021/apr/25/going-vegan-can-switching-to-a-plant-based-diet-really-save-the-planet-based-diet-based-based-based-based-based-based-based-based-based-based-based-based-based-based-based-based-base$

4. Identify whether this weak signal will have consequences at a national or a regional level. For the purpose of this exercise, we are using the following regions (West Coast, Central Canada, Ontario/Quebec, Maritimes and Northern Canada)

Shifts in diet will be differentiated regionally. However, impacts to farmers over the next 10 years will depend upon their markets. People living in the provinces of British Columbia and Ontario were more likely to identify as vegetarians or vegans than those living in the Prairies, Quebec or the Atlantic region, and city dwellers were three times more likely to commit to veganism than those residing in small towns.⁶⁹

5. What opportunities and risks will farmers and their supply chains face have to manage if these weak signals become the "norm".

Fruit, vegetable, and grain farmers are likely to see sales increase as consumers shift their food preferences. Given Canada's climate this could include a continued growth in greenhouse production and related technologies.

Meat, poultry, and dairy farmers may see a reduction in sales and a decrease in prices as demand drops. Those that diversify production and get organic certification may be able to offset these losses.

6. What is the current status quo? Please support your statement with a reference to current facts.

- The typical Canadian diet continues to be one that relies heavily on meat, dairy and pulses.
- According to an IPSOS poll, fewer than one-in-five (17%) Canadians consume the Canada Food Guide Recommended 5 servings of fruits or vegetables, and only 5% consumed the recommended servings of cereal, grains or bread.⁷⁰
- In 2004 Stats Canada reported that, 7 out of 10 children aged 4 to 8 had less than five servings of vegetables and fruit a day (<u>Chart 3</u>). At ages 9 to 13, 62% of girls and 68% of boys did not meet the minimum. Consumption was somewhat higher among adults, but around half fell short of the five-serving minimum.⁷¹, ⁷²

⁶⁹ Source: <u>https://wedc.org/export/market-intelligence/posts/canadian-consumers-shift-to-plant-based-diets/</u>

⁷⁰ Source: <u>https://www.ipsos.com/en-ca/news-polls/so-what-foods-are-canadians-eating-and-how-healthy-do-they-think-they-are-eating</u>

⁷¹ Source: <u>https://www150.statcan.gc.ca/n1/pub/82-003-x/2006004/article/habit/4148989-eng.htm</u>

⁷² Source: <u>https://foodpolicyforcanada.info.yorku.ca/backgrounder/problems/poor-diet/</u>

Annex 4: Phase 1 Results from Carbon Asset Evaluation Systems Research

1. What is an important weak signal associated with climate change that you consider consequential to farming operations and their supply chains?

The development of carbon asset evaluation systems for agriculture in Canada will be an important economic driver in 5-10 years.

2. Please provide quotes and references that support your suggestion of the weak signal.

- Olds College is working extensively with start-ups interested in developing appropriate technologies and practices to support carbon asset evaluation systems
- Companies like Nutrien are making commitments as follows "Our 2030 Commitment By the year 2030, we aim to launch and scale a comprehensive carbon program, empowering growers and our industry to accelerate climate-smart agriculture and soil carbon sequestration while rewarding growers for their efforts. We are creating a network of growers, suppliers, government and industry players to gather key learnings and scale this important initiative and meet common sustainability goals and objectives.⁷³

3. What are the key drivers for this weak signal?

The Paris Agreement Climate Targets will require widespread use of carbon pricing to steer the world into a low carbon pathway. To enable, systems will need to be developed to quantify carbon assets and monetize throughout the value chain.

The Guelph Statement. A Vision to 2028. Federal and provincial ministers have stated that one of the top priorities agriculture and food production is "Tackling **climate change and environmental protection** to support GHG emission reductions and the long-term vitality of the sector while positioning producers and processors to seize economic opportunities from evolving consumer demands"⁷⁴

Regulations will be a key driver in promoting the development of carbon asset evaluation systems. Canada has imposed a carbon levy, with other regulations likely to follow.

Agriculture is now considered to be part of the solution for sequestering GHGs as opposed to being just a source of emissions.⁷⁵

⁷³ Source: <u>https://www.nutrien.com/sustainability/strategy/feeding-planet-sustainably/carbon-program</u>

⁷⁴ Source: <u>https://agriculture.canada.ca/en/about-our-department/key-departmental-initiatives/meetings-federal-provincial-and-territorial-ministers-agriculture/guelph-statement</u>

⁷⁵ Source: <u>https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/climate-action/reducing-agricultural-ghgs</u>

4. Identify whether this weak signal will have consequences at a national or regional levels. For the purpose of this exercise, we are using the following regions (West Coast, Central Canada, Ontario/Quebec, Maritimes and Northern Canada)

Answer: This signal will have national impacts, though regional nuances are likely. Each province and territory are likely to embrace carbon markets at their own pace.

5. What opportunities and risks will farmers and their supply chains face have to manage if these weak signals become the "norm".

Risk

• Farmers that ignore carbon markets will miss revenue opportunities

Opportunities

There is an opportunity for farmers to:

- Embrace circular economic principles to get a full picture of their carbon footprint
- Focus on overall soil health will likely require that farmers adopt practices that bring further resilience benefits to their businesses.
- Market products based upon carbon sequestration

6. What is the current status quo? Please support your statement with a reference to current facts

Answer: Farmers currently focus on yield and cost, without looking at long term health or impact on soil health.

Annex 5: Phase 1 Results from Carbon Trading Research

1. What is an important weak signal associated with climate change that you consider consequential to farming operations and their supply chains?

Answer: Carbon trading/credits will materially affect farm and ranch operations.

2. Please provide quotes and references that support your suggestion of the weak signal.

- The province of Alberta has developed a GHG emission reduction strategy that targets the agriculture sector with 4 protocols (strategies) including (i) Conservation Cropping, (ii) Fed Cattle (Reducing Greenhouse Gas Emissions from Fed Cattle), (iii) Microgeneration (Distributed Renewable Energy Generation) and Biogas (Anaerobic Decomposition of Agricultural Materials)⁷⁶
- Microsoft bought nearly 200,000 of the farm-based credits at an undisclosed price among the largest-ever purchases of agricultural credits - as part of a larger deal to buy 1.3 million credits. But the tech giant rejected far more of the more than 5 million credits offered by agriculture projects because of systemic problems with measuring their climate benefit.⁷⁷
- The Agricultural Producers Association of Saskatchewan (APAS) has released updated estimates of the impact this increase will have on farmers. "Our updated numbers show that the cost of producing wheat could go up to over \$12.50 per acre in 2030 due to the carbon tax," said APAS President Todd Lewis.⁷⁸

3. What are the key drivers for this weak signal?

- In order to accelerate the market adoption of the technologies and practices needed to reduce emissions and to build a prosperous low carbon economy, Canada proposed in <u>a Healthy</u> <u>Environment and a Healthy Economy</u> to increase the price on carbon pollution annually at a rate of \$15 per tonne from 2023-2030. ⁷⁹⁸⁰
- August 12, 2021, The On-Farm Climate Action \$200-million Fund will provide direct support to farmers to adopt beneficial management practices that store carbon and reduce greenhouse gas (GHG) emissions in three target areas: cover cropping, nitrogen management, and rotational grazing practices. These three on-farm actions not only reduce GHG emissions but also offer farmers a cost-effective solution to improve soil health and achieve other environmental benefits.⁸¹
- Several companies (<u>Cargill</u>, Bayer and <u>Farmers Edge</u>) have already implemented carbon payment programs for farmers

⁷⁶ Source: <u>https://www.alberta.ca/agricultural-carbon-offsets-overview.aspx</u>

⁷⁷ Source: https://www.reuters.com/business/energy/farmers-struggle-break-into-booming-carbon-credit-market-2021-04-28/

⁷⁸ Source: <u>https://apas.ca/pub/documents/News%20Releases/2021/apas-carbon-costing-january-7-2021.pdf</u>

⁷⁹ Source: <u>https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/carbon-pollution-pricing-federal-benchmark-information.html</u>

⁸⁰ Source: <u>https://www.cbc.ca/news/politics/carbon-tax-hike-new-climate-plan-1.5837709</u>

⁸¹ Source: <u>https://www.canada.ca/en/agriculture-agri-food/news/2021/08/helping-farmers-to-reduce-ghgs-and-improve-resiliency-to-climate-change.html</u>

• Farms are now recognized as both sources of GHG emissions as well as sinks thereby shifting mindsets of farmers to one of embracing opportunities.⁸², ⁸³

4. Identify whether this weak signal will have consequences at a national or regional levels. For the purpose of this exercise, we are using the following regions (West Coast, Central Canada, Ontario/Quebec, Maritimes and Northern Canada)

National, with regional distinctions based upon provincial programs and regulations. Compliance markets are already trading at a premium relative to voluntary ones in Canada and the U.S.

5. What opportunities and risks will farmers and their supply chains face have to manage if these weak signals become the "norm".

<u>Risks</u>

• There will be increased costs associated with inputs and supplies for farms. This has implications for business plan and organizational structure of farm operations.

Opportunities

- New revenue streams and lowered costs for farms related to carbon credits that manage their farms using new methods (regenerative agriculture).
- Carbon credits could be used to offset additional costs with fertilizer, fuel, transportation that will be passing the costs on of carbon taxes.

6. What is the current status quo? Please support your statement with a reference to current facts

The current federally mandated pricing for carbon taxes does not impact how farmers manage their operations. However planned increases likely will.

Intermediaries are taking profit potential from farmers associated with new carbon credits/markets

Many farmers have not actively researched or engaged in carbon market consultations and research. As a result, they are largely disengaged from benefiting from anticipated future opportunities.

⁸² Source: <u>https://thenarwhal.ca/canadian-farmers-climate-change/</u>

⁸³ Source: https://podcasts.apple.com/tt/podcast/s2-ep1-are-carbon-markets-the-new-ethanol/id1539075283?i=1000540739719&l=fr