TOWARDS SUSTAINABLE FOOD PRODUCTION SYSTEMS:

A Theory of Change and Associated Metrics

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EXECUTIVE SUMMARY

Food production is a complex, energy-intensive process that emits approximately 15 per cent of global greenhouse gasses.¹ As global populations and demand for food grow, so too does the strain on land, a non-renewable resource critical to farming and our survival.² Agriculture, on a large scale, has transitioned from subsistence farming to monoculture, relying heavily on inputs such as pesticides. Agriculture accounts for 38 per cent of the world's total available surface land, one-third of which is used to grow crops.³ In 2014, just nine crop plant species accounted for over 66 per cent of worldwide crop production.⁴

Agriculture is a vital part of Canada's economy. In 2022, agriculture and agri-food generated \$143.8 billion, or seven per cent, of Canada's gross domestic product.⁵ Farming was essential to Canada's economic development in the 19th and 20th centuries. From coast to coast, rural life and farming were ever-present in the fabric of Canada's history. However, changing agricultural economics has pressured farms to scale in size and become increasingly specialized (i.e., monoculture).

Consequently, small- and medium-sized farms declined by 37.5 per cent between 2015 and 2020.⁶ While the industry managed to reap economies of scale and gains from specialization, there are concerns that agriculture has not sufficiently moved toward circular and self-sustaining systems. For instance, an historic focus on agricultural productivity (e.g., yield) in Canada has come at the expense of increased environmental negative externalities.⁷

Land degradation, biodiversity loss, and climate change are some of society's biggest threats. Given its emissionsintensive nature, many forward-thinking players in the agricultural sector have begun to explore more sustainable ways of producing food.⁸ Proponents of sustainable farming techniques emphasize its potential for improving the agri-food industry's sustainability and mitigating the damaging effects of climate change.⁹ There is growing interest in how Canada can transition from its current linear economic model (i.e., take-makewaste) to a more resilient, less-wasteful, and regenerative economy. How we grow food and manage land is a crucial part of this transition. Food producers are adapting their practices but need support to transition to more sustainable farming methods. Meanwhile, investors further up the supply chain recognize this as a priority. A cohesive framework is required to match individual agricultural practices with various results-oriented funding.

Yet, to successfully enable and sustain this shift, it is crucial to identify existing barriers to adopting sustainable practices and potential actions or initiatives to address those barriers. It is also essential to develop a set of metrics to assess and monitor the outcomes of those initiatives. On the following pages, we explain our proposed methodology to pursue those two analytical steps. Our research approach is participatory to make sure that diverse rightsholders and stakeholders contribute to the understanding of principles, barriers, and outcomes of a truly sustainable food production system.¹⁰ Our approach differs from traditional expert-driven approaches that often fail to "listen" and accommodate differences in local knowledge, traditions, and experiences.



Our research contributions

Our research makes three contributions. First, it identifies the complex set of potential social, ecological, and economic outcomes associated with alternative approaches to sustainable food production. Next, it provides a suite of metrics that could be used to measure and track outcomes over time at both farm and societal levels. These metrics, in turn, support the assessment of complementary initiatives to incentivize and enable farmers and other actors in the food chain to transition towards sustainable food production.

The report is structured as follows:

• First, we unpack why we refer to sustainable food production rather than using different terminology such as regenerative or climate-smart agriculture. We define sustainable food production as a system that provides affordable, nutritious food while preserving natural resources and enabling ecosystem services such as carbon sequestration, water filtration, and retention. This can be obtained through diverse configurations of practices that achieve similar socio-ecological outcomes in various socio-ecological settings.

- Second, we describe our research methodology.
- Third, we identify critical problems that prevent the development of sustainable food production systems in Southern Ontario.
- Fourth, we introduce our proposed Theory of Change (ToC): a series of potential initiatives that can catalyze the development of more sustainable food production systems in Southern Ontario. We also discuss potential extrinsic and intrinsic incentives to promote improved outcomes in sustainable food production systems
- Finally, the ToC informs the analysis of possible outcomes and metrics. In the appendices, we provide examples of potential outcomes and metrics using secondary data.

Key Takeaways

The project sought to explore possible initiatives that could guide the development of sustainable food production systems in Southern Ontario. We refer to "sustainable food production" as a system that provides affordable, nutritious food while preserving natural resources and enabling ecosystem services like carbon sequestration, water filtration, and retention, among others. The term is preferred over "regenerative" or "climate-smart agriculture" to avoid confusion and division among stakeholders and rightsholders. The definition of "sustainable food production" strongly aligns with that of agroecology.

The research emphasizes a participatory approach that prioritizes diversity and inclusion in the formulation of initiatives as well as the outcomes metrics that could guide the development of sustainable food production systems. Specifically, the project team engaged diverse rightsholders and stakeholders, including farmers, agronomists, industry associations, food processors, municipalities, hospitality, academia, and civil society.

Input and feedback from a diverse group of participants was essential in developing and refining a Theory of Change (ToC) as well as its associated outcome metrics (*See main report to examine the Theory of Change*). Our ToC constitutes potential initiatives that can catalyze the development of more sustainable food production systems in Southern Ontario as well as throughout Canada and beyond. It also provides sub-theories of change, subsets of paths of action, for accomplishing discrete societal and farm-level outcomes.

The proposed ToC framework can inspire other research groups and civil society organizations (CSOs) in Canada and abroad to consider and implement bottom-up initiatives to develop management principles and outcome metrics that guide the development of sustainable food production systems. This is provided that research groups and CSOs tailor their approach to local circumstances and conditions.

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Key Takeaway #1: Barriers to the development of sustainable food production systems

There is a lack of universally accepted frameworks and metrics for measuring the outcomes of agricultural processes, leading to confusion and inefficiencies. The absence of clear, and locally tailored definitions and measures creates challenges for farmers, processors, retailers, investors, researchers, and policymakers, making it difficult to develop and promote effective agricultural policies and practices.

Key barriers to the development of sustainable food production systems include the perception of marginal, long-term economic returns under market conditions that offer minimal compensation for positive ecosystem services; higher operational complexity relative to conventional farming; the need for specialized equipment; and the challenges of learning and aligning practices with local conditions and cultural backgrounds.

Confusion around the definitions, management principles, and outcome metrics of sustainable food production can enable greenwashing, where companies misrepresent their sustainability efforts. A lack of consensus on definitions, management principles, and outcomes complicates the communication of the real benefits of sustainable food production systems. However, these issues can be mitigated through developing commonly agreed-upon principles and standards.

Key Takeaway #2: A Theory of Change for the Development of Sustainable Food Production Systems

Our ToC identifies specific outcomes at both farm and societal levels and proposes preliminary metrics to assess them. Our metrics aim to support the food system in achieving benefits related to economic costs, soil health, biodiversity, and food security through ongoing experimentation and modification of metrics and data sources. Our sub-ToCs provide thematic pathways for targeted action (See main report for sub-Theories of Change based on Communities of Practice, Financial and Supply Chain, and Government and Public Policy). Besides the importance of explicit incentives from public policy and supply chain contracts, our ToC reveals the importance of developing regional and inclusive farming communities. These networks would help to define sustainable farming principles and outcomes; fostering these communities also facilitates lateral learning and collaboration among farmers at a regional level.

A critical lesson learned during our study is the necessity of developing more sustainable food production systems through a bottom-up approach that respects farmers' knowledge, traditions, and unique conditions. Top-down imposition of practices through public policies and supply chain contracts, as has been happening in Europe, can alienate farmers and cause them to fail to consider their cultural backgrounds and relationships with land and with each other, impacting their ability to develop more sustainable production systems.^{11,12}

Conversely, regional and inclusive communities of practice are integral to changing values and norms at a societal level, making them a foundational mechanism for driving sustainable food production.

The report emphasizes the importance of fostering relationships among farmers and with other critical actors within the food system to build capacity for the long-term implementation of sustainable food production. It is crucial to diffuse the responsibility for addressing environmental risks within the agri-food system across various actors and supply chain tiers instead of placing the entire burden on farmers. Interactions between diverse actors, including municipal programs, can either incentivize or disincentivize sustainable practices, highlighting the need for a fair distribution of responsibilities.

Our ToC advocates for a flexible approach to implementing sustainable food production principles, allowing locally constructed initiatives to gain traction and become institutionalized at the regional level. This study underscores the importance of collaborative and community-driven approaches to sustainable food production that engage diverse actors and adapt to local circumstances. It advocates for ongoing learning and flexibility in implementing sustainable production systems to adhere to specific principles and enhance specific environmental and societal outcomes.

The project acknowledges the global context of food security and biodiversity and emphasizes knowledge transferability across communities of practice in

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diverse regions, though adaptations are necessary to accommodate local conditions. The insights gained from this project can inform initiatives and outcome metrics in other countries where agriculture is a significant source of welfare.

This project focused on developing a ToC and related metrics that could guide the development of more sustainable food production systems in Southern Ontario, and possibly beyond. We recruited a diverse group of experts from farming, food processing, municipalities, hospitality, industry associations, academia, and civil society to participate in our workshops. They provided invaluable feedback towards creating our ToC, which we used to refine our thinking. Their feedback led to updates to our inputs, activities, outputs, activity outcomes, societal outcomes, and the definitions thereof.

Key Takeaway #3: A bottom-up development process and taking an outcomes-based approach

A key lesson from this project is the need for a bottom-up, outcomes-based approach to promote sustainable food production. Agriculture is exposed to numerous economic, political, and socio-cultural pressures, and farmers may push back to management principles or practices imposed top-down, as observed in Europe. Our workshop participants were firm in their assessment that the system still needs standard definitions and that imposing certain practices can alienate farmers and fail to respect their cultural traditions and backgrounds. Furthermore, if associated with government and public policy, such top-down initiatives could be compromised by a change of elected representatives with distinct and opposing ideological perspectives. This is where our societal outcome of "Institutionalizing Sustainable Practices" takes on greater resonance.

Thus, building relationships between key actors along the value chain over time builds capacity and can improve the chances of implementing sustainable food production principles and performance outcomes that are long-lasting. Building communities of practice has been identified as a much needed first step to bring together diverse farmers and other critical food actors to discuss, deliberate, and enact sustainable values and norms. Along these lines, any monitoring and measurement system to

track the evolution of sustainable food production should accommodate distinct and heterogeneous practices that such self-organized groups propose and implement at the regional level.

Our research shows that creating regional communities of practice that connect farmers with each other and with other critical actors in the food system (i.e., players downstream in the supply chain, local government, investors) can help to more equally share risks and gains along the implementation of sustainable food production principles. Given the complexity of interactions and relationships between diverse actors in the food system for example, how municipal programs can (dis)incentivize farming—fair distribution of this responsibility can alleviate pressure on farmers.

The way forward

This project provides evidence supporting the applicability of a more flexible approach to developing sustainable food production systems that relies on locally constructed initiatives that can be progressively institutionalized at the regional and country levels. There is also interest in improving soil health and biodiversity outcomes and ensuring food security globally, partly fed by pressures like reduced supply due to war, climate change, and international agreements. Approaches that are bottom-up and flexible like the ones identified in our study could be promoted in Canada to trigger sustainable production, pursued in other countries where agriculture represents a significant source of income, and adapted to suit the local context.

From a methodological standpoint, interested research groups and civil society organizations across Canada and abroad can discuss and apply the proposed ToC framework toward developing sustainable food production systems. Such groups can take inspiration from the elements in our ToC, outcomes, and metrics. However, they must tailor a ToC's development to local circumstances. Management principles and outcome metrics should be developed by regional and communities taking a bottom-up, inclusive approach. Agriculture has similarities globally, but critical differences regarding climate, soil, and management histories persist. Thus, those taking inspiration from our research could adapt it to local conditions.

REPORT

List of references

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- 1 Newton, Peter, Nicole Civita, Lee Frankel-Goldwater, Katharine Bartel, and Coleen Johns. 2020. "What Is Regenerative Agriculture? A Review of Scholar and Practitioner Definitions Based on Processes and Outcomes." Frontiers in Sustainable Food Systems 26 (October). https://doi.org/10.3389/fsufs.2020.577723.
- 2 Bodirsky, Benjamin Leon, Susanne Rolinski, Anne Biewald, Isabelle Weindl, Alexander Popp, and Hermann Lotze-Campen. 2015. "Global Food Demand Scenarios for the 21st Century." Edited by Andrea Belgrano. PLOS ONE 10 (11): e0139201. https://doi.org/10.1371/journal.pone.0139201.
- 3 Food and Agriculture Organization of the United Nations. 2020. "Land Use in Agriculture by the Numbers." May 7, 2020. https://www.fao.org/sustainability/news/detail/en/c/1274219/.
- Pilling, Dafydd, and Julie Bélanger. 2019. "The State of the World's Biodiversity for Food and Agriculture." 4 Rome: FAO Commission on Genetic Resources for Food and Agriculture.
- 5 Agriculture and Agri-Food Canada. 2023b. "Overview of Canada's Agriculture and Agri-Food Sector - Agriculture.Canada.Ca." 2023. https://agriculture.canada.ca/en/sector/overview.
- 6 Statistics Canada. 2023. "Canada's 2021 Census of Agriculture: A Story about the Transformation of the Agriculture Industry and Adaptiveness of Canadian Farmers." Government of Canada. January 9, 2023. https://www150.statcan.gc.ca/n1/daily-quotidien/220511/dq220511a-eng.htm.
- 7 Kröbel, R, E C Stephens, M A Gorzelak, M-N Thivierge, F Akhter, J Nyiraneza, S D Singer, et al. 2021. "Making Farming More Sustainable by Helping Farmers to Decide Rather than Telling Them What to Do." Environmental Research, no. 16 (May). https://doi.org/10.1088/1748-9326/abef30.
- 8 Foley, Jonathan A., Navin Ramankutty, Kate A. Brauman, Emily S. Cassidy, James S. Gerber, Matt Johnston, Nathaniel D. Mueller, et al. 2011. "Solutions for a Cultivated Planet." Nature 478 (7369): 337–42. https://doi.org/10.1038/nature10452.
- 9 Newton, Peter, Nicole Civita, Lee Frankel-Goldwater, Katharine Bartel, and Coleen Johns. 2020. "What Is Regenerative Agriculture? A Review of Scholar and Practitioner Definitions Based on Processes and Outcomes." Frontiers in Sustainable Food Systems 26 (October). https://doi.org/10.3389/fsufs.2020.577723.
- 10 Spinuzzi, Clay. 2005. "The Methodology of Participatory Design." Technical Communication 52 (2): 163-74.
- 11 Schmitz, Rob. 2024. "European Farmers Angry at Climate Policies Could Help Sway EU Parliamentary Elections." NPR. June 8, 2024. https://www.npr.org/2024/06/08/nx-s1-4977249/eu-parliament-elections-european-farmers
- 12 Hancock, Alice, and Andy Bounds. 2024. "The Power of Europe's Rebellious Farmers." Financial Times. February 9, 2024. https://www.ft.com/content/c642343b-589e-4347-9a7f-ff04b83728ff.

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