AGRICULTURAL INNOVATIONS

VOLUME VI

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Canada

Agricultural Innovations Volume VI

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Introduction

Canada's food production system is resilient and innovative, sustains our environment, and supports our growing economy. In 2022, the entire agriculture and agri-food system employed 2.3 million people, provided 1 in 9 jobs in Canada, and generated approximately $144 billion of Canada's gross domestic product.

In Canada and around the world, publicly funded research is undergoing an important transformation. In the changing landscape of the agriculture and agri-food sector, the role of science is being reassessed to address the emerging opportunities and challenges, such as new technology, climate change, threats to biodiversity, and the ever-changing consumer and market demands. As Agriculture and Agri-Food Canada (AAFC) looks to the future, we continue to promote excellence in innovation while accelerating discovery across our national network of science facilities, and in collaboration with our domestic and international partners.

To build on our past successes but enable us to plan for future challenges, AAFC has created the **Strategic Plan for Science** to guide us over the next decade. This renewed vision for our science places a unique emphasis on the results of our research that is focused on economic, environmental, and social sustainability.

Our mission areas are:

- mitigating and adapting to climate change;
- increasing the resiliency of agro-ecosystems;
- advancing the circular economy by developing value-added opportunities;
- accelerating the digital transformation of agriculture and agri-food.

The outcomes of research under each mission are clear and measurable, and will positively impact the agriculture and agri-food sector, making meaningful contributions to the lives of Canadians.

We hope you enjoy learning more about AAFC and some of our recent scientific achievements in this issue of Agricultural Innovations.

AAFC AT A GLANCE

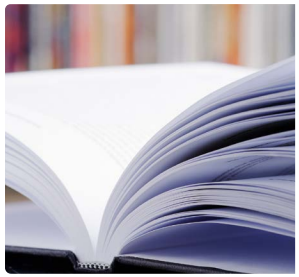
Key Figures 2022–2023

2178
Science and Technology staff

928
Science and Technology projects

20
Research and Development Centres

29
Satellite Research locations



1767
Science articles published in
336 Journals

Intellectual Property and Commercialization 2022–2023

AGREEMENTS

122
Research Participant Agreements executed

198
Material Transfer Agreements executed

248
Collaborative Research Agreements executed

3702
Active Research Agreements

PLANT VARIETIES

9
Plant Breeders' Rights granted

10
New varieties registered

219
Active Plant Breeders' Rights held by AAFC

499
AAFC-developed varieties currently sold

PATENTS

4
Patent applications submitted

4
Patents granted

11
Invention disclosures received

132
Active patents in **30** countries for **47** technologies

COMMERCIALIZATION

2
Business opportunity documents developed

22
Commercialization License Agreements executed

165
Entries by AAFC on ExploreIP Marketplace

661
Active licenses (technologies and varieties)


AAFC RESEARCH AND DEVELOPMENT CENTRES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
ATLANTIC REGION
Summerland
Agassiz
Lacombe
Lethbridge
Saskatoon
Swift Current
Brandon
Morden
St. John's
Charlottetown
Fredericton
Kentville
Quebec
Saint-Hyacinthe
Sherbrooke
Saint-Jean-sur-Richelieu
Ottawa
Guelph
London
Harrow
Coastal Region
Prairie Region
Ontario-Quebec Region

Satellite locations

COASTAL REGION

Clearbrook sub-station
Abbotsford, British Columbia

Harrington Research Farm
Harrington, Prince Edward Island

Benton Ridge sub-station
Woodstock, New Brunswick

Nappan Research Farm
Nappan, Nova Scotia

Dalhousie University's Agricultural Campus
Truro, Nova Scotia

Avondale sub-station
Avondale, Newfoundland

ONTARIO-QUEBEC REGION

Honourable Eugene F. Whelan Experimental Farm, Woodslee, Ontario

The Ontario Development and Technology Transfer unit, Guelph, Ontario

Research Farm at Vineland Station
Vineland Station, Ontario

Saint-Augustin-de-Desmaures Research Farm, Saint-Augustin-de-Desmaures, Quebec

Normandin Research Farm
Normandin, Quebec

L'Acadie Experimental Farm
Saint-Jean-sur-Richelieu, Quebec

Sainte-Clotilde Experimental Farm
Sainte-Clotilde de Châteauguay, Quebec

Frelighsburg Experimental Site
Frelighsburg, Quebec

PRAIRIE REGION

Beaverlodge Research Farm
Beaverlodge, Alberta

University of Alberta
Edmonton, Alberta

Vauxhall Research Farm
Vauxhall, Alberta

Calgary office
Science and Technology Branch

Edmonton office
Science and Technology Branch

Melfort Research Farm
Melfort, Saskatchewan

Scott Research Farm
Scott, Saskatchewan

The Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
Outlook, Saskatchewan

Indian Head Research Farm (IHRF)
Indian Head, Saskatchewan

Prairie Directorate Regina Office
Regina, Saskatchewan

The Canada-Manitoba Crop Diversification Centre
Portage la Prairie, Manitoba

The Canadian Centre for Agri-Food Research in Health and Medicine (CCARM)
Winnipeg, Manitoba

The Richardson Centre for Functional Foods and Nutraceuticals (RCFFN)
Winnipeg, Manitoba

The Canadian Centre for Grain Storage Research
Winnipeg, Manitoba

The Cereal Quality Laboratory
Winnipeg, Manitoba

Genetic resources and biological collections

Agriculture and Agri-Food Canada (AAFC) maintains the following biological collections and offers numerous resources to assist producers, industry, and researchers in their efforts to analyze, gauge, and manage important agricultural and environmental issues.

Animal Genetic Resources of Canada (AnGRC)

The AnGRC is a genebank for livestock and poultry genetic resources (DNA, semen/sperm or embryos) that stores tissues and cells at very low temperatures (cryobiology) to study, understand, and reintroduce genetic variability.

Canadian Collection of Fungal Cultures (DAOMC)

The DAOMC is a repository and distributor of fungal genetic resources that holds the largest collection of its kind in Canada—more than 20,000 living fungal cultures—with important agricultural and environmental species and strains for use by national and international researchers.

Canadian National Collection of Insects, Arachnids and Nematodes (CNC)

The CNC is a national resource with about 18 million specimens—one of the five largest collections of its kind in the world. It supports science that protects Canada's biodiversity, reduces the flow of invasive alien species into Canada, and identifies new invasive pests of concern.

Canadian National Mycological Herbarium (DAOM)

With approximately 350,000 irreplaceable fungal and fungal plant disease specimens, the DAOM is the largest collection of non-lichenized fungi in Canada. It documents the existence of indigenous and invasive species in all Canadian provinces and territories, and across the globe, for use in scientific research. The DAOM serves as a physical and historical archive of species existence and distribution which contributes to Canadian and international biodiversity research initiatives, as well as agricultural development and control.

Canadian Collection of Arbuscular Mycorrhizal Fungi (CCAMF)

The CCAMF is a collection of AM (arbuscular mycorrhizal) fungi that live with plants and are beneficial to their growth and protection against stresses. It offers high-quality AM fungi to scientists and the clean-technology industry, helping them develop new bioproducts and biotechnologies capable of sustaining the quality and yields of Canadian agriculture.

National Collection of Vascular Plants (DAO)

With approximately 1.5 million irreplaceable specimens of dried vascular plants, the DAO is the largest herbarium in Canada. The collection facilitates the identification of vascular plants from anywhere in Canada, provides information for the development of new crops and for ecological studies, and supports research on plant classification worldwide via the global network of herbaria.

Plant Gene Resources of Canada (PGRC)

The PGRC is a genebank for cultivated plants of importance to Canadian agriculture and their wild relatives. It contributes to food security and the sustainability of agriculture by preserving more than 120,000 samples of plant genetic resources for food and agriculture, and making this material and associated information accessible. As part of the Canadian National Plant Germplasm System, the Canadian Potato Gene Resources (CPGR) maintains a core collection of germplasm for conservation and utilization in breeding, research and training. The Canadian Clonal Genebank (CCGB) does the same for fruit germplasm.

Canadian Plant Virus Collection (CPVC)

The CPVC is one of the largest virus collections in the world, with over 720 isolates representing almost 300 virus species. It includes herbaceous infecting viruses that can be stored freeze-dried, as well as tree fruit and other woody plant viruses that need to be maintained in living plants. It acquires, distributes, and conserves virus isolates; provides reliable control samples for regulatory testing; supplies reference material when dealing with viral outbreaks; and provides samples to researchers for identification, characterization, and analysis of the viral samples.

More information on each of the above collections can be found at AAFC's Genetic Resources and Biological Collections.

Resources for farmers

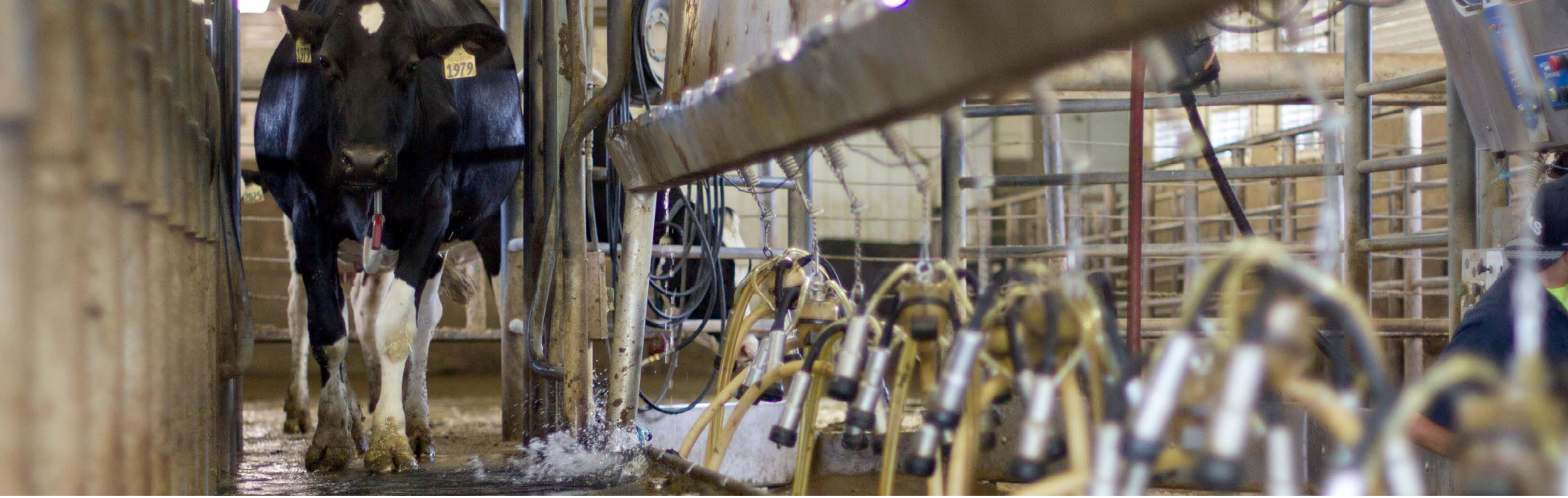
In addition, AAFC supports agricultural production by providing practical information, tools, programs, and resources for farmers. This includes agroclimate maps and monitoring tools, available on our Weather and Drought web page, which help farmers plan their activities and prepare for extreme weather.

Our research offers numerous solutions to help producers mitigate climate change and build sustainable farming practices. The agri-environmental indicators are a resource for web-based interactive maps, reports, and data on measurements of the environmental sustainability of Canadian agriculture. These help gauge the impact of agriculture on the environment and determine, for example, how to reduce agricultural emissions.

Crop protection information and methods are available for producers so they can manage plant disease, insects and other pests, and mitigate risks to crops in drought conditions. Our Pest Management Centre is a national resource in this area, helping Canadian growers protect the yield, value, and quality of their produce by providing access to new and effective crop protection products and technologies for minor crops, and alternative pest management solutions for major and minor crops.

More information on these resources can be found at AAFC's website under "Agricultural production tools and data", "Science and innovation", and "Environment and sustainability".

AAFC RESEARCH SUCCESSES



Incomplete milking: the secret to healthier dairy cows

Some Canadian producers, especially in Quebec, are now adopting a new easy-to-use and cost-efficient practice to ensure better health for their dairy cows. Despite the high-energy feeding strategies used, many cows fail to get sufficient nourishment during the first month after a calf is born. Producing large quantities of milk can stress their metabolism and weaken their immune system, resulting in higher rates of udder infections and acetonemia (a disorder causing loss of appetite and reduced milk production). Agriculture and Agri-Food Canada scientists have shown that incompletely milking cows (only taking a third of their milk) during the first five days of lactation can greatly improve their health and immunity.

With incomplete milking only 6% of cows suffer from acetonemia, while with conventional milking 47% of cows suffer from it. With a stronger immune system, cows eliminate 45% of udder infections during the first month of lactation without treatment, while only 25% of cows in conventional milking management do so. Researchers found this practice will not decrease the amount of milk produced during 44 weeks of lactation, and the practice can often be done with existing equipment on dairy farms.

As more Canadian dairy farms adopt this practice, reduced veterinary and medication costs, and improved well-being of cows, mean happier farmers and cows all around!

Raising healthier, happier pigs outdoors

Canadian pig farmers can improve their animals' welfare more naturally—by raising the pigs outdoors on pasture land. To help pasture-based farms achieve their animal welfare and productivity goals, Agriculture and Agri-Food Canada scientists and their university colleagues conducted experiments to address the challenges and risks associated with this practice.

Heat stress in sows (from temperatures above 25° C) can cause shorter pregnancies, abortions, reduced appetite in lactating sows, and reduced milk production for piglets. During the study, scientists offered pregnant and lactating sows three ways to reduce heat stress: a mud hole, farrowing hut, and shaded area. The sows used all three but preferred the mud hole, spending 40% of their time there when pregnant. However, when nursing, they preferred the farrowing huts which were less efficient. Scientists concluded that if a lactating sow has a mud hole near the farrowing hut, she will regularly cover herself with mud to reduce body temperature.

Researchers also identified the best forage-enriched diet. In addition to traditional feed, they looked at forage mixtures combining legumes (red clover and alfalfa) and grasses (timothy and tall fescue), either as dry hay, haylage (forage preserved by fermentation), or fresh cut forage. The sows favoured forage containing lots of legumes, preferably as haylage, then as fresh forage, and lastly as dry hay. Fresh forage can replace at least 10% of traditional concentrate feed rations during pregnancy, and probably more, without impacting the sows' health negatively. Adding forage to their diet during pregnancy can encourage them to eat more during lactation which is better for the piglets.

Reducing herbicide use ... no small potatoes!

Weeds can severely impact potato production. They compete for light, water, and nutrients; they serve as hosts for insect pests and diseases; and their resistance to commonly used herbicides threaten crops. With potato being the largest vegetable crop in Canada, accounting for 28% of all vegetable farm gate receipts (field and greenhouse [2020]), Agriculture and Agri-Food Canada scientists rose to these challenges by finding a new purpose for an old invention.

Originally designed to control an insect pest, the potato vine crusher attaches to the rear of a harvester and crushes anything going through it, including problematic weeds like lambsquarters, redroot pigweed, barnyard grass, yellow foxtail, and volunteer canola. After the seeds go through the crusher, germination is reduced in the seeds: up to 60-95% in petri dishes and 50-75% in field soil.

This new use of an old tool is a major breakthrough in weed management for horticultural crops and provides a way to limit weed seeds and in particular those that are herbicide-resistant from going back into a producer's field. The simple design of this tool means that farmers can easily build and use their own. With potatoes grown nationwide, this innovation is sure to please spud lovers!

Using a tiny worm to protect carrots

Carrot growers across Canada could soon have a new ally in their fight against the carrot weevil—a pest that can cause up to 40% yield loss. Despite pest management measures already in use, the carrot weevil is becoming resistant to pesticides and, possibly due to climate change, is now able to produce a second generation during a growing season in southern Canada.

Looking to protect one of the most valuable vegetables on the farm ($133.3 million in 2019), Agriculture and Agri-Food Canada (AAFC) has identified a nematode (tiny worm) that can reduce carrot weevil populations. This nematode invades the body of the weevil larva to feed and reproduce, without killing it. This nematode infection leaves female weevils unable to produce eggs. The female weevil, although now sterile, continues egg-laying behaviour but instead of weevil eggs, it releases more nematodes ready to infect a larger number of weevils. As the nematode breeds inside its host, each infected female weevil will spread more than 5,000 nematodes!

The nematode castrator of the carrot weevil could become a powerful ally in biological control, reducing the use of pesticides. Currently, the Pest Management Centre is evaluating its use and AAFC is investigating the commercial possibilities of its large-scale use. Relax bunnies … help is on the way!

New nitrogen tool grows corn farmers' profits

With the signing of an exclusive license to commercialize a new tool developed in part by Agriculture and Agri-Food Canada (AAFC), grain corn farmers are now able to reduce their costs and greenhouse gas (GHG) emissions, as well as increase their profits.

The precision farming tool is called SCAN (Soil, Crop, Atmosphere, and Nitrogen), and it allows a major shift in calculating the nitrogen fertilizers needed in grain corn production. The use of nitrogen fertilizer is critical to the success of this crop, but care must be taken to minimize the costs to farms and the environment. Tests showed that using SCAN resulted in an increase in average profits of $37/hectare!

The outcome of many years of research, SCAN was initiated by an AAFC researcher and involved 11 scientists from Canada, the United States and Mexico. Four years of trials applying the tool at 51 sites in North America generated SCAN's large initial database. The tool was also enhanced with data about soil and climate, and then subjected to a systematic review. One of SCAN's most beneficial effects is the reduction of nitrous oxide emissions, a GHG that is 300 times more damaging than carbon dioxide. SCAN is licensed with Logiag, a Quebec-based company making the tool available in Canada.

Biodigester for smaller farms a big win for the environment

Recent collaborative work by Agriculture and Agri-Food (AAFC) scientists has given new life to a process that can transform manure (solid waste) and slurry (liquid waste) into bioproducts with high value like biogas and biofertilizer. This process, called anaerobic digestion or biomethanation, can produce and recover methane, one of the largest sources of greenhouse gas emissions, so it can be reused as a renewable energy.

In the 2000s, to help reduce the environmental footprint of large hog farms, AAFC scientists developed a low-temperature biomethanation process where microorganisms decompose organic materials in manure and slurry into value-added bioproducts. More recently, other AAFC scientists increased the process' efficiency in reducing methane emissions and made it adaptable to smaller and more varied livestock farms (medium-sized hog, dairy, and poultry farms). Researchers are also developing tools to evaluate the economical and ecological impacts of building biodigesters on farms, so producers can assess the benefits.

Built at an AAFC research centre, the farm-scale biodigester allows scientists to continually make improvements and develop processes to increase the economic benefit from the products created: recovered methane (for on-farm electricity and heat); liquids (used as fertilizer); and solid residues (used as fertilizer or animal bedding material).

A great example of science helping fight climate change!

Decades long study helps farmers adapt to a changing climate

After almost three decades of gathering and analyzing data, the results are in for Agriculture and Agri-Food Canada's (AAFC) Alternative Cropping Systems study (1994-2013). They point to key practices that farmers can adopt to manage the impacts of climate change, improve their crop yield, and protect the environment.

The first comprehensive study of its kind in Canada, it examined nitrogen leaching (which is harmful to the environment) and phosphorus availability for plants. Researchers assessed how climate change affects nitrogen loss in agricultural runoff, and measured available phosphorus in different agricultural systems (looking at tillage, fertilizer, and pesticides) and in combination with diverse crop rotations.

The results show that climate change increased nitrogen leaching by 28% and reduced available phosphorus by 12%, when compared to historical weather patterns. Twelve percent of the nitrogen loss was due to changes in summer precipitation. The study showed that crop diversity combined with reduced tillage treatments and careful fertility planning, based on soil test recommendations, maintained soil levels of nitrogen and phosphorus. In summary, reduced tillage plus diverse grain crops in rotation are a sustainable, practical solution for minimizing the effects of climate change on farming. Study findings will be delivered to farmers through seminars, field days, and the agricultural media.

Biochar: An ancient tropical remedy benefits temperate agriculture

Could an ancient remedy used in tropical climates like the Amazon rainforest hold benefits for modern agriculture in the colder Canadian climate? New research from Agriculture and Agri-Food Canada (AAFC) proves just that. While the benefits of adding biochar (a carbon-rich material made from plant biomass) to soil has long been documented in tropical agriculture, AAFC showed it can also significantly help soil health and greenhouse crop yields in Canada.

This research took place on peat-based and mineral soils, commonly found on temperate climate farms, and proved that biochar (e.g. maple bark and pine chips) can: increase beneficial soil bacteria, improve water retention and nutrient availability, reduce fertilizer use by up to 50 percent in greenhouse production, and reduce soil's nutrient loss caused by harmful leaching into waterways. It also helps reduce nitrous oxide emissions from soils, a potent greenhouse gas that contributes to climate change. In addition, researchers showed biochar can increase the yields of tomatoes and sweet peppers grown in greenhouses.

Incorporating biochar into soil today, just as ancient Amazon civilizations did more than 2,000 years ago, can enhance soil and plant resilience and productivity in temperate agriculture—good news for farmers and the environment!

SPOTLIGHT

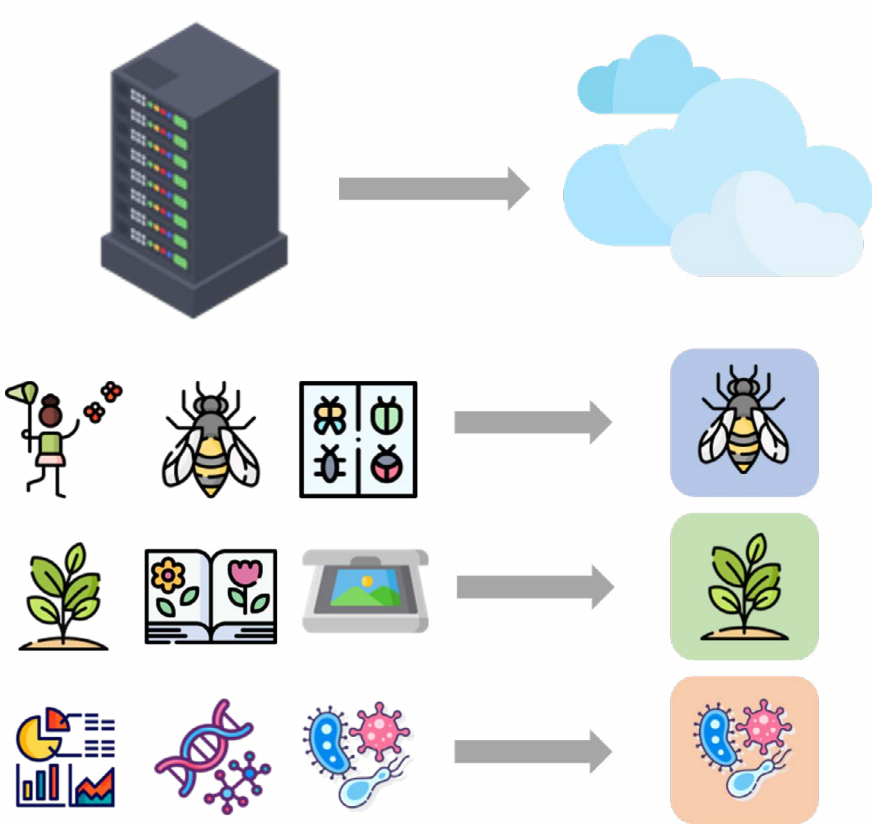
AAFC Collaborating with others

Collaborating with other countries

There is strength in numbers … that is why **Agriculture and Agri-Food Canada (AAFC) partners with countries and organizations around the world on global agricultural issues**. For example, AAFC has collaborated with ProciNorte, a Cooperative Program in Research and Technology for the Northern Region (USA, Canada, and Mexico), for 25 years. Our science representatives participate on the Plant Health, Genetic Resources, and Soil, Water, and Climate Change task forces. AAFC has also collaborated with the United States Department of Agriculture since 2013. Chief scientists from both organizations meet regularly to exchange information, link networks, and capture synergies, generating more and better results for both countries. Currently, there are three priority areas where scientific cooperation is encouraged: Agroecosystem Living Labs and Climate Partnerships; Genome Editing; and Pollinator Health. Having access to international networks, and sharing resources and ideas, are just some of the merits of this type of collaboration.

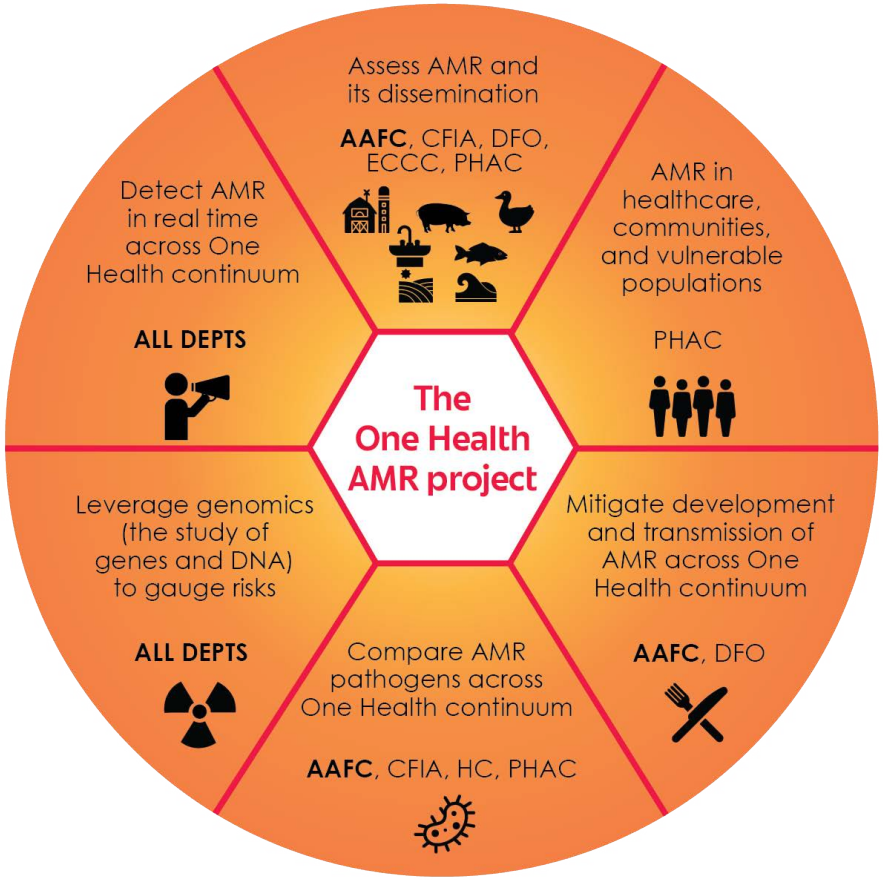
We are stronger when we work together!

Collaborating with other science-based government departments



Scientific workflows were migrated to the cloud into self-contained apps

Through Laboratories Canada, **AAFC successfully won the bid to lead an Experimentation and Innovation Pilot Project**. The project enabled bioinformatics programmers to easily develop and share scientific data analysis software and tools in a Government of Canada Cloud environment. The goal was to dramatically reduce redundancy; advance scientific analysis of biological data; and extensively facilitate scientific collaboration on a scale never seen before between federal departments.



Collaboration of AAFC with other federal departments and agencies

AAFC - Agriculture and Agri-Food Canada
CFIA - Canadian Food Inspection Agency
DFO - Fisheries and Oceans Canada
ECCC - Environment and Climate Change Canada
HC - Health Canada
NRC - National Research Council Canada
PHAC - Public Health Agency of Canada

Antimicrobial resistance (AMR)—when bacteria and other microbes adapt and become resistant to antibiotics and other medication used to treat them—is a serious global threat to animal and human health and the economy. **AAFC was one of five federal departments and agencies working on the** AMR project (2016-2022) which used genomics (the study of DNA) to understand how agriculture contributes to the development of antimicrobial resistance, and explored how to reduce this threat in food production.

Initial findings from the AMR project show that feeding cranberry extracts to poultry can help reduce antibiotic use. As well, early indications show no evidence that AMR in beef cattle transmits to humans. In recognition of the complex nature of AMR, funding was received for a second interdepartmental AMR project (2022-2027). This project expands towards a One Health approach by identifying targets for action through mapping the development and transit of AMR through healthcare settings, animals, plants, and the environment.

Collaborating with industry

In an effort to reduce their carbon emissions and environmental footprint, **Maple Leaf Foods contacted AAFC to help them incorporate the concept of circular agriculture (reducing waste and creating added value) into their processes**. AAFC was conducting research with a cutting-edge biodigester that converts dry/liquid manure and other agricultural residues from the livestock sector into high-value bioenergy and bioproducts, specifically for the cooler Canadian climate. Together, they're investigating several novel processes (such as anaerobic digestion, acidification, and nutrient recovery techniques) to help this innovative company create change for a more sustainable future.

Listen to the podcast "Turning manure into gold" and hear how Maple Leaf Foods, with help from AAFC, aims to become the most sustainable protein company on earth.

The future is here. For the past two years, **AAFC has teamed up with Koidra Inc., a provider of autonomous growing solutions, and Great Lakes Greenhouses, one of the largest cucumber growers in North America, to increase its cucumber and eggplant yield, increase productivity, and maximize profits**. The autonomous growing technology helps adjust humidity, temperature, water, nutrients, and more. During trials, eggplant yield increased 28.5% and cucumber yield increased 19% compared with traditional (non-autonomous) practices.

Get ready … this collaboration and technology are about to transform the greenhouse industry.

Are you a food company or processor needing to test food safety, processing technologies, or new recipes? **Two of AAFC's research and development centres offer state-of-the-art pilot plants, giving companies access to the leading-edge technologies, equipment, and scientific expertise they need:**

The **Saint-Hyacinthe Research and Development Centre** focuses on food processing research. Half of the Centre is made up of pilot plants that manufacture processed foods in quasi-industrial conditions. It specializes in small and medium-scale processing trials and research/development for products or processes. Its Industrial Program allows companies to lease the multi-functional pilot plants and access sensory evaluation services.

The **Guelph Research and Development Centre's** pilot plant, a level 2 containment facility, specializes in developing and testing new and existing food processing technologies to improve food safety demands of industry.

Every year, more than 50 companies dealing with meat, produce, animal, and dairy products take advantage of AAFC's pilot plants. Versatile, innovative, and equipped to handle your food challenges, these pilot plants are advancing food safety and food processing, helping to meet consumers' needs and promote Canadian companies at home and abroad.

Collaborating with people in Canada

Based on AAFC's successful Living Laboratories Initiative (2018–2023), **the Agricultural Climate Solutions – Living Labs program (2021–2031) consists of a network of 14 new regional collaborations across Canada, with at least one living lab in every province**. These living labs bring together farmers, scientists, and stakeholders to collaborate and co-develop, test, and evaluate new solutions to tackle climate change. The focus is on innovative practices to reduce greenhouse gas emissions and sequestering carbon in real life, on-farm conditions. Having farmers involved in the planning and decision-making throughout the process will help accelerate adoption of the solutions discovered.

Learn more about two of the original living labs and meet the people behind the projects in their videos:

- Living Lab – Eastern Prairies
- Living Lab – Quebec

Of the 14 new living labs under the **Agricultural Climate Solutions – Living Labs program**, one of them, **the Bridge to Land Water Sky project** **in central Saskatchewan within Treaty 6 Territory**, **is the first ever Indigenous-led living lab**. There are more than 20 First Nation reserve lands in the project area, making up more than a third of all First Nation reserve lands in the agricultural region of Saskatchewan. With a tradition of collaboration, Mistawasis Nêhiyawak and Muskeg Lake Cree Nation aim to partner with area producers to improve land management strategies, protect biodiversity and water, and increase food security and sovereignty. They hope the knowledge and solutions gained will encourage a new wave of Indigenous producers and celebrate Indigenous insight as a key factor in building a more climate-resilient agricultural industry.

A place of healing, learning, reflecting, and sharing … **the recently built Mikinàk Lodge, located at AAFC's Central Experimental Farm in Ottawa, sits on the ancestral territory of the Algonquin Anishinaabeg people**. The name "Mikinàk" is the Anishinaabe word for "turtle", which symbolizes "truth" to many nations. Established in the spirit of reconciliation and inspired by First Nations, Inuit, and Métis Nation cultures, the Indigenous ceremonial lodge is dedicated to traditional teachings with Elders, awareness and learning sessions, and other Indigenous-led events for both Indigenous and non-Indigenous federal government employees and members of the public.

You are invited to book a visit of the Lodge today and expand your knowledge of Indigenous cultures.

Extreme weather and variable climate events such as flooding and drought can severely impact farm businesses and the Canadian economy. To understand what's happening in the different regions, **AAFC stays in contact with producers through the Agroclimate Impact Reporter (AIR) online survey**. AIR volunteers fill out the monthly survey during the growing season (April to October) to inform AAFC about the effects of climate and weather on their farms. This information is then combined with scientific data to produce reports and maps, incorporated into the monthly **National Agroclimate Risk Reports** and the **Canadian Drought Monitor**, and used to develop programs and policies which assist the agricultural industry during extreme weather events.

Listen to how citizen science is helping scientists stay informed about regional climate events across Canada.

New antibody a promising treatment for *E. coli* in livestock

In an exciting discovery, Agriculture and Agri-Food Canada (AAFC) researchers have developed an antibody to treat *E. coli* infection when fed to livestock. This could revolutionize how we protect livestock, our food and water, and consequently people, against *E. coli* infection.

The O157:H7 strain of *E. coli* is a serious threat to humans (12,800 illnesses in Canada [2016]) and the sustainability of the agri-food sector. The bacteria colonize the intestines of animals (cattle, sheep, goats, and pigs) and contaminate raw meat during slaughter and processing, as well as ground water and fruits and vegetables through contaminated manure application.

This new antibody, produced in plants, binds to and neutralizes the O157:H7 strain, plus three other *E. coli* strains. In collaboration with PlantForm Corporation and Western University, AAFC is developing this antibody as a feed additive. In fact in pigs, the cell walls of the plant matter protect the antibody during digestion, enabling it to reach the gut. Feeding the antibody directly to livestock, rather than injecting a treatment, could save up to 80-90% of the treatment cost.

This discovery is pending patent approval but it promises to significantly reduce the risks of one of the world's key threats to human health.

First identified in the late 1880s, the bacterial pathogen *E. coli* did not gain widespread attention in North America until outbreaks occurred in the 1980s.

Lights, Colour, Nutrients! LEDs play a starring role in providing nutrients

Do LED lights (light emitting diodes) produce the same nutrients in vegetables as natural sunlight? Agriculture and Agri-Food Canada (AAFC) scientists recently discovered LEDs not only increase plant yield but significantly improve nutritional quality.

Used in greenhouses and vertical farming systems, LEDs are single wavelength (i.e. red, blue, and amber light) that can be combined to provide various full spectra of light (from infrared to near-ultraviolet) required for plants to make their own nutrients. Not all wavelengths are equal though, and it was unknown if LED light produced the same nutrients as natural light—until now.

Researchers studied microgreens and found that under increasing amber-blue and decreasing red lights, the total carotenoid content (nutrients that include a type of vitamin A found only in plants) increased 20 to 44 percent and individual carotenoid content increased from 10 to 55 percent. Further study demonstrated that these lights actually activated the genes that produce carotenoid antioxidants (helpful in reducing age-related eye-disorders). Scientists also found that under this light, plants produced more total antioxidants, which further improved their nutritional value.

This research could lead to growing microgreens and other produce with increased health-promoting antioxidants, giving more options for personalized nutrition to growers, consumers, and northern communities relying on indoor agricultural production.

Novel Vitamin E extraction gets an 'A' for ingenuity

Canola is one of Canada's most celebrated crops, and its oil is one of the world's most important vegetable oils, containing high concentrations of Vitamin E (important for vision, reproduction, and the health of your blood, brain, and skin). However, traditional extraction and refining processes to produce canola oil degrade the Vitamin E found in canola. Now, scientists from Agriculture and Agri-Food Canada (AAFC) and the University of Manitoba have found a "greener" way to extract more than 90% of the Vitamin E from canola seeds, with more than 10 times higher concentrations of Vitamin E than in oil produced the traditional way!

AAFC's researchers had experience in using a supercritical fluid extraction process for obtaining specific nutrients and antioxidants from raw materials (e.g. fruit, vegetables, and seeds). In fact, they developed this innovative technology to extract vitamin E-rich oil from canola seeds. This environmentally friendly process uses only water and carbon dioxide to extract Vitamin E, without any chemical solvents. Using low temperature and pressure, the process minimizes oxidation and ensures high quality and superior health benefits of the final product.

This value-added product creates greater value for canola, which is grown on almost 23 million acres in Canada, as it could be used in nutritional supplements and pharmaceutical ingredients!

This new "green process" to extract more and better quality Vitamin E from canola seeds has now been commercialized through Hermay Labs Corporation in Alberta.

Beans contain high amounts of potassium, magnesium, folate, iron, zinc, and protein.

Perfecting the nutrition of dry beans — a global first!

Beans are rich in nutrients and an important source of protein in vegetarian diets. However, for optimal human nutrition, beans must have higher levels of methionine and cysteine, two essential amino acids (building blocks of protein). In one of the biggest breakthroughs in bean technology in recent history, scientists from Agriculture and Agri-Food Canada, the University of Manitoba, Manitoba Pulse and Soybean Growers, and the US Department of Agriculture found a way to significantly improve dry bean seeds, giving them protein that is more balanced for human nutrition.

Scientists first discovered that proteins can be changed at the molecular level in bean seeds and looked at how amino acids accumulate. By combining the genetic make-up of seeds high in protein (but lacking methionine and cysteine) with that of seeds high in methionine and cysteine, scientists successfully combined the essential amino acids in beans so their overall protein content is more balanced. This resulted in two new breeding lines that contain all the amino acids essential for human nutrition. These lines are also well suited to shorter growing seasons, which is good news for growers in provinces like Manitoba. This exciting advancement could result in new “enriched” beans for consumers to enjoy both here and in developing countries where vegetable protein is fundamental to the diet.

Blueberries have a farm gate value of $273 million (2020).

Testing blueberries in the field proves fruitful

Being proactive before a disease becomes a problem is one way Agriculture and Agri-Food Canada (AAFC) helps farmers get ahead of the curve. Recently, AAFC scientists and their collaborators designed a rapid, molecular-based diagnostic test to protect blueberries, Canada's most valuable fruit crop, from blueberry stunt disease caused by phytoplasmas (plant pathogenic bacteria spread by insects that feed on plant leaves).

With phytoplasma-infected blueberry bushes, stunt disease symptoms are subtle and can be mistaken for other diseases. Plants can have multiple viruses, further complicating the diagnosis. Once the disease progresses, it can cause severe yield loss and plant death. After testing nearly 2,000 blueberry samples from Quebec and Nova Scotia, scientists validated the test by confirming the disease's presence at several sites. This inexpensive test has been licensed by and is available through: Harvest Genomics (ON), Laboratoire d'Expertise et de Diagnostic en Phytoprotection (QC), and Pest Surveillance Initiative (MB).

The team also created a quantitative test showing when phytoplasmas are most abundant in the plant. As a result, early August is recommended as the best time for farmers in Eastern Canada to test for stunt disease. This coincides with when they screen for other viruses that co-infect with blueberry stunt disease.

It appears being proactive—not reactive—bears good fruit!

Using UV-C rays to reduce pesticide use? A berry good idea!

A new method, using ultraviolet C (UV-C) rays, to preserve strawberries in the field and greenhouse will help growers reduce pesticide use to control fungal and possibly bacterial diseases. Strawberries are the sixth most-grown fruit in Canada, and the greenhouse strawberry market is growing steadily. However, many strawberries succumb to disease. In collaboration with international academic partners, Agriculture and Agri-Food Canada made two major advances to protect this valuable crop.

Scientists first discovered that by exposing strawberry plants to low doses of UV-C rays, a component of solar radiation, the plants managed to withstand minimal stress and strengthen their defences. Researchers determined the exact dose and frequency of treatment that is most beneficial. Too high a dose and the growth and harvest are harmed, while low doses do not damage fruit quality. Secondly, scientists observed how strawberry plants improve their self-defence system. The UV-C treatment stimulates genes that trigger the plants' defences. The leaf surface is then modified, making it difficult for diseases to infect them. In addition, other molecular components are induced in the plants and serve as antifungals or antibacterials.

These discoveries offer immense potential for strawberry production, especially for the organic sector, as they reduce pesticide use. This method may also help other fruit and vegetable producers.

In Canada, one third of fruits and vegetables are lost each year to fungal or bacterial diseases.

Fighting food fraud faster!

Watch the SpectrAAC-2 in action as it measures food quality.

Thanks to an Agriculture and Agri-Food Canada (AAFC) invention, Canadian processors may soon be able to accurately and quickly assess the quality of food and beverages like never before. AAFC developed the SpectrAAC-2, a device that verifies the quality or authenticity of liquid and solid foods using their optical fingerprint. The process works rapidly and at low cost—a real game changer for quality control of food!

The SpectrAAC-2 is a small, easy-to-use module that indicates in seconds whether a food or beverage has an abnormality, such as an unexpected ingredient or a flavour defect. The device captures natural fluorescence, which is light emitted by antioxidants in food and beverages subjected to ultraviolet rays. It compares these light spectra with those in a database and detects foods with an abnormal optical imprint. Applications can be developed from the databases of a company's specific food products. Processors could use it to: identify non-compliant products; evaluate the quality of different food batches; and judge the freshness of basic ingredients.

Currently under review by the Canadian Food Inspection Agency, the SpectrAAC-2 heralds a powerful way to detect fraudulent food and could expand the supply of high-quality food to Canadian consumers. Think of it as a lie detector for food and beverages!

AAFC has already used AODP to resolve potential trade disputes involving wheat, soybeans, and corn.

New detective on the case—DNA tool identifies pathogens and resolves trade disputes

Shipments of agricultural crops are routinely screened at international borders to ensure they are free of pests (insects, diseases, and viruses) and prevent their spread. However, current "off-the-shelf" screening tools may not be sensitive enough to properly identify separate species with similar DNA. Failing to identify pests in shipments can trigger trading sanctions, resulting in millions of dollars in lost revenue for Canadian exporters. To help, Agriculture and Agri-Food Canada created the "Automated Oligonucleotide Design Pipeline" (AODP) tool that provides significantly higher accuracy in less time!

The AODP software extracts and detects DNA short subsequences (smaller parts of a DNA sequence) that perfectly match reference sequences unique to specific pathogens, thereby identifying samples with such pests/pathogens. Similar to DNA tests revealing the culprit of a crime, this process proves the presence or absence of key DNA sequences from pests/pathogens. What used to take hours is now done in minutes and with higher accuracy! AODP is also more precise when identifying genetically close relatives of regulated pathogens.

This tool helps Canada safeguard important trade relations and warns of new outbreaks and invasive species.

SPOTLIGHT

AAFC Tackling food waste

Improving food conservation

In Canada, 40% of food is wasted annually. Preserving perishable food as it travels across this huge country, in widely varying temperatures, is challenging. To find solutions, **Agriculture and Agri-Food Canada (AAFC) researchers have developed a series of models to simulate cold chains** (the refrigeration process that ensures food is kept at the optimal temperature during transport and storage). These models can simulate many different transport and storage conditions. They can identify weak links in the land and air routes, and on ice roads (northern Indigenous and Inuit communities are particularly vulnerable). By predicting what will not work, they can ultimately reduce food waste and the chance of contamination from bacteria which threatens human health.

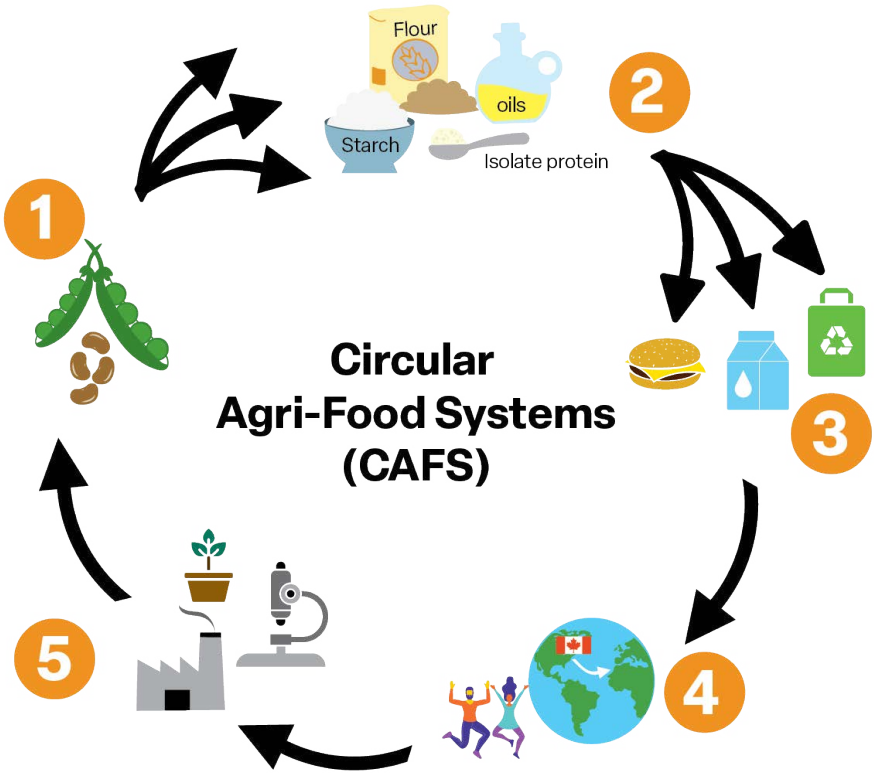
Waste less food, feed more people, and save money, water, energy, and labour … how cool is that?!

Read more about this food conservation research.

Reducing waste through circular agri-food systems

Once crops are harvested and animals are processed, some of the unused portions are used as fertilizer, animal feed or, if appropriate, go to food banks. However, much is discarded. After discussions with Canadian agricultural stakeholders, **AAFC developed the Circular Agri-Food Systems (CAFS) strategy to find innovative ways to help the agricultural processing industry reduce its waste and create added value**. The goal? To move food production and processing from a traditional, linear system resulting in waste, to circular systems that maximize the use of crops, livestock, and other resources.

AAFC CAFS projects are helping address industry concerns by working on minimizing waste in dairy processing, adding value to culled sweet cherries to create new market opportunities, and adding value to oilseeds- and pulse-based ingredients to create nutritionally improved processed foods. Ultimately, this research will help the industry shift to more efficient systems that are more economically, socially, and environmentally sustainable.



1. Canadian farmers produce high quality foods.
2. These are processed to create additional products using environmentally friendly techniques.
3. Many food and non-food value-added products are then created.
4. This in turn meets the domestic and international demands for healthy, high quality, and innovative products.
5. This influences production methods and research to reduce environmental impacts and greenhouse gases.

Donating to food banks

Every year, AAFC research sites across Canada produce tonnes of crops to conduct research. While some surplus crops go into animal feed or compost for fertilizer, there are still unused crops that end up in landfills. The Associate Director of AAFC's St. John's Research and Development Centre saw the potential for research centres to reduce food waste by donating surplus crops to local food banks. **After discussions with GCSurplus, Food Banks Canada, and Second Harvest, AAFC surplus crops started getting into food insecure households across Canada**. This project is now going strong across several AAFC research and development centres with approximately 68,000 pounds of crops having been donated to Canadian food banks since 2021:

- carrots, potatoes, lettuce, rutabaga, cabbage, broccoli, and cranberries from St. John's;
- hydroponic lettuce from Kentville;
- potatoes from Charlottetown and Fredericton;
- onions, potatoes, and cabbage from Saint-Jean-sur-Richelieu;
- apples and pears from Summerland;
- blueberries from Agassiz;
- and starting in 2023, 250 litres of milk will be donated monthly from Sherbrooke.

Reducing food waste and helping our local communities … we are proud to make a difference!

Find out more about AAFC's donations.


FIND OUT MORE...

Want to stay up to date on the latest news about Agriculture and Agri-Food Canada's (AAFC) research and initiatives? Here are just a few ways to do that: listen to our podcasts from your tractor; catch up on the markets and trade information while at work; inspire the next generation of researchers with amazing stories about scientific breakthroughs; and enjoy learning what goes into making your food delicious and healthy.

If you want to read about Canadians making a difference in agriculture, look no further than **Good News Grows**. These stories feature amazing farmers, scientists, youth, and more and will leave you smiling.

AGRI info

Subscribe to **Agri-Info** to keep up to date on AAFC's programs and services for industry, markets and trade information, and science and innovation news.

Be inspired by these **Women in Science** who are laying the foundation for more young girls and women to choose careers in science, technology, engineering, and math.

The **First Sixteen**

A **podcast** from Agriculture and Agri-Food Canada

The First Sixteen is AAFC's podcast series that is for anyone who has an eye on the agricultural sector. Every episode features in-depth interviews with the people who are making breakthroughs and knocking down barriers. Big ideas and the changemakers behind them!

Still hungry for more science stories? Check out this **blog series** from our research centre in the Okanagan Valley in British Columbia.

Get to know some of our scientists and discover why they're passionate about their **Fields of Science**.

Canadian farmers and agricultural businesses are dedicated to bringing us quality food while protecting the environment. Meet the people behind your food, and **Taste the Commitment** they bring to our tables.

At **science.gc.ca**, you can find our scientists' profiles and our research and development centres.

Read our **feature articles** highlighting recent scientific discoveries, new technologies, and successes accomplished by researchers from Agriculture and Agri-Food Canada.