FROM RESEARCH TO ADOPTION

Strengthening Public-Private Collaborations in Canada

Prepared by
Lauren Benoit

Nuffield Canada
AGRICULTURAL SCHOLARSHIPS

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GRAIN FARMERS OF ONTARIO

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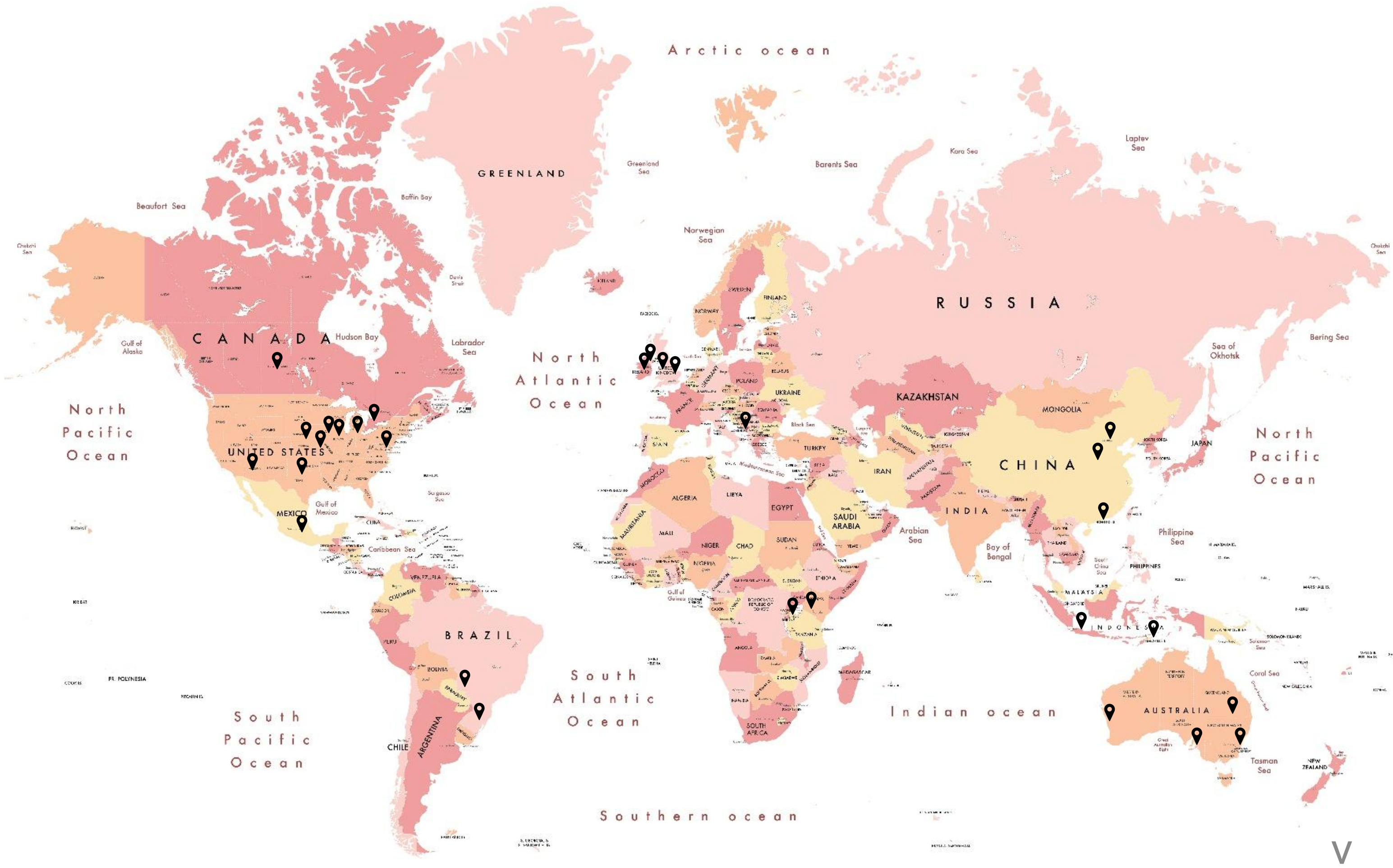
About The
AUTHOR

Lauren Benoit is a Research Agronomist with Bayer Crop Science and an incoming PhD student at the University of Saskatchewan. Raised on a grain farm in Ontario, she developed an early passion for agriculture that led her to study weed management and herbicide resistance at the University of Guelph. She's built a career that blends a love of science with a drive to make farming more productive and sustainable. Her career has spanned field research in early-stage herbicide development in Australia to farmer-facing agronomy roles in Ontario, where she thrived on helping farmers find creative, practical solutions to agronomic challenges.

Lauren is motivated by a desire to contribute to a future where farming is profitable, rural communities thrive, and food systems are sustainable. She chose her Nuffield project on public–private collaboration in agricultural innovation because it blends industry relevance with her passion for science and research. Her Nuffield travels took her to six of the seven continents with visits in eleven countries over the course of two years. Outside of work, Lauren can usually be found camping, biking, curling, enjoying live music with friends or wrangling her two cats, Zoey and Simone (named for her gymnastic ambitions).



EXECUTIVE SUMMARY

Canadian agriculture faces the dual-challenge of reversing the productivity loss experienced in the last three decades and to do so while increasing the sustainability of the sector and its contribution to combatting climate change. From 1993–2000, agricultural productivity rose by more than 2% annually; today it sits around 0.8–1.4% (Kwarteng, 2023), putting roughly $30 billion in potential growth at risk over the next decade. At the same time, Canada has committed to cut economy-wide emissions to 40–45% below 2005 levels by 2030 and reach net-zero by 2050, including agriculture-relevant targets to reduce fertilizer-related emissions to 30% below 2020 by 2030 and cut oil, gas, and methane emissions at least 75% below 2012 levels by 2030.

The system tasked with delivering these outcomes is critically underpowered. Public investment in research has fallen 21% over the past decade, leaving Canada last among major OECD peers. At the same time, extension services are fragmented, regulatory burdens are increasing, and farmers have limited influence over research agendas. Together, these weaknesses limit Canada's ability to innovate at the scale and speed needed to remain competitive and meet climate targets. Because innovation is a system activity, overperformance in one function cannot compensate for underperformance in another. For example, increased investment in research without adequate extension efforts or market opportunity won't generate results. Strengthening each function of the innovation system, and the links between them, will be essential for translating research into real world practices to achieve these goals.

Drawing on in-person and virtual interviews, field tours, and author observations, this report examines different aspects of agricultural innovation systems in eleven countries—including Australia, the United States, the Netherlands, Brazil, Kenya, Rwanda, and the UK. The findings highlight how well-structure public–private collaboration accelerates the translation of research into on-farm practice. Successful collaborations depend on connecting industry, government, academia and producers through clear governance, sustainable funding, well-resourced extension, and an enabling regulatory environment.

Key Lessons

- **Clarity of mission and roles** enables collaborations to avoid duplication and deliver outcomes.
- **Networks and intermediaries**, such as grower groups in Australia, reduce transaction costs, build trust, and accelerate adoption.
- **Extension systems vary in form**: publicly funded in the U.S., privatized in the Netherlands, but in all cases depend on skilled agents and trust-based relationships.
- **Universities must balance research**, teaching, and industry engagement, with flexibility to let academics contribute according to their strengths.
- **Funding models shape innovation**: levy-based systems like Australia's Grains Research and Development Corporation pool farmer and government resources for long-term impact, CRCs support mid-term multi-stakeholder collaborations, while the UK's ADOPT Fund empowers farmer-led research.
- **Efficient regulatory environments are critical**. Science-based frameworks accelerate adoption, while duplicative or politicized processes stall progress and impose high opportunity costs.

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INTRODUCTION

Canada's agricultural innovation system has undergone significant structural changes over the past three decades. Traditionally, government agencies and public institutions led research and provided farmer support services. Beginning in the 1990s, public funding for agricultural research began to decline, while private-sector investment increased (Pray & Fuglie, 2015). Between 2013 and 2022, public investment in agricultural research in Canada dropped from $860 million to $680 million, a 21% reduction, placing Canada last among the top seven OECD countries in agricultural research spending (Gulab & L'hermie, 2025). Governments' failure to invest in agricultural research can stifle innovation and trigger negative outcomes across the farm sector. While returns on investments (ROI) in research are often years to decades in the making, the net positive gain is undeniable. ROI estimates range from 10:1 for agriculture research conducted in low- and middle-income countries (LMICs) to 80:1 for cotton breeding in Australia (Alston, Pardey, & Rao, 2021; ACIL Allen Consulting, 2014). The shortfall in absolute spending in Canada raises concerns about future innovation capacity and competitiveness. This report argues that coordinated collaboration offers a pathway to sustain productivity growth and meet climate targets.

Declining public investment has shifted the innovation burden increasingly toward the private sector. Driven by new technologies and strong intellectual property rights, agribusiness companies dramatically increased their research and development spending in the 1990s and 2000s. (Klotz-Ingram & Day-Rubenstein, 1999). Globalization and market opportunities motivated seed, fertilizer, and equipment firms to invest in developing new products, while many governments encouraged public–private partnerships to bring innovations to market. Private sector engagement has brought efficiency and a clearer focus on commercialization, but it has also narrowed the scope of innovation toward areas with direct market returns. The reduction in publicly available research funding has placed growing pressure on universities and public research institutions to seek private co-funding, often at the expense of fundamental or exploratory research traditionally housed in academic institutions (Gulab & L'hermie, 2025). Long-term or systemic challenges, such as sustainable water use, soil health, or climate resilience, often lack the short-term payoff needed to attract private research investment alone.

Research does not occur in isolation, and scientific advances alone are insufficient to drive productivity or sustainability gains within a sector. Effective funding models, coordinated resource allocation, and accessible extension systems are all essential to ensure that research programs deliver tangible outcomes. As public investment falls and private sector priorities dominate, understanding how the broader system of actors works together becomes critical. This whole-of-system approach is captured in the concept of Agricultural Innovation Systems (AIS), which provides a useful framework for analyzing these dynamics. AIS emphasizes collaboration between universities, government research stations, agribusiness, and farmer-led organizations to maximize efficiency, reduce duplication, and achieve outcomes that align with both productivity and sustainability goals.

This report focuses on a subset of system functions within an AIS that most strongly influence whether ideas move from research to farm-level impact. It explores knowledge diffusion—how grower groups, extension networks, and intermediaries translate research into practice. It then examines resource mobilization, highlighting the need for flexibility within academic institutions and comparing funding models that sustain long-term, public-good research. Next, it assesses regulatory efficiency, using the TELA maize pathway to show how policy can enable innovation. Across each section, international examples are used as test cases, followed by concise recommendations for how Canada can strengthen public-private collaboration within the Canadian agri-food innovation system.

AGRICULTURAL INNOVATION SYSTEMS

CORE FUNCTIONS

(Hermans, Geerling-Eiff, Potters, & Klerkx, 2019) identify seven core functions that effective agricultural innovation system must deliver:

Entrepreneurial Activities

Innovators, such as farmers, turning knowledge into business opportunities.

Market Formation

Creating markets for new products or technologies, including incentives for sustainable practices.

Knowledge Development

Generating new insights through research and on-farm experimentation.

Resource Mobilization

Securing funding, resources and human capital to support innovation.

Knowledge Diffusion

Spreading information via networks, extension, and learning platforms.

Regulatory Efficiency

Enabling efficient, science-based regulatory environments and policies.

Guidance of Search

Aligning visions and setting shared priorities across stakeholders.

A practical example comes from Australia's development of long coleoptile wheat varieties. Improving drought tolerance has long been a national priority (**guidance of search**). Strategic investments from farmer research levies and federal funding (**resource mobilization**) enabled the discovery of genes that extend coleoptile length, allowing wheat plants to be sown deeper for better access to early-season moisture (**knowledge development**). Findings were shared with seed companies (**knowledge diffusion**) to integrate the trait into elite germplasm, followed by large-scale national trials to validate performance in farming systems (**knowledge development**). Several long coleoptile varieties have been approved for sale (**regulatory efficiency**), with projected benefits to farmers estimated at $2.3 billion to $2.4 billion annually through higher yields and improved drought resilience (**entrepreneurial activities**)(Zhao, Wang, Kirkegaard, & Rebetzke, 2022).

(Photo: Adobe Stock)

BALANCING

BASIC & APPLIED RESEARCH

Progress in agriculture depends on the connection between basic research, which expands scientific understanding, and applied research, which translates those insights into practical solutions for farmers. Basic research is typically conducted without immediate commercial objectives, aiming to generate new knowledge; genomic mapping of crop species, investigations into the molecular and biochemical pathways of photosynthesis, and studies of microbial interactions in soil all fall toward the basic end of the research spectrum. Applied research, by contrast, builds on this foundation to develop practical technologies or practices that address real-world challenges. In the context of grain farming: crop variety development, comparisons of soil health management practices, and fertilizer efficiency trials fall toward the applied end of the research spectrum. The distribution of basic and applied research within a research ecosystem influences both the pace and the direction of innovation within a sector.

Public research institutions are particularly well-suited to undertake basic research. As basic research involves longer timelines, uncertain outcomes, and significant public benefits it can often be seen as an unattractive investment for private industry. Innovation accelerates when public and private research efforts are complementary. In Brazil, for instance, partnerships between the Brazilian Agricultural Research Corporation (EMBRAPA) – Brazil's publicly funded research organization — and private agribusiness transformed the Cerrado region from a vast savannah of degraded pastureland into the largest soybean producing region in the world. The initial work of developing soybean cultivars that could perform in the Cerrado's acidic soils, advancing soil correction techniques with lime and phosphates, and investing in biological nitrogen fixing technologies suited to the tropical soils was led by EMBRAPA. These initial investments made it technically feasible to cultivate soybean in the region, private sector engagement was needed to achieve widespread adoption and commercialization of soybean production. As the industry grew the market potential for agri-business also grew, seed companies began breeding cultivars for the Brazilian market, machinery companies tailored products for the growing conditions of the Cerrado, and export businesses invested heavily in transportation and storage infrastructure required to access international markets. As a result of this joint investment Brazilian soybean production has quadrupled over the past twenty years, from 705 million bushels in 2004 to 3,744 million bushels in 2023 (Colussi, Schnitkey, Janzen, & Paulson, 2024).

(Photo: Lauren Benoit)

"It's all applied research, we just don't always know where, when, or how it's going to be applied"

Dr. Jonathan Clarke
Head of Business Development,
John Innes Centre,
Norwich, UK

Balancing productivity with sustainability is a global challenge and Brazil is no exception. Growth of soybean production in Brazil has come at the expense of increased GHG emissions and biodiversity loss in the Cerrado. As such, there is a need to transition to more sustainable production practices without sacrificing the economic viability of the sector. EMBRAPA has continued to take a leading role in evolving Brazil's soybean industry to a more sustainable framework. The Low Carbon Soy Program, coordinated by EMBRAPA in partnership with industry, aims to define technical guidelines to validate low-carbon soybean certification methodology as well as promote no-till systems, biological nitrogen fixation and crop-livestock integration for further reductions in GHG emissions from Brazil's soybean crop (EMBRAPA, 2023). The first version of the technical guidelines for Low-Carbon Soy Certification was published in 2024 and laid the groundwork for further development of the low-carbon soy market nationally and internationally. Currently, approximately 50 per cent of EMBRAPA's budget is focused on crop-related projects with more than 30 per cent allocated to projects that include social innovation, nutrition and health, climate change or climate resilience as cross-cutting topics (Dalberg Asia., 2021). The evolution of soybeans in Brazil from a minor crop to major agricultural product and now into more sustainable production systems demonstrates how well-defined goals and synergy between the public and private sectors fosters compounding research benefits and enables sector-wide progress.

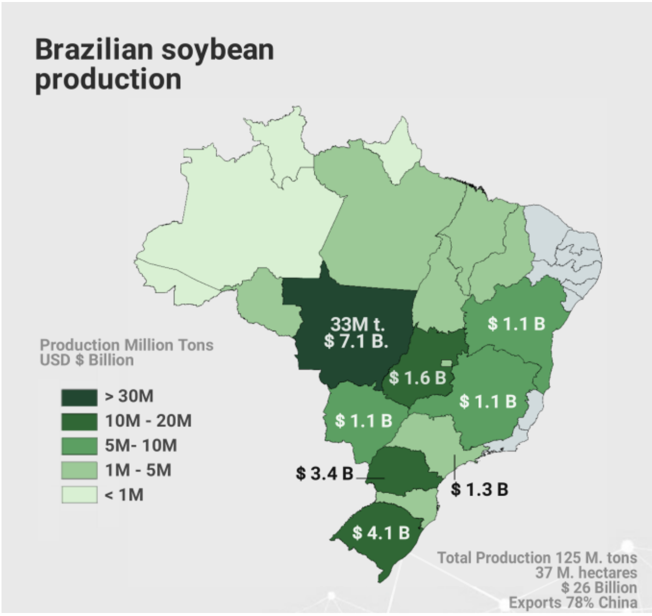


Figure 1: Distribution of soybean production in Brazil.
(Source: CONAB, 2023)

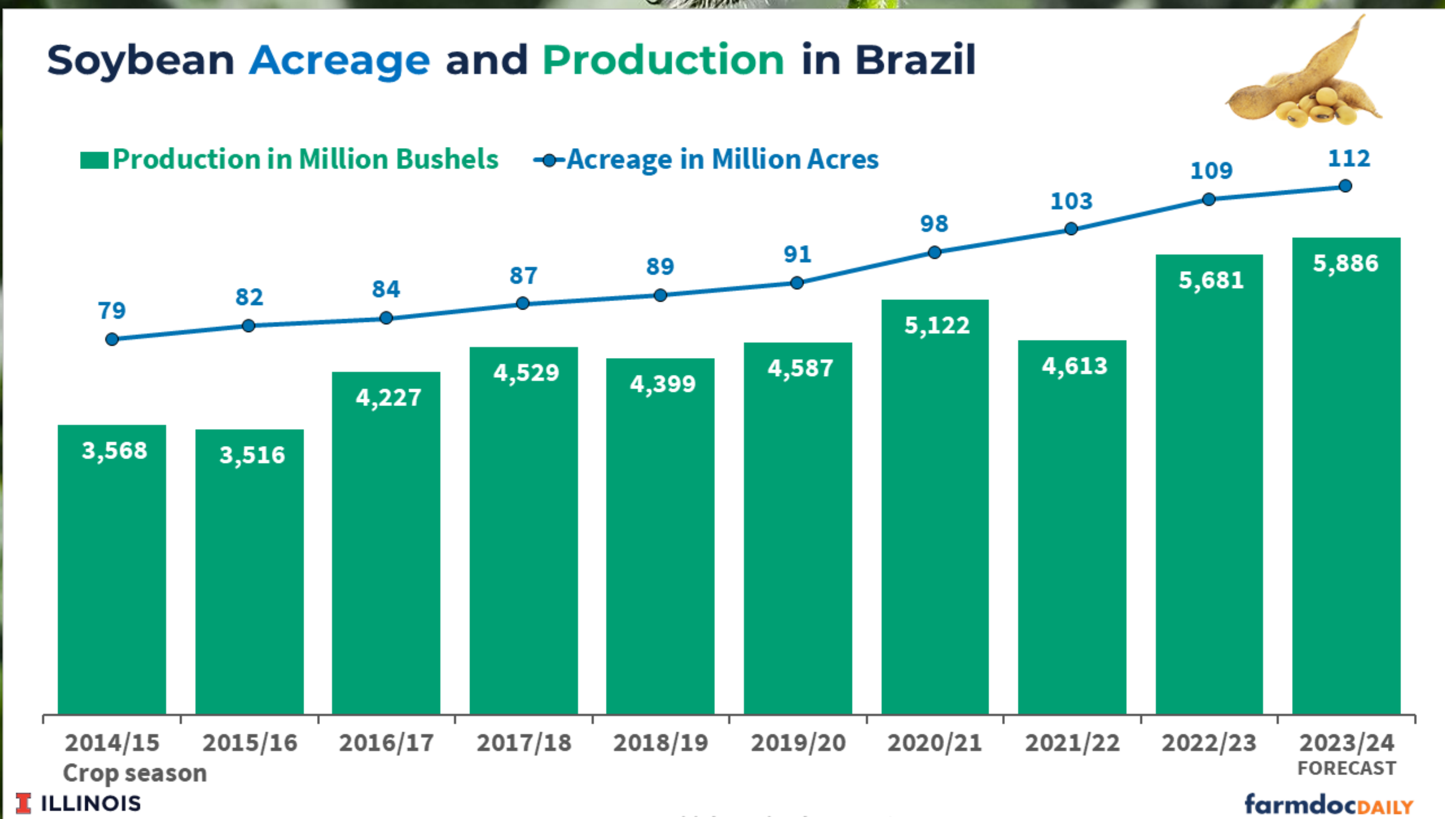


Figure 2: Soybean acreage and production in Brazil.
(Source: CONAB, 2024)

POTENTIAL INEFFICIENCIES

Despite clear benefits, potential inefficiencies do exist. One concern is "crowding out", where public agencies invest in areas with strong commercial viability, reducing incentives for private firms to do so (Malla & Gray, 2000). Examples of crowding out are difficult to identify as we cannot observe the counterfactual. Crowding out is easiest identified in hindsight, when sectors see an increase in private research and development expenditure after public investment stagnates or declines.

There is some evidence of this phenomenon in the Australian wheat breeding industry. Prior to the 1980s, the vast majority of wheat breeding research was driven by public institutions (Jarrett, 1990). Through the 1980s and into the 1990s there was a shift – in Australia and globally – on the role of government in agricultural research and development. This included the government having a larger focus on areas of market failure, greater environmental protection, and increasing privatization of production-focused work (Productivity Commission, 1998). As fiscal priorities began to shift, the resources available to public breeders to develop competitive germplasm became limited. In response, Australia made three strategic institutional changes in how germplasm research was funded: the Grains Research and Development Corporation (GRDC) was created through farmer levy-based research funding, the Plant Breeder's Rights Act and implementation of an end-point royalty (EPR) system was created, and three for-profit corporations were established to undertake wheat breeding and commercialization (Alston J. G., 2013; Kingswell, 2003). These approaches changed the distribution of innovation costs from predominately public to predominately private and there was a significant increase in the total funding for wheat breeding in Australia (Gray & Bolek, 2012). Currently, wheat breeding in Australia is funded entirely by EPRs while funding from the GRDC, CSIRO (Australia's national science agency), state and federal governments has been re-directed to upstream pre-breeding and development of new genomic techniques. This redistribution of research dollars and subsequent advances in commercialization of wheat germplasm further supports the premise that positioning basic research with public institutions opens pre-competitive learnings to be leveraged by industry and commercialized into viable products by private businesses.

A second challenge in moving innovation from public institutions into commercialization is misguided or ineffective management of intellectual property (IP). When structured well, patents and licenses can serve as effective technology transfer tools, allowing publicly funded discoveries to be taken up by private firms and translated into market-ready products. Problems arise, however, when the purpose of patenting shifts from enabling commercialization to maximizing revenue. Many universities evaluate their technology transfer offices based on licensing income rather than the successful diffusion of innovations. This creates incentives that mirror private business models, focusing on commercial returns, rather than a public institution's mandate to generate broad public benefits. Revenues from technology transfer are often marginal compared to other sources such as tuition fees, private research contracts, and public research grants (Rubenstein, King, & Heisey, 2006). Declining public funding exacerbates this problem by pushing universities to search for alternative income streams and rely more heavily on IP revenue. The effectiveness of technology transfer offices depends not only on managing contracts and intellectual property but also on understanding the commercial and regulatory environments in which potential adopters operate.

Public institutions are best positioned to advance pre-competitive, basic research, but their outputs must be structured in ways that enable private partners to carry innovations forward.

Effective IP management should fairly compensate public institutions for their role in discovery while ensuring that research outputs remain accessible enough to foster commercial adoption. Increasing public funding for academic research can help break this cycle by easing financial pressures on universities, reducing overreliance on IP revenue, and allowing them to prioritize innovation pathways that maximize long-term benefit to the sector. Building stronger connections between researchers, technology transfer professionals, and industry partners can improve the alignment between early-stage discoveries and real-world market needs.

Combines harvesting soybeans in sync in Brazil
(*Photo: Adobe Stock*)

Beverely, Western Australia
(Photo: *Lauren Benoit*)

COLLABORATION
ACROSS INNOVATION SYSTEMS

Collaboration between industry, academia and government is a defining feature of effective agricultural innovation systems. Networks, funding structures, and policy frameworks can incentivize or disincentivize collaboration within a sector. Looking at innovation through a system-wide lens helps highlight where efforts should be focused, and how investment in one area can create positive ripple effects elsewhere. This section looks at the conditions and structures that support meaningful collaboration, and how those elements come together to drive sustainable innovation and practical productivity.

CLARITY OF OBJECTIVES, PRIORITIES, AND GOVERNANCE

Clarity is critical in multi-stakeholder collaborations, where partners often bring different goals and resources to the table. Some efforts have clearly defined objectives from the outset; others evolve over time; regardless, guided stakeholder engagement builds trust and momentum. Effective collaborations require leaders to articulate the project's intentions, scope, timelines, and resources. Just as importantly, individual organizations need a strong grasp of their own mission and values so they can decide when, where, and how to contribute meaningfully—without overextending their capacity or diluting their purpose.

The Ontario Soil Network (OSN) is an excellent example of an organization that has a clear understanding of their mission. As a farmer-led initiative, OSN is dedicated to strengthening Ontario's agricultural sector by supporting the advancement of the science of soil health, promoting peer-to-peer education, and advocating for sustainable farming practices. In conversation with Paige Allen, Program Coordinator, and Tori Waugh, Executive Director, both emphasized how important having a clear direction has been to OSN's success.

This approach highlighted two benefits of having a clearly articulated mission. First, it enables OSN to efficiently assess potential collaborations, ensuring alignment with their core objectives and optimizing resource allocation in line with their members' and funders' expectations. Second, OSN's integration within a broader network of agricultural organizations allows them to direct inquiries to appropriate partners, such as Ecological Farmers Association of Ontario (EFAO) for applied research or 4H for youth agricultural education. A strategic referral minimizes redundancy inside the entire system and promotes specialization across organizations, enhancing the overall efficacy of Ontario's agricultural support infrastructure. In a sector where it is easy to get pulled in multiple directions, OSN's disciplined approach serves as a model for how clarity can lead to more successful collaborations and impact.

> *"We build a farmer-led network for people interested in improving soil health in Ontario. If you reach out wanting to do applied research, that's great but go to EFAO [Ecological Farmers Association of Ontario], want to work with kids? Awesome, try 4H".* **– Tori Waugh, Executive Director, Ontario Soil Network**

While it is important for any organization to understand its core values and capacity to engage in collaborations, it is not mandatory for every stakeholder to have the exact same objective for a collaboration to be successful. In fact, it is the differences in what each party brings to the table that makes collaborations stronger and more dynamic. These differences in motivations, strengths and perspectives should not be seen as barriers to collaboration, but as advantages. Although differing viewpoints can strengthen a collaboration's output, there is a risk that if left poorly communicated they can cause confusion and misalignment between stakeholders.

The easy part is reducing emissions and building climate resilience. The hard part is that all the stakeholders need to coordinate and cooperate for years.

(Source: https://www.cartoonstock.com/)

The Food and Agriculture Climate Alliance (FACA) in Washington, D.C. is a very diverse, multi-stakeholder initiative with the intention of advancing voluntary, incentive-based, and science driven climate policy for American agriculture. Formed in 2020, this political coalition brings together over 90 organizations including farm groups, foresters, plant science companies, biotechnology firms, environmental NGOs and food manufacturers. The alliance steering committee includes the American Farm Bureau Federation, Environmental Defense Fund, National Council of Farmer Co-operatives, the National Farmers Union, the Food Industry Associations, National Alliance of Forest Owners, and the National Association of State Departments of Agriculture (Food and Agriculture Climate Alliance, n.d.). Funding for the coalition is strictly private, collected through a tiered membership dues structure.

A critical factor in FACA's success is its administration by The Russell Group, a bipartisan government relations firm specializing in food and agriculture policy. The Russell Group facilitates consensus-building among the members, ensuring that no single organization's agenda dominates the coalition's objectives. This third-party facilitation provides a neutral platform for members to confidentially voice concerns and work through disagreements constructively. The alliance has become a trusted resource for policy makers, who benefit from consolidated guidance rather than having to reconcile multiple positions from individual organizations (U.S. Senate Committee on Agriculture, Nutrition, and Forestry., 2021). FACA has produced over 40 policy recommendations across six key areas: soil health, livestock and dairy, forests and wood products, energy, research, and food loss and waste (Food and Agriculture Climate Alliance, n.d.). As a result, the agriculture industry in the United States has seen climate policy that is incentive-based and voluntary while other sectors have been subjected to increased regulation and penalty-based systems. FACA's model demonstrates that when organizations can put aside their differences and clearly commit to shared goals, they can collectively drive impactful policy changes within the agricultural sector.

Across all case studies, clarity was the single biggest enabler of collaborative success. In both cases, clarity is what builds trust and keeps time and funding focused on measurable, shared outcomes. It allows each organization to understand its role and limitations while aligning its contributions with a shared purpose. As demonstrated by both the Ontario Soil Network and the Food and Agriculture Climate Alliance, a clearly defined mission enables actors to assess alignment, strategically contribute, and reduce duplication across the system. Maintaining this alignment can be achieved through strong internal leadership, as seen with OSN's disciplined focus, or through third-party facilitation, such as the role played by The Russell Group in FACA.

BRIDGING RESEARCH AND ADOPTION THROUGH NETWORKS

For decades, agricultural extension followed a top-down model in which researchers generated knowledge, extension agents transmitted it, and farmers were expected to adopt it. Such linear approaches often failed to account for the social, economic, and institutional contexts shaping farm-level decisions. Networks that connect farmers, researchers, and intermediaries can provide the structure for knowledge to be exchanged, tested, and adapted to real-world contexts (Passioura, 2020). Beyond simply connecting actors, networks perform specific functions that shape how collaboration unfolds and how innovations move from research into practice.

Networks generally serve three key purposes: information sharing to spark new ideas, experience sharing to limit repeated failures, and benchmarking to measure success. Not all networks serve the same purpose, and individual stakeholders will need to engage with a variety of networks depending on their individual goals. In terms of collaboration, networks provide the scaffolding necessary for sustained interaction and alignment of goals. While collaborations that aim for systemic change benefit particularly from facilitated networks that include diverse perspectives by articulating shared problems and building trust among stakeholders, strong peer-to-peer networks can facilitate faster adoption of new practices across a target group. Networks that enable farmer knowledge sharing on lived experiences enhance innovation outcomes and reduce reliance on formal external facilitation (Wood, et al., 2014). Similarly, informal, trust-based learning environments have been shown to foster experimentation and collective problem-solving (Skaalsveen, Ingram, & Urquhart, 2020).

The International Maize and Wheat Research Improvement Center (CIMMYT) is an internationally renowned research facility headquartered in Texacoco, Mexico. CIMMYT focuses on developing improved wheat and maize varieties for the global south and has developed a highly effective hub model that leverages multiple research platforms through a network approach. CIMMYT is a not-for-profit organization supported by the CGIAR Trust Fund and receives additional funding from national governments, development banks, philanthropy organizations and other public and private agencies.

CIMMYT's innovation hubs are made up of four interlinked components: research platforms, farmer modules, extension and impact areas. The specific research priorities are first identified by a group of local stakeholders then worked backwards into research and extension efforts. Research platforms include the structured experiments located at research stations and on-farm trials with local farmers. These platforms test new genetics and practices under realistic local conditions while also serving as extension sites for farmer training and communication efforts. In 2018, twelve hubs were operational in Mexico, including 68 research platforms, 1,841 modules and 9,916 extension areas. Technologies improving sustainability of field practices were adopted on 159,944 ha, resulting in an average corn yield increase of 21% and profitability increase of 41% (Gardeazabel, 2021).

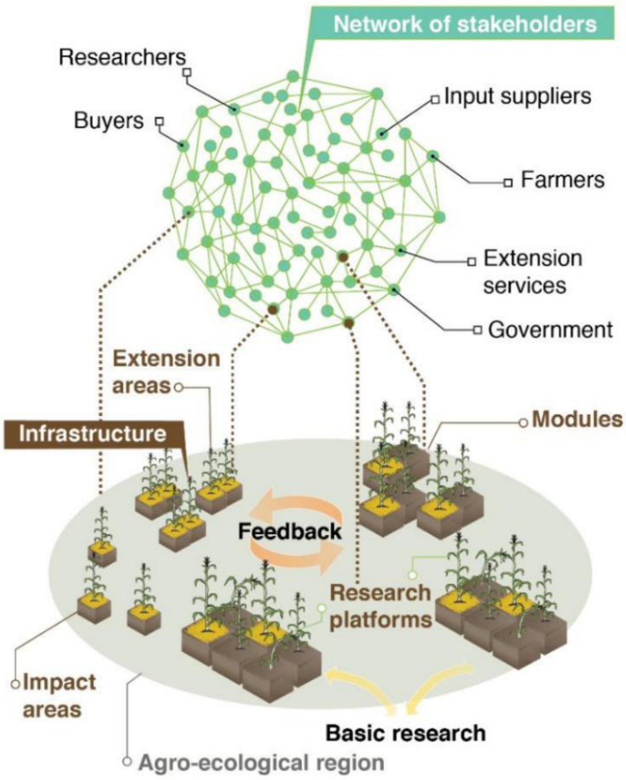


Figure 3: A schematic illustration of CIMMYT hubs (Source: *Gardeazabel, 2021*)

CIMMYT's hub model creates a continuous feedback loop between research, extension and farmers. Insights from field trials feed into farmer-facing extension modules where they are tested under less-controlled, real world farming conditions. These results are used to draw localized solutions and further refine research protocols to meet grower needs. The hub model lowers the transaction costs and risks typically associated with innovation. It also enhances resource mobilization by promoting knowledge exchange and aligning research methodologies across hubs. Having a diverse network of research platforms all operating with shared protocols and data management systems enables meta-data analysis across sites and environments, further leveraging the work being done at any one research location and leading to more coordinated and efficient innovation efforts. This is aligned with research that has shown that treating farmers as full partners, from problem definition to field-level validation, increases utility and uptake of research results (Hermans et al., 2019; Klerkx et al., 2009; Lacoste, et al., 2022).

Different network structures suit different stages of innovation. When the aim is for system transformation - such as in emerging, smallholder economies, networks benefit from high diversity and broader stakeholder engagement (Beers, Potters, & Klerkx, 2012). While CIMMYT provides an example of an internationally coordinated, centralized research hub, in mature agricultural sectors, networks tend to focus on system optimizations: sharing knowledge and improving efficiency. In contrast, Australia offers a decentralized, farmer-led perspective on how networks can quickly disseminate research across remote farming regions.

Social networks play a critical role in influencing growers' adoption of technology or practice by leveraging how information and trust circulate amongst farming communities. Farmers who are involved in formal or informal networks such as grower groups or peer groups, are more likely to be exposed to information, demonstrations, ideas and the experiences of others that reduce the risk of adopting new practices. These networks function as learning channels, with early adopters often acting as central nodes who introduce innovation that subsequently diffuses through the network to other farmers.

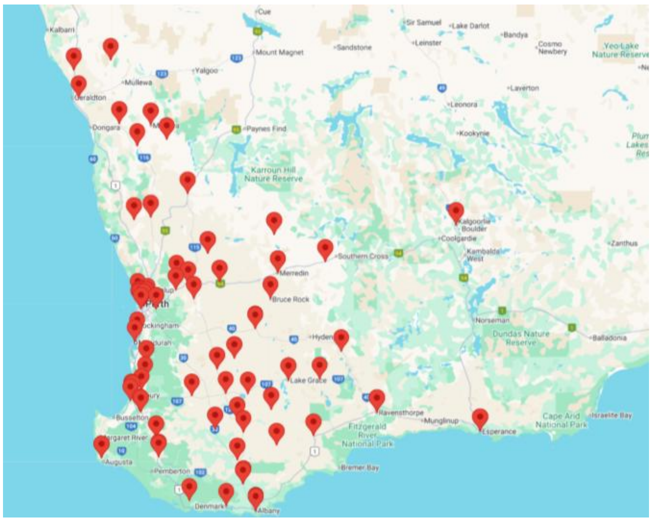


Figure 4: A map of grower group locations in Western Australia. (Source: *The Grower Group Alliance*)

In Australia, grower groups have played a significant role in agricultural research and extension, particularly in regions where public extension services have declined. Australia's agricultural regions are often characterized by homogenous farming systems. For example, Western Australia is dominated by broadacre grain cropping with some grazing livestock, and similar environmental conditions across large areas. This relative uniformity has enabled grower groups to focus on research and extension efforts on a shared set of challenges. These groups have emerged as grassroots organizations connecting farmers directly with researchers, private companies, and public funding bodies to ensure innovation and research priorities are locally relevant and rapidly adopted. Individual grower groups, like the Liebe Group or Minegenew-Irwin Group, are independent, farmer-led organizations that focus on locally relevant research and extensions for their members.

The Grower Group Alliance (GGA), located in Perth, serves as a unifying national network for the grower groups. The GGA provides support by facilitating collaborations and streamlining administrative tasks associated with funding and governance. Through the GGA, grower groups can participate in larger-scale projects and leverage data from multiple locations. Grower groups serve as trusted intermediaries between researchers and farmers, improving adoption rates by ensuring local relevance, demonstrating practices in realistic conditions. Field days, newsletters, on-farm trials, and local research result books produced by local grower groups are consistently cited as highly valued tools for knowledge dissemination (Anil, et al., 2015).

Mingenew-Irwin Grower Group fall trials review day. (*Photos: Lauren Benoit and the Mingenew-Irwin Group*)

While there are varying levels of capacity between grower groups, the largest and most well-established ones have their own trial farms where research groups can come and conduct their research. This includes trials such as the GRDC National Variety Trials, fertilizer or crop protection trials from agribusiness or other agronomically relevant work from academia. It is at the discretion of the grower to decide which projects will be hosted at the trial sites based on what will best serve their members. Surveys show that members value grower groups for improving their decision-making, especially around variety selection, soil management, and controlled traffic farming. In Western Australia, the economic return on investment for grower group activities has been estimated at 10:1, with $12 million of annual investment yielding $120 million in benefits (Grower Group Alliance, 2017).

Competition for limited funding can strain relationships within the network, and some groups have raised concerns that GGA's administrative structure may dilute local group capacity. Many grower groups rely heavily on volunteer involvement, and their effectiveness is directly tied to the contributions of their members. When one or two individuals bear the majority of the workload, burnout can set in, leading to disengagement and a decline in group participation. Members of the academic community have also raised concerns about the consistency of data quality and experimental standards in grower group research. While grower groups are strong in applied, field-based research and extension, academic research is still needed to provide the resources or technical expertise for more complex lab-based work, such as molecular herbicide resistance testing, chemical residue analysis or soil microbiome profiling. Grower group research and academic research are most effective when integrated into a broader research system that can combine scientific oversight and support with real-world applications .

Agricultural innovation is fundamentally a social process shaped by people in shared learning environments. Networks, whether formalized through platforms like CIMMYT's innovation hubs or farmer-led initiatives like Australia's grower groups, serve as critical infrastructure for bridging the divide between research and practice. By fostering trust, enabling co-creation of knowledge, and ensuring feedback between stakeholders, these networks enhance both the relevance and impact of innovation. Recognizing and investing in these collaborative systems is essential to driving sustainable, scalable change across the entire sector.

A murmuration of starlings is one of the most beautiful examples of effective collaboration in the animal kingdom. Starlings flock together and move as one, not because of a single leader but because each bird reads cues from its neighbours and adjusts in real time. As a whole the flock benefits from shared body heat, increased protection from predators, and shared information about food and water sources.

(Photo: Adobe Stock)

Extension Work in Public and Private Systems

Extension comes in all shapes and sizes! Sophie Gregory presenting about dairy farming to school children. (*Photo: Lauren Benoit*)

Agricultural extension is a system of education and support that helps farmers, agri-businesses, and rural communities apply research-based knowledge to improve productivity and sustainability. Extension acts as a bridge between scientific research and on-farm practice, ensuring that innovations and best practices are understood and adapted in real-world settings (Abhijeet, et al., 2023). An effective extension agent combines technical knowledge with strong communication and facilitation skills. They must understand local farming conditions, build trusting relationships with farmers and act as a connector between researchers, policymakers and producers (Chowdhury & Kabir, 2024). Although researchers will also be required to take on some extension activities a researcher will generally focus on generating new knowledge through experimentation, whereas an extension agent specializes in translating and applying that knowledge in practice (Chowdhury, 2024b).

Within an innovation system, extension agents play a critical role in identifying and addressing barriers to adoption. Their work extends well beyond transferring research results and includes all facets of helping farmers make informed decisions in complex environments. For example, low uptake of a new technology may reflect uncertainty about its fit with local conditions, confusion around subsidy criteria, or misalignment between researcher design and farmer priorities. In this way, they act as both facilitators of adoption and conduits of information back into the system. Beyond one-time visits, effective extension involves sustained follow-up, troubleshooting, and trust-building over time. In many cases, success hinges less on the novelty of an innovation and more on the ongoing support that enables farmers to adopt and adapt it under real conditions.

As Passioura (2021) notes, knowledge transfer in agriculture is not simply about moving information down a pipeline from lab to field. Rather, it is a relational and iterative process that requires tailoring messages to the audience and acknowledging the different forms of expertise each group holds. Extension activities differ markedly depending on whether the target audience is other researchers or farmers. Researcher-to-researcher extension typically involves technical exchanges through publications, datasets, protocols, or professional networks, where the aim is to refine methods and advance scientific understanding. Farmer-oriented extension, on the other hand, prioritized applied problem-solving and if often communicated through demonstrations, factsheets, workshops, or direct consultations.

While researcher-to-researcher extension may value technical detail and theoretical rigor, farmers prioritize usability, clarity, and relevance to their operation.

Both forms are essential; the former sustains scientific progress, while the latter ensures knowledge is adapted to local contexts and contributes to tangible on-farm change.

Figure 5: A map of U.S. Extension Programs Located at Land-Grant Institutions (*Source*: *Congressional Research Service*)

The way that agricultural extension systems around the world accomplish this varies widely in structure, ranging from fully public to fully private models. On one end of the spectrum, public systems, like those of the United States Land Grant Universities, are largely government-funded and university-linked, with a focus on delivering unbiased, research-based information and addressing public goods such as environmental stewardship and farmer productivity. At the other end, fully private systems are driven by commercial actors, such as consultants, retailers, and agribusinesses, who offer tailored advice for a fee. In the Netherlands, private advisors, agribusinesses and farmer organizations play a central role in day-to-day advisory services. Mixed model advisory systems aim to balance public interests with market responsiveness, leveraging the strengths of both sectors to serve diverse farmer needs.

While Canada has moved toward a more pluralistic system in recent decades, the U.S. remains a strong example of a state-anchored public model, and the Netherlands represents a more privatized, market-oriented approach. The U.S. Cooperative Extension System is an established nationwide network tied to Land Grant Universities. It operates through a three-tier structure: federal (USDA oversight and funding), state (LGU-led coordination), and county (local extension offices with on-the-ground educators). Funding comes from a mix of federal, state, and county sources. Federal grant funding often requires matching contributions from states. In 2024, capacity grants (core operational support) made up the bulk of funding, but there is a growing share of competitive grants targeting specific projects.

The land-grant model's impact on innovation and productivity is well documented. A 2019 study using historical patenting and variety registration data as a proxy for innovation found that counties where a land-grant college was established saw significant increases in local innovation (Andrews, 2019). Land Grant extension agents, who often live and work in the areas they serve, are well-positioned to tailor advice and programming to local needs, building strong relationships and trust within the community. Extension agents work closely with both farmers and university researchers, without the burden of expectations to engage in international research communities the same way that academics are, this structure enables them to fully invest their time into extension activities over publishing work.

TAPS plot sign and a tour of the field site at the ENREEC facility (*Photos: University of Nebraska-Lincoln*)

One example of this integration is the University of Nebraska-Lincoln's (UNL) Testing Ag Performance Solutions (TAPS) program at the Eastern Nebraska Research, Extension and Education Center (ENREEC). The TAPS program is a collaborative, real-world farming competition that allows producers to virtually manage real field plots using actual agronomic, market and financial data. Through a blend of decision-making, peer learning, and expert feedback, farmers test strategies for irrigation, nutrient management, and profitability. Participants gain insights not only from university research but also from each other, often reevaluating their own on-farm practices as a result. Interviewees described TAPS as a "game-changer" in how extension builds both technical capacity and social learning among producers. It exemplifies how well-designed extension initiatives can move beyond one-way knowledge transfer toward co-creation of solutions with stakeholders.

Despite these strengths, the broader extension system in the United States is under pressure. Inflation-adjusted funding for core programming fell from $582.5M USD in 2017 to $561.7M USD in 2024 (Congressional Research Service, 2025). As states lean more on competitive grants, service delivery fragments and favours well-resourced institutions. This has started to create a gap in support to farmers, and the rise of commodity board agronomists, private consultants and agribusiness advisors has created a more pluralistic advisory landscape. As land-grant university leadership focuses more heavily on research outputs and global rankings, extension's role as a public service is, in some cases, being deprioritized.

In summary, the U.S. extension system continues to play a critical role in connecting science to practice in agriculture and rural development. However, maintaining its relevance and impact will depend on renewed investment, structural adaptability, and clarity of purpose in an increasingly complex advisory landscape.

In contrast, the Netherlands has moved away from a public model and pursued a model that prioritized privatized extension. The Dutch extension system has undergone significant changes since the mid 1980's. Public funding has shifted toward research and innovation projects with private consultants, input suppliers and farmer organizations now playing central roles in extension.

Ontario Snapshot

The Ontario Agri-Food Research Initiative has specifically supported knowledge translation and transfer, projects since 2019. The first two calls awarded $4.1 million. In 2023, governments committed up to $16.5M for 2023–28 with an additional $3.5M in 2024. To date, over 80 projects have been funded, reinforcing networks that move research into practice and delivering gains in farm profitability and faster adoption of sustainable management practices.

L-R: Tom Scrope (UK), Andrea McKenna (Canada), Nick Marriner (UK), Tim Fields (UK), Michael Gooden (Australia) discussing the value of grower groups at Groundswell Regenerative Ag Festival (*Photo: Lauren Benoit*)

One of the primary benefits of privatization of the Dutch system was increased flexibility and responsiveness to farmer needs. This shift allowed for the emergence of farmer-funded research through commodity board mechanisms and the proliferation of private extension businesses to bridge the gap between research, policy, and practice. BO Akkerbouw is a levy-funded knowledge organization for arable farmers in the Netherlands. As the coordinator of the country's largest body of producer-funded research and knowledge transfer, and with strong ties across industry, academia, and government, BO Akkerbouw is well-positioned to serve as a platform for farmers to exchange ideas and access support. Their organization includes farmer-driven priority setting, multi-stakeholder collaboration, and strong integration with research institutions such as Wageningen UR, to ensure projects are both scientifically valid and relevant to their farmer members. This privatized extension system encouraged a more demand-driven and entrepreneurial culture, particularly among innovative and business-oriented farmers.

The shift to privatized extension has brought greater efficiency and responsiveness in some areas, but it has also introduced challenges related to equitable access and the fragmentation of advisory services. The system tends to benefit larger, more innovative, or entrepreneurially minded farmers, while potentially sidelining smaller or less-connected producers. As one farmer noted in a study by Klerkx and Leeuwis (2009), "You have to be good at networking to find what you need…the information is out there, but the road to it isn't clear." These issues have been acknowledged within the sector, and efforts are underway to address fragmentation and improve farmers' access to knowledge. In 2022, BO Akkerbouw established the Sustainable Practice Network for Arable Farmers to address this issue.

> *"In addition to the farmers learning from each other, we can use these insights at BO Akkerbouw to provide feedback to researchers on what topics and research is resonating with growers."*
>
> - **Lotte van Dueren den Hollander, Knowledge Coordinator, BO Akkerbouwc**

L-R: Lotte van Dueren den Hollander, Lauren Benoit, Marijn van Doorjn (Bo Akkerbouw) at a potato industry field day in the Netherlands (*Photo: Lotte van Dueren den Hollander)*

A second example is Crkls, a digital platform designed to improve the accessibility and clarity of agricultural research. Crkls hosts concise, standardized summaries of both BO Akkerbouw-funded projects and other publicly submitted research relevant to Dutch agriculture on a freely accessible website. Each summary is reviewed by a Crkls editor and assigned a reliability score and an impact score to help farmers evaluate its potential relevance to their operations. The platform serves as a practical archive of agronomic data and includes information on both completed and ongoing projects Crkls also helps reduce common barriers to knowledge sharing associated with in-person meetings, such as geographic distance or time constraints, by offering farmers a convenient and reliable space to look up research information on their own time. Research has shown farmers consistently cite other farmers as their most trusted sources of information and ideas (Cooreman, et al., 2018; Ensor & de Bruin, 2022). In the Dutch system, as in the Canadian system, the heavy lifting of extension work is done through personal interaction. Digital platforms like Crkls very efficiently store information in an accessible format, but their impact relies on researchers actively contributing to the data base and the intended audience knowing where to look. Developing personal networks and platforms for farmers to share ideas is still the most effective way to disseminate knowledge and increase rate of adoption, digital tools and platforms can be supplementary to this but should not be seen as a replacement to in-person learning.

Annemarie Bruekers, Associate Director at TKI Agri-Food—a foundation that distributes federal funding for research and innovation in the agri-food sector—cited another challenge with an entirely privatized extension system is the lack of a direct feedback loop from growers to policymakers, saying, "There is an increasing number of people in the government that have expertise in policy and processes much more than agriculture and food".

"There is no direct responsibility for the Dutch government to stay up to date on producer concerns and industry challenges. Without this feedback loop, farmer perspectives risk being overlooked in policy discussions."

-Annemarie Bruekers, Associate Director, TKI Agri-Food

Agricultural extension systems remain essential to bridging the gap between research and practical application on the farm, but their structure and effectiveness vary depending on the broader policy and funding environment. The U.S. system shows how a publicly funded model can foster trusted, locally relevant support when institutions are well-resourced and incentives for those involved, particularly extension agents, are aligned with outreach goals. The Dutch system, by contrast, illustrates how privatization can drive innovation and responsiveness, but presents challenges around access, coordination and feedback to government. Both public and private extension models can be effective in meeting farmer needs, but each depends on specific conditions to function well. Public systems require stable funding and structures that reward engagement with producers rather than academic metrics alone. Private systems depend on a market that can support the cost of advisory services, and on mechanisms to ensure accessibility and continuity. Across both systems, there is a need for skilled intermediaries, who can navigate complex landscapes and connect stakeholders. As agriculture continues to evolve in response to climate, market, and policy pressures, so too must extension systems, ensuring they remain connected to both science and farmer experience.

ALIGNING UNIVERSITY-INDUSTRY COLLABORATION

"The most important product of any university, is its graduates"
- Dr. Rene Van Acker, President and Vice-Chancellor, University of Guelph

The role that universities play within innovation systems has been one of the most challenging to define. Academics are often being pulled in many different, and sometimes conflicting directions. Research, write, publish, mentor, teach, apply for grants, advise policy, talk to farmers, the list goes on. Each academic will have their own strengths and priorities; some individuals are exceptional educators and excel at training students. To train student with skill sets that are relevant to industry there needs to be strong ties between academia and industry; co-sponsored research trials feed directly into student learning and workforce training. Other academics excel in foundational or basic research, and their research isn't yet at a point that is directly translatable to farmers. These academics should be incentivized to continue their research and the collaborative initiatives for these academics will look different than their more applied counterparts. Ultimately, as the roles of universities shift, the most successful ones will give their employees freedom to operate within an innovation ecosystem and use their unique skill sets to the best of their ability.

Tom MacMillian is the Elizabeth Creak Chair in Rural Policy and Strategy at the Royal Agricultural University, he has contributed formally and informally to a range of policy developments, including the UK's National Food Strategy and new fund (ADOPT) for farmer-led innovation. As a faculty member with limited teaching requirements, he was able to identify areas within the UK innovation ecosystem that he could provide value and was enabled by the University's leadership to pursue these opportunities. The RAU has three tracks that academic staff can pursue, weighted respectively towards teaching, research or knowledge exchange. Tom cited this flexibility as helpful in allowing him and others to focus effort where they can bring most value .

Effective university engagement in agriculture is needed to move innovation from basic research into real-world practice and commercialization, while building a future workforce with the skills needed to meet growing global demands. Continued research and exchange of best practices will further inform how universities worldwide can optimize their role in agricultural development. Balancing diverse functions is challenging, but by enabling each individual academic to work with their strengths will ultimately be a catalyst for progress.

Conservation agriculture plots at the RICA Campus.
(Photo: Lauren Benoit)

Rwanda has identified agriculture as a cornerstone for future economic growth. The Rwanda Institute for Conservation Agriculture (RICA) is a model of higher education designed to meet this priority. Rather than training students solely to become employees, RICA's mandate is to produce employers who will drive the sector forward. The program is structured around experiential learning, combining academic coursework with hands-on practice across RICA's integrated farm systems. Students rotate through crop and livestock enterprises, gaining practical expertise in conservation agriculture, agribusiness, and resource management. In their fourth year, every student is required to design and launch a business venture. This can be anything from agronomic advisory services, value-added processing or primary production. The approach builds entrepreneurial capacity within the country and illustrates how universities can move beyond conventional teaching and research roles to act as engines of economic development.

DESIGNING FLEXIBLE FUNDING MODELS

The structure and availability of research funding plays a critical role in shaping the direction of agricultural innovation and can influence how quickly new practices are adopted on farms. Different funding models create distinct incentives and pathways for collaboration, impacting everything from on-farm experimentation and farmer engagement to long-term, cross-sector research initiatives. The following three case studies highlight funding mechanisms designed to address different gaps in the agricultural innovation system: the UK's ADOPT Fund supports farmer-led research from the ground up; Australia's GRDC model provides whole-sector coordination and long-term investment through co-funded levies; and Australia's Cooperative Research Centres (CRCs) bring together multi-stakeholder consortia to address specific, sector-wide challenges over mid-length timelines.

The ADOPT fund (Accelerating Development of Practices and Technologies) is a new UK funding scheme under the Department for Environment, Food & Rural Affairs (DEFRA)'s Farming Innovation Programme, launched in 2025 and administered through InnovateUK. With a total budget of £20.6 million, the fund provides government grants for farmer-led, collaborative on-farm trials of innovative technologies and practices. Funding is offered in two stages: small Support Grants (to help less-experienced applicants develop proposals with expert facilitation) and larger Full Grants (up to £100k for 6–24 month on-farm research projects). This structure is designed to bridge the gap between research and real-world application by fully involving farmers as co-creators of the research and not just beneficiaries.

The ADOPT funding model positions farmers at the center of research and builds from the bottom up. Projects must be "farmer-led" and collaborative, meaning farmers take the lead in project ideas and execution, while working with a team of other farmers, agronomists, or local researchers. Early lessons from similar schemes identified two common challenges: limited experience among farmers in applying for research funding and a lack of established networks between researchers, farmers and other ag professionals needed to fully realize a project's potential. To address these barriers, each project must include a registered facilitator who acts as a project manager. Facilitators help form partnerships, guide farmers through proposal development and compliance requirements, and support communication and knowledge-sharing among all collaborators. By reducing administrative burdens and offering technical support, the facilitator role makes it easier for farmers to participate in research and helps build stronger relationships between farmers and researchers. Farmers can also connect with potential collaborators or join existing initiatives through the digital Farm Performance Enhancement Platform (FarmPEP). All project teams are expected to openly share their trial results and insights, extending the impact of each project beyond the immediate team and contributing to knowledge exchange across the broader sector.

"The long-awaited ADOPT Fund puts farmers in the driving seat of innovation, enabling them to harness the new technologies or innovations they believe could bring productivity gains,"

- Tom Allen-Stevens, Founder of the British On-Farm Innovation Network.

The ADOPT fund offers an accessible entry point for farmer-led research, but its scope is inherently limited by relatively small grants and short project durations. The on-farm trials are typically modest in size and may address very localized problems. While this is valuable for on-farm innovation and applied research, it might not directly foster large academia–industry partnerships or major technological breakthroughs beyond the farm level. The ADOPT fund needs to be seen as an additional piece of the innovation value chain, designed to meet farmer demand for applicable research and drive adoption, and not as a replacement for more fundamental work. If successful, the ADOPT model could demonstrate how relatively small, smartly-structured, public investments can enable farmer-led innovation and involvement within the entire research space. While ADOPT supports localized, bottom-up innovation the GRDC represents a more centralized and system-wide approach to funding agricultural research.

Australia's Grains Research and Development Corporation (GRDC) provides a longstanding example of a co-funded public–private partnership supporting agricultural research. Established in 1990 as a statutory Rural Research and Development Corporation, GRDC is jointly financed by grain producers and the federal government. Farmers contribute a compulsory levy of 0.9% of farm-gate crop revenue, which the government matches up to 0.5% of the industry's gross value of production. Together, this generates an annual research budget of roughly $200 million AUD, which GRDC reinvests into research, development, and extension for the grains sector.

By comparison, the farm-gate revenue of corn, soybeans, wheat, barley, and oats grown in Ontario in 2023 was $5.7 billion (OMAFA, 2025). The Grain Farmers of Ontario currently collect a levy on these crops, of which approximately $1.8 million is directed toward research—equivalent to just 0.0003% of gross farm-gate revenue.

If Ontario farmers contributed the same portion of farm-gate revenue as their Australian counterparts, the result would be a farmer-funded research pool of more than $51 million annually.

While measuring research investment as a share of farm-gate revenue provides a useful snapshot, it does not account for differences such as Ontario's higher production costs or the portion of GRDC's budget directed to administration and operations rather than research. Using funding allocated directly toward research as a portion of net farm revenue would provide a more accurate comparison. Ontario growers also benefit from additional support through national organizations, which helps offset some of the difference but adds to the fragmentation of the system. Overall, the comparison underscores how Ontario's farmer-funded research remains limited but also reveals an opportunity to increase impact through greater investment and stronger coordination.

A key strength of the GRDC funding model is its sustainable, large-scale funding base which has underpinned significant long-term research programs. By pooling industry funds and government support, GRDC can pursue multi-year projects and strategic initiatives that individual companies or farmers likely could not fund alone. GRDC does not conduct any research in-house; instead, it contracts and co-funds projects with universities, national science agencies (CSIRO), state agriculture departments, private companies, and grower groups, strategically leveraging the strengths of each organization. While GRDC's role as a national funder enables coordination across states, the system can be complex to navigate – smaller or less well-connected researchers and grower groups might find it hard to secure funding if they're outside the GRDC's priority focus. The GRDC involves growers directly in priority-setting and extension by maintaining regional panels and local research advisory committees where farmers, researchers, and extension officers meet to identify needs and monitor project progress. Despite best efforts and extensive consultation there is always a risk that top-down priority setting could overlook niche or emerging issues, particularly if growers in a certain region aren't fully engaged in the advisory process. Regardless, GRDC's stability over thirty years has translated into tangible productivity gains for the industry. Over the past thirty years, Australia's wheat sector has achieved an average total factor productivity growth rate of 2.75% per year, effectively dwarfing Canada's TFP growth rate of 0.61%.

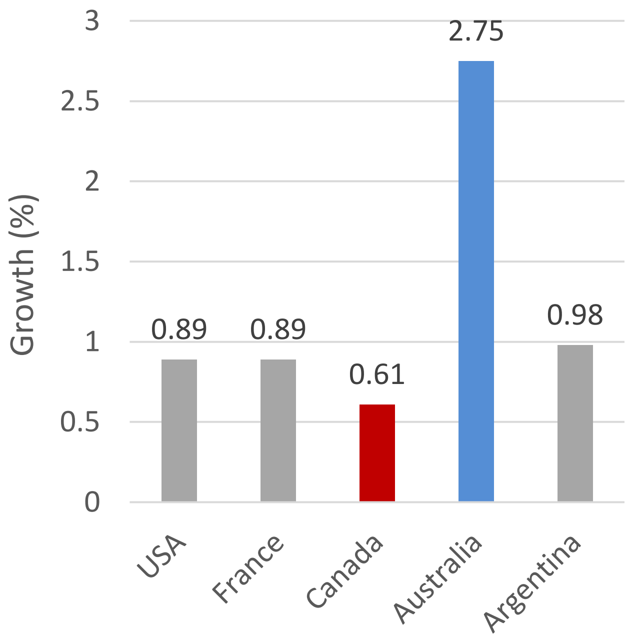
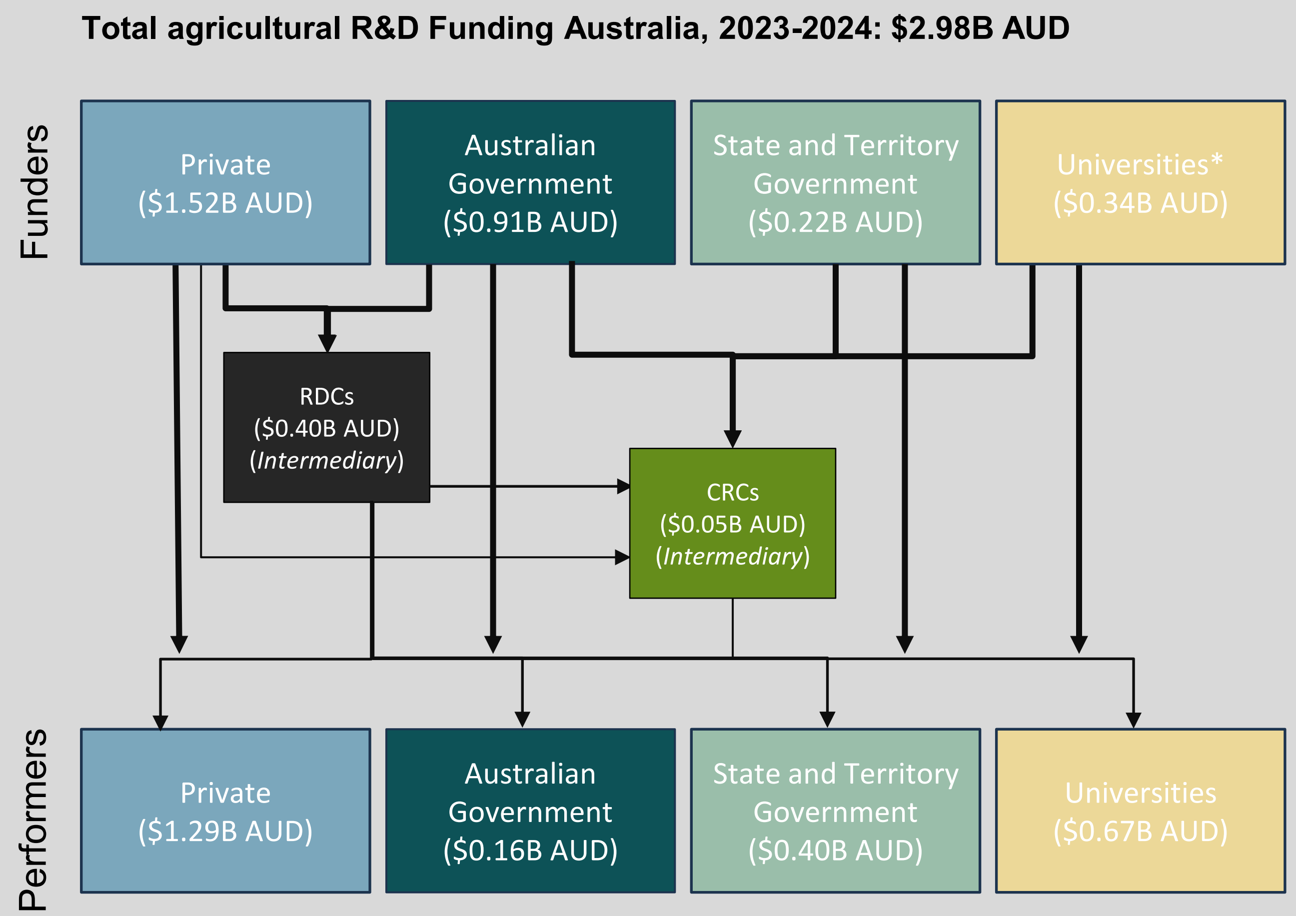


Figure 6: Annual average wheat total factor productivity (TFP) growth rate 1990-2020.
(Source: SCIL Allen, 2023)

> *"If you build resilience through research and development, you're less susceptible to shocks to the system and less reliant on government policy."*
>
> **- Andrew Todd, Laharna Farms, Western Australia**

As the largest funder of grains research in Australia, GRDC plays a central role in shaping the direction and focus of research within the grains sector. Academic researchers are more likely to align their programs with GRDC's strategic priorities, knowing that doing so increases their chances of securing funding and having their work taken up by industry. In contrast, more fragmented environments may require academics to secure funding from multiple sources, and balance competing priorities, leaving grower priorities at a higher risk of being diluted. With the GRDC model, government contributions are matched at the levy level rather than awarded on a project-by-project basis through national funding organizations. This gives GRDC full discretion over how both grower and public funds are invested, enabling the organisation to fund sector-wide priorities with consistency and reduce fragmentation.

The GRDC model shows how sector-led, co-invested funding can align public and private priorities, reduce fragmentation, and sustain long-term collaboration across the grains industry. Its stability has delivered measurable productivity gains and a more responsive innovation system. To address cross-sector challenges, Australia complements this model with Cooperative Research Centers—mid-term, industry-led partnerships between government, academia, and business designed to coordinate efforts around specific national priorities.



*Note: Where university R&D funding is received from Australian federal, state and territory governments, it is captured in the 'Universities' box. This amount is not included of 'double counted' in the 'Australian government' or 'State and Territory Government' boxes.

Figure 7: Total agriculture R&D funding Australia, 2023-2024 *(Source: Australian Department of Agriculture, Fisheries and Forestry)*

Australia's Cooperative Research Centers (CRC) program is a federal funding model designed to forge mid-term collaborations between industry, academia, and government, for specific, high-priority areas. Established in 1990 as a federal initiative, the CRC program provides sizable, multi-year grants (often 5–10 years) to consortia that address specific innovation challenges. Each CRC is an industry-led collaboration: a group of partners (typically companies, industry bodies, universities/research institutes, and sometimes government agencies or community organizations) comes together around a common research objective and applies for funding as a consortium (Cooperative Research Australia, 2025). If successful, the government grant is matched by contributions from the partners (in cash or in-kind). Over three decades, the Australian Government has invested over $4 billion AUD in more than 200 CRCs, with industry and other participants contributing over $12 billion AUD, roughly a 3:1 leverage of public funding (Featherstone, 2019). Active CRCs exist across sectors like agriculture, mining, manufacturing, and health; agricultural examples have included the Zero Net Emissions from Agriculture CRC (ZNE-Ag CRC), the CRC for Solving Anti-Microbial Resistance in Agribusiness, Food and Environments (SAAFE) and the CRC for High Performance Soils (SoilCRC). The ZNE-Ag CRC is the largest CRC to date with $87 million dollars in funding from the Australian government and 73 partners across industry, government and education. "We will coordinate an industry-led approach to help safeguard the profitability and marketing access of Australian agri-business as we make the transition to net zero", says NZ-Ag CRC CEO Richard Heath.

CRC's create a platform for academia-industry partnerships that enables flexible use of the funding, in addition to funding research projects they also fund education, commercialization and capacity building activities. CRCs commonly sponsor PhD students who work on industry-relevant topics within the Centre, thereby training a new generation of scientists with visibility across the industry and giving companies early access to talent. Bringing all voices to the table is particularly valuable when research outcomes are directly tied to grower adoption or change in on-farm practice. The mid-length timeframe provides stability and allows for projects to extend past the traditional 3-year academic funding cycle. Unlike short projects or one-off grants, a 7–10 year CRC provides time for relationships to mature and for research to progress through to application. This continuity is critical for complex challenges (such as breeding new crops, reducing methane emissions, or improving soil health) that require sustained collaboration.

The biggest challenge facing CRCs is the delicate balance needed between the interests and capacities of a very diverse group of stakeholders. Many CRCs have had large boards made up of representatives from each major partner; this can occasionally lead to issues where board members act in the interest of their home organization rather than the CRC's mission. Recently, CRCs have been pushed towards more independent boards, where key stakeholders are able to appoint a board member from outside of their organization instead of having a seat themselves. Another potential weakness is the time-limited nature of CRC funding, while 7-10 years is a longer time frame than many grants will usually allow, there is often still a need to extend work beyond that time frame. Some CRCs have been able to become self-sustaining or spin commercial businesses out from the initial coalition but not all have been able to do this. The CRC experience highlights the value of targeted, mid-term funding models for tackling cross-sector challenges that fall outside the scope of commodity-specific organizations. By combining research with commercialization and training, CRCs strengthen both the innovation pipeline and the networks that support adoption. Despite challenges in governance and long-term sustainability, CRCs continue to deliver high-impact results in areas that require a broad group of stakeholders.

Figure 8: Zero Net Emissions Agriculture CRC logo (Source: https://zneagcrc.com.au)

Sunset at Glenalbyn Santa Gertrudis, Dubbo, NSW.
(*Photo: Lauren Benoit*)

IMPACT OF REGULATION ON INNOVATION ADOPTION

While public research investment and extension services have been widely recognized as contributors to successful innovation, less attention has been paid to the role of regulatory efficiency. An effective regulatory environment is not simply about ensuring human and environmental safety; it is a determinant of how quickly innovations can move from pre-commercial to commercial implementation. The Canadian regulatory system is becoming increasingly burdensome. A recent Statistics Canada study found that the volume of federal regulatory requirements grew by 2.1% annually from 2006 to 2021 – a 37% increase in 15 years (Gu, 2025). This regulatory accumulation has imposed real costs on growth. Gu's analysis estimates that the rise in regulatory provisions over that period reduced business-sector GDP growth by 1.7 percentage points and employment growth by 1.3 points. Regulatory inefficiencies delay adoption, increase costs, and often privilege large businesses over small and medium enterprises.

Agri-business may tolerate regulatory hurdles in countries with large, high-value markets, the same is not true for smaller or middle-income countries, where limited commercial potential means burdensome regulations quickly deter investment (Divanbeigi & Saliola, 2017). The influence of regulation on progress is most clear in Africa, where, despite identical science, access to the same technology (TELA maize) was approved rapidly in some countries but stalled for years in others.

The development of TELA maize is the result of an incredibly effective public–private partnership between Bayer Crop Science (formerly Monsanto), the Gates Foundation and African Agricultural Technologies Foundation (AATF). The name TELA is derived from the Latin word "*tutela*", meaning protection. TELA maize is a portfolio of improved maize hybrids that combine drought tolerance with insect resistance, developed specifically for African smallholders. The initiative began as the Water Efficient Maize for Africa (WEMA) project in 2008 and evolved into the TELA Maize Project, spanning seven countries (Kenya, Uganda, Tanzania, Ethiopia, Mozambique, South Africa, and Nigeria). Over WEMA's first decade the partnership delivered over 100 non-GM drought tolerant maize varieties across six countries. WEMA/TELA is led by AATF, a Nairobi-based nonprofit that coordinates the effort across countries and manages regulatory and distribution processes. The Bill & Melinda Gates Foundation has been the primary funder of the work, underwriting the research and capacity-building needed to develop and release the hybrids. Bayer Crop Science donates access to elite maize germplasm, drought-tolerance genes and *Bt* insect-resistance traits royalty-free for humanitarian use in Africa. This means TELA maize seed can be developed and sold to farmers without technology fees, a critical factor in keeping them affordable.

"When the project started 10 years ago, it was rather unclear how it would go," noted Mark Edge, Director of Seeds, Traits and Business Development for LMIC's at Bayer, "but together, we are making progress".

On the back of the success of the WEMA project, the decision was made to roll out TELA biotech maize – a drought-tolerant, insect-resistant GM crop. Two early participant countries, Nigeria and Kenya, had very different experiences, illustrating how national regulatory environments can make or break farmers' timely access to innovations.

In Nigeria, a modern biosafety framework and strong political will enabled a clear, science-based approval process for TELA maize. Nigeria established a one-stop biosafety agency, the National Biosafety Management Agency (NBMA) in 2015 and by 2018 had joined the TELA project. In three years of regulatory engagement, Nigerian scientists progressed from trials to approval. The NBMA granted an environmental release permit for TELA maize in October 2021, clearing the way for national performance trials on farmers' fields in all major maize-growing zones. Nigeria was the first African country outside of South Africa to permit GM maize. Regulators focused on evidence of safety and efficacy, and the process was straightforward and predictable.

As a result, by the 2023 cropping season Nigeria was able to commercially release four TELA hybrid varieties to farmers. The results have been outstanding in counties that have been able to commercialize these products. Nigeria's newly released TELA hybrid SAMMAZ 75T yielded 5.1 tons/ha in on-farm trials, 54% higher than non-TELA maize, resulting in significantly greater income per hectare for farmers. Research collected across 642 smallholder farms recorded an extra ₦1.1 million (≈$2,100 USD) profit per hectare with TELA hybrids, due to both higher yields and reduced spending on pesticides (Marechera, et al., 2019).

"TELA maize represents a key step forward in achieving climate-resilient, profitable farming. It delivers on multiple fronts – higher output, reduced input costs, and better environmental outcomes," says Dr. Sylvester Oikeh, TELA project manager at AATF.

Farmer evaluations have echoed this, describing TELA as "more reliable" and "stress-free" due to its uniform growth and built-in pest protection (Obunyali, et al., 2019). In addition to TELA maize, Nigerian farmers also have access to Bt cotton and Bt cowpea as part of a broader strategy to equip farmers with climate-smart, high-yield tools. Nigeria's experience shows how a science-based regulator with political backing can rapidly translate research into on-farm adoption.

In contrast, Kenya illustrates how duplicative and unclear regulations, compounded by political interference can stall agricultural innovation. Kenya's Biosafety Act (enacted 2009) established the National Biosafety Authority (NBA) as the principal regulator. However, in practice the approval process became mired in overlapping mandates: other agencies like the Environmental Management Authority (NEMA) and the plant health inspectorate (KEPHIS) insisted on additional reviews, creating redundant hurdles (Ongu, Olayide, Alexandersson, Zawedde, & Eriksson, 2023). In November 2012, the Kenyan cabinet imposed a moratorium on GM crop approvals, which effectively froze any progress on biotech maize for about 10 years. Confined field trials of WEMA/TELA maize did take place and showed promising results, but approvals were repeatedly delayed by administrative bottlenecks, interference from activist groups and political uncertainty. In 2022, Kenya's government lifted the ban on GM cultivation signaling support for science-based regulation. Despite recent progress the cost of regulatory delay has been enormous: a recent analysis estimated that just five years of postponing GM crop adoption (including Bt maize) cost Kenyan farmers $157 million in productivity loss. For maize specifically, the study found that blocking Bt maize from 2019–2024 accrued losses of $67 million (Kovak, et al., 2024). Regulatory inertia and lack of policy coordination in Kenya caused real loss for farmers by delaying access to TELA maize for nearly a decade. As African nations seek to improve crop yields and climate adaptation, science-based regulatory agencies that act efficiently will be just as important as the innovations themselves.

TELA maize (right) shows better resistance to stem borer and fall armyworm than the non-GM variety.
(Photo: Alliance for Science)

The experiences of Nigeria and Kenya demonstrate that regulatory frameworks can either accelerate or stall innovation, regardless of scientific merit. This pattern is not limited to Africa. Globally, governments are seeking ways to modernize regulation so that farmers and consumers gain quicker access to advances in science. The United Kingdom's recent reforms on gene editing provide one such example. Decades of restrictive GMO rules in the EU have been linked to forgone productivity and farm income, a gap the UK is now trying to avoid. A 2019 peer-reviewed analysis found that since the introduction of GM crops in the mid-1990s, U.S. corn and soybean yields have increased significantly relative to EU yields, a divergence attributed largely to the EU's ban on GM crop cultivation (Brester, Atwood, Watts, & Kawalski, 2019).

Farmers manually breaking ground to plant crops in Rwanda. *(Photo: Lauren Benoit)*

By contrast, there was no such gap in wheat yields, a crop for which no GM varieties have been grown in either region. The benefits of new genomic techniques are not limited to strictly yield improvement. In recent years researchers have used gene editing to develop vitamin-D fortified tomatoes, high-oleic soybean for increased shelf-life and lower cholesterol, hornless cattle for improved animal welfare and nitrogen-producing microbes to reduce reliance on synthetic fertilizers. A recent analysis using Swedish cultivation and pesticide data estimated that gene-edited late blight-resistant potatoes could reduce pesticide usage by over 80%, and that changes enabling pesticide reductions could collectively save farmers up to €70 million if EU rules were amended (Brookes, 2022).

In the absence of an effective regulatory pathway, many of these innovations cannot reach EU farmers or consumers. A 2023 scenario-based economic analysis by researchers at the Breakthrough Institute and Cornell's Alliance for Science estimated that maintaining stringent EU regulations on new genomic techniques could impose opportunity costs on the order of billions of euros per year (Alliance for Science, 2023). While the exact magnitude of projected impact varies depending on assumptions and adoption rates, it is clear that regulatory delays and uncertainty dampen investment and slow the delivery of public benefits from new traits. Europe's cautious approach has carried real costs, and the United Kingdom is moving to avoid a similar outcome.

In 2023, the United Kingdom passed the Genetic Technology (Precision Breeding) Act, creating a separate category for "precision bred organisms" (essentially gene-edited crops with no foreign DNA), distinguishing them from transgenic GMOs. This reform, implemented in England, has been promoted to accelerate research and investment by providing greater predictability for innovators. This modernization is already spurring investment in crop breeding research; DEFRA has set aside a £12.5 million fund to invest in mid-stage precision breeding projects for arable and horticulture crops. Institutions like the John Innes Centre and Rothamsted Research are moving quickly to position themselves as leaders in the space and align research pipelines with the new framework. The UK's regulatory reforms aim to reverse that trend by fostering an environment where innovation can translate into productivity gains, economic growth, and tangible benefits for consumers and farmers alike.

Regulatory inefficiency is more than a bureaucratic inconvenience; it directly impacts progress towards productivity and sustainability goals. As the African and European experiences show, unclear or duplicative regulations slow the adoption of proven technologies, leaving farmers with fewer tools and lower returns. For Canada, modernizing regulatory frameworks would improve global competitiveness, increase business investment in the sector and help ensure that innovations generated through public and private research translate into measurable gains on Canadian farms.

Harvesting forage trials, Nairobi, Kenya.
(*Photo: Lauren Benoit*)

CONCLUSION

Effective innovation is a networked system in which funding, research, extension, and regulation reinforce one another. In Canada, decades of declining public investment have weakened those connections and created bottlenecks between discovery and adoption. The private sector has filled some gaps, but market incentives alone cannot sustain the long-term, pre-competitive, public-good research historically led by governments and universities. The result is a landscape that is becoming increasingly disjointed. Restoring coordination is essential if Canada is to sustain competitiveness and realize sustainability goals in an increasingly intensive agri-food economy.

International examples show no single actor in an innovation system can drive progress alone. Brazil's transformation of the Cerrado through EMBRAPA's foundational research, combined with private commercialization efforts, demonstrates how early public investment in basic science enables future market expansion. Similarly, Australia's experience with wheat breeding, underpinned by the levy-based Grains Research and Development Corporation demonstrates how stable, co-funded frameworks deliver durable productivity gains. CIMMYT's hub model in Mexico, Australia's grower-group networks, the U.S. Land-Grant system, and the Netherlands' privatized extension model all underscore that innovation is social: it depends on trusted relationships and two-way feedback between farmers and researchers.

In Canada, public extension programs are under increasing amounts of pressure; many farmers operate without access to dedicated extension agents or structured peer networks. Reinvestment needs to prioritize regional hubs, and funded peer group facilitation. Research budgets should explicitly include extension deliverables and timelines. Universities can play a critical role in this, flexible academic models that value teaching, research, and knowledge exchange on equal footing in addition to hybrid roles that combine academic expertise with community would strengthen feedback from farms into research agendas and policy.

Canada's challenges are primarily organizational. Canada has strong scientists and skilled producers, but funding and governance are dispersed across provinces, commodities, and institutions. Public research investment has fallen by more than 20% over the past decade, and no single body plays the integrative role GRDC plays in Australia. Farmer levies for research exist through commodity groups, yet the collective scale is modest. Redirecting even a small portion of farm-gate value toward coordinated, co-funded research would multiply the sector's innovation capacity. Matching mechanisms, like GRDC's government-industry model, would create predictable funding, and ensure public investment delivers public good while aligning with industry-identified needs.

Coordinated funding and strong extension only translate into impact if regulation enables timely access to new technologies. The TELA maize experience illustrates this: Nigeria's streamlined, science-based biosafety pathway moved quickly from trials to farmer access, with measurable yield and income benefits. The UK's Precision Breeding Act reflects similar learning: after the opportunity costs of restrictive EU rules, the UK has taken significant steps towards creating a path to market for gene-edited crops. The lesson is not that "less regulation is better," but that modern, risk-proportionate regulation is a driver of progress. Canada's system is rigorous but often slow and duplicative; streamlining approvals and adopting proportionate approaches for emerging technologies would improve predictability while maintaining public trust and safety.

Put simply, effective innovation systems are built deliberately: clear roles, steady and matched funding, strong networks, outcome-focused extension activities, and practical, science-based regulation. Well-coordinated innovation systems increase sector competitiveness and advance sustainability goals. In Canada, there is an opportunity to improve our agricultural innovation system to meet both productivity and sustainability goals.

RECOMMENDATIONS

Thank you for reading and engaging with this report., I would love to hear any thoughts or feedback that you may have. Strong collaborations across industry, academia, and producer groups are the bedrock of driving industry change, be that in the form of strong networks, adequate and accurate research funding, or regulatory modernization.

The ten recommendations are outlined below are non-exhaustive; some can be applied at an individual level, while others call for broader structural and policy change. Collectively, they outline strategies to strengthen collaboration within the agriculture industry and would help Canada fully leverage its agricultural innovation system to deliver on both productivity and sustainability goals.

1. Prioritize Clarity of Purpose in Collaborative Initiatives

Clarity of mission was the single most important determinant of collaborative success. When roles, goals, and expectations are explicitly defined, it becomes easier to align decisions, avoid duplication, and track progress.

2. Reinvest in Public Agricultural Research

Canada's decline in public agriculture research investment threatens both innovation capacity and climate resilience. To meet domestic productivity needs and international climate commitments, federal and provincial governments must restore long-term funding for foundational agricultural research. Public research should be positioned to address systemic challenges, like soil health, biodiversity, and emissions reduction, that require patient capital and public oversight.

3. Increase Farmers Investment in Research

Compared to Australian farmers, who collectively invest over $100 million AUD annually into research through the GRDC levy (0.9% of farm gate value), Ontario grain producers contribute far less through the GFO research fund ($1.8 Million or 0.0003% of farm gate value). If Ontario farmers want more influence over research agendas and more tailored innovation, they must be willing to increase their financial stake. With greater investment comes greater say, and ultimately, greater returns in productivity, sustainability, and market competitiveness.

4. Establish Grower Advisory Boards Across Research Institutions and Agri-Business

Regular and structured input from farmers improves the relevance, uptake, and impact of research. Universities, agribusiness companies, and non-profits should formalize grower advisory boards that inform research agendas, validate priorities, and shape extension strategies. Formalizing farmer involvement helps bridge the gap between research and on-farm application.

5. Support Third-Party Facilitators

Many promising collaborations falter due to unclear coordination or unbalanced participation. Independent facilitators can help reduce administrative burden, manage expectations, resolve conflicts, and keep projects on track. Investing in neutral third-party facilitators adds value by making space for diverse voices and sustaining momentum through complex partnerships.

6. Enable Flexible Academic Roles

Universities should be encouraged to recognize, and support differentiated roles for academics within agricultural research and extension. Institutions should create space for researchers to contribute according to their strengths, whether that means training students through industry-linked projects, leading long-term fundamental research projects, or participating in extension and knowledge transfer. By aligning institutional incentives with the diverse capacities of their staff, universities can more effectively contribute to innovation and the development of a future-ready workforce.

RECOMMENDATIONS

7. Clarify Extension Roles and Improve Access

Ontario's advisory system is characterized by a wide range of actors, including public extension, agribusiness, independent consultants, and NGOs. Chowdhury et. al, 2024 shows that the system's effectiveness is constrained by a lack of coordination and transparency around provider roles and accountability. To strengthen impact, Ontario should support the development of coordination mechanisms and fund trusted intermediaries who can help farmers navigate available resources and link research to practice more effectively. Investments should be made in developing person-to-person networks for information sharing over creating additional digital libraries of research summaries.

8. Design Funding Mechanisms Around Audience

Research funding is often designed around academic timelines or bureaucratic constraints rather than farmer needs. Canada should adopt more outcome-oriented funding models that prioritize measurable impact and lower the administrative barriers to farmer participation. This includes simplified application processes, more flexible timelines, and funding structures that support co-creation of research right through to extension, demonstration, and peer learning.

9. Modernize and Streamline Regulatory Processes

Canada should treat regulatory modernization as a central pillar of its agricultural innovation strategy. Over the past two decades, growing regulatory burden has added duplication and slowed farmer access to new technologies. A comprehensive review, guided by a panel including farmer and industry voices, would help streamline approvals so research outputs move more quickly from discovery to adoption while maintaining Canada's high standards for health and safety.

10. Treat Collaboration as a Personal Responsibility

At the end of the day, collaboration depends on people, not programs or institutions. Researchers, growers, and industry leaders each play a role in making partnerships work by being open, consistent, and willing to act. No governance framework or funding model can replace the need for individual initiative and mutual respect.

APPENDIX

As I traveled, I did my best to capture the details of every meeting, conversation, and shared pint. Of course, not every story could make its way into this report, but I want to recognize the people behind them. Every interaction, big or small, added perspective and helped shape the conclusions I've drawn.

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