

Technology and Agriculture: Adoption and Barriers



PARTNERS

Diversity Institute



LOCATIONS

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CONTRIBUTORS

Diversity Institute

Executive Summary

The agricultural sector is a major contributor to Canada's economy and will continue to have an important role in the years ahead. However, for the sector to remain competitive in the market, it will need to address labour market gaps and adopt agribusiness innovations. While Canada's agricultural technology (or AgTech) ecosystem is growing, the adoption of technologies varies by enterprise size and ownership. Reactive environmental policies, as opposed to proactive, are hindering the adoption of innovations. Without explicit educational support, small and midsize enterprises (SMEs) and diverse-owned agribusiness may be left out of the AgTech revolution. Skills-based supports are needed to maintain market competitiveness and ensure technology literacy and adoption issues are equalized—not accentuated—among groups.

The report reviewed several agricultural innovations, including controlled-environment agriculture technologies, data aggregation platforms powered by AI and the Internet of Things, environmental and chemical sensor technologies, nutrient and water delivery systems, soil and growth media, renewable energy systems, robotics and autonomous farming, germplasm modification and biostimulants.

We identified several barriers that impact technology adoption, including high costs for technology and training, compatibility issues where technologies are designed for larger operations and not small agribusiness contexts, educational barriers and a widening skills gaps on technology as current training programs lag innovations, as well as insufficient community and technological infrastructure to implement technologies in many enterprises.

We propose several recommendations to improve AgTech adoption in Canada. These include providing funding for SMEs and equity-deserving groups to cover capital costs of innovations and costs of technology skills training; addressing sector stereotypes by positioning agriculture as a field with diverse career opportunities; broadening education and skills-training opportunities through micro-credentials, specialized certificates and work-integrated learning to offer up-to-date technology training; and wraparound supports for training and education to ensure access for equity-deserving entrepreneurs.

KEY INSIGHTS

- 1 Technology adoption is generally led by large farms, with 81% of operations over 5,000 acres using digital agriculture tools; comparatively, smaller farms under 2,000 acres lag at 36% adoption.
- 2 Canada's AgTech ecosystem includes innovations predominantly generated by medical, telecommunications, and food and beverage companies for large commodity cropping enterprises, which are often not applicable to small and diverse agribusiness.
- 3 Improved AgTech adoption for small and diverse agribusinesses requires increased funding for capital procurement and training, flexible and up-to-date skills training that keeps pace with innovation, infrastructure to participate in training and implement technologies within operations. Policy barriers, which are contributing to reactive as opposed to proactive technology adoption, also need to be addressed.

► The Issue

Agriculture in Canada is a major contributor to the Canadian economy. It employed one in nine people and contributed about \$144 billion to the GDP in 2023. Maintaining Canadian agriculture and agri-food market competitiveness relies on the adoption of AgTech such as greenhouses and vertical farms. These technologies can be used to improve plant yields, reduce environmental impacts and labour requirements, and support year-round growing while addressing resource constraints (e.g., arable land). However, AgTech is disproportionately and slowly adopted by large producers, and many small businesses are left out.

Small agribusinesses, often owned by Indigenous Peoples and equity-deserving groups, lack the capital and education to employ AgTech. Small agribusinesses often find that AgTech tools are neither applicable nor cost-effective, nor do they have the necessary infrastructure like internet and utilities. Additionally, few policies, educational initiatives or funds are dedicated to supporting smaller and equity-deserving agribusinesses to adopt AgTech.

In the absence of AgTech-trained staff, small and diverse agribusinesses struggle to incorporate technology, often incurring additional costs in hiring technical specialists to support automation.

Adopting AgTech is crucial to maintaining Canadian market competitiveness. Adopting digital tools in agriculture could unlock an additional \$750 million to \$1.5 billion in annual revenue for Canadian agribusiness, while innovations in agri-food—such as cellular cultivation and precision fermentation—could support an additional \$18.8 billion toward GDP. Continued investment and innovation are necessary to abate the impact of job vacancies, predicted at a \$3.1 billion annualized sector loss.

While Canadian agriculture is increasingly diversifying to improve

market differentiation, such as in the role immigrants play in supporting operation succession among farms in Canada, continued, proactive and explicit support are needed to improve

technology adoption. This requires that we understand what barriers are hindering technology adoption in agriculture and agri-food businesses, specifically SMEs and those operated and owned by Indigenous Peoples and equity-deserving groups.



What We Investigated

This report reviews the current adoption of agriculture and agri-food technologies, including a variety of digital tools (e.g., cloud data management platforms and predictive farm models), precision agriculture technologies (e.g., GPS, autosteer and precision fertigation) and common agriculture technologies (e.g., soil and climatological sensors).

This report focuses on identifying barriers to adoption for technologies that span production, food manufacturing and food preparation. We employed a literature review combining academic sources, grey literature from industry and policy documents ranging from municipal to federal jurisdictions on AgTech adoption. Specifically, we sought to answer the following:

- What are the barriers to AgTech adoption in Canada?
- How are adoption barriers different for SMEs and diverse-owned and -operated agribusinesses?

Building on Agriculture and Agri-Food Canada's AgriDiversity Program, we focused on specific barriers faced by underrepresented sector participants, including Indigenous Peoples, women, immigrants and newcomers, as well as small-enterprise owners and operators.

What We're Learning

AgTech, existing and new, has the potential to greatly support agriculture operations led by diverse SMEs and workers in the sector, but adoption remains limited.

Cost is the largest barrier to implementation. Operational expenses have been increasing for producers in Canada, driven by rising fertilizer costs associated with geopolitical events and tariffs. Economic strains are particularly felt among agriculture SMEs that may not have production contingency plans. The costs of capital assets (e.g., tilling machines, packaging equipment) deter AgTech adoption, favouring large organizations with greater capacity.

The skills and capacity required to work technologies are limiting adoption. Existing training is based on a series of competency frameworks for sector workers; however, they disproportionately target field crop and livestock operations, which are not always applicable for diverse agripreneurs and workers. Instead, many small operations rely on the intergenerational transfer of knowledge, limiting readiness to adopt new technology-driven practices. Where skills training exists, it is often at the cost of the agripreneur or worker and generalized to the sector, with specific technology training under-delivered. Postsecondary training exists, but applicable technology training lags behind technological innovations, limiting applicability. Realizing the benefits of AgTech requires additional non-technical education to assess technology compatibility and perceived benefits to existing operations, including economic forecasting, or the ability to assess capital feasibility to an operation.

We identified AgTech producers that are innovating a variety of technologies and found that most technologies are generated by large telecommunication, food and medical enterprises.

AgTech inventions often occur in intensive research-and-development environments, led by researchers with scientific and engineering backgrounds who develop solutions for larger agriculture organizations with specialized expertise. Agricultural technologies tend to begin in a boardroom and not a barn, and thus are often not applicable to SMEs, remote operations or operations run by equity-deserving groups.

The lack of infrastructure, especially internet infrastructure, excludes many older farmers, rural communities and Indigenous Peoples from AgTech adoption. Community infrastructure, including community and peer networks, and trusted advisors are particularly important to SMEs and diverse operators, as these communities will often look to these sources for evidence of success before following “industry-leading” practices.

We identified several policy barriers that impede the adoption of innovative technologies by SMEs and diverse-owned agriculture and agri-food businesses. For instance,

- interprovincial trade barriers limit market access for major agricultural sectors, such as livestock production and processing;
- tariffs with trading partners are impeding imports for primary production;
- the lack of regulation for new technologies—namely controlled environmental agriculture—implicate the use of pest control products in production.

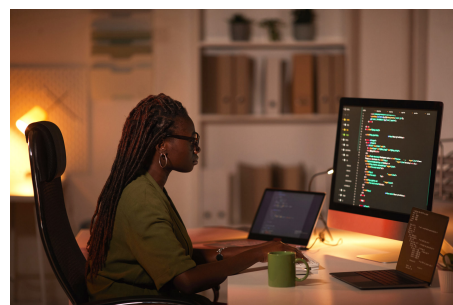
Improvements to technology adoption will require policy changes to rectify interprovincial legislation redundancies and pace with new technologies as they develop.

★ Why It Matters

Adoption of AgTech is critical to improving Canadian market competitiveness and addressing growing labour shortages. A variety of social, environmental and economic factors influence how AgTech is adopted.

Our research shows that technology platforms are not optimized for SMEs in the sector but, rather, large commodity and livestock operations, as well as food and beverage manufacturers. When AgTech is purpose-built for large operations, SMEs are less likely to adopt it. Further, data and technical knowledge gaps among operators may further a digital divide, as SMEs struggle to understand specialized technologies compared to large corporations with specialized expertise. When more agricultural technologies are geared toward SMEs and diverse-owned enterprises, and when technical skills are encouraged and stereotypes are rectified, opportunities emerge for small AgTech innovators to develop tools that scale across enterprise sizes.

A variety of recommendations can facilitate greater AgTech adoption.



State of Skills: Digital Tools in the Skills Ecosystem

There is considerable promise in the role digital tools and virtual career services can play in improving access to training and career development, particularly for those with geographic barriers or constraints such as family care or other work responsibilities.

[Read Thematic Report](#)

Improving access to capital remains the single most important way to address adoption. Systematic integration of agriculture into federal funding allocations, and proactive funding for innovation will prioritize the sector. The lack of funding support for technology skills, and for purchasing and maintaining operational assets, has made agricultural operations responsive, not proactive, and threatens Canadian market competitiveness. Additional and flexible financing opportunities for specific groups are needed to improve access to capital and thus sector participation.

Several cultural, sectoral and engendered stereotypes remain in the sector and position agriculture as a low-income labour practice rather than a potentially high-income and skilled one with extensive workforce opportunities. Improved awareness of high-skilled occupations in the sector is needed, particularly regarding the diversity of career opportunities, which emphasize technology, data and AI literacy as well as managerial expertise. Successful agripreneurs and diverse-sector participants should also be showcased to help recruit new, tech-savvy and younger talent to the sector.

Skills training is needed to improve AgTech adoption. Training programs need to be cognizant of the lateral, multi-faceted role operators and workers in SMEs and diverse-owned enterprises occupy, as compared to specialized and vertical knowledge among larger agriculture institutions. As university and college certificate programs lag in AgTech adoption, diversified education and skills training opportunities through micro-credentials, specialized certificates and work-integrated learning can provide up-to-date technology training while meeting educational requirements of diverse learners.

Finally, continued wraparound support is needed to improve AgTech adoption. Effective supports include improved internet and technology access, and capital to participate in skills training programs. Additionally, flexible and/or hybrid learning, fee waivers, education programs tailored to cultural contexts, mental health services, childcare and family support position equity-deserving groups to better participate in upskilling initiatives.

What's Next

Leveraging the findings from this report to inform national and provincial strategies that promote and support technology adoption within agri-food SMEs is integral to ensuring these SMEs have the resources to implement new technologies and address existing gaps. It is imperative to include tailored support for firms owned by equity-deserving groups, as they face a disproportionate lack of entry and often fewer resources, which impede their ability to succeed within the sector. Given that access to capital is the single most important determinant of technology adoption among agriculture and agri-food businesses, an increase in granular-level research to identify specific funding needs of diverse-owned operations and firm types is necessary to guide effective funding allocation.

Insightful and effective strategies require further collaboration, nationally and regionally, between the agriculture sector, agri-food institutions, and educational and research institutions to improve knowledge dissemination and fill gaps in understanding. Standardizing innovative sustainability and environmental protection at the core of initiatives to balance both crucial productivity increases and preservation is paramount for long-term growth.

Have questions about our work? Do you need access to a report in English or French? Please contact communications@fsc-ccf.ca.

How to Cite This Report

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