Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada



# Science and Innovation for Canada

# *The Way Forward*



Canada

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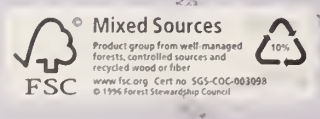



Canada, like the rest of the world, is facing a number of challenges that will continue to have an impact for generations to come. Population and consumption growth, increasing competition for resources, environmental protection compliance and the effects of climate change will all have significant bearing on how we farm. But even in the face of these constraints, Canada can flourish as a producer of food and agricultural products, provided we continue to use science and innovation to achieve our objectives. Science and innovation are essential to maintaining and growing a competitive advantage.

Recruiting the best scientific capacity will be key to achieving the results we need to deliver. Science is in the midst of a paradigm shift in the manner in which it is delivered; key to this is how different science providers interact. Whereas science itself has always entailed a collegial approach, the combination of growing costs and complexities necessitate a much wider activity network, one that involves multiple players working to a common objective.

# Our Vision

A world-class science organization that stimulates knowledge creation and its transformation into innovations that fuel the competitiveness of Canada's agriculture.

# Our Mission

To lead, perform and leverage world-class scientific discovery and innovation, creating synergies with other organizations, to contribute to the long-term prosperity, environmental performance, and security of the agriculture sector.

# Table of Contents

# A Strategy for Science and Innovation

The AAFC Science and Innovation Strategy presents a set of key results that must be met in order to maintain and grow a competitive advantage for Canada. It represents a different approach to agriculture and agri-food research in Canada, one that will pave the way to a coordinated national innovation system. The scope of the plan is such that it necessitates an evolutionary shift to the way we collectively conduct science in Canada.

It is important to note that the core business of Research Branch and other organizations will endure. AAFC will continue to conduct research in its labs. AAFC will continue to perform the public good research as well as the applied research that generates innovative market opportunities and builds a knowledge base to sustain the sector. How we deliver on our investment in science and innovation is the focus of our strategy.

# How We Got Here

The path that brought us to where we are now is a merger of many sources, both domestically and internationally. Social developments, economic factors, advances in science and innovation, environmental issues, and shifts in government policy have all contributed to the evolution of this strategy.

## Social developments

Canada has an aging population where the number of senior citizens is likely to reach 25 per cent by 2031. Moreover, our current population growth is being fuelled by immigration, a trend that is expected to continue. The impact of these trends plays out in a number of challenging ways. As people get older, health, wellness and safety increase in importance. As the population becomes more diverse, interest in new foods and products will follow.

## Economic factors

The rise to prominence of nations such as India and China has created both voracious new markets and fierce competition for Canadian producers. A growing demand for differentiated products offers both challenges and opportunities. Trade agreements and non-tariff trade barriers further influence trade patterns. Input costs continue to rise for energy, fertilizers and crop protection products. The recent economic downturn has seriously restricted financing options as financial institutions tighten credit.

## Advances in science and innovation

New disciplines are rewriting the book on biology, with new chapter headings such as genomics, proteomics, metabolomics, glycomics and transcriptomics. Molecular genetics, nanotechnologies and other biotech advances push the envelope for what can be learned and modified. Synthetic biology and systems research will further contribute to a greater understanding of the elements of life, creating opportunities for practical applications.

## Environmental issues

The relationship between agriculture and the environment is being tested through a number of pressures on natural resources. Climate change will present its own mixed bag of challenges to agriculture, and fossil fuel depletion will trigger increased input costs. Some species will remain at risk; others will no doubt invade Canadian habitats.

# Evolution of Government Policy

Over the past decades, a number of key policy directions helped shape Canada's public S&T directions. For instance, the Council of Science and Technology Advisors released the *Science Advice for Government Effectiveness* (SAGE) report, which confirmed the federal role in performing public-good research. The 2005 *Framework for Federal Science and Technology* advice further underscored the importance of matching federal S&T activities to the priorities of Canadians and building on effective collaborations. *Advantage Canada: Building a Stronger Economy for Canadians*, published in 2006, forms the basis for the current federal science and technology strategy.

Against this backdrop, science and innovation policy at AAFC has been written to parallel and incorporate federal S&T objectives. A number of programs were developed to increase research activities and linkages with the agri-food industry. The Matching Investment Initiative was designed to increase industry participation in AAFC research projects. The Agricultural Policy Framework (APF) contained provisions for developing research networks through the Broker and Agri-Innovation programs. These opportunities were expanded for the current Growing Canadian Agri-Innovations program under Growing Forward. Other instruments have also been made available to increase the level of cooperative research activity, such as the Agricultural Bioproducts Innovations Program (ABIP) and the Sustainable Agriculture Environment Systems (SAGES) initiative.

After a number of industry-wide consultations, Research Branch developed the Science and Innovation Strategy, a document aimed at reconciling industry, federal and departmental S&T priorities to ensure that all Canada's agri-food research efforts were focused through the same lens.

# Partnerships and Collaborative Research

To foster a culture of innovation, we have to look beyond the scientific outputs themselves and consider their uses. We need to pursue coordinated and collaborative opportunities, with greater integration across value chains. As costs and complexities of science increase, this approach is gaining traction in research institutions around the world.

As the issues facing the agriculture and agri-food sector grow in complexity, it only makes sense that we address them with a collaborative approach. Research Branch has a number of entry points to collaborative research along the innovation continuum.

## Within AAFC and government

A multi-disciplinary approach with colleagues across our various science areas will bring together the relevant science activities to achieve the objectives of the national priorities of the S&I Strategy. We can better integrate Research Branch activities from a planning and programming perspective with other agencies in areas of joint responsibility and interest. We know that regulatory decisions hinge on good science, just as we are bound by those same regulations. We can build upon our relationships with other federal organizations in areas of mutual interest and to address overarching government objectives.

## With the sector, academia and other government bodies

We can develop partnerships with industry, other governments and academia that better leverage resources and expertise by:

- Engaging a wide range of partners to develop strategic focus and take collaborative action,
- Accelerating the flow of science and technology along the innovation continuum,
- Supporting partners to enhance the sector's capacity to innovate.

# Collaborative Mechanisms Available to Research Branch

AAFC has been exploring and engaging in a number of ways to leverage our investment in research through collaboration.

**Growing Canadian Agri-Innovations Program** – a Growing Forward program composed of four initiatives, namely,

- **Canadian Agri-Science Clusters** – to help develop industry-led clusters of scientific expertise and resources aimed at innovation
- **Developing Innovative Agri-Products** – to support industry-led projects that transform ideas into marketable realities
- **Promoting Agri-Based Investment Opportunities** – to create linkages between potential investors and agri-entrepreneurs
- **Agricultural Bioproducts Innovation Program** – a program to develop and support networks of private, public and academic talent to build research capacity in specific areas of agricultural bioproducts and bioprocesses. There are nine such networks up and running.

# The Way Ahead

The AAFC Science and Innovation Strategy identifies a broad vision for the agriculture agri-food sector which charts a course for the short, medium and long term. It identifies seven strategic science and innovation goals that are aimed at sharpening the sector's competitive edge.

The AAFC Science and Innovation Strategic Action Plan will deliver on key outcomes associated with each priority, both through Growing Forward programming and other science and innovation activities.

## The priorities are:

| | |
|---|---|
| i | Enhancing human health and wellness through food, nutrition and innovative products |
| ii | Enhancing the quality of food and safety of the food supply |
| iii | Enhancing the security and protection of the food supply |
| iv | Enhancing economic benefits for all stakeholders |
| v | Enhancing environmental performance of the Canadian agricultural system |
| vi | Enhancing the understanding of Canadian bioresources and protecting and conserving their genetic diversity |
| vii | Developing new opportunities for agriculture from bioresources |

# Human Health and Wellness

We need to better understand the link between food, nutrition, health and wellness. We also have the responsibility to help farmers and food processors develop innovative products in the areas of functional foods, nutraceuticals and natural health products in an economically viable way.

## Specific results to be accomplished over the next four years are:

- Identification of new food-feed bioactives with health and wellness benefits through screening, well characterized and their preliminary efficacy demonstrated (in-vitro, cell and tissue culture, animals)
- Identification and production of food products with high level of bioactives to study their effect on targeted health issues (diseases) and wellness conditions.
- Scientific data generated in key result 1 and 2 are used to substantiate health, novel foods and ingredient claims (Growing Forward Regulatory Action Plan – Health Claims, Novel Foods and Ingredients Initiative) in support of the Canadian regulatory process.

## Research activities include:

- **Health and Wellness Attributes of Agri-food and Agri-based Products** is focused on improved understanding of the link between food, health, nutrition and wellness leading to increased opportunities for agriculture in producing foods and nutraceuticals and other innovative health-related products. The linkages between food and health will support the science base needed for product approvals and provide balanced information to consumers permitting informed choice-making.
- **Health Claims and Novel Foods and Ingredients Program** aims to accelerate the market entry of new food products through industry engagement and knowledge transfer to assist the industry in its understanding of the regulatory process as well as its regulatory and science substantiation activities to address regulatory barriers to food innovation.

Science is essential to the regulatory process to substantiate regulatory submissions for products, fill knowledge gaps, make better use of reputable data from regulatory agencies, help define standards and approval criteria, and develop approval protocols.

- **Science Substantiation Program** will fill gaps in evidence required for novel ingredient safety and health-claim validity. Work is conducted in collaboration with Health Canada, hospitals, university research networks and international partners.This will pave the way to innovative food products with added nutritional components that will compete for market share and broaden consumer choice.

# Food Quality and Safety

The safety of the Canadian food system is the responsibility of the Government of Canada, but it is necessary to work with all sector players to ensure a safe food supply. AAFC supports the development and implementation of tools and techniques for food safety, biosecurity and traceability risk management systems. This will ensure that the food production, processing and retailing sectors are better prepared in the event of widespread disease and attendant market losses.

These systems also support emergency management aimed at limiting the likelihood or spread of animal and plant diseases and food safety events, thereby reducing the economic, environmental and social impacts of a crisis.

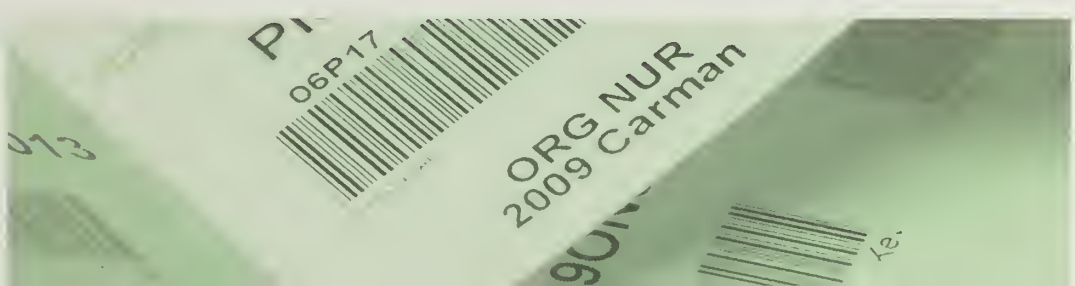
While the Government of Canada is responsible for the safety of the food system, it is important for industry to play a larger role in carrying out research on food quality.

## Specific results to be accomplished over the next four years are:

- Development of new scientific knowledge in partnership with the Canadian agri-food sector to help produce and market novel food products that satisfy consumer expectations with regards to quality
- Development and transfer of new scientific knowledge and tools to Canadian farmers and food processors to proactively self-mitigate biological or chemical food safety risks
- Development of efficient alternatives to antibiotics for livestock production growth and transfer of these alternatives to farmers

## Research activities include:

- **Food Safety and Biosecurity Science** which focuses on food safety, security and protection of food systems. Food safety research includes the detection and characterization of current and emerging food borne hazards in food production, processing, storage and distribution. The research work provides the science base for predictive modeling of security and regulatory actions. The work is complementary to the operational regulatory work of the Canadian Food Inspection Agency (CFIA). Target groups for this research are industry, government regulatory departments and agencies and consumers



# Security and Protection of the Food Supply

Detection, monitoring and control of threats to the safety of our food supply are of increasing concern to Canadians. These threats are constantly changing, as invasive alien species and new plant diseases emerge or spread, and the threat of bioterrorism remains quite real. We will need to continue to work in collaboration with the CFIA and all sector stakeholders to ensure information technology development is shared, and that new technologies are deployed effectively to assure the continuity and protection of the food supply.

## Specific results to be accomplished over the next four years are:

- New germplasm and sources of genetic resistance in cereals, oilseeds, legumes and horticultural crops at risk from potentially catastrophic threats, and new agronomic and pest control strategies
- Control of major livestock threats through incorporation of genetic resistance into adapted germplasm; devising avoidance, treatment and mitigation techniques for potentially catastrophic diseases of livestock in Canada
- Improved understanding of the special implications surrounding intentional contamination of the food supply via introduction of biotic or abiotic agents, leading to improved analytical tools and strategies to deal with food contamination
- New information is generated on incidence, movement and development of new pests that threaten the security of the food supply. AAFC will conduct research pertinent to new threats to crop production which will underpin CFIA risk assessment activities and assist in the development of mitigation strategies

## Research activities include:

- **Security of the Food System Science** for the improvement of knowledge, tools and techniques that enhance the security and protection of the food supply including the development and application of biological and physical systems models to predict the probable spread, behavior and impact of threats to the security of the Canadian food production and distribution systems such as pathogens, pests and climate, and deliberate contamination of food. This work is complementary to the risk management function of the CFIA in providing knowledge and tools for system-based enhancement of food security. Target groups are industry, government regulatory departments and agencies and consumers.

# Enhancing Economic Benefits for All Stakeholders

Agriculture and Agri-Food Canada contributes to the competitiveness of the agriculture, agri-food and agri-based products industry by supporting innovation designed to improve profitability in new and existing products, services, processes, and markets. Canadians will benefit directly through access to improved products and processes, as well as through the overall economic and social benefits stemming from an innovative and prosperous sector.

An integrated planning approach that engages industry, government and academia is critical to guiding investment in science and innovation. AAFC will work collaboratively with its partners to encourage farmers, entrepreneurs, agri-based companies, and bio-products and biofuels facilities to adopt new technologies and commercialize new products and services. We aim to support collaborative, industry-led responses to new and emerging issues and opportunities through programming that accelerates the flow of science and technology along the innovation continuum, and through the use of foresight and pathfinding.

## Specific results to be accomplished over the next four years are:

- Develop better basic understanding of livestock, poultry and integrated crop livestock production systems to ensure producer profitability by decreasing risk, decreasing cost of production and improving overall economic and environmental sustainability
- Develop applied understanding of livestock, poultry and integrated crop livestock production systems to ensure producer profitability by decreasing risk, decreasing cost of production and improving overall economic and environmental sustainability
- Develop crop production systems to ensure producer profitability by decreasing risk, decreasing cost of production and improving overall economic and environmental sustainability
- Develop and implement an integrated, multidisciplinary systems approach to maintain and enhance Canadian capacity to face existing disease and pest and weeds on crop and livestock. Enhance Canadian capacity to face current and future biotic and abiotic stress on crops and livestock.

# An Environmentally Sustainable Sector

Environmentally responsible agricultural production and processing have widespread benefits. Climate change and greenhouse gas emissions, water quality and availability, and the interactions between commercial agriculture and natural ecosystems are critical issues to address. AAFC supports the sector through initiatives that help it to better make decisions about potential environmental risks and identify suitable corrective actions.

## Specific results to be accomplished over the next four years are:

- Development of new science based tools (*concepts, theories, and process models*) to assess (*understand, describe, measure*) soil processes and to understand the impacts of contaminants, and the benefits of agricultural activities, on the environment (soil, air and water quality)
- Development of Best Management Practices (BMPs) to allow compliance to environmental regulations, to ensure sustainability of production systems, or to add value to the sector in the form of EG&S
- Integrated assessment of long term environmental effects of agricultural practices at farm, landscape, watershed and regional scales.

## Research activities include:

- **Agri-Environmental Soil, Water, Air and Bioresource Protection** - New knowledge and improved understanding of the interactions between agriculture and the environment provide improved protection of the agri-environment through the use of new technologies, tools and BMPs and secure the use of our soil, air, water and bioresources for current and future generations of Canadians
- **Sustainable Agriculture Environmental Systems** conducts peer reviewed innovation and discovery research focusing on cross-cutting issues such as water quality and climate change as well as more targeted issues such as nutrients and contaminants in water and greenhouse gas balance in relation to agriculture (mitigation) as well as adaptation to climate change (threats and opportunities)

These programs will further enhance knowledge and develop technologies that will minimize the impact of agricultural production on the environment while maintaining or improving sector competitiveness.

# Canadian Bioresources and Protecting and Conserving Their Genetic Diversity

Enhanced understanding of the biological resources associated with Canadian agriculture and risks threatening them are at the heart of Canada's ability to develop a more sustainable agricultural sector. It is the government's responsibility to obtain, conserve, maintain, characterize, evaluate, document and increase utilization of genetic resources; however, this work is of relevance to farmers, other governments, regulatory agencies, international bodies, universities and industry.

## Specific results to be accomplished over the next four years are:

- Improved conservation, regeneration and acquisitions of AAFC collections and germplasm banks, taking into account current risks and opportunities for the agricultural, agri-food and agri-based products sector.
- Characterize and evaluate current biological collections to identify attributes that will have a significant economic and environmental impact for Canada.
- Improved access to and knowledge of AAFC's biological collections.

## Research activities include:

- **Canadian Bioresources and Genetic Diversity Protection and Conservation** provides increased understanding of Canadian bioresources and protection and conservation of their genetic diversity. Basic and applied research is conducted to provide factual information on Canadian bioresources and to acquire advanced knowledge and develop science based models to predict the behavior of biological resources in response to changes in the environment. This knowledge is useful in identifying new products or functions that will contribute to economic prosperity. Developing authoritative information on the nature and characterization of Canadian bioresources is a core public good activity. This research provides a wealth of information that supports further work to achieve economic, environmental, and social and security objectives.

- **Animal and Plant Health Research** conducts research on plants and animal health focusing on emerging threats to the sector, such as wheat rust and clubroot, and will develop risk mitigation strategies and measures to be adopted by the Canadian agriculture and agri-food sector. Scientific research will also support these efforts by developing new technologies that can be adapted to assist both farm and post-farm sectors with respect to food safety and the protection of the plant and animal resource base.

These programs contribute to the development, adoption and implementation of government recognized, science based food safety, biosecurity and traceability practices, tools and systems at the farm and agri-business level that are national in scope. They support emergency management, provide safer food to Canadians, prevent and reduce the spread of animal and plant diseases, mitigate and reduce the costs associated with responses to disease outbreaks, and protect and enhance market access.

# New Opportunities from Bioresources

Agriculture has the potential to replace or supplement non-renewable or environmentally costly materials with sustainably produced and environmentally benign materials through the development and application of bioproducts and bioprocesses. AAFC will support this objective through the development of biopesticides, industrial crop development, biochemical and bioprocessing technologies, biofuels and bioenergy biochemicals, and bio-based materials. The development of a vibrant bioeconomy will require a long term commitment of both public and private resources. AAFC will support the early stage development of technologies and practices that will diversify agriculture and enhance rural communities.

## Specific results to be accomplished over the next four years are:

- Development of effective biopesticides from micro-organisms and bioactive compounds for weed, plant disease, and insect control in rural and urban environments; and
- Development of bioenergy, bioindustrial chemicals, and biomaterials using agricultural biomass platforms (e.g., cereals, oilseeds, pulses, forages, potatoes, by-products), conversion technologies and engineering systems through feedstock improvement and utilization.

## Research activities include:

- **Science Supporting Agricultural Innovation** focuses on basic research to capture new business opportunities in emerging differentiated product markets for food, feed, fibre, health and wellness products, energy and industrial ingredients to support the agriculture, agri-food and agri-based products sector transformation strategies. New knowledge, ideas, processes and products and services will be generated and accelerate the flow of science and technology results into the innovation continuum.
- **New Opportunities from Bioresources** – Current and new agricultural commodities can be an ongoing source of innovative commercial products beyond food and feed, including such products such new manufacturing materials, industrial, chemicals, energy sources, biochemicals, and health and wellness products. This program supports the development of innovative commercial products from agriculture beyond food and feed.
- **Agricultural Bioproducts Innovation Program** increases value-added opportunities for the agri-food sector through the innovative use of agricultural bioresources arising from research and development network activities, technology transfer and commercialization of bioproducts and processes.

Together these key expected results will diversify agricultural products and open new market opportunities for producers, stimulate new economic activity for agri-businesses by creating new opportunities in production, manufacturing and sales, creating a sustainable and competitive feedstock production chain for new products and applications.

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