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The Greenhouse Innovation Service-Delivery Ecosystem in Southern Ontario

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INTRODUCTION

This project maps and analyzes the ecosystem of greenhouse technology service delivery in Southern Ontario, focusing on agricultural intermediaries (loosely defined as organizations that support the development and uptake of greenhouse technology[1]) as public service/program delivery entities. Our research questions ask: How do intermediary organizations support greenhouse agribusinesses and promote the uptake of innovation? How do they create value for their end-users? Who do they include in their network to achieve their goal of promoting innovation in the agrifood industry?

The discussion is structured as follows: In the next section, we review the global literature on agricultural and agrifood innovation systems (AIS) to provide the background context for our analysis of the greenhouse technology innovation system in Southern Ontario. Using social network analysis (SNA), we then map the network of greenhouse innovation program delivery entities and their constellations of partners and service/program end-users in the region. In the third section, we analyze interview data comprising the individual perceptions/perspectives of key actors (including service providers and end-users) regarding the strengths and weaknesses of the network structure and processes that shape intermediaries' activities and the outcomes of value co-creation in the greenhouse innovation ecosystem. The discussion concludes with key lessons and policy recommendations for action, drawing on our case study and the extant literature. We also reflect on directions for future research.

[1] We provide a more formal definition and in-depth discussion of intermediaries in the literature review section of the paper.

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AGRICULTURAL AND AGRIFOOD INNOVATION SYSTEMS:
A LITERATURE REVIEW

In this section, we start with a definition of agricultural and agrifood innovation systems (AIS). This is followed by a discussion of key AIS actors, including intermediary organizations, governments, post-secondary institutions, and industry. We then outline the processes typically involved in creating innovation systems and the programs and services they often deliver. Given the pervasiveness of digital technology as an enabling platform of service delivery, we also examine how it has been deployed to facilitate AIS interactions.

AIS are networks of actors, institutions, and linkages that collectively generate, diffuse, and apply new and improved knowledge to advance shared industry goals. Scholars such as Hermans et al. (2013, 2015) conceptualize AIS as configurations of actors embedded within institutional environments that enable innovation through interaction and learning. Similarly, Klerkx and Begemann (2020) emphasize the co-production of technological, social, and institutional innovations, while the OECD (2013) frames AIS as systems that integrate organizations and individuals to support improved products, processes, and services.

A defining feature of AIS is their systemic nature. It is premised on the belief that innovation does not occur in isolation but emerges from interactions among producers, researchers, policymakers, and intermediaries.

This approach moves beyond linear models of technology transfer toward interactive, network-based perspectives. In Canada, for example, Agriculture and AgriFood Canada (AAFC, 2017) describes the agrifood system as an integrated value chain supported by knowledge infrastructures and institutional arrangements. Importantly, AIS are not static structures but dynamic systems that evolve over time in response to changing economic, environmental, and technological conditions. For instance, this dynamism is captured in mission-oriented frameworks, where innovation is guided by societal goals such as sustainability, climate resilience, and food security (Klerkx & Begemann, 2020).

AIS encompass a diverse set of actors performing complementary roles. Governments often act as funders, regulators, and strategists. Industry actors, including tech firms and producers, serve as key innovators and adopters. Research institutions usually generate knowledge and train skilled labour, while intermediaries facilitate coordination among knowledge funders, producers and users (OECD, 2013). The composition of actors varies depending on sectoral characteristics and technological intensity (Garbade et al., 2012). The effectiveness of AIS depends not only on the presence of these actors but also on the quality of their interactions and the institutional conditions that enable collaboration.

Intermediary organizations play a pivotal role in the quality of AIS interactions by connecting actors, facilitating knowledge exchange, and coordinating innovation processes. Their functions typically involve problem

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identification, partner matching, dialogue facilitation, and supporting value creation (Hermans et al., 2013). Recent literature challenges the notion that intermediaries are neutral brokers. Cardona et al. (2021) argue that intermediaries often pursue specific agendas and exercise influence over innovation trajectories. Rather than acting as passive conduits, they actively shape networks and steer collaboration. Germundsson et al. (2021) describe intermediaries as facilitators of "value-creating meetings," highlighting their role in generating economic and social outcomes. From a governance perspective, intermediaries can be conceptualized as carriers of institutional authority within market spaces. They translate policy objectives into operational practices and align private innovation activities with public goals (Klerkx & Begemann, 2020).

The development of AIS typically follows a series of iterative processes. These include problem identification, network formation, experimentation, institutionalization, and scaling (Hermans et al., 2013). In the early stages, actors identify challenges or opportunities that trigger collaboration. Intermediaries then facilitate network building and dialogue. Experimentation follows, often supported by government policies that enable pilot projects and learning. Successful initiatives are institutionalized through funding mechanisms and organizational structures, and eventually scaled for broader impact. McAdam et al. (2014) describe stages of learning, market orientation, and renewal, while Klerkx and Begemann (2020) emphasize gradual, mission-oriented transitions. These frameworks underscore the importance of continuous adaptation and learning.

AIS deliver a range of programs and services that support innovation. These include research funding, knowledge-sharing platforms, training and education programs, and networking events (OECD, 2013). Other services include market intelligence, product development support, export promotion, and advisory services. Intermediaries play a key role in delivering these services by connecting actors and facilitating collaboration (Germundsson et al., 2021). Extension services remain particularly important for translating knowledge into practice and supporting adoption among producers.

Finally, digital technologies have become central to AIS by enhancing communication, data sharing, and coordination. Information and communication technologies (ICTs) and, more recently, AI-enabled tools and platforms, integrate farmers, technology providers, and public actors in ways that exponentially expand the scope of innovation systems (OECD 2013; Germundsson et al., 2021; Klerkx and Begemann 2020). However, digitalization also introduces challenges related to data governance, privacy, ownership, interoperability, and access, particularly for smaller producers.

In the next two sections, we undertake an empirical investigation of the greenhouse innovation ecosystem in Southern Ontario, starting with a mapping of the AIS network's structure and then, in the following section, using interview data to shed light on actors' perceptions of intermediaries' program/service delivery within the system.

MAPPING THE GREENHOUSE INNOVATION DELIVERY STRUCTURE IN SOUTHERN ONTARIO:

SOCIAL NETWORK ANALYSIS

In this section, we used Social Network Analysis (SNA) to map the greenhouse innovation service-delivery ecosystem in Southern Ontario to understand the role of innovation intermediaries in the greenhouse sector. "Networks are a way of thinking about social systems that focus our attention on the relationships among the entities that make up the system, which we call actors or nodes" (Borgatti, Evertt & Johnson, 2018, p. 2). This approach allowed for the identification of actors (i.e. organizations) in this informal network, their 'network' location, and level of connectedness across nine types of innovation identified in the literature.

Data were collected in the Fall of 2025 via a self-report online questionnaire that contained five (5) demographic questions about the organization (e.g. financing, sector, scope, etc.) and then nine (9) questions that asked respondents to indicate up to five (5) organizations they linked with in the last three years across the nine (9) types of innovation. Emergent and purposely broad contact lists were developed through online searches and key communications with local leaders. A list of 56 organizations within Southern Ontario resulted from this effort, and these organizations received an email with a survey link and follow-up emails when necessary.

At the end of the data collection period, we received 23 usable surveys representing actors across various sectors and types of organizations. In two cases, two different units at one organization completed the survey, so answers were combined into one. While this return rate is lower than we would have liked, there is still valuable information that can be gained about which organizations worked together to promote goals in the agrifood industry. Results indicated that most respondents had operations national in scope (n=16) representing private sector organizations (n=15). In terms of the type of operation, this was fairly evenly distributed across three options: sector-wide focused (n=6), commodity-industry-focused (n=8) and technology-focused (n=9).

We began the SNA process by mapping ties between organizations. With this step, all organizations identified by respondents are inputted into matrices across the nine types of innovation. Most ties were reported in relation to working with others in research and development (47 ties) and/or validating and prototyping new technologies (43 ties). Fewer ties were reported for advocacy (three ties) and/or interoperability standards promotion (one tie) work.

TYPES OF INNOVATION STUDIED

- Supporting or conducting upstream R&D or early-stage research

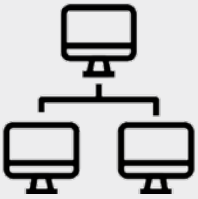
- Validating and prototyping new or improved technologies

- Mobilizing or commercializing new or improved technologies

- Supporting technology adoption by farmers and businesses

- Regulation, safety & technology interoperability standards promotion

- Technology interoperability standards promotion



- Facilitating linkages among tech developers and end-users in the network

- Policy advocacy on behalf of the network

- Public education and public relations on behalf of the network.

ALL-LINKS MAP

To give a holistic picture of how organizations in this informal network were linked to each other, all nine innovation ties were combined to create one matrix/map (see below). Each organization (actor) is represented by a square box. Larger squares reflect many ties and may indicate a key role in the network. Lines connecting boxes indicate a tie between two organizations. The majority of ties identified by respondents were non-reciprocal ties meaning that both organizations did not name each other (i.e. arrow only appears at one end of line).
In only three situations were ties reciprocal meaning that both organizations indicated a tie (i.e. arrows at both ends of line).

This network represents quite a bit of network activity—even if most of the activity is through non-reciprocal ties. Note: There were six isolates in the 'all-links' map (five private sector organizations and one post-secondary institute/centre), which means these six organizations did not link to any other organization. Key organizations, those represented by large squares in the 'all-links' map, were primarily private-sector organizations (five) and post-secondary institutes/centres (two). A private organization has the greatest number of outgoing ties with 18—meaning this organization reached out to 18 different organizations across all types of innovation studied. These key actors represent those organizations that are perceived to hold power, influence, and serve as gatekeepers to the overall network. And because there are seven of these organizations, power is more diffused.

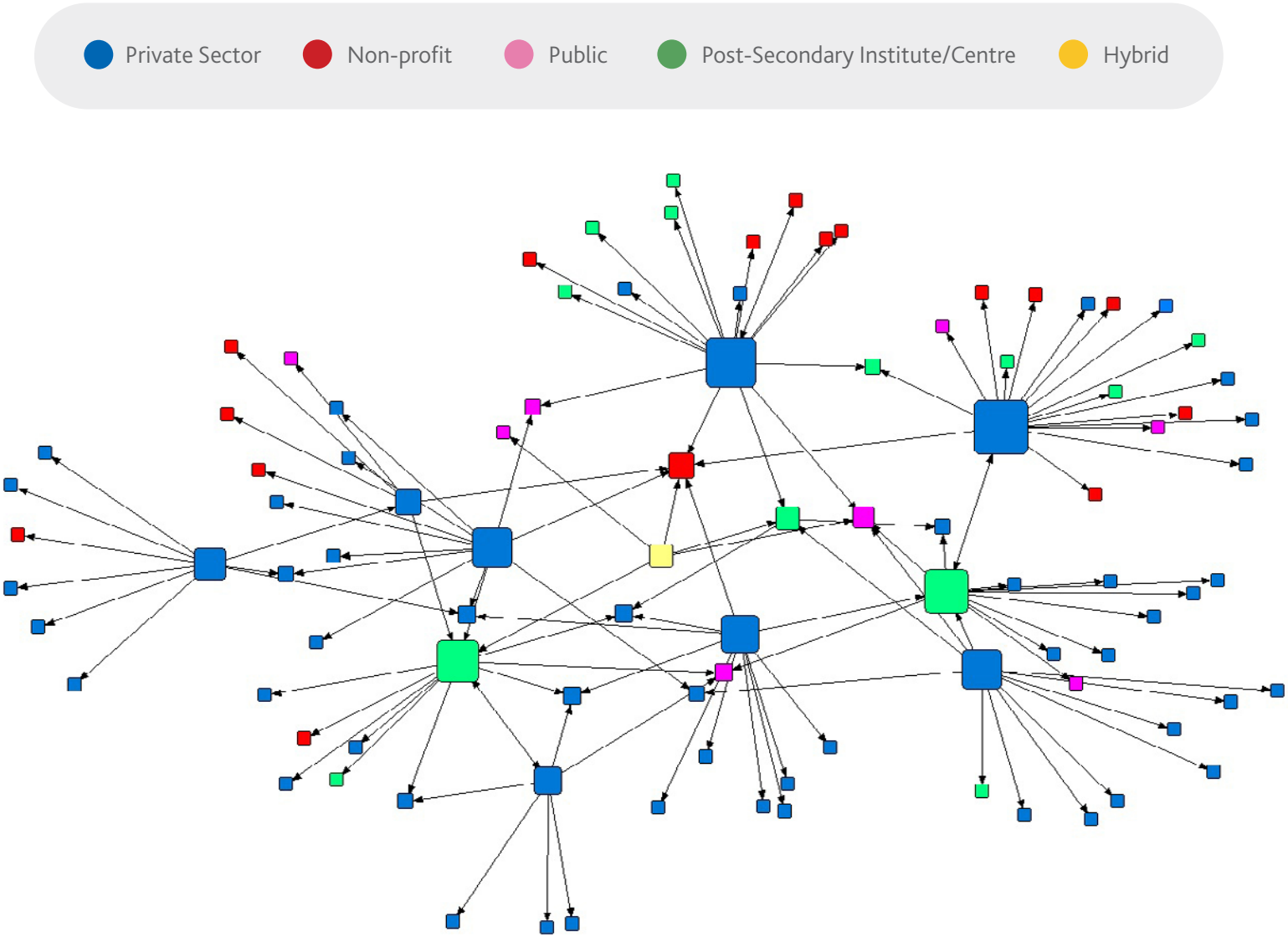


Table 1: Sector of Actors Identified in the All-Links Map

Sector & Map Colour	Number of Actors Identified
Public Sector (Pink)	9
Non-Profit Sector (Red)	16
Private Sector (Blue)	57 (+5 isolates not pictured in map)
Hybrid (Yellow)	1
Post-Secondary Institute/ Centre (Green)	13 (+1 isolate not pictured in map)

To understand the network and its structure, SNA metrics were calculated. Average degree scores indicate the average number of ties each actor has in the network (Borgatti, Everett & Johnson, 2018) and therefore reflect network connectivity. When it comes to the 'all-links' map, the average degree measure is more than one tie for each organization in the network (1.176) but not quite two. All of the individual types of innovation scores are less than one, suggesting low levels of network connectivity. However, this SNA metric also points to opportunities to turn existing single ties into multiple ties with strategic action. A denser network can be created with increased exchanges and opportunities to form relationships between organizations. For example, in many places throughout the map, we see an organization that is linked to only one other organization. To improve the density and connectivity of this network, key organizations (i.e. large squares) could be encouraged to develop activities that provide an opportunity for smaller, peripheral organizations to meet with other organizations, share information and potentially expand their ties.

Centralization (ranging from .000 to 1.000) is another measure used to describe networks and actor domination. Measures that are closer to 1.000 indicate a single actor dominates the network (Borgatti, Everett & Johnson, 2018). Scores across all types of innovation indicate that a single actor does not dominate the network. The innovation type with the highest centralization score is "supporting technology adoption by farmers and businesses" (.197) and it still reflects many actors dominating the network. An organization from the post-secondary sector holds a key position (amongst a small number of organizations) in the network, suggesting that for the few organizations that named an organization in this question, this post-secondary institute was often listed. Interestingly, a lower centralization score is reported for the "all-links" map—reiterating that not just one organization holds a key role in the overall greenhouse network—there are several organizations holding key roles.

Table 2: Social Network Analysis Metrics by Type of Innovation Link

Type of Innovation Link	# of nodes	# of ties	Average Degree	Centralization
All links	**102**	**120**	**1.176**	**0.159**
Supporting or conducting upstream R&D or early-stage research	52	47	0.904	0.128
Validating and prototyping new or improved technologies	52	43	0.827	0.151
Mobilizing or commercializing new or improved technologies	42	30	0.714	0.143
Supporting technology adoption by farmers and businesses	28	15	0.536	0.197
Regulation and safety & technology interoperability standards promotion	28	7	0.250	0.100
Technology interoperability standards promotion	Only one tie reported. Majority of respondents indicated their *"organization has not worked with another organization on technology interoperability standards promotion in the greenhouse technology sector".*			
Facilitating linkages among tech developers and end-users in the network	27	8	0.296	0.100
Policy advocacy on behalf of the network	Only 3 ties reported. Majority of respondents indicated their *"organization has not worked with another organization on policy advocacy on behalf of the network".*			
Public education and public relations on behalf of the network.	31	11	0.355	0.082

In summary, the map of this greenhouse network reveals that many organizations share single ties as there were very few reciprocal ties. Also, tie relationships differ based on innovation type in the greenhouse sector. For example, many organizations share a tie when it comes to "supporting or conducting upstream research and development or early-stage research," while fewer organizations share a tie for the purposes of "facilitating linkages among tech developers and end-users in the network". Additionally, there are several key actors who hold influential positions, meaning the network does not resemble a 'hub and spoke'.

CAVEATS

Caveats with the current SNA portion of this research: First, we began with six main intermediaries identified through an environmental scan. Each received and responded to the survey. However, in two cases, the intermediary respondent indicated they preferred not to answer the question that asked for the names of organizations across all nine types of innovation. Perhaps this was based on the need to protect client confidentiality. However, the other four intermediary respondents did name the organizations with which they worked, so this may not have been a common sentiment. Also, the survey brought to light many other organizations serving intermediary roles; however, they did not receive/complete the survey. These two caveats would negatively impact the number of reciprocal ties in the map. Second, given that we asked respondents to name organizations they had worked with in the previous three years, there is potential for forgotten or incorrect information to be provided.

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A DEEPER DIVE INTO THE GREENHOUSE INNOVATION-DELIVERY ECOSYSTEM:
THE PERCEPTIONS OF ACTORS

The analysis in this section draws on our interview dataset to analyze actors' perceptions of the AIS network structure and the processes intermediaries deploy in their program/service delivery in Southern Ontario's greenhouse innovation ecosystem. Our interviews were conducted between December 2025 and March 2026. We conducted 12 one-on-one interviews over Teams with four private companies and eight entities that perform some or all of the intermediary functions we discussed in the literature review above. The length of the interviews ranged from a half-hour to an hour. We asked nine key questions concerning network actors, functions, programs/services, the process of value creation, and improvement pathways. The rest of this discussion analyzes the data, providing an analysis of core features of the region's greenhouse AIS, with a focus on the roles of intermediaries and an assessment of strengths and weaknesses of delivery systems.

The greenhouse innovation system in Southern Ontario comprises a heterogeneous set of actors spanning public, private, and hybrid domains. Private entities include individual growers and technology firms, who are not only end-users but also often co-creators of innovation. Many are innovation-driven and focused on sustainability, engineering solutions, or niche agricultural applications. They often engage the AIS as industry partners. Growers and processors play vital roles in testing, adoption, and feedback loops. Private technology developers, such as specialized engineering firms and independent consultants, contribute technical expertise that complements institutional knowledge. Industry associations also provide a strong footprint in their role of representing growers and sectors, facilitating collective action and knowledge sharing.

Academic institutions (universities and colleges in the region) feature prominently in their contributions to research capacity, talent development, and infrastructure. In this regard, they not only provide applied research capacity but also serve as anchors within regional innovation ecosystems. Provincial and federal government agencies such as the Ontario Ministry of Agriculture, Food and Agribusiness (OMAFA) and the Federal Economic Development Agency for Southern Ontario (FedDev), respectively, are typically involved in funding, regulating, and providing policy direction within the ecosystem.

Most importantly, the interview data confirms the SNA analysis above in highlighting the absence of a 'hub and spoke' network in which one intermediary would operate at the centre of the ecosystem. Instead, different kinds of organizations are performing intermediary functions. These include publicly funded research centres, not-for-profits, large private enterprises, hybrid public-private entities, and post-secondary institutions. They also include innovation hubs, incubators, and accelerators. What they all share in common is that they act as central coordinators and brokers. These actors collectively form a multi-level, multi-scalar system, spanning local, regional, national, and international linkages in Southern Ontario's greenhouse ecosystem. Given our focus on intermediaries, the rest of the discussion sheds further light on their roles, programs and delivery processes.

Consistent with what we found in the global literature, intermediary organizations in Southern Ontario's greenhouse innovation ecosystem perform several critical functions as connectors, translators, and facilitators within innovation systems that enable innovation uptake: they act as bridges and brokers, connecting firms with research institutions, funding bodies, and partners, thereby reducing coordination failures.

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They also undertake knowledge mobilization, translating scientific research into practical, industry-relevant solutions. Another vital function they perform is risk reduction through pilot projects, test environments, and validation services, which de-risk the adoption of new technologies. They provide funding navigation by helping firms access and align funding sources, an essential service in complex funding environments. Importantly, the intermediaries in Southern Ontario's innovation ecosystem operate through relationship-driven, high-touch engagement models that emphasize trust and long-term collaboration.

The programs and services provided by intermediaries in Southern Ontario's innovation ecosystem are diverse. They include research and development support, such as prototyping, testing, and engineering services tailored to client needs; access to infrastructure such as specialized labs, greenhouses, and manufacturing facilities; incubation and acceleration services through structured programs that help startups refine business models, develop products, and prepare for commercialization; funding navigation and support such as assistance with grant applications, funding strategies, and compliance requirements; workforce development in the form of student internships, apprenticeships, and collaborative research projects; market and network access through trade shows, industry events, and introductions to potential clients or partners; and intellectual property support, offering guidance on IP development, though conflicts and ownership issues are noted challenges. Examples of their programs and services specific to the greenhouse sector include plant breeding, genetics, and crop innovation, vertical farming and LED-based systems.

Intermediaries in Southern Ontario's greenhouse innovation ecosystem achieve their goals by cultivating extensive, diverse networks that span academic institutions, government agencies, industry associations, grower groups, technology firms, startups, and regional economic development organizations. These connections, linking both local clusters and global networks, facilitate knowledge flow, technology transfer, and scaling. Crucially, no single actor or sector dominates. Innovation programs and service-delivery processes depend on ecosystem-level complementarity, with each contributor playing a distinct role across stages of development. Digital technologies also play a vital role in expanding intermediaries' delivery processes and reach across Southern Ontario, enhancing scalability, coordination, and precision. They support integration with adjacent sectors such as manufacturing and software, strengthening cross-sector innovation. Collaboration platforms connect geographically dispersed partners, while data technologies support real-time monitoring, experimentation, and optimization. Online innovation platforms link startups with investors, mentors, and service providers. Digital channels such as webinars, training programs, and virtual networks expand access to knowledge and expertise. Overall, digital technologies increase the efficiency, scalability, and inclusivity of innovation systems while extending engagement beyond geographic constraints.

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STRENGTHS AND CHALLENGES

Intermediaries in Southern Ontario's greenhouse innovation ecosystem show several key strengths. They effectively connect actors across institutional boundaries, draw on strong technical expertise and applied research capacity, and remain responsive to evolving industry needs. Their engagement is built on trust and sustained relationships, supporting knowledge mobilization and commercialization. More broadly, the network benefits from a solid scientific base and a culture of openness among growers to adopt new technologies, alongside strong access to expertise, high engagement, integration of student talent, a practical research orientation, diverse support programs, and an ability to bridge scientific knowledge with market needs.

However, intermediaries and clients alike identified several weaknesses and challenges that continue to limit innovation and growth within the ecosystem. Most notably, organizations rely heavily on government funding, with perennial challenges such as funding instability and limited long-term planning. For instance, participants pointed to declining grant opportunities, uncertain program renewals, and increasing competition for available funding. Several respondents emphasized that the timing of funding for research activities often fails to align with agricultural realities, including seasonal production schedules and biological life cycles. This mismatch can significantly reduce the effectiveness of otherwise valuable support programs. Many intermediaries also argued that existing funding durations are too short to support innovation projects through the critical mid-stage technology readiness levels, creating discontinuities between research and commercialization. A related funding concern was the prevalence of lengthy approval timelines and slow bureaucratic processes of the public sector. These delays affect research partnerships, creating uncertainty that can discourage innovation and slow commercialization.

The dependence on government funding and its attendant challenges is compounded by fragmentation and siloed structures within the ecosystem, which prevent a coordinated effort to properly fund and develop cross-agrifood innovations. As the SNA map in the previous section indicates, the greenhouse innovation ecosystem in Southern Ontario is not a hub-and-spoke network structure with a central intermediary coordinating activities within the ecosystem. Instead, it is a dispersed network with several organizations performing intermediary functions. Many industry participants felt that this systemic fragmentation means that substantial resources are absorbed by intermediary processes rather than reaching innovators directly. Respondents described a system in which resources are often dispersed across multiple programs and organizations, making it difficult for businesses to identify and access the support they need. Resource constraints in staffing and infrastructure, particularly for smaller entities, mean significant administrative burdens as they strive to manage diverse stakeholder expectations. In some cases, innovators reported limited engagement or follow-up despite clear opportunities for collaboration. The resulting perception among interview respondents is that the ecosystem is hampered by limited collaboration among intermediaries. Businesses, researchers, and support programs are often seen as operating independently rather than as part of an integrated innovation system. Research activities are frequently organized around specific crops, institutions, or disciplines, limiting opportunities for knowledge transfer across industries, crops, regions, and stakeholder groups.

A closely related concern that presents yet another challenge for the ecosystem is misalignment between the slower pace of academic research and the relative speed of industry timelines, which operate under the time-is-money principle. Academic researchers are often rewarded for producing rigorous, long-term research outcomes, while businesses require practical solutions that can be implemented quickly. As a result, industry partners in the ecosystem can become frustrated when innovation projects do not progress as quickly as anticipated. This difference in priorities can create friction when aligning project objectives, timelines, and expected deliverables. These misaligned incentives often complicate relationships, especially between startups and research institutions within the ecosystem.

Smaller firms face time and staffing capacity constraints that limit their ability to fully participate in innovation activities, while regulations and institutional protocols add layers of complexity. Network actors report intellectual property (IP) conflicts and regulatory and policy barriers. For instance, post-secondary institutions' IP frameworks are often seen as incompatible with the needs of early-stage companies, particularly when startups need flexibility to rapidly commercialize innovations. Tensions also often arise between institutional policies that encourage publication and knowledge dissemination and industry partners' preference for confidentiality and proprietary ownership. Furthermore, the structure of many funding programs was viewed by industry actors as problematic because resources frequently flow to research institutions rather than directly to innovators. Participants reported that some grants do not allow founders to compensate themselves, creating financial pressures during critical growth stages. Regulatory complexity further complicates the institutional and policy

architecture of the ecosystem in Southern Ontario. Actors must often navigate multiple layers of federal, provincial, and municipal regulations, such as the Greenbelt and Niagara Escarpment policies, local land-use planning frameworks and restrictive zoning regulations. Several respondents also noted the absence of a coordinated national food security and agrifood innovation strategy in Ontario (and in Canada), resulting in fragmented policy interventions and disconnected innovation pathways across levels of government.

Finally, significant inequities and systemic biases in access to resources create uneven opportunities within the ecosystem, preventing some racialized actors from contributing to or benefiting from innovation processes. While there are several large and successful agricultural operations in the network, newcomers and startup founders are not easily connected to resources or opportunities that could support their success. In particular, racialized actors struggle to navigate the ecosystem as they sometimes encounter negative assumptions and prejudices based on appearance. An example from an industry founder is that people in the ecosystem often assume a particular co-founder who happens to be non-Caucasian is a temporary foreign worker rather than a company leader. Interviewees note that discussions about race and bias are often avoided, making it difficult to address the realities faced by diverse entrepreneurs from racialized backgrounds seeking support.

Together, these challenges diminish the overall effectiveness and inclusiveness of innovation networks and reflect a paradox of strong underlying capabilities yet weak coordination and integration, as illustrated by the absence of a hub-and-spoke network in the SNA map above.

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PATHWAYS FOR IMPROVEMENT & POLICY IMPLICATIONS

Improvements to the greenhouse innovation ecosystem in Southern Ontario point to several interconnected priorities that can strengthen its effectiveness and long-term impact. We outline them below.

1 ADDRESS FUNDING INSTABILITY AND IMPROVE INNOVATION FINANCING

- Establish multi-year greenhouse innovation funding streams. Provincial and federal governments should introduce funding programs with five- to seven-year commitments, allowing intermediaries, researchers, and firms to undertake long-term innovation projects with greater certainty. Stable funding horizons would improve strategic planning and reduce disruptions caused by unpredictable grant renewals.
- Align funding cycles with agricultural production realities. Funding application windows, project start dates, and reporting requirements should be synchronized with seasonal growing cycles and biological research timelines. Flexible program delivery would improve project effectiveness and reduce the mismatch between administrative schedules and agricultural operations.
- Create dedicated mid-stage commercialization funding. Governments should develop funding mechanisms specifically targeted at technologies within the mid-range Technology Readiness Levels (TRLs), where many innovations stall between research and market deployment. Such programs could bridge the "valley of death" between proof-of-concept and commercial adoption.
- Accelerate approval and contracting processes. Public-funding agencies should adopt streamlined review procedures, standardized agreements, and expedited approval timelines for collaborative innovation projects. Faster decision-making would reduce uncertainty and allow firms to respond more effectively to market opportunities.
- Expand patient capital and risk-sharing mechanisms. Governments and financial institutions should support sector-specific venture funds, loan guarantees, and innovation investment tax credits that encourage private investment in greenhouse and controlled-environment agriculture technologies.

2 IMPROVE ECOSYSTEM COORDINATION AND REDUCE FRAGMENTATION

- Establish a Greenhouse Innovation Coordination Platform. A dedicated regional coordinating body could bring together the various intermediaries to align their priorities, reduce duplication, and facilitate ecosystem-wide collaboration across crops.
- Develop a one-stop innovation navigation platform. Even if intermediaries continue to operate their distinct programs, a centralized digital platform should provide information on available funding, research expertise, testing facilities, commercialization support, and regulatory guidance. This would reduce search costs and improve access to ecosystem resources for innovators and startups.
- Introduce performance incentives for intermediary collaboration. Funding programs should reward intermediaries for jointly delivering services, sharing resources, and demonstrating measurable collaborative outcomes rather than operating as isolated organizations.
- Support shared infrastructure and service hubs. Governments should invest in regional shared facilities, including demonstration sites, testing centres, digital agriculture infrastructure, and commercialization spaces that can be accessed by multiple organizations rather than duplicated across institutions.
- Fund cross-disciplinary and cross-crop innovation initiatives. New programs should encourage collaboration across commodities, scientific disciplines, and industry sectors to facilitate broader knowledge exchange and reduce innovation silos.

3 BETTER ALIGN ACADEMIC AND INDUSTRY INCENTIVES

- Expand industry-responsive research funding. Governments should create programs requiring co-designed research agendas that balance academic rigour with industry needs and practical timelines.
- Incorporate commercialization metrics into academic evaluation systems. Post-secondary institutions should recognize patent generation, industry collaboration, technology transfer, startup formation, and community impact alongside traditional scholarly outputs.

- Support embedded research models. Programs that place graduate students and researchers directly within greenhouse firms can improve knowledge transfer and strengthen relationships between academia and industry.
- Develop milestone-based collaborative agreements. Research partnerships should establish clear expectations regarding timelines, deliverables, intellectual property, and commercialization goals at the outset of projects.

4 REDUCE FINANCIAL AND COMMERCIALIZATION BARRIERS

- Create commercialization grants directly accessible to startups. Funding programs should permit founders to compensate themselves during critical development stages and provide businesses with greater flexibility in allocating resources.
- Support pilot and demonstration projects. Governments should help offset the costs associated with testing and validating new technologies under commercial greenhouse conditions, reducing adoption risks for producers.
- Encourage procurement-based innovation policies. Public-sector procurement programs could provide early market opportunities for innovative agricultural technologies developed by local firms.

5 REFORM INTELLECTUAL PROPERTY AND COMMERCIALIZATION FRAMEWORKS

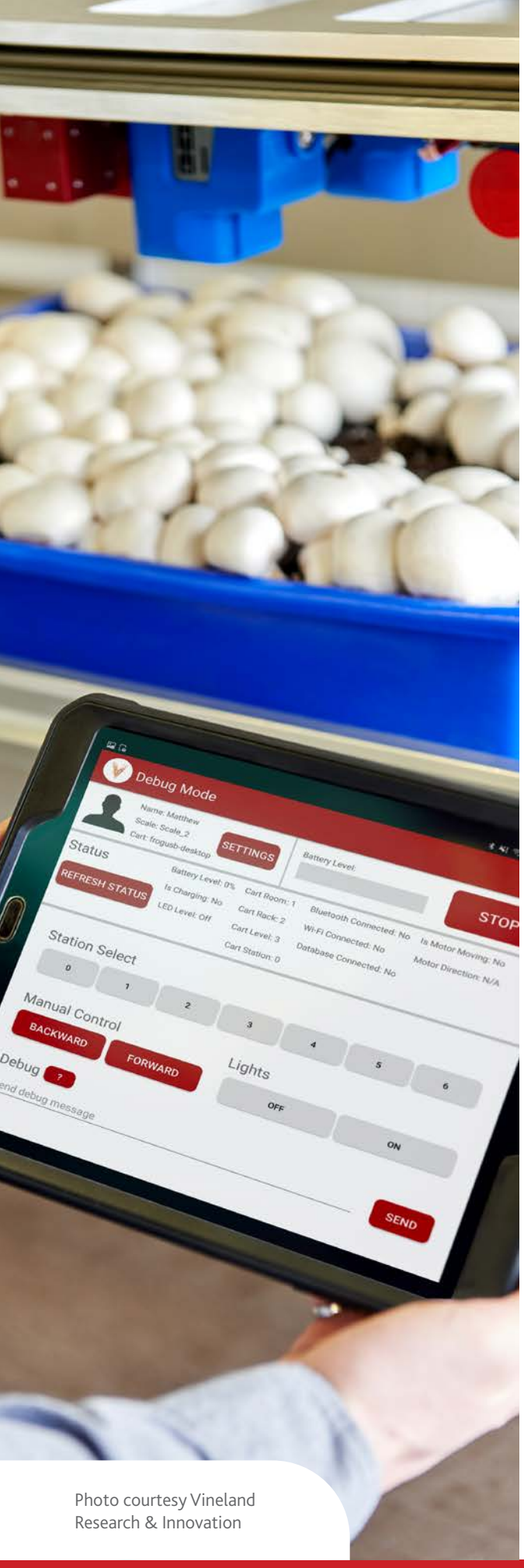
- Develop standardized IP agreements for agrifood partnerships. Provincial and federal agencies could create model agreements to simplify negotiations between research institutions and startups while protecting the interests of both parties.
- Promote flexible IP arrangements. Universities should adopt more adaptable licensing and ownership models that reflect the needs of early-stage firms and facilitate rapid commercialization.
- Support commercialization mediation services. Independent advisory services could help resolve IP disputes and facilitate negotiations between industry and academic partners before conflicts escalate.

6 MODERNIZE REGULATORY AND POLICY ENVIRONMENTS

- Establish regulatory coordination mechanisms. Governments should improve coordination among municipal, provincial, and federal regulators to reduce duplication and improve regulatory clarity for greenhouse innovators.
- Review land-use and zoning frameworks. Provincial and municipal governments should evaluate whether existing planning regulations unnecessarily restrict greenhouse expansion, agritech facilities, and innovation infrastructure.
- Develop a national agrifood innovation and food security strategy. A coordinated national strategy could align federal and provincial objectives, improve funding coherence, and provide long-term direction for the sector.

7 PROMOTE EQUITY, INCLUSION, AND NETWORK ACCESS

- Create targeted entrepreneurship support for racialized innovators. Dedicated mentorship, accelerator programs, and funding opportunities can help address barriers faced by underrepresented entrepreneurs.
- Expand network-building initiatives for newcomers and startups. Structured networking programs should connect emerging entrepreneurs with established industry leaders, investors, researchers, and government agencies.
- Require equity and inclusion practices in publicly funded programs. Organizations receiving public funding should demonstrate efforts to improve access, representation, and participation among underrepresented groups.
- Support bias-awareness and inclusion training. Ecosystem organizations should receive training to address unconscious bias, improve cultural competency, and foster more inclusive innovation environments.
- Collect and monitor diversity data. Governments and intermediaries should track participation patterns across innovation programs to identify inequities and inform evidence-based policy interventions.



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CONCLUSION

Our exploratory case study and the broader literature have highlighted several policy implications as outlined above. AIS, as a conceptual lens, provides a compelling framework for understanding the nature, strengths, and challenges of innovation service/program delivery processes that emerge within complex network structures comprising diverse actors. Intermediaries play a central role in orchestrating these interactions, while governments, universities, and industry contribute complementary functions. AIS are dynamic systems shaped by evolving technologies, institutional arrangements, and societal goals. Their effectiveness depends on the quality of collaboration, the alignment of incentives, and the capacity to adapt to changing conditions.

Given that our case study reveals an ecosystem with strong capabilities but weak coordination, the most important overarching policy implication and recommendation is to establish a network governance framework anchored by a coordinating platform. Such a platform would not replace existing intermediaries but would serve as a network orchestrator, aligning funding, facilitating collaboration, reducing duplication and rivalry, improving inclusion, and creating a more integrated innovation system. Future research should further explore the governance of AIS beyond our exploratory case study, particularly the role of intermediaries as agents of coordination and transformation beyond the greenhouse sector and in other regions of the country. A comparative study consisting of several cases across Canada can shed further light on how these systems can balance complexity, inclusivity, and coordination to address agriculture and food systems challenges in Canada and worldwide.

To conclude, the innovation ecosystem in Southern Ontario's greenhouse sector is a complex, multi-actor network in which intermediary organizations play a central role. It bridges gaps between research and commercialization, reduces risk, and enables collaboration. However, the evidence from our network analysis (SNA) indicates the lack of a central convenor that can orchestrate collective action within the network. Instead, a constellation of intermediaries from the public, private and nonprofit sectors play diverse roles as connectors, translators, and enablers, attempting to bridge gaps between research, industry, and policy. Our interviews reveal that although the network demonstrates strong technical capacity in supporting innovation adoption, actors operate within systems that remain fragmented and constrained by funding, institutional, and cultural barriers that reveal a more fragmented and competitive environment than cooperative. Improving these systems requires structural reform for greater coordination and a stronger emphasis on commercialization. With these changes, intermediary organizations can more effectively support innovation networks in realizing their mission to drive technological advancement, economic growth, environmental stewardship and food system resilience.

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