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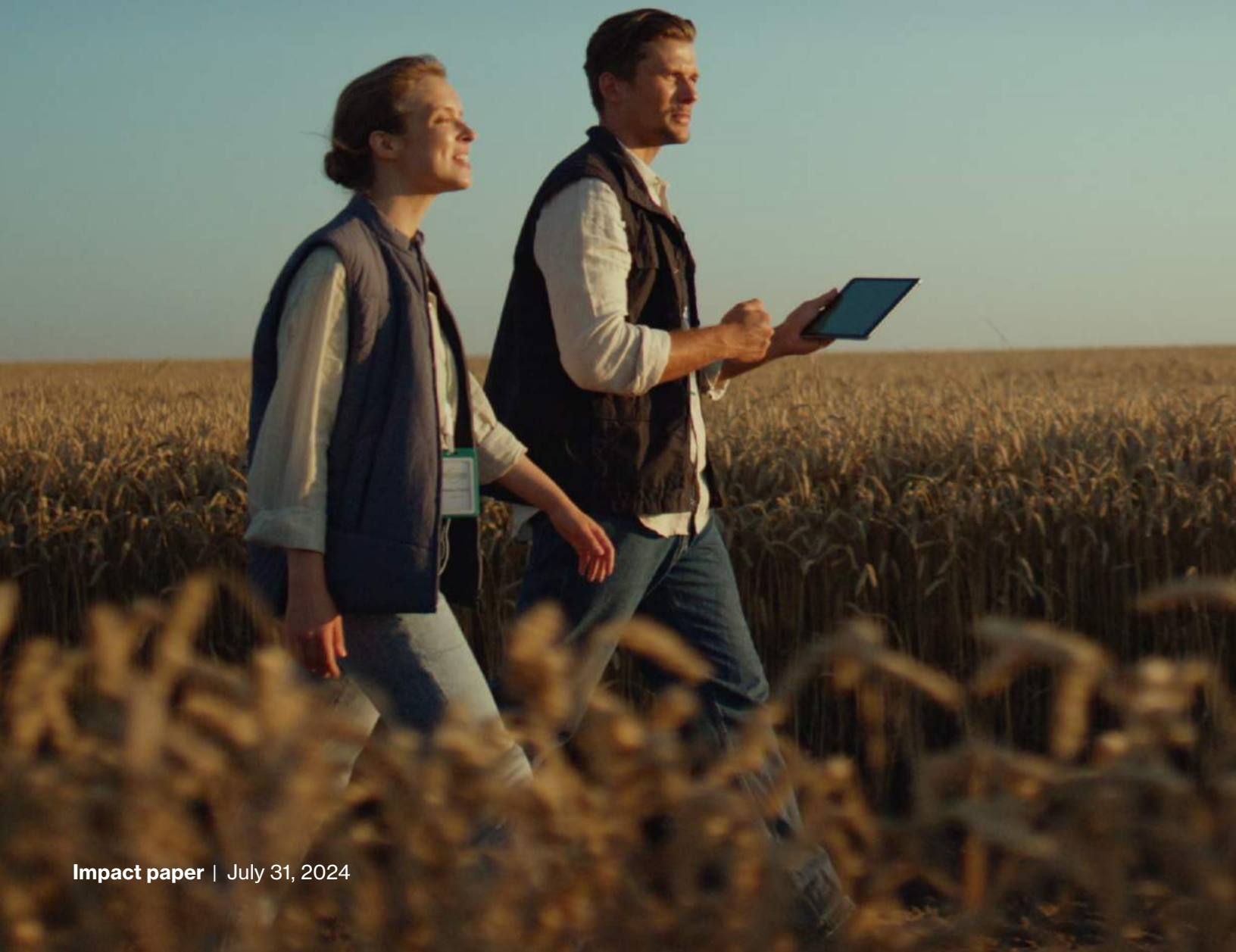
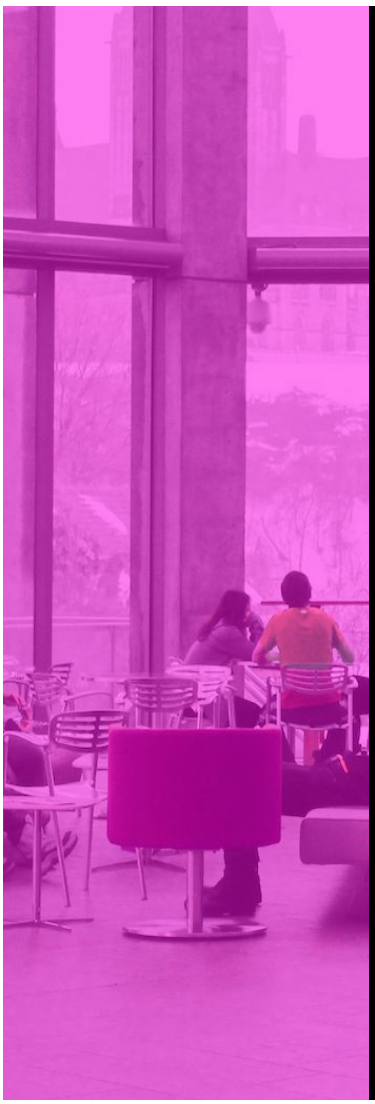
The Next Frontier in Canada's Agri-Food Sector

Technology-Driven Labour and Skills Transitions



Impact paper | July 31, 2024



Future Skills Centre | Centre des Compétences futures

The Future Skills Centre – Centre des Compétences futures (FSC-CCF) is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead.

The Future Skills Centre was founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada.

If you would like to learn more about this report and other skills research from FSC, visit us at fsc-ccf.ca or contact info@fsc-ccf.ca.

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Funded by the Government of Canada's Future Skills Program | Canada

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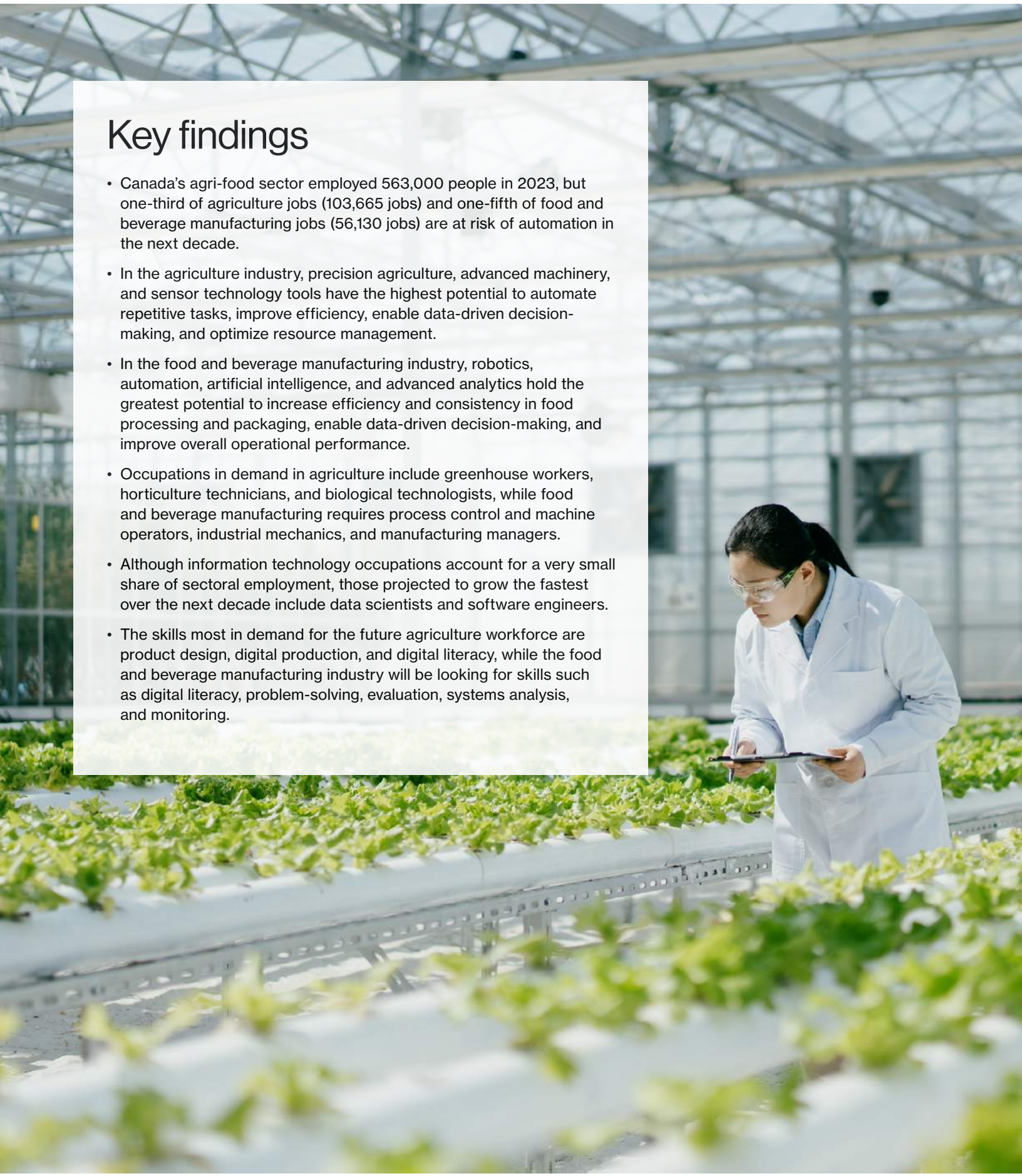


Key findings

- Canada's agri-food sector employed 563,000 people in 2023, but one-third of agriculture jobs (103,665 jobs) and one-fifth of food and beverage manufacturing jobs (56,130 jobs) are at risk of automation in the next decade.
- In the agriculture industry, precision agriculture, advanced machinery, and sensor technology tools have the highest potential to automate repetitive tasks, improve efficiency, enable data-driven decision-making, and optimize resource management.
- In the food and beverage manufacturing industry, robotics, automation, artificial intelligence, and advanced analytics hold the greatest potential to increase efficiency and consistency in food processing and packaging, enable data-driven decision-making, and improve overall operational performance.
- Occupations in demand in agriculture include greenhouse workers, horticulture technicians, and biological technologists, while food and beverage manufacturing requires process control and machine operators, industrial mechanics, and manufacturing managers.
- Although information technology occupations account for a very small share of sectoral employment, those projected to grow the fastest over the next decade include data scientists and software engineers.
- The skills most in demand for the future agriculture workforce are product design, digital production, and digital literacy, while the food and beverage manufacturing industry will be looking for skills such as digital literacy, problem-solving, evaluation, systems analysis, and monitoring.

Recommendations

To facilitate a smooth transition and help strengthen the industries' competitiveness, we propose the following recommendations:

- **Invest in education and professional development programs that** focus on developing workers' proficiencies in digital tools, product design, and complex problem-solving and emphasize soft skills such as adaptability.
- **Promote the role of farming and food production in the economy, with an emphasis on the need for tech-focused individuals in the sector.** Illustrate how agri-food professionals contribute to finding solutions for global food security, environmental sustainability, and resource management to help recruit new and younger talent to the sector.
- **Help small-to-medium-sized farmers provide in-house or manufacturer training to their staff.** Government and industry organizations can provide support and resources to enable small-to-medium-sized agri-food stakeholders, such as primary producers, processors, and distributors, to offer this training to their employees. Industry organizations can facilitate partnerships between agri-food stakeholders and equipment manufacturers to develop tailored training programs that address the specific needs and challenges of each industry.
- **Facilitate the creation of knowledge-transfer programs, connecting aging farmers with new entrants in their region.** Policy-makers and industry associations could develop and promote initiatives that foster mentorship and knowledge-sharing between experienced farmers and new entrants to preserve valuable skills and expertise around planting and harvesting schedules, crop rotation, soil management, irrigation, pest control, and breeding.

Skills for a smooth transition

Canada's agri-food sector is an important contributor to the economy.[1] In 2023, it employed 563,000 people domestically (around 2.8 per cent of total employment).[2] It also generated $72.1 billion in value-added or around 3.3 per cent of Canada's gross domestic product (GDP), with agriculture contributing to 1.7 per cent of GDP and the food and beverage manufacturing industry contributing to 1.6 per cent.[3]

The sector benefits from abundant land and water resources and a strong global reputation as a trusted supplier of safe, high-quality food. These factors have the potential to make Canada a leader in sustainable food production and processing. However, taking advantage of these opportunities and leveraging the country's strengths depends on the sector's ability to adapt to technological change and access a qualified labour force. Only then can the sector remain competitive, sustainable, resilient, and prosperous into the future.

1 The agri-food sector consists of agriculture and food and beverage manufacturing industries. We define the agriculture industry as including the following NAICS codes: 111 crop production,112 animal production and aquaculture, 1151 support activities for crop production, and 1152 support activities for animal production. We define the food and beverage manufacturing industry as including the following NAICS codes: 311 food manufacturing, and 3121 beverage manufacturing.

2 Statistics Canada, Table 14-10-0377-01; Statistics Canada, Table 14-10-0202-01.

3 Statistics Canada, Table 36-10-0449-01.

To this end, this report provides an overview of the technological trends and occupational employment changes in Canada's agri-food sector, with an aim to

- inform agri-food stakeholders (e.g., primary producers, processors, and distributors) and organizations involved in workforce development (e.g., educational institutions, training providers) about technological transformations;
- highlight the emerging abilities, skills, and knowledge-area requirements within the sector; and
- provide strategic recommendations on workforce development initiatives that can support sustainable growth and competitiveness in the global market.

We leverage Statistics Canada and The Conference Board of Canada's labour market information, complemented with information from interviews with 10 key informants, to identify occupations that are emerging as pivotal to the sector's future growth. Furthermore, we examine the skills gaps that present challenges for sector-wide workforce transitions and propose recommendations for stakeholders to address these gaps.

Technology trends in the sector

Understanding technology trends in agri-food is crucial for workers, sector representatives, and educators in preparing for the future of work in the sector. As technology continues to revolutionize the agri-food sector, it's essential to recognize the resulting shifts in skills requirements and labour demand as this will support sector innovation, enable workers to adjust and thrive in a rapidly changing environment, and ensure a competitive agri-food sector in Canada.

Automation technologies are revolutionizing Canada's agri-food sector

As the pace of technological innovation ramps up, so does the need for technology deployment and integration across the entire food supply chain. In response, Canada's agriculture industry is adopting precision agriculture, which uses advanced technologies such as sensors, robotics, and artificial intelligence to optimize crop yields, reduce waste, and improve overall efficiency.[4] Similarly, the food and beverage manufacturing industry is undergoing a renaissance with the implementation of Industry 4.0 technologies (e.g., automation, robotics, data analytics) to enhance productivity, quality control, and supply chain management.[5] While these technologies hold the potential to optimize production and enable data-driven decision-making, their adoption has led to increased demand for workers with higher levels of education and skills. For example, cognitive skills, technological literacy, and specialized knowledge are becoming increasingly important for people working in this sector.[6]

4 Mitchell et al., *Adoption Barriers for Precision Agriculture Technologies in Canadian Crop Production.*

5 *BDC, Canadian Food and Beverage Industry.*

6 Howard and Lincoln, *The Future of Work in Agriculture.*

The adoption and integration of technology within Canada's agri-food sector has been steadily growing. In a study published by the Information and Communication Technology Council of Canada (ICTC), Canada ranked seventh globally in the total dollar value of new agri-food technology investments (US$508 million) and sixth in the number of new deals.[7]

Technology adoption trends in Canada's agri-food sector vary across different industries and by establishment size. In agriculture, the adoption of precision technologies such as GPS-guided equipment, variable rate nutrient application, and yield mapping has been growing steadily, particularly among larger farms.[8] According to a 2021 survey by Agriculture and Agri-Food Canada, 64 per cent of farms with annual revenues over $1 million reported using precision agriculture technologies, compared to only 24 per cent of farms with revenues under $100,000. In food and beverage manufacturing, the adoption of automation and robotics has been more prevalent in larger, well-established companies, while smaller businesses have often faced barriers to adoption due to high costs and a lack of in-house expertise.[9]

Integrating technology in the agri-food sector presents significant opportunities for growth and innovation. The use of precision agriculture technologies can help farmers to reduce waste, conserve resources, and improve crop yields, while the implementation of automation and robotics in food and beverage manufacturing can enhance product quality, safety, and traceability.

Adoption being driven by labour shortages

As the agri-food sector continues to embrace technological advancements, it is important to recognize that these transformations are not only driven by the pursuit of productivity, production/process efficiency, and cost savings[10] but also by the pressing need to address the challenges posed by labour shortages.

The agriculture industry regularly faces labour shortages. For example, even with tens of thousands of seasonal foreign workers supporting the industry during periods of peak demand, the ratio of job vacancies to employment in the industry has, on average, been 11 per cent above the Canadian average over the past four years.[11] As well, with an older-than-average workforce the industry will face high retirement rates. On average, over 10,600 workers, including owner-operators, are expected to retire each year between 2023 and 2030, for a total of over 85,300 retirements or almost 30 per cent of the industry's current Canadian workforce.[12]

As businesses struggle to find and retain skilled workers, they are increasingly turning to automation and advanced technologies to fill this gap. By implementing these technologies, companies can reduce the demand for manual labour, improve efficiency, and maintain production levels despite workforce challenges. Moreover, the adoption of technology will help to attract a younger generation of workers to the agri-food sector by offering more technologically advanced and engaging work environments.

Despite these potential benefits, Canada's agri-food sector is displaying a lethargic record of technology adoption in the face of several key barriers. Perceived insufficient returns on investment, a lack of government support and funding, and a lack of in-house expertise to guide the process are slowing the rate of adoption.[13] This underscores a lingering need for targeted support and resources to facilitate workforce transitions.

7 Ivus et al., *Canadian Agri-food Technology.*

8 Lemany et al., *Preliminary Findings of a Provincial Survey on the Adoption of Automation and Robotics Technologies in Ontario's Agriculture Sector.*

9 Sparrow and Howard, *Robots in Agriculture.*

10 Lemay et al., *Preliminary Findings of a Provincial Survey on the Adoption of Automation and Robotics Technologies in Ontario's Agriculture Sector.*

11 Statistics Canada, Table 14-10-0442-01.

12 Canadian Agricultural Human Resource Council, *Sowing Seeds of Change.*

13 Lemay et al., *Preliminary Findings of a Provincial Survey on the Adoption of Automation and Robotics Technologies in Ontario's Agriculture Sector.*

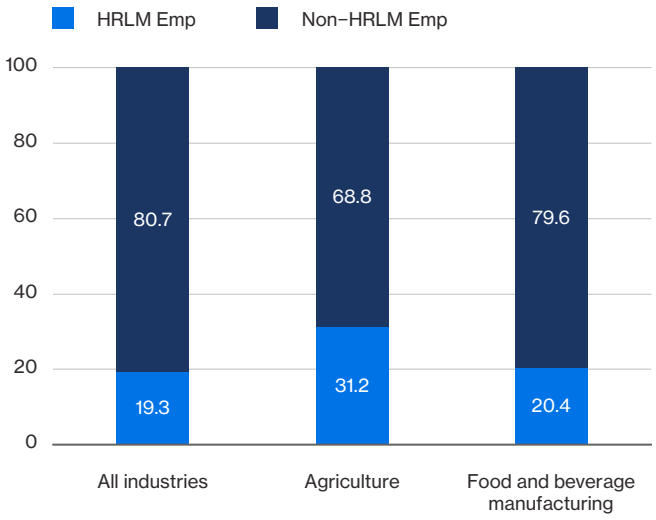
Labour implications of automation

As automation and other technological advancements transform workplace roles, it is crucial to understand how the sector can best make use of existing workers and shift people into emerging roles. By analyzing labour market projections, we can inform strategies for supporting workers and industries through the transition to a more technology intensive agri-food sector.

Agri-food automation will replace a substantial portion of human labour

Emerging technologies are poised to automate many repetitive tasks currently carried out by humans. Our analysis indicates that nearly one in three jobs in agriculture and one in five jobs in food and beverage manufacturing can be automated within the next decade and that these jobs have limited transition options. (See Chart 1.) We define these as high-risk, low-mobility (HRLM) roles.[14]

Chart 1
Canada's agriculture industry has elevated automation risk compared to the other industries
(percentage of employment)



HRLM = high-risk, low-mobility unemployment.
Non-HRLM = non-high-risk, low-mobility employment.
Source: The Conference Board of Canada; Statistics Canada.

14 See "Gresch, Darren, Responding to Automation: How Adaptable Is Canada's Labour Market?" for how we define high-risk, low-mobility (HRLM) occupations.

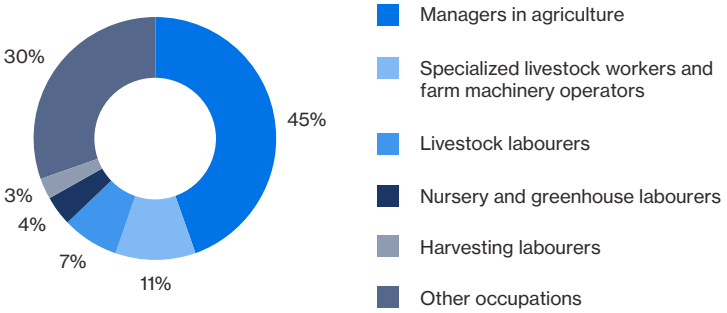
The agriculture industry currently employs workers from 308 different occupations, while the food and beverage manufacturing industry employs workers from 258 different occupations. However, employment in these industries is highly concentrated among a limited number of occupations. In the case of agriculture, the top five occupations account for 70 per cent of employment, while in food and beverage manufacturing the top five occupations account for 45 per cent of employment. (See Chart 2 and 3.)

With agri-food employment concentrated in a handful of occupations, the automation impacts can be large. Automation and labour shortages will both contribute to a decline in domestic employment in agriculture over the next decade. All but one top occupation (nursery and greenhouse labourers) will lose employment over the next decade. In the case of food and beverage manufacturing, only one occupation, labourers in food and beverage processing, will experience a decline in employment, but this accounts for more jobs than any other in the industry. Workers will need to reskill if they are to remain in the agri-food sector and take advantage of the growing demand for other roles.

Chart 2

The top five occupations account for 70 per cent of employment in agriculture

(workers in agriculture, percentage of total employment)

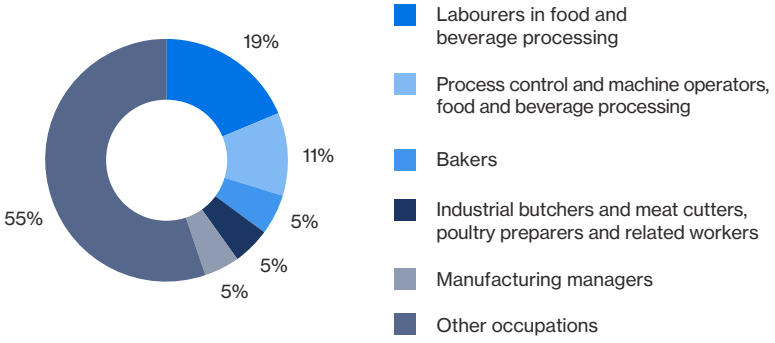


Source: The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Chart 3

The top five occupations account for 45 per cent of employment in food and beverage manufacturing

(workers in food and beverage manufacturing, percentage of total employment)



Source: The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

While some roles will grow, others will shrink

The agricultural labour market is poised for significant shifts due to technological adoption and automation. Domestic employment in agriculture is projected to decrease by 0.8 per cent from 2023 to 2033, but there are a wide range of differences in the growth rates of different occupations.[15] The top five fastest growing occupations over the next decade in terms of absolute employment gains will experience growth ranging from 9.7 per cent to 41.4 per cent. These occupations reflect the increasing emphasis on specialized skills in plant care, transportation logistics, and animal welfare, aligning with advancements in agricultural technology. (See Table 1.)

Conversely, the top five declining occupations are projected to see decreases ranging from 4.7 per cent to 9.5 per cent. These declines underscore automation's impact on traditional managerial roles and manual labour tasks as well as the streamlining of administrative functions through technological integration. On top of automation, many of these occupations are experiencing high retirement rates and the increased employment of foreign workers, which further contribute to declining employment levels.[16] Overall, these data highlight the dual effects of technological innovation in agriculture, signaling both opportunities for specialized skills development and the need for workforce adaptation amid shifting job dynamics.

Table 1
The future landscape of agricultural employment is poised for big shifts due to automation

Top 5 fastest growing occupations

Occupation	2023	2033	Gain	Change (%)
Process control and machine operators, food and beverage processing	39,998	45,140	5,142	12.9
Construction millwrights and industrial mechanics	6,797	8,304	1,507	22.2
Manufacturing managers	17,009	18,497	1,488	8.7
Material handlers	14,747	16,151	1,404	9.5
Production and transportation logistics coordinators	2,395	3,392	997	41.6

Top 5 fastest declining occupations

Occupation	2023	2033	Gain	Change (%)
Managers in agriculture	120,317	114,634	–5,683	–4.7
Specialized livestock workers and farm machinery operators	29,021	27,196	–1,825	–6.3
Livestock labourers	20,272	18,547	–1,725	–8.5
Harvesting labourers	7,530	7,067	–463	–6.1
Accounting technicians and bookkeepers	3,907	3,534	–373	–9.5

Note: The top 5 status is determined by absolute gain in employment instead of percentage change to ensure we capture the substantial changes that will impact the largest number of workers.
Source: The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

15 While foreign workers are an important part of the agri-food workforce, they are not included in these employment estimates since the skills analysis in this report pertains only to the Canadian workforce.

16 Hiring of temporary foreign workers is not counted in Canadian employment.

The labour market in food and beverage manufacturing is also expected to undergo major changes. Although overall employment in the industry is predicted to rise by 2.3 per cent between 2023 and 2033, the growth rates of various occupations will vary considerably, with some experiencing rapid expansion and others facing decline or even contraction. (See Table 2.)

The projected labour market trends in food and beverage manufacturing underscore the impact of technological adoption. Among the top five fastest growing occupations by employment gains, roles such as process control and machine operators reflect the increasing integration of automation and advanced manufacturing technologies. These occupations are slated to see gains ranging from 8.7 per cent to 41.6 per cent, indicating a heightened demand for skilled professionals adept at overseeing and optimizing automated processes.

The top five fastest declining occupations will see declines ranging from 4.5 per cent to 20.9 per cent in employment, underscoring the impact of automation on the role of traditional manual labour. These changes highlight the need for workforce adaptation amidst the evolving technological landscape.

Table 2
Automation technologies will reduce demand for repetitive labour while they increase demand for more technical roles in food and beverage manufacturing

Top 5 fastest growing occupations

Occupation	2023	2033	Gain	Change (%)
Nursery and greenhouse labourers	10,693	11,731	1,038	9.7
Transport truck drivers	4,280	4,822	542	12.7
Landscape and horticulture technicians and specialists	2,408	2,850	442	18.4
Pet groomers and animal care workers	1,041	1,472	431	41.4
Biological technologists and technicians	1,358	1,688	330	24.3

Top 5 fastest declining occupations

Occupation	2023	2033	Gain	Change (%)
Labourers in food and beverage processing	67,283	62,372	–4,911	–7.3
Labourers in fish and seafood processing	5,956	4,709	–1,247	–20.9
Fish and seafood plant workers	5,501	4,697	–804	–14.6
Shippers and receivers	7,505	6,758	–747	–10.0
Retail salespersons and visual merchandisers	9,548	9,117	–431	–4.5

Note: The top 5 status is determined by absolute gain in employment instead of percentage change to ensure we capture the substantial changes that will impact the largest number of workers.
Source: The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Experts agree–upskilling the agri-food workforce will present challenges

Key informants spoke at length about the role of technology in the automation of low-skill, repetitive tasks in occupations. While automation technologies reduce demand for low-skilled workers to perform these tasks, these changes will also lead to the emergence of new roles requiring a more educated workforce.

Increasing output in agriculture is not just about automating tasks but collecting data and insights to predict and improve farming operations and add more value to the business. For example, when advanced machinery and robotics equipment operate in the field, the sensors attached to them gather data which, in combination with cloud connectivity, advanced analytics, and machine learning algorithms, can create a world of new possibilities to manage and increase efficiencies along agri-food production chains.[17]

Need for transitions influenced by rural locations

One of the major challenges for the sector is to prepare for technological change and adoption. Employers will need to recruit for new types of roles and skills, while creating pathways for vulnerable workers to upskill and transition to these new roles.[18] Enhancing training and/or upskilling is especially important in the context of agri-food in Canada, given that this sector is more likely to operate in rural regions where the talent pool is smaller and residents often lack equal access to training opportunities.

Constraints in the number of people willing and able to work in the agri-food sector already create recruitment challenges. Industry experts we spoke to indicate that it is difficult to entice workers to relocate to rural regions. Moreover, one interviewee noted that the traditional trend of younger generations taking over agri-food businesses is becoming less common as those born on farms are preferring to move to urban areas or other industries with more flexibility.

Given the limited supply of workers, the expected technological shifts will require the sector to make the best use of the people that are available. This will mean retraining existing workers so they can shift from roles where demand is shrinking to those where it is growing.

There are several reasons why we should develop a job transition model that leverages the available workforce in rural areas to facilitate transitions from declining occupations to growing ones in the agri-food sector. Rural areas often possess a wealth of human capital potential, including individuals with a deep understanding of agricultural practices. A model that focuses on rural locations can tap into this rich talent pool, offering opportunities for employment continuity and economic stability within local communities.

Furthermore, a model that facilitates transitions to growing occupations in agriculture, such as nursery and greenhouse labourers or landscape technicians, could help individual workers adapt to evolving job markets and bolster the agriculture industry. This targeted approach would not only benefit workers by providing pathways to secure and fulfilling employment but would also contribute to the long-term resilience and prosperity of rural economies and the agriculture industry as a whole. The following section focuses on those transitions by identifying skills gaps between growing and declining occupations.

17 Christiansen et al., *The Future of Work in Agri-Food.*
18 Ibid.

Skills differences in job transitions

As the agri-food sector undergoes significant transformations due to automation, it is crucial to understand the feasibility of job transitions for workers in declining occupations. This analysis quantifies the differences in skills, abilities, and knowledge areas between declining and growing occupations, providing valuable insights for workers, industry stakeholders, and policy-makers.

By leveraging The Conference Board's Model of Occupations, Skills and Technology (MOST) and the comprehensive Occupational and Skills Information System (OaSIS) framework developed by Economic and Social Development Canada (ESDC), we identified key skills gaps and competencies required to successfully transition workers into growing roles. This information can enable industry representatives to develop targeted training programs and strategies, minimizing the impact of job displacement and maximizing the benefits of technological adoption.

Mapping potential transitions within the sector

We identified origin and destination occupations based on the estimated employment growth rate over the next decade (2023-33), calculated using MOST data. Origin occupations are those that are estimated to decline (i.e., growth rate below zero), while destination occupations are those that are projected to grow faster than the economy average of 8.3 per cent over the next 10 years.

We used job gains and losses as conditions to ensure that we transition employees from shrinking roles to growing ones. (See Table 3.) This makes transitions forward-looking and accounts for changes such as technological evolution, which will make skills associated with origin occupations less relevant while making skills associated with destination occupations more relevant.

We then analyzed skills compositions of origin and destination occupations to identify differences in abilities, skills, and knowledge areas between the respective occupation groups. We weighted skills values by job gains and losses to account for the prevalence of competencies in the industries reviewed. For example, two destination occupations "biological technologists and technicians" and "software engineers and designers" are estimated to gain 330 and 67 jobs, respectively, by 2033. Because the gain in the number of biological technologists and technicians is five times the gain in software engineers and designers, we valued the skills associated with the former as five times greater than the skills associated with the latter.

Table 3
Automation technologies will reduce demand for repetitive labour while they increase demand for more technical roles in food and beverage manufacturing

	Origin Occs.	Emp. Gain / Loss	Destination Occs.	Emp. Gain / Loss
Agriculture	78	–11,424	136	8,345
Food and beverage manufacturing	92	–11,096	91	17,715

Source: The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Lastly, to reveal gaps we subtracted origin job averages from destination job averages for abilities, skills, and knowledge areas.[19] In interpreting skills gaps between growing and declining roles, we judged that a 10 per cent difference should be the cut off point for measuring a significant difference.[20] Anything below this value is either not statistically significant or not big enough to require dedicated training (i.e., workers can close those gaps on the job or by themselves). Lastly, we assume that workers could transition from any origin occupation to any destination occupation.

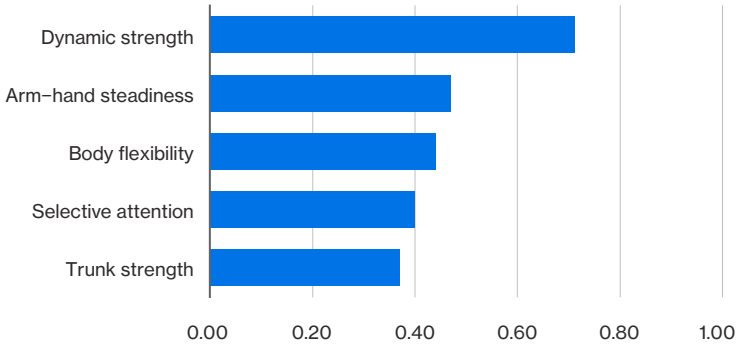
Small skills differences in agriculture indicate easier transitions

Physical abilities are still in demand despite technological shifts

Transitions between declining and growing occupations will be relatively seamless in terms of abilities, with only two out of 49 abilities showing a difference greater than 0.5 (on a scale of 0 to 5). Dynamic strength emerges as the most pronounced difference, with a notable gap of 0.7 proficiency points between declining and growing roles. Arm-hand steadiness follows closely behind, with a difference of 0.5 proficiency points, indicative of the heightened importance of fine motor skills in emerging occupations such as process control and machine operation. (See Chart 4.)

This underscores that there will continue to be demand for roles necessitating physicality, despite the fact that several interviewees said that agri-food roles are becoming less manual. This trend is likely driven by the operational requirements of technologically advanced processes.

Chart 4
Transitioning workers need to have physical abilities
(differences in proficiency level, max = 5)



Source: ESDC Occupational and Skills Information System (OaSIS); The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Product innovation skills needed for a transforming industry

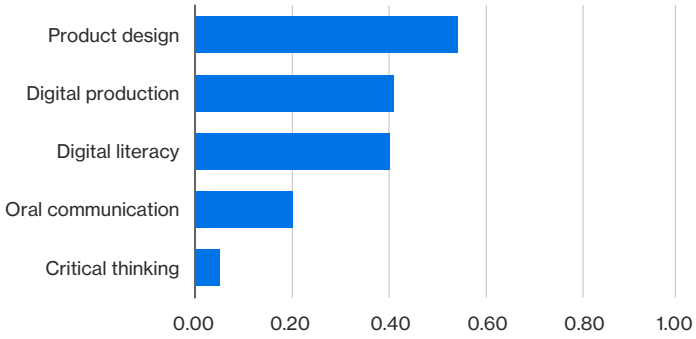
Similarly, transitions between declining and growing occupations will be relatively smooth in terms of developing skills in agriculture, with product design the only skill out of 33 showing a difference greater than 0.5 (on a scale of 0 to 5). This skill is crucial for some growing agriculture occupations as it enables workers to innovate and develop solutions that enhance efficiency, sustainability, and market competitiveness in agricultural production. (See Chart 5.)

As an example, one interviewee noted the growing trend of community supported agriculture (CSA) models, where farmers develop a food box that is delivered or picked up by local residents, eliminating the need for an intermediary in the sales process.

19 Skills and abilities ratings measure the proficiency level required by an occupation on a scale of 0 to 5 (i.e., 1 equals the minimum while 5 equals the maximum level of proficiency; 0 indicates that a particular skill or ability is not applicable to an occupation). Knowledge areas are measured by the knowledge level on a scale of 0 to 3.

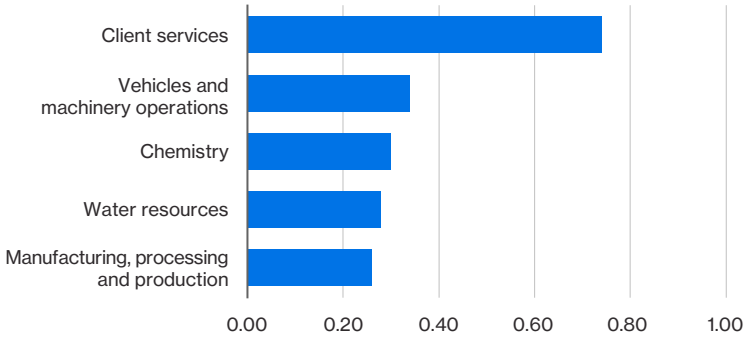
20 Ten per cent corresponds to 0.5 in the difference between proficiency levels for abilities and skills and 0.3 shows the difference in the proficiency level for knowledge areas.

Chart 5
Product innovation and digital skills are needed to transition
(differences in proficiency level, max= 5)



Source: ESDC Occupational and Skills Information System (OaSIS); The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Chart 6
New knowledge areas are needed to transition
(differences in proficiency level, max = 3)



Source: ESDC Occupational and Skills Information System (OaSIS); The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

New knowledge areas are needed but the transfer of old knowledge cannot be overlooked

In terms of knowledge areas, only five out of 33 areas show a difference greater than 0.3 (on a scale of 0 to 3), indicating relatively easy transitions. However, there are several important differences between declining and growing occupations, shedding light on the evolving competencies required in response to technological advancements. (See Chart 6.)

Notably, client services emerges as the most pronounced differentiator, with a difference of 0.7 on the proficiency scale, underscoring the heightened emphasis on customer-centric approaches and relationship management in evolving roles. Meanwhile, vehicle and machinery operations, chemistry, water resources, and manufacturing, processing, and production each exhibit differences of 0.3, highlighting the growing importance of technical expertise and domain-specific knowledge in modernizing agricultural practices.

While new knowledge is important, there is also a crucial need to ensure the transfer of knowledge and experience to the next generation. However, nearly 30 per cent of the agriculture workforce is expected to retire over the next decade in Canada,[21] which could be a challenge for this needed exchange of knowledge. One industry informant we spoke to said they are trying to get ahead of this trend and are having retired employees return to mentor new employees. Phased retirement approaches can also allow veteran workers to provide training, easing the learning curve for newcomers.

Skills differences in food and beverage manufacturing are larger

Nearly 41 per cent of abilities need greater proficiency for growing occupations

Occupational changes in the food and beverage industry will require much more involved upskilling than those in agriculture. For example, for 20 of the 49 abilities described in the OaSIS system there is a difference greater than 0.5 (on a scale of 0 to 5) between declining and growing occupations in food and beverage manufacturing.

21 Canadian Agricultural Human Resource Council, *Sowing Seeds of Change.*

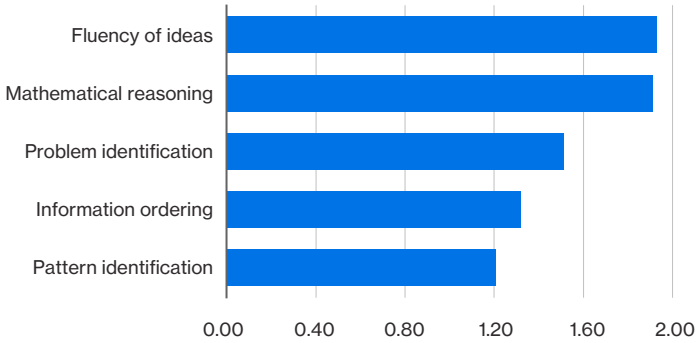
The top five abilities with the largest differences reveal important skills to focus on for successful transitions. These include fluency of ideas (1.9), mathematical reasoning (1.9), problem identification (1.5), information ordering (1.3), and pattern identification (1.2). (See Chart 7.) The first two abilities underscore the role of creativity and analytical thinking in growing occupations. The next three abilities highlight the importance of efficient troubleshooting, streamlined production processes, and effective quality control where workers are able to recognize, prioritize, and discern patterns in complex production settings.

Nearly all skills for growing roles have large proficiency needs compared to declining roles

Transitions between declining and growing occupations in food and beverage manufacturing will be challenging in terms of skills as 28 out of 33 listed occupations show a skills difference of 0.5 or greater (on a scale of 0 to 5). The top five skills with the largest differences are digital literacy (1.8), problem-solving (1.7), evaluation (1.6), systems analysis (1.5), and monitoring (1.5). These differences indicate a considerable gap in the proficiencies required for growing occupations. (See Chart 8.)

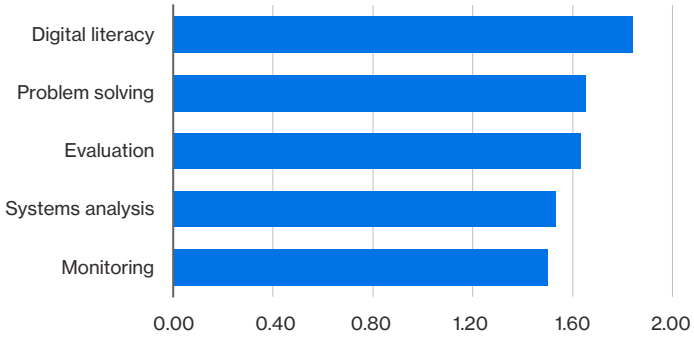
Emerging as the most pronounced differentiator, digital literacy highlights the growing importance of digital tools and platforms in modernizing production processes and leveraging data-driven insights. The other skills underscore the heightened emphasis on analytical thinking and systematic approaches to problem-solving in response to complex operational challenges.

Chart 7
Transitioning workers need to develop a variety of abilities
(differences in proficiency level, max = 5)



Source: ESDC Occupational and Skills Information System (OaSIS); The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Chart 8
Digital literacy has the largest skill gap that needs to be closed
(differences in proficiency level, max = 5)



Source: ESDC Occupational and Skills Information System (OaSIS); The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Knowledge areas have less of a proficiency gap but more business and operations knowledge would be helpful

Transitions in most knowledge areas will be easier compared to abilities and skills, with only 16 out of 44 knowledge areas showing a difference equal to or greater than 0.3 (on a scale of 0 to 3). The top five knowledge areas with the largest differences are business administration (0.9), performance measurement (0.8), clerical principles (0.8), human resources and labour relations (0.6), and vehicle and machinery operations (0.6). (See Chart 9.)

Business administration, as the most pronounced differentiator, underscores the focus on managerial acumen and strategic decision-making in response to changing business landscapes. Meanwhile, performance measurement and clerical knowledge highlight the growing importance of data-driven performance evaluation and administrative efficiency in optimizing production processes. Human resources and labour relations, and vehicle and machinery operations are attributable to the evolving role of workforce management and technical expertise in driving operational excellence and organizational effectiveness.

It will be easier to transition workers within agriculture than those in food and beverage manufacturing

In agriculture, the small magnitude of differences between most abilities, skills, and knowledge areas suggests that workers in declining occupations already possess many of the attributes required for growing occupations, making transitions more feasible. With only minor upskilling or reskilling required, workforce transitions will likely be accessible for workers and manageable for employers. On the other hand, workforce transitions in food and beverage manufacturing are much more likely to require significant investments in targeted training programs.

Chart 9
Transitioning workers need to learn more business and operations knowledge
(differences in proficiency level, max = 3)

Source: ESDC Occupational and Skills Information System (OaSIS); The Conference Board of Canada, The Model of Occupations, Skills and Technology (MOST), 2024.

Recommendations

Our analysis suggests that nearly one-third of jobs in the agriculture industry and one-fifth of jobs in the food and beverage manufacturing industry are at risk of automation within the next decade. By embracing automation and technological advancement, Canada's agri-food sector stands to increase productivity and competitiveness, potentially exceeding those seen in many other industries, while addressing some of the labour challenges it faces. The integration of automation and digital technologies is not only reshaping the landscape of these industries but also the skills sets required to thrive within them. However, this transition will require the development of new skills sets.

Addressing the skills gap and altering perceptions about careers in these industries will enable organizations to attract and retain the talent necessary for embracing these technological advancements. To facilitate a smooth transition and help strengthen the industries' competitiveness, we propose the following recommendations:

- **Invest in both education and professional development programs:** Policy-makers and sector stakeholders should prioritize training initiatives that enable workers to effectively adopt and integrate advanced technologies in the agri-food sector. These programs should focus on developing workers' proficiencies in digital tools, product design, and complex problem-solving, as well as emphasizing soft skills such as adaptability. By providing workers with opportunities to acquire these sought-after skills, policy-makers and sector stakeholders could help bridge the skills gaps that currently hinder the adoption of advanced technologies in the agri-food sector as well as help transition at-risk workers.
- **Promote the role of farming and food production and debunk stereotypes to attract more tech-focused individuals into the sector:** Given the challenge of rural recruitment, sector stakeholders and educational institutions should showcase the innovative and technologically advanced aspects of modern agriculture and food production. Challenging outdated perceptions and attracting a diverse, tech-savvy workforce is needed. For example, emphasizing how the use of advanced technologies such as drones, robotics, AI, sensors, and data analytics are revolutionizing traditional farming and manufacturing practices can attract tech-savvy workers into the sector. Moreover, illustrating how agri-food professionals contribute to finding solutions for global food security, environmental sustainability, and resource management could help recruit new and younger talent to the sector.

- **Support small-to-medium-sized farmers in providing in-house or manufacturer training to their staff:** As equipment becomes more specialized, training will become increasingly important. Government and industry organizations could provide support and resources to enable small-to-medium-sized agri-food stakeholders, such as primary producers, processors, and distributors, to offer this training to their employees, either in-house or through a manufacturer. Moreover, governments could offer financial support in the form of grants, subsidies, or low-interest loans to these stakeholders for investing in training programs and purchasing equipment for employee training. Additionally, industry organizations could facilitate partnerships between agri-food stakeholders and equipment manufacturers to develop tailored training programs that address the specific needs and challenges of each industry. These partnerships could help ensure that training materials are up-to-date and aligned with the latest technological advancements in the agri-food sector.
- **Facilitate the creation of knowledge-transfer programs, connecting aging farmers with new entrants in their region:** Policy-makers and industry associations could develop and promote initiatives that foster mentorship and knowledge-sharing between experienced farmers and new entrants. Programs like this could advance the industry by ensuring that workers are provided with new knowledge through the preservation and transfer of valuable skills and expertise around planting and harvesting schedules, crop rotation, soil management, irrigation, pest control, and breeding.

Strategies for upskilling and reskilling workers are a key part of ensuring that Canada's agriculture and food and beverage manufacturing industries not only adapt to technological advancements but also lead the way in innovation and sustainability.

Appendix A

Methodology

About the research

This research is designed to address the following question: What is the potential impact of technology and automation in the agriculture and food and beverage manufacturing industries on future skills requirements and labour demand? We use a combination of literature review, employment forecast analysis, skills transitions, and key informant interviews to answer this question.

Detailed methods

Literature review

We scanned academic studies and reports published by governments, professional organizations, and consultancies to identify technological and workforce trends in the agri-food sector in Canada. We identified more than 20 sources and reviewed 10 different studies for this purpose. The output of this was the identification of key technologies that are transforming the agri-food sector and the number of agricultural workers that are expected to retire by 2030.

Skills gaps between origin and destination occupations

Identifying similarities in the skills composition of origin and destination occupations helps determine the retraining needed for transition. We estimated differences in abilities, skills, and knowledge areas between origin and destination occupations as follows.

First, we identified relevant occupations in each of the agriculture and food and beverage manufacturing industries, using 2023 industry-occupational employment from MOST. In 2023, there were 308 different occupations in agriculture and 253 occupations in food and beverage manufacturing.

Second, we grouped these occupations into declining, stable, and growing buckets in respective industries. We used the projected employment growth rate from 2023 to 2033 to make this determination. Declining occupations are forecast to lose employment; stable occupations are forecast to grow, but by less than the economy average (8.3 per cent); growing occupations are forecast to grow faster than the economy average. For the skills gaps and transition analysis, we labelled declining occupations as “origin” and growing occupations as “destination.”

Third, we identified the skills composition of occupations by specifying the proficiency levels for abilities, skills, and knowledge areas for both origin and destination occupations. We weighted proficiency values by job gains or losses to account for the prevalence of competencies in the industries. We then summed the weighted proficiency level values for specific abilities, skills, and knowledge areas in origin and destination groups (see Table A1). At the end of this step, we had average proficiency level scores for 49 different abilities, 33 different skills, and 44 different knowledge areas for origin occupations and destination occupations, respectively.

Fourth, we created a hypothetical job transition scenario in which all employees with origin occupations are transitioned to destination occupations. For this, we subtracted the average proficiency value for the origin occupations from the average proficiency value for the destination occupations. We sorted the differences in descending order to identify the top five abilities, skills, or knowledge areas for workers to close in on a successful transition scenario.

The skills gaps were calculated based on OaSIS (Occupational and Skills Information System). To address the lack of standardized occupational and competency information in Canada, Employment and Social Development Canada created a database that connects competencies to occupations. This database, OaSIS, builds upon international best practices and lessons learned from systems like the American ONET. It expands on the National Occupational Classifications (NOC) by providing detailed information on 900 occupations, compared to 516 NOC unit groups. Table A1 details this database’s components and definitions and the number of dimensions of the data.

Table 1
Thousands of Different Data Inputs Are Used in the Calculation of Skills Gaps

Input	Dimensions	Definition
Abilities	49	Enduring attributes that influence an individual's performance.
Skills	33	Developed capacities that facilitate learning or the more rapid acquisition of knowledge.
Knowledge areas	44	Organized sets of principles and facts that apply in general domains related to branches of learning.

Sources: OaSIS; O*NET; the Conference Board of Canada.

Key informant interviews

To examine technology adoption, talent, skills, and transition into agriculture and food and beverage manufacturing, we conducted 10 key informant interviews between April and May 2023. Organizations consulted consisted of the following:

- four industry associations
- two aquaculture companies
- two farm enterprises
- one farm management company
- one agriculture feed company.

Four interviewee organizations are national, three are based in Ontario, two are based in British Columbia, and one is based in Quebec, with several of these organizations having regional offices in other parts of Canada.

To recruit interviewees, we used a split methodology. First, we created a list of target organizations to interview and cold reached out to this target list. We then further secured interviews through contacts met at an industry event. Interviews took place between April and May 2023 and ranged from 20 to 50 minutes each. Interviews were conducted virtually through Microsoft Teams, with the interviewer transcribing the contents. Overall, the research generated 288 minutes of recorded interviews, making up 70 transcribed pages with 43,002 words. Coding and analysis of the interviews were done through NVivo.

Interviews were semi-structured and meant to supplement our skills gaps analysis. The interview questions were as follows:

Context

1. Could you briefly describe the work carried out by your organization and your role within it?
2. Within the agriculture and food and beverage manufacturing industry, where do you see the greatest potential for growth over the next ten years?

New technologies

3. What new and emerging technologies are being adopted and/or disrupting the industry to the largest degree?
4. What are the key sustainability trends in your sector and are new technologies being implanted to address sustainability challenges?
5. Are there any new occupations likely to emerge in the next few years, especially regarding new technologies? If so, which ones?
6. Which occupations are particularly at risk of disruption within the agriculture and food and beverage manufacturing industry, if any? Which ones will see increased demand?

Occupations & skills

7. What are the main challenges facing employers when it comes to hiring and retention?
8. What strategies do employers currently leverage to attract and retain talent?
9. What skills are/will be necessary for agriculture and food and beverage manufacturing industry occupations, especially considering new technologies? To what extent do workers already have these skills?
10. If skills gaps exist, what types of support could help workers acquire the requisite skills?

Workforce transitions

11. What barriers could be preventing workers from successfully transitioning, up-skilling, and re-skilling?
12. How can employers, governments, and other stakeholders better facilitate transitions, up-skilling, and re-skilling into the agriculture and food and beverage manufacturing industry?

Wrap-up

13. Are there any other topics we may have missed regarding the agriculture and food and beverage manufacturing industry?
14. Could you recommend other individuals we should interview for this research?

Appendix B

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Acknowledgements

This impact paper was prepared with financial support provided through the Future Skills Centre. The Conference Board of Canada is proud to serve as a research partner in the Future Skills Centre consortium. For further information about the Centre, visit the website at fsc-ccf.ca.

Many Conference Board of Canada colleagues collaborated to bring this research to life. Michael Burt, Vice-President, MA, conceived of this research project and provided overall project direction and oversight. Zafer Sonmez, Lead Research Associate, PhD; Daniel Carpenter, Research Associate, MA; Nicholas Palaschuk, Senior Research Associate, PhD; were the lead researchers on this project. We thank Alain Francq, Director of Innovation and Technology, MBA, for providing feedback on drafts of this research. This impact paper was designed by Sarah Casselman, Senior Graphic Designer.

We also thank the 10 industry experts who participated in key informant interviews.

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To cite this research: Conference Board of Canada, The. *The Next Frontier in Canada's Agri-Food Sector: Technology Driven Labour and Skills Transitions*. Ottawa: The Conference Board of Canada, 2024.

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