Springboard 360° AGRIFOOD

Innovation Advisory Committee

Agrifood Consultations 2023

From Farm to Table:
Defining Challenges and Opportunities, and Exploring Research Insights and Future prospects of Agrifood Research in Atlantic Canada

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Preface: 360° Series tackles challenges in Atlantic Canada

The Springboard 360° Series was convened in 2021 to identify research and innovation opportunities that will enhance the lives of Atlantic Canadians and usher the transition to a green sustainable economy.

By bridging industry, research institutions and governments, industry, the Springboard 360° Series aimed to promote meaningful collaborations to achieve these ambitious goals.

Cleantech 360° Series

The first stream of the Springboard 360° Series focused on Cleantech. This was a natural starting point given government's commitment to net-zero emissions by 2050. The Cleantech focus also recognized research strengths and projects already underway in the region's post-secondary institutions.

The Springboard 360° Series Innovation Advisory Committee released its final report in March of 2022. It recommended further engagement between industry and academia based on needs identified in the report.

Agrifood 360° Series

The Agrifood 360° Series kicked off in April 2022 with meeting limitations imposed by restrictions of the COVID-19 pandemic. The Innovation Advisory Committee met both virtually and in-person, concluding their consultations in early 2023.

This second stream embraces the goals of the 360 Series to improve the lives of Atlantic Canadians through research and innovation in the Agrifood sector.

This project recognizes the unprecedented demand for food and agricultural production as the global population grows.

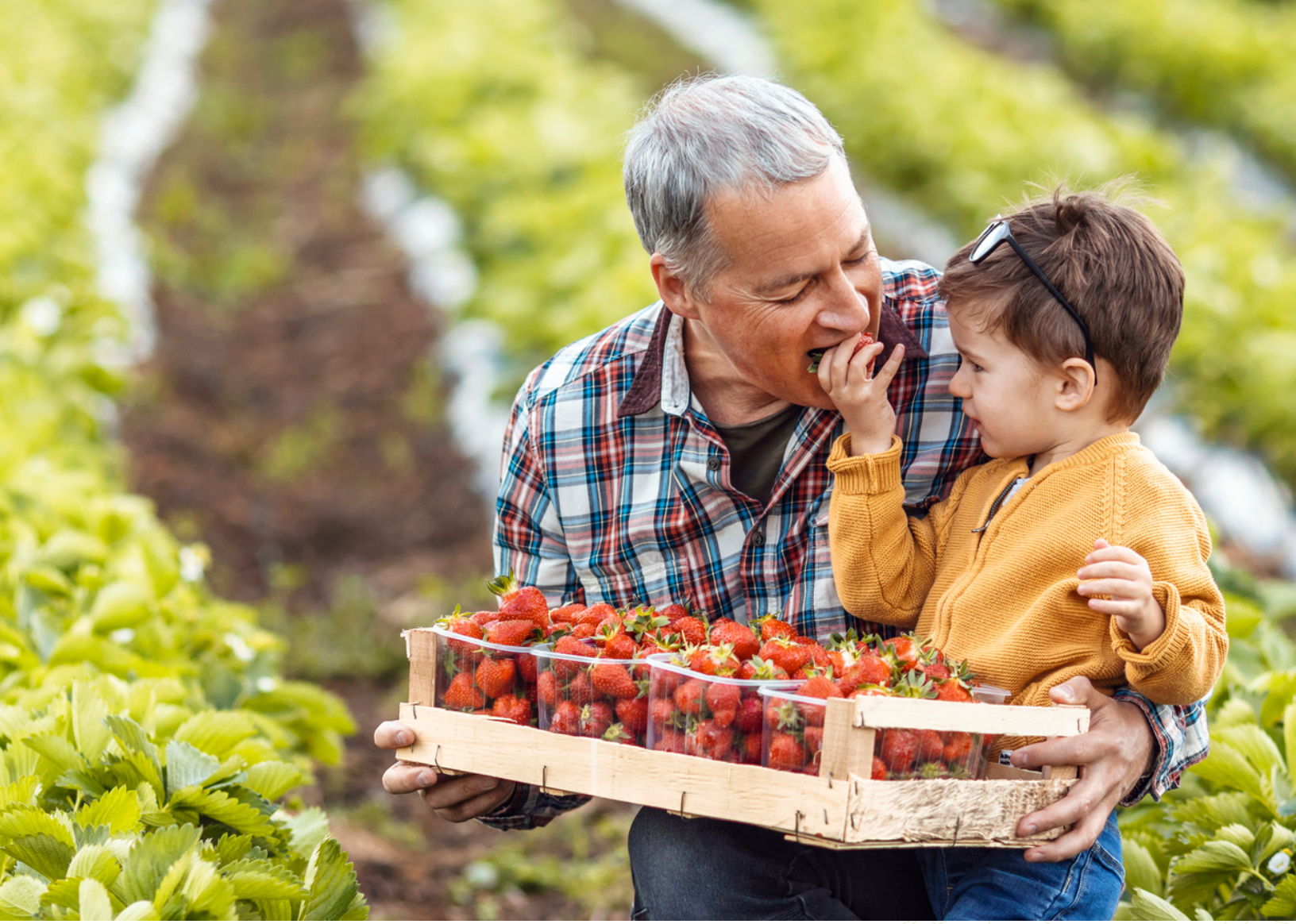
This has produced immense pressure on the way our food is grown, processed and delivered to the dinner plates of Atlantic Canadians. There are also significant challenges to this industry with the dynamics of climate change and resource depletion. The Agrifood sector is also grappling with the transition to environmental sustainability.

In this context, the Agrifood Innovation Advisory Committee has identified key challenges and research opportunities to support the Agrifood sector in the region.

The committee found that there is a need for further a research, innovation and industry collaboration in the following areas:

- Food waste research
- Collaboration between producers, governments and researchers
- Technology adoption
- Integration of solution providers, supply chains and other stakeholders
- Food waste reduction technology
- Carbon footprint reduction
- Climate change adaptation

Daryl Genge,
President & CEO
Springboard Atlantic



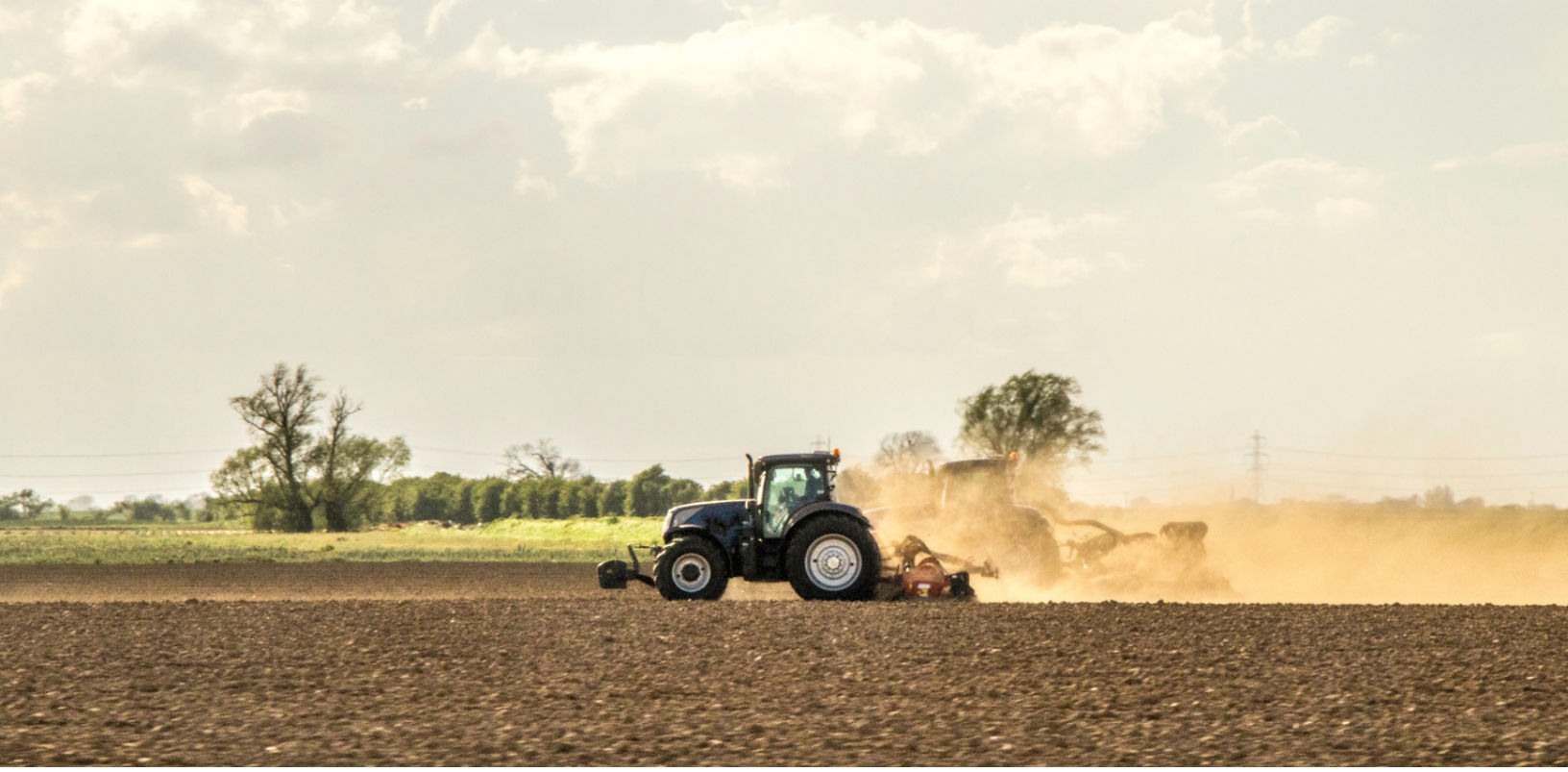
Springboard overview

Springboard Atlantic is a network of 19 post-secondary institutions supported by ACOA.
The network is designed to grow Atlantic Canada's innovation economy through collaboration among the member institutions and industry.

In 2020, Springboard and ACOA proposed an expanded role for the organization to:

- Address innovation gaps in key sectors in Atlantic Canada
- Accelerate opportunities for sector growth through increased commercialization and collaboration among industry, academia, and government
- Introduce new technologies or solutions to address specific regional challenges

This led to the creation of the Springboard 360 Series — a specialized approach for convening experts across industry, government, and academia to focus on new opportunities for applied research, and the domestic adoption of innovative technologies within those sectors key to the Atlantic economy. The initial three main areas of focus are: Cleantech, Agri-Food and Life Sciences/MedTech.



Introduction: From Farm to Table:

As the global population continues to grow, the demand for food and other agricultural products is increasing at an unprecedented rate (FAO, 2021).

This has placed immense pressure on food production, processing, and supply chains which are responsible for ensuring that food is produced, processed, and delivered efficiently and sustainably.

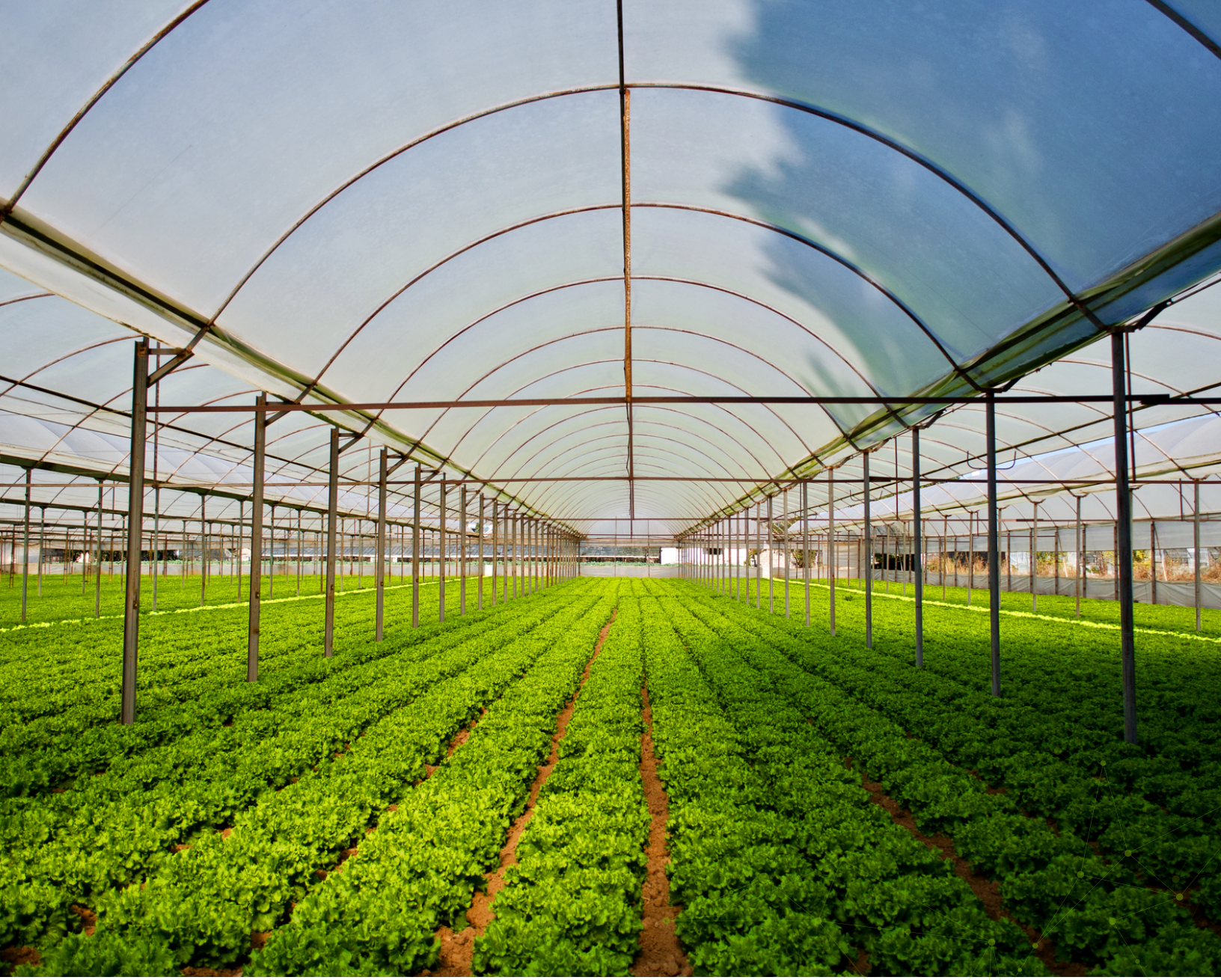
These sectors face a variety of challenges, ranging from climate change and natural resource depletion to changing consumer preferences and market volatility.

Agrifood 360 Series

In this report, we analyze these issues identified by the Innovation Advisory Committee (IAC). It is tasked with responsibility of prioritizing key areas of research and industry collaboration in CleanTech, Agrifood, and MedTech in Atlantic Canada.

This report includes the challenges faced, market opportunities available, and the research that has been done and is needed to support the agri-food sectors in Atlantic Canada.

The analysis covers a wide range of subsectors within primary production, food processing, and supply chain, providing insights into the unique challenges and opportunities facing each.



Key challenges and market opportunities

This section focuses on the key challenges facing the primary production, food processing, and supply chain sectors in the agrifood industry in Atlantic Canada.

At the same time, there are significant market opportunities for organizations in these sectors to capitalize on.

The report provides an analysis of the unique challenges and opportunities faced by different subsectors within these industries.

The primary production sector in Atlantic Canada

The primary production sector in Atlantic Canada is facing a range of challenges and market opportunities, with specific challenges varying by crop.

These challenges and opportunities have been analysed into six distinct categories:

- Sustainability and climate-related
- Input cost and efficiency
- Labour-related
- Pest and disease-related
- Market-related
- Technological

Dairy production faces challenges such as high input costs and the need to reduce carbon footprints.

Berry production faces challenges related to climate adaptation and labour shortages.

Opportunities for improvement

There are also opportunities for developing more efficient and sustainable production methods, creating value-added products, and transitioning to tech to create longer growing seasons.

See Table 1 on next page

Addressing challenges critical for region's agrifood sector

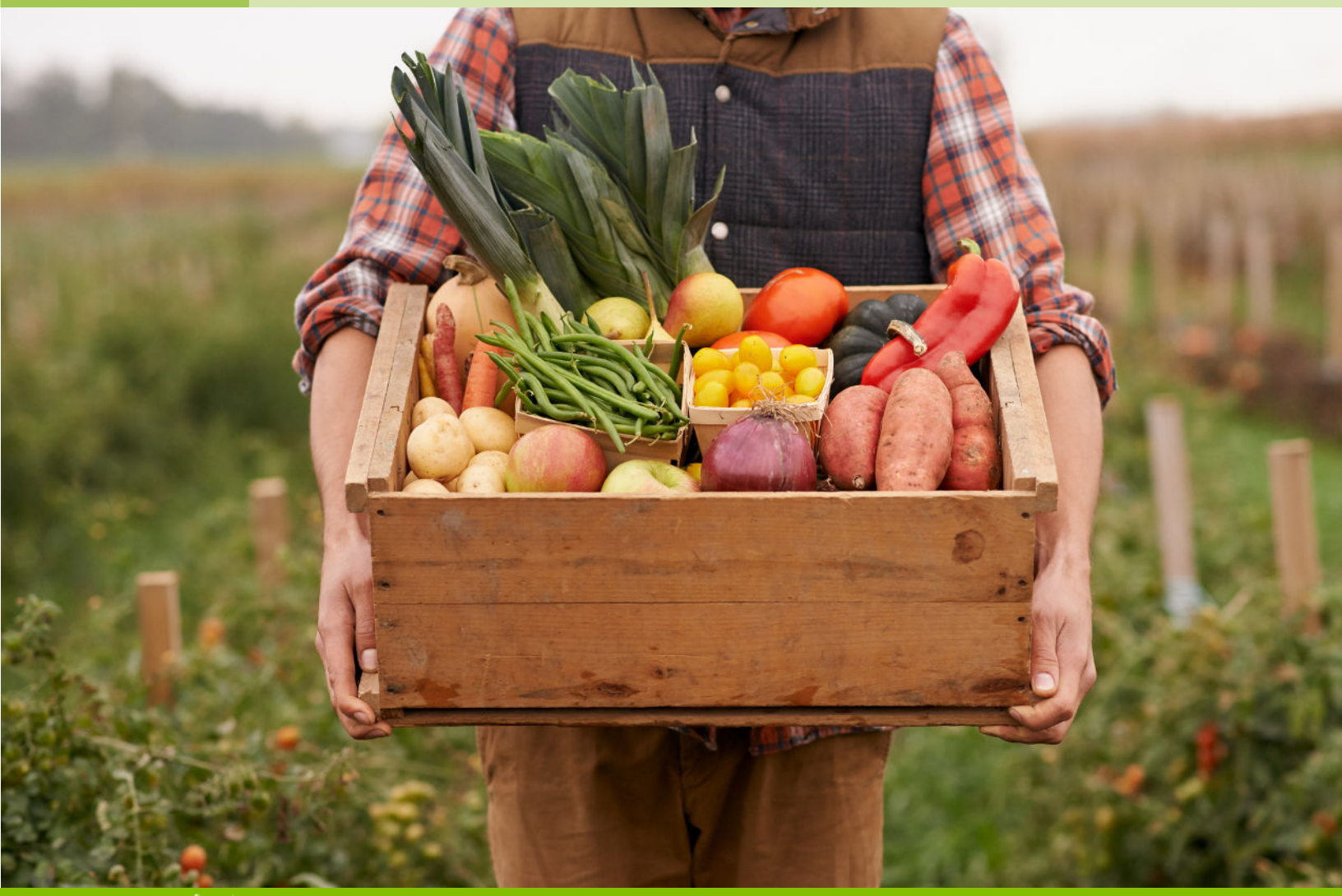
Overall, addressing these challenges and capitalizing on market opportunities will be crucial for the success of primary production in Atlantic Canada.

Table 1: Primary Production – Challenges and Opportunities

	Diary	Potatoes	Berries	Apples, Grape & Pears	Maple	Grains
Sustainability & Climate related	• Mitigating carbon footprint • 2. Meeting 2050 net zero goal	• Impact of BMPs and carbon sequestration/ emission • Production or more sustainable products	• Climate adaptation • Weather hindrance to progression for soft fruit (raspberries, blackberries)	• Climate adaptation (e.g., vineyard frost mitigation in grapes) • Weather is a huge challenge, particularly wind		
Input costs & Efficiency	• High input costs, for SNFs (Solids not fat), Fuel & cost of production • Improving production efficiency, e.g., milk production	• Increased input cost • Optimizing fertilizer and amendment uses (limit lost, promote uptake)				
Labour related			• Limited labour availability	• Limited labour availability (eg. Honey crisp apple with harvesting window)		
Disease & Pest		• Disease prevention, e.g., potato wart (especially in PEI)	• Soil pests are a hindrance to progression for raspberries, blackberries	• Disease prevention		
Market related	• Falling market share	• Limited production in Nova Scotia	• Limited "Haskap" market growth	• Limited pear production and grower interest (harder to manage not as profitable		

Table 1 (Continued)

	Diary	Potatoes	Berries	Apples, Grape & Pears	Maple	Grains
Technological	• Leveraging milk powder production for novel products in dairy production	• Breeding (Lack of high-value crops, e.g., water/drought resistant plants)	• Value-addition from blueberries and blueberry waste (i.e., leaves) • Precision framing • Indoor or protected production	• Automated apple harvesting technologies for orchards • Vineyard Frost mitigation/prevention technologies for grapes	• Limited processing capacity	• Adapting agricultural practices for existing malt barley varieties • Use of industrial hemp as a rotational crop



Food processing

The food processing sector faces several key challenges and market opportunities. These challenges and opportunities have been analysed into five distinct categories

- Sustainability and climate-related
- Infrastructural & technological
- Financial
- Market-related
- Labour related

The challenges include:

- Inadequate infrastructure and storage capacity for processing fruits, vegetables, and meat
- A lack of expertise in robotics integration and repair
- Disease prevention in potatoes, water and drought-resistant plant
- waste reduction for meat production

Market opportunities for the sector include:

- Upcycling waste streams for beverage production
- Developing sustainable packaging
- Producing value-added agri-food products from on-farm by-products

Additionally, there is potential for the development of locally grown and produced malt in local beer and spirits, as well as the production of craft non-alcoholic alternatives to beer and wine.

See Table 2 on next page

Scaling up is a challenge for small processors

Scaling up production to increase volume is a challenge for many small processors. There is a need for subsidies and support for midsize facilities to realize economies of scale and increase efficiency.

Finally, import replacement and support for local procurement, as well as regulatory support for food safety, are crucial for the success of the food processing sector.

Table 2: Food Processing – Challenges and Opportunities

	Beverage	Meat	Vegetable	Added value, Products	Seafood
Sustainability & Climate related	• Upcycling from waste streams	• Greenhouse gas reduction			
Infrastructural / Technological	• Low storage capacity, bottling, canning	• Low infrastructure /capacity • Limited technological advancement	• Lack of processing infrastructure	• Robotics integration • Value added industrial products for on-farm waste (eg: biogaz, fertilizer, soil amendments, compost, bedding) • Value addition from on-farm bi-products (e.g., juice, flakes, fermentation products, etc.) • Toll HPP facility needed	
Financial	• Support to start-ups • Financial support to help off set price of developing local products	• Limited information on cost of production		• Need for incentives for more facilities	
Market related	• Levies and taxes affecting cross-provincial trade • Small volumes inhibiting scaling up • Integration of more locally grown and produced • Non-alcoholic alternatives to beer and wine • Economies of scale to realize efficiencies	• Identifying alternatives (cell-based proteins) • Limited federal capacity		• Import replacement (local over foreign)	• Market availability in NL (seafood treated as a commodity and not food)
Labour related				• Lack of solution providers and integrators • Lack of repair experts	

Supply Chain

Key challenges and market opportunities for the supply chain sector are identified for packaging, storage, and distribution processes.

These have been grouped into four categories: sustainability and climate-related, infrastructural, and technological, financial, and market related (see Table 3).

- Sustainability and climate-related
- Infrastructural & technological
- Financial
- Market-related

The challenges present a formidable obstacle. They include:

- The need for innovative solutions to replace single-use plastics
- Optimizing storage capacity and energy efficiency
- Improving distribution logistics.

See Table 3 on next page.

Market opportunities include:

- Developing sustainable and environmentally friendly packaging
- Regional food hubs
- Energy-efficient storage solutions.

To reduce challenges and harness opportunities, the sector could benefit from increased support for research and development, investments in new technologies, and collaborations among stakeholders.

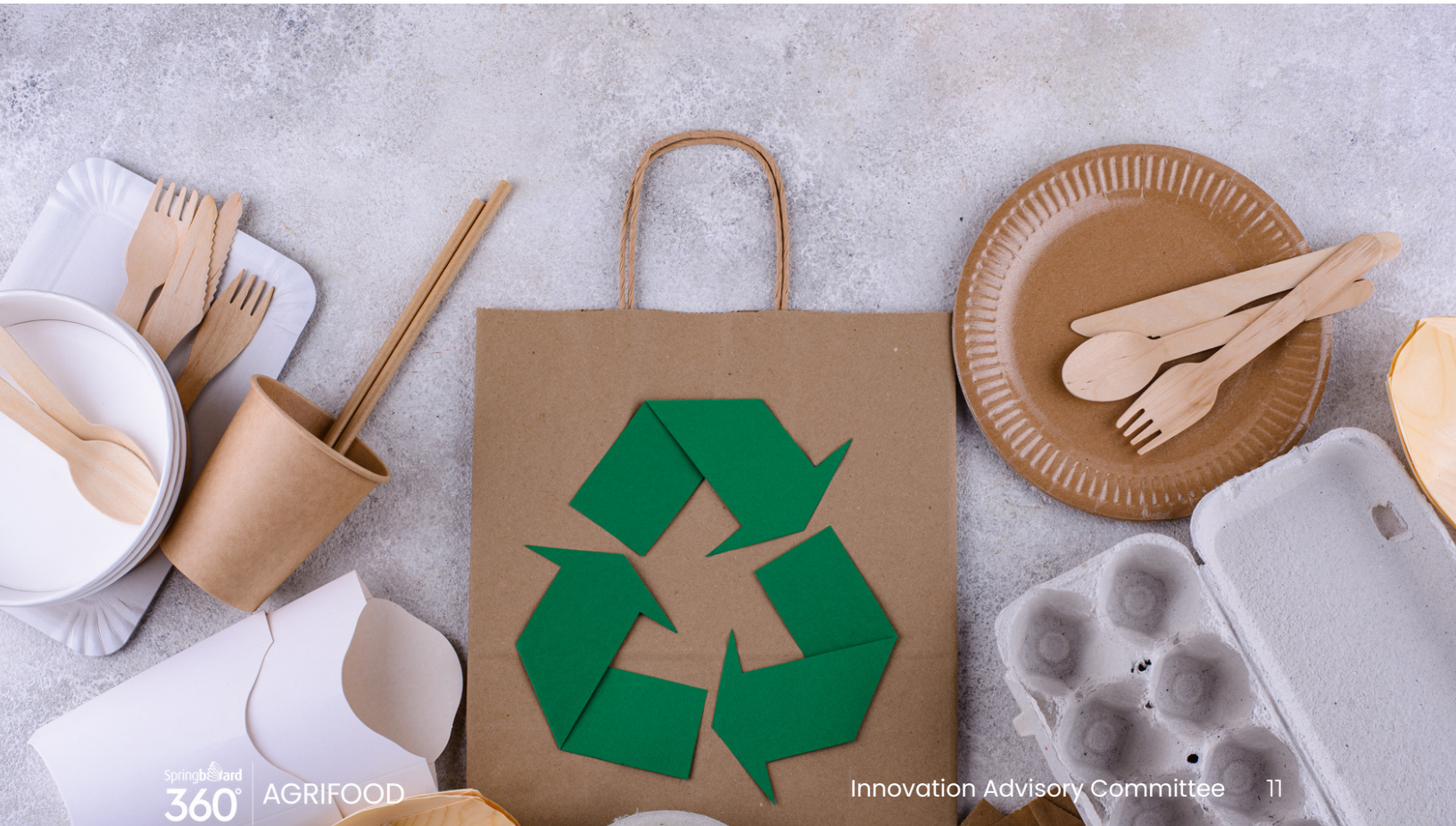


Table 3: Supply Chain – Challenges and Opportunities

	Packaging	Storage	Distribution
Sustainability & Climate related	• Innovative solutions to ban single-use plastics • More sustainable packaging	• Energy efficiency solutions (i.e. lack of CO2 refrigeration suppliers/contractors)	• Interruptions due to weather/barricades
Infrastructural / Technological	• Alternative packaging technologies • Optimize packaging materials and techniques for longer shelf-life • Innovation - packaging with algae • Limited opportunity to diversify (e.g., apples - variety selection is dictated by the packers to the growers)	• Low storage capacity (e.g., freezer and fridge space) • Capacity optimization • More public cold storage • Storage management	• Understanding of distribution channels is needed
Financial	• Financial support for packaging research	• No publicly supported research	• Transportation cost impacting profits • Fuel costs fluctuation
Market related	• Limited local options in storage facilities and food hubs	• More regional storage hubs needed	• Capacity of smaller companies for scaling (transportation, facility share) • Tools for better matching of supply and demand • Need for asset utilization efficiency • Develop regional food hubs • Limited federal capacity

Research completed, and needed

Research plays a critical role in the food production, food processing, and supply chain sectors in Atlantic Canada

These sectors face numerous challenges which include:

- Adapting to changing consumer demands
- Increasing competition
- Unpredictable weather patterns.

Additionally, research can help improve the efficiency and sustainability of these sectors, reduce waste, and increase profitability.

By investing in research, Atlantic Canada can ensure the long-term viability and success of its food production, processing, and supply chain industries.

In recent years, several research initiatives have been undertaken in Atlantic Canada in the primary production and food processing sectors.

While the number of research projects is significant, the Innovation Advisory Committee has identified several that are particularly important in these sectors.

This report describes this research for each sector.

Research in primary production

a.	**Tissue culture/ cryotherapy for grapevine viruses**	This research involves using tissue culture and/or cryotherapy to eliminate specific viruses from grapevines. It is useful because it can help to reduce crop losses and the need to replace infected grapevines.
b.	**Spidermites infestation**	This research focuses on finding ways to control spider mites' infestations on hydroponic crops. Spider mites are a major pest that can cause significant damage to crops, and this research can help to reduce crop losses and increase yields.
c.	**Spotted Wing Drosophila (SWD) repellency**	This research aims to develop natural repellents that can be used to prevent SWD infestations in berries and fruits. SWD is a type of fruit fly is a major pest, that infests the ripening fruit before harvest, which only becomes visible on store shelves, leading to income losses and food waste.
d.	**Data analytics:**	This involves using data analytics to improve farming practices and increase efficiency. It is useful because it can help farmers to make better decisions and optimize their operations.
e.	**Genetics:**	This research involves studying the genetics of crops to develop new varieties that are more resistant to pests and diseases, and that have higher yields. It is useful because it can help to improve crop productivity and reduce losses.
f.	**Electrification:**	This research involves using electrification to power farm equipment and reduce greenhouse gas emissions.
g.	**Gene editing:**	This research involves using gene editing techniques to improve crop traits such as disease resistance and yield. It is useful because it can help to improve crop productivity and reduce losses.
	Pest and disease detection & treatments	This research involves developing new tools and technologies for the early detection and treatment of pests and diseases in crops. It is useful because it can help to reduce crop losses and improve yields.
i.	**Storage and variety technology:**	This research focuses on developing new technologies for crop storage and preservation, as well as developing new crop varieties. It is useful because it can help to reduce food waste and improve crop yields.
j.	**Additional novel cultivar development**	This research involves developing new crop varieties with desirable traits such as disease resistance, high yields, and improved nutritional content. It is useful because it can help to improve crop productivity and meet the changing needs of consumers.

Research in food processing

a.	**Chemical analyses and product development:**	This research involves analyzing the chemical composition of foods and developing new food products. It is useful because it can help to improve the quality and safety of food products, as well as develop new products that meet consumer demand.
b.	**Sensory testing to provide consumer feedback & ensure best market entry**	This research involves conducting sensory testing to get feedback from consumers about food products. It is useful because it can help to ensure that food products are well-received by consumers and have a successful market entry.
c.	**Full lifecycle understanding of GHG:**	This research involves studying the full lifecycle of food products to understand their greenhouse gas emissions. It is useful because it can help to identify ways to reduce the carbon footprint of food products.
d.	**Valorization of the waste stream for high value products:**	This research involves finding ways to use waste from food processing to create high value products. It is useful because it can help to reduce waste and create new revenue streams for food processors.

Research needed in primary production

a.	**Climate change adaptation and mitigation**	Research is needed to develop effective strategies to adapt to and mitigate the impact of climate change on agriculture in Atlantic Canada.
b.	**Malt barley**	Further variety trials are needed in New Brunswick and Nova Scotia to ensure high-quality malt barley for craft malt houses in Atlantic Canada.
c.	**Industrial hemp**	More extensive, multi-year, and multi-site data on large-scale variety trials are needed, along with scaled-back technology suitable for small farms, energy storage, and community hubs.
d.	**Alternative models for business and production**	Research is needed on alternative models for business and production, including automation, to improve efficiency and productivity.
e.	**Trade issues**	Research is needed on the effects of trade issues such as potato and vulnerability indexes on the agriculture industry in Atlantic Canada.
f.	**Data management**	Research is required to develop data management systems that improve transparency across the value chain.
g.	**Technology adaptation**	Research is required to develop technology adaptation strategies for smaller-scale agriculture.
h.	**Genetics of crops:**	Research is needed to explore how we can tweak the genetics of crops to enable Atlantic Canada to grow crops more efficiently and sustainably.
i.	**Cost models**	Research is needed to develop cost models for economic sustainability.

Research needed in primary production

(**Continued**)

j.	**Data management**	Research is required to develop data management systems all along the value chain to improve transparency and provide evidence-based claims to consumers. Carbon sequestration: Best practices for optimizing carbon sequestration and minimizing GHG emissions need to be developed.
k.	**Federal inspection stations:**	Research is required to explore viable ways of establishing federal inspection stations.
l.	**Secondary production:**	Ways to increase secondary production of produce ready for export need to be explored.
m.	**Non-animal products**	Research is required to develop non-animal products suitable for Atlantic Canada.
n.	**Low input vs. high input systems:**	Comparing low input versus high input production systems is needed to determine the most effective system for Atlantic Canada.
o.	**Net-zero approach:**	A holistic approach is needed to achieve net-zero, looking at the cow to the field and back.
p.	**Apple - fungicide research:**	Research is required to explore the impact of pest deregistration (e.g., black rot management) on apples.
q.	**Fruit load management**	Thinning/fruit load management for efficiency and research into harvest aids/automation and products (plant growth regulators) or techniques that can manipulate or influence the harvest timing is required.
r.	**Wind breaks**	Research is needed on windbreaks for orchards to reduce crop loss due to wind damage.

Research needed in food processing

a.	**Craft Malt integration**	Further research into the integration of craft malt into the craft brewing industry could benefit the entire value chain. This research can explore the optimization of processes to enhance the flavor profile of the beer and reduce production costs.
b.	**Federal inspection stations**	Research is required to explore viable ways of establishing federal inspection stations.
c.	**Secondary production:**	Ways to increase secondary production of produce ready for export need to be explored.
d.	**Non-animal products**	Research is required to develop non-animal products suitable for Atlantic Canada.
e.	**Low input vs. high input systems**	Comparing low input versus high input production systems is needed to determine the most effective system for Atlantic Canada.
f.	**Net-zero approach**	A holistic approach is needed to achieve net-zero, looking at the cow to the field and back.
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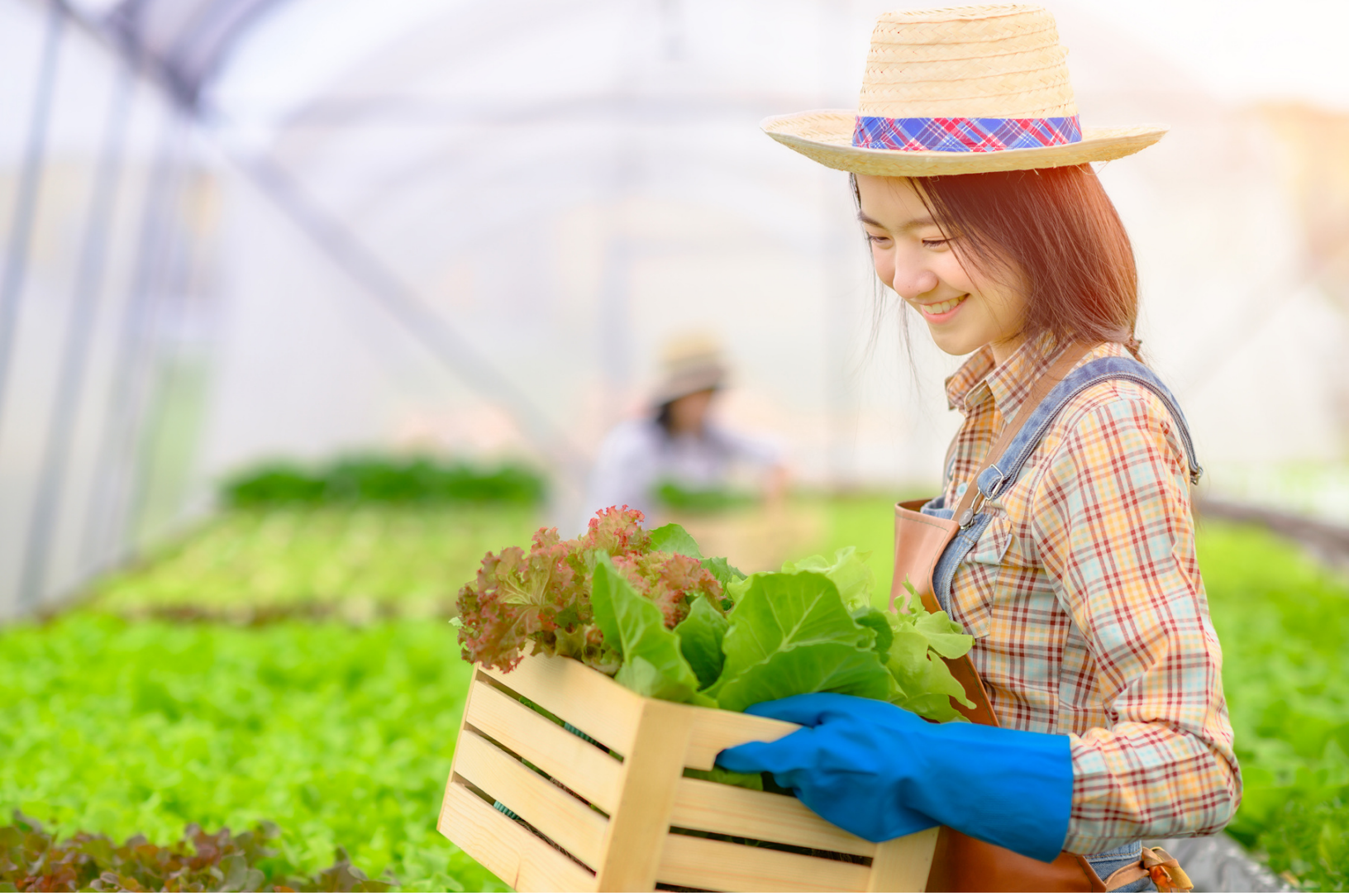
i.	**Wind breaks**	Research is needed on windbreaks for orchards to reduce crop loss due to wind damage.

Research needed in supply chain sector

a.	**Inventory management**	A database that shows available inventory or predicts inventory levels can be matched more quickly to demand requests. Research on how to improve inventory management can lead to reduced food waste, improved customer satisfaction, and increased profitability.
b.	**Harvest prediction**	Harvest predictions can be improved through data analytics and machine learning. This can lead to better planning and optimization of the supply chain.
c.	**Bioplastics & green alternative materials**	Research on bioplastics and other green alternative materials can lead to more sustainable and environmentally friendly packaging options. This can help reduce waste and carbon footprint in the supply chain.
d.	**Supply chain optimization**	Research on supply chain optimization can lead to more efficient and cost-effective supply chain processes. This can lead to reduced costs, increased productivity, and improved customer satisfaction.
e.	**Collaboration with food producers and packers:**	Collaboration between food producers and packers can lead to better communication and coordination, resulting in more efficient and effective supply chain processes.
f.	**Cost-effective storage technologies:**	Research on cost-effective storage technologies can lead to improved shelf-life of products and reduced waste.
g.	**Cost-effective storage technologies**	Research on cost-effective storage technologies can lead to improved shelf-life of products and reduced waste.
h.	**Shipping alternatives**	Thinning/fruit load management for efficiency and research into harvest aids/automation and products (plant growth regulators) or techniques that can manipulate or influence the harvest timing is required.



Conclusion

The Innovation Advisory Committee concluded its work on Springboard 360 Agrifood project and report in 2023.

It recommendations further research and collaboration between research and industry to improve the agrifood industry in Atlantic Canada.

It identifies a number of areas where the need is most urgent. This is not an exhaustive list but it does highlight the priorities.

Top priorities include:

- Research on food waste
- Collaboration
- Technology adoption
- Intermediary engagement
- Food waste reduction technologies
- Carbon footprint reduction technologies
- Climate change adaptation technologies

A special thank you to all the members of the Innovation Advisory Committee who contributed with their time and expertise to this work.

Areas for Improvement

a.	**Research on food waste:**	Collaboration between different producers, government agencies, ecosystem supports, and stakeholders is essential to the success of the agrifood industry in Atlantic Canada. It is important to create a network that can help connect these groups and provide a point of contact for questions and information sharing. The benefits of this include increased collaboration, improved efficiency, and the development of new partnerships and opportunities.
b.	**Collaboration**	Collaboration between different producers, government agencies, ecosystem supports, and stakeholders is essential to the success of the agrifood industry in Atlantic Canada. It is important to create a network that can help connect these groups and provide a point of contact for questions and information sharing. The benefits of this include increased collaboration, improved efficiency, and the development of new partnerships and opportunities.
c.	**Technology adoption**	The "technology valley of death" is a barrier to the adoption of new technologies in the agrifood industry in Atlantic Canada. Small producer size (it is easier for bigger operations to implement new technology), the cost of implementation, lack of large number of young farmers interested in implementing technology, are a few barriers to the adoption of new technologies. New schools of thought should be considered to overcome these barriers.
d.	**Intermediaries**	Intermediaries such as system integrators, solution providers, and equipment suppliers can play a critical role in the adoption of new technologies and processes in the agrifood industry in Atlantic Canada. Identify how intermediaries can be better utilized to support small and medium-sized businesses that may not have the resources or expertise to deal directly with academia is needed. The benefits of this include improved access to technology, increased innovation, and improved competitiveness.
e.	**Food waste reduction technologies**	There is a need to identify technologies that can help reduce food waste across all sub-sectors of the agrifood industry in Atlantic Canada. This is important because it will help identify new opportunities to reduce waste and create value-added products. The benefits of this include reduced environmental impacts, increased efficiency, and potential cost savings. The process may involve identifying technologies with potential, testing them in pilot projects, and scaling up successful solutions.
f.	**Carbon footprint reduction technologies**	Research is needed to identify technologies and methods that can help food companies across all sub-sectors to reduce their carbon footprint. This is important because it will help identify opportunities to reduce greenhouse gas emissions and improve sustainability.

Areas for Improvement (Continued)

g. Climate change adaptation technologies

Research is needed to identify technologies that can help food companies across all sub-sectors to adapt to the impacts of climate change. This research is important because it will help identify new opportunities to improve resilience and reduce risks.

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