

GREAT LAKES ST. LAWRENCE

SUSTAINABLE AGRICULTURE RESEARCH AGENDA

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GOVERNORS
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CHAIR'S WELCOME

On behalf of the eight States and two Provinces of the Conference of Great Lakes and St. Lawrence Governors and Premiers (GSGP), I'm pleased to share our 2026 Sustainable Agriculture Research Agenda.

The Great Lakes St. Lawrence region boasts incredible natural and human resources, supporting a \$9.3 trillion (US) economy. The food, agriculture, and forestry sector is central to the region's economy and cultural identity, and I'm proud to lead GSGP's newest effort to ensure the sector's prosperity well into the future: the Great Lakes St. Lawrence Sustainable Agriculture Initiative (Initiative).

The Initiative's mission is to foster sustainable agriculture in the region, strengthen the region's agriculture economy, and increase resilience and food security. In the face of trade barriers, fluctuating policy landscapes, and increasingly difficult weather conditions, this work requires unprecedented regional partnership and collaboration to foster innovative and resilient solutions in agriculture. Thanks to the adoption of the Initiative in October 2025, the GSGP States and Provinces are rising to the challenge.

The Initiative's first step was to identify the information needed to achieve our goals. In a few short months, the States and Provinces have come together to collaboratively develop a set of shared research priorities for agricultural sustainability at a regional scale. This Sustainable Agriculture Research Agenda (Agenda), which you'll read in this publication, introduces a set of joint challenges and needs among GSGP partners that informs and identifies the work that lies ahead. The challenges are formidable, representing some of the most wicked problems for addressing agricultural sustainability among the States and Provinces. But, by undertaking a deep assessment of the issues and drawing from a wealth of knowledge and experience, this group has illuminated a path forward with five priority research areas. By prioritizing these topics, GSGP is setting the stage to improve farm sustainability, increase access to fresh and healthy products, and accelerate innovation and resiliency in our regional food system.

The Initiative is just getting started, but this Agenda already demonstrates the potential of collaboration among the Great Lakes St. Lawrence States and Provinces. I'm proud of the work done by our team so far, and I look forward to the progress we'll continue to make for sustainable agriculture in our region.



Dr. Tim Boring is Director of the Michigan Department of Agriculture and Rural Development and Chair of the GSGP Sustainable Agriculture Initiative.



CONTEXT

The Great Lakes St. Lawrence region is home to more than 110 million people, a \$9.3 trillion (US) regional economy, and abundant natural resources including water, forests, and fertile soils. This region also supports one of North America’s most rich and diverse agricultural sectors, making the eight States and two Provinces uniquely positioned to be a center for innovative and collaborative solutions to address the challenges currently facing the agricultural industry.

As in other parts of North America, the Great Lakes St. Lawrence region’s agricultural industry faces increasing risks to operate because of less predictable and more extreme weather, rising production costs, uncertain international markets, an aging farming population, loss of available farmland, and decreased labor availability (Tremblay, 2025; Nature United, 2024). These risks are exacerbated for beginning farmers who face barriers to enter the industry, such as high cost of land and equipment and limited access to capital, technical assistance, and critical infrastructure (Benson, 2024). Meaningful solutions to these risks require a unified, regional response.

Regional Sustainable Agriculture Initiative

The Great Lakes St. Lawrence Sustainable Agriculture Initiative (Initiative), led by the Conference of Great Lakes St. Lawrence Governors and Premiers (GSGP), was launched in 2025 following the adoption of a resolution¹ by the eight U.S. Governors and

two Canadian Premiers. The Initiative advances sustainable agriculture across the region’s States and Provinces, strengthens the agricultural economy, and increases resilience and food security. As described in the resolution, “...sustainable agriculture should create social benefits such as a robust and resilient economy, healthier people, and environmental benefits including improved soil health, water quality, and water management.”

Economic, environmental, and social competitive advantages are within reach for the Great Lakes St. Lawrence region by leveraging our unique natural resources and productive agricultural capacity to better develop higher value sustainable agricultural systems that feeds people, expands economic opportunities, and sustains the region’s resources. Achieving this vision requires purposeful action and investments to capture these opportunities for long-term regional competitiveness.

GSGP is taking steps to leverage the expertise of member States and Provinces toward a shared strategic plan for agricultural sustainability and long-term competitiveness. The Initiative will catalyze innovation in the agricultural sector by offering new opportunities for cooperation and resource-sharing among GSGP member States and Provinces. Through coordinated investments in regional agriculture, Great Lakes States and Provinces stand together to sustain the industry, grow the economy, and improve quality of life in the region.

¹ October 6, 2025, Resolution creating the Great Lakes St. Lawrence Sustainable Agriculture Initiative: <https://gsgp.org/media/w2gfsovk/sustainable-ag-resolution.pdf>

Sustainable Agriculture Research Agenda

Unified strategic planning begins with a shared set of information needs and research priorities conceptualized in this Great Lakes St. Lawrence Sustainable Agriculture Research Agenda (Agenda).

The purpose of the Agenda is to establish the select information needs and research priorities identified by GSGP member States and Provinces which require collaboration across administrative and institutional boundaries in the Great Lakes St. Lawrence region. Addressing these needs and priorities would help inform regional policies, program designs, and investment decisions toward sustainable agriculture. By aligning priorities across jurisdictions; harmonizing approaches to data, monitoring, and metrics; and highlighting models with potential for regional replication, the Research Agenda aims to advance sustainable agriculture, economic resilience, and food security on a regional scale.

To develop the Agenda, a Research Committee composed of representatives from each of GSGP’s member State and Provincial Departments/Ministries of Agriculture first identified challenges impacting the region’s agricultural industry and the actions needed to properly address the challenges. The Committee then developed research themes and priority areas associated with the challenges and solutions, ensuring research efforts are tied directly to current needs. The challenges, needs, and priority research areas were then vetted through stakeholder engagement, including an in-person gathering of the Committee and external stakeholders.

The purpose of the Agenda is to establish the select information needs and research priorities identified by GSGP member States and Provinces which require collaboration across administrative and institutional boundaries in the Great Lakes St. Lawrence region.



The cross-cutting and inter-jurisdictional nature of the challenges, needs, and priority research areas demands collaboration and a collective intent from the Great Lakes regional partners. The Research Agenda is the first building block in a multi-phase, multi-stakeholder process that will not only develop shared solutions for sustainable agriculture but will also facilitate a regional culture of collaboration in the agricultural space among government institutions, policy makers, growers, academia, industry, and agricultural sustainability advocates. In addition to addressing fundamental questions about regionally shared problems and solutions, this integrated effort will result in more robust and durable Initiative outcomes.

This document does not commit new funding but rather provides a coordinated framework to guide research, collaboration, and decision-making across the Great Lakes St. Lawrence region.

A chart comparing the identified Priority Research Areas (columns) with regional Challenges & Needs (rows).

	Support Technological Innovation & Crop Diversification	Build Resilient and Transparent Supply Chains	Assess the Effectiveness of Conservation Practices and Programs	Determine Social, Behavioral, and Economic Drivers of Producer Adoption	Develop Strategies to Address Contaminants of Emerging Concern
Access to Land, Labor, and Capital	✓	✓		✓	
Behavioral Trends	✓	✓	✓	✓	
Varied Metrics and Monitoring	✓	✓	✓	✓	✓
Environmental Stressors and Emerging Risks	✓	✓	✓	✓	✓



CHALLENGES & NEEDS

Producers in the Great Lakes St. Lawrence region face several barriers that threaten their ability to operate efficiently and profitably. This section provides insight into the needs and challenges that, if addressed, will support the implementation of sustainable agriculture strategies throughout the region. Primary challenges include access to land, labor, and capital; varied metrics and monitoring; behavioral trends; and environmental risks.

1. Access to Land, Labor, and Capital

Agricultural production is land, labor, and capital intensive, and limited access to these resources presents a significant challenge to many producers in the Great Lakes St. Lawrence region. Consolidation of farmland and competing land use pressures are limiting available agricultural lands (MacDonald, 2020; Xie et al., 2023). Labor costs increase year over year, and sustainable management practices tend to require more labor (Carlisle et al., 2019). The costs of new equipment and on-farm infrastructure also continue to rise, along with interest rates for operating loans (Mills & Kim, 2026).

1.1 Operating costs

Changes in economic policies, land use, climate, and markets have increased the cost to operate and made it difficult for producers to gain and maintain access to resources essential to their agricultural operations. Operating costs include those related to purchasing or leasing land, hiring labor, purchasing inputs, and purchasing or repairing equipment. These increased

costs have an outsized impact on smaller and mid-sized farms, resulting in the consolidation of farmland into fewer, larger operations. Larger agricultural operations can leverage their size to outbid smaller producers for access to land, more efficient equipment, new technologies, and bulk fuel. Innovative approaches to reducing operating costs are needed to ensure economic sustainability of farms.

1.2 Successional planning and labor availability

Producers in the Great Lakes St. Lawrence Region averaged 56.4 years old in 2022 (Community Indicators Consortium, 2024; USDA NASS, 2022). There is a need for dedicated resources that connect prospective young producers with agricultural operations to facilitate succession planning for retiring producers. Such plans require education and experience through hands-on training, mentorship, and a pathway to asset ownership. Ideally, prospective producers would receive no/low-cost training or nominal stipends while receiving this training to incentivize succession planning and reduce barriers to entry.

1.3 Access and proximity to domestic markets

Access to markets for agricultural products is a primary component of economic viability for agriculture in the Great Lakes St. Lawrence region. Producers in the region often struggle to access niche, domestic markets and face uncertain international markets, which creates hesitance to adopt new practices and grow or sustain the current operation. Solving logistical

challenges, such as transportation costs; infrastructure, manufacturing, and processing limitations; and regional disparities in market demand would improve competitiveness and profitability for agricultural systems. Assistance connecting niche commodities and products to market would increase the likelihood that novel or alternative crops will be grown in a given area.

1.4 Policy and regulatory barriers

Complex and evolving policy frameworks can also impose significant compliance obligations resulting in additional costs and administrative complexity. Regulatory requirements should consider or even include technical or financial support to ensure producers can maintain flexibility while maintaining compliance. Further, changes in non-agricultural policy, such as limiting access to temporary workers, would ideally consider impacts on agricultural business sustainability, especially for smaller operations.

1.5. Cost of new technology, automation, and infrastructure

Although technological innovations offer opportunities for efficiency and productivity gains, the cost of adopting new technologies—such as automation, [precision agriculture](#) tools, and modern infrastructure—remains prohibitive for many smaller operations. Additionally, these modern farming practices often rely on reliable broadband internet access, but many rural areas still lack adequate access to the internet. Investments in new technology and expanding broadband to rural areas will bridge this digital divide to expand innovation and competitiveness for rural operations.

2. Behavioral Trends

In the food system, the choices that producers and consumers make are influenced by several internal (e.g., attitudes, values, demographics) and external (e.g., access, availability, quality) factors

(Kostadinova, 2016). While values and attitudes can play an important role in decision making, production cost and purchase price remain the primary drivers of producer and consumer behavior. For example, although consumers signal an increasing interest in sustainably produced goods and food products, the higher prices of those products limit their uptake in the market (Aschemann-Witzel & Zielke, 2017). From an economic perspective, increasing the implementation of sustainable agricultural practices requires a shift in production costs and/or in consumer prices. However, those producers and consumers who prioritize sustainable production demonstrate that values and attitudes can overcome cost and price signals. A multi-

pronged approach is required to address the challenges of supply, demand, and price/cost sensitivity in the food system.

2.1 Consumer price barriers

Cost has a strong influence on what consumers choose to buy at the grocery store. Sustainably sourced food products are often more expensive than conventional alternatives, and affordability outcompetes sustainability for most shoppers (Pankratz et al., 2022). Additionally, American and Canadian consumers are faced with an affordability crisis

and are, on average, becoming less able to afford more expensive options (Statistics Canada, 2024; Urban Institute, 2025). There is a need to improve the affordability of sustainably sourced food products to place them within reach of average consumers and to help them become cost-competitive with conventional products.

2.2 Producer cost barriers

Like consumers, producer behavior is influenced by several factors, with farm economics playing a prominent role (Liu et al., 2018). High upfront costs of transitioning to sustainable or diversified production

Changes in economic policies, land use, climate, and markets have increased the cost to operate and made it difficult for producers to gain and maintain access to resources essential to their agricultural operations.



systems and uncertain financial returns of sustainable practices limit producers' capacity to make changes to their operation. In the face of rising debt and interest rates, taking on additional costs is out of reach for many producers (AEI, 2025; USDA ERS, 2026). For those who do transition, the market for sustainably grown products is more limited than the conventional market because of lower or more nuanced consumer demand. As business owners, many producers respond to the market signals that promise the highest profits. Without making the business case for sustainable agriculture, many producers will not move away from the status quo. Strategies are needed to reduce the cost and risk of transitioning to sustainable agricultural practices.

While values and attitudes can play an important role in decision making, production cost and purchase price remain the primary drivers of producer and consumer behavior.



for both consumers and producers. As of 2025, the number of Americans who pay attention to food labels is increasing, and yet only 16% find labeling trustworthy (NSF, 2025). Additionally, producers receive information from a multitude of sources and frequently trust private sector sources adjacent to the

farm operation, such as input suppliers, over other resources that align more closely with consumer sentiments (Stuart et al., 2018). Enhanced trust and transparency in the food system would boost the success of sustainably sourced food product marketing.

3. Varied Metrics and Monitoring

Sustainable agricultural programs include a wide range of initiatives administered

by Federal, State, Provincial, or local governments; agricultural organizations; non-profit organizations; and industry. These programs are typically designed to help producers improve both crop stability and environmental sustainability, and they often provide financial or technical assistance to encourage producer adoption of conservation practices. Varied approaches to collecting data and administering sustainable agricultural programs, due to programmatic practices, institutional norms, and capacity for monitoring and evaluation, can make comparison of success across multiple jurisdictions challenging. Additionally, jurisdictions are reliant upon complex modeling approaches with varying or unverified accuracy as an alternative to the high costs of monitoring efforts.

3.1 Regional metrics and analysis

The cost and complexity of conservation programs and agricultural management systems pose challenges for consistent data collection, monitoring, and reporting of outcomes. There is a need to develop cost-effective methods to measure, monitor, and

2.3 Outreach and engagement

While costs and prices have a strong influence on the behavior of producers and consumers in the food system, there is increasing evidence that non-financial factors may play an equal role in decision making (Huber et al., 2024; Swart et al., 2023). Improved outreach and engagement to influence values and attitudes toward sustainable agriculture may help to secure a broader market for industry. That said, the attitude-behavior gap is well-documented in the sustainable consumer behavior literature (e.g., Borges-Tiago et al., 2024), and outreach and engagement efforts should be designed to bridge that gap for real-world impact.

2.4 Trust and transparency in the food system

In the current United States and Canadian food systems, consumers and producers are typically separated by long and complex supply chains (Dorneich et al., 2023; Truong et al., 2021). Trust in the food system has degraded because of this separation, exacerbated by a lack of transparency

model environmental impacts across the whole-farm system while addressing producers' data privacy concerns. Similarly, jurisdictional programmatic monitoring efforts vary, which results in non-standard data collection and analysis, complicating a regional approach to agricultural sustainability. Efforts to harmonize data collection protocols, monitoring, and reporting methods are needed to ensure regional compatibility while accommodating local variability and diversity.

3.2 Accuracy of data collection

Data collection remains a challenge for sustainable agriculture at a regional scale; it is not feasible to monitor and evaluate every subfield-level interaction between agriculture and the environment. Complete data collection is resource-intensive (e.g., time, cost, labor), and generates privacy concerns from producers, so strategies exist to gather incomplete data and use it to inform sustainable management decisions. Common approaches to data collection include producer reported data, soil mapping, USDA long-term agroecosystem research (LTAR) stations research, U.S. Geological Survey and Geological Survey of Canada gauge stations, on-farm research projects, and remote sensing.

The data from these sources are used in modeling techniques, which estimate the outcomes and impacts of agricultural practices with varying complexity and accuracy. Data collected with more spatial-temporal accuracy may improve model performance and provide insights into sustainability approaches missed by more generalized data collection efforts. However, while localized data is useful, it can be a challenge to use it to explain what is happening across a larger region. Innovative, collaborative data collection methods data collection methods need to be developed to facilitate a

Efforts to harmonize data collection protocols, monitoring, and reporting methods are needed to ensure regional compatibility while accommodating local variability and diversity.



regional approach to sustainable agriculture.

3.3 Long-term monitoring programs

Some outcomes and landscape changes created by agricultural management practices take several years to be detected, and thus require a long-term, multi-year monitoring approach to fully understand the benefits or consequences (Betanzo et al., 2015). This lag can be a challenge as funding, staff availability, institutional commitment, and other factors can fluctuate and hamper the success of a multi-year project. Strategies are needed to secure project implementation and monitoring against changes in resources and other external factors.

4. Environmental Stressors and Emerging Risks

A growing number of environmental stressors is placing pressure on regional agricultural systems, ecosystems, and communities. Extreme weather events (e.g., intense precipitation, flooding, drought, wildfires, severe storms/wind, heat waves), contaminants of emerging concern (e.g., PFAS, nanoplastics), and deteriorating biodiversity, soil health, and water quality are threatening the function and productivity of agricultural systems. At the same time, invasive species and plant and animal pathogens continue to spread, compounding existing vulnerabilities. Together, these interconnected threats highlight the need for coordinated, proactive strategies to safeguard environmental and economic well-being.

4.1 Soil health and water quality

Soil health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans, and connects agricultural and soil science to policy, stakeholder needs and sustainable

supply-chain management (Lehmann et al., 2020). Soil biodiversity plays a key role in the ability for soils to support agriculture, as the microbial component of the soil is responsible for facilitating critical nutrient cycles, including those of carbon, nitrogen, and phosphorus (Robertson & Groffman, 2024). While pesticides and other agricultural chemicals can often improve productivity and reduce losses in cropping systems, their overuse results in significant impacts to microbial ecology and water quality, as well as human and animal health (Aktar et al., 2009; Daisley et al., 2022). Increased understanding of how to refine and reduce the input of pesticides and fertilizers (e.g., [integrated pest management](#), [precision nutrient management](#)) is needed to help protect soil health and improve water quality. A successful approach would also aim to integrate [agroecological](#) management approaches into mainstream agricultural production.

4.2 Extreme weather events

In the Great Lakes St. Lawrence region, extreme weather events have increased since 1951 and are projected to further increase by mid-century (GLISA, 2024). In 2024 alone, U.S. farmers lost \$20.3 billion in damages due to extreme weather, and the bulk of national losses resulted from either heat and drought or excess precipitation and flooding (Munch, 2025). Mitigating the impacts of precipitation variation and uncertainty is a critical challenge to the Great Lakes region, where rainfall is expected to decrease in the summer months and increase in fall and spring (GLISA, 2024). In addition to on-farm impacts of extreme weather and precipitation variability, heavy rains in the spring exacerbate nutrient loading into the Great Lakes and St. Lawrence River, accelerating [eutrophication](#) and creating optimal conditions for harmful algal blooms (HABs) (Larsen et al., 2020). Research is needed to identify novel approaches that increase on-farm resilience to drought and flood conditions that can also mitigate nutrient and sediment runoff.

4.3 Spread of pests, invasive species, and pathogens

The spread of pests, invasive species, and pathogens is detrimental to the agricultural and ecological

functioning of the Great Lakes St Lawrence region. Pests pose a significant regional threat to food security and farm/greenhouse economic viability. For example, in 2016, estimated production losses to pepper weevil in Ontario were between \$67-\$80 million (CAN) (Chiu, 2020). Crop losses to the spotted wing drosophila that was first detected in 2010 and is now established in all Ontario fruit growing regions could be as high as 80-100% if susceptible crops are left untreated (Collège Boréal, 2025). Additional threats to agriculture in the region include the reemergence of the New World screwworm in North America (Valdez-Espinoza et al., 2025), spotted lanternfly (USDA APHIS, 2026), and others. A coordinated strategy to mitigate the spread of these organisms and prevent the introduction of new threats is needed throughout the region.

4.4 Contaminants of Emerging Concern

Contaminants of Emerging Concern (CECs) are pollutants that have been found in the environment that may impact human or ecological health, but often the health risk they pose is not fully understood (Wang et al., 2024). As a result, they are frequently not regulated under current environmental laws (Zhao et al., 2025). Priority agricultural CECs are typically those that can potentially impact the health of plants, crops, or animals; those that may enter the environment from agricultural inputs (e.g., from fertilizers and pesticides); or those that enter the food supply providing an additional exposure route for humans. Examples of CECs that may impact agriculture or pose a health risk from within the food system include per- and polyfluoroalkyl substances (PFAS), such as PFOS and PFOA, micro- and nanoplastics, and pharmaceuticals (Carter et al., 2026). Strategies are needed to address CECs at a regional level. Regional coordination to identify and manage current or potential CECs is needed to leverage expertise and financial resources to enable a rapid response that is protective of human and ecosystem health.



PRIORITY RESEARCH AREAS

This section briefly describes the priority research areas identified by the Great Lakes St. Lawrence State and Provincial Departments/Ministries of Agriculture, including specific research priorities by the Departments and Ministries with input from regional stakeholders.

I. Support Technological Innovation and Crop Diversification

Innovation and diversification are foundational to advancing sustainable agriculture and ensuring long-term food security. Innovation in the development of precision farming tools and circular and [regenerative practices](#) can optimize resource use while minimizing environmental impacts. These advancements help producers adapt to changing extreme weather, reduce greenhouse gas emissions, manage inputs, and improve soil and water health (Rosária et al., 2022). Innovation of digital tools can foster and improve real-time data analytics, remote sensing, and blockchain for traceability, which enhance efficiency and transparency across agricultural supply chains. Innovations, such as precision nutrient management and yield stability analyses, may also reduce input costs and increase the feasibility of crop diversification, leading to more profitable operations (Basso et al., 2025).

Crop diversification is equally critical for building resilience within farming systems. By expanding crop rotations and integrating livestock into their operation, producers can reduce dependency on single commodities, mitigate risks from pests and

diseases, and improve soil health through crop rotation and cover cropping (Redlich et al., 2018). Diversified cropping systems support biodiversity, enhance ecosystem services, and reduce reliance on synthetic inputs, contributing to both environmental sustainability and economic stability (Wood et al., 2015). Additionally, diversification creates opportunities for producers to consider other market opportunities (i.e., for value-added products and niche markets), which creates higher returns on investment and adaptability to evolving consumer preferences for diverse, local, and sustainably produced foods (Archer et al., 2018). This priority research area includes the following themes:

- Expand agronomic research to facilitate diversification of novel crops and related food processing systems;
- Innovation of sustainable solutions for commonly grown crops (e.g., precision nutrient management), including risk management programs to support adoption;
- Use life-cycle analyses of agricultural products to minimize waste, reduce greenhouse gas emissions, and move toward a more circular bioeconomy with sufficient return on investment for producers;
- Investigate business or operating models that improve the likelihood and success of diversification.

2. Build Resilient and Transparent Supply Chains

Building resilient and transparent supply chains is critical for the Great Lakes St. Lawrence region's agricultural operations, which supports food security; strengthens local, regional and national economies; and provides environmental goods and services. Resilient supply chains minimize the impact of disruptions (e.g., natural disasters, pandemics) on producers and consumers by addressing vulnerabilities and enabling systems to adapt quickly to maintain operations (Krantz et al., 2024). As seen during the COVID-19 pandemic, supply chain disruptions create uncertainty for both producers and consumers (Weersink et al., 2021).

Transparency enhances trust among consumers, regulators, and stakeholders through improved traceability, accountability, and equitable access to capital and markets (Kraft et al., 2022). Market research on consumer behavior can inform producer decision-making by identifying emerging or niche markets, including opportunities related to livestock and crop varieties. Similarly, industry can work to improve the sustainability and transparency of existing supply chains.

Industry signals suggest that over the next decade, more global markets will shift from voluntary monitoring to mandatory enforcement of sustainability targets (World Economic Forum, 2024). These requirements may include emissions reporting, traceability, packaging, waste reduction, and responsible sourcing. Supporting producers in meeting evolving expectations will help maintain their market access and profitability while advancing broader sustainability goals.

Together, resiliency and transparency enable the Great Lakes St. Lawrence agricultural sector to adapt to emerging risks, support farms of all sizes and foster

sustainable growth in one of North America's most important agricultural regions. This priority research area includes the following themes:

- Develop advanced traceability systems, including data interoperability standards for farm-to-market tracking and methods for real-time monitoring of product movement and quality;
- Develop predictive models to help producers prepare for climatic and economic disruptions, including:
 - Predictive analytics and tools for climate-related disruptions and extreme weather events,
 - Modeling impact of economic shocks on supply chains;
- Analyze agricultural business frameworks, including:
 - Cooperative structures and related marketing systems and shared infrastructure;
 - Public-private partnership structures that enhance food system resilience;
- Evaluate regulations and policies that impact supply chain resilience and transparency;
- Identify market trends and opportunities for current crops and novel crops, including those that are certified [organic](#), [non-GMO](#), and/or [ethically sourced](#) and the impact on producer operations;
- Assess supply chain infrastructure gaps that prohibit producer participation in new or existing markets (e.g., specialty processing infrastructure).

3. Assess the Effectiveness of Conservation Practices and Programs

Evaluating the effectiveness of conservation practice systems—and the programs that support producers' implementation and adoption—is a regional priority. Consistent participation in State- and Province-led sustainable agricultural programs² across the region

² For example, see:

MI: Michigan Agricultural Environmental Assurance Program (MAEAP) (<https://www.michigan.gov/mdard/environment/maeap>)

MN: Reinvest in Minnesota (RIM) Reserve (<https://bwsr.state.mn.us/reinvest-minnesota-overview>)

OH: H2Ohio Program (<https://h2.ohio.gov/about-h2ohio>)

ON: Lake Erie Agriculture Demonstrating Sustainability (LEADS) (<https://news.ontario.ca/en/release/1000989/governments-improving-water-quality-and-farming-around-lake-erie>)

indicates ongoing demand for practice-adoption assistance.

Traditionally, the effectiveness of conservation practice systems is assessed using environmental modeling since it enables landscape-scale evaluation of practice performance. However, environmental models are constrained by the complexity of natural systems, data limitations, and challenges in scaling farm-level outcomes to watershed and regional assessments (Koldasbayeva et al., 2024).

Addressing these limitations will require expanded research on conservation practice effectiveness to strengthen measurement, monitoring, and verification of environmental outcomes. Given the region's scale and heterogeneity in soils, topography, weather conditions, commodities, and specialty crops, research and field trials should be responsive to local conditions while using consistent baseline metrics to quantify and report practice-system impacts across the Great Lakes St. Lawrence region.

Across the region, State and Provincial programs provide financial and technical assistance to encourage adoption of environmentally sustainable practices. Program reporting typically focuses on participation and implementation metrics (e.g., number of producers enrolled, practices installed, acres treated, funds invested) and sometimes includes modeled estimates of environmental impact (e.g., pollutant-load reductions). Direct measurement and monitoring of project outcomes are less commonly conducted or reported, largely due to cost and complexity. For example, assessing water quality outcomes of conservation practices requires a watershed-scale approach that accounts for off-farm sediment and nutrient sources (e.g., streambank erosion) as well as the effects of extreme weather. This priority research area includes the following themes:

- Improve environmental models that account for the complexity of natural systems, changing climate and extreme weather conditions, limited datasets, scalability, and regional differences;
- Assess cost-effectiveness and implementation



of measurement and monitoring strategies across the region to better quantify the benefits of conservation practices;

- Investigate the effectiveness of conservation practices considering environmental stressors (e.g., changing climate, extreme weather, invasive species, CEC), soil type, and/or concurrent practices.
- Analysis of traditional incentive-based conservation programs (e.g., pay-for-practice) versus innovative outcomes-based conservation programs (e.g., pay-for-performance; pay-for-outcome).

4. Determine Social, Behavioral, and Economic Drivers of Producer Adoption of Sustainable Practices

Producers' decisions about which sustainable practices to adopt are influenced by numerous social and economic circumstances (Drescher et al., 2024; Varyvoda et al., 2025). A better understanding of the role each of these factors plays in the uptake of programs and the application of practices would support the advancement of sustainable agriculture across the region.

Research has shown that peer-to-peer knowledge sharing among farmers is an effective method for farmers to adapt to a wide range of operational challenges (White et al., 2023). In the Great Lakes St. Lawrence region, characterizing the association between practice adoption and peer network influence would inform regional planning efforts for greater program impact and more efficient use of resources.

In addition to understanding the economic drivers of behavior, the region would benefit from analyses of policy- and business-derived economic conditions and their impact on farmer behavior. Estimating regional impacts of policy alternatives to the status quo (e.g., Eubanks, 2013) would help develop a clear picture of the policy options available to reach sustainable agriculture goals. Additionally, assessing the role of landlord-tenant agreements (e.g., Huffman &

Fukunaga, 2008) and the effects of agribusiness (e.g., input providers) on farmer decisions in the region would provide crucial context for program goals.

More generally, barriers to adopting sustainable practices, including economic constraints, limited market access, access to equipment and technology, labor shortages, and knowledge gaps, require additional study. High upfront costs of transitioning to sustainable production systems, risks, and uncertain financial returns of sustainable practices also limit adoption.

Additionally, this theme would also benefit from more translation of research findings for government decision-makers to support future agri-environmental programming to accelerate adoption and outcomes achieved (e.g., improving outreach and communication). This priority research area includes the following themes:

- Assess successful peer learning networks to better understand producer behavior change and what is needed to scale up these changes across the region;
- Analyze policies and regulations, including the extent to which government regulation either incentivizes or impedes adoption of practices;
- Analyze the role of other participants in the agri-food system which involves the influence of non-operating landowners (i.e., landlords) and private agribusiness stakeholders; and
- Develop cost-share models that reduce/spread the cost burden for sustainable agricultural practices across the supply chain.

5. Develop Strategies to Address Contaminants of Emerging Concern

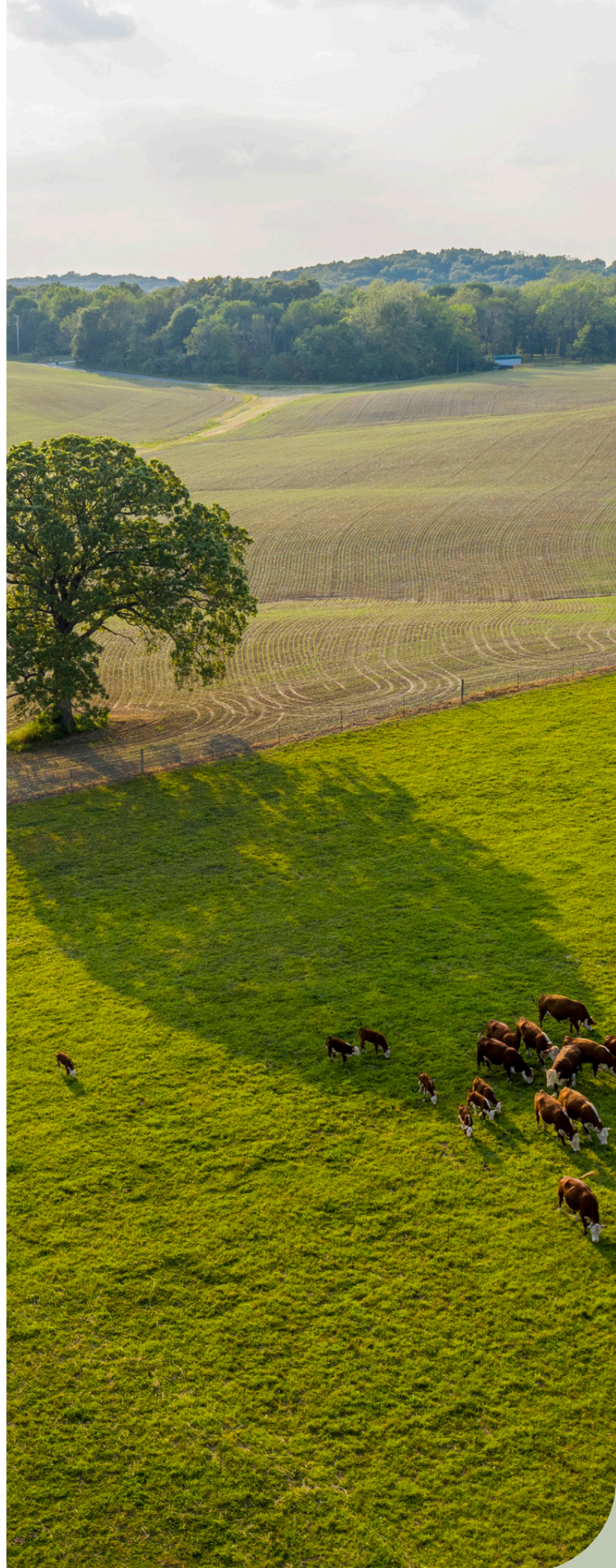
Contaminants of Emerging Concern (CEC) may be present in broad categories of substances, such as pharmaceuticals and personal care products (e.g., antibiotics), cyanotoxins (e.g., microcystin), industrial chemicals (e.g., PFAS), agricultural chemicals (e.g., pesticides), and micro- or nanomaterials

(e.g., microplastics, silver nanoparticles) (Sauvé & Desrosiers, 2014). A defining CEC characteristic is the need for more research to understand sources, fate and transport, low-level and chronic health impacts, and mitigation approaches.

Due to the difficulties of managing CEC and the variety of potential impacts, sharing knowledge and resources among several jurisdictions is a critical aspect of a regional management strategy. Shared efforts could include, but are not limited to, collaborative research, spatial and temporal monitoring, and harm mitigation efforts. Establishing more and better pathways to share data, expertise, and funding can improve the timeliness and decisiveness of CEC responses. Additionally, an appropriate strategy could include bolstering jurisdictional capacity for CEC response, guided by regional research efforts.

To address CEC in agriculture throughout the Great Lakes St. Lawrence region, the highest priority need is to develop strategies, templates, or models for coordinating and operationalizing a wide-scale response with minimal information. This priority research area includes the following themes:

- Assess models from other contaminant responses (e.g., nutrient or pathogen responses) that could inform coordinated regional approaches to CEC;
- Develop risk-reduction strategies producers can implement to mitigate the impact of CEC;
- Improve understanding of what knowledge and support is needed to reduce barriers for implementation of these strategies;
- Identify CEC-response approaches that could be operationalized and harmonized across the region in response to novel CEC, including understanding policies that are required to protect the food system from an unknown CEC;
- Identify effective communication strategies to inform stakeholders and the public of current work on CEC and their potential risks.



REPORTING

The Great Lakes St. Lawrence Sustainable Agriculture Initiative will track progress towards each priority research area over the next five years. Findings will be disseminated to the Research Committee via webinars, shared research database, and reporting at annual meetings. Under the Initiative, GSGP will identify opportunities to share progress with partners from the broader agricultural sector at conferences and published reports when appropriate.

GLOSSARY

Agroecological (agroecology): A holistic and integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of sustainable agriculture and food systems. It seeks to optimize the interactions between plants, animals, humans and the environment while also addressing the need for socially equitable food systems within which people can exercise choice over what they eat and how and where it is produced. <https://www.fao.org/agroecology/overview/en/>

Ethically sourced: A practice that ensures products are created with people, the environment, and local communities in mind. Fair labor practices, safe and environmentally responsible work environments, and a sustainable supply chain are examples of ethically sourced products. <https://fsc.org/en/blog/ethically-sourced#definition>

Eutrophication: The process by which a body of water becomes enriched in dissolved nutrients (such as phosphates) that stimulate the growth of algae and aquatic plant life usually resulting in the depletion of dissolved oxygen. <https://www.merriam-webster.com/dictionary/eutrophication>

Integrated Pest Management: A thorough, ecological approach to managing pests in agricultural systems, involves the strategic integration of multiple control methods, including cultural, biological, and chemical tactics, to maintain pest populations below economically damaging levels while minimizing risks to the environment and public health. <https://pmc.ncbi.nlm.nih.gov/articles/PMC11465254/#ref1>

Non-genetically modified organisms (non-GMOs): A plant, animal, or microbe in which there have been no changes to the genome to alter the characteristics of an organism. <https://www.genome.gov/genetics-glossary/Genetically-Modified-Organism-GMO>

Organic agriculture: As defined by the United Nation's Food and Agriculture Organization, "Organic agriculture is a safe, sustainable farming system promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It focuses on producing healthy crops without damage to the environment. It avoids the use of artificial chemical fertilizers and pesticides on the land, relying instead on developing a healthy, fertile soil and growing a mixture of crops." <https://www.fao.org/platforms/green-agriculture/areas-of-work/natural-resources-biodiversity-green-production/organic-agriculture/en>

Precision Agriculture: Precision Agriculture is a management strategy that takes account of temporal and spatial variability to improve sustainability of agricultural production. <https://www.ispag.org/resources/definition>

Precision Nutrient Management: A management strategy to optimize nutrient application ratio, rate, timing, place, and method better to match nutrient supply and crop nutrient demand in amount, space, and time for increased nutrient use efficiency, yield, crop quality, and economic returns and protection of the environment. Also called variable rate nutrient management, precision fertilization, or smart nutrient management. https://link.springer.com/rwe/10.1007/978-3-030-89123-7_154-1

Regenerative agriculture (USDA): A conservation management approach that addresses natural resource concerns through soil health, water management, and biodiversity to improve the productivity and prosperity of agriculture, communities, and ecosystems. <https://directives.nrcs.usda.gov/sites/default/files/2017/06/20170620/20170620%20Regenerative%20Agriculture%20Initiative.pdf>

Regenerative agriculture (Agriculture and Agri-Food Canada): Regenerative agriculture considers every aspect of the land's ecological system, from the soil to the water, to the diversity of plant life, ensuring every part of the ecosystem is healthy and working well together. <https://agriculture.canada.ca/en/sector/canadian-food-system/taste-commitment/regenerating-hope>



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